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FOLIAGE INSECTS OF SPRUCE IN CANADA

BY
A. W. A. BROWN

Forest Insect Investigations
Division of Entomology



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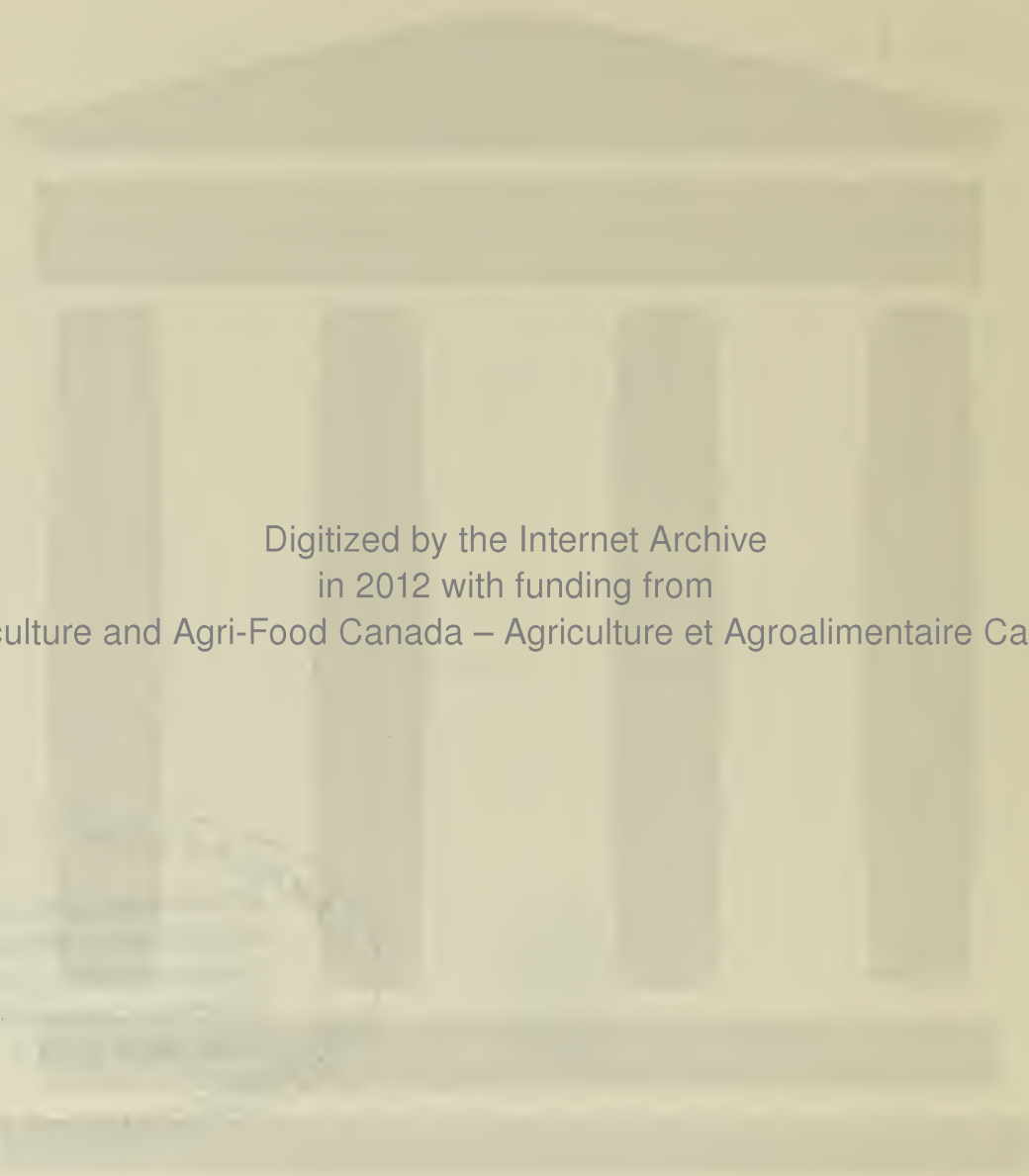
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FOLIAGE INSECTS OF SPRUCE IN CANADA

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A. W. A. BROWN

The information presented in this paper represents a part of the results obtained by the Canadian Forest Insect Survey, a co-operative enterprise between industry, protection services and forest entomologists, launched in 1936. A detailed account of the organization of this project may be found in the Annual Report of the Forest Insect Survey, Division of Entomology, Science Service, Department of Agriculture, Ottawa, 1939.

In addition to the results obtained by the headquarters laboratory at Ottawa, information for their particular regions has been contributed by L. S. Hawboldt of Fredericton, N.B., working under the direction of R. E. Balch, and by H. B. Leech of Vernon, B.C., under the direction of G. R. Hopping.

Mr. A. R. Gobeil, Director, and the staff of the Entomological Service of the Department of Lands and Forests of the Province of Quebec have co-operated very closely with the Dominion Division of Entomology in the Forest Insect Survey. The greater part of the records from central and eastern Quebec are based on collections and rearing experiments made by them. This important contribution is hereby duly and gratefully acknowledged.

Specialized work in various groups has been contributed by the following members of the scientific staff: W. C. McGuffin, larvae of the Lepidoptera; G. A. Bradley, adult Coleoptera, Aphidoidea and Coccidae; W. W. Judd, Hemiptera. Basic assistance has been freely given by Dr. J. McDunnough, Chief of the Systematic Investigations unit, and the following members of his staff: W. J. Brown, Coleoptera; G. S. Walley, Ichneumonoidea and Hemiptera; Dr. O. Peck, Tenthredinoidea and Chalcidoidea; G. Shewell, Diptera; T. N. Freeman, Lepidoptera. Miss Jean Burnham of Fredericton has kindly determined certain Aphidoidea, and C. S. Smith of Belleville some parasitic Diptera.

Approximately 37 per cent of the total timber resources of Canada is composed of the 5 species of spruce (*Picea*), namely, white, red, black, Engelmann, and Sitka, with their intermediate forms. Indeed, about 20 per cent* of all the spruce in the world is to be found in the Dominion, representing a large part of the international pulpwood supply. Since softwoods are easily killed by defoliating insects, a knowledge of the various forms feeding on spruce over the vast extent of Canada is of considerable importance.

The greater number of these forms are larvae of Lepidoptera, of which some 70 species are listed in this paper. The sawflies, however, are in many respects the most important group, although only 6 species have been recognized. There have also been recorded on spruce 8 species of adelgids, 7 aphids, 4 cercopids, 4 fulgorids, and 2 recognized species of coccids. Although outbreaks of leaf-eating insects occur very often in Canada, there are only 2 species of outstanding importance at the present time: namely, the spruce budworm, *Cacoecia fumiferana* Clem., a native insect; and the European spruce sawfly, *Gilpinia polytoma* Htg., first noted in 1930. Probably 8 other species are more

* Estimate kindly supplied by J. D. B. Harrison, Dominion Forest Service.

or less harmful, the most common of these being the native yellow-headed spruce sawfly and balsam fir sawfly. It should be remembered, however, that species which are usually unimportant in the forest may at times cause considerable damage in nurseries and ornamental plantations, and that, under circumstances particularly favourable to their multiplication, certain species may unexpectedly become forest pests of the first rank.

It is remarkable that of the 101 species of foliage insects listed in this paper as spruce feeders, only 6 species can be said to attack no other trees. These are the sawflies *Gilpinia polytoma*, the 2 species of *Pikonema*, the caterpillar *Taniva albolineana*, and the gall-aphids *Adelges abietis* and probably *Pineus similis*. However, the caterpillars *Zeiraphera ratzeburgiana* and *Z. fortunana*, *Dioryctria reniculella* and *Zanclognatha minoralis* may possibly belong to this category. The forms that feed on other softwoods as well are much more numerous. An insect which prefers spruce will nearly always attack balsam also. Finally, some of the insects found on spruce are general feeders and may occur on broadleaved trees and even shrubs and herbs.

Great variety in the manner of feeding is to be observed in these forms. The following 9 types of attack may be noted:

1. Mainly restricted to old foliage, as in *Gilpinia polytoma* and *Neodiprion abietis*.
2. Mainly restricted to new foliage, as in *Pikonema*.
3. All foliage eaten indiscriminately, as in most Macrolepidoptera.
4. Needles lightly webbed together, as in Tortricidae.
5. Restricted to sprouting shoots, as in *Cacoecia* and *Peronea*.
6. Needle-mining, as in *Taniva*, *Epinotia* and *Recurvaria*.
7. Foliage drawn together to form "frass nests", as in *Cephalcia* and *Dioryctria*.
8. Surface of shoot attacked, as in cercopids and fulgorids.
9. Gall-makers—adelgids.

The following pages list the insect species feeding on spruce, together with notes on their most important characteristics. Where possible each is given a common name taken from authorized lists or from special publications, or, in some cases, made up for use in connection with the survey. For each species the total number of samples received in the Forest Insect Survey followed by the total number of specimens is shown in brackets immediately after the name of the species. Information on geographical range has been compiled from the detailed distribution maps on which every sample of the species concerned is plotted. The first and last dates of emergence are then given. In cases of emergence after hibernation, the figures following the term "incubation" indicate the number of days spent in an incubator at 75° F and 95 per cent R.H. Whenever a list of parasites is given, the order followed shows which species are most often represented in the samples received. Since nearly all host insects collected in the survey were in the larval stage, many pupal and cocoon parasites are lacking. Supplemental information obtained from literature or from specimens in the Canadian National Collection will be found in brackets. Each section closes with one or more references to biology or larval description, where available.

A section of this paper has been devoted to the principal predacious groups to be found on spruce foliage, namely the hemerobiids, chrysopids, syrphids, pentatomids, carabids, clerids, melyrids and coccinellids. In many cases only the number of samples received, but not the number of specimens, is indicated, and other information available in the divisional files has been either presented in condensed form or completely omitted. This section is closed by a list of 20

of the most common species that may be beaten from spruce. These are almost entirely composed of elaterids, whose larvae prey on sawfly cocoons, and of wood-boring insects.

At the end of this paper there is a series of keys to the most important species covered in the text. These keys have been made as simple as possible, making full use of colour characteristics and features that may be seen with a hand lens; the small number of the species concerned has made these liberties possible. It should be distinctly understood that these keys are intended for use only in the determination of species actually found on spruce. Thus it is hoped that by the introduction of keys and of suitable common names, this paper may be of value to every field man, whether forest entomologist, forester, or forest ranger.

TENTHREDINIDAE—Sawflies

Neodiprion abietis Harr. Balsam fir sawfly. (691:7464).—White, black, red, Engelmann and Sitka spruce; also balsam. (Specimens on red and jack pine are a separate species; those on balsam, on eastern spruces, and on western spruces may constitute 3 separate subspecies.*) Very common, occasionally defoliating quite seriously balsam, and also spruce. Skeena River to Churchill River, James Bay and Newfoundland, south to United States border. Overwintering: egg. Cocooning: June 19 to July 27 (average July 10). Emergence: July 11 to September 3 (average August 4). Sex ratio 66 per cent. Pupal parasitism 10 per cent (2 per cent summer emergence, 8 per cent following spring).

Parasites: *Phorocera* near *hamata* A. & W.
Spathimeigenia spinigera Tns.
Spathimeigenia aurifrons Curr.
Lamachus lophyri Ashm.
Lamachus contortionis Dav.
Amblymerus verditer Nort.
Lamachus ruficoxa Cush.
Delomerista diprionis Ashm.
Hemiteles tenellus Say (hyperparasite).
Euceros frigidus Cress.
Bessa selecta Mg.
Exenterus affinis Rohw.
Mesochorus spp. (hyperparasite).
Gelis sp. (hyperparasite).

Ref.: Bird. Ann. Rept. Ent. Soc. Ontario, 1929, p. 76.

*Atwood, C. E., personal communication.

Gilpinia polytoma Htg. European spruce sawfly. (3229:110547).—White, red, black and Norway spruce. Exceedingly destructive and persistent infestation since discovery in 1930. Lake Abitibi, Georgian Bay and Lake Huron, east to Anticosti Island, Cape Breton Island and Nova Scotia; extremely rare in Gatineau and Algonquin regions. Generations: mainly 1 in Northern Coniferous Forest, mainly 2 in Mixed Forest. Overwintering: prepupa in cocoon, a certain proportion exhibiting diapause for 2 to 7 years. Cocooning July 1 to November 13. Emergence: incubation 11 to 52 (average 14) days; (summer generation July 6 to September 16). Sex ratio 99.5 per cent. Pupal parasitism 0.1 per cent.

Parasites: **Microplectron fuscipennis* Zett.
Bessa selecta Mg.
 **Exenterus* sp.
Phorocera near *hamata* A. & W.
 ***Spathimeigenia aurifrons* Curr.
 ***Spathimeigenia spinigera* Tns.
Lamachus contortionis Dav.
Aptesis indistincta Prov.
Aenoplex sp.
Stylocryptus subclavatus Say.

Ref.: Balch. *Canadian Forest Insects* Spec. Circ., Dep. Agr., Canada.
 Reeks. Ann. Rept. Ent. Soc. Ont., 1938, p. 25 (parasites).

*Introduced parasite.

**May be two intergraded forms of *S. spinigera* (C. S. Smith).

Pikonema alaskensis Roh. Yellow-headed spruce sawfly. (1998:17502).—White, black, red, Engelmann and Sitka spruce. Very common; small sporadic infestations on open-grown trees. (Alaska), northern British Columbia to Great Slave Lake, Fort Severn, James Bay, Labrador boundary and Newfoundland, and south to United States border. Overwintering: prepupa in cocoon. Cocooning: June 25 to October 29 (average August 10). Emergence: incubation period 15 to 52 (average 25) days. Sex ratio 80 per cent. Pupal parasitism 6 to 11 per cent.

Parasites: *Erromenus bedardi* Prov.
Monoblastus n.sp.
Scopiorus quebecensis Prov.
Bessa selecta Mg.
Smicroplectrus velox Wly.
Phorocera near *hamata* A. & W.
Mesoleius sp.
Hypopteromalus tabacum Fitch (hyperparasite).
Holocretnus sp.
Orthostigma sp.
Brachymeria compsilurae Cwfd.
Euceros sp.
Monoblastus? *varifrons* Cress.
Melittobia chalybii Ashm.
Mesochorus spp. (hyperparasite).

Ref.: Nash. Jour. Econ. Ent., 32, 330.

Pikonema dimmockii Cress. Green-headed spruce sawfly. (794:3213).—White, black, red, Engelmann and Sitka spruce. Very common and widespread but never destructive. Northern British Columbia to Great Slave Lake, Fort Severn, James Bay and Newfoundland, and south to United States border. Overwintering: prepupa in cocoon. Cocooning: June 26 to September 26. Emergence: incubation period 12 to 30 (average 20) days. Sex ratio 86 per cent. Pupal parasitism 5 per cent.

Parasites: *Erromenus bedardi* Prov.
Holocretnus sp.
Scopiorus quebecensis Prov.
Monoblastus n.sp.
Mesochorus sp. (hyperparasite).

Ref.: Ross. Proc. Ent. Soc. Washington, 40, 17.

PAMPHILIIDAE—False Webworms

Acantholyda sp. Evergreen false webworm. (87:95).—White, black and Engelmann spruce; also balsam, hemlock, white and jack pine. Common but apparently never destructive. British Columbia interior, Northwest Territories, Saskatchewan, Manitoba, Ontario, Quebec and New Brunswick. Overwintering: prepupa in soil. Cocooning: entered soil about June 23. Emergence: incubation period 4 to 5 days; may exhibit diapause for one or more years.

Cephalcia sp. Orange-striped false webworm. (70:130).—White, black and Engelmann spruce; also white, red and jack pine. Common, with occasional local infestations. British Columbia interior, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Newfoundland. Overwintering: prepupa in soil. Cocooning: entered soil about August 1. Emergence: incubation period 17 to 29 days; may exhibit diapause for one or more years.

Parasite: *Zenillia fronto* Coq.

ARCTIIDAE—Tiger Moths

Halisidota argentata Pack. Silver-spotted halisidota. (1:1).—Sitka spruce; also Douglas fir, (western yellow pine and grand fir). Occasionally abundant and moderately destructive. British Columbia coast. Overwintering: larva. Pupation: late June. Emergence: July. Ref.: Doane, et al. *Forest Insects* McGraw-Hill p. 286.

Lexis bicolor Grt. Northern smoky moth. (38:42).—(Probably lichen on) white spruce; also Douglas fir. Common and widespread. Rocky Mountains to (Great Bear Lake), northern Saskatchewan, Lake St. John and Newfoundland, south to Sault Ste. Marie and Ottawa River. Overwintering: larva. Pupation: June 22 to August 10. Emergence July 3 to August 19.

Parasite: *Amblyteles* sp.

PHALAENIDAE—Noctuids

Panthea acronyctoides Wlk. Spruce tufted caterpillar. (106:117).—White and black spruce; also balsam, tamarack and white pine. Common but unimportant. Lake Winnipeg to Lake Abitibi, Lake St. John and Gaspé, south to United States border. Overwintering: pupa. Pupation: July 31 to September 28 (average August 20). Emergence: incubation period 8 to 18 (average 10) days (June 27 to August 5). Sex ratio 57 per cent. Pupal parasitism 11 per cent.

Parasite: *Apanteles* near *congregatus* Say.

Ref.: Thaxter. Can. Ent., 23, 35. (*Audela acronyctoides*.)

Panthea virginaria Grt. Western spruce tufted caterpillar. Engelmann spruce; also Douglas fir. Not uncommon. British Columbia interior, northern Alberta. Overwintering: pupa. Pupation: September 5. Emergence: incubation period 15 days (July 16).

Anomogyna elimata Wlk. Chameleon caterpillar. (19:23).—White, black and Engelmann spruce; also balsam, hemlock, red and jack pine. Not uncommon (record of great abundance at Nichequon in far northern Quebec). Ontario, Quebec, New Brunswick; also northern Alberta (this may be a variety). Overwintering: larva. Pupation: June 17 to July 17. Emergence: July 22 to August 16. Sex ratio 53 per cent.

Ref.: Guenée. *Histoire naturelle des Lépidoptères*, 5, 533.

Gibson. Ann. Rept. Ent. Soc. Ont., 1901, p. 79.

McDunnough. Can. Ent., 64, 109.

Anomogyna perquiritata Morr. (13:22).—White and black spruce; and balsam. Also Engelmann spruce (this may be a variety). Generally uncommon. (British Columbia), northern Alberta to Gulf of St. Lawrence (and Newfoundland); common in northern Quebec. Overwintering: larva. Pupation: June 25 to July 12. Emergence: July 13 to 29.

Feralia jocosa Gn. Green-striped spruce caterpillar. (394:408).—White, black and Engelmann spruce; also balsam, hemlock, and jack pine. Common but unimportant. South-eastern British Columbia, Saskatchewan to Chibougamau, Anticosti Island and Cape Breton, south to United States border. Overwintering: pupa. Pupation: July 19 to September 20. Emergence: incubation period 2 to 3 days (April 20 to May 30); very susceptible to drying out as pupa. Pupal parasitism 5 per cent.

Parasites: *Madremyia saundersii* Will.

Euplectrus sp.

Ref.: Seifert. Jour. N.Y. Ent. Soc., 6, 182.

Beutenmuller. Bull. Am. Nat. Hist. 14, 236.

Feralia major Sm. (2:3).—White spruce. Rare. Ontario and northeastern Quebec. Overwintering: larva. Pupation: August 16 to 22. Emergence: incubation period 1 to 9 days (April 20 to May 10).

Elaphria versicolor Grt. Fir harlequin. (399:620).—White, black and red spruce; also balsam, tamarack and white cedar; yellow birch, walnut and oak. Common, occasionally partly defoliating balsam. Lake Winnipeg to Lake St. John, Cote Nord and Maritimes; more common in Eastern Canada. Generation: 1 (2 in Virginia). Overwintering: pupa. Pupation: August 5 to September 22 (average September 1). Emergence: incubation period 10 to 15 days (June 7 to July 3). Sex ratio 56 per cent. Pupal parasitism: 15 to 38 per cent.

Parasites: *Chaetophlepsis* prob. *orbitalis* Web.

Wagneria helymus Wlk.

Ref.: Packard. Fifth Report U.S. Ent. Comm., p. 840.

Elaphria festivoides Gn. (1:1).—White spruce. Rare. (Saskatchewan, Manitoba, Ontario), Quebec, (New Brunswick, Nova Scotia). Overwintering: pupa. Pupation: September 21. Emergence: incubation period 14 days (May 31 to July 20).

Autographa selecta Wlk. Verdigris autograph. (54:71).—White, black and Engelmann spruce; also white pine, balsam, Douglas fir and lodgepole pine. Quite common. British Columbia entire, northern Saskatchewan, Ontario, Quebec, New Brunswick (Nova Scotia). Overwintering: larva. Pupation: June 20 to July 16 (average June 28). Emergence: July 1 to 29.

Parasite: *Copidosoma* sp.

Autographa alias Ottol. Spruce white autograph. (67:118).—White and black spruce. Quite common. (Manitoba), Ontario, Quebec, (New Brunswick, Nova Scotia). Overwintering: larva. Pupation: June 9 to July 21 (average June 20). Emergence: June 20 to August 3 (average July 1).

Autographa alias interalia Ottol. (3:3).—Engelmann spruce. Not uncommon. British Columbia, Alberta. Overwintering: larva. Pupation: July 1 to 18. Emergence: July 23 to 26.

- Autographa rectangula* Kby. Checkered autograph. (16:18).—White and black spruce; also balsam. Uncommon. (Ontario), Quebec, (New Brunswick, Nova Scotia). Overwintering: larva. Pupation: June 26 to July 5. Emergence: July 3 to 21.
Ref.: Hampson. Cat. Lep. Phal. Brit. Mus., p. 421 (*Syngrapha*).
- Epizeuxis americalis* Gn. (3:3).—White spruce, (described as destructive on sweet corn and leguminous plants, and as an inquiline in ants' nests). Rare. (British Columbia to Saskatchewan), southern Manitoba and northwestern Ontario, (Quebec and Nova Scotia). Overwintering: larva (?). Pupation: June 23. Emergence: July 2.
Ref.: Guenée. *Histoire naturelle des Lépidoptères*, 8, p. 78.
- Epizeuxis aemula* Hbn. Spruce epizeuxis. (2:4).—White spruce, (inquiline in squirrel's nest*). Rare. (British Columbia to Manitoba), southern Ontario, (northern Ontario, Quebec and Maritimes). Overwintering: larva (?). Pupation: June 22. Emergence: July 4 to 8.
Ref.: Packard. Fifth Rep. U.S. Ent. Comm., p. 843.
American Naturalist, 4, 229.
*Freeman, T. N., personal communication.
- Zanclognatha minoralis* Sm. (10:21).—White and black spruce. Rare. Southern Ontario, southern Quebec, New Brunswick, (Nova Scotia). Overwintering: larva (?). Pupation: June 20. Emergence: June 29.
- Zanclognatha protumnusalis* Wlk. (9:11).—White spruce; also red and white pine. Uncommon. Manitoba, Ontario, Quebec. Overwintering: larva (?). Pupation: June 14 to 28. Emergence: June 30 to July 11.
- Palthis angulalis* Hbn. Spruce harlequin. (63:75).—White, black, red, Engelmann and Sitka spruce, also balsam. Unimportant but fairly common. All British Columbia; Lake Superior to Lake Abitibi, Gaspé and Newfoundland, south to United States border (record from Italy of German authors doubted by Guenée). Overwintering: prepupa in loose cocoon, spun August 16 to October 16. Pupation: incubation period 6 days (June 23). Emergence: incubation period 14 to 18 days (May 31 to July 5).

LIPARIDAE—Tussock Moths

- Notolophus antiqua* L. Rusty tussock moth. (132:698).—White, black, red and blue spruce; also tamarack, and deciduous trees, shrubs and herbs. Common; often abundant on blue spruce, and quite destructive to certain deciduous trees. Prince Albert to Lake Abitibi, Gaspé and Newfoundland, and south to United States border. Overwintering: larva. Pupation: July 9 to August 24. Emergence: July 29 to September 12. Sex ratio 25 to 33 per cent. Pupal parasitism 8 to 15 per cent.
Parasites: *Itoplectis conquisitor* Say.
Iseropus coelebs Wlshm.
Casinaria orgyiae How.
Hyposoter pallipes Prov.
Amblyteles unifasciatorius Say.
Exorista mella Fitch.
Campoplex sp.
Ref.: Gibson. Bull. 99 (n.s.) Dept. Agr. Canada, p. 14.
Treherne. Ann. Rept. Ent. Soc. Ontario, 1915, p. 188 (parasites).
- Notolophus antiqua badia* Hy. Edw. Western rusty tussock moth. (9:10).—Engelmann and blue spruce, also Douglas fir, and deciduous trees and shrubs. Quite destructive to ornamental blue spruce. British Columbia entire. Overwintering: larva. Pupation: August 4 to 23. Emergence: August 19 to September 14.
Ref.: Edwards. Proc. Cal. Acad. Sci., 5, 183.
- Olene plagiata* Wlk. Grey spruce tussock moth. (127:141).—White and black spruce; also white pine and other conifers, and elm, yellow birch and basswood. Common but unimportant. Churchill Lake to Chibougamau and Gulf of St. Lawrence, and south to United States border. Overwintering: larva. Pupation: June 15 to July 8 (but larvae found until September 2). Emergence: June 24 to August 10 (average July 20). Sex ratio 52 per cent. Pupal parasitism: 24 per cent.
Parasites: *Compsilura concinnata* Mg.
Casinaria orgyiae How.
Sturmia sternalis Coq.
Zenillia amplexa Coq.
Ref.: Barnes & McDunnough. *The North American Species of the Liparid genus Olene*, Decatur, Illinois.
- Olene griseifacta* Dyar. (4:4).—Engelmann and Sitka spruce. Quite common. North, central and eastern British Columbia, northwestern Alberta. Overwintering: larva. Pupation: June 20 to 27. Emergence: June 27 to July 18.
Ref.: Ibid. Species in this genus are insufficiently characterized.

GEOMETRIDAE—Loopers

Nemoria mimosaria Gn. (5:8).—White spruce; also balsam, hemlock and tamarack, and oak. Rare. (Manitoba), Ontario, Quebec—Gatineau and Lievre valleys, (Nova Scotia). Overwintering: pupa. Pupation: August 28 to 31. Emergence: incubation period 12 days (June 2 to 29).

Ref.: Packard. Fifth Rep. U.S. Ent. Comm., p. 864.
American Naturalist, 18, 933 (*Aplodes coniferaria*).

Nyctobia limitaria Wlk. (11:16).—White, black, red and Engelmann spruce; also tamarack. Not common. British Columbia interior, northwestern Ontario, lower St. Lawrence river and New Brunswick. Overwintering: pupa. Pupation: July 9 to 20. Emergence: incubation period 5 days (also 38 days).

Parasites: *Chorinaeus* sp.
Proctotrypidae sp.

Eupithecia palpata Pack. Brown spruce looper. (152:255).—White, black and Engelmann spruce; also balsam and white pine. Unimportant but common. Northern and central British Columbia, Ontario, Quebec, Maritimes. Overwintering: pupa. Pupation: August 16 to October 22 (average September 2). Emergence: incubation period 8 to 25 (average 10) days (June 4 to July 18). Sex ratio 37 per cent.

Parasite: *Casinaria* sp.

Eupithecia luteata Pack. Fir-needle inchworm. (8:11).—White, and red spruce; also balsam (white pine and juniper). Not uncommon. (Manitoba), Ontario, Quebec, New Brunswick. Overwintering: pupa. Pupation: August 11 to September 14 (average August 31). Emergence: incubation period 9 to 12 days (May 26 to July 15).

Ref.: Packard. Fifth Report U.S. Ent. Comm., p. 865.

Eupithecia luteata bifasciata Dyar. (2:3).—Engelmann spruce. Not uncommon. British Columbia, Alberta. Overwintering: pupa. Pupation: September 12 to 14. Emergence: incubation period 10 days.

Eupithecia filmata Pears. (2:2).—White spruce. Rare. (Alberta, Ontario), Quebec, (New Brunswick, Nova Scotia). Overwintering: pupa. Pupation: June 27 to August 2. Emergence: incubation period 5 to 6 days (April 25 to May 20).

Eupithecia castigata Hbn. (2:2).—White spruce; also balsam. Rare. Northern British Columbia, (Alberta to Ontario), Quebec, (New Brunswick, Nova Scotia). Overwintering: pupa. Pupation: September 14 to 31. Emergence: incubation period 10 days (June 4 to July 16).

Hydriomena divisaria Wlk. Transverse-banded looper. (1682:5077).—White, black and red spruce; also balsam and tamarack. Unimportant but common. Northern Saskatchewan to Gulf of St. Lawrence and Cape Breton, south to United States border. Overwintering: pupa. Pupation: August 25 to November 22. Emergence: incubation period 7 to 14 days (May 28 to July 7). Sex ratio 55 per cent. Pupal parasitism 8 per cent, 9 per cent, 5 per cent.

Parasites: *Rhogas* sp.
Campoplex sp.
Euceros couperi Cress.
Campoplegidea luctuosa Prov.
Madremyia saundersii Will.
Sagaritis sp.

Hydriomena renuntiata Wlk. variety. Western transverse-banded looper. (12:17).—White and Engelmann spruce; also lodgepole pine. Uncommon. British Columbia interior northwards. Overwintering: pupa. Pupation: September 24 to October 6. Emergence: incubation period 11 to 12 days.

Semiothisa granitata Gn. Green spruce looper. (1682:5077).—White, black and red spruce; occasionally on balsam and tamarack. (Also a larger form in British Columbia on Engelmann and Sitka spruce, Douglas fir, western hemlock and alpine fir.) Unimportant but exceedingly common. British Columbia entire (larger form); northern Saskatchewan to Gulf of St. Lawrence and Newfoundland and south to United States border. Generation: 1 (occasional emergence in late summer). Overwintering: pupa. Pupation: August 7 to October 23. Emergence: incubation period 8 to 13 (occasionally up to 101) days (May 28 to July 10). Sex ratio 65 per cent. Pupal parasitism 36 per cent, 33 per cent, 13 per cent.

Parasites: *Casimaria* sp.
Rhogas spp.
Mesochorus spp. (hyperparasite).
Chaetophlepsis orbitalis Webb.
Hyposoter near *geometrae* Ashm.
Microgaster probably new sp.
Euceros couperii Cress.
Ophion sp.
Meteorus reticulatus Mues.
Campoplegidea vicina Prov.
Campoplegidea lobata Wly.
Campoplex sp.
Platylabus ornatus Prov.
Amblyteles spp.
Microplitis n. sp.
Euceros frigidus Cress.
Thelairodoria sp.
Apanteles spp.
Macrocentrus uniformis Prov.
Paranomalon sp.
Chorinaeus probably new sp.
Madremyia saundersii Will.

Semiothisa oweni Swett. Owen's green looper. (11:21).—Black and white spruce; mainly on tamarack. Uncommon on spruce. (Manitoba), Ontario, northern Quebec, New Brunswick, (Nova Scotia). Generation: 1 (occasional emergence in late summer). Overwintering: pupa. Pupation: July 28 to September 12. Emergence: incubation period 11 days (June 6 to July 21).

Eufidonia notataria Wlk. (13:20).—White, black and red spruce; mainly on white and jack pine, also on tamarack and hemlock. Uncommon. Northern Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia. Overwintering: pupa. Pupation: August 14 to 20. Emergence: incubation period 12 to 15 days (June 7 to July 5). Sex ratio 63 per cent.

Ref.: Packard. Fifth Report U.S. Ent. Comm., p. 782.
 Goodell. Can. Ent., 14, 199.

Paraphia piniata Pack. Pine measuring-worm. (55:59).—White, black and Engelmann spruce; also tamarack, balsam, white, lodgepole and Scots pine. Not uncommon. Central British Columbia, northern Saskatchewan to Lake Abitibi, Cote Nord, New Brunswick and Nova Scotia. Overwintering: larva. Pupation: June 4 to July 21 (average July 1). Emergence: June 24 to July 31 (average July 11). Sex ratio 69 per cent. Pupal parasitism 9 per cent.

Parasite: *Amblyteles caeruleus* Cress.

Melanolophia canadaria Gn. (3:3).—White spruce; also balsam, (pine, tamarack and hemlock), red maple, (basswood, oak and sweet fern). Uncommon on spruce. (Manitoba, Ontario), Quebec, (Nova Scotia). Generation: 1 and partial second (emerging August 15 to September 21). Overwintering: pupa. Emergence: incubation period 2 to 7 days (May 13 to June 15).

Ref.: McDunnough. Can. Ent., 65, 123.

Melanolophia imitata Wlk. (13:12).—Engelmann and Sitka spruce; also Douglas fir. Not uncommon. British Columbia coast and interior. Overwintering: pupa. Pupation: August 3 to 22. Emergence: incubation period 5 to 15 days (May 23 to June 21). Sex ratio 43 per cent.

Parasite: *Astiphromma* sp.

Ref.: Dyar. Psyche, 12, 58 (described under *M. canadaria*).

Protoboarmia porcelaria Gn. Dotted-line looper. (245:513).—White spruce; also balsam, tamarack and white pine. Quite common. Northern Saskatchewan and Manitoba to Gulf of St. Lawrence, south to United States border. Generations: 2 successive broods (both univoltine). Overwintering: larva, occasionally as pupa. Pupation: June 13 to July 5 (summer generation); November 10 (overwintering as pupa). Emergence: June 22 to July 19 (summer generation); May 10 (overwintering as pupa).

Parasites: *Amblyteles acerbus* Cress.
Amblyteles promptus Cress.
Pimpla pedalis Say.
Mastrus aciculatus Prov.
Aphanistes sp.
Platylabus sp.
Euceros sp.

Ref.: Guenée. Histoire Naturelle des Lépidoptères, 9, 252 (*Boarmia*).

Protoboarmia porcelaria indicataria Wlk. Western dotted-line looper. (10:15).—Engelmann spruce; also Douglas fir, western cedar, western hemlock, and lodgepole pine. Quite common. British Columbia, (Alberta). Generations: 2 successive broods (both univoltine). Overwintering: larva or pupa. Pupation: June 29 to July 18 (summer generation); August 1 to October 15 (overwintering as pupa). Emergence: July 21 to August 3 (summer generation); incubation period 5 to 52 days, or June 21 to July 10 (overwintering as pupa).

Ref.: McDunnough. Bull. 18 Dept. Agr. Canada, p. 19 ("northern paler form").

Anacamptodes vellivolata Hlst. (4:5).—White and black spruce; also tamarack and white pine. Uncommon. Manitoba, Ontario, (Quebec), New Brunswick. Overwintering: pupa. Pupation: July 27 to August 16. Emergence: incubation period 2 to 4 days (May 26 to June 24).

Ref.: McDunnough. Ibid, p. 31.

Anacamptodes larvaria Gn. (8:8).—White and black spruce; also balsam and tamarack. Emergence: June 11 to July 18.

Ref.: McDunnough. Ibid, p. 29.

Ectropis crepuscularia Schiff. Saddled larch looper. (49:105).—White spruce; also tamarack, hemlock, balsam, white cedar; birch, maple, locust and other deciduous trees and shrubs. Common. Europe; British Columbia interior, northern Saskatchewan and southern Manitoba, Algoma to Manikouagan and Matapedia. Overwintering: probably larva. Pupation: July 23 to August 29 (average July 30). Emergence: August 10 to September 25 (average August 20).

Parasites: *Aphanistes* sp.

Amblyteles sp.

Ref.: Barnes & McDunnough. Psyche, 20, 17.

Pero morrisonarius Hy. Edw. (6:7).—White spruce; also tamarack and balsam. Rare. (British Columbia to Manitoba), Ontario, Quebec, New Brunswick, (Nova Scotia). Overwintering: pupa. Pupation: September 10 to 11. Emergence: incubation period 15 days (May 6 to July 10).

Pero behrensarius Pack. (4:6).—Engelmann spruce. Not uncommon. British Columbia, (Alberta). Overwintering: pupa. Pupation: September 5 to 27. Emergence: incubation period 12 to 18 days (May 14 to July 6).

Nepytia canosaria Wlk. False hemlock looper. (347:630).—White, black, red and Engelmann spruce; also hemlock, red pine, white cedar, tamarack and Douglas fir. Abundant but not important. Southeastern British Columbia; northern Saskatchewan to Lake Abitibi, Cote Nord and Maritimes, south to Lake Ontario. Overwintering: egg. Pupation: July 7 to August 25 (average August 2). Emergence: August 9 to October (average August 25). Sex ratio 70 per cent. Pupal parasitism 10 per cent, 12 per cent.

Parasites: *Madremyia saundersii* Will.

Meteorus hyphantriae Ril.

Meteorus near vulgaris Cress.

Itoplectis conquisitor Say.

Apechthis ontario Cress.

Zenillia blanda O.S.

Zele sp.

Amblyteles puerilis Cress.

Apanteles sp.

Mesochorus sp. (hyperparasite).

N.B.—Two larval colour phases, green and crimson, yield similar adults; about 20 per cent of larvae are crimson phase.

Nepytia phantasmaria Stkr. Green hemlock looper. (10:29).—Sitka and Engelmann spruce; also western hemlock and Douglas fir. Common. Southwestern British Columbia, as far northwest as Lillooet. Overwintering: egg. Pupation: July 18 to August 23 (average August 4). Emergence: August 28 to September 22 (average September 2). Sex ratio 59 per cent.

Parasite: *Chaetophlepsis orbitalis* Webb.

Ref.: Day. Proc. Ent. Soc. B.C., 18, 32.

Caripeta divisata Wlk. Grey spruce looper. (457:779).—White, black, Engelmann and Sitka spruce; also tamarack, balsam, western hemlock and Douglas fir. Common but unimportant. British Columbia, northern Alberta, northern Manitoba to Gulf of St.

Lawrence, south to United States border (not yet found in southwestern Ontario). Overwintering: pupa. Pupation: August 27 to November 9 (average October 1). Emergence: incubation period 15 to 48 (average 24) days (June 24 to August 1). Sex ratio 58 per cent. Pupal parasitism 18 per cent, 26 per cent, 3 per cent.

Parasites: *Madremyia saundersii* Will.
Casinarina sp.
Thelairodoria sp.
Euceros couperi Cress.
Paranomalon sp.
Macrocentrus uniformis Prov.
Zenillia blanda O.S.

Ellopiia fiscellaria Gn. Hemlock looper. (486:1304).—White, black and red spruce; also hemlock, balsam, red pine, white cedar and trembling aspen. Destructive on hemlock in Great Lakes region, on balsam around Gulf of St. Lawrence; common but unimportant on spruce. Lake Winnipeg to Lake Abitibi and Newfoundland, south to United States border. Overwintering: egg. Pupation: July 24 to August 27 (average August 5). Emergence: August 3 to October 1 (average August 26). Sex ratio 54 per cent (68 per cent). Pupal parasitism 7 per cent, 9 per cent, 16 per cent.

Parasites: (*Winthemia* sp.)
Chaetophlepsis orbitalis Webb.
Madremyia saundersii Will.
Amblyteles velox Cress.
Blondelia near *eufitchiae* Tns.
Apechthis ontario Cress.
Campoplegidea ellopiiae Wly.
Zelee sp.

Ref.: de Gryse & Schedl. Scientific Agr., 14, 23.
 Watson. Ibid, 14, 669.

Ellopiia fiscellaria lugubrosa Hlst. Western hemlock looper. (54:181).—Engelmann and Sitka spruce; (mainly western hemlock, also alpine fir, Douglas fir, western white pine and some hardwoods). Destructive infestations in western hemlock types through south coastal British Columbia, and in the interior mountains in spruce types. British Columbia entire. Overwintering: egg. Pupation: July 11 to September 3 (average August 14). Emergence: August 16 to October 18 (average September 1). Sex ratio 73 per cent (33 per cent Hopping). Pupal parasitism 25 per cent.

Parasites: *Hyposoter* near *geometrae* Ashm.
Apechthis ontario Cress.
Apanteles sp.
Mesochorus sp. (hyperparasite).

Ref.: Hopping. Scientific Agr., 15, 12. (*E. somniaria*).

Cingilia catenaria Dru. Chain-spotted geometer. (12:295).—(three specimens of the variety *rubiferaria* Swett.). Black spruce; also tamarack, birch, alder, blueberry, sweet fern, and other trees and shrubs. Occasionally destructive in Nova Scotia blueberry barrens. (Alberta), northern Ontario, northern Quebec, Nova Scotia. Overwintering: egg. Pupation: August 1 to September 8. Emergence: August 23 to October 11. Pupal parasitism 18 per cent.

Parasite: *Zenillia blanda* O.S.

Ref.: Psyche, 9, 250.

Tetracis lorata Grt. (8:9).—White spruce; also tamarack, balsam, (hemlock), and willow (and black cherry). Not common. Ontario, Quebec, New Brunswick. Overwintering: pupa. Pupation: September 11. Emergence: incubation period 13 days.

Ref.: Packard. Fifth Report U.S. Ent. Comm., p. 873.
 Schaffner & Griswold, U.S.D.A. Misc. Pub., 188, p. 101.

PYRALIDAE—Snout Moths

Herculia thymetusalis Wlk. Spruce needle worm. (24:52).—White and black spruce; single record from jack pine. Unimportant but quite common. Northern Saskatchewan to James Bay, Gulf of St. Lawrence and Maritimes, south to Ottawa River. Overwintering: larva (occasionally as pupa). Pupation: May 18 to July 4 (occasionally in previous September). Emergence: June 1 to July 20 (occasionally in previous September).

Parasite: *Meteorus* sp.

Dioryctria reniculella Grt. Spruce cone worm. (39:151).—White spruce; cones, twigs and buds. Common, frequently serious on open-grown and young spruce. Saskatchewan, Manitoba, Ontario, Quebec. Overwintering: pupa. Pupation: September 20 to November 2. Emergence: incubation period 12 to 20 days (June 16 to 18). Sex ratio 54 per cent.

Parasites: *Microbracon* sp.
Epiurus sp.
Erigorgus sp.
Phaedroctonus sp.

Ref.: Packard. Fifth Report U.S. Ent. Comm., p. 854.

Dioryctria reniculella Grt. Foliage form of the above; adults similar but may prove to be a separate species. (26:35).—White spruce; also Engelmann and occasionally black spruce. Local; frequently mixed with spruce budworm larvae. Central British Columbia, Ontario, Quebec, New Brunswick; 75 per cent of samples come from Algoma. Overwintering: larva. Pupation: July 12. Emergence: July 8 to 20.

Dioryctria abietella D. & S. Cone pyralid. (2:3).—White spruce. Apparently uncommon. Europe; (British Columbia, Alberta), Ontario, (Quebec), Nova Scotia. Overwintering: pupa. Pupation: September 30. Emergence: October 16; however 2 flights—early (June 20 to August 3) and late (September 22 to October 22).

Ref.: Ratzeburg. *Die Forst-Insekten*, 2, p. 244.

OLETHREUTIDAE—Shoot-moths

Polychrosis new sp. (2:3).—Black spruce. Apparently very rare. Northwestern Quebec. Overwintering: pupa. Pupation: August 4 to September 6. Emergence: incubation period 7 to 8 days.

Taniva albolineana Kft. Webbing spruce-leaf miner. (2:7).—Engelmann, white, Norway and blue spruce. Occasional damage by leaf-mining, especially in plantations. British Columbia, Ontario, Quebec, (Maritimes). Overwintering: larva. Pupation: June 30. Emergence: July 3 to 4.

Ref.: Keen. U.S.D.A. Misc. Pub., 273, p. 86.

Felt. N.Y. State Mus. Bull., 274, p. 167 (*Olethreutes abietana*).

Zeiraphera ratzeburgiana Sax. Spruce bud-moth. (7:19).—White, black, Engelmann and Sitka spruce. May cause trouble where established. Europe; British Columbia as far northeast as Glacier; (Ontario, Quebec), New Brunswick, (Nova Scotia). Overwintering: larva. Pupation: June 19 to 28. Emergence: July 5 to 12.

Ref.: Ratzeburg. *Die Forst-Insekten*, 2, p. 227.

Packard. Fifth Report U.S. Ent. Comm., p. 845 (*Steganoptycha*).

Keen. U.S.D.A. Misc. Pub., 273, p. 84.

Zeiraphera fortunana Kft. (22:66).—White spruce. Common in southern New Brunswick, rare elsewhere. Ontario, (Quebec), New Brunswick, (Nova Scotia). Overwintering: larva. Pupation: June 10 to 24. Emergence: June 22 to July 11. Pupal parasitism 25 per cent.

Parasite: *Clistomorpha dorsalis* Coq.

Ref.: McAndrews. Can. Ent., 59, 27.

Zeiraphera diniana Gn. Douglas fir cone moth. (3:4).—Engelmann spruce foliage; mainly Douglas fir cones, also tamarack foliage. Rare; but common in Douglas fir cones in British Columbia. British Columbia, (Alberta, Manitoba), Ontario, Quebec, (Labrador, Nova Scotia). Overwintering: larva. Pupation: June 27 to July 31. Emergence: July 11 to August 8.

Ref.: Doane et al. *Forest Insects*, McGraw-Hill, p. 310.

Epinotia nanana Treit. Green spruce-leaf miner. (1:5).—Black, Norway and blue spruce; (also balsam). Very occasionally noticeable. Southwestern British Columbia, (southern Ontario, southern Quebec). Overwintering: larva. Emergence: June 20.

Ref.: Johannsen. Maine Agr. Exp. Sta. Bull. 210, p. 34 (*E. piceafoliana*).

TORTRICIDAE—Leaf Rollers

Amorbia humerosana Clem. Pine amorbia. (12:29).—White spruce; also balsam, (white pine, sumach, and poison ivy). Rare; but common in Nova Scotia. Ontario, Quebec, (New Brunswick), Nova Scotia. Overwintering: pupa. Pupation: August 23 to September 24. Emergence: incubation period 11 to 13 days (June 1 to July 6). Sex ratio 75 per cent.

Ref.: Packard. Fifth Report U.S. Ent. Comm., p. 791.

Sparganothis tristriata Kft. (4:4). White spruce, also balsam (and tamarack). Rare. Ontario, Quebec. Overwintering: larva. Pupation: July 15 to 28. Emergence: July 24 to August 5.

Cacoecia fumiferana Clem. Spruce budworm. (527:3864).—White, black, red, Engelmann, Sitka and Norway spruce; mainly balsam, also alpine fir, Douglas fir, tamarack and hemlock. Very destructive; widespread periodic infestations lasting 3 to 5 years, typically causing mortality of 90 per cent balsam, 10 per cent spruce. Prince Rupert to Great Slave Lake, Lake Winnipeg, Lake Abitibi to Anticosti Island and Maritimes, south to United States border. Generation: 1 (1 generation in 2 years in northern British Columbia). Overwintering: young larva. Pupation: June 5 to July 26 (average June 26). Emergence: June 16 to August 7 (average July 10). Sex ratio 58 per cent. Pupal parasitism 15 per cent, 18 per cent.

Parasites: *Itoplectis conquisitor* Say.
Apechthis ontario Cress.
Phaeogenes hariolus Cress.
Zenillia caesar Aldr.
Glypta fumiferanae Vier.
Nemorilla maculosa Mg.
Meteorus trachynotus Vier.
Zenillia vulgaris Fall.
Winthemia fumiferanae Toth.
Amblymerus verditer Nort.
Actia interrupta Curr.
Ascogaster sp.
Hypopteromalus sp. (hyperparasite).
Eulophus sp.
Apanteles sp.
Amblymerus sp.
Lypha dubia Fall.
Sarcophaga sp.

Ref.: Swaine & Craighead. Bull. 37, Dept. of Agr., Canada.
 Gibson. Trans. Roy. Soc. Canada, Section 5, 1925, p. 195.
 Treherne. Ann. Rept. Ent. Soc. Ontario, 1915, p. 132 (parasites).

Archips striana Fern. (3:4).—White spruce. Very rare, except for occasional periods: larvae confused with *Peronea*, pupae with *Tortrix* and *Cacoecia*. (Alberta), Ontario, Quebec. Overwintering: larva. Pupation: June 18 to July 18. Emergence: June 26 to July 27.

Tortrix packardiana Fern. Fir tortrix. (31:65).—White, black, Engelmann and Sitka spruce; also balsam. Common: occasionally slightly destructive. Northern British Columbia, Manitoba to Nova Scotia. Overwintering: larva. Pupation: June 8 to July 19. Emergence: June 20 to July 21. Sex ratio 62 per cent.

Parasite: *Macrocentrus* possibly *peroneae* Mues.

Ref.: Packard. Fifth Report U.S. Ent. Comm., p. 849.

Argyrotaenia lutosana Clem. Fall spruce needle moth. (124:198).—White, black and Engelmann spruce; occasionally on balsam, tamarack and lodgepole pine. Common but generally unimportant. Northern and southeastern British Columbia, Kenora along height of land to Gulf of St. Lawrence and New Brunswick; rare in southern Ontario. Overwintering: pupa. Pupation: August 30 to October 6 (average September 18). Emergence: incubation period 6 to 14 days (average 8 days). Sex ratio 62 per cent. Pupal parasitism 15 per cent, 20 per cent.

Parasites: *Exochus pallipes* Cress.
Phytodietus annulatus Prov.
Glypta sp.
Eclytus pleuralis Prov.
Chorinaeus sp.

Peronea variana Fern. Black-headed budworm. (604:1736).—White, black, red and Engelmann spruce; also balsam, Douglas fir, and western hemlock. Important: occasional restricted outbreaks mainly on balsam. Prince Rupert to Great Slave Lake, Lake Winnipeg, Lake Abitibi and Newfoundland, south to United States border. Overwintering: young larva. Pupation: June 22 to August 13. Emergence: July 2 to September 7. Sex ratio 50 per cent. Pupal parasitism 18 per cent, 31 per cent, 24 per cent.

Parasites: *Phytodietus* sp.
Phytodietus annulatus Prov.
Exochus sp.
Exochus annulicrus Wlshm.
Phaeogenes gaspesianus Prov.
Anachaetopsis tortricis Coq.
Campoplex sp.
Atrometus clavipes Dav.
Meteorus trachynotus Vier.
Microgaster peroneae Wly.
Actia diffidens Curr.
Nemorilla maculosa Mg.
Eubadizon sp.
Eclytus prob. *pleuralis* Prov.
Ascogaster sp.
Diocles obliteratus Cress.
Cremastus sp.
Labrorychus sp.
Hemiteles tenellus Say.
Mesochorus spp. (hyperparasite).
Ephialtes montana Cush.
Actia interrupta Curr.

Ref.: Balch. *Canadian Forest Insects*. Sp. Circular Dept. of Agr., Canada.

GELECHIIDAE—Leaf Miners

Recurvaria piceaella Kft. Red spruce-leaf miner. (1:8).—Red and Norway spruce; (also balsam). Inconspicuous. Southern Ontario, (southern Quebec, Maritimes). Overwintering: larva. Emergence: June 20 to August 4.

Ref.: Kearfott. Jour. N.Y. Ent. Soc., 11, 155.

Packard. Fifth Report U.S. Ent. Comm., p. 850 (*G. obliquistrigella*).

There remains a number of species in the Lepidoptera whose larvae, feeding mainly on other hosts, are occasionally found on spruce:—

| | | |
|---------------|---|----------------------------|
| Lasiocampidae | <i>Tolyte laricis</i> Fitch | Larch lappet moth |
| Phalaenidae | <i>Acronicta</i> spp. esp. <i>grisea</i> Wlk. | Dagger moths |
| | <i>impressa</i> Wlk. | |
| | <i>fragilis</i> Gn. | |
| | <i>Graptolitha</i> spp. | Fruit worms |
| | esp. <i>innominata</i> Sm. | |
| | <i>baileyi</i> Grt. | |
| | <i>Zale</i> spp. | Grey underwings |
| Geometridae | esp. near <i>helata</i> Sm. | |
| | near <i>benesignata</i> Harv. | |
| | <i>Alsophila pometaria</i> Harr. | Fall cankerworm |
| | <i>Eupithecia gibsonata</i> Tayl. | |
| | <i>Vitrinella pampinaria</i> Gn. | |
| Tortricidae | <i>Prochoerodes transversata</i> Dru. | Oblique-banded leaf roller |
| | <i>Cacoecia rosaceana</i> Harr. | |

CERCOPIDAE—Spittle Bugs

Aphrophora parallela Say. Pine spittle bug. (201).—White and black spruce; mainly jack, Scots, red and white pine; also balsam, hemlock and tamarack. Common; occasionally destructive to young pines. Northern Saskatchewan to Lake Abitibi and Gulf of St. Lawrence, south to United States border. Adults: July 4 to September 30.

Ref.: McAndrews. Ann. Rept. Ent. Soc. Ont., 1938, p. 35.

Aphrophora saratogensis Fitch. Saratoga spittle bug. (60).—White and black spruce; mainly (Scots and) white pine. Northern Saskatchewan to Lake Abitibi and Maritimes, south to United States border. Abundant in Gatineau valley. Adults: July 17 to October 2.

Ref.: Britton. *Hemiptera of Connecticut*, p. 218.

Aphrophora signoretii Fitch. Signoret's spittle bug. (52).—White, black and Engelmann spruce; also balsam, Douglas fir, tamarack and jack pine. British Columbia entire; Northern Saskatchewan to Lake Abitibi, Cote Nord and Maritimes, south to United States border. Adults: June 19 to September 22.

Ref.: Ibid, p. 219.

Aphrophora permutata Uhl. Western pine spittle bug. (46).—White, Engelmann and Sitka spruce; also lodgepole, jack and western white pine, and Douglas fir, alpine fir and western cedar. British Columbia entire, northwestern Alberta. Adults: June 26 to September 23.

Ref.: Walley. Can. Ent., 60, p. 188.

FULGORIDAE—Lantern Bugs

Epiptera slossoni Van D. Slosson's lantern bug. (54).—White, black and Engelmann spruce; also balsam, alpine fir, tamarack, jack and white pine. Northern British Columbia and interior; Great Slave Lake to James Bay, Cote Nord and Maritimes, south to Sault Ste. Marie and Ottawa River. Adults: June 2 to September 28.

Epiptera brittoni Metc. Britton's lantern bug. (53).—White, black, and Engelmann spruce; also balsam, alpine fir, Douglas fir, western hemlock, lodgepole, jack and white pine. Yukon, British Columbia entire. Churchill River to Lake Abitibi to southern New Brunswick, south to Sault Ste. Marie and Ottawa River. Abundant in northern and eastern British Columbia and in western Quebec. Adults: June 5 to September 7.

Epiptera variegata Say. (4).—White spruce. Ottawa valley. Adults: August 24 to September 29.

Cixius basalis Van D. (19).—White, black and Engelmann spruce. Northern British Columbia and Rocky Mountains, Patricia and northern Quebec, south to United States boundary. Adults: July 31 to September 22.

Ref.: Osborn. *The Fulgoridae of Ohio*. Bull. 35, Ohio Biol. Survey.

APHIDIIDAE—Aphids

Cinara palmerae Gill. (12).—White, black and Engelmann spruce; also balsam. British Columbia, Alberta, Manitoba, Saskatchewan, Ontario, Quebec. Samples: June 6 to July 14.

Ref.: Hottes and Frison. Bull. 111. Nat. Hist. Survey, 19, Article 3.

Cinara coloradensis Gill. (3).—Engelmann spruce. British Columbia. (Fairly common, especially in parks.) Samples: June 29 to July 19.

Ref.: Gillette & Palmer. *The Aphidiidae of Colorado*. Ann. Ent. Soc. Am. 24, p. 849.

Cinara engelmanni G. & P. (1).—Engelmann spruce. British Columbia. Sample: July 20.

Ref.: Gillette & Palmer. Ibid, p. 852.

Cinara vandykei Wilson. (2).—White and Engelmann spruce. British Columbia. Samples: June 20 to 29.

Ref.: Gillette & Palmer. Ibid, p. 874.

Neomyzaphis abietina Wlk. Sitka spruce aphid. (2).—White, black, Engelmann, Sitka and Norway spruce (apparently also an alternate host). British Columbia. Samples: May 1 to July 1.

Ref.: Wilson. Proc. B.C. Ent. Soc., 1915, p. 82.

Panimerus hyalinus Koch. (1).—White (and Norway) spruce; (also Scots and Austrian pine). Europe; southern Ontario. Sample: June 15.

Ref.: Theobald. *Aphididae of Great Britain*, Vol. 3, p. 152.

Mindarus abietinus Koch. Balsam twig aphid. (16).—White spruce; mainly balsam, also white pine and alpine fir. British Columbia, Alberta, Manitoba, Ontario, Quebec, New Brunswick. Occasionally quite destructive to balsam and even spruce. Samples: June 20 to August 10.

Ref.: Swaine & Hutchings. Bull. 63 n.s. Dept. Agr. Canada.

ADELGIDAE—Gall Aphids

Adelges abietis L. Spruce gall aphid. (139).—White, black, red and Norway spruce. Overwintering on spruce. Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick. Occasionally quite destructive on open-grown and young trees. Samples: June 15 to August 21.

Ref.: Swaine and Hutchings. Bull. 63, n.s. Dept. Agr. Canada, p. 51.

Herrick and Tanaka. Cornell U. Agr. Exp. Sta. Bull. 454.

Adelges cooleyi Gill. Blue spruce gall aphid. (10).—Engelmann, Sitka and blue spruce. Alternating with Douglas fir. British Columbia entire, northwestern Alberta. Occasionally quite destructive on both spruce and Douglas fir. Samples: August 11 to September 10.

Ref.: Chrystal. Ann. Rept. Ent. Soc. Ont., 1916, p. 123.

Adelges lariciatus Patch. No specimens. White spruce. Overwintering on tamarack. (New Brunswick.) Gall almost indistinguishable from that of *A. abietis*.

Ref.: Patch. Maine Agr. Exp. Sta. Bull. 173, p. 294.

Adelges strobilobius Kalt. Larch woolly aphid. (2).—Black spruce. Overwintering on tamarack, European and Japanese larch. Ontario.

Ref.: Swaine. Ann. Rep. Ent. Soc. Ont., 1912, 87.

Pineus pinifoliae Fitch. Pine-leaf chermes. (4).—White and Engelmann spruce. Overwintering on white and western white pine. Northwestern Alberta, Ontario and New Brunswick. Samples: June 19 to July 22.

Ref.: Annand. Stanford U. Publications, Biol. Sciences, 6, No. 1, p. 93.

Pineus similis Gill. Ragged spruce-gall aphid. (18).—White (black, red) and Norway spruce. Overwintering possibly on spruce. Saskatchewan, Manitoba, Ontario, Quebec. Samples: June 6 to July 15.

Ref.: Annand. Ibid, p. 108.

Pineus floccus Patch. No specimens. Red and black spruce. Overwintering on white pine. (New Brunswick.)

Ref.: Annand. Ibid, p. 105.

Pineus boycei Annand. (6).—Sitka and Engelmann spruce. British Columbia coast, also interior. Samples: July 12 to August 22.

Ref.: Annand. Ibid, p. 102.

COCCIDAE—Scales

Physokermes piceae Schr. Spruce bud scale. (13).—White and Norway spruce. Ontario, Quebec. Very common, but seldom destructive. Samples: June 15 to September 4.

Ref.: Herrick. *Insect Enemies of Shade Trees*, Ithaca, p. 366.

Phenacaspis pinifoliae Fitch. Pine leaf scale. (7).—White spruce; mainly pines, also firs and hemlocks. British Columbia, Alberta, (Saskatchewan), Manitoba, Ontario, (Quebec, Maritimes). Very common but seldom destructive. Samples: June 11 to July 7.

Ref.: Herrick. Cornell U. Agr. Exp. Sta. Bull. 515 (*Chionaspis*).

Treherne. Ann. Rep. Ent. Soc. Ontario, 1915, p. 180 (parasites).

PREDATORS

HEMEROBIIDAE

Hemerobius conjunctus Fitch. (17:21).—On white and Engelmann spruce; jack and lodgepole pine. British Columbia interior northwest to Yukon; northern Alberta to northern Ontario and western Quebec. Adults: June 10 to September 30.

Hemerobius pacificus Bks. (4:4).—On Engelmann and Sitka spruce; lodgepole pine and alpine fir. Northern British Columbia. Cocooning: August 30. Emergence: September 20.

Hemerobius kokaneeanus Carr. (9:10).—On Engelmann spruce; Douglas fir, western white pine and western yellow pine. British Columbia interior. Cocooning: June 25 to July 5. Emergence: July 20 to 25.

Hemerobius stigmaterus Fitch. On white spruce, balsam, jack and lodgepole pine. Northern British Columbia to Kenora and northwestern Quebec. Adults: July 27 to September 16.

Kimminsia longifrons Wlk. (10:10).—On white, black and Engelmann spruce. British Columbia interior, Manitoba and Quebec. Adults: June 17 to August 27.

Ref.: Banks. Trans. Am. Ent. Soc., 32, 28.

CHRYSOPIDAE—Lacewing Flies

Chrysopa harrisii Fitch. (5:26).—On white spruce; also mugho pine. Southern Ontario and southern Quebec. Cocooning: June 22 to August 20. Emergence: August 3 to September 12.

Parasites: *Chrysopoctonus rileyi* Fitch.
Hemiteles tenellus Say (hyperparasite).

Chrysopa harrisii externa Hag. (5:5).—On Engelmann spruce; also Douglas fir. British Columbia interior. Cocooning: June 19 to July 20. Emergence: July 18 to August 9.

Chrysopa plorabunda Fitch. (11:11).—On white, black, Engelmann and Sitka spruce; also tamarack, Douglas fir and western cedar. British Columbia entire; Great Slave Lake to Manitoba, Ontario and Quebec. Cocooning: July 10 to 19. Emergence: August 3 to 10.

Chrysopa plorabunda californica Coq. (4:5).—Engelmann and Sitka spruce; also Douglas fir and tamarack. British Columbia entire; northern Saskatchewan. Cocooning: June 30 to July 31. Emergence: July 26 to August 30.

Chrysopa downesi Smith. (3:3).—Engelmann spruce. British Columbia interior and north-western Alberta. Cocooning: June 22 to July 24. Emergence: July 25 to August 31.

Ref.: Smith. Ann. Ent. Soc. America, 24, 579.

SYRPHIDAE—Hover Flies

Metasyrphus lapponicus Zett. (57).—Northern aphid-eater. (Lapland); British Columbia entire, Alberta, northern Saskatchewan to Lake Abitibi, Gaspé and Nova Scotia, south to United States border. Pupation: May 30 to July 22. Emergence: June 2 to August 8.

Parasite: *Syrphoctonus agilis* Cress.

Ref.: Fluke. Trans. Wisc. Acad. Sci. Arts. & Letters, 28, 67.

PENTATOMIDAE—Soldier bugs and Stink bugs

| Species | No. of samples | Geographical range of samples |
|---|----------------|---|
| <i>Brochymena quadripustulata</i> Fab. | 2 | Southern Ontario. |
| <i>Brochymena arborea</i> Say. | 5 | Southern Ontario, southern Quebec. |
| <i>Peribalus piceus</i> Dall. | 1 | Saskatchewan. |
| * <i>Chlorochroa uhleri</i> Stal. | 10 | British Columbia coast and interior, Ontario and Quebec. |
| <i>Euschistus euschistoides</i> Voll. | 10 | British Columbia coast and interior, Saskatchewan, Ontario, Quebec. |
| <i>Euschistus tristigmus</i> Say. | 148 | Kenora to Lake St. John, New Brunswick and Nova Scotia, south to United States border. |
| <i>Neottiglossa undata</i> Say. | 2 | British Columbia interior. |
| <i>Cosmopepla bimaculata</i> Thom. | 9 | Northern and central British Columbia, Quebec, Prince Edward Island. |
| <i>Banasa dimidiata</i> Say. (<i>Banasa</i> stink bug.) | 69 | Southern British Columbia (coast and interior); Algoma to Lake St. John, New Brunswick and Nova Scotia. |
| <i>Banasa sordida</i> Uhl. | 1 | British Columbia coast. |
| <i>Meadorus lateralis</i> Say. | 153 | British Columbia coast and interior, Lake Athabaska to Anticosti and Nova Scotia south to United States border. |
| <i>Elasmotethus cruciatus</i> Say. | 87 | British Columbia entire; Lake Athabaska to Newfoundland and New Brunswick. |
| <i>Elasmotethus interstinctinus</i> L. | 1 | Northwest Territories. |
| * <i>Perillus exaptus</i> Say. | 1 | British Columbia coast. |
| * <i>Apateticus cynicus</i> Say. | 1 | Ontario. |
| * <i>Podisus modestus</i> Dall. (Modest soldier bug.) | 28 | Northern and eastern British Columbia, Ontario, Quebec, New Brunswick. |
| * <i>Podisus placidus</i> Uhl. | 1 | Southern Ontario. |
| * <i>Podisus serieventris</i> Uhl. (Forest soldier bug.) | 172 | Southeastern British Columbia; Manitoba to Gaspé and Maritimes, south to United States border. |
| <i>Zicrona caerulea</i> L. | 1 | New Brunswick (Europe, Asia, East Indies). |

*Species known to be predacious.

CARABIDAE—Ground Beetles

| Species | No. of samples | Geographical range of samples |
|---|----------------|--|
| <i>Pemphus angusticollis</i> Mann. | 3 | British Columbia coast. |
| <i>Sphaeroderus lecontei</i> Dej. | 3 | Ontario, Quebec. |
| <i>Calosoma frigidum</i> Kby. | 2 | Ontario. |
| <i>Calosoma calidum</i> Fab. | 1 | Ontario. |
| <i>Leistus ferruginosus</i> Mann. | 1 | Northern British Columbia. |
| <i>Holciophorus ater</i> Dej. | 8 | British Columbia coast. |
| <i>Euferonia coracina</i> Newm. | 2 | Quebec. |
| <i>Lyperopherus punctatissimus</i> Rand. | 3 | Quebec. |
| <i>Bothriopteris luczoti</i> Dej. | 1 | Quebec. |
| <i>Percosia obesa</i> Say. | 1 | Manitoba. |
| <i>Platynus sinuatus</i> Dej. (Lithe ground beetle.) | 118 | Northern British Columbia; northern Saskatchewan to James Bay and Gulf of St. Lawrence, south to United States border. |
| <i>Platynus quadripunctatus</i> Dej. | 7 | Rocky Mountains, Manitoba, Ontario, Quebec. |
| <i>Platynus bogemanni</i> Gyll. | 1 | Quebec. |
| <i>Lebia grandis</i> Hentz. | 1 | Ontario. |
| <i>Dromius piceus</i> Dej. | 12 | British Columbia interior, Quebec. |
| <i>Plochionus timidus</i> Hald. (Shy ground beetle.) | 69 | Northern Manitoba and Kenora to Ottawa valley and Matapedia; rare in Maritimes. |
| <i>Anadaptus baltimorensis</i> Say. | 1 | Quebec. |

CLERIDAE—Checkered Beetles

| | | |
|----------------------------------|----|--|
| <i>Trichodes nuttalli</i> Kby. | 1 | Ontario. |
| <i>Thanasimus undulatus</i> Say. | 19 | Rocky Mountains, northern British Columbia and Alberta; Great Slave Lake to Patricia, northern Quebec and New Brunswick. |

MELYRIDAE

| | | |
|---|----|---|
| <i>Hoppingiana brevilabris</i> Blais. (Little jet beetle.) | 51 | British Columbia entire (except coastline) to Yukon, Great Bear Lake, and northern Manitoba (2 samples from Algoma, 1 from Gatineau River). |
|---|----|---|

COCCINELLIDAE—Lady-beetles

| | | |
|---|----|--|
| <i>Hyperaspis undulata</i> Say. | 1 | Ontario. |
| <i>Hyperaspis signata binotata</i> Say. | 5 | Ontario, Quebec. |
| <i>Microweisea misella</i> Lec. | 1 | Northern British Columbia. |
| <i>Scymnus phelpsi</i> Cr. | 9 | British Columbia entire, mainly coast. |
| <i>Psyllobora vigintimaculata</i> Say. | 2 | British Columbia interior. |
| <i>Psyllobora 20-maculata taedata</i> Say. | 1 | British Columbia coast northwards. |
| <i>Ceratomegilla fuscilabris</i> Muls. | 5 | Ontario, New Brunswick, Prince Edward Island. |
| <i>Hippodamia convergens</i> Guer. | 5 | Saskatchewan, Manitoba, Ontario, Quebec. |
| <i>Hippodamia tibialis</i> Say. | 4 | Rocky Mountains, northern Saskatchewan, New Brunswick. |
| <i>Hippodamia lunatomaculata apicalis</i> Csy. | 1 | Alberta. |
| <i>Coccinella trifasciata</i> L. (Three-banded lady-beetle.) | 18 | Ontario, Quebec, New Brunswick. |
| <i>Coccinella trifasciata perplexa</i> Muls. | 7 | British Columbia interior, Ontario, Quebec. |
| <i>Coccinella hieroglyphicus tricuspis</i> Kby. | 1 | British Columbia. |
| <i>Coccinella monticola</i> Muls. | 5 | Ontario, Quebec. |
| <i>Coccinella novemnotata</i> Hbst. | 5 | Quebec. |

COCCINELLIDAE—Lady-beetles—Concluded

| Species | No. of samples | Geographical range of samples |
|--|----------------|--|
| <i>Coccinella transversoguttata</i> Fald. (Five-spotted lady-beetle.) | 14 | Peace River, Saskatchewan, Ontario, Quebec. |
| <i>Coccinella quindecimnotata</i> Kby. | 2 | Northwestern British Columbia and interior. |
| <i>Coccinella undecimpunctata</i> L. | 1 | Prince Edward Island. |
| <i>Cycloneda munda</i> Say. | 1 | British Columbia coast. |
| <i>Cycloneda sanguinea</i> L. | 5 | British Columbia coast. |
| <i>Adalia disjuncta</i> Rand. | 12 | Alberta, Saskatchewan, Ontario, Quebec. |
| <i>Adalia bipunctata</i> L. | 5 | British Columbia interior, Alberta, Quebec. |
| <i>Adalia frigida</i> Schn. | 7 | Northern and eastern British Columbia, Alberta, Ontario, Quebec. |
| <i>Adalia frigida melanopleura</i> Lec. | 1 | British Columbia interior. |
| <i>Cleis picta</i> Rand. (Pine lady-beetle.) | 248 | Great Slave Lake to James Bay, Anticosti and Cape Breton, south to United States border. |
| <i>Cleis picta minor</i> Csy. (Western pine lady-beetle.) | 68 | British Columbia entire; Alberta north-eastwards to Lesser Slave Lake. (2 samples from Algoma.) |
| <i>Cleis hudsonica</i> Say. | 4 | British Columbia, Alberta. |
| <i>Anisocalvia duodecimmaculata</i> Gebl. (Twelve-spotted lady-beetle.) | 31 | British Columbia interior; northern Saskatchewan to Anticosti and Nova Scotia, south to Ottawa River. |
| <i>Anisocalvia quattuordecimguttata</i> L. | 6 | Manitoba, Ontario, Quebec, Nova Scotia. |
| <i>Anatis mali</i> Say. (Apple lady-beetle.) | 140 | Southern Rocky Mountains; southern Alberta and central Saskatchewan to Lake St. John and Maritimes, south to United States border. |
| <i>Anatis quindecimpunctata</i> Oliv. | 6 | Ontario, Quebec, New Brunswick. |
| <i>Anatis rathvoni</i> Lec. | 2 | British Columbia interior. |
| <i>Neomysia subvittata</i> Muls. (Tiger lady-beetle.) | 76 | Central Saskatchewan to Lake Abitibi, Gaspé and Nova Scotia, south to United States border. |
| <i>Neomysia randalli</i> Csy. | 12 | British Columbia, Alberta. |
| <i>Neomysia montana</i> Csy. | 3 | Rocky Mountains in British Columbia and Alberta. |
| <i>Neomysia horni</i> Cr. | 1 | British Columbia interior. |
| <i>Chilocorus bivulnerus</i> Muls. (Twice-stabbed lady-beetle.) | 23 | British Columbia entire, mainly interior; Alberta, Ontario, Quebec, and Maritimes. |

20 ADDITIONAL SPECIES COMMONLY TAKEN FROM SPRUCE FOLIAGE

| | | |
|---|-----|--|
| Lampyridae | | |
| <i>Lucidota corrusca</i> L. | 321 | Southern Manitoba to Lake Nipigon, Lake Mistassini, Gaspé and New Brunswick south to Ottawa valley and Bay of Fundy. |
| Tenebrionidae | | |
| <i>Scaphidema aeneolum</i> Lec. (Little spruce darkling beetle.) | 275 | British Columbia interior to Peace River, Churchill River, Hudson Bay, Gaspé and Nova Scotia, south to Sault Ste. Marie and Ottawa River. |
| Elateridae | | |
| <i>Ludius propola</i> Lec. (Two-barred click-beetle.) | 273 | Northern and interior British Columbia; central Saskatchewan to Lake Abitibi, Anticosti Island and Nova Scotia, south to United States border. |
| Elateridae | | |
| <i>Ludius nitidulus</i> Lec. (Polished click-beetle.) | 258 | Kenora to Lake Abitibi, Cote Nord, Gaspé and Nova Scotia, south to Sault Ste. Marie and Ottawa valley. |
| Elateridae | | |
| <i>Ludius triundulatus</i> Rand. (Three-barred click-beetle.) | 236 | British Columbia interior; Athabaska River to James Bay, Gulf of St. Lawrence and Cape Breton, south to United States border. |

20 ADDITIONAL SPECIES COMMONLY TAKEN FROM SPRUCE FOLIAGE—*Concluded*

| Species | No. of samples | Geographical range of samples |
|---|----------------|---|
| Curculionidae <i>Hypomolyx piceus</i> DeG. (Large spruce weevil.) | 193 | British Columbia interior to Yukon; Lake Athabaska to James Bay, Gulf of St. Lawrence and Maritimes, south to Muskoka. |
| Elateridae <i>Ludius appropinquans</i> Rand. (Inky click-beetle.) | 175 | Lake Athabaska to Lake Abitibi, Cote Nord, and Cape Breton, south to United States border. |
| Elateridae <i>Agriotes limosus</i> Lec. (Little brown click-beetle.) | 158 | Great Bear Lake and Lake Athabaska to northern Manitoba, Cote Nord and southern Newfoundland, south to Nova Scotia and Lake Ontario. |
| Cerambycidae <i>Pogonocherus penicellatus</i> Lec. (Little spruce sawyer.) | 85 | British Columbia interior, Yukon and Great Slave Lake to northern Manitoba, Lake Abitibi and Gaspé, south to Ottawa River and northern New Brunswick. |
| Cerambycidae <i>Monochamus scutellatus</i> Say. (Black sawyer.) | 81 | Yellowknife, N.W.T., to northern Manitoba, James Bay and Gulf of St. Lawrence, south to United States border. |
| Elateridae <i>Ludius hieroglyphicus</i> Say. (Egyptian click-beetle.) | 56 | British Columbia interior; southern Manitoba to Algoma, Gatineau River, Saguenay River, New Brunswick and Nova Scotia, south to Lake Erie. |
| Buprestidae <i>Dicerca tenebrosa</i> Kby. (Pine dicerca.) | 55 | Rocky Mountains; Great Slave Lake to Patricia, Lake St. John, Gaspé and New Brunswick, south to Ottawa River. |
| Elateridae <i>Ludius medianus</i> Germ. (Dun click-beetle.) | 52 | Lake Athabaska; Kenora to Algoma, Nipissing, Gatineau River, New Brunswick and Nova Scotia, south to Lake Ontario. |
| Buprestidae <i>Buprestis maculativentris</i> Say. (Flat-headed pine borer.) | 49 | Ontario, Quebec, New Brunswick. |
| Elateridae <i>Ludius aratus</i> Lec. (Furrowed click-beetle.) | 48 | Saskatchewan, Ontario, Quebec, Maritimes. |
| Elateridae <i>Ludius spinosus</i> Lec. (Nigger click-beetle.) | 39 | Ontario, Quebec, New Brunswick. |
| Chrysomelidae <i>Syneta ferruginea</i> Germ. (Rusty birch leaf-beetle.) | 35 | Lake Winnipegosis to Lake Nipigon, Gatineau River, Cote Nord, southern Newfoundland, New Brunswick and Nova Scotia, south to Ottawa River. |
| Tenebrionidae <i>Upis ceramboides</i> L. (Forest darkling beetle.) | 32 | Northern British Columbia and Yukon; Lake Athabaska to Lake Nipigon, Abitibi and Lake St. John, south to Sault Ste. Marie and Ottawa River. |
| Helodidae <i>Cyphon variabilis</i> Thunb. (False flower-beetle.) | 27 | Yukon south to Cariboo and Rocky Mountains; northern Alberta to James Bay, south to Kenora, Nipissing and Montreal. |

| | | |
|----|--|---|
| 1. | Seven pairs of ventral prolegs. Six pairs of ventral prolegs. | 2 3 |
| 2. | Head black, body olive with broad dark stripes. (Pl. Ia.) Head brown with black markings, body green with white stripes. (Pl. IIc.) | <i>Neodiprion abietis</i> <i>Gilpinia polytoma</i> |
| 3. | Head greenish, body green with white stripes. (Pl. IIa.) Head brown, body olive with darker stripes. (Pl. IIb.) (Head sometimes black, then recognized by paired dorsal hair-lines.) | <i>Pikonema dimmockii</i> <i>Pikonema alaskensis</i> |

1. Body clear green with faint dorsal line, head greenish. *Acantholyda* sp.
Body yellow-green to orange, with prominent dorsal, lateral and ventral stripes. *Cephalcia* sp.

1. Dorsal tufts grey, body hairs black, white and grey. *Olene plagiata*
Dorsal tufts yellow; two lateral black pencils present. (Pl. Ic.) *Notolophus antiqua*

| | | |
|--|--|----|
| 1. Body grey-brown to black, with tufts of grey hairs arising from whitish bases (verrucae). (Pl. IIe.) | <i>Panthea acronyctoides</i> | 2 |
| Bodies smooth, with single primary setae only. | | |
| 2. Larvae green with white stripes. | | 3 |
| Larvae with black and brown as dominant colours. | | 5 |
| 3. Vermilion subspiracular line wholly or partially present. | <i>Feralia jocos</i> | 4 |
| Vermilion line wanting; with white stripes only. | | |
| 4. Two pairs of ventral prolegs. (Pl. II f.) | <i>Autographa</i> (spp. inseparable) | |
| Four pairs of ventral prolegs. | <i>Anomogyna elimata</i> | |
| 5. Large, typical cutworms, up to 28 mm. long. | | 6 |
| Small forms, up to 14 mm. long. | | 7 |
| 6. Segmental oblique black bars give dorsum a "herring-boned" appearance. | <i>Anomogyna elimata</i> | |
| Dorsum more finely mottled with black; row of lateral yellowish spots. | <i>Anomogyna perquiritata</i> | |
| 7. Enlargement of abdominal segments I and VIII give larvae humped appearance. | | 8 |
| Larvae without humps or particular enlarged segments. | | 9 |
| 8. Head dark brown with light stripes; body grey, skin without granulations. | (Pl. II g.) <i>Elaphria versicolor</i> | |
| Head light brown; body ruddy brown with dense minute granulations. | <i>Palthis angulalis</i> | |
| 9. Body heavily mottled with black or ruddy brown. | <i>Zanclognatha minoralis</i> | 10 |
| Body lightly mottled with brown; prominent dorsal and subdorsal stripes. | | |
| 10. Lateral margin of adfrontal sclerites markedly wavy. (Pl. II d.) | <i>Zanclognatha protumnusalis</i> | |
| Lateral margin of adfrontal sclerites nearly straight. | <i>Epizeuxis americalis</i> | |

GEOMETRIDAE—Loopers

Larvae with but one pair of ventral prolegs.
(Contributed by W. C. McGuffin.)

- | | | |
|--|--|----|
| 1. Larva with segmental flap-like projections; colour red-brown. | <i>Nemoria mimosaria</i> | |
| Larvae without flap-like projections; colours various. | | 2 |
| 2. Small, somewhat flattened larvae, reddish brown in colour. | | 3 |
| Medium to large-sized, cylindrical larvae. (Pl. IIh.) | | 4 |
| 3. Midventrum light orange, lighter than ground colour. | <i>Eupithecia palpata</i> | |
| Midventrum brown, darker than ground colour. | <i>Eupithecia luteata</i> | |
| 4. Larvae with banded appearance, due to colourless intersegments and ruddy segmental suffusion. | <i>Hydriomena divisaria</i> | |
| Larvae striped or patterned, without banded appearance. | | 5 |
| 5. Heads regularly marked with round black spots. | | 15 |
| Heads not marked with round black spots. | | 6 |
| 6. Larvae green with longitudinal stripes. | | 7 |
| Larvae grey or brown, patterned rather than striped. | | 10 |
| 7. White and yellow dorsal stripes. | | 8 |
| Dark green dorsal stripes. | | 9 |
| 8. Body clear green, subdorsal lines greenish-white, head clear green. | <i>Nyctobia limitaria</i> | |
| Body yellow green, subdorsal and addorsal lines yellow, head with yellow bar on cheek. | <i>Eufidonia notataria</i> | |
| 9. Subventral stripe uniform green. | <i>Semiothisa oweni</i> | |
| Subventral stripe dark grey. | <i>Semiothisa granitata</i> | |
| 10. Body smooth, without swellings or ridges. | <i>Paraphia piniata</i> | |
| Body with tubercles, swellings or ridges. | | 11 |
| 11. Body with tubercles only. | | 12 |
| Body with swellings or ridges, as well as tubercles. | | 14 |
| 12. Head deeply cleft, vertex peaked on either side. (Pl. II n.) | <i>Pero morrisonarius</i> | |
| Head normal, vertex rounded. | | 13 |
| 13. Small larvae with dark interrupted dorsal line, full-grown in spring. | (Pl. II k.) <i>Protoboarmia porcelaria</i> | |
| Large larvae without dorsal line, full-grown in autumn. | <i>Caripeta divisata</i> | |
| 14. Light spots on sides, black transverse ridge on 8th abdominal segment. | <i>Ectropis crepuscularia</i> | |
| No light spots on body, black middorsal line on last three segments. | <i>Tetracis lorata</i> | |
| 15. Four black spots on dorsum of each abdominal segment. (Pl. II m.) | <i>Ellopiia fiscellaria</i> | |
| Dorsum with longitudinal stripes but without spots. | | 16 |
| 16. Longitudinal paired lines are black and heavy; ground colour pale. | <i>Cingilia catenaria</i> | |
| Longitudinal paired lines are weak; ground colour green or crimson. | <i>Nepytia canosaria</i> | |

PYRALIDAE, OLETHREUTIDAE AND TORTRICIDAE

Small, smooth, supple and wormlike larvae with four pairs of ventral prolegs, silk-spinners.

- | | | |
|---|--|---|
| 1. Larvae with body-colour clear green. | | 2 |
| Larvae coloured brown, black or reddish-brown. | | 5 |
| 2. Head, and margins of prothoracic shield, black-brown. | <i>Peronea variaria</i> | |
| Head and prothoracic shield mainly green. | | 3 |
| 3. Head green, overlaid with light brown, without markings. | <i>Taniva albolineana</i> | |
| Head green with definite brown or black markings. | | 4 |
| 4. Eight ventral stripes running down vertex. (Pl. II q.) | <i>Argyrotaenia lutosana</i> | |
| Vertex unmarked, black marks in ocellar area and at angle of jaw. | (Pl. II o.) <i>Tortrix packardiana</i> | |
| 5. Four conspicuous round white setiferous plaques on each segment. | | 6 |
| Setiferous plaques inconspicuous; body with longitudinal stripes. | | 8 |

PYRALIDAE, OLETHREUTIDAE AND TORTRICIDAE—Concluded

6. Head and body reddish-yellow to honey-yellow. *Zeiraphera ratzeburgiana*
Head black or brown, body brown with olive suffusion. 7
7. Prothorax partly or wholly sclerotized; anal plate paler in colour, pale
lateral stripe conspicuous. *Cacoecia fumiferana*
Prothorax pale, not sclerotized; anal plate of ground colour, without
conspicuous lateral stripe. *Amorbia humerosana*
8. Head and prothorax light brown; five narrow dark dorsal stripes.
(Pl. IIp.) *Herculia thymetusalis*
Head black-brown, prothorax pale; dorsum tan, subdorsal bands broad
and black. Shoot form of *Dioryctria reniculella*

PENTATOMIDAE—Soldier Bugs and Stink Bugs

Bugs roughly pentagonal in shape, the wings overlapping, and with five antennal segments.
(Adapted from G. S. Walley—unpublished.)

1. Tarsi two-segmented; sternum with distinct longitudinal keel. 2
Tarsi three-segmented; sternum without a keel. 3
2. Orifices of metasternum short and broadly rounded. *Meadorus lateralis*
Orifices of metasternum long and narrow; dorsum with a red cross. *Elasmotethus cruciatus*
3. First segment of beak largely imbedded between the large bucculae. 4
First segment of beak largely free, bucculae small. 6
4. Blunt median ventral tubercle on first abdominal segment; pronotum
usually greenish. *Banasa dimidiata*
Ventral tubercle wanting; pronotum never greenish. 5
5. Tylus as long as juga; median row of black spots under abdomen. *Euschistus tristigmus*
Tylus distinctly shorter than juga; median row of spots lacking.
(Pl. IIs.) *Euschistus euschistoides*
6. Second joint of antenna one-third longer than third; femora with numerous
purple dots; length 11 mm. or more; darker form. (Pl. IIr.) *Podisus serieventris*
Second joint of antenna only one-fourth longer than third; femora without
purple dots; length 10 mm. or less; lighter form. *Podisus modestus*

CERCOPIDAE AND FULGORIDAE—Spittle Bugs and Lantern Bugs

Bugs with wings held sloping at sides; nymphs (of Cercopidae) secreting white froth.
(Adapted from Stearns, in Britton, 1923; and Osborn, 1938.)

1. Antennae inserted between eyes; anterior margin of pronotum angulate. 2
Antenna inserted below eyes, on sides of head. 5
2. Front of head inflated and produced, nearly at right angles with vertex. 3
Front scarcely inflated, flattened convex, at acute angles with vertex. 4
3. Head narrow, elongate; apex of elytra blunt. (Pl. IIIt.) *Aphrophora parallela*
Head broad, short; apex of elytra sharp. *Aphrophora permutata*
4. Colour deep fulvous, light bands across elytra, and light median stripe
atop head. *Aphrophora saratogensis*
Colour varying ochraceous, light bands and stripes obscure or wanting. *Aphrophora signoreti*
5. Elytra, when folded, overlapping at apex. 6
Elytra not overlapping at apex, fuscous on basal third only. *Cixius basalis*
6. Face black, with distinct white cross-band. *Epiptera brittoni*
Face without distinct white cross-band. 7
7. Vertex very short, broader than long. *Epiptera variegata*
Vertex as long as broad. *Epiptera slossoni*

APHIDAE—Aphids

Pear-shaped, soft-bodied insects with delicate wings.

(Adapted from Gillette and Palmer, 1931; and Hottes and Frison, 1931.)

1. Rostrum of beak acute; radial sector of forewing arising from stigma. (Pl. IIu.) *Cinara* spp.
 Rostrum obtuse, radial sector arising proximal of stigma. (Pl. Ik.) *Mindarus abietinus*

ADELGIDAE—Gall Aphids

Aphids recognized mainly by the type of gall made on the growing shoots of spruce.

(Adapted from Patch, 1909; and Annand, 1928.)

1. Galls not terminal—"pineapple galls." (Pl. Im.) 2
 Galls terminal, occupying tip of or entire shoot. 3
2. Gall aphids with media of hind wing almost at right angles to radial sector. (Pl. IIu.) *Adelges abietis*
 Gall aphids with media of hind wing at an acute angle with radial sector. *Adelges lariciatus*
3. Gall sufficiently resembling a cone to be mistaken for one. *Pineus pinifoliae* 4
 Galls recognizable as deformed shoots.
4. Gall a ragged and deformed shoot, needles not much shortened. *Pineus similis* 5
 Galls usually well-formed.
5. Needles much shortened, small, compact and roundish gall. *Adelges strobilobius* 6
 Needles not much shortened.
6. On black and red spruce, galls up to $1\frac{3}{4}$ " long. *Pineus floccus*
 On blue spruce, galls up to $2\frac{1}{2}$ " long and curved downwards. *Adelges cooleyi*

COCCIDAE—Scales

Small insects sometimes naked, sometimes living beneath a scale. Legs and antennae usually not visible with the naked eye.

1. Globular brown scale at bases of shoots. *Physokermes piceae*
 White shell-like scale on surface of needles. (Pl. In.) *Phenacaspis pinifoliae*

PLATE I

- a. Sawflies—Tenthredinidae (example *Neodiprion abietis*).
- b. False Webworms—Pamphiliidae.
- c. Tussock Moths—Liparidae (example *Notolophus antiqua*).
- d. Noctuids—Phalaenidae.
- e. Loopers—Geometridae.
- f. Snout Moths—Pyralidae (example *Dioryctria reniculella*).
- g. Soldier Bugs—Pentatomidae.
- h. Spittle Bugs—Cercopidae.
- j. Lantern Bugs—Fulgoridae (example *Epiptera slossoni*).
- k. Aphids—Aphiidae (example *Mindarus abietinus*).
- m. Work of Gall Aphids—Adelgidae (example *Adelges abietis*).
- n. Scales—Coccidae (example *Phenacaspis pinifoliae*).

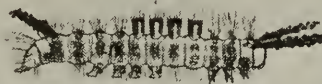
a, c, d, e & f after illustrations by R. G. Calvert; b after Yuasa, g after Hickman, h after Stearns, j after Sim, m after Patch, and n after de Gryse.



a



b



c



d



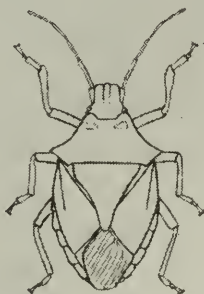
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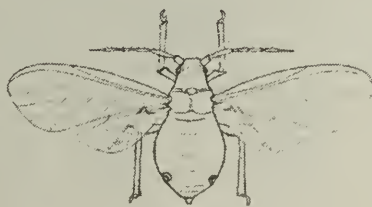
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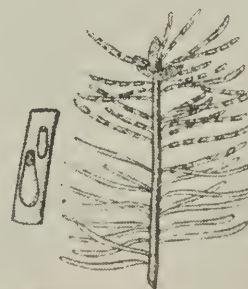
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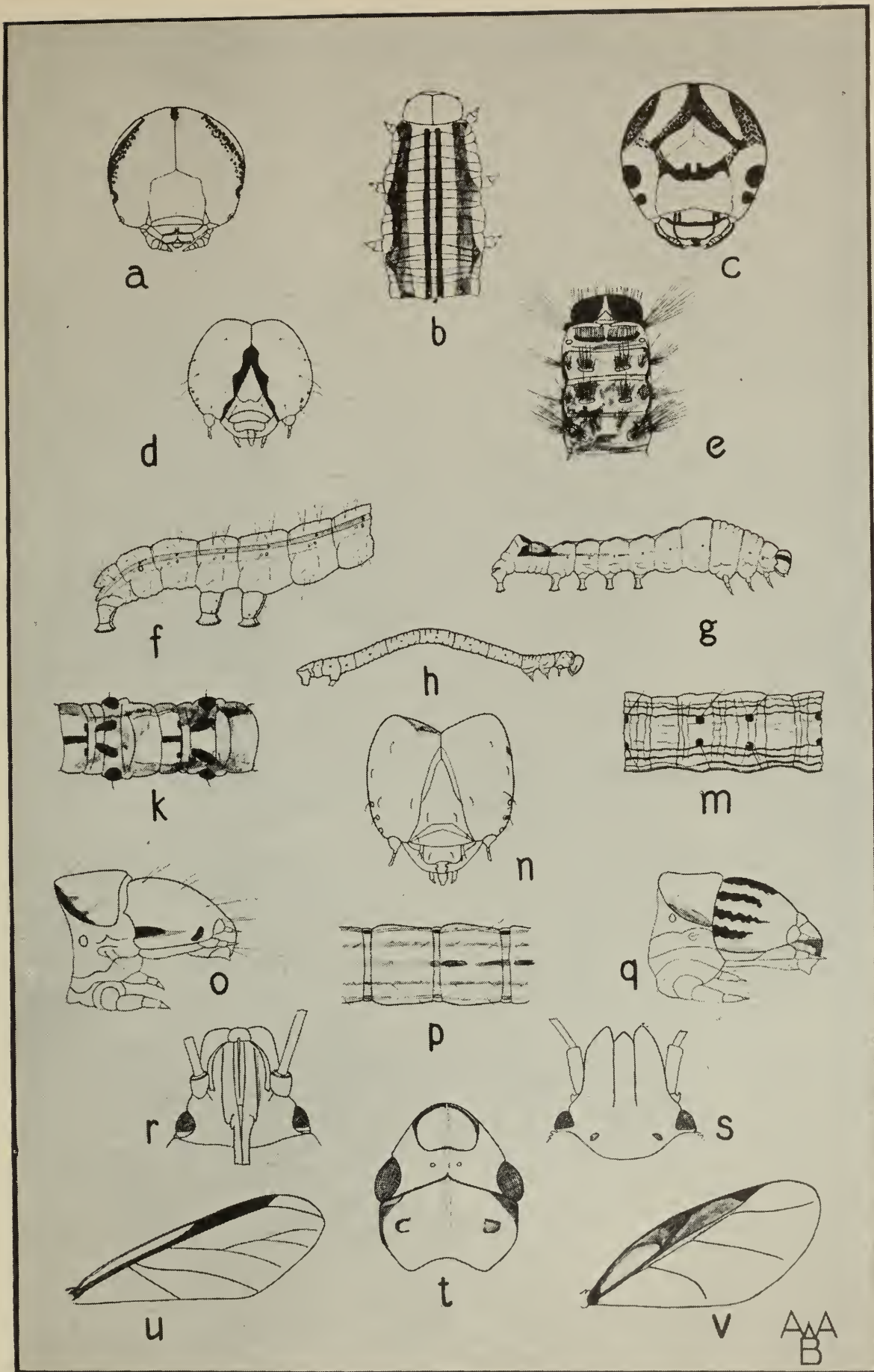
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PLATE II

- a. *Pikonema dimmockii*. Frontal view of head.
- b. *Pikonema alaskensis*. Dorsal view of anterior segments of larva.
- c. *Diprion polytomum*. Frontal view of head.
- d. *Zanclognatha protumnusalis*. Frontal view of head showing adfrontals.
- e. *Panthea acronyctoides*. Dorsal view of anterior segments of larva.
- f. *Autographa* sp. Lateral view showing two pairs of ventral prolegs.
- g. *Elaphria versicolor*. Lateral view.
- h. *Eupithecia palpata*. Lateral view.
- k. *Protoboarmia porcelaria*. Dorsal view of mid-section of abdomen.
- m. *Ellopiia fuscellaria*. Dorsal view of mid-section of abdomen.
- n. *Pero morrisonarius*. Frontal view of head.
- o. *Tortrix packardiana*. Lateral view of head.
- p. *Herculia thymetusalis*. Dorsal view of mid-section of abdomen.
- q. *Argyrotaenia lutosana*. Lateral view of head.
- r. *Podisus serieiventris*. Ventral view showing beak and bucculae.
- s. *Euschistus euschistoides*. Dorsal view showing tylus and juga.
- t. *Aphrophora parallela*. Dorsal view of head and prothorax.
- u. *Cinara* sp. Wing of alate viviparous form.
- v. *Adelges abietis*. Wing of alate oviparous form.





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