ANNUAL REPORT
1934

1934

ANNUAL REPORT

OF THE

VERNON FOREST INSECT LABORATORY.

Ralph Hopping,
Entomologist.

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Organization.

Forest Insect Laboratory, Vernon B.C.

Entomologist	Ralph Hopping, Officer in Charge
Assistant Entomologist	Geo. R. Hopping
Junior Entomologist	M.G. Mathers, in charge Vancouver sub-laboratory
Junior Entomologist	H.A. Richmond
Pest Investigator	H.B. Leech
Pest Investigator	K. Graham
Stenographer, Grade 1	Miss Grace Jackson

Note: Miss Jackson is also stenographer for the Field Crop and Fruit Insect Laboratory, Mr. E.R. Buckell, Entomologist in Charge.

Vernon Forest Insect Laboratory.

Annual Report for 1934.

Introduction.

During recent months there has been considerable agitation in the British Columbia legislature to replace the high-lead system of logging by the system of selective cutting. It has been pointed out by certain government members and by private interested parties that there has been gross mismanagement in the administration of the forests from the standpoint of conservation and that British Columbia has practically squandered her most valuable resources. Eighteen years is now given as the maximum time our virgin stands will last.

From the above it appears that even the government is beginning to realize something must be done. The suggestion to do away with the high-lead system and to substitute some system more in accord with sane forestry practice is the one bright ray in the dark forestry picture in western Canada. If this should be accomplished it would make possible much greater co-operation between the forest entomologist, the forest service and commercial operators. Insect control measures which are not feasible under the high lead system will become practicable and desirable under selective cutting and the role of the forest entomologist will assume a greater value in the eyes of commercial timber interests.

The practice of shipping entire logs, with the bark on, to foreign countries has grown by leaps and bounds during the past two years. This, of course, is extremely undesirable from a forest insect standpoint, but more undesirable from an economic

one. It is gratifying to note that the government is contemplating stopping this practice.

The bark beetle situation has become more serious in eastern British Columbia during the past year. The B.C. Spruce Mills Ltd. of Lumberton have lost several million feet B.M. of Engelmann spruce and in the fall of 1934 another outbreakwas reported in Kootenay National Park. The infestation at Lumberton was examined and control recommendations were made to the company as noted later in this report. Snow conditions prevented examination of the Kootenay Park area last fall but examination will be made as soon as conditions will permit this spring. This infestation is also in Engelmann spruce.

Considerable investigation of the larch sawfly outbreak around Fernie was made in 1934. The spread of the infestation, biology of the sawfly and parasites, growth studies, etc., were determined. The parasite Mesoleius tenthredinis Morley was liberated in considerable numbers at one point on Lizard Creek. These parasites were sent from the parasite laboratory at Belleville. It is hoped that more will be sent next summer. Large collections of pupal cases will be made this spring in an attempt to recover Mesoleius in the field. Many thousand Coelopisthia nematicida Pack. parasites were shipped from Fernie to Belleville for possible use against the European spruce sawfly, Diprion polytomum Hartig.

At the Vancouver laboratory, studies are continuing with regard to the attack on saw logs by ambrosia insects. A new phase of the problem to be carried on during 1935 will be the prevention of attack by the use of sprays. With this in view data on previous work of this nature has been accumulated and some of the more

promising sprays used in the past will be tried again as well as new ones. The period of the year during which logs will not be attacked in the woods has been definitely determined. During the remainder of the year operators will be advised to remove logs from the woods as soon as possible after cutting.

Bark beetle studies at Aspen Grove are going forward although a complete report on this is not available at present.

In addition to major projects noted above, there are a great number of minor problems which are being continually dealt with.

A great deal of work has been done in the determination of Coleoptera sent in by other workers as well as considerable systematic work.

The Spruce Barkbeetle, D. engelmanni Hopk.

Lumberton Infestations.

On September 11th, the Provincial Forest Branch sent us a copy of a letter from the B.C. Spruce Mills of Lumberton, B.C., in which they requested that an investigation be made of an outbreak of bark beetles on their limits.

Examination of this infestation was made by Geo. R. Hopping on September 28th in company with Mr. Norman Moore, Woods Superintendent. The infestation is concentrated on three areas, No. 1 (see map) on T.L. 2758, on which 3,000,000 ft. B.M. have been killed, No. 2, S.L. 106 Parcel L on Weaver Creek, 6,000,000 feet, one-third killed, and No. 3 Meyie Tie Reserve, 6,000,000 feet, one-third killed. On the first two areas the infestation appears to have died out but on the third the infestation is very active and the mortality probably will reach over 50% by this spring.

Many of the trees had not coloured up by September and it will be impossible to make an accurate estimate until spring.

The history of this infestation is quite clear. The company has been practicing a modified form of selective cutting and have apparently made some attempt to leave proper seed trees and young trees. To do this, tractors and horses have been employed to get the logs to the decks. The logs are then flumed a distance of 12 to 16 miles to the mill at Lumberton. Although the system employed does not meet all of the standards of technical forestry, the method is so far ahead of the high-lead knock-down and drag-out tactics employed in most sections that this operation is outstanding among logging operations of British Columbia. The good reproduction they have obtained over their cut-over lands is in sharp contrast to the bare scars of the high-lead loggers.

Mr. Moore considers the burning of slash impractical under their conditions, and after going over the limits we are inclined to agree with him. However, here we have the key to the whole bark beetle situation on this area. Several years ago a shut-down became imperative, due to falling lumber prices. This shut-down continued to the fall of 1934. Up to the time of the shut-down logging had been practically continuous, and there was no trouble with bark beetles in the standing timber. The bark beetle population was absorbed by the fresh slash being continually laid down. Then the shut-down occurred, the beetle population had no fresh slash to enter. Aided by favourable climatic factors they transferred their operations to the standing timber.

Our recommendations to the B.C. Spruce Mills Ltd. were based upon the following considerations:--

1. Continuance of operation might be justified in view of improved lumber market conditions.

2. Infested and beetle-killed timber must be salvaged immediately if it is not to be a total loss.

3. All slab wood and waste materials are burned at the mill.

With these points in mind our recommendations were:--

1. Commence logging as soon as possible in the vicinity of the infested areas and lay down fresh slash to absorb the emergence of beetles in the spring of 1935.

2. Salvage all infested material as soon as possible.

3. Be sure that all bark and slab wood from infested logs goes into the burner at the mill.

4. Lay down fresh slash contiguous to previously logged areas, or in other words avoid isolated slash areas.

5. Logs should be removed from the woods as soon as possible after cutting.

In view of the above advice Mr. H.P. Klinestiver, general manager of the B.C. Spruce Mills, intimated that strong recommendations would be made to the directors of the company to recommence logging operations in the fall and winter of ~~1935-36~~ 1934-35.

Mr. Klinestiver and Mr. Moore seemed well satisfied with the measures recommended, and we, on our part, have assured them of our continued co-operation. An inspection will again be made in the spring of 1935 and an attempt made to determine the approximate mortality due to the severe winter. The fresh slash laid down will be examined to see if it is fulfilling its expected role in absorbing the infestation.

Kootenay Park Infestation.

During the latter part of November a letter was received from Mr. J.W. Ruttledge, acting superintendent of Kootenay National Park, stating that the spruce bark beetle was killing much spruce

timber in the vicinity of McLeod Meadows. He suggested that examination be left until spring due to the difficulty of getting into the area in winter.

We have assured the Park authorities that we will make an examination as soon as conditions are favourable in the spring of 1935.

Report on the Field Station at Fernie, B.C., June-August inclusive, 1934.

Hugh B. Leech.

Introduction:

Messrs. George R. Hopping and Hugh B. Leech arrived in Fernie on May 30th, and camp was established on the 31st. Several days were spent in renovating a disused Forestry cabin. This building (see Illustration #1) located in Cedar Valley near town, and in the midst of the Larch Sawfly infestation, was placed at the disposal of the Entomological Branch through the kindness of Provincial Forestry Officers, and we understand that it will be free for similar occupancy in 1935. The various kindnesses shown throughout the season by the local Ranger, Mr. H.J. Coles, and his assistant, Mr. L. Cheston, were greatly appreciated.

Mr. George Hopping left Fernie on June 4th, and visited the camp again with Mr. R. Hopping in the latter part of July, returning in mid-August for a two-weeks stay.

Situation and Flora.

Fernie is situated in the lower valley of the Elk River and about thirty miles above the point where the latter joins the Kootenay River. The valley at Fernie lies almost north and south. The Field Station is on a tributary to Lizard Creek, in Cedar Valley, and about two miles from town.

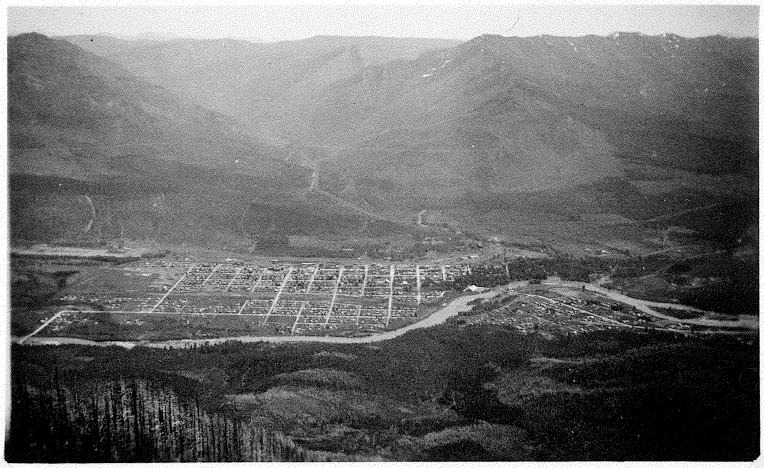
The surrounding country has been very thoroughly logged off during the past forty years, and almost all logged areas and immature or inaccessible green stands have been burnt more or less severely by forest fires. Accordingly there are no stands of

mature larch (Larix occidentalis Nutt.) remaining, and trees of more than fifty years of age, or one foot in diameter, are rare. There are, however, a number of stands of larch-spruce (Picea engelmanni Eeng. Carr.), where the former average about 7" in diameter; the latter form heavy stands in the higher valleys. Western red cedar (Thuja plicata Donn.) attains a large size in the upper Lizard Creek area, but the trees are of little value except for fence-posts, as they are hollowed and attacked by a dry-rot to a considerable height. Alpine fir (Abies lasiocarpa Hook. Nutt.) and Lodgepole pine (Pinus contorta Doug.) are common throughout, the latter often in dense stands of about 15 years of age. Douglas fir (Pseudotsuga taxifolia Lamb. Britt.) and Western white pine (Pinus monticola Doug.) are more occasional, while Western Hemlock (Tsuga heterophylla Raf. Sarg.) is rare. Western Yellow Pine (P. ponderosa Doug.) is common in the drier Kootenay River Valley, which is about twenty miles south of Fernie.

Of the deciduous flora, Aspen (Populus tremuloides Michx.) is the most abundant. Alders, various willows, and black cotton-wood (Populus trichocarpa T. & G.) occur along the rivers and streams. Fireweed (Epilobium angustifolium L.) is everywhere in evidence.

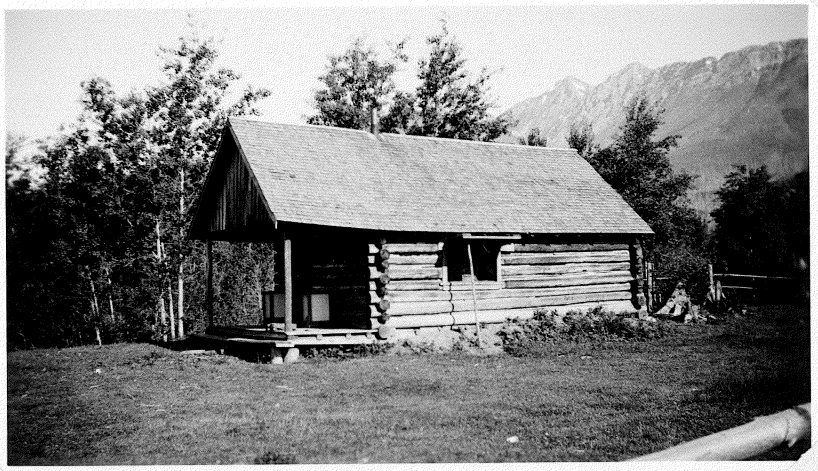
The Larch Sawfly (Lygaeonematus erichsonii Hartig.)

The major project at the Fernie station is an investigation of the bionomics of the Larch Sawfly. This species, thought to have been introduced into Canada from Europe, via the United States, in 1882 (1) was first reported to the Entomological Branch

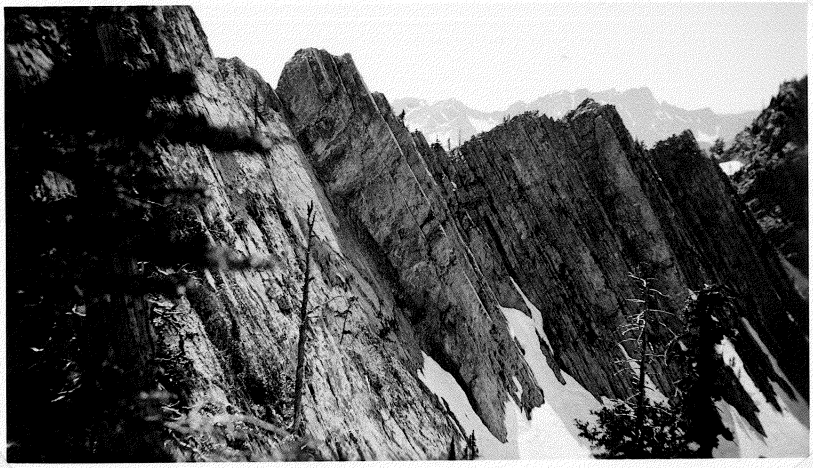


City of Fernie from the top of Mt. Fernie. The Hosmer, Upper Elk and Corbin infestations are up river to the left the Lizard Creek area half a mile down river June 17-1934

Upper part of Cedar or Lizard Creek valley from the top of Mt. Fernie. The Lizard Creek area is down valley about one mile. The timber stand shown is chiefly western red cedar. June 17-1934.



Forestry cabin on Lizard Creek, used as field station headquarters, 1934. Mt. Fernie (South face) in the background



Northwest face of Mt. Fernie, the Lizard Range in the distance. The Lizard Creek Sawfly area is in the valley between and many adult L. erichsonii Hartig were carried onto the tops of these mountains by winds - June 17-1934

in August, 1933. Despite this, defoliation was heavy enough in the Upper Elk Valley (Grave Creek) in 1930, to attract the attention of Provincial Forestry officers engaged in a survey of the region.

Mr. W.G. Mathers made a survey of the infested area in Sept. 1933, and his findings are recorded in the Annual Report of the Vernon Office for that year.

Area of Infestation, 1934 (see map).

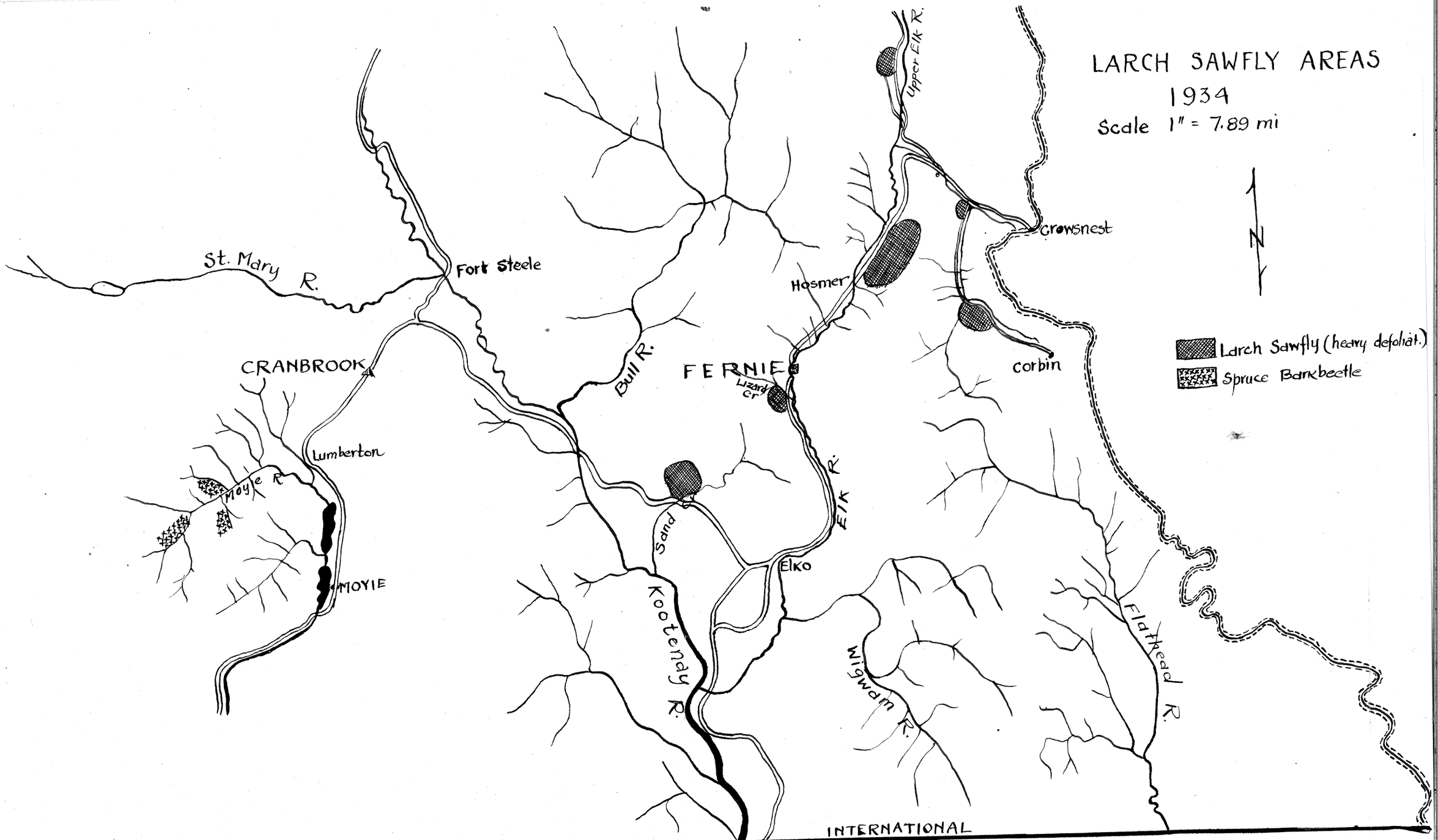
Between August 10th and 21st, Messrs. George Hopping and Hugh Leech made several trips with the object of establishing the present range of the Larch Sawfly in the East Kootenay district. No trouble was experienced where infestation was reasonably heavy, but along the south and south-west fringe, an unexpected complication was met in the form of a native sawfly, whose egg-laying, larval feeding and pupation habits are almost identical with those of the introduced species. Accordingly, to make certain of the spread in the areas south, west and north of Elko, it will be necessary to cruise the country while the larvae of both species are present on the larch foliage, etc., in July, 1935.

In general, it may be said that with the exception of some areas not visited by Mr. Mathers, but where Lygaeonematus was undoubtedly present in 1933, the 1934 survey did not extend the previously mapped infestation very greatly, but did show the areas of heavy defoliation to be more extensive.

Bionomics.

The following observations are based on field notes taken throughout the season, and on cage records.

(1) Criddle, 1928.


LARCH SAWFLY AREAS
1934
Scale 1" = 7.89 mi
N
Larch Sawfly (heavy defoliat.)
Spruce Barkbeetle
St. Mary R.
Fort Steele
CRANBROOK
Lumberton
Moye R.
MOYIE
Bull R.
FERNIE
Lizard Cr.
Hosmer
Upper Elk R.
Crowsnest
Corbin
Elk R.
Sand
Elko
Kootenay R.
Wigwam R.
Flathead R.
INTERNATIONAL

Emergence.

Egg-laying had started, and some larvae were already on the foliage, when camp was established on the last day of May. Hence emergence of adults must have begun between May 10th and 15th, or even earlier. Emergence continued almost steadily until the last few days of June, with a peak during the first part of the month. Adults appeared spasmodically during July, but continued at least until the 26th, as three fresh females were found ovipositing on the 27th. It is probable that the late July emergences are confined to the higher altitudes and to dense Larch stands on North slopes, where the forest floor warms up more slowly. Dr. Baird, studying L. erichsonii in New Brunswick in 1922, found an even longer period of emergence and in addition a hold-over for at least one season of about 25% of the larvae. This latter probably occurs in B.C. too, but has not yet been investigated.

The freshly emerged sawflies are quite able to burrow for an inch or more through a compact clay soil; in June, when logs were turned over during a search for pupal cases, these burrows were frequently exposed, some being unfinished and with the live adults still imprisoned.

Sexes: In L. erichsonii Hartig, parthenogenesis is the typical form of reproduction. Only a single male was seen during the season at Fernie.

Oviposition. Observations at Fernie did not add anything in particular to the data given by Dr. Hewitt (1912). Briefly: The females oviposited in the young terminal and lateral shoots only. In each case observed, the sawfly hung to the under-

side of the sheet, with her head towards the main twig, and started to lay near the tip of the sheet, gradually working towards the base. Dr. Hewitt, reporting on egg laying in Larix europeae, said that the eggs were usually placed alternately in a single row. This is uncommon on L. occidentalis (see photo, p. 19) where the eggs are almost always in two adjacent and more or less parallel rows.

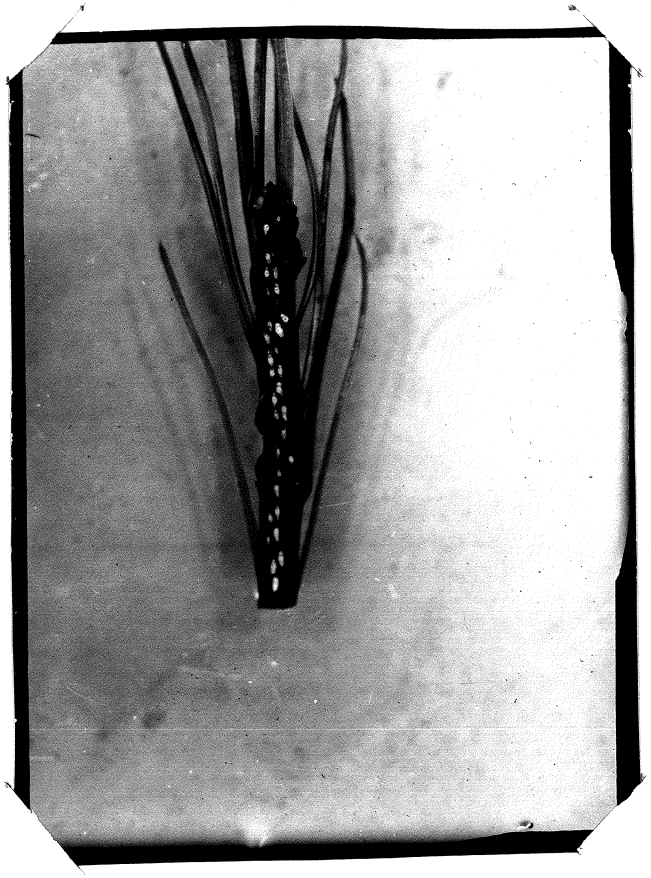
It is unlikely that any females lay their full complement of eggs in a single tip, and sometimes more than one female will lay in a sheet; hence egg-counts per sheet have little significance, especially as the tips themselves vary so greatly in length. However, counts from thirty sheets picked at random are tabulated below:-

Example No.	No. of eggs per sheet.	Example No.	No. of eggs per sheet.	Example No.	No. of eggs per sheet.
1	14	11	24	21	33
2	14	12	24	22	34
3	15	13	25	23	36
4	16	14	25	24	36
5	16	15	27	25	37
6	18	16	27	26	37
7	19	17	29	27	38
8	20	18	30	28	
9	22	19	30	29	41
10	22	20	30	30	46

These give an average of 27 eggs per sheet, which checks well with Hewitt's "about 30."

Eggs.

Data for this heading will be reported in detail after next season's studies. For the present: At Fernie in 1934, egg-laying continued intermittently from about the middle of May until the end of July. The largest larvae to be found on June 6th were on trees in Mr. Hartley Wilson's well-kept gardens in the town of Fernie, and on isolated trees on dry southern slopes on the Lizard Creek



Typical egg laying of Lygaeonematus erichsonii Hartig in Larix occidentalis at Fernie B.C. Larvae are almost ready to emerge from these eggs. Magnification about 1.5×

A small Larix occidentalis heavily defoliated by L. erichsonii Hartig. Lizard Creek area, Fernie B.C. Aug. 31-1934.

area, indicating that the earliest laying took place there. Eggs were noted in the field as late as August 5th, but only at slightly higher elevations, and on north and N.E. slopes.

There was a very heavy egg mortality, especially during the latter part of the season; eggs were found which contained parasite larvae, but these latter died during an attempt to rear them. It is thought that most of the egg mortality was due to predators, but no definite records were secured; this subject will be studied intensively next season.

Larvae.

The larvae and their habits have been described in detail in the literature.

Instars.

From June 6th to August 5th inclusive, larvae were collected at six-day intervals, and preserved in alcohol for head-capsule studies. Measurements of 303 heads show that there were five instars. The average for each class and the corresponding values from the calculated geometrical progression are in fairly close accord, and indicate that no instars have been missed.

Breadths	Instar	Instar	Instar	Instar	Instar
calculated	#1.	#2.	#3.	#4.	#5.
in mm.	-	.798	1.11	1.55	2.17
Breadths found in mm.	.57	.80	1.10	1.56	2.05

In addition, the measurements secured show that:--

(a) 3rd instar larvae were present on the Lizard Creek area on June 6th.

(b) Mature larvae were present on the trees on Mr. Wilson's grounds on June 18th.

Typical Habits.

The young larvae are strongly gregarious, and when disturbed, they cling tenaciously to the foliage with thoracic legs and mandibles, so that if a bit of the needle does not give way, the body can often be pulled from the head. These young specimens are decidedly passive as compared with many other sawfly larvae, or with mature examples of their own species, for when disturbed, they rarely lash about with their abdomen. During their 3rd and 4th instars the L. erichsonii caterpillars will let go of the needles quite readily, while the mature larvae are so "touchy" that they will drop if one makes a sudden movement near them.

Individuals showed very little tendency to wander from the clusters which form and travel slowly along a branch, defoliating it almost completely for as far as they go. It was very noticeable that freshly emerged larvae did not begin to eat the foliage of the shoots in which the needles were single, but went back an inch or more to where the leaves were in clusters. This same trait was observed in cage experiments, where the long coarse needles of ten fast-growing shoots were left until all other foliage had been finished.

Dr. Hewitt found that the defoliation of a tree usually began on the lower branches. This was not the case at Fernie, where, at the end of the season, it was common to see the upper half of a tree quite 75% defoliated, and the lower part untouched except for a few terminals.

When mature, the larvae simply let go of the tree and fall to the ground, the type of coverage deciding whether they will then enter the soil within a few inches of where they fall, or wander for

some distance first. On a private estate in Fernie, several thousand cocoons were collected in an hour from the friable soil of a currant garden. On the same estate, larvae were seen burrowing directly into the lawn, and later their cocoons were found amongst the grass roots. Other larvae fell onto a sunken gravelled pathway, and though their cocoons were concentrated in the soil at the edges, many were placed quite openly on the surface of the ground, in the very thin litter of dead larch needles and bits of grass. Still others spun up in the very damp soil of a flower garden, which was kept constantly wet; and here the larval mortality by a fungus disease was higher than on any other area visited.

Under forest conditions, the majority of the larvae wander for a distance of several feet from where they drop to the ground; large numbers of cocoons are spun up in the soil and duff under and directly around logs; this habit can be taken advantage of when cocoons are being collected, and it would probably be feasible, in areas of light infestation, to partially bury small logs near suitable trees, to aid in subsequent collecting.

Cocoons.

Normal, fresh cocoons are reddish-brown in colour, not at all transparent, and have the surface distinctly shining and coarsely, irregularly reticulated.

Cocoons from the Mosmer area were all light yellow, almost transparent, more strongly shining, and non-reticulate. The reason for this is not evident, though it may have to do with the fact that this area has a west and southwest exposure, with a very dry, shallow soil covering the rocks, and that the open stand of

young trees gives little protection from the sun.

The greatest concentration of cocoons under forest conditions, were inside damp, well-rotted coniferous logs; some logs of 12" in diameter contained more than 100 cocoons per linear foot. In addition, it may be noted that cocoons from such logs will retain their surface reticulations and light colour for several seasons, in contrast to those which have been in the soil for a year or more, and which become smooth, and almost black in colour.

The first 1934 cocoons were found on June 28th, on the Wilson estate, the most advanced area. Eggs and larvae of various stages, were still present here at the time.

Natural Enemies.

Predators:

Birds. Only a single bird, a Western Robin, was observed to feed on the Lygaeonematus caterpillars. No birds or animals were seen to eat the adults.

Mammals. It is probable that some species of mice and voles open the cocoons and eat the contents, but definite information was not secured.

Insects. "Yellow-jackets" (Vespa sp.) preyed on the larvae to a small ~~insect~~ extent.

Parasites:

Introduced Parasites. Through the kindness of Dr. J.M. Swaine, Dr. A.B. Baird, and various officers of the Entomological Branch, three shipments of Mesoleius tenthredinis Morley were received and released. These parasites were reared at Belleville from Larch sawfly cocoons collected in Parke Reserve, Quebec.

They were all released at one point (within a yard of the N.W. corner-post of Sample Plot #1) in the midst of the Lizard Creek infestation. The host larvae were at that time present in all stages with the majority in the third instar. Following is a tabulated resume of the Meseleius:

Shipment No.	Date Rec'd.	Liberation	Temp.	Wind	Number shipped. ♂	Number shipped. ♀	No. received alive & liberated. ♂	No. received alive & liberated. ♀
1A[x]	9.vii.34	9.vii.34 6-7 p.m.	67°F. sunny	nil	140	81	137	79
1B	9.vii.34	10.vii.34 10-11 a.m.	65°F. sunny	nil	105	78	100	73
1C[#]	9.vii.34	10.vii.34 10-11 a.m.	65°F. sunny	nil	220	-	18	-
2	11.vii.34	11.vii.34 2.30-3 p.m.	78°F. sunny	light breeze	100	100	92	79
3"	16.vii.34	17.vii.34 10-11 a.m.	66°F. sunny	light breeze	156	147	46	49
Totals:					721	406	393	280

673

x - The females were mated previous to shipment.

- shipped in Smith cage.

" - weak when shipped. In addition, ice got into cage compartment of container.

In the spring of 1935, sets of L. erichsonii cocoons will be collected at points of regularly increased distance from the centre of liberation, in an attempt to recover Meseleius tenthredinis, and if possible, to plot the spread. If specimens are obtained, re-colonization under cage conditions will be tried.

Indigenous Parasites:

Coelopisthia nematicida Pack. may perhaps be considered as native, though data is lacking.

Larvae and pupae of C. nematicida were found in L. erichsonii cocoons collected on the Lizard Creek area on June 1st. It is

highly probable that the parents of this generation emerged a month earlier, and were themselves from eggs laid in September 1933. On the other hand these first specimens collected may represent the first series to emerge in 1934.

A series of fresh (1934) cocoons taken from the Wilson gardens on July 6th produced number of Coelopisthia on July 26th to 27th. These specimens laid eggs during the two succeeding days, and the next generation began to appear on August 25th, giving a complete life history under field conditions in 29 days. These latter adults represent the second complete generation to mature in the 1934 Larch Sawfly larvae. Their progeny emerged at Vernon during the last few days of Setpember and early October, and represent the 3rd generation to complete development in the 1934 larvae; they would normally have laid eggs in other cocoons, and it is presumed that the resulting generation would have passed the winter as larvae, and matured in the spring of 1935, giving rise to (possibly) two more generations before any 1935 L. erichsonii would be available. It appears from this that under optimum conditions at Fernie, B.C., the sawfly larvae of any one year may be the hosts of perhaps six, and certainly five, complete generations of Coelopisthia nematicida Pack.

On the basis of the data secured, it is suggested that C. nematicida Pack. may be ranked as a major parasite in the Fernie region. The following table summarizes the results of examining cocoons from each of the three areas, and shows Lygaeonematus larvae mortality due to Coelopisthia alone:--

Area	Cocoons collected on:	No. of cocoons examined:	No. of cocoons containing healthy sawfly larvae.	No. of cocoons containing Coelopisthia stages.	% of parasitism by Coelopisthia.
Wilson's (Fernie city)	13 (correction) ~~14~~.VIII.34	455	310	76	16.7
Hosmer	27.VIII.34	132	64	44	33.3
Upper Elk River	23 ~~20~~.VIII.34	355	245	41	11.5
Totals:		942	619	161	17.1

If these collections had been made a month later, the percentages of parasitism by Coelopisthia probably would have been higher; though the city area cocoons were examined two weeks before those from the Upper Elk, the Coelopisthia generations are probably comparable, as the sawfly stages of the former area were fully two weeks in advance of those of the latter.

So far as noted at Fernie, the habits of the little Chalcid agree with Newitt's observations made in Eastern Canada. Even in cocoons which contain only the eggs of C. nematicida, the sawfly larvae are absoultely inactive, and readily distinguished from healthy specimens, which wriggle and lash about whenever touched. A few counts, made at random, of the numbers of Coelopisthia stages per L. erichsonii cocoon, showed:--

Cocoon #:

1. 27 Coelopisthia eggs.
2. 13 " larvae.

Snowfield on the northwest slope of Mt. Fernie. Adults of L. erichsonii Hartig were common on such snowbanks June 17-1934

Cocoon # (continued).

3. 34 Coelopisthia larvae.
4. 27 " "
5. 21 " "
6. 38 " "
7. 72 " pupae.

Average per cocoon 33.1

Other Hymenoptera; Half a dozen specimens of a green Chalcid, and four examples of a small parasite appeared in cage experiment #17556 (experiment dealt with later in report) but their relation to Lygaeonematus erichsonii larvae is not known. No large Hymenoptera were recovered, though some may emerge next spring from the 772 caged cocoons which are overwintering at Fernie.

Dipterous Parasites.

Twenty Tachinidae were reared. They emerged between July 25th and August 15th, and may represent two species. In the field, Tachinid eggs were seen on the 4th and 5th instar sawfly larvae, usually one to a caterpillar, and never more than two; the eggs were placed indiscriminately.

Fungus.

In cocoons which had been spun in damp situations, larval mortality definitely attributable to a parasitic fungus averaged 9%. In contrast, cocoons from the dry shallow soil of the Hosmer area showed less than 1% mortality due to fungus.

Associated Insects.

Sawflies: Four species, in addition to Lygaeonematus erichsonii Hartig, were found on Larix occidentalis. Adults were reared in only one case, hence it is impossible as yet to list the species

by name.

A. A species with habits very similar to those of L. erichsonii was found in the Kootenay River Valley, from the Montana border, to Columbia Lake; work of what is probably the same species was noted at several points between Cranbrook and Creston. A survey of the Kootenay country would undoubtedly extend the known range of this sawfly very greatly.

The eggs are laid in young shoots, as with L. erichsonii, but the egg-scars, both individual and total, are appreciably smaller than those of the latter species. The larvae defoliate in a similar manner. A single larva (parasitised by a large Hymenopterous larva) was recovered from a cocoon; it was greenish, with several longitudinal dark-green stripes, and somewhat tapered, suggesting the Diprioninae. The cocoons are placed in the forest duff, and resemble those of L. erichsonii in colour, but are decidedly smaller.

It will be imperative to study this species, if the range and damage due to Lygaeonematus is to be accurately gauged; though as yet it has not been found in the known points of infestation of the imported Larch Sawfly.

B (Experiment #17563). A species found on the Lizard Creek and Upper Elk areas. A mature larva, taken on July 30th, was 12 mm. long. It spun a greenish cocoon on the Larch foliage next day. The adult female emerged between August 9-12 (between which dates the writer was away on an inspection trip) and by the latter date had laid ten eggs.

This species lays eggs in the needles of clusters or verticils, and occasionally in those of the terminal shoots. Usually

[illegible] on a needle. The female hangs onto the lower surface of the leaf, with her head towards the base; the abdomen is bent downward and slightly forward, the tip of the "saw" is inserted and is pushed forward (i.e. towards the insect's own head and the leaf's base) without any apparent sawing action. Only the veriest outer skin of the needle is cut and raised. When the cut is long enough, the abdomen is gradually drawn back to its starting position, and as it moves, an egg is released and left in the slit; it is covered only partially, and by a very thin film of leaf epidermis, and has the appearance of lying directly on the needle surface. Oviposition was timed. The complete act of laying one egg was found to average 70 seconds. This sawfly has several somewhat overlapping generations.

Egg parasite larvae were dissected out but not reared; two species of primary Hymenopterous parasites were recovered from sawfly cocoons.

C. (Experiment #17560). Only larvae of this species were seen. The first specimen was taken on July 13th. It was 11 mm. long, strongly tapering from anterior to posterior; head yellow, thorax and abdomen pale green with four darker green stripes, which show more clearly posteriorly. This specimen died.

On July 24th, thirty more larvae of various sizes were secured by beating small Larch trees; several of these died later; of the rest, all but two had entered the soil by August 9th. A few more were collected on the 22nd, and soon spun up; the whole lot were buried for the winter on Aug. 31st.

D. (Experiment #17561) Secured by beating Larix; similar in shape to the preceding species, but much rarer. The larvae (the only stage seen) are white along the sides, gray and black or brown dorsally, except for a narrow median white stripe. When not feeding, a larva of both this and the previous species stretches itself along the length of a needle, with the head towards the needle base. In this position they are very difficult to see.

By August 21st only one larva was alive; it then measured 18 mm. in length. It was larger and still feeding on Aug. 31st, at which time the station was being closed; so the larva was buried in soil in hopes that it was almost fully grown, and able to spin a cocoon.

Lepidoptera (Experiment #17562). Larvae of three species of Geometridae were secured by beating small larch trees, but found difficult to rear. Egg-laying probably starts early in July and continues for several weeks.

Aphids. Two species, one small and green, the other large and dark red, were noted. Unless present in far greater numbers than were noted in 1934, they could hardly be of economic importance. The large species feeds most commonly on the season's terminal shoots and leaders.

Rust. A rust which attacked the foliage of green Larix trees was very common, but did not appear to harm the sawfly larvae. Affected needles turned yellowish; the rust spores were bursting out as a bright yellow powder, in June.

Cage Experiments.

Two major cage experiments were carried out with the larvae of Lygaeonematus erichsonii Hartig, in hopes of recovering parasites.

Experiment #17556. A complete small Larch tree was enclosed in a 6' x 6' x 6' cheesecloth cage. Larvae were placed on the tree as follows:--

Date	No. put on tree	Source	Instar of majority	No. showing Tachinid eggs.	Remarks
23.VI	20	Caged tree	3rd	-	These were on the tree before cage was built; all were removed when cage was started, and replaced on this date.
27.VI	53	Wilson's	4th	-	Collected on 19.VI., and kept on tree near cage till now, in hopes of additional parasitism.
29.VI	34	"	4th	34	26 showed 1 egg each 8 " 2 " "
1.VII	219	E. side of hill behind cabin	4th	4	Soil placed in corners of cage floor on this date.
(3.VII	-	-	-	-	First cocoons noted in soil in cage)
7.VII	140	Wilson's	2nd, 3rd, 4th & 5th instars represented	1	

Date	No. put on tree	Source	Instar of majority	No. showing Tachinid eggs.	Remarks
10.VII.	88	Burnt areas across Lizard Cr.	1st, 2nd, 3rd & 4th.	-	
13.VII.	260	Top of hill behind cabin	25%-2nd 50%-5th rest mixed	6	
14.VII.	110	Area across Lizard Cr.	2nd	2	Collected on area where Meseleius tenthredinis were liberated.
	924			Total number of Tachinid eggs - 89.	

It was found highly desirable to collect larvae for the cage on one day, starve them overnight, and put them on the caged tree in the morning, before the sun became too hot. When treated in this way, they began to feed at once. If put on the tree directly after being collected, they wandered and continually dropped to the floor.

Parasites recovered: Dipterous parasites (Tachinidae) emerged as follows:--

July 30th	1
" 31st	3
Aug. 1st	4
" 3	1
" 4	4
" 5	-
" 6	2
	15

The discrepancy between this total and the 89 Tachinid eggs seen on the caterpillars may be due to one or all of the following:

(a) The larvae moulting before the parasite eggs had hatched.

(b) Several species of parasites being concerned, with some whose stages remain in the larvae of their cocoons over-winter.

(c) The Tachinidae may be native to B.C., and hence not fully adapted to the introduced host.

It was noted that in some cases the mature maggots made their way from the sawfly cocoons and pupated in the soil nearby, while others made similar emergence holes - one hole per cocoon, and always in an end - and then remained in the cocoons to pupate. In the latter cases, the flies usually had trouble in escaping, finding the holes too small for anything more than their heads.

On August 30th all cocoons were removed from the cage.

Total number of larvae put into the cage.....924

" " " cocoons recovered.....787

larvae unaccounted for.....137

Fifteen of the 787 cocoons had each a larva hole in one end; this checks perfectly with the number of Dipterous parasites recovered. The remaining 772 cocoons were buried for the winter.

Only five dead caterpillars were seen on the cage floor; it is probable that many of the first instar larvae were damaged in handling, or failed to establish themselves on the tree.

In addition to the above, several small Hymenopterous parasites appeared, but their relations to the Larch Sawfly is not yet known.

Experiment #17557.

In this experiment a small tree was caged as in #17556, with the intention of continuing the latter when the food supply there had been finished. Some interesting data was secured, but not on the subject desired; from the point of view of parasite recovery, the thing was a total failure.

Soon after the cage was constructed, a number of small green sawfly larvae (not Lygaeonematus) were found on the tree; for fear that some might have been missed, and subsequently spoil the parasite data, a little "Fly Tox" was sprayed into the cage during the heat of the day. As a result, 26 Sawfly and 6 Lepidopterous caterpillars were killed, and dropped from the tree. But - the small amount of coal-oil and hellebore which settled on the Larch needles remained actively toxic for a month, and effectively poisoned all larvae which fed on the leaves.

Between July 24th and August 15th, 807 L. erichsonii caterpillars were collected from the Lizard Creek area and placed on the caged tree. The floor soon became littered with dead, shrivelled larvae. A few, almost mature when introduced, were able to spin cocoons, though some were mere open network. Examination on August 30th showed 32 cocoons.

August 30th showed 32 cocoons.

26 contained dead, shrivelled caterpillars.

5 " living caterpillars.

1 " a dead caterpillar, and a Dipterous puparium.

It should be noted that no rain fell during the period of this experiment.

Sample Plots.

Sample Plot #1.

On Aug. 15th and 16th, Messrs. George Hopping and Hugh Leech established a sample plot 200 ft. square, on a hillside with a N.N.E. exposure and across Lizard Creek from the Field Station. 175 Larch trees (Larix occidentalis) were numbered

with metal tags, and a record kept to show thediameter and approximate percentage of defoliation of each. The N.W. corner post of this plot is also the exact point of liberation of the sawfly parasites (Mesoleius tenthredinis Morley) received from the Belleville Laboratory.

On August 28th an increment boring was taken from every fifth tree, beginning with #1 and ending with #171.

For the convenience of future reference, the subject is here reported in some detail:--

Tie-in stump is on the south bank of Lizard Creek, and just above the falls. It is south 20° east of Cage #17557, which latter is about 100 yds. north-east of the Forestry Cabin, and on the hillside.

From here a line was run due south (magnetic) for 381 feet at which point the Homestead trail was reached. The N.W. corner post of Sample Plot #1 is thirty feet up the trail from here, and two feet to the east.

The 175 tagged trees constitute the total number of larch trees, four inches or more in diameter. The following table gives details:--

Sample Plot No. 1.

Tree No.	D.B.H. Ins.	Approximate % defoli-ation.	Age in yrs.	Growth of last dec-ade in mm.	Width of last 3 rings mm.	Remarks
1	7.8	10	40	11.0	2.5	Increment Aug. 28 - 1934
2	5.0	10				
3	5.3	10				
4	8.9	10				
5	7.8	10-				
6	8.5	25	46	8.5	1.5	Increment Aug. 28 - 1934
7	11.4	25				
8	8.5	25				
9	10.6	25				
10	8.9	10				
11	7.4	10	36	11.5	2.0	Increment Aug. 28 - 1934.
12	9.1	25				
13	9.1	10				
14	8.4	25				
15	9.0	0 x (see footnote)				
16	6.4	10	47	2.5	.95	Incremmt Aug. 28 - 1934
17	10.6	10				
18	8.2	10				
19	5.8	25				
20	9.7	10				Lower branches dead. Unhealthy tree.
21	7.7	10	44	6.0	1.5	Increment Aug.28, 1934
22	7.4	10				
23	10.2	10-				
24	5.5	10-				
25	9.4	10-				
26	9.1	10	41	6.5	1.0	Increment Aug. 28, 1934.
27	12.5	10				
28	9.8	25				
29	7.6	10-				
30	12.0	25 x				
31	9.1	0 x	44	11.0	1.5	Increment Aug.28, 1934
32	9.1	10-				
33	8.0	25				
34	4.7	0				
35	12.1	0				
36	6.5	25	47	11.0	2.0	Increment Aug 28, 1934.

X = The "x's" used in this table denote + - i.e "plus"

Sample Plot Data (cont.)

Tree No.	D.B.H. Ins.	Approximate % defoliation.	Age in yrs.	Growth of last decade in mm.	Width of last 3 rings mm.	Remarks
37	10.2	10-				
38	6.2	10				
39	4.2	0				
40	11.2	10				
41	10.9	10x	47	15.0	2.0	Increment Aug. 28, 1934
42	9.0	10				
43	10.6	25				
44	9.5	25				
45	6.7	10				
46	10.0	25	36	10.0	3.0	Increment Aug. 28, 1934
47	9.1	10				
48	13.4	0x				
49	10.1	10x				
50	13.4	10				
51	11.8	10	44	11.5	3.0	Increment Aug. 28, 1934
52	12.7	10x				
53	10.3	25				
54	10.7	10-				
55	11.9	0x				
56	9.0	10	37	12.0	3.5	Increment Aug. 28, 1934
57	10.6	10				
58	5.8	10-				
59	11.6	0x				
60	9.2	10x				
61	13.0	25	40	11.5	3.5	Increment Aug. 28, 1934. Tree 61 is nearest to the s.w. corner post.
62	11.9	0x				
63	7.8	10				
64	8.6	25-				
65	6.5	50				
66	8.9	10	45	4.5	.9	Increment-Aug. 28, 1934
67	8.2	10				
68	11.3	10x				
69	7.7	25x				
70	10.2	25				
71	11.3	0x	41	16.0	3.5	Increment Aug. 28, 1934.
72	5.4	10				
73	11.0	10				
74	8.4	10				
75	9.0	10				
76	7.0	10x	42	8.5	1.5	Increment Aug. 28, 1934.
77	8.8	50				
78	8.4	10				
79	9.6	10				

Sample Plot Data (cont.)

Tree No.	D.B.H. Ins.	Approximate % defoliation.	Age in yrs.	Growth of last decade in mm.	Width of last 3 rings mm.	Remarks
80	8.6	10x				
81	9.5	10	46	8.0	1.5	Increment Aug. 28, 1934
82	9.1	0x				
83	9.8	50				
84	9.1	10-				
85	6.5	10-				
86	8.2	0x	42	9.5	3.0	Increment Aug. 28, 1934
87	6.2	25				
88	8.5	10				
89	9.1	25				
90	9.8	10-				
91	10.8	10x	46	14.5	2.5	Increment Aug. 28, 1934.
92	9.6	10x				
93	10.9	10x				
94	9.8	25				
95	8.8	10x				
96	10.2	10-	46	13.5	2.5	Increment Aug. 28, 1934
97	10.6	10-				
98						Tree not marked - tag missing.
99	9.8	0x				
100	7.3	25				
101	7.9	10x	45	10.5	2.0	Increment taken Aug. 28, 1934
102	10.2	10				
103	9.7	10				
104	6.7	25				
105	9.6	0				
106	11.2	10	42	13.0	3.5	Increment taken Aug.28, 1934
107	6.0	25				
108	11.9	10-				
109	9.1	10x				
110	12.0	75				Insects (Lepidoptera?) working in bark at base of trunk.
111	7.0	10	45	6.5	1.5	Increment taken Aug. 28, 1934
112	7.2	10				
113	7.7	25				
114	4.7	50				
115	8.0	25				
116	6.4	10	43	3.5	.5	Increment taken Aug.28, 1934
117	8.6	10x				
118	9.2	10				
119	7.6	25				
120	12.1	25				
121	8.0	25	43	10.5	2.0	Increment taken Aug.28, 1934
122	5.5	10x				
123	11.4	10				
124	8.2	10x				

Sample Plot Data (cont.)

Tree No.	D.B.H. Ins.	Approximate % defoliation.	Age in yrs.	Growth of last decade in mm.	Width of last 3 rings mm.	Remarks
125	6.8	10				
126	11.3	10x	44	11.5	2.0	Increment taken Aug. 28, 1934
127	6.0	25				
128	7.8	10				Nearest to N.E. corner post
129	6.0	25				
130	6.8	25				
131	9.8	50	45	5.5	1.0	Increment taken Aug.28, 1934
132	9.7	10-				
133	6.6	10				
134	11.6	10				
135	7.9	0x				
136	5.5	10x	40	6.0	1.0	Increment taken Aug. 28, 1934
137	11.6	10				
138	9.7	10x				
139	7.8	10				
140	8.5	10				
141	8.4	10	44	7.5	2.0	Increment taken Aug.28, 1934
142	10.4	10				
143	6.6	0x				
144	11.5	0x				
145	7.7	10x				
146	9.8	75	45	12.5	2.5	Increment taken Aug. 28, 1934
147	8.4	25				
148	11.0	0x				
149	12.0	0x				
150	7.7	10				
151	8.0	10	44	14.5	4.5	Increment taken Aug. 28, 1934
152	10.3	25				
153	11.4	25x				
154	10.9	0x				
155	9.6	10x				
156	10.1	10x	37	15.0	1.5	Increment taken Aug. 28, 1934
157	11.4	10				
158	8.5	10				
159	12.2	10				
160	10.4	10				
161	11.0	25	45	13.0	1.5	Increment taken Aug. 28, 1934
162	11.0	25				
163	11.6	25				
164	9.4	100				Defoliation may not be due to sawfly larvae. Larvae of Cerambycidae & Buprestidae working in base.
165	8.0	0x				
166	9.9	10-	41	7.0	3.5	Increment taken Aug.28, 1934.

Sample Plot Data (cont.)

Tree No.	D.B.H. ins.	Approximate % defoliation.	Age in yrs.	Growth of last decade in mm.	Width of last 3 rings mm.	Remarks
167	6.1	10-				
168	11.5	0x				
169	14.5	0x				
170	11.2	0x				
171	10.4	10	36	20.0	5.0	
172	4.9	50				
173	10.1	0x				
174	8.9	0x				
175	9.2	10				

Ave. D.B.H. of 175 trees on plot -- - 9.1 inches
Ave. % defoliation 175 trees on plot- - - 14.5%
Ave. age of 35 trees on plot - - - - - - 42.7 yrs.
Ave. growth of 35 trees on plot in last decade - - - - 10.3 mm.
Ave. " " " " in last three yrs.- 2.2 mm.

On August 22nd ten small (ave. height 15 ft.) larch trees on top of the hill N.N.E. of the cabin were marked with metal tags, measured, and % defoliation recorded. The object was to provide data on the effect of repeated heavy defoliation and to check against plot number 1. These trees were heavily defoliated in 1933.

Sample Plot No. 2.

Tree No.	D.B.H. inches	Approx. % defoliation.	Remarks
176	4.0	75	Upper half of tree 75%,
177	2.6	75	lower half 10% x
178	2.3	75	Upper 2/3rds of tree 75%, lower third 10% x
179	4.7	75	
180	3.0	75	
181	2.4	75x	
182	4.1	75	
183	4.2	10	Most westerly tree check tree.
184	5.6	50	
185	2.8	75x	Most southerly tree
Ave.	3.6	66.0	

The growth studies of sample plot 1 will be checked

with similar plots established entirely out of the present range of the European larch sawfly. In addition a second plot will be established adjacent to No. 1. These plots will be established in 1935.

Other Insects Studied.

Sawflies (Species undetermined; listed by host plants).

1. Engelmann Spruce (Picea engelmanni Parry, Engel.) About a dozen small (6 ft. high) spruces, used as ornamentals on the grounds of a house between Fernie and Hosmer, were very heavily defoliated by sawfly larvae. The same species has been collected in the North Okanagan; it is not introduced.

As there was no lack of other work on hand at the time that the specimens were reported by Mr. L. Chesten, it was thought best to defer a study of this species until the 1935 season, at which time a full life-history may be secured. In 1934 the majority of larvae were fully grown by June 20th.

2. Lodgepole Pine (Pinus contorta Dougl.)

Three larvae, one 20 mm. long, and the other two each about 16 mm. long, were secured on August 7th by beating lodgepole pine.

On August 13th two of the larvae spun yellowish-green cocoons, almost out of sight amongst the bases of the needles of a bushy branch tip; they were very insecurely attached to the needles. On Aug. 19th the remaining larva spun its cocoon amongst debris on the surface of the soil in the cage. The three cocoons were buried for overwintering.

3. False Hellebore (Veratrum viride Ait.)

Sawfly larvae collected on this host at Fernie seem to be identical with those reared on V. viride at Vancouver.

Larvae were secured on June 17th. All had entered the soil by July 4th.

Eggs were noted in the tissue of the lower surface of leaves, and were placed in small groups lying parallel to the main veins, with the eggs end to end, but not touching each other.

4. Salix(willows)

A number of greenish larvae, belonging probably to four or more spp., were studied.

5. Aspen (Populus tremuloides Michx.)

A small species whose eggs are laid through the upper surface, near the edge of the leaf, but are inserted so deeply as to be just under the outer tissue of the under surface. The leaves fold under at these points, forming little pockets, similar to those formed by some aphids and in them the sawfly larvae feed. No specimens were reared to maturity.

6. Black Cottonwood (Populus trichocarpa T. & G.)

(a) A species with habits similar to these of the preceding. Egg parasites were found, and reared to the pupae stage, after which they died. Only one sawfly larva matured, and it spun a dark-brown cocoon on July 18th. The larva was still alive in the cocoon on Aug. 30th.

(b) A single elongate (20 mm.) red larva was found on June 26th. It spun a red cocoon three days later, and was still in the prepupal stage on July 21st.

7. Red-osier Dogwood (Cornus stolonifera Michx.)

A number of larvae, yellowish, with two dorsal and a lateral series of black spots, and with a light covering of a white waxy substance which stands up in tufts on definite areas, were found late in July. They weremature by Aug. 20th and readily bored in the pith of dead Sambucus stems provided.

8. Snowberry (Symphoricarpus racemosus Michx.)

(a) A few sawfly larvae were found in bud-galls during the early part of June. This species proved difficult to rear, and the only recovery was that of a single primary Hymenopterous (Chalcid) parasite.

(b) A large species. The larvae are greenish, prettily marked with black dots and patches of yellow; mature examples are just over 20 mm. long. The first specimens were secured by sweeping the bushes with a net, on June 12th. One spun a brownish cocoon on the floor of the cage, three days later. By July 4th, all but two had entered the soil. On August 31st the jar containing the earth and cocoons wasburied for the winter.

Lepidoptera. A few species were reared and sent to Dr. McDunnough.

Coleoptera. A species of Trirhabda was reared.

An outbreak of leaf-eating beetles, identified by Mr. Ralph Hopping and by Mr. H.C. Fall as Calligrapha verrucosa Suffr. occurred at Fernie. Inhabitants said that the same species was common in 1933. The larvae and adults defoliate several species of willows, and to a lesser extent poplar and alder. They were reported also on a few garden (flowering) plants. The heaviest infestation was on an island in the Elk River, opposite West Fernie. Here adults were present in thousands on June 26th, and at the same time larvae in all stages were fairly common.

Another Chrysomelid, identified by Mr. H.C. Fall as Calligrapha sigmoidea Lec., was very common (adults only) on Musk Mallow (Malva moschatus L.) on August 29th. The plants grow

on the lower slopes of Mt. Fernie, at about 4,000 ft., and the beetles skeletonize the leaves.

Hemiptera: A few species were noted on unusual hosts, and forwarded to Mr. W. Downes of Victoria.

General Collecting: A number of moths were collected at light, and sent to Dr. McDunnough, who reported that practically all the records were o interest to the National Collection.

There was little time for beetle collecting, but several new records for B.C. were secured.

Temperature Records, 1934.

Note: Readings taken at 9 p.m.

Date	Max.	Min.	Remarks.
June			
11	88°F.	Not taken.	Hot, sultry; very heavy thunderstorm at 6-7 pm.
12	82.5	45.5°F.	Hot
13	85	40.5	Clear and hot
14	81.5	43	Thunderstorm and very heavy rain 6-7 p.m.
15	77.5	46	Sunny, windy
16	76	36.5	"
17	83	34	"
18	72	43	Hot. Thunder & heavy rain in p.m.
19	72.5	36	" " " " " " "
20	73.5	33	Sunny
21	69	48	" Heavy rain in p.m.
22	59	47.5	Dull. Rain; wind.
23	71	33.5	Sunny, with shower.
24	77	40	Sunny, hot.
25	81	46	Sunny, hot
26	62.5	46	Rain all day
27	69	49	Dull
28	72	37	Sunny, warm, in a.m.; very heavy rain
29	75.5	39	Hot sun, breeze, (all p.m. light clouds.
[illegible]	[illegible]	[illegible]	
30	83	43	Hot sun, breeze, light clouds.
July			
1	83	46.5	Clear and hot

Temperature Records, 1934 (cont.)

Date	Max.	Min.	Remarks
July			
2	75	45	Clouded, some rain
3	72.5	36.5	Cool, showers
4	84.5	38	Clear and hot
5	79	52.5	Clouded, some rain
6	88.5	47	Clear and hot
7	76.5	46	Cloudy, windy, sultry, rain.
8	73.5	53	Dull to sunny
9	80	45	Hot
10	79	49	Hot, strong west wind
11	82	33	Hot and clear
12	77.5	42	Cloudy, wind, rain in p.m.
13	75	50	" " " " "
14	81	42	Hot and sultry. Rain at 6-7 p.m.
15	80	41	Hot and clear.
16	81.5	48	" " " in a.m. Rain in p.m.
17	79.5	51	Clear and hot
18	Not secured. Instruments tampered with.		
19			Hot, sultry.
20	68.5	49.5	Rain in a.m. Windy
22	67	51	Rain at intervals
23	85	33.5	Hot and clear during day. Cloudy in evening.
24	83.5	50	Sunny to clouded, breeze
25	85.5	50	Hot
26	95.5	47.5	Hot and clear
27	100	47.5	" " "
28	106	51	" " "
29	90.5	49.5	Hot, first nearby forest fires
30	91	55.5	" , smoky
31	93	58	" "
August.			
1	Not recorded		
2	97	41.5	Hot, not smoky
3	78	46	Hot, smoky, windy
4	82	50.5	Clear and hot
5	89.5	37	Hot and smoky
6	79	43	" " "
7	84	43	Sunny, windy, high clouds.
8	82.5	32	" " " "
9	91	36.5	Smoky
10	Away from camp.		Hot, smoky
11	84	Not recorded.	Hot smoky.
12	66	"	Cloudy.
13	82	47	Hot, smoky
14	83	44	" "

Temperature Records, 1934 (cont.)

Date	Max.	Min.	Remarks
15	93	40	Hot, smoky
16	96.5	40	Hot and clear
17	91	42	Hot and smoky
18	80	40	Hot and smoky
19	88.5	35	Hot, very smoky
20	91	39.5	" " "
21	83	47.5	" " "
22	88	39	" " "
23	79.5	46	Cool, not so smoky
24	82.5	36	Smoke bad
25	83.5	37.5	" very bad
26	88	44	Hot, smoke haze
27	94	44.5	" " "
28	84	42.5	Smokiest day yet
29	78.5	45.5	Very smoky
30	83.5	41	Slightly clearer
31			Camp "broken" for season

Suggestion for 1935.

1. It would be highly desirable to have a hygrothermograph at the Fernie Station.

2. The high egg-mortality of Lygaeonematus erichsonii Hartig, in 1934, suggests that a study of the factors should be a major problem in 1935.

3. Another major consideration should be the attempted recovery and recolonization, under cage conditions, of the Larch Sawfly parasite, Mesoleius tenthredinis Morley.

4. Further shipments of this parasite, from Belleville, would be of the greatest experimental value.

5. Due to the broken nature of the Fernie country, several of the Larch sawfly infestations (especially the Corbin and Upper Elk areas) are relatively isolated. Mr. G. Hopping has suggested that if cocoon examinations early in 1935 show heavy Coelopisthia nematicida Pack. parasitism, it may be feasible to engage extra labour for a few days at each area, make large collections of cocoons, and put the latter in wire cages which would permit parasites, but not sawflies, to escape.

6. A survey of the Flathead area should start on or about June 20th.

7. The area between Rosen (McBains) Lake and Bull River should be checked at the same time.

8. A one or two day walking trip, by trail through the higher country, from Coal Creek to Michel Creek 8 miles below Corbin, should be made as early as would be practical.

9. One trip should be made to the Larch stands of the Gold Creek area, south of Cranbrook.

Summary.

1. The Fernie Field Station was established on May 31st, and closed on August 31st.

2. The major study is that of the European Larch sawfly, which is known to have been present in outbreak form on the Upper Elk River area as early as 1930, though unreported to the Entomological Branch until late in 1933, at which time the outbreak was well established at Fernie.

3. The Larch (Larix occidentalis Nutt.) in the Fernie region is practically all second growth and much of it is on burned-over land. The coverage is discontinuous, chiefly because of the irregular nature of the land, and the great differences within short distances of soil conditions and annual precipitation.

4. The area of infestation in 1934 is very much as Mr. Mathers found it in 1933. One additional outbreak was found near Corbin. Regions of heaviest infestation have shifted somewhat. In the southern and western limits, a native sawfly on Larch made the L. erichsonii range somewhat uncertain.

5. Emergence had started before camp was established. Egg-laying began presumably about May 10th and continued intermittently until the end of July, with a peak in the early part of June. The earliest laying probably took place on Mr. Hartley Wilson's grounds, inthe City of Fernie.

6. Measurements of 303 head capsules of larvae collected at 6-day intervals throughout the season indicate 5 instars.

7. 3rd instar larvae were present (Lizard Creek) on June 6th. Mature larvae were present (Wilson's) on June 18th.

8. The first 1934 cocoons were found on June 28th, on the Wilson grounds, the most advanced area.

9. Predators of L. erichsonii are probably negligible.

10. 721 males and 406 females of the Larch Sawfly parasite, Mesoleius tenthredinis Morley, were shipped from the Belleville Parasite Laboratory. Of these 393 males and 280 females were received alive, and liberated on the Lizard Creek infestation.

11. The Chalcid Coelopisthia nematicida Pack. was found in varying ~~xxxxxxxxx~~ concentrations over the whole area. Parasitism of Lygaeonematus cocoons of this species alone was 33.3% at one place. Under optimum conditions at Fernie the sawfly larvae of any one year may be the hosts of perhaps six, and certainly five, complete generations of Coelopisthia.

12. Other parasites, including Diptera and a fungus, are relatively unimportant.

13. Four species of sawflies, in addition to Lygaeonematus, were found defoliating Larix occidentalis. One species has habits almost identical with those of the introduced sawfly.

14. Several species of Lepidopterous larvae (Geometrids) were found on Larch.

15. Two major cage experiments were carried out in hopes of securing parasites of L. erichsonii. The complete results will not be known until 1935.

16. Partial life-histories were secured by rearing of: -

12 spp. of sawflies (other than those on Larch).
5 " " " Lepidoptera.
3 " " " Coleoptera.

17. A sample plot 200 feet square, was laid out in the midst of the Lizard Creek infestation (Lygaeonematus) which latter is on the uptrend. 175 larch trees were labelled with numbered metal tags, and infestation and growth data taken. A second plot, similar to #1, was deferred till 1935.

18. A check plot of ten trees was established on the hill behind the Field Station.

19. Temperature records were taken with one each, maximum and minimum, Negretti and Zambra thermometers.

20. The help of Mr. Jack Coles, Forest Ranger, and other members of the Provincial Forestry Department, is gratefully acknowledged. In addition, Mr. Hartley Wilson and his gardener, Mr. Woodhouse, helped very materially in several ways.

Memo. for Fernie Field Station, 1935.

1. Collect Spruce sawfly cocoons on Mr. Chesten's farm. This species emerges earlier than does Lygaeonematus.

2. Examine small Larch trees in evenings, during the first two weeks of July, to secure Geometrids while laying eggs.

3. Make Silver Springs trip in middle of May.

4. Ask for Hygrothermograph.

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Annual Report of the Vancouver Sub-Laboratory.

- 1934 -

W.G. Mathers,
Junior Entomologist.

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Annual Report of the Vancouver Sub-Laboratory.

- 1934 -

Introduction.

The major problem at the Vancouver Sub-laboratory during 1934 was the continuation of the investigation of Ambrosia beetles attacking western hemlock, Tsuga heterophylla (Raf.) Sarg. As the coast district of British Columbia was this year remarkably free of any major outbreaks of forest insects it was possible to spend considerable time on the various phases of the main problem with particular attention to the determination of the moisture content and acidity of the logs at the time of attack.

In addition to the major project various minor problems were investigated and several rearing experiments carried out. During the year over 140 letters were written, many of which were in reply to inquiries about particular insect pests. In October an inspection trip was made to Vancouver Island for the purpose of examining a reported insect outbreak near Campbell River and while on the Island the opportunity was taken to re-examine the areas on which the spruce budworm was epidemic from 1927 to 1930.

A short paper on "Some Meteorological Observations in Relation to the Spruce Budworm" was read at the annual meeting of the British Columbia Entomological Society, held in Vancouver on February 24th while on October 17th a talk,

supplemented with lantern slides, on "Our Forest Enemy, the Bark Beetles" was given to a meeting of the Vancouver Natural History Society.

Personnel.

W.G. Mathers, Junior Entomologist, assumed charge of the Vancouver Sub-laboratory at the end of February, having been transferred from the Vernon Laboratory. On April 10th, Mr. K. Graham, Insect Pest Investigator, was also transferred to this laboratory for the purpose of continuing the investigations at the Steelhead Field Station. The field station was closed for the season on September 14th and after spending the balance of the month assisting at the Vancouver Laboratory, Mr. Graham returned to the Vernon office.

Co-operation.

Close co-operation has been maintained with the University of British Columbia, the Dominion Forest Products Laboratory, and the Provincial and Dominion Forest Services. The arrangement with the Universwity by which we have been permitted the use of a room in the Agriculture Building as an office and laboratory was very kindly extended in September for an additional year. The University forestry department has also continued to allow us free use of its forestry plot on the campus, while special acknowledgement is due to Dr. G.H. Harris of the Faculty of Agriculture for his helpful suggestions and use of equipment in the determinations of the acidity of the logs in the Ambrosia studies. During the absence of Professor Spencer in the summer various requests received by the University for information on household and

garden insects were referred to this office for reply and we have been pleased to be of assistance in the systematic re-arranging of the University's collection of bark beetles.

The determinations of the moisture contents of the logs used in the Ambrosia studies have been made in co-operation with the Dominion Forest Products Laboratory at the University. The staff of this laboratory has co-operated with us throughout the year at every opportunity, especially in regard to entomological problems which have been submitted to them and in the providing of space for our portable cages.

Owing to the absence of any important infestations of forest insects the co-operation with the Forest Services has not been as evident this year as in the past. However, several minor outbreaks were reported to us and special attention was given to insect problems arising in the Provincial forestry nursery at Green Timbers near New Westminster, B.C. The Dominion Forest Service, through Mr. C. MacFayden, has kindly permitted us to store our field equipment in the seed extraction plant at New Westminster.

Summary of Forest Insect Conditions during 1934.

Western Hemlock Looper - Ellopia somniaria Hulst.

The outbreaks of this destructive defoliator which occurred in 1928-1930 have subsided completely. No reports of any fresh outbreaks have been received nor were any evidences of the insects to be found in the vicinity of Vancouver or on Vancouver Island.

Spruce Budworm - Cacoecia fumiferanae Clem.

This defoliator was also at a very low ebb during the past year although an increase can be expected within the next couple of years. Several larvae were recovered this year on trees in the Botanical Garden at the University. Areas on Vancouver Island which were heavily infested by the spruce budworm during the years 1927 to 1930 now show complete recovery from the attack.

Black-headed Budworm - Peronea variana Fern.

No evidence of this defoliator was found during the year.

Snowy Girdle - Nepytia phantasmaria Stkr.

No visible feeding by the larvae of this defoliator was observed this year although a few adults were noticed in flight in September, both in Stanley Park and at the Steelhead Field Station.

Pine Butterfly - Neophasia menapia Feld.

This butterfly attacks Douglas fir in the coast region of British Columbia. A heavy flight of the adults on the holdings of the Campbell River Timber Company near Campbell

River was reported in August but on visiting the area in October no evidence of any defoliation was found. However, a close watch is to be kept next year by the company for the probable re-appearance of the species.

Douglas Fir Webworm or Silver-Spotted Halisidota - Halisidota argentata Pack.

A report of a small outbreak of this defoliator on Douglas fir near Chilliwack, B.C., was received in March, through the Provincial Forest Service. A single colony of the caterpillars was also found on a hemlock on the University Campus. From records available outbreaks of this species have never assumed serious proportions in this province, such outbreaks invariably subsiding within a year or two without causing any great damage.

Satin Moth - Stilpontia salicis L.

Several poplar trees on the University campus were fairly heavily defoliated this year by the satin moth.

Willow Leaf Beetle - Galerucella carbo Lec.

An infestation of this leaf beetle extending over several city blocks, occurred this year in South Vancouver. A few native willows in Stanley Park were also found infested by the same species.

Douglas Fir Bark Beetle - Dendroctonus pseudotsugae Hopk.

Although the Douglas fir bark beetle has caused serious losses to the logging industry in recent years, no reports of any outbreaks were received this year.

Scolytus unispinosus Lec.

This small bark beetle was found killing Douglas

firs in two instances on property in the newer residential section in the Point Grey district of Vancouver. In each case the trees attacked were native trees of about 8 inches D.B.H. which had been retained for their aesthetical value.

Gnathotrichus sulcatus Lec.

Trypodendron cavifrons Mannh.

Platypus wilsoni Sw.

These ambrosia beetles have continued to cause a great amount of damage in freshly felled logs throughout the coast region and during the year constituted the major problem studied at this laboratory.

Anisandrus pyri Peck.

In April, 20 of 130 young ornamental Japanese cherry trees were attacked and killed by this shot-hole borer. The trees had been set out only a short time before on a new real-estate sub-division in West Vancouver and at the time of attack were far from vigorous. This species was also found in April attacking and killing several young fruit trees in the Municipality of Burnaby.

Pissodes sitchensis Hopk.

An outbreak of this species occurred this year in a nursery plot of about five year old Sitka spruce at the Provincial Green Timbers Forestry Station. The leaders of about forty trees were attacked and killed. Control was obtained by pulling up and burning the infested trees.

Miscellaneous Insects attacking Green Logs.

In October of this year word was received from a

local shipper of green logs to Australia that part of one shipment had been condemned because of the presence of live grubs in the logs. Unfortunately specific identification was lacking, only the family names Trogositidae, Buprestidae and Scolytidae being quoted.

Miscellaneous Insects Attacking Seasoned Wood.

Damage to box shook made from true fir and stored in a powder magazine on James Island near Victoria, B.C., was identified as the work of carpenter ants. These ants and also termites are found frequently infesting the butts of cedar telephone poles in Vancouver.

An instance occurred during the past year where adults of the Anobiid, Coelostethus quadrulus Lec., on emerging from a telephone pole, had penetrated the lead sheathing of a telephone cable which was fastened to the side of the pole.

Two dead adults of the Anobiid, Hadrobregma gibbicollis Lec., were recovered from timbers taken from a church which had been erected in 1872 in Victoria, B.C. In addition to these specimens several live wood-boring grubs were also found and efforts are being made to rear these through to adults.

Fleas in Fuel Sawdust.

During the year several reports were received of fuel sawdust stored in private residences being infested with fleas. In each instance where specimens were available the fleas proved to be either the common dog or common cat species. Invariably such an animal was present or had recently been present in the houses where such infestations have occurred.

Major Project.

Investigation of Ambrosia Insects.

The investigation of ambrosia beetles attacking western hemlock was first undertaken at the Vancouver Sub-Laboratory in 1931 and since that time various phases of the problem have been studied. The effects of air-seasoning on the mortality of ambrosia insects in green lumber was studied in 1931 and 1932. In 1932 kiln tests were made for the determining of treatment necessary to control these insects while in 1933 experiments with chemical dips were carried out. In July 1932 logs preference studies were commenced near a logging operation at Steelhead, about 8 miles from Mission, B.C., for the purpose of determining the effects of time of cutting on the susceptibility of logs to ambrosia beetle attack. Preliminary observations on the life history and habits of the various species of ambrosia beetles were made in 1931 and 1932 at the Vancouver Sub-Laboratory while in the spring of 1933 a field station was established at Steelhead for the purpose of conducting more detailed biological studies.

As undertaken this year this investigation has consisted of three main phases:--

(1) Log Preference Studies.

(2) Brood Studies.

(3) Studies of Life History and Habits.

The field work of the investigation was conducted at the Steelhead Field Station. The results of the latter two phases are dealt with in Mr. Graham's report on the Steelhead

Field Station, page 12 #9 , while the results of the Log Preference Studies are presented herewith.

Log Preference Studies.

The basis of this phase of the investigation has been a series of 24 hemlock trees felled at the site of the Steelhead Field Station. The first tree of the series was felled in July 1932 and the rest at monthly intervals subsequent to that date. The object of these studies was to determine whether or not the time of cutting had any effect on the susceptibility of the logs to attack by Ambrosia beetles. During the season of 1933 all data relative to these studies were recorded by Mr. Hugh Leech, who was at that time in charge of the Field Station while during the current year Mr. Graham made and recorded all field observations. The dimensions of the trees are given in Table I while a summary of the attacks are given in Tables II and III. The break in the date of falling which occurs with tree No. 16 was due to a misunderstanding with the party who was to fall the trees after the closing of the field station for that season. Hence there is no tree listed for October 1933. However, for comparative purposes Tree No. 16 is considered as the October tree and likewise the subsequent trees are considered as belonging to the month preceding the date on which they were felled.

As shown by these studies the time of cutting has but very little effect on the immunity of the logs to attack by Ambrosia beetles. All logs in the series were eventually attacked by Gnathotrichus. This species was in flight almost continually from the middle of April to the first week in September and although having an apparent preference for the

Table I.
Showing Dimensions of Logs Used in Log Preference Studies.

Tree No.	Date Felled	Log Length in ft.	Log Butt Dia. in ins.	Log Top Dia. in ins.	Length of bole in ft.	Length of Crown in feet	Total Length less Stump in feet	Rings No. on Stump	Rings No. in last Inch radius	Exposure
	1932									
1	July 20	78	15	10	38	81	119	86	11	Exposed
2	Aug. 20	75	17	10.5	54	71	125	100	14	Moderate
3	Sept.20	50	13	12	54	61	115	145	14	"
4	Oct. 20	67	17	10	40	60	100	141	19	"
5	Nov. 20	60	16	10	66	36	102	94	8	"
6	Dec. 20	93	21	8	54	73	127	90	24	Exposed
	1933									
7	Jan. 20	83	17	10	28	105	133	94	8	Heavy shade
8	Feb. 20	85	20	10	30	117	147	95	10	Moderate
9	Mar.20	90	22	9	38	90	128	101	14	Heavy shade
10	Apr.20	90	18	10	9	103	112	104	10	" "
11	May 20	98	20	9	40	97	137	148	22	Moderate
12	June 20	60	15	9	31	112	143	95	23	Heavy shade
13	July 20	84	21	10	44	82	126	128	39	Moderate
14	Aug. 20	92	25	8	29	84	113	174	7	Exposed
15	Sept.20	70	14	8	50	63	113	112	30	Moderate
16	Nov. 1	74	16	10	64	55	119	108	19	"
17	Dec. 1	80	24	12	71	67	138	138	17	"
	1934									
18	Jan. 1	70	17	10	60	48	108	115	29	Heavy shade
19	Feb. 1	88	21	11	57	90	147	153	30	Moderate
20	Mar. 1	72	15	8	53	62	115	146	35	"
21	Apr. 1	77	18	11	52	76	128	128	17	"
22	May 1	78	15	10	58	65	123	110	14	"
23	June 1	72	13	8	39	65	104	142	16	"
24	July 1	53	12	9	33	70	103	103	66	"

Table II.

Summary of Ambrosia Beetle Attacks

Tree No.	Date Felled	Species	First Attack	Intensity	Secondary Attacks	Intensity
	1932					
1	July 20	Gnath.	June/33	Light	July-Aug./33	Heavy
		Tryp.	-	-	-	-
		Plat.	Aug./34	Light	-	-
2	Aug. 20	Gnath.	July/33	Light	Aug./33	Light
		Tryp.	Apr./34	Heavy	-	-
		Plat.	-	-	-	-
3	Sept.20	Gnath.	July/33	Light	-	-
		Tryp.	Apr./34	Light	-	-
		Plat.	-	-	-	-
4	Oct. 20	Gnath.	July/33	Light	-	-
		Tryp.	Apr./33	Light	July/33	Heavy
		Plat.	-	-	-	-
5	Nov. 20	Gnath.	July/33	Light	Aug./33	Light
		Tryp.	Apr./34	Light	-	-
		Plat.	-	-	-	-
6	Dec. 20	Gnath.	July/33	Light		
		Tryp.	(-/33)	Medium	Apr./34	Light
		Plat.	Aug./33	Heavy	July-Aug./34	Light
	1933					
7	Jan. 20	Gnath.	Apr./34	Light	May-July/34	Medium
		Tryp.	-	-	-	-
		Plat.	July/34	Light	Aug./34	Light
8	Feb. 20	Gnath.	July/33	Medium	-	-
		Tryp.	Apr./34	Light	-	-
		Plat.	Aug./33	Medium	July-Aug./34	Heavy
9	Mar. 20	Gnath.	July/33	Light	-	-
		Tryp.	(-/33)	(Light)	Apr./34	Light
		Plat.	-	-	-	-
10	Apr.20	Gnath.	July/33	Light	-	-
		Tryp.	Apr./34	Light	-	-
		Plat.	Aug./33	Light	July-Aug./34	Light
11	May 20	Gnath.	July/33	Light	May/34	Light
		Tryp.	Apr./34	Heavy	-	-
		Plat.	Aug./33	Light	-	-
12	June 20	Gnath.	July/33	Medium	-	-
		Tryp.	Apr./34	Light	-	-
		Plat.	July/34	Light	-	-

Table II (continued)

Tree No.	Date Felled	Species	First Attack	Intensity	Secondary Attacks	Intensity
13	July 20	Gnath.	Aug./33	Medium	May/34	Light
		Try.	Apr./34	Medium	-	-
		Plat.	Aug./33	Heavy	July/34	Light
14	Aug.20	Gnath.	May/34	Light	-	-
		Try.	-	-	-	-
		Plat.	July/34	Light	Aug./34	Medium
15	Sept.20	Gnath.	Apr./34	Light	May-June/34	Light
		Try.	-	-	-	-
		Plat.	July/34	Light	-	-
16	Nov. 1	Gnath.	Apr./34	Light	June/34	Medium
		Try.	Apr./34	Heavy	May/34	Heavy
		Plat.	-	-	-	-
17	Dec. 1	Gnath.	Apr./34	Light	June-July/34	Heavy
		Try.	Apr./34	Medium	June/34	Light
		Plat.	-	-	-	-
	1934.					
18	Jan. 1	Gnath.	July/34	Light	-	-
		Try.	-	-	-	-
		Plat.	-	-	-	-
19	Feb. 1	Gnath.	June/34	Light	July/34	Medium
		Try.	-	-	-	-
		Plat.	-	-	-	-
20	Mar. 1	Gnath.	May/34	Light	June-July/34	Light
		Try.	-	-	-	-
		Plat.	-	-	-	-
21	Apr. 1	Gnath.	Apr./34	Light	May-July/34	Heavy
		Try.	-	-	-	-
		Plat.	July/34	Light	Aug./34	Light
22	May 1	Gnath.	May/34	Light	June/34	Medium
		Try.	-	-	-	-
		Plat.	Aug./34	Light	-	-
23	June 1	Gnath.	June/34	Heavy	-	-
		Try.	-	-	-	-
		Plat.	July/34	Light	Aug./34	Light
24	July 1	Gnath.	July/34	Light	-	-
		Try.	-	-	-	-
		Plat.	July/34	Light	-	-

Table III.

Showing Time of Ambrosia Beetle Attack on Logs at Steelhead, B.C.

Tree No.	Date Felled.	Months from Date of Falling. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	1932																									
1	July 20	-	-	-	-	-	-	-	-	-	-	G	G	G	-	-	-	-	-	-	-	-	-	-	-	P
2	Aug. 20	-	-	-	-	-	-	-	-	-	-	G	G	-	-	-	-	-	-	-	T	-	-	-	-	-
3	Sept.20	-	-	-	-	-	-	-	-	-	G	-	-	-	-	-	-	-	-	T	-	-	-	-	-	-
4	Oct. 20	-	-	-	-	-	T	-	-	TG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Nov. 20	-	-	-	-	-	-	-	G	G	-	-	-	-	-	-	-	T	-	-	-	-	-	-	-	-
6	Dec. 20	-	-	-	-	(T)	-	G	P	-	-	-	-	-	-	-	T	-	-	P	P	-	-	-	-	-
	1933																									
7	Jan. 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	G	G	G	GP	P	-	-	-	-	-	-
8	Feb. 20	-	-	-	-	G	P	-	-	-	-	-	-	-	T	-	-	P	P	-	-	-	-	-	-	
9	Mar. 20	-	-	-	(T)	G	-	-	-	-	-	-	-	T	-	-	-	-	-	-	-	-	-	-		
10	Apr. 20	-	-	G	P	-	-	-	-	-	-	-	T	-	-	P	P	-	-	-	-	-	-			
11	May 20	-	G	P	-	-	-	-	-	-	-	T	G	-	-	-	-	-	-	-	-	-				
12	June 20	G	-	-	-	-	-	-	-	-	T	-	-	P	-	-	-	-	-	-	-					
13	July 20	GP	-	-	-	-	-	-	-	T	G	-	P	-	-	-	-	-	-	-						
14	Aug. 20	-	-	-	-	-	-	-	-	G	-	P	P	-	-	-	-	-	-							
15	Sept.20	-	-	-	-	-	-	G	G	G	P	-	-	-	-	-	-	-								
16	Nov. 1	-	-	-	-	-	TG	T	G	-	-	-	-	-	-	-	-									
17	Dec. 1	-	-	-	-	TG	-	TG	G	-	-	-	-	-	-	-										
	1934																									
18	Jan. 1	-	-	-	-	-	-	G	-	-	-	-	-	-	-											
19	Feb. 1	-	-	-	-	G	G	-	-	-	-	-	-	-												
20	Mar. 1	-	-	G	G	G	-	-	-	-	-	-	-													
21	Apr. 1	G	G	G	GP	P	-	-	-	-	-	-														
22	May 1	G	G	-	P	-	-	-	-	-	-															
23	June 1	G	P	P	-	-	-	-	-	-																
24	July 1	GP	-	-	-	-	-	-	-																	

G - Gnathotrichus T - Trypodendron P - Platypus

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fresher logs, one log, No. 7, was not attacked until 15 months from the time it was cut.

Trypodendron was at no time found attacking logs less than 5 months old, the species apparently preferring logs which had been cut for from 5 to 20 months. This species has several flight periods during the season with the heaviest occurring in April. In 1934 a second flight was recorded in the middle of May while flights occurred in July of both 1933 and 1934. However, no attack was recorded during the flight in July of 1934.

In contrast to the above two species, Platypus had only one flight period during the year. In 1933 the flight extended from about the middle of August to the first week in Septemberwhile this year it was about one month earlier. The time of cutting seemed to have little effect on the susceptibility of the logs, to attack by this species, as attacks varied from within one month up to 25 months from the time of cutting.

From the foregoing discussion and from Tables II and III it is evident that a period of at least 7 months, namely from September to March inclusive, exists at Steelhead when ambrosia beetles are not in flight. Logging could be safely carried on during this period without any danger of ambrosia beetle attack providing that the logs are removed from the woods by not later than the first week in April. However, during the balance of the year all logs should be removed from

the woods immediately after falling in order to minimize the danger of injury from ambrosia insects. This practice has the added advantage of keeping the ambrosia insect population down to a minimum in the locality. In this regard Mr. Graham in the latter part of August found on one area where the logs were removed to the mill almost immediately after falling, that ambrosia insects were relatively scarce, whereas on a second area logs which had been cut between April and June but were still in the woods were found to be heavily infested with both Platypus and Gnathotrichus.

In an effort to determine the factors governing attack by ambrosia insects special attention was paid this year to the moisture content and acidity of the logs.

For making the moisture content (MC) determinations the following procedure was adopted:--Sample pieces of sapwood of approximately 6" x 4" and to a depth of about 2" were cut from the upper half of the logs and immediately wrapped in wax paper and placed in a large thermos can for transporting to the Vancouver Laboratory. There on the following morning the samples were trimmed to an average depth of one inch. The width and length of the sample were of minor importance so long as the sample did not exceed 100 grams which was the capacity of the scales. The moisture content of each trimmed sample was then determined by weighing before and after drying in a small electric oven, the results being expressed in percentage of dry weight. The first samples were taken on May 21st with the initial object of determining the present M.C.

of all the logs. Later the work was more or less confined to the more recently felled logs. Mr. J.H. Jenkins, chief of the Division of Timber Products of the Dominion Forest Products Laboratory at Vancouver, was very much interested in this M.C. determinations, particularly as it furnished interesting data on the change in the M.C. of logs left in the woods. The actual determinations were made by Mr. F.W. Guernsey of the same division. The results obtained with the various samples taken during the season are shown in Table IV.

Although no definite relationship between the moisture content of the logs and ambrosia beetle attack is indicated by these data, a minimum ~~temperature~~ moisture content of approximately 90% below which the beetles will not attack undoubtedly exists.

In attempting to devise the most satisfactory technique for determining the acidity of the logs various methods of taking the samples were tried. In the first place wood samples such as for the M.C. determinations were brought to the Vancouver Laboratory where the bark was removed and a definite amount of fine shavings scraped from the face of the sapwood. These shavings were immediately placed in a test tube with just the amount of distilled water which would be readily absorbed by the shavings. After standing for a few minutes the PH value of the moisture which could be squeezed from the shavings was then determined electrically by means of a Quinhydrone PH Indicator. However, the results obtained were far from satisfactory so that for samples taken on June 13th and 28th the method was altered to taking the shavings

TABLE IV.

Log Preference Studies - Moisture Content Determinations.

Tree No.	Date Felled	Direction of Top	Distance from Butt May 21, 1934.	Side of Log May 21, 1934.	MC % May 21, 1934.	Distance from Butt June 5, 1934.	Side of Log June 5, 1934.	MC % June 5, 1934.	Distance from Butt June 28, 1934.	Side of Log June 28, 1934.	MC % June 28, 1934.	Distance from Butt July 25, 1934.	Side of Log July 25, 1934.	MC % July 25, 1934.	Distance from Butt Sept. 27,	Side of L
	1932															
1.	July20	N	15'	L	129	24'	L	131	-	-	-	-	-	-	-	-
2.	Aug.20	E	19	L	125	9	L	127	-	-	-	-	-	-	-	-
			38	L	93	48	L	94								
						87	L	166								
3.	Sep.20	W	-	-	-	23	L	105	-	-	-	-	-	-	-	-
4.	Oct.20	N	17	L	184	-	-	-	-	-	-	-	-	-	-	-
5.	Nov.20	N	-	-	-	19	R	117	-	-	-	-	-	-	-	-
6.	Dec.20	N	45	L	192	-	-	-	-	-	-	-	-	-	-	-
	1933															
7.	Jan.20	SE	-	-	-	15	L	104	-	-	-	12'	L	115	-	-
8.	Feb.20	SE	20	L	114	-	-	-	-	-	-	-	-	-	28'	R
9.	Mar.20	SE	-	-	-	35	L	137	-	-	-	-	-	-	-	-
10.	Apr.20	S	20	R	119	-	-	-	Stump	S	143	-	-	-	-	-
11.	May 20	SE	-	-	-	30	L	95	-	-	-	-	-	-	-	-
12.	June20	SE	13	L	98	-	-	-	Stump	N	94	-	-	-	19	L
13.	July20	E	-	-	-	23	L	113	44'	L	145	-	-	-	-	-
									64	L	190	-	-	-		
14.	Aug.20	E	10	L	104	-	-	-	14	R	59	-	-	-	-	-
									14	L	131					
15.	Sep.20	S	-	-	-	14	L	127	-	-	-	-	-	-	10	L
16.	Nov. 1	S	23	L	147	-	-	-	15	R	169	-	-	-	18	L
			77	L	93				59	L	179	-	-	-		
17.	Dec. 1	S	-	-	-	25	L	162	-	-	-	-	-	-	-	-
	1934															
18.	Jan. 1	SW	47	L	106	20	L	121	-	-	-	12	L	115	13	L
19.	Feb. 1	S	-	-	-	-	-	-	15	R	111	12	R	114	26	R
20.	Mar. 1	S	9	L	130	-	-	-	-	-	-	12	L	114	6	L
21.	Apr. 1	SW	40	R	159	30	R	149	28	R	130	14	R	89	18	L
22.	May 1	SW	11	L	94	-	-	-	27	L	110	12	R	102	11	R
23.	June 1	S	-	-	-	13	L	112	45	L	127	12	L	106	14	L
									74	L	66					
24.	July 1	S	-	-	-	-	-	-	#10	R	107	12	R	110	11	R

Sample taken July 18/34.

y.

: Content Determinations.

Side of Log 5, 1934.	MC %	Distance from Butt June 28, 1934.	Side of Log	MC %	Distance from Butt July 25, 1934.	Side of Log	MC %	Distance from Butt Sept. 27, 1934.	Side of Log	MC %	Intensity of Attacks
L	131	-	-	-	-	-	-	-	-	-	Gnath. medium.
L	127	-	-	-	-	-	-	-	-	-	Gnath. light 30-75'.
L	94										Tryp. heavy to 30' & in top.
L	166										
L	105	-	-	-	-	-	-	-	-	-	Gnath. & Tryp. both light.
-	-	-	-	-	-	-	-	-	-	-	Gnath. light; Tryp. heavy.
R	117	-	-	-	-	-	-	-	-	-	Gnath. & Tryp. both light.
-	-	-	-	-	-	-	-	-	-	-	Gnath. light; Tryp. medium;
L	104	-	-	-	12'	L	115	-	-	-	Platypus heavy.
-	-	-	-	-	-	-	-	28'	R	136	Gnath. medium.
L	137	-	-	-	-	-	-	-	-	-	Gnath. medium; Tryp. light.
-	-	Stump	S	143	-	-	-	-	-	-	Tryp. light.
L	95	-	-	-	-	-	-	-	-	-	Gnath., Tryp. & Plat. light;
-	-	Stump	N	94	-	-	-	-	-	-	Gnath. light in stump.
L	113	44'	L	145	-	-	-	10	L	109	Gnath. light; Tryp. heavy.
		64	L	190	-	-	-	-	-	-	Gnath., Tryp. & Plat. light;
-	-	14	R	59	-	-	-				Stump uninfested.
		14	L	131				-	-	-	Gnath. & Tryp. medium;
L	127	-	-	-	-	-	-				Platypus heavy.
-	-	15	R	169	-	-	-	10	L	105	Gnath. light; Plat. medium;
		59	L	179	-	-	-	18	L	160	S side (R) uninfested.
L	162	-	-	-	-	-	-				Gnath. light.
L	121	-	-	-	12	L	115	-	-	-	Gnath. med. & Try. heavy to 50',
-	-	15	R	111	12	R	114	13	L	116	Try. heavy 50-74' & above light.
-	-	-	-	-	12	L	114	26	R	89	Gnath. heavy.
R	149	28	R	130	14	R	89	6	L	91	Gnath. light.
-	-	27	L	110	12	R	102	18	L	113	Uninfested up to 50'.
L	112	45	L	127	12	L	106	11	R	108	Gnath. light 25-50';below uninfest.
		74	L	66				14	L	91	Gnath. heavy; Plat. light. ed.
-	-	#10	R	107	12	R	120				Gnath. medium; Plat. light.
								11	R	143	Gnath. heavy to 72'; Plat. light
											25-45'; top uninfested.
											Platypus light.

directly from the logs in the field and immediately placing them in separate vials along with equal quantities of distilled water. The vials were then corked and taken to Vancouver where on the following morning the PH value of the solutions were determined electrically. Whereas with these samples a definite volume of shavings was taken in each case, with samples taken on July 5th the shavings were taken by weight. The results obtained from the various series of samples are given in Table V. No definite relationship between the acidity of the sapwood and the time or intensity of ambrosia attack is indicated by these data but to prove whether this is actually the case or the result of faulty technique will require further investigation.

TABLE V.

Log Preference Studies - Acidity Determinations.

Tree No.	Date Felled	Direction of Top	Distance from Butt June 13, 1934.	Side of Log	PH	Distance from Butt June 28, 1934.	Side of Log	PH	Distance from Butt July 5, 1934.	Side of Log	PH	Intensity of Attacks
	1932											
1.	July 20	N	34'	L	5.0	-	-	-	12'	R	6.4-	Gnath. medium.
5.	Nov. 20	N	-	-	-	-	-	-	6	R	5.8+	Gnath. & Tryp. light.
6.	Dec. 20	N	47	L	4.9+	-	-	-	-	-	-	Gnath. light; Tryp. medium Platypus heavy.
	1933											
10.	Apr. 20	S	-	-	-	Stump	-	5.4-	7	L	6.0	Gnath. light.
11.	May 20	SE	45	L	5.2+	-	-	-	-	-	-	Gnath. light; Try. heavy; Platypus light.
12.	June 20	SE	-	-	-	Stump	-	5.6+	-	-	-	Uninfested.
13.	July 20	E	-	-	-	43	L	5.6	-	-	-	Gnath. & Try. medium; Platypus heavy.
14.	Aug. 20	E	-	-	-	14	R	5.6	-	-	-	Gnath. light; Plat. medium S side (R) uninfested.
						14	L	5.5+				
15.	Sept. 20	S	26	L	5.2+	-	-	-	6	R	5.8-	Gnath. & Plat. light.
16.	Nov. 1	S	32	L	5.1-	-	-	-	-	-	-	Gnath. medium; Try. heavy.
17.	Dec. 1	S	-	-	-	30	L	5.6	-	-	-	Gnath. heavy.
	1934											
18.	Jan. 1	SW	32	R	5.2	-	-	-	-	-	-	Gnath. light.
19.	Feb. 1	S	-	-	-	9	R	5.6	-	-	-	Uninfested.
20.	Mar. 1	S	-	-	-	-	-	-	6	R	5.7-	Uninfested.
21.	Apr. 1	SW	30	R	4.8+	34	R	5.1	6	R	5.5	Gnath. heavy; Plat. light.
22.	May 1	SW	41	L	5.3+	39	R	5.4+	8	R	5.4-	Gnath. med.; Plat. light.
23.	June 1	S	48	R	5.5	45	L	5.4+	6	R	5.3-	Gnath. heavy.
24.	July 1	S	-	-	-	-	-	-	#	R	5.5+	Platypus light.

Report of the Steelhead Field Station, 1934.

K. Graham,
Insect Pest Investigator.

The Steelhead Field Station was re-opened this year on April 18th with the writer in immediate charge, and was continued until September 14th, when it was closed for the season. Cheese-cloth cages providing the space of fifteen compartments were made with the aid of Mr. W.G. Mathers, in charge of the Vancouver sub-laboratory. These cages were to assist in life-history and brood studies and for miscellaneous rearing experiments.

The main project at this station was an investigation of the ambrosia beetles attacking western hemlock. The chief phases of this problem consisted of detailed studies of the broods, life-history and behaviour of the various species of ambrosia beetles concerned and a continuation of the log preference studies from last year. In conjunction with these studies, detailed meteorological data were recorded throughout the season (see accompanying graph) and several miscellaneous rearing experiments were attempted. This report covers all phases of the work at Steelhead during the past season, except the log preference studies.

Life-history studies were made on the three most injurious ambrosia beetles, Gnathotrichus sulcatus, Platypus

wilsoni and Trypodendron bivittatum. A fourth species, Xyleborinus spp., was so scarce that nothing concerning it was found. Brood studies of the first three species yielded little information, the broods of Gnathotrichus and Platypus extending over too long a period for one season's observation. Trypodendron showed an unwillingness to attack.

A general technique was devised for the study of the habits of the different species, with some modifications for each.

For examinations of the early stages of gallery projection use of an axe proved satisfactory, but as the depth increased and eggs and larvae appeared, another method became necessary. This consisted in making a cross-section of the log with a saw near the entrance to the gallery, preferably about 1 cm. distant, since both Platypus and Gnathotrichus frequently deviate somewhat from the plane at right angles to the wood fibres. The tunnel was then traced down from the entrance by following along the clearly definite line of stain, which extends a short distance into the wood. This was done by means of a three-quarter-inch gouge chisel which of necessity was exceedingly sharp to prevent the crushing of the wood into the tunnel and damage to the insects. (Very dry wood will crush somewhat in any case). The gallery was not actually exposed by the chisel, but this was left to be done with strong tweezers.

In order to observe some of the characteristics of the ambrosia fungus growth in the case of Platypus and Gnathotrichus, galleries in a fresh log in which no previous growth of fungus had been present were marked and at different known

ages were opened. Pieces of wood with the gallery or different parts of it were isolated in separate clean glass vials and corked. The development of conidia was observed, it being assumed that in the wood where no conidia appeared the fungus was not present in any form at the time the wood was isolated, and vice versa. The results proved more successful than had been hoped.

The use of stains proved too difficult under the conditions in which they were attempted.

Platypus wilsoni Sw.

Preliminary observations on this species were made at Steelhead in the summer of 1933 by Mr. Hugh Leech. This work included general observations and the marking of new galleries in ways that they might be located and identified later. The study was continued during the season of 1934 by the present writer and these marked galleries proved of great assistance in locating the particular species. The technique employed has been indicated above.

The study was based on observations in over 50 galleries opened at intervals between April 23rd and Sept. 27th. Besides these marked ones several galleries in a dead standing tree were found. This tree was cut down August 15th and tunnels opened.

Hosts.

In the Steelhead area the beetles were observed to attack only logs of Western Hemlock and Amabilis Fir. Logs of diameters larger than 11 inches were chosen, and

those which had been lying from three (possibly even only two) weeks to two years. On no occasion were stumps found infested.

Flight and Attack.

Flight and attack continued from July 22nd to the last week in August, a month earlier than in 1933. About eighty galleries were marked, those on July 22nd with small squares of cheesecloth, those between then and August 13th with pieces of red painted metal, and those appearing until August 24th with pieces of grain sack. The main part of flight occurred in the late afternoon and evening after the heat of the day, at a time when the light was greatly diminished in intensity and energy value. It is not certain which of the factors has the greatest effect - that of wood temperature, air temperature or light value. The attack began at the time of year when fireweed seeds were beginning to be carried about by air currents.

Galleries.

The tunnel is begun by the male and continued by the female, who enters after the first two or three centimetres of gallery are dry. The female then does the excavating and the male remains near the tunnel entrance, head inward, and ejects the characteristic splintery boring dust. The male remains on guard and the spike-like termination of the elytra probably affords substantial passive protection against intruders. When disturbed, the male produces a squeaking noise. No proof as to the origin of the sound can

be given at present, but during the production of noise the terminal abdominal segments are in motion and the noise stops as soon as the movement of these segments ceases. No stridulating organs could be found in this region of the body.

The rate of boring varies, but is faster during the early stages, sometimes as much as 8 cm. a week. During excavation the tip of the gallery remains plane, but it is made concave when complete. The tunnels are nearly always simple, unbranched, extending in long curves in a plane at right angles to the wood-fibres, though sometimes a great deviation from this plane occurs in standing trees, to a distance of as much as 38 cm. through sapwood and heartwood indiscriminately (Plate II, Fig. 1). Gravity is of no consideration to the beetles at work and does not affect their course. Occasionally another branch was projected, and in one case two branches, also in the same plane (Plate II, Fig. 2). On no occasion was there more than one male and one female present. One Platypus entered the heartwood of a thin cross-section of hemlock log. Stebbing (4) mentions P. curtus Chap. entering logs at the cut end as easily as through the bark, being singular in this respect. However, P. wilsoni was not observed to make this a regular habit, but it is of interest to note its ability to enter a log at a cut end.

Food.

Ambrosia-fungus growth developed first near the entrance in the tunnel and gradually appeared inward. It was not found present in any form until galleries were ten centimetres or more deep, and then only near the entrance.

It encroached inward gradually, the conidial stage appearing first, with its translucent spheres supported each by a tiny black stalk. The second stage, in which the fungus coats the walls of the tunnel with a yellowish layer (staining black in the sapwood), did not develop by the end of September, but since it is present in spring it must develop during winter.

It is on this second stage of fungus that the adults and larvae of P. wilsoni appear to feed, and abandoned galleries become almost choked with the layer. Opinions, however, vary. So do species.

Chamberlin(1) speaks of them feeding on "the tender shoots of the ambrosia fungus." This is questionable. He also speaks of the beetles tending their fungus garden with great care. Graham (2) says "It is nothing more than a very interesting example of a symbiotic relationship between a fungus and an insect." Nusslin (3) speaking of Platypus cylindrus of Europe says that the adult beetles feed on wood fibres, the larvae only on the sap on the walls, not on wood or fungus. ("Die Altkafer nahren sich von Holzfasern, die Larven nur von dem Saftbrei an den Wanden, nicht von Holz oder Pilzen.")

Eggs.

The eggs are smooth, opalescent, oval in outline, .88 mm. long and .60 mm. wide (Plate III, Fig. 1) and laid loosely at the extreme tip of the tunnel and not in groups along it. In galleries commenced in late August 1933 eggs were beginning to be laid April 23, 1934, and appeared in increasing numbers until the middle of July. On July 17th a gallery,

with two branches off the main tunnel contained 17 larvae and 25 eggs - a total of 42 eggs, having been laid by one female. This, however, appears to be quite exceptional for this species, an average of 20 eggs laid being about the limit in a season in British Columbia.

Date of Observation.	Length of Tunnel.	No of Eggs.	No. of Larv.	Total eggs plus larvae
April 23	-	3	None	3
May 3	-	6	"	6
May 3	-	7	"	7
May 7	17½ cm.	10	"	10
May 7	18½ cm.	8	"	8
May 21	22 cm.	7	"	7
May 21	20 cm.	12	"	12
June 13	38 cm.	14	2	16
June 15	21 cm.	8	3	11
June 22	-	14	2	16
July 8	-	15	3	18
July 17	Branched	25	17	42
July 18	-	4	5	9
July 26	-	12	8	20
Aug. 7	-	12	9	21
Aug. 7	-	11	7	18
Aug. 18	-	9	9	18
Aug. 23	-	7	8	15
Aug. 23	-	11	12	23
Sept. 5	-	10	12	22
Sept. 13	-	8	11	19
Sept. 27	-	5	6	11

Average number of eggs laid as indicated by galleries opened after July 17 = 20.

Chamberlin (1) states that the female of this species produces a hundred or more eggs. He does not, however, state his authority for saying so, nor where observations were made.

Larvae.

From the time of their first appearence on June 13th until the end of September larvae were preserved by Shelford's method of placing them in 80% alcohol and heating at the alcohol's boiling point for twenty minutes. Head capsule measurements were made later and it seems quite impossible to determine the number of instars by this method. Judging from the measurements made, the head capsule grows to such an extent at each moult that the distinctness of each group is lost. Measurements appear as follows

Width of Head Capsule in Millimetres.	Cont.	cont.	cont.
.40	.76	1.16	1.20
.44	.76	1.16	1.20
.44	1.00	1.16	1.20
.44	1.00	1.16	1.20
.44	1.00	1.16	1.20
.44	1.00	1.16	
.44	1.04	1.16	
.44	1.04	1.16	
.44	1.04	1.16	
.48	1.04	1.16	
.48	1.04	1.16	
.52	1.04	1.16	
.52	1.04	1.16	
.56	1.04	1.16	
.60	1.12	1.16	
.64	1.12	1.20	
.64	1.12	1.20	
.72	1.12	1.20	
.72	1.16	1.20	
.76	1.16	1.20	
.76	1.16	1.20	
.76	1.16	1.20	
.76			
.76			
.76			

The very youngest of the larvae are white, footless, with heads wider than the body, which is short, broad and almost pillow-shaped in profile. Along their side-margins are large prominent papillae and from the base of each a long seta. (Plate III, Fig.2). They are extremely active and

travel with equal facility forward or backward with a rhythmical wave motion and are able to climb with ease a vertical wall of smooth glass. Frequently eggs adhere to them and become transported along the tunnel until dislodged by some obstruction, so that occasionally a secondary group of eggs is formed in this manner.

On June 15th a second stage of larvae appeared. They were more nearly cylindrical but slightly humped, more elongate and slightly less active. At each successive instar they continued to lengthen relatively as well as actually and lost much, but not all, of their mobility (Plate II, Fig. 3). Some had reached their last instar by July 16th, but even on Sept. 27th none had pupated. During the summer soft dark pellets of frass were being ejected from the tunnel by the male. Pupation does not occur until the next spring and summer, when the larvae cut pupal chambers along the plane of the wood fibres to a length of from 6 to 8 mm., crawl in backwards and seal themselves in, where they pupate and later transform to adults. (Plate III, Fig. 4). Food is dealt with in an earlier paragraph.

Chamberlin (1) states that the larvae reach maturity in five or six weeks. He does not say where. The present study indicates about one year for larval development.

Pupae.

Pupae are elongate, white, and are sealed in their pupal chambers, facing the tunnel. The time of their first appearance is not yet determined, but it is undoubtedly in the early summer in their second year.

Stebbing (4) does not mention pupal chambers for the Indian species. Nusslin (3) describes them for P. cylindrus. Chamberlin (1) claimed that P. wilsoni produced pupal chambers and it is found to be so.

Review of Life History.

Attack occurs between late July or August and September, beginning just as the fireweed seeds are ripening. Galleries are completed by the end of September but egg-laying does not commence until the following spring and summer, an average of twenty eggs being laid by each female. Larvae hatch from the eggs throughout the second season, some becoming almost mature by fall. Pupation does not occur until the third season, when pupal chambers are cut. Some pupae become adults and make an attack. Probably some of the larvae resulting from eggs late in the second season do not reach maturity until the fourth season. And this is not improbable, since if they did not do this there would soon arise in the species two separate races which by circumstances could never mix. The biological significance of the overlapping is that different season's broods are brought together.

Nothing was determined in regard to the duration of life of the individual. The present study is far from being complete but a periodic observation for another season would do much towards its completion.

Literature Cited.

(1) Forest Entomology - W.J. Chamberlin (undated) Part I, p.83.
(2) Principles of Forest Entomology - S.A. Graham, 1929.
(3) Forstinsektenkunde - Nusslin, 1927.
(4) Indian Forest Insects - Stebbing, 1914.

Trypodendron bivittatum Kirby.

Observations made by Mr. Hugh Leech in 1933 showed that the beetles of this species project at least two sets of galleries in their life-time. The first attack spread over a month from mid-April to the middle of May. A second attack occurred between the middle of June and the beginning of July.

Studies were resumed by the present writer in 1934. In this season three flights occurred; the first in early April, the second in the middle of May and the third in mid-July. The first flight produced the heaviest attack, the second much lighter with preference much more restricted, while after the third flight no attack was found.

Cage experiments were quite unsuccessful for reasons undetermined. An attempt at brood studies was made by caging sections from uninfested logs in the Log Preference Experiment. The beetles emerged but were reluctant to enter sticks from Logs No. 2, 5, 15 and 23 (Log Preference Study) and preferred to re-enter their original log, indicating a second brood. The broods became hopelessly confused.

Observations were begun on April 16th at which time the beetles were working actively.

The galleries are begun by the female who is distinguishable from the male by the convexity of the head. With the male the front of the head is concave.

Eggs are white, translucent, and perfectly elliptical, 1 mm. long by .72 mm. wide (this is larger than Platypus eggs). They are packed each in a niche cut into the sides of the

tunnel. The first ones were found on April 28th.

Eggs under observation showed an incubation period of ten days, this during rainy weather when maximum temperatures ranged from 49° to 59°F. The first signs of incubation appeared when the eggs began to collapse.

Larvae are white and footless, and lie curled up in their cradles when at rest facing the pore in the plug which separates it from the gallery. As they grow they turn in their cradle and enlarge the cavity, but they were not observed to discard any wood particles. There seems a possibility that they may obtain some of their nourishment directly from the wood which they excavate. One larva which was exposed just sufficiently for observations seemed quite undisturbed by the exposure since it continued to eat something at the entrance to its cradle. Examination with a hand-lens showed this substance to be frass. There was also a quantity of frass in the cradle itself. In the process of feeding, the larva extended its head slightly forward and with its fork-like array of palpi, together with its mandibles, picked up a small amount of the frass. The head was retracted and the food consumed. The palpi vibrated in unison with a lateral sympathetic motion not opposing, while the mandibles, also moving laterally, operated regularly at a considerably slower speed, coming together once in about every second. The larvae turned to the frass in its cradle and eventually to that which was issuing from its own body.

Larvae were preserved and head capsule measurements made in the laboratory indicate but two instars.

Measurements are as follows in the table:--

Width of Head Capsule (millimetres)	Continued	Continued
.40	.72	.76
.44	.72	.76
.44	.72	.76
.44	.72	.76
.48	.72	.76
.48	.72	.76
.48	.72	.76
.48	.76	.76
.72	.76	.76
.72	.76	.76
.72	.76	.76
.72	.76	.80
.72	.76	.80
.72	.76	
.72		

In the logs in the field only a very small percentage of the progeny matured. The beetles attacked only the wettest logs and yet in those very logs they appeared to find moisture conditions overpowering, and projected galleries so close to the surface of the log that they were visible from the exterior of the wood (Plate IV, Fig. I.) .

Field observations showed that pupae appeared within twenty-one days after larvae were present. This was in warm weather when the maximum temperature ranged from 51° to 80°F. Pupae appearing May 16th became teneral adults by May 28th - a pupal period of ten days.

The last stray Trypodendron was found in flight on August 30th.

A microscopic examination of the blood of the adult beetle showed the presence of long roundworms, tapered at both ends, but with a somewhat longer tapering anteriorly.

Gnathotrichus sulcatus Lec.

Studies on this species were conducted in 1933 by Mr. Hugh Leech and a continuation of his studies was undertaken this year (1934) the first observations being made on April 16th.

Hosts.

The beetles were observed to attack logs and stumps of Western Hemlock, Amabilis Fir and Douglas Fir, choice in the order named. They appear to prefer mainly fresh wood and logs as new as nine days after being felled. They would not attack peeled sections. On one occasion they attacked a standing growing tree.

Flight and Attack.

Flight and attack took place continuously between the middle of April and the first week in September, but more intensely in the middle of May and mid-June. Although some beetles were in flight in the daytime most appeared in the evening before dusk. They even took advantage of momentary cessations in rains and were to be seen flying between showers.

Galleries.

The tunnel is begun by the male and the female enters later. On June 23rd a male beetle was found penetrating into the bark of a tree with the tip of its body just visible. A female travelling over the bark discovered him and very impatiently tried to dislodge him by the disturbing method of tapping him with her front tarsi. Before she succeeded in taking over the work of digging the gallery she became frightened and started to escape.

The first three or four centimetres of gallery are directed nearly straight towards the centre of the log, then a branch from 1 to 2 decimetres long is projected, following the growth rings in the spring wood which is soft. After eggs are laid and the branch tunnel is completed the original tunnel is projected deeper and another branch, usually in the opposite direction to the first one, is made. A third and sometimes a fourth branch are produced, but they never penetrated into the heartwood (Plate IV, fig. 2). Rate of boring varied from 1 to 3.2 cm. per week.

Ambrosia fungus was present at different stages of gallery projection, in one case when the tunnel was only 1.7 cm. deep but in another instance not even when it was 5 cm. deep. The first stage is not apparent until the gallery is at least a month old, when there arise, each on a tiny black stalk, glistening, translucent, spherical bodies or conidia which later fall and give way to a thick yellowish layer. As this becomes older it is blackened by a stain which penetrated along the wood vessels for a distance of half a centimetre.

Eggs.

Eggs are laid in niches cut in the walls of the branch tunnels and sometimes in the central one, and packed in with fine particles of boring dust. The number of larval cradles and pupal chambers combined was seldom less than forty and in one instance fifty-eight pupal chambers were found in one set of tunnels, indicating that at least that number of eggs had been laid.

Incubation period was undetermined.

Larvae.

Larvae are white, footless and lie curled in their cradles. They are distinguishable from the larvae of Trypodendron by the presence of very evident hairs on the medial portion of the head. As they grow they enlarge their cradle, and before pupation they lengthen it considerably, straighten out their bodies and lie facing the tunnel, sealed in by a plug at the entrance to the pupal chamber.

Head capsule measurements of a rather inadequate series of larvae indicates two instars.

Head Capsule Width in Millimetres. Continued.

.44	.68
.44	.68
.44	.68
.48	.68
.48	.68
.48	.68
.48	.68
.48	.68
.48	.68
.48	.68
.48	.68
	.72
	.72

The average width of head in each instar being .47 and .69 millimetres respectively.

Pupae.

The first pupa was found on April 19th. The young adults remain in their pupal chambers until their bodies begin to show pigmentation. After that they crawl into the tunnel where they feed for a time on the ambrosia fungus. The grayish pellets of frass are pushed out from the mouth of the tunnel.

The first teneral adult was found May 2nd. On May 9th some young adults were in the main gallery, others were still in their chambers, head inward and apparently eating wood. Still others were so pale and immature that they had not removed the plug which sealed them in. The old adults were present in the galleries when observed on April 19th, showing that they hibernate in the logs.

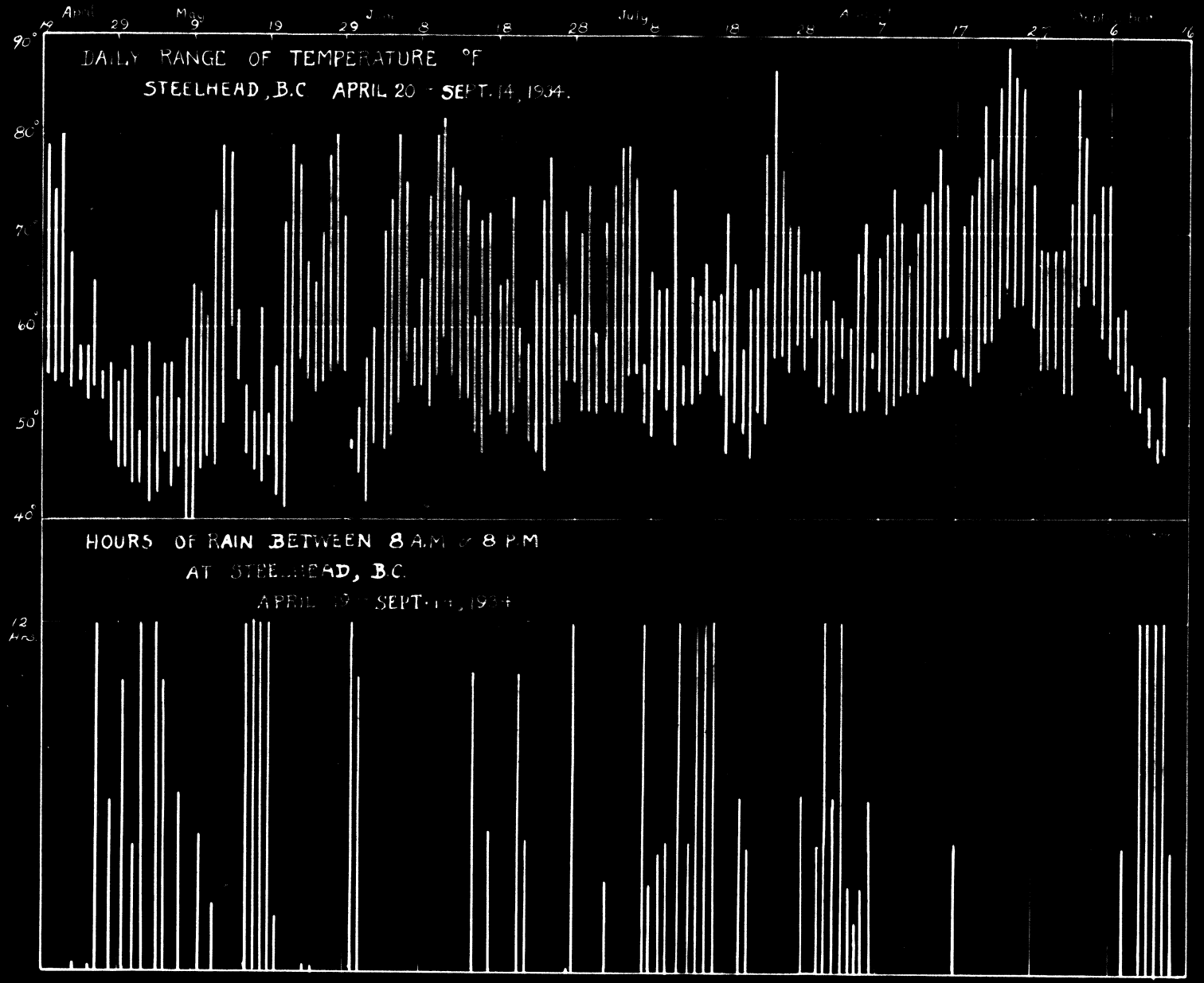
DAILY RANGE OF TEMPERATURE °F
STEELHEAD, B.C APRIL 20 - SEPT. 14, 1934.
90°
80°
70°
60°
50°
40°
HOURS OF RAIN BETWEEN 8 A.M. & 8 P.M
AT STEELHEAD, B.C.
12 Hrs.

PLATE I.

Steelhead Field Station. Showing cabin and portion of cages
W.A.M. 1934.

Fig. 1.

Fig. 2.

PLATE II.

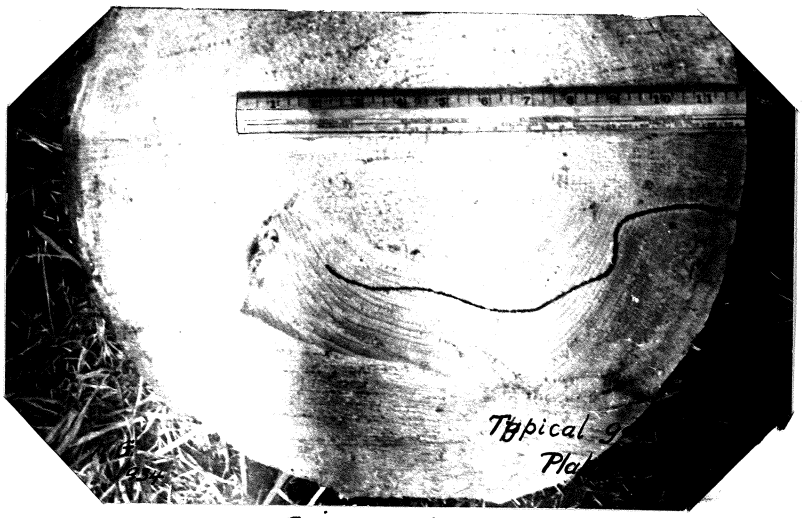

Figure 1.

Figure 2.

PLATE III.

Figure 1.
Eggs of Platypus wilsoni Sw. Magnified.

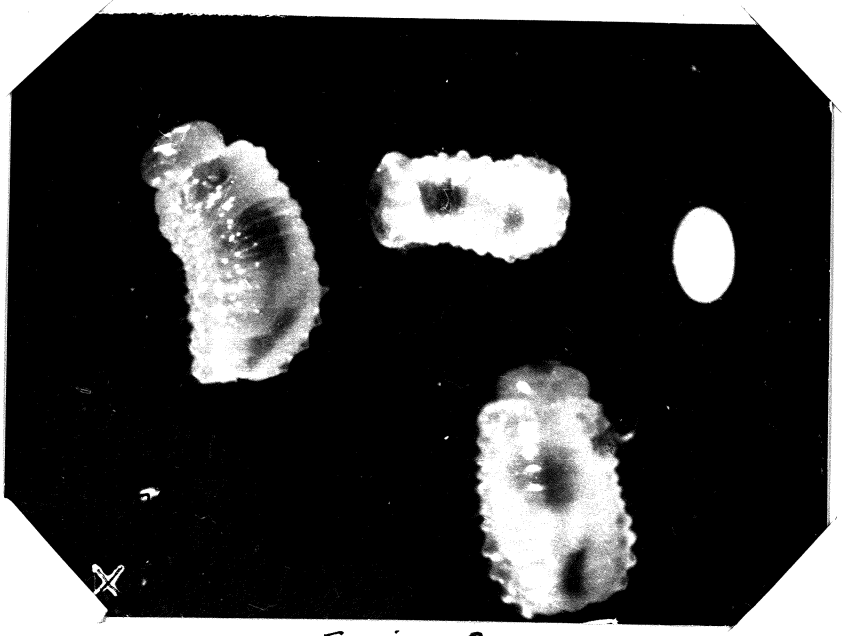

Figure 2.

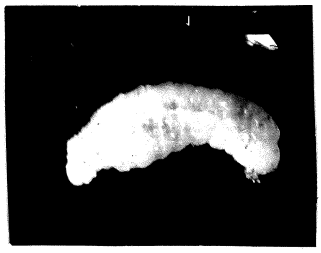

Figure 3.
Mature larva of Platypus wilsoni Magnified.

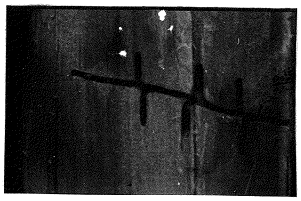

Figure 4.
Pupal chambers of Platypus wilsoni X 2/3

Photos by K. Graham 1934.

PLATE IV.

Figure 1.

Figure 2.

Minor Projects

Damage to Lead Sheathing of Telephone Cable.

A unique case of insect damage to the lead sheathing of a telephone cable was reported this year by the British Columbia Telephone Company to the Dominion Forest Products Laboratory, and in turn was referred to this office. Samples of the sheathing showed several holes about the size that would be made by gunshot (Figure 1). These holes had permitted the entrance of moisture which had disrupted the telephone service.

On investigation the cable was found to be a "lateral" fastened to the side of a telephone pole located in the city of Vancouver. As the punctures in the sheathing had occurred on the side next to the pole they were undoubtedly the work of insects. The pole, western red cedar and in service for at least fifteen years, was almost riddled from the base to the top with various size holes, many of which were similar in size to those in the sheathing (Figure 2). On cutting into the pole two live adults of an Anobiid and two live larvae of apparently the same species were recovered. In addition dead Hymenoptera were taken from a number of the larger size holes.

The Anobiid which undoubtedly was responsible for the damage to the cable was identified by Mr. Ralph Hopping as Coelostethus quadrulus Lec. The explanation for the damage being that adults of this species on attempting to emerge from the pole had encountered the lead cable and in its eagerness to emerge had bored on into the cable. However, the beetles did not penetrate through the opposite side of the

cable, and it is not known whether they re-entered the pole and sought new exits or whether they died within the cable. Unfortunately the sheathing had been removed and flattened before the possibility that insects might be responsible for the damage was considered, and no search had been made for the remains of specimens.

A comparatively simple method of avoiding such damage would be to offset the cable from the pole a sufficient distance to allow the borers to emerge without encountering the cable.

The Telephone Company was very much interested in the problem and very generously replaced the infested pole and delivered it to us at the University. The pole was 24 feet from the ground level to the top and with diameters of 11 ins. at the top and 16 ins. at the ground. On delivery the pole was sawed into 4 sections of 5 feet each and a fifth section, the top, 4 feet long. A cloth cage was constructed into which the three centre sections were placed on end (Fig. 3), while the butt and top sections were examined by splitting. This work was completed by the middle of April, the cage having been constructed on April 5th.

From the uncaged sections of the pole one additional adult of C. quadrulus and four larvae of possibly the same species were recovered. Although several miscellaneous cocoons were taken from some of the tunnels, nothing emerged from them. In addition several earwigs and an adult of the Coccinellid, Adalia bipunctata L., were found hibernating within checks on

these sections. Furthermore the butt section was found fairly heavily infested with termites and sowbugs. It was interesting to find that practically all the tunnels in the pole were confined to the outer 2 inches.

The emergence from the caged sections included the following:--

3 - Adalia bipunctata L. (Coleop.)
1 - Diacrisia virginica Fabr. (Lepid.)
1 - Lasiocampidae (Lepid).

These specimens undoubtedly had been hibernating in the pole. In addition two adults of an unidentified species of Perimegatoma (Coleop) and a series of 22 Hymenoptera were recovered. The latter consisted of at least five different species, two of which were wood-boring bees.

This experiment is to be continued next year.

Douglas Fir Webworm or Silver-Spotted Halisidota, Halisidota argentata Pack.

This year efforts were made to rear two separate colonies of the Douglas fir Webworm in outside cages at the laboratory.

The first colony was taken on March 17th on a hemlock (Tsuga heterophylla) on the University campus. This colony consisted of 17 specimens averaging about 15 mm. in length. The caterpillars were placed on a caged young hemlock but development was so retarded that on May 15th the host was changed to Douglas Fir. By June 12th three of the specimens had died and on that date four of the remaining specimens were removed and preserved. The first cocoon was found on June 23rd in some forest floor debris which had been placed in a corner of

the cage. The first moth was recovered on July 25th. In all, 8 moths, 4 females and 4 males, emerged and in no case was the pupal period of less than one month duration.

The second colony was received on March 22nd through the Provincial Forest Service and were immediately placed on a caged young Douglas fir, the original host. At the time of caging the colony consisted of 19 specimens all of which were considerably larger than those of the first colony, the largest being 25 mm. long. During the course of the rearing five specimens were removed from the cage. Although the first cocoon was found as early as May 15th the first moth did not emerge until July 7th, a pupal period of close to 7 weeks duration. Only 4 moths, all females, were recovered from this cage. In addition, however, one Hymenoptera parasite was taken on June 5th.

An attempt was made to study the oviposition habits of this species by liberating freshly emerged moths in a small cage containing a potted young Douglas fir. However, none of the moths deposited any eggs nor were any of the moths observed in copulation. The abdomen of one newly emerged female moth was dissected and found to contain 405 eggs.

The life history of this species may be summarized as follows:-- Eggs laid in mid-summer and hatch in the fall with the winter being passed as young larvae. Feeding is resumed with the first warm weather of spring and the larvae are gregarious until about two-thirds grown. Up until this time the caterpillars spin a considerable amount of webbing. During their later stage the larvae feed singly and when mature pupate

in the debris on the forest floor. The pupal period is of approximately one month duration with the flight period occurring in July.

Control of Lyctus species.

On July 27th a "Sundowner" stool infested with Lyctus was received by the Forest Products Laboratory for identification and control and in turn was referred to this laboratory. The stool which had been carved from a single block of a native African wood had been received in Vancouver from Africa about 6 months previously In co-operation with the Products Laboratory, the stool was exposed to a temperature of 140°, with the humidity at 100 per - cent, for 3 hours. However, as this exposure did not succeed in killing all the insects the same treatment was repeated. Following the second exposure no evidence of any live insects were to be found nor did any checking develop inthe wood in spite of the quite unusual structure of the stool.

Spray Injury.

On May 8th the writer's attention was directed by Mr. A.E. Pickford, Superintendent of the Provincial Forestry Station near New Westminster, B.C., to about fifteen young Sitka spruce which were in a nursery plot at the station. The upper one-third to upper three-quarters of these trees had suddenly wilted and died at about the time the buds were beginning to open in April of this year. One of the affected trees, which was transferred to a flower-pot for convenience in photographing, is shown in Figure 4. Below the killed portion the trees were still healthy and an examination did not reveal

any insect work or pathological factor which might have been responsible for the damage (Figures 5 and 6).

However, in discussing the probable cause of the dying-back of the tops it became apparent that the affected trees were confined to a portion of the plot which had received an application of full strength kerosene-emulsion solution on July 20th of last year. At that time an inexperienced man who had been assigned the task of mixing the stock solution had commenced to apply the mixture without dilution and it was not until two rows of the plot had been so sprayed that the mistake was realized. Although a number of tips were killed, the trees soon regained a healthy appearance and at the end of the season it was thought that they had recovered completely. However, the sudden dying-back of the tops of some of the trees this spring was undoubtedly a delayed after-effect from the overdose of kerosene-emulsion. The only other tree to be killed back in a similar manner was a young spruce, located near the work-shop, which had also received the same strong spray last year. No injury was evident among the trees on the remainder of the plot which had received the normal 1-10 dilution.

The fact that the tops of only 15 of the 200 trees which had received the overdose died this year may be accounted for by variations in the quantity of spray applied to each tree and by the possible lack of uniformity in the emulsion due to insufficient mixing. The killing of the tops was due in all probability to the kerosene penetrating through the bark to the cambium, but the penetration being so gradual that its

effect was not evident until the commencement of growth this year.

Miscellaneous Rearings.

Anisandrus pyri Peck.

On April 25th a portion of the trunk of a young plum tree which had been recently infested with Anisandrus pyri Peck. was caged. The original female adults were then present. No definite re-emergence of these adults occurred during the balance of the season although 7 specimens were taken in the cage on May 9th and odd specimens were to be found in the cage throughout the summer.

On examining a small portion of the sample on July 14th the new brood was found present as almost mature adults. No emergence of these adults occurred this year, and on Nov. 7th representative series of both mature male and female new brood adults were taken from a portion of the sample.

In addition to the Anisandrus the sample was found to contain a species of Xyleborus, of which over thirty adults were recovered in the cage during August and September.

Pissodes sitchensis Hopk.

Close to 100 adults of Pissodes sitchensis Hopk. were bred from a number of young Sitka spruce tops taken at the Provincial Green Timbers Forestry Station near New Westminster. The infested trees were first examined on July 26th, at which time larvae, pupae and teneral adults were present. The larvae of this species first mine the cambium layer of the main leader and then mine into the pith of the stem where pupation takes place (Figs. 7 & 8). The emergence of the adults from the caged

material commenced on August 1st and continued until August 25th. Only one parasite adult was recovered from this material.

Brachyrhinus sulcatus Fab.

A larva of this snout beetle was found on May 12 th about the root of a young English yew in a local nursery. The specimen which was placed in a rearing block transferred to the adult stage on May 18th.

Galerucella carbo Lec.

On July 11th a series of eighty larvae of the leaf beetle Galerucella carbo Lec. were taken on willow in South Vancouver. Seventy of the specimens were liberated on a caged young willow while ten were placed in a breeding-jar with willow foliage. This species pupates on the soil. The first pupa was observed in the breeding-jar on July 23rd and by July 30th this specimen had transformed to the adult stage. Succeeding adults emerged on August 1, 3 and 4th.

The first adults from the caged material were recovered on August 3rd with maximum emergence occurring on Aug. 6th. Very heavy mortality occurred among the caged larvae, a total of only sixteen adults being recovered. This species undoubtedly hibernates as adults for after feeding on willow foliage for several weeks the adults sought shelter in a quantity of debris in the cage and became dormant.

Spruce Budworm - Cacoecia fumiferanae Clem.

Several spruce budworm larvae were reared during the year. One medium size specimen was taken on May 11th on an Engelmann spruce in the University Botanical Garden and reared in a shell vial. Pupation occurred on May 18th and the moth, a male, emerged on May 29th. Also on May 11th a smaller specimen was taken on a western hemlock in the Botanical Garden and placed in a shell vial with hemlock foliage. However, development was so retarded that on May 28th Douglas fir was substituted for the hemlock. Pupation occurred previous to June 5th and the moth, also a male, emerged on June 12th.

On May 14th two additional spruce budworm were taken on Engelmann spruce in the Botanical Garden. One specimen pupated on May 22nd and the moth emerged on May 31st, while the second larva pupated on May 23rd and the moth emerged on June 1st. The emergence dates of these moths were fully three weeks earlier than any previous record of the writer for this species in the coast district.

Satin Moth - Stilpontia salicis L.

A series of twelve satin moth caterpillars, taken on May 14th on a poplar tree on the University campus, were placed in a jar in the laboratory for rearing. The first pupa was formed on May 28th and the first moth emerged on June 5th. In all 7 moths, 3 males and 4 females, emerged between June 5th and June 15th with the pupal periods ranging from 8 to 10 days in length. In addition 3 small Hymenoptera parasites were recovered on May 25th and 28th. These parasites, which have not yet been determined, spin a small white to creamy cocoon about

5 mm. in length on the leaves or bark of the trees, and were quite numerous on the infested poplars.

Pteronidea Spp.

A colony of this sawfly was taken on July 11th on willows in South Vancouver and transferred to a small caged willow. At that time the larvae were black in colour but by August they were full-grown and speckled. Several of the larvae were found on August 7th to be entering the soil for pupation. The emergence of the adults commenced about August 23rd and by Sept. 5th the larvae of the succeeding generation had hatched.

In addition to the above specimens several as yet unidentified species of insects were also reared from various hosts during the course of the year.

Hol

Figure 1.

Showing holes inlead sheathing of telephone cable made by Coelostethus quadrulus Lec. X .67

Photo by W.G.M.

Figure 1.

Figure 2.

Showing insect exit holes in section of telephone pole. Several of the holes shown contain dead Hymenoptera. X .86

Photo by W.G.M.

Figure 2.

Figure 3.

Showing cage containing three 5-foot sections of telephone pole.

Photo by W.G.M.

Figure 4.

Showing young sitka spruce from nursery plot with top killed back as a result of an application of full strength kerosene-emulsion stock solution.

Photo by W.G.M.

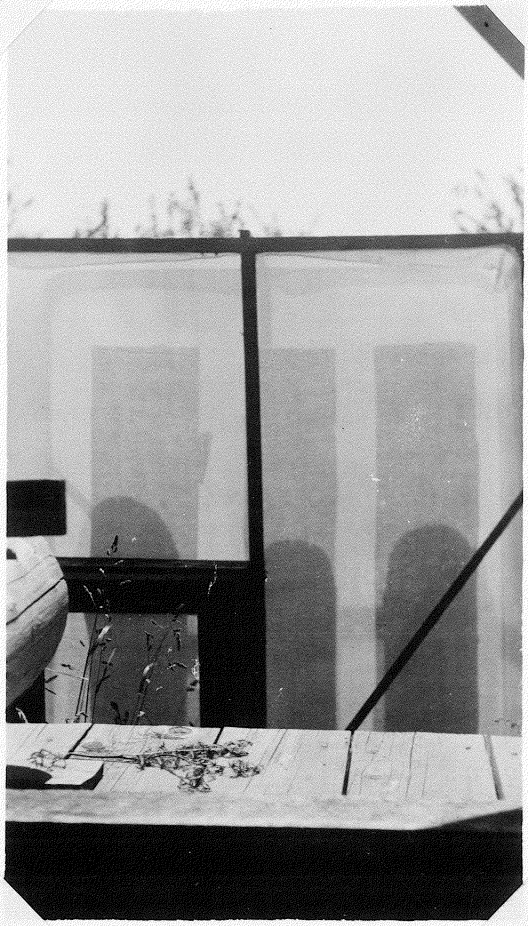

Figure 3.

Figure 4.

Figures 5 and 6.

Showing spray injury to young sitka spruce.
Portion above branches with needles dead. See Figure 4.

Photos by W.G.M.

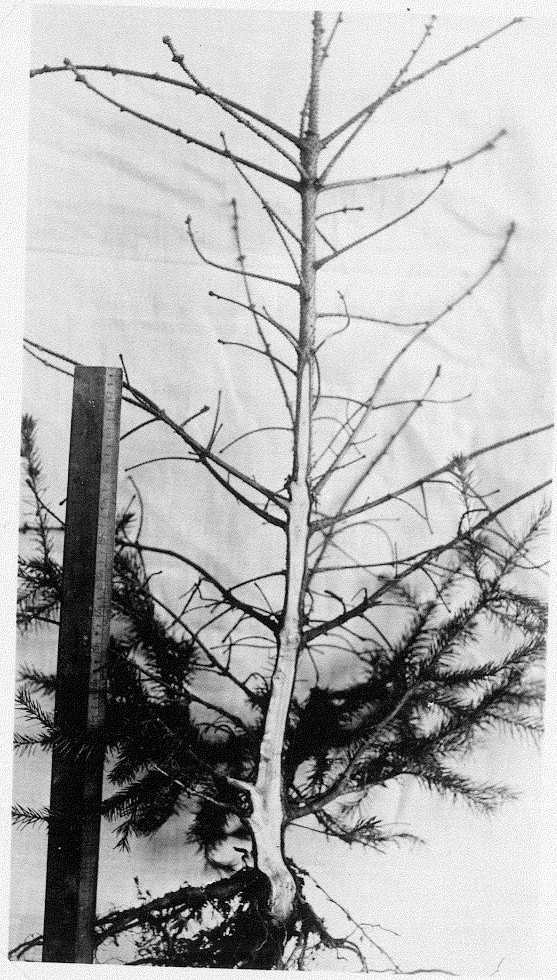

Figure 5.

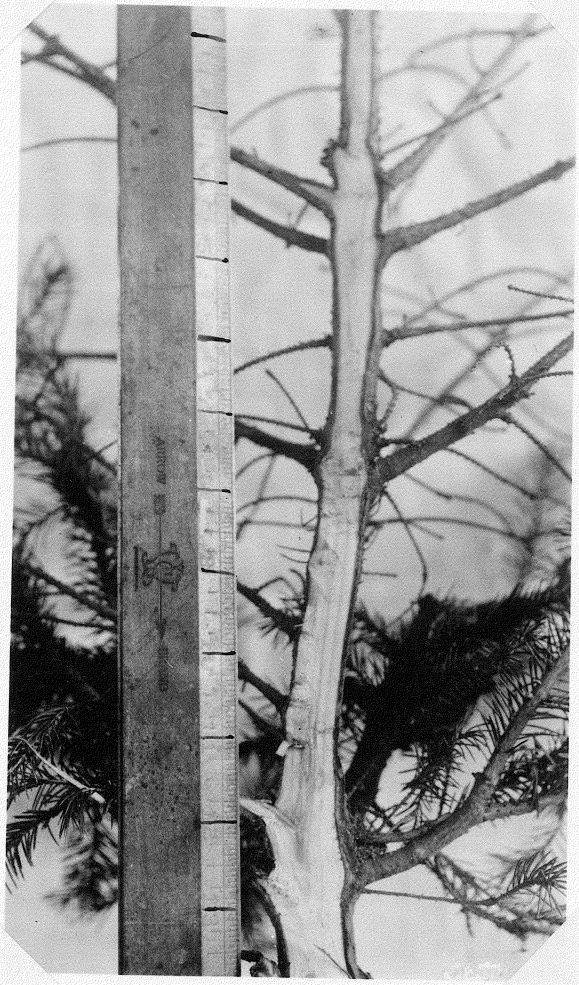

Figure 6.

Figure 7.

Showing leader of young sitka spruce killed by Pissodes sitchensis Hopk. Tree of same size and age as Figure 4. Portion of bark and wood removed for comparision with spray injury.

Photo by W.G.M.

Figure 8.

Same as Figure 7. Showing in more detail mined cambium layer and pupal cells of Pissodes in pith of leader.

Photo by W.G.M.

Figure 7.

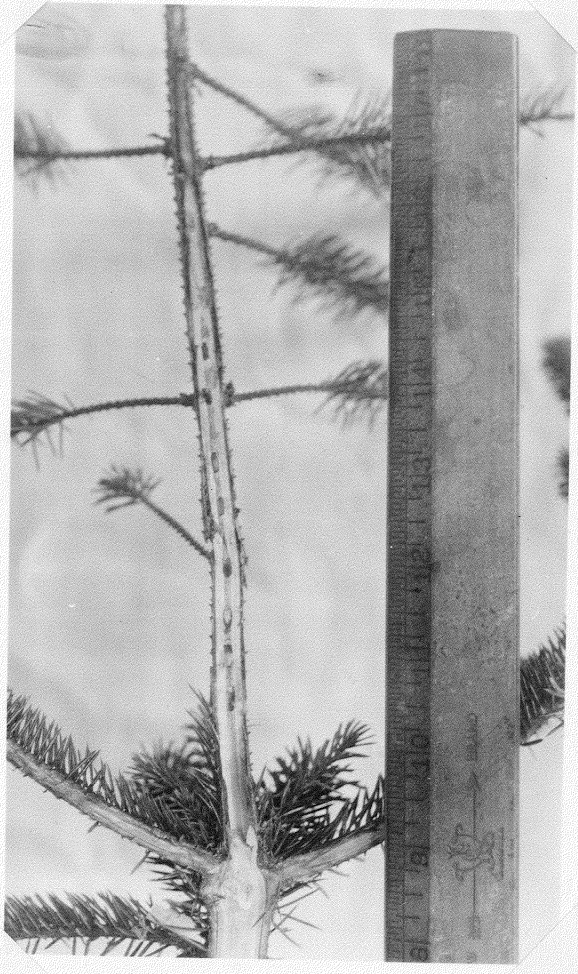

Figure 8

Summary of Season's Work.

Aspen Grove Project.

- 1934 -

(H.A. Richmond)

The following summarized activities in Aspen Grove for the season of 1934. This report is necessarily brief as the time available only allows for general statements. A great deal of detailed work is left to do at a future date including the analysis of data collected in the field, meteorological records and the working over of larvae of both Dendroctonus and Enoclerus particularly with reference to head capsule measurements.

The studies undertaken during the season are listed below with their corresponding experiment numbers.

17494 - Brood studies continued from 1933.
17537 - Brood studies on overwintered broods.
17538 - Brood study field observations.
17496 - Clerid life history studies continued from 1933.
17533), 17543A) Overcrowding study
17545), 17545A) Overcrowding study
17546), 17546A) Overcrowding study
17544), 17544A) Overcrowding study
17536 - Caged 1933 infested logs.
17540 - Artificially infested log. Check on 17541 and 17542.
17541 - Influence of Hypophloeus.
17542 - Influence of Clerids.
17547 - Studies on the progress, development and mortality of D. monticolae, including egg counts and other observations.
17548 - Reconnaissance work
17539 - General.

Caged Infested Logs.

Experiment 17536.

The primary object of this study was for the collection of adult D. monticolae for use in the overcrowding studies. It served at the same time as a population study for trees in the AspenGrove region.

The logs procured were housed in a cage measuring 6 ft. wide, 6 ft. high and 18 ft. long. Each log was taken from a different tree so that a good average was obtained. The following lists the logs with their measurements:--

Log No.	Diameter		Length
	Big End	Small End	
1	10½	9	12 ft.
2	13	10½	19 "
3	15	9	30
4	12	8	10½
5	14	9	6
6	10½	7	6½
7	10	7½	6
8	13	8½	6
9	9	7	10
10	12	7	12½
11	10	6	12
12	12	7	12
13	12	8	7
14	9½	7	12½
15	14	10	8
16	12	10	7
17	10	8	8
18	10	8	8
19	11	9	6
20	9½	7	11
21	9	7½	11½
22	13	9	9
23	16	11	5
24	12	7	13

This cage was completed on May 30th and due to rains, the first collection was made on June 4th. Daily collections

were made thereafter until Aug. 24th. At this time the main emergence was over with only a few Hypophloeus left. The logs were therefore rolled from the cage and analyzed in connection with the Clerid studies (Exp. 17496).

The material accumulated from this cage has not yet been analyzed, and no information is available as to the population of these logs.

Brood Studies.

Hector A. Richmond,
Vernon Entomological Laboratory.

Brood studies for the year of 1934 were of two series.

The first consisted of a continuation of the 1933 brood study. This was run with *Dendroctonus monticolae* infesting a leg procured in Kane Valley in 1933. The summary of this for last year is given in the report for 1933. The 1934 continuation is summarized in the following tabulation.

Unfortunately, the other logs from 1933 could not be continued as this was one, as they were removed from the cages by vandals during the winter. While they had been labelled before leaving in the fall, these cards had been torn off, apparently when the logs were pulled out of the cages.

To summarize the study I may mention that the season's first attack of the old adults occurred on June 3rd, and by June 11th the log in which these old adults were attacking was sufficiently infested to be isolated with a fresh log. This newly attacked log was labelled OB. By June 29th, the fresh log had become heavily infested and was confined as 2OB. A fresh log was added which was first attacked on July 27th, representing the third attack for the season. By Aug. 29th but five entrances were visible and on Sept. 4th an examination was made of all logs to determine the condition of the progeny which has already been set forth in the tabulation.

The second series of brood studies was run from a portion

of a tree which had been attacked in the woods in 1933.

Due to the very advanced season, and to the fact that the writer was delayed in commencing work this spring, the log when caged on May 30th was found to contain mostly young adults. The first emergence therefore was quite likely to be the young brood for 1934. In adding a fresh log to this cage I did not attempt to procure an infestation of the old adults, but left it until it was well infested with the young brood. The emergence of this young brood was checked by field observations on the tree from which the original log was procured.

By June 23rd the fresh log was heavily infested and isolated under the designation of Cage A. A fresh log was added on June 26th and on June 29th the first attack was noted, being the young adults in their second set of egg galleries. By July 11th the log was sufficiently infested to be isolated and was called 2. A fresh log was added on July 12th and the first attack of the young adults projecting their third set of egg galleries occurred on July 25th. By August 9th but three entrances had been noted, and by Aug. 29th there were but six. On Sept. 4th an examination was made of all the progeny which is set forth in the tabulation.

An interesting deviation from previous years records is to be found in Experiment 17537. In this instance young adults which had overwintered probably as pupae during 1933-34 emerged to project their first set of tunnels on June 9th and the progeny of these were emerging as young adults on Sept. 4th. This is our first record of a complete generation occurring in a single season. It should be remembered however that this was in caged

conditions and no records indicate this occurrence in the field. However, checking this, with the development of broods in the same cages for previous years, should give us a correlation of the rate of development and weather factors.

In addition to the cage results, certain notes were procured from the field. Certain 1933 infested trees were selected in the early part of the season in which the progeny of the attacking beetles was in various stages. By making periodical examinations the following notes were obtained.

Pupae present in trees on May 21st had transformed to young adults by June 12th. All larvae present in the trees examined on May 21st had transformed to the pupal stage by June 20th. Eggs present on May 21st were in the form of small larvae by June 12th and pupae and young adults by June 30th. By July 8th all trees under observation contained young adults.

Observations further disclosed old adults depositing eggs on June 4th in trees attacked in 1933. Other observations on July 16th showed an adult extending a gallery which it had commenced in 1933. This gallery contained pupae near its entrance, larvae mid-way up and eggs at its extremity, with the adult still in the course of projecting the gallery. We have observations from past years too, which show the attack of old adults on trees infested in the year previous.

The first attack of Dendroctonus monticolae on a green standing tree was noted on July 4th. This can quite safely be set as the first date of attack, as very intensive searches were made continually over the country without finding an attacked tree prior to this date. On the same date an examination at Brookmere

revealed no newly infested trees, but an interesting point was noted. A considerable number of trees were seen that were only just beginning to turn colour (July 4th). An examination showed that these trees had all been attacked on one side only, some time during the season of 1933. The uninfested sides on the date examined were in the course of attack by what I took to be adults of the new brood for 1934. The majority of these were only just entering although a few had projected galleries three or four inches in length, and were depositing eggs.

This may explain the point, that while young adults were present in trees as early as June 9th, no attack was found until July 4th, even though these young adults were emerging in the cages in large numbers prior to June 23rd, and monticolae adults were taken from the tent wall on June 28th. While the cages are naturally somewhat advanced to outdoor conditions, it seems there should be some attack earlier than July 4th. In the event that these are being re-absorbed into 1933 infested trees, it might explain a delay in the attack of green timber.

Continuation of 1933 studies. Experiment 17494

Parent Beetles. Date of Origin.	Tunnels	Date of Attack.	History of Progeny. Designation of Broods.
Hibernated as old adults from 1933	1st	July 12/33	Overwintered as large larvae OB
	2nd	June 3/34	Sept.4/34, progeny as large to med.-sized larvae 2 OB
	3rd	June 29/34	Sept.4/34, progeny as med.-sized larvae 3 B
	4th	July 27/34	Sept. 4, progeny as eggs. Represented by five entrances. 4 OB
Cage OB Large larvae, the progeny of old adults of 1933	1st	June 29th	Sept. 4, progeny as small to med.-sized larvae. A
	2nd	July 26th	Progeny eggs with many empty niches 2 A
	3rd	None	

1934 Brood Tables, experiment 17537

Cage A.	1st	June 9	Sept. 4, progeny larvae, pupae and young adults with emergence of young adults occurring within the cage. A
	2nd	June 29	Sept. 4, progeny large larvae, pupae and young adults; no emergence occurred. 2A
	3rd	July 25	Sept. 4, progeny as med.-sized larvae 3 A

Overcrowding Studies.

Experiment 17543 - 17546.

The overcrowding studies listed above are for 1934. In addition to these we continued the 1933 studies into this year, but the results I am afraid are of little concern.

The 1933 logs, after having absorbed their quota of D. monticolae, were kept over to 1934 to see what the emergence of their progeny would be according to the degree of infestation. This spring, however, it was found that the tar-paper roof which had been constructed for protection from excessive water and snow had been removed during the winter. The logs were water-soaked and a very black stain which had covered the ends completely obliterated the numbers by which the logs could be identified. Nevertheless, the logs were analyzed and by their measurements recorded, but due to them being so much alike in size this too prevented accurate identification.

The significance of these logs, however, being so doubtful, the value of correct identification assumes little importance. The larvae ranged from 4 to 28 (alive) and in only one log did they exceed this, reaching 133. Live old adults ranged from 19 to 56. One log contained 28 pupae, the others none. I believe, therefore, that this can be discarded in view of our 1934 results. The only value of the 1933 studies comes in the fact that I collected all beetles that emerged after first entering the overcrowded logs. This material has not yet been worked over but will indicate the ratio of sexes that emerge after projecting their first set of egg galleries in the overcrowded logs.

The 1934 studies, guided by the failure of 1933, have produced better results. The procedure this year was to infest logs of both Western Yellow pine and Lodgepole pine with a given degree of intensity. Fresh logs were included after the beetles were well established, so that they might migrate from the first as necessity demanded. In this manner it would be possible to determine if an extra brood could be forced by overcrowding. After the season terminated an analysis of all logs would reveal peculiarities of the egg galleries and mortality of larvae according to the degree of crowding.

The results as worked out this season are given herewith.

Cage 17543.

Length of log 42".

Inside circumference 16" and 14".

Inside area 15.4 sq. ft.

The object was to crowd this log to a moderate degree. Adults were added from June 12th to June 24th, by which time 850 adult monticolae had been introduced. On June 26th the surplus were removed leaving a net number of 777 within the log. A fresh log was added immediately to absorb any emerging adults. By July 20th the fresh log was quite infested and was isolated in cage 17543A. For the remainder of the summer there was no emergence from the new log, 17543 A, so that this migration from the old to the new logs seemsto be more of the normal second brood of this insect.

On August 29th, an anelysis of these two logs was made, and the results are given in the tabulation that follows.

Cage 17544.

In cage 17544 a log was crowded to the highest degree possible. The measurements of the log follow:--

Length 42 inches.

Inside circumference of ends 46 and 49 inches.

Inside area 13.9 sq. ft.

Adult monticolae were added from June 25th to July 4th, at which time 1645 had been introduced.

On July 11th, 65 were removed and on the 13th 7 more. Following this a new log was added. This new log was heavily infested and isolated on July 25th, and designated as 17544A. A certain emergence continued from 17544 which was collected, but there was none from 17544 A. An analysis was made of these logs on Aug. 30th, which follows in the tabulation.

Cage 17545.

In a similar manner, a series of overcrowding studies was run on lodgepole pine. This log measured 45 inches long with a D.I.B. 10 and 8 inches. Inside bark area 9.6 sq. ft. Adults were added from July 4th to July 24th when a total of 724 had been introduced. On July 26th, 58 were removed, leaving a net number of 666. A fresh log was added on this date. Constant observations revealed that while a small emergence occurred throughout the summer there was but little attack on the fresh log. An analysis of these two logs was made on Aug. 29th, the results of which follow.

Cage 17546.

Another log of the lodgepole series was infested, but

due to a decrease in the supply of monticolae it could be only lightly infested. I therefore used this log for a comparison of heavily infested and very lightly infested logs. The adults were added on July 26th and 27th, a total of 42 being introduced. An analysis was made on Sept. 3rd which follows:--(See p. 10).

These three logs are the three overcrowding logs to which the adult monticolae were added.

Considering the first, 17543, the egg galleries were very mixed up. I attempted as best as possible to trace their course with an indelible pencil and measured a sample of 78 from which an average length of 16.5 mm. was recorded. The larval mines could not be counted nor even distinguished in the mass of chewed bark, but the live larvae were counted. Samples of all stages were preserved to see if there is any difference in growth due to a crowded conditions.

In the next, No. 17544, the bark was excavated to such an extent that nothing was left to indicate egg galleries nor larval mines. The dried-up skins of dead larvae were present but so badly mixed with boring dust, a count would have meant little, for there would be no indication of its accuracy.

Samples of live and dead were collected.

In Log No. 17545, a lodgepole log, the bark peeled off readily, revealing a solid mass of excavations and as in the previous one, no count could be made of galleries. The live larvae and pupae, however, were rolled together and counted. There were no dead larvae to be seen, and while they may have been present, they certainly did not figure to an extent to be of much significance. Samples were preserved of all stages found.

Log No.	Inside Bark Area Sq.Ft.	No. adults Attack.	No.Egg Gals.	No. live Larvae	No. dead Larvae	No.live Pupae	No.dead Pupae	No.Young Adults.
17543	15.4	777	250	820	5	241	3	36
17544	13.9	1573		617	Many	89	0	2
17545	9.6	666		1400	0	50	0	0

Considering now the logs which were added to these original logs, we have the following figures:--

LogNo.	Inside Bark Area.	No. Egg Galleries	No. Live Larvae.	No. Dead Larvae	Pupae	Average Length of Egg Galleries.
17543 A	10.8	150	1850	12	0	25 mm.
17544 A	10.4	300	1800	62	0	22.8 mm.

Comparing No. 17543 A to 17543, a great difference is found in the placement of galleries. On one side, the galleries were inclined to be crowded while on the other they were widely spaced. The longest galleries were found where there was no indication of crowding. On this side their length ran as much as 40, 50 and 60 mm. in length with an average of 25 mm. for the 37 galleries measured. The parent adults could not be accurately counted as many were hidden within the exit holes. Of those counted in the egg galleries 1/3rd were dead and 2/3rds alive.

The count on Log 17544 A is very similar to the previous log. The placement of galleries was heavier on one side than on the other, but not to such an extent that the mines could not be counted.

In both these logs where individual egg galleries could be analyzed this was done and the data for the present is left with the egg count records.

Logs 17545 A and 17546 A were both of a condition which made peeling of the logs impossible. The bark would come off only in small chips, and what larvae had hatched were in the first instar with many eggs present in all galleries. Lengths were recorded of

egg galleries, but none of them were completed, so the final lengths cannot be averaged. Measurements, however, were obtained for their length to date.

Before drawing conclusions, another point observed in the field should be stated. It was found in almost all bark samples removed, that the larvae of D. monticolae will penetrate the bark to a depth of as much as ¼ inch, even in early instars and without any apparent cause. Photographs were procured to illustrate this point. These larvae then are not apparently dependent upon the nourishment of the cambium layer of the tree, but can survive quite as well on other portions of the bark. This being the case, it is not reasonable to expect that the larvae should starve simply because their mines intercross. Furthermore, larvae having hatched from eggs deposited along a gallery in very close proximity to a second egg gallery were found to be actually within this second egg gallery. Whether they would manage to carry on feeding from this other egg gallery is of course a question. With these points in mind, and by referring to the small number of dead larvae found it does not seem that crowding will materially affect the life and development of bark beetle larvae.

The conclusions therefore are:--

1. Overcrowding does not cause any appreciable mortality of the larvae.
2. Overcrowding has a decided tendency to shorten the length of egg galleries projected.
3. Overcrowding seems to cause a forced evacuation from the log, but the final result does not produce any more broods than would ordinarily be produced under normal circumstances.
4. It is very questionable if such a thing as crowding occurs in natural conditions. In no logs examined in the field or in the cage was there any indication of bark beetles selecting a section of log in which they would be less crowded. This is further exemplified by the great quantity of green trees still standing where the epidemic has died out and the not uncommon condition

where portions of a hole will be heavily infested while another part will be free of attack. If, therefore, overcrowding was common in nature, one would expect some provision of a selection of habitat to relieve a congested condition.

5. There seems to be little relationship between the number of egg galleries projected and the number of larvae resulting therefrom.

6. The fact that the cambium layer is completely mined and chewed does not cause starving for larvae can and do readily subsist within the bark itself, sinking into it for a depth of ½ inch or more with no apparent reason.

Before proceeding to other work several other analyses of caged logs were made which might be mentioned in connection with the overcrowding studies. These logs were infested for other purposes but their population may be recorded here for comparisons.

Log. No. 17540.

No. egg galleries.....69
No. live larvae.....464
No. dead larvae..... 5
Live Pupae.....206
Dead Pupae..... 10
Live Young Adults.....123
Ave. length of egg gallery....34 mm.

Log No. 17541.

No. egg galleries.....68
No. live larvae.....649
No. dead larvae..... 23
No. live pupae... 94
No. dead pupae..... 3
Live young adults.....255
Ave. length of egg gallery...38 mm.

It should be mentioned that in Log 17540 the two longest egg galleries were projected where there was no interference of others, and these measured 75 mm. and 58 mm. in length. In the second, Log 17541, we again find an unusually high average length of egg galleries with the three longest measuring 52, 55 and 75 mm. These occurred on the side with the smallest degree of infestation.

Influence of Predators.

A study was undertaken this year on the effects of predators with special reference to the Clerids and Hypophloeus. Considerable evidence has already been gathered on the Hypophloeus both from the cage and field. Past work of this nature has consisted of a correlation between the approximate number of eggs laid, the final emergence and the number of Hypophloeus present. This produced strong evidence that this species was an important predator. Other studies consisted of feeding Hypophloeus adults on various stages of D. monticolae and they were observed to feed readily on the egg, larvae and pupal stages.

In studies for 1934, a green log was confined, and to it 100 Dendroctonus monticolae(adult) were added. After they were well established, 100 Hypophloeus were added. A check log was run in conjunction with this and both logs were analyzed on Aug. 27th. The analysis showed very little difference between the two logs and no Hypophloeus were present within the log. The conclusions reached with this study was that in this case, the Hypophloeus exerted no influence on the developing brood. The analysis of this log is given in the tabulation which follows:
(17541):

The writer, however, would be cautious in discarding the importance of this insect as a predator on the above evidence. This small beetle appears in the galleries of bark beetles in thousands and has been found actually consuming the bark beetle larvae under natural conditions. I feel quite certain that itspresence in infested trees has a certain significance but that it is of a limited nature

and not as great as its numbers would seem to indicate.

In a like manner adult Clerids were added to a cage containing an artificially infested log. The Clerids were collected in pairs and their eggs were deposited upon the log.

A total of seven pairs of Clerids were introduced as well as 20 Clerid eggs which were placed by the writer on the log. An analysis on Sept. 4th showed 34 Clerid larvae present. These were collected for future study.

In an examination of the tables it appears on the face of it that the presence of the Clerids had little effect on the brood. These Clerid larvae, however, have been observed in natural conditions feeding on bark beetle larvae and in one instance upon an adult Graphisurus. Furthermore, they are frequently found deep in the excavations where monticolae larvae have penetrated into the bark. I therefore am reluctant in drawing too definite conclusions from these cage results.

Counts for the Hypophloeus, Clerid and check logs are given herewith:

Log No. 17540. (Check Log)

No. live larvae:	464
No. dead larvae:	5
No. live pupae:	206
No. dead pupae:	10
No. young adults:	123
No. egg galleries:	60

Log No. 17541: (Hypophloeus)

No. live larvae:	649
No. dead larvae:	23
No. live pupae:	94
No. dead pupae:	3
No. young adults:	255
No. egg galleries:	68

Log No. 17542 (Clerids).

No. live larvae: 636
No. dead larvae (?)
No. dead pupae: (?)
No. young adults: 0
No. egg galleries: 60

Other observations on the feeding habits of Clerids show that Clerids in the larval stage will live for a period of two and one half months with no food other than moist powdered bark. At the end of this time two larvae pupated, but both died in this stage. Further observations in the field show many Clerid larvae strong and active under moist bark with no apparent signs of food being present.

Other observations have disclosed Clerid larvae within the larval mines actually feeding on monticolae larvae. One Clerid larva was found on the outside of a caged log, feeding on an adult Graphisurus. This borer had half emerged trough its exit hole when the Clerid larva had removed its head and when found was half within the body cavity of its prey, feeding on its contents.

The fact that adult Clerids will deposit eggs on trees in which bark beetles are ready for emergence would further indicate that they can feed on any type of food that is convenient to them. To find a Clerid larva feeding, however, is not a common occurrence, and the writer has never recorded them consuming the larvae of borers, which would constitute a plentiful food supply for them. Further details on the Clerid life history are included under that study.

Clerid Life History Study.

Exp. 17496.

This study is a continuation of the 1933 study. Summarizing this we have the following records:

Adult Clerids were found in copulation by May 31st but no eggs were located prior to June 5th. First eggs found in 1933 were on June 17th, and in view of the early spring it is reasonable to expect this somewhat earlier for 1934. On June 6th of this year eggs were taken singly and in clusters as follows:--

1 egg	3 eggs	2 eggs	2 eggs
1 "	1 "	2 "	1 "
2 "	1 "	8 "	3 "
4 "	1 "	3 "	2 "
4 "	1 "	2 "	5 "
	1 "	2 "	1 "
		3 "	

Eggs were quite plentiful at the earlier stage of the season but by June 22nd they had become very scarce and difficult to find. Their incubation period ranged from 12 to 14 days, but in that some required 23 days in 1933, it seems that the period varies according to conditions.

An attempt was made to rear these small larvae in moist bark frass where they could be constantly watched. Large quantities of eggs were procured so that larvae could be used with a known date of incubation. Many such larvae were obtained and samples preserved at intervals in bovine for later head capsule measurements. This system, however, was not satisfactory as a heavy mortality occurred, regardless how carefully they were attended to. In its place, samples of Clerid larvae were procured from the same trees throughout the entire season and from later

studies and head capsule measurements, it is hoped to accumulate data on their development and duration of instars. These larvae were taken from both 1933 and 1934 infested trees. For the present, therefore, nothing can be stated regarding the development of Clerid larvae. All sizes of these larvae were taken throughout the summer from trees in which the larval mortality studies were being conducted. In view of this and the presence of adults in copulation it is safe to say that egg laying continues throughout the summer.

On July 29th a Clerid larva was taken from a cage wall in which 1933 infested logs were stored. A similar record was taken in 1933 on Aug. 15th. No doubt this larva was migrating to the soil for hibernation, although the exact period in which this occurs is not determined. In a further effort to determine the hibernation habits, all these caged logs were removed from the cage, examined externally, peeled, and the cage floor thoroughly combed. No results were obtained except the one larva feeding on the Graphisurus as already mentioned. Following this a careful search was made about the base of 1933 and 1934 infested trees. Large Clerid larvae were found about the bases of these trees from Aug. 28th and on. The majority came from 1933 trees, although an occasional one was taken from under a 1934 tree. They were all within two inches of the tree, near the surface of the ground. They appear to construct hibernacula of small sand and frass particles, and to line the interior with an aluminium-looking coating. Unfortunately these are so delicate that none were procured intact. On one occasion a larva was found half within an oval saucer-like cavity, measuring 1.5 cm. x 1 cm. in

the bark, just at ground level. This may or may not have been constructed by the larva, but it was lined with the characteristic aluminium-like coating. In an endeavour to procure more data on this point some of these larvae were placed in a box of soil from the base of a tree. A slab of bark was placed on end in the soil to correspond to a tree-trunk. At the time of leaving, however, these larvae were still as they were when placed within.

The following summarized our present knowledge on the life history of Enoclerus sphegeus.

Adult beetles overwinter in crevices and under protective slabs of bark particularly on yellow pine trees. Activity commences with the first warm weather of spring. Egg-laying occurs early in June and continues throughout the summer. Clerid adults are apparently attracted to a newly-infested tree by an olfactory response since a freshly-cut tree will be found covered with Clerid adults long before the appearance of any bark beetles. Just what difference there is between the numbers attracted to old and newly attacked trees is a point of doubt.

The incubation period of eggs ranges from 12 days to 3 weeks.

The very young larvae are very agile and immediately seek the seclusion of darkness. In that eggs are placed near bark beetle entrances and the tendency of the small larvae is for darkness they no doubt penetrate the egg-galleries through the entrance hole. All stages of Clerid larvae are present within a newly-attacked tree throughout the season and samples of these were collected periodically throughout the season. Full-grown larvae migrate

Progress, Development and Mortality Studies of Dendroctonus monticolae for 1934.

Experiment No. 17547.

This study is probably the most important of all work done during the season, and occupied practically all of the writer's time from mid-summer on.

Object. The object of this study was to determine the progress of egg deposition, and the development of larvae throughout the season. Particular emphasis was given to the larval mortality, with details of the cause and the stage at which this occurred.

Procedure. Careful scouting was done both in the Aspen Grove region and the Brookmere country prior to attack. As newly infested trees were found, they were numbered, their size and species and the date of attack were recorded. From then on daily observations were made. To this end, slabs of bark were removed, and all data pertinent to the conditions found were recorded. Notes were kept as follows:--

As a slab of bark was removed it would be examined for the numbers of dead and alive larvae. This information was recorded under the following heads:--

Group No.	Date	Area	Height from Ground.	Larvae: Alive	Larvae: Dead. Cause Unknown.
23	Aug.20	2½'x8"	12'	23	0

Larvae (continued): Dead. Cause Predators.	Total No. Mines.	Lot Designation of Collection.	Remarks
222	246	L.32 and 33	See Gal.59-62

Having procured this data on the slab as a whole, the individual egg galleries were examined and recorded as follows:--

		Eggs				Larvae	
Gallery No.	Length mm.	Total No. Deposited	Infertile	Empty Niches	No. Present	No. Mines	Lot Designation of Collection
59	15	48	6	6	0	36	32 & 33
60	25	33	1	9	0	23	"
61	14	36	4	2	0	30	"
62	27	53	6	30	0	17	"

Adults					
No.	Alive	Dead	Tree No.	Date	Remarks.
0	-	-	1A	Aug.20	See Group 23
0	-	-	1A	Aug.20	
0	-	-	1A	Aug.20	
1	-	Female	1A	Aug.20	

Following this there was usually the necessity of some detailed discussion. Such was kept in another section of notes, which allowed for as lengthy a discussion as one wished. Egg gallery counts were made only from slabs of bark which had also been analyzed for mortality.

In making these counts, it was impossible to segregate the larval mines due to the network of excavations. This was overcome by counting the mines at their junction with the egg gallery. For the same reason live and dead larvae could not be assigned to any one egg gallery, so rather than try to work from this angle, the larval counts were made for an entire slab, with as many egg galleries as possible analyzed on each slab.

Fortunately dead larvae were easily counted. These were to be found in the extreme ends of the mines, sometimes as entire larvae but more often as deflated skins. The head capsules were

always present. All dead specimens were preserved for later head capsule measurements when we will know in what instar death occurred. In a few cases during the later part of the season, practically no remnants of the dead larvae were to be found. Their death was, however, always revealed by a black mould. Counts, therefore, of dead larvae are accurate to a very high percentage. Naturally a great deal of material was collected for head capsule measurements, as specimens of live and dead larvae were taken from every piece of bark examined.

To summarize all this material at this time is impossible. A few statements, however, will indicate the general death rate of the larvae.

Considering a single tree on which observations were made throughout the season the following is revealed.

Tree No. 15. Attacked July 7th. Up to Aug. 2nd no larvae had appeared and on Aug. 3rd eggs were hatching with many small larvae present, none of which were dead. On Aug. 6th dead larvae were beginning to be found. In the days that followed the mortality averaged approximately as follows: -

Aug. 3 - 0%
6 - 4%
8 - 11%
10 - 20%
12 - 34%
14 - 59%
Aug. 16 - 75%
18 - 85%
20 - 92%
24 - 95%
30 - 95%

The above figures were taken from an average curve plotted from the percentages of mortality recorded from this tree. The actual figures do not run as smoothly, for on Aug. 16th, two slabs of bark analyzed showed 100% mortality, while one slab on Aug. 14th showed only 20%. No samples from Aug. 16th to

31st showed any less mortality than 92%.

In only a few cases were there dead larvae whose death could not be traced to predators. Such numbers were so small, in fact, that they have little significance. This mortality in other trees of Aspen Grove ranged fairly close to the figures given.

A small Dipterous larva appears responsible for the majority of dead larvae found. In most cases the predator was still in the act of consuming the body contents of the dead larva. Many of these were preserved and while no adults have been reared to date such will be done next season.

Early spring records bear further testimony of this heavy death rate. Of 17 slabs of bark averaging 2 ft. long by 4 ft. examined in early May by Mr. Leech, only 93 live larvae and 26 dead larvae were recovered from the entire lot. Seven trees were analyzed and sections of bark were examined at all heights. At the time these counts were made, the cause of the mortality could not be ascertained. This condition differs somewhat from 1933, when live and dead larvae were very numerous in many of the trees.

In Bane Valley, where in the spring of 1933 there was practically 100% mortality, an examination revealed almost identical conditions in 1934. While only a few detailed counts were made, they were supplemented by field observations. It was found as in 1933, that the drier portions of the trees were characterized by numerous short larval mines with no progeny present and that in wet sections a certain number of larvae were found.

A very marked contrast to this is in evidence in the Brookmere infestation. Examinations of this stand were made along its extreme margin, where it is very active, namely, on the Canyon House Road. Although these counts were not as extensive as those in Aspen Grove, the figures show a marked difference. This mortality between Augu. 22nd and Sept. 3rd ran from 12% to 50%, as compared to about 90% in Aspen Grove during the same period.

Figures derived from the analysis of logs caged and infested by the addition of adult Dendroctonus bear further evidence that this heavy mortality is due to the actions of predators rather than any other cause. The figures have already been tabulated on pages 10, 11 and 13 and difference in live progeny between those in cages and those in the field is apparent.

In conjunction with these studies an analysis of the egg galleries was made. These may be summarized as follows:--

In Aspen Grove a total of 1617 cm. or 54 feet of egg galleries were analyzed. These averaged 1.60 eggs per cm. Similar counts in the Brookmere infestation which though not on as large a scale averaged 1.73 eggs per cm. of egg gallery.

In analyzing the caged infested logs, No. 17543A, in which 10 egg galleries were analyzed, we find 2.19 eggs per cm., and in No. 17544A, in which 11 galleries were studied, we find 1.57 eggs per cm.

Analyzing some of these egg galleries individually we find that the apparent crowding of population had very little influence on the eggs laid per cm. Since one usually finds the longest egg galleries where the population is the least crowded the long egg

galleries may be assumed to have been projected when the population was the least dense. On this basis the following figures point to the lack of correlation between crowding and the number of eggs laid.

Gallery Length.	No. Eggs.	No. per cm.
35	76	2.17
45	114	2.5
58	96	1.6
43	63	1.4
40	41	1.0
50	120	2.4
41	124	3.0
39	96	2.4
51	74	1.4
31	107	3.4
38	47	1.2
50	80	1.6
38	70	1.8
25	84	3.3
20	78	3.9

In selecting the above from the records, the longest galleries and those containing the greatest number of eggs were chosen. Many other short galleries show less than 1 per cm.

Considering these egg galleries from the standpoint of fertility of eggs, the following figures are derived:--

Aspen Grove.....10.7% infertile
Brookmere.....9.0% "
Caged Log 17543 A.....2.4% "
" " 17544 A.....2.0% "
" " 17545 A..... 0% "
" " 17546 ..... 0% "

In counting infertile eggs, only those actually seen were included. Empty niches were counted separate. Infertile eggs were of a black withered nature and easily recognized. A sample was preserved.

Upon an analysis of the above figures, this question arises. Why is there such a difference between the percentage of infertile

eggs in the field and in the cages? A tentative answer is that the term "infertile" may be in error and such black eggs may be the result of predators which have sucked away the contents or punctured the egg shell. Occasionally mites are found within the egg galleries which might easily produce this effect. Samples of such mites are also preserved.

The empty egg niches are listed below:--

Aspen Grove.....	32.0%
Brookmere.....	8.0%
Caged Log 17543A..	8%
" " 17544A..	0%
" " 17546 ..	0%

At the time of analysis it seemed in the writer's mind that niches might easily be excavated and have no eggs deposited within. In view of the caged logs, however, which show none, it seems reasonable to assume that these empty niches actually represent the work of predators. No one predator can be assigned to their destruction, for any species studied has been found to feed on eggs as well as other stages of bark beetles.

Reconnaissance Work.

In checking over the infestation during the past summer and fall, several points that were strongly hinted at in the past have definitely come to pass.

The chief of these is the decided decrease in intensity of the epidemic in Aspen Grove. This was not unexpected, however, for with the disappearance of bark beetles in Kane Valley, the same was anticipated for Aspen Grove. The current year's attack in Aspen Grove is unquestionably the lightest we have records for. Kane Valley, as last year, shows no signs of activity and only an occasional tree is to be found attacked.

The Olsen Lake country, which is located eight miles south of the camp and two miles from the main road, shows a most sudden decline. This region two years ago was heavily infested. In 1933 it was declining in intensity and in 1934 only four small patches were found. There is furthermore an abundance of green yellow pine scattered through the dead timber, so one can hardly say the infestation has dropped from a shortage of food supply.

Continuing further south into the Canyon House country, considerable bark beetle activity is to be found. This is a continuation of the Brookmere infestation and a large area of dying timber was found this spring. This region represents the only active epidemic seen in the entire country. While a considerable amount of work has been done in that region, the point of interest is, what will the duration of this activity be, and what will the duration of inactivity of other regions be?

The eastern extremity of the yellow pine stand was also examined. This is the region where the timber merges with the open grazing country of the Douglas Lake Cattle Co. Scattered patches of infested timber are quite common but in no place could a large area of dying timber be found. These patches comprise 2 to 40 infested trees. There is very little evidence of infestation prior to 1933.

Forest Insect Problems to be Dealt with in 1935.

Vernon Forest Insect Laboratory.

1. Spruce Bark Beetle.

A study of the effect of fresh slash on the infestation at Lumberton, B.C. Determine definitely if the fresh slash is absorbing the emergence from the standing trees.

Determine the winter mortality of the brood in the standing trees.

Investigation of the Kootenay Park Infestation with recommendations as to control and the feasibility of disposing of the timber affected.

II. Larch Sawfly, Fernie Field Station.

1. The first procedure after establishing the Fernie field station is to make large collections of cocoons in an attempt to recover the parasite Mesoleius tenthredinis Morley. These collections will be made in the immediate vicinity of the liberation point and at regular distances from this point north, southeast and west. Should sufficient material be recovered, colonization will be carried on in outside cages in an effort to secure concentrations for liberation.

2. A study should be made of the causes for the indicated abnormal egg mortality. Some egg parasites were noted in 1934 but the season was too far advanced to obtain definite data.

3. A second sample plot should be established contiguous to the first, and a third plot entirely off the sawfly range, to be used as a control.

4. An attempt should be made to obtain more parasites (Mesoleius tenthredinis Morley) from Eastern Canada.

5. Scouting for larch sawfly larvae should be done in the Flathead area, in the Rosen Lake-Bull River area, between Elko and the international boundary, and northward into the Banff area.

6. Further shipments of Coelopisthia nematicida Pack. can be made to Belleville from the Fernie area if necessary.

Bark Beetle Studies (Aspen Grove)

To be outlined later.

Projects for 1935.

The more important projects to be undertaken at the Vancouver Sub-Laboratory in 1935 are:--

a. Continuation of the Ambrosia beetle investigation with special attention to repellents.

b. Investigation of the occurrence of fleas in fuel sawdust.

c. Population study of one of the more important forest defoliators.

d. Survey of insect damage to seasoned wood.

e. Accumulation of data on insects attacking green logs.

a. Ambrosia Beetle Investigation.

The ambrosia beetle investigation in 1935 will consist chiefly of experiments with repellents and a further study of the relationship of the moisture content and acidity of the sapwood of logs to ambrosia beetle attack. The Steelhead Field Station will not be re-opened this year but instead the main part

of the field work will be carried on at the site of a small logging operation at Green Timbers, about 24 miles from Vancouver. However periodic trips will be made to Steelhead for the purpose of completing the observations on the log preference and life history studies undertaken there during the past two years. Such observations will be supplemented by data obtained at the new site.

The object of the repellent experiments will be to determine whether or not a satisfactory repellent exists which when applied to logs will protect them from Ambrosia beetle a ttack. Such a repellent would be of great value in protecting decked logs in the case of a sudden shut-down in operation, an event which is all too common in this district. The experiments will be limited this year to only about six of what are considered to be the more promising chemicals. One log only will be treated at first with each chemical while several additional logs will be reserved as checks and for obtaining data on other phases of our work. The logs will be cut in early March and the repellents applied in April just previous to the first emergence of the beetles. Observations as to the effectiveness of the chemicals will be made at weekly intervals.

b. Occurrence of Fleas in Fuel Sawdust.

During the past year several reports of fleas breeding in sawdust were received from residents in Vancouver using sawdust as fuel. This condition is causing the sawdust dealers considerable concern. It has been recently estimated that there are now over 8,000 sawdust burners installed in this city alone. However, definite information on this problem is lacking. As a result an investigation will be undertaken this year for the

purpose of determining:--

1. The prevalence of fleas in fuel sawdust.
2. The factors governing outbreaks, and
3. Control measures.

In regard to the first phase of the study the co-operation of all sawdust dealers is being sought although an antipathy among parties concerned to admit the occurrence of fleas has already been encountered. However, this should be overcome by the assurance that all information will be treated confidentially and that the control or eradication of such outbreaks is very much desired. Special attention will be paid to the source of infestations and the ability of fleas to breed in sawdust, while in connection with control measures the effects of various insecticides on the fuel value of the sawdust will be investigated in co-operation with the Forest Products Laboratory. The possibility of so treating the sawdust as to make it immune from fleas will also be considered.

c. Population Study.

A study of at least one of the more important forest defoliators from the standpoint of factors affecting the rise and fall of outbreaks was planned for the past year but unfortunately sufficient foundation material was not to be found. It is hoped that the study can be commenced this year. This work will extend over a period of years and data would be secured from both field observations and rearing experiments, on mortality and causes, sex ratio, fecundity of moths, fertility of eggs, etc.

d. Survey of Insect Damage to Seasoned Wood.

Various reports of insect injury to seasoned wood have been received during the past few years. Products injured have ranged from antique furniture to structural timbers and telephone poles and in order to determine the extent of such injury a survey will be undertaken this year in Vancouver and the surrounding district.

e. Insects Attacking Green Logs.

Since the embargo on the exporting of green logs from British Columbia was lifted a number of reports of wood borers infesting such logs have been received. In several instances the presence of such borers was sufficient to cause entire shipments to be turned down. As long as the exporting of green logs is permitted this entomological problem is bound to re-occur unless adequate steps can be taken to prevent attack. Although a considerable portion of the Ambrosia beetle investigation has a direct bearing on this problem, an effort is to be made to accumulate as much data as time will permit on other insects attacking logs in order to have definite information available for parties interested.

In addition to the above projects various miscellaneous rearings will be undertaken, including the continuation of several carried over from 1934.

Estimates for 1935-1936.

Vernon Forest Insect Laboratory.

2.	Communication Services.			
	Telegraph	20.00		
	Telephone	130.00		
	Postage	40.00		190.00
3.	Equipment.			
	Automobile maintenance	600.00		
	Repairs to equipment	15.00		
	Scientific	300.00		
	Spray			
	Office			915.00
7.	Miscellaneous Current Expenses.			
	Licenses	4.00		
	Storage	10.00		14.00
9.	Personal Services.			
	Permanent.			
	Hopping, R.	2880.00		
	Jackson, G.	840.00		3720.00
	Temporary.			
	Hopping, G.	2040.00		
	Mathers, W.G.	1620.00		
	Richmond, H.	1620.00		5280.00
	Temporary (Seasonal)			
	Leech, H.B. (6 mos.)	660.00		
	Graham, K. (6 mos.)	660.00		1320.00
	Extra Labour.			
	1 man, 70 days at $3.00:	105.00		105.00
11.	Rents.			
	Laboratory, cabin at Steelhead		45.00	
	Equipment, P.O. boxes		10.00	55.00

13. Supplies.

Chemicals	20.00..... 20.00	
Hardware	20.00..... 20.00	
Insectary	100.00.....100.00	
Subsistence in camps	550.00	705.00

14. Transportation of Things.

Freight	25.00	
Express	15.00	
Cartage	20.00	60.00

15. Transportation of Persons.

Permanent.

Hopping, R.	250.00	

Temporary.

Hopping, G.	350.00	
Mathers, W.G.	150.00	
Richmond, H.	50.00	
Graham, K.	50.00	
Leech, H.B.	50.00	900.00

Mileage.

Mathers, W.G.	200.00	
Richmond, H.	225.00	
Leech, H.B.	150.00	
Graham, K.	100.00	675.00

Total:--$13,939.00

VERNON DIVISION OF FOREST INSECTS.

Revised in Ottawa - 1934-35.

2.	**Communication Services.**			
	Telegraph	25.00		
	Telephone	125.00		
	Postage	40.00		190.00
3.	**Equipment.**			
	Automobile - Acquisition			
	Maintenance	600.00		
	Repairs	20.00		
	Scientific	300.00		
	Spray			
	Office-furniture			
				920.00
6.	**Buildings.**			
7.	**Miscellaneous Current Expenses.**			
	Licenses (Car)	4.00		
	Storage	48.00		
	Water, Light & Taxes			
	Miscellaneous			
	Janitor			52.00
9.	**Personal Services.**			
	Permanent			
	Hopping, R.	2880.00		
	Jackson, Miss	840.00	3720.00	
	Temporary			
	Cont.-Temp.			
	Hopping, G.	2040.00		
	Mathers, W.G.	1620.00		
	Richmond, H.	1620.00	5280.00	
	Temp.-Seasonal			
	Leech, H.B. (6 mos.)	660.00		
	Graham, K. (6 mos.)	660.00	1320.00	
	Extra Labour			
	1 man, 70 days at $3.00	105.00	105.00	
			10,425.00	
	Less 10%		1,042.00	9383.00

11.	**Rents.**			
	Laboratory, Cabin at Steelhead	45.00		
	Land			
	Equipment, P.O. Box	5.00		50.00
13.	**Supplies.**			
	Typewriter ribbon			
	Fuel			
	Chemicals	10.00		
	Insecticides			
	Hardware	15.00		
	Photographic	25.00		
	Insectary-lumber & cage material	194.00		
	Subsistence in camps	550.00		
	Miscellaneous	15.00		
	Stationery			
	Medical			
	Lumber			809.00
14.	**Transportation of Things.**			
	Freight	25.00		
	Express	15.00		
	Cartage	20.00		60.00
15.	**Transportation of Persons.**			
	Permanent			
	Hopping, R.	250.00	250.00	
	Temporary			
	Hopping, G.	380.00		
	Mathers, W.G.	150.00		
	Richmond, H.	50.00		
	Graham, K.	50.00		
	Leech, H.B.	50.00	630.00	
	Mileage:			
	Mathers, W.G.	200.00		
	Richmond, H.	225.00		
	Leech, H.B.	100.00	525.00	1405.00
			Net Total for Lab:	$12,869.00
			Gross " " "	13,911.00

Sub-allotment	April	May	June	July	August	September	October	November	December	January	February	March	Totals	Remarks
2. Communication Service.														
Telephone	14.67	12.39	12.23	14.46	10.80	13.10	10.27	9.90	10.95	9.53	11.86	10.06		Includes service for K.R. Buckell's Laboratory
Telegraph	.45			2.63	1.80	.95	.90							
Postage	5.22	6.79	2.30	7.15	4.25	3.46	5.46	.82		6.46	1.66	5.72		Allotment 190.00
Totals:--	20.34	19.18	14.53	24.42	16.85	17.51	16.63	10.72	10.95	15.99	13.52	15.78	196.42	Balance - - -6.42 minus
3. Equipment.														
Auto maintenance	29.21	161.84	29.10	48.05	90.19	62.22	21.30	14.75	13.70	18.85	14.05	25.85		
Scientific	6.75		104.50	4.00	.25					15.00		23.30		
Field	29.76	9.30	31.45		16.80									
Equip.repairs		5.00	.50					.75	.50		.85	1.65		Allotment 220.00
Totals:--	65.72	176.14	165.55	52.05	107.24	62.22	21.30	15.50	14.20	33.85	14.90	50.80	779.47	Balance - 140.53
7. Miscellaneous.														
Licenses											4.00			
Storage														
P.O. Boxes			.90	5.00		1.75								
Janitor Service		5.00		5.00		6.35		5.00		5.00		6.25		Allotment 52.00
Totals:--		5.00	.90	10.00		8.00		5.00		5.00	4.00	6.25	44.15	Balance - 7.85
9. Personal Services.														
Hopping, R.	205.20	205.20	205.20	205.20	205.20	205.20	205.20	205.20	205.20	205.20	205.20	205.20		
Jackson, C.	66.50	66.50	66.50	66.50	57.47	66.50	66.50	66.50	66.50	66.50	66.50	66.50		Includes stenographic service for K.R.Buckell's lab.
Hopping, G.R.	153.00	153.00	153.00	153.00	153.00	153.00	153.00	153.00	153.00	153.00	153.00	153.00		
Mathers, W.G.	121.50	121.50	121.50	121.50	121.50	121.50	121.50	121.50	121.50	121.50	121.50	121.50		
Richmond, H.		98.80	135.00	135.00	135.00	117.00	9.00							
Leech, H.B.	59.40	99.00	99.00	99.00	99.00	99.00	99.00	99.00	99.00					
Graham, K.	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00					
Extra Labour			57.60											Allotment 9383.00
Totals:--	715.60	851.00	948.00	890.20	881.17	872.20	764.20	755.20	755.20	546.20	546.20	546.20	9071.37	Balance 311.63
11. Rents. (Cabin, Steelhead)	7.50	7.50	7.50	7.50	7.50								37.50	Allotment 50.00
														Balance 12.50
13. Supplies.														
Subsistence	11.44	91.71	82.55	80.59	85.77	11.01								
Chemicals		1.35	12.27			.15	4.50	.87						
Photographic Materials	69.75	.45	7.50	1.12	.90	1.35						10.39		
Office		63.52	85.90	15.40	6.80	.65			2.25		1.15	4.00		
Medical		3.46	1.00			1.00								Allotment 809.00
Totals:	81.19	160.48	189.22	95.11	93.57	14.16	4.50	.87	2.25		1.15	14.39	656.89	Balance 152.11
14. Transportation of things.														
Express	.90	3.31	3.50	.22		3.78								Allotment 60.00
Freight				3.00									15.11	Balance 44.89
Cartage		.50												
Totals:	.90	3.81	3.50	3.22		3.78								
15. Trans.of Persons.														
Hopping, R.				35.25		16.35		142.65	67.60		51.30			
Hopping, G.R.	11.46	20.50	2.00	39.47	12.50	42.80					49.00			
Mathers, W.	1.20	.90			.75	.95	17.95		19.70		21.20	.55		
mileage	40.95	25.48	33.37	26.17	25.32	33.02	36.21	5.11	12.81		17.02	20.02		
Richmond, H.	11.40	1.50	2.00	2.00	2.00	1.50								
mileage		55.17	26.10	43.56	42.39	28.89								
Leech, H.B.	4.85	6.90	2.35	3.60	2.15	5.20			20.25					
mileage					10.98	62.10	18.70							
Graham, K.	24.85	.40	2.95	1.20	1.20	31.11								Allotment 1405.00
mileage			13.86	12.42	12.96	6.48	22.66	147.76	120.36		138.52	20.57	1291.25	Balance 113.72
Totals:	94.71	110.95	82.63	164.27	110.25	228.44								
Totals:	985.86	1333.96	1411.83	1246.77	1216.58	1206.31	879.49	935.05	902.96	601.04	718.35	653.99	12092.19	Grant Total$12092.19

Total Allotment:--$12869.00
Total Expenditure:-- 12092.19
Surplus:-- 776.81

Vernon Forest Insect Laboratory.

Supplies - 1935-1936.

(1) **Stationery and Office Equipment.**

(Stationery covered in Buckell's list)

6 tubes LePage's glue
6 books lenspaper
6 squares ar t gum
6 bottles Higgins waterproof India ink
6 boxes Moore's adhesive labels, No. 2001
2 balls strong white twine
6 sheets bristol board

(2) **Books.**

B.P. Uvarov - Insects and Climate - 1931.

Can be purchased from John D. Sherman Jnr., 132, Primrose Avenue, Mount Vernon, New York.

Karl Schedl - Morphology of the Genus Gnathotrichus - price 50¢.

(3) Scientific Equipment.

Controlled condition cabinet for the study of the effect of various temperatures and humidities on forest insects. For the price and other details see memorandum accompanying.

(4) Laboratory equipment.

One 50 c.c. graduate.
" 100 c.c. graduate.
" 250 c.c. graduate.
Four 250 c.c. beakers (pyrex)
one photograph trimming board with 12" knife
1 gross corks to fit bottle aperture 8 mm. inside diam.
1 " " " " " " 10 mm. " "
1 " " " " " " 12 mm. " "
1 " " " " " " 14 mm. " "
1 " " " " " " 16 mm. " "

(5) Chemicals.

Two gallons 95% grain alcohol - 1 gallon to be shipped with main shipment and 1 gallon to follow when needed.

(6) Photographic equipment.

Four Zeiss Ikon Pernox Filmpacks No. 26°, 8 x 10½ cm.
Printing papers and other perishable supplies to be ordered when our present supplies are used up.

(7) Entomological Supplies.

4000 No. 1 Insect Pins

6 Schmitt Insect Cases (Ont. Hughes-Owens Co.)

Inventory.

Office Equipment.

Vernon Laboratory.

1	Portable typewriter
1	copy stand (defective)
1	file punch
1	double paper punch
1	pencil sharpener
1	leather manuscript carrying case
4	canvas manuscript carrying cases
2	inkwells
2	wire filing baskets
3	oak office tables
4	oak flat top office desks
7	oak office chairs, straight back
1	oak office chair, swivel tilting
2	oak office chairs, swivel tilting (both defective - one not useable)
1	oak swivel stenographer's chair (defective)
1	common bent wood chair
1	elm stenographer's typewriter's desk
1	fir coat cupboard
1	oak hat and coat hanger
1	steel 4-drawer letter size filing cabinet
4	oak, 3" x 5", 5-drawer card index sections, 17" deep
2	" 2-drawer 3" x 5" " " " " "
1	" " " 3" x 5" " " " 14" "
1	oak, 4-drawer (two tiers) 5" x 8", card index section, 14" deep.
1	" 3" x 5" card index case, 9" deep
2	double desk lamps
2	single desk lamps

Motor Cars.

1	Chevrolet 4-door Sedan, 1931 (Vernon Laboratory)
1	Chevrolet 2-door Sedan (Confederation Model) 1932 (Coast Forest Insect Laboratory)

Scientific Instruments- Vernon Laboratory.

3 hand lens - single
1 hand lens - double, 16 x 30x
5 pairs entomological scissors
10 " " tweezers
1 boxwood engineers' scale rule
3 millimeter steel rules
1 pair insect callipers
2 increment borers, 9" x 6"
2 folding collecting nets
1 100' steel measuring tape
1 steel tree diameter tape (damaged)
1 Topley's aneroid barometer
1 pedometer (one hand broken)
1 light directing lens and stand
1 Bausch & Lomb compound microscope
1 " " " monocular field glass
1 Leitz binocular microscope
1 Spencer " "
2 Hygrothermographs, recording Negretti & Zambra
1 sling psychrometer
2 sets Tycos Maximum and Minimum thermometers (broken)
2 Max.-Min. thermometers (with magnets)
1 Zeiss Camera lucida
1 stage micrometer, Will corp.
1 ocular micrometer disc, Will. corp.
1 camel hair paint brush
1 Klimax camera - 3 x 5½
1 Camera - Zeiss Ikon Maximar 3½ x 4½ with attachments
1 Exposure Calculator
2 camera tripods
1 tilting triped head
1 film pack adapter
1 camera case
1 ruling pen
1 automatic shutter release
1 microscope sub-stage lamp
2 Negretti & Zambra thermometers (maximum)
2 " " " " (minimum)
1 pair small dissecting scissors
2 scalpels
2 prs. dissecting forceps, 1 curved, 1 straight
3 dissecting needles
2 glass funnels
2 graduates 100 c.c.
2 " 250 c.c.
1 " 50 c.c.
1 blast burner (Bethel)
1 Abney hand level
1 De Gryse insect trap
1 Tycos 6" special minimum registering thermometer

Field Equipment, Vernon Laboratory.

7 Wood's eiderdown sleeping bags (2 worn out)
1 Baker tent, 7' x 9'6
2 tents, duck, 10' x 12'
1 tent, silk, 10' x 12'
3 tents, silk, 7' x 9'
1 cook tent, 12' x 15' x 4'
1 tent fly, 10' x 12'
2 tarpaulins, 9' x 16'
1 mosquito net for tent
2 pack sacks
2 boy's axes
2 axes, single-bitted
1 axe, double bitted
1 iron waffle griddle
1 canvas water bag
1 draw knife
2 cross cut saws
2 handsaws
1 shovel
1 rake
1 mattock
2 hammers
2 tack hammers
2 carborundum stones
3 coal oil lanterns
2 Coleman lanterns
1 " cooking stove
1 camp cook stove and pipe
3 kitchen chairs
1 Lufkin 36" rule
800 yards cotton cage cloth
1 three-man camp cooking outfit (Stanley)
1 five-man camp cooking outfit (Aspen Grove)
1 auto trailer
(also miscellaneous cooking utensils)
1 canvas fly, 16' x 16', 12 oz. treated

List of Equipment.

Coast Forest Insect Laboratory.

(As on March 1, 1935)

Scientific.

1 Spencer binocular dissecting microscope, complete with 3 sets of eye pieces, 3 objectives and case.
1 Bausch & Lomb stage micrometer
1 Micrometer ocular disc
1 Bausch & Lomb hand lens, X15
1 Zeiss monocular field glass, 6X with leather case

1 Negretti & Zambra hygrothermograph with charts
2 " " " minimum registering thermometers
2 " " " maximum " "
1 unmatched set Tycos maximum and minimum registering thermometers with panel. (Maximum thermometer 12" mercury. Minimum thermometer -10", coloured spirit).
1 set Tycos wet and dry thermometers mounted on panel
1 Edney swing psychrometer
1 Zeiss Ikon Maximar camera, 9 x 12 cm. complete with Compur shutter #1178457, Zeiss Tessar F/4.5 lens #1188356, focussing ground glass and leather case.
1 Drem Justophot automatic exposure meter
1 Metal tripod
1 Tilting head attachment for tripod
5 Schmitt boxes
2 pairs scissors
4 pairs tweezers
1 ruling pen
1 Mattson increment borer, 10"
19 Small Riker mounts - 6 used, 13 empty
21 Medium size Riker Mounts - 14 used, 7 empty.
21 Large size Riker Mounts - 10 used, 11 empty.

Office.

1 Flat-top office desk
1 Swivel chair
1 Three-drawer steel filing cabinet
1 Underwood standard portable typewriter
1 Wire letter basket
1 electric extension cord

Field.

1 Richardson collapsible collecting set
1 Steel tape, 50'
2 Eiderdown sleeping bags
1 Tarpaulin, 16' x 16'
1 Canvas carrying case
1 Wood's pack sack
1 Coleman camp stove
1 " lantern
1 two-man cooking outfit
1 McClarey 2-gallon coal oil can
1 SMP 1-gallon coal oil can
1 double-bitted axe
1 boy's axe
1 Spear & Jackson "Superior" hand saw
1 Henry Wilson & Son hand saw
1 Crosscut saw, 4'
1 " " , 5'
2 hammers
1 long-handled shovel
1 rake
1 Carborundum stone, round
1 flat file, 10"
1 chisel, 3/8"
1 gouge, 3/4"
1 wood scraper, 5"
1 folding carpenter's rule (broken)
1 tin funnel, 5½" top
1 United Drug Co. W, 151, first aid kit
12 portable insect cages, 18" x 18" x 30"
6 glass insect breeding jars, 5" square
6 flower pots, 8" top

Books.

"Principles of Forest Entomology" - S.A. Graham.

Field Equipment.

Fernie Field Station.

200 aluminium tree tags
1 Coleman gas stove
Camping equipment for two men
1 shovel
1 hoe
1 Queen heater and 10 length pipe
1 hammer
1 Coleman lantern
1 6' crosscut saw

List of Books.

Vernon Forest Insect Laboratory.

Dr. Asa Grey	New Manual of Botany
J.W. Henry	Flora of Southern British Columbia
Trelease & Yule	Preparation of Scientific & Technical Papers
Hodgman & Lange	Handbook of Chemistry & Physics
Sir Wm. Schlich	Manual of Forestry, vol.III
S.A. Graham	Principles of Forest Entomology (2 copies)
J.H. Comstock	An Introduction to Entomology
Needham, Frost & Tothill	Leaf Mining Insects
E.O. Essig	Insects of Western North America
E.P. Felt	Manual of Tree & Shrus Insects
W.J. Chamberlin	Catalogues of the Buprestidae of North America
Blatchley & Leng	Rhyncophora or Weevils of N.E. America
W.J. Chamberlin	Forest Entomology, Part I
" "	" " " II
W.S. Blatchley	Coleoptera or Beetles Known to Occur in Indiana
Chr. Aurivillius	Coleopterorum Catalogus, Parts 73 and 74
	Cerambycidae-lamiinae, Parts I & II
	Coleopterorum Catalogus, Part 39 (2 copies)
	Cerambycidae-Cerambycinae
Boving and Craighead	Larvae of Coleoptera
Leng	Check List of Coleoptera
Nusslin	Forstinsektenkunde
Curran	North American Diptera

Also a number of separates of individual articles.

Publications of the Vernon Laboratory.

(Division of Forest Insects, 1920-1933)

Ralph Hopping.

1920 - "A New Species of the Genus Pissodes (Coleoptera)."
The Canadian entomologist-Vol.52,pp.132-134,June 1920

1920 - "Popular and Practical Entomology - Some Winter Insect Life."
The Canadian Entomologist -Vol.52,pp.217-18, Oct.1920

1921 -"The Control of Bark-Beetle Outbreaks in British Columbia."
Dom.Dept. Agric., Ent.Branch Circular No. 15 (June-1921)

1921 - "A Review of the Genus Monochamus Serv.(Cerambycidae, Coleoptera)."
The Canadian Entomologist, vol.53,pp.252-258,Nov. 1921

1922 - "Coniferous Hosts of the Ipidae of the Pacific Coast and Rocky Mountain Regions."
The Canadian Entomologist, vol.54,pp.128-133,June 1922

1922 - "New Species of the Old Genus Leptura and Allied Genera (Coleop.)
The Canadian Entomologist, vol.54, pp.162-166, July 1922.

1924 - "Yellow Pine (Pinus ponderosa) as a Host in British Columbia."
The Canadian Entomologist, vol.56, pp.125-128, June 1924.

1925 - "Juniperus scopulorum as a Host."
The Canadian Entomologist, vol.57, pp.105-6, Aug. 1925

1925 - "New Coleoptera from Western Canada."
The Canadian Entomologist, vol.57, pp.206-8, Aug. 1925.

1928 - "Some Notes on Examination of Types of Coleoptera in the Leconte and Casey Collections." The Canadian Entomologist, vol.60, pp.6-8, Jan. 1928.

1928 - "Influence of Slash on Bark-Beetle Outbreaks."
The Forestry Chronicle, vol.IV, no.2, June 1928.

1931 - "Two Very Common Mistakes of Entomological Writers."
The Canadian Entomologist, vol.63, pp.72-3, March 1931

1931 -"Notes on Pogonocherus."
The Pan-Pacific Entomologist,vol.7,pp.105-6, Jan.1931

Ralph Hopping (continued)

1931 - "III. New Coleoptera from Western Canada."
The Canadian Entomologist, vol.63, pp.233-8, Oct. 1931

1932 - "A Synonymic Note (Coleop.)"
The Canadian Entomologist, vol.64, pp.72-3, March 1932

1932 - "A Taxonomic Note."
The Canadian Entomologist, vol.64, pp.173, August 1932

1933 - "A New Buprestid from British Columbia, with Notes on the Genus Buprestis." The Pan-Pacific Entomologist, vol.9, pp.84-88, April 1933.

1933 - "New Coleoptera from Western Canada IV."
The Canadian Entomologist, vol.65, pp.281-6, Dec. 1933

1934 - "The Chief Forest Insec t Problems of the Pacific Coast of North America." Proc. Fifth Pacific Science Congress, 1934.

1934 - "A New Neobellamira." Can. Ent. May, 1934

1935 - "New Coleoptera from Western Canada. V." Can.Ent., Jan. 1935

J.M. Swaine & Ralph Hopping.

1928 -"The Lepturini of America North of Mexico, Part I."
Dom. Dept. Mines, Nat. Museum of Canada, Bull. No. 52 (1)
(Biological Series No. 14) 1928

Hopping, Ralph & Geo. R.

1929 - "II. New Coleoptera from Western Canada."
The Canadian Entomologist, vol.61, pp.251-3, Nov.1929

1934 - "A Revision of the Genus Cephaloon." Pan-Pacific Ent., vol.X, No. 2, April, p.64. (3) (4)

Hopping, Geo.R.

1926 - "A New Melasis with a key to the species (Coleoptera)."
The Canadian Entomologist, vol.57, pp.225-228, Sept.1926 (5) (6)

1927 - "Studies in the Life History of Trachykele blondeli Mars. (Coleoptera)." The Canadian Entomologist, vol.59, pp.201-4, Sept. 1927.

1928 - "The Western Cedar Borer (Trachykele blondeli Mars.)"
Dom.Dept.Agr.Ent.Branch, Pamphlet No. 94, N.S.
July 1928.

Hopping, Geo. R. (continued).

1928 - "New Cerambycidae (Coleoptera)."
The Canadian Entomologist, vol.60, pp.246-7, Oct. 1928

1932 - "Studies in the Life History of Trachykele blondeli Marseul." The Canadian Entomologist, vol.64, pp.189-191, Aug. 1932.

1932 - "A Revision of the Clytini of Boreal America (Cerambycidae, Coleoptera)." Annals of the Entomological Society of America, vol.25, no.3, pp.529-577, Sept. 1932. (2)

1934 - "An Account of the Western Hemlock Looper, Ellopia semniaria Hulst., on conifers in British Columbia."
Scientific Agriculture, Sept. 1934.

Hopping, Geo. R., and J.H. Jenkins.

1933 - "The Effect of Kiln Temperatures and Air-Seasoning on Ambrosia Insects (Pinworms)."
Dom.Dept. Interior, Forest Service, Circular 38, 1933.

W.G. Mathers.

1931 - "The Biology of Canadian Barkbeetles - The Seasonal History of Dryocoetes confusus Sw."
The Canadian Entomologist, vol. 63, pp.247-8, Nov. 1931.

1932 - "The Spruce Budworm in British Columbia."
The Forestry Chronicle - Vol.8, no.3, p.154-7, Sept. 1932.

K.A. Richmond.

1933 - "Host Selection Studies of Dendroctonus monticolae Hopk., in southern British Columbia."
The Forestry Chronicle, vol.9, no.2, pp.60-61, June 1933.

1930 - "A Coleopterous Fish."
The Canadian Entomologist, vol.62, p. 184, August 1930.

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