Insects

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of the

ENTOMOLOGICAL SOCIETY of BRITISH COLUMBIA

Volume **39.** Issued October 10, 1942

PAGE

Change in Make-up. This is the first volume of our "Proceedings" to have a two-column printed page. The "Journal of Economic Entomology" uses a similar format, which is said to be less tiring to the eyes than the full-width page. Comments from members will be appreciated.

Volume *vs.* **Number.** Readers will notice that on the cover and title page, this copy is called "Volume 39". In the past each issue has been called a "Number", but as they are strictly speaking annual volumes, and as the word *number* is commonly used for one issue of a periodical, the above change is made.

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Arthur Alexander Dennys (1894-1942)

Alec Dennys was born on June 27, 1894, in Mussoorie, India, the son of Colonel and Mrs. W. Dennys. He was educated in England at Bedford Grammar School, St. Lawrence College, Dulwich College and Battersea Polytechnic, coming out to British Columbia in 1912 at the age of 17. He passed away in the Vancouver General Hospital on September 9, 1942, at the age of 48. He is survived by his wife and two sons, Kenneth W., in the Royal Canadian Air-Force, and Ronald G., at home; also by his father, three sisters and three brothers.

On coming to Canada he made his home near Salmon Arm. There he operated an apple orchard and was well known for his genial and kindly nature and for the help and advice he was always so ready to give in matters relating to fruit growing and the control of insect pests. The writer was privileged to know him since his arrival in 1912, and to have him on his staff in the Vernon Entomological office for 14 years.

Alec Dennys was interested in everything. He was an enthusiastic hunter and fisherman, a crack shot in spite of the fact that he lost the sight of his right eye at an early age, and an adept with a fly rod. He was a member of the Vernon Fish and Game Protective Association and for a time its secretary. He joined our Entomological Society in February, 1926.

Unselfish to a marked degree, he insisted on bearing more than his share of any work that there was to be done. On field trips he was always the first to cut the firewood, fetch water and do the many little tiring chores that befall the camper at the end of a weary day in the hills. For a number of years he had been interested in mining and geology, and many are the mining prospects in Southern British Columbia that at one time or another he had visited. But most of all Alec Dennys was interested in doing good work.

He was appointed to the Dominion Entomological Laboratory at Vernon in 1925, and served continuously until sickness forced him from his work in November, 1941. For sixteen years he travelled the fruit districts of the Interior of the Province working with growers at their spray machines, experimenting with new poisons, ever curious about anything that promised help in the war on insects. From his youth when he arrived at Salmon Arm from England, he worked in the orcharding business and at the time of his death still owned his original farm, "Westbourne". Perhaps it was this first-hand acquaintance that made him such an untiring enthusiast in attempting to solve the problems of the fruit grower.

Shortly after his appointment to the Dominion Entomological Branch he was sent to the East Kootenay district to work out the seasonal history and the best methods of control for the Colorado potato beetle, then a recently discovered immigrant to British Columbia. His energy and enthusiasm had such results that for years no new infestations were located. Later he accomplished the first detailed work on the biology and control of the apple mealy-bug in the Kootenay Valley. So thorough was this biological study that it has proved sufficient to guide all later control investigations. The apple woolly aphid was another insect that he studied very carefully. For its control he developed a canker paint that has been commonlv and successfully used by fruit growers of the Interior.

Not often is a man so gifted with the power of concentrating on his work as was Alec Dennys. An example of that characteristic is the work that led to his discovery of a radical new procedure in controlling that worst enemy of the apple grower, the codling moth.

In 1939 he found by careful laboratory experiment that, contrary to what had been generally accepted, the codling moth adult could be killed by the use of a certain type of insecticide that it absorbs as it takes moisture from the surface of apple foliage. Laboratory research in 1940 confirmed his first results, so in 1941 he undertook to demonstrate by field experiment that his discovery was applicable to commercial practice. Week after week, Sundays and holidays, throughout the season he plunged into the investigation. He was far from well but he stuck to it until by October he had proved his point. A month later he left his desk and entered hospital. Even then he insisted on writing up and summarizing his data. This spring he published one of the most original contributions to the literature on the codling moth.

In addition to publications bearing on entomology, which are listed below, he often wrote short articles on natural history or hunting experiences, and gave several radio talks on entomological subjects over Station CKOV, Kelowna.

He was a photographer of unusual ability and handled all the photographic work at the Vernon Fruit Insects Laboratory. Among other devises he constructed a useful piece of apparatus for micro-photography.

In his passing the public has lost a fine servant and his host of friends and acquaintances a true friend.

E. R. Buckell.

Partial List of Articles by A. A. Dennys

1928. Some notes on the hibernating habits of insects in dry trees in the interior of B.C. Proc. Ent. Soc. British Columbia (1927), 24: 19-25, 1 text fig.

1933. Materials used as canker paints in woolly aphis control. Proc. Ent. Soc. British Columbia (1933), 30:8-10. (Abstract in Rev. Applied Ent. 22 (Ser. A, Pt. 2): 108).

1937. An orthopterous pest of apple trees in the interior of B.C. Proc. Ent. Soc. British Columbia (1936), 33:6-7, 1 text fig.

1938. Vigorous and varied tests being made as to new methods of combatting codling moth: interesting experiments at Vernon insectary. Country Life in British Columbia [Vernon, B.C.], 22(7): 20.

1942. Recent progress in codling moth control in British Columbia. II. Killing the adult. Scientific Agric. 22(10): 577-583.

Mr. G. O. Day, enthusiastic member and past President of our Society, died last spring. We have not yet been able to get the necessary information for a full obituary notice.

BIOLOGY OF THE KLAMATH MIDGE, CHIRONOMUS UTAHENSIS (Diptera, Chironomidae) *

D. E. Bonnell and D. C. Mote

Department of Entomology, Oregon State College, Corvallis, Oregon.

Introduction. During the past decade, midges have occurred in epizootic numbers in the Klamath Lakes area of Oregon and have occasioned annoyance and financial loss to the residents. The hordes of tiny winged insects, which superficially resemble mosquitoes, have upon many occasions been so great as to impede breathing and induce nausea in some persons. Tourist trade, summer residents, and resort owners were seriously disturbed. The radiators of travelling automobiles became clogged with the insects, causing the motors to overheat and the cars to stall. Cows became so irritated by the clouds of midges in the air and

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on pasturage, that they refused to eat, thus substantially reducing milk and butterfat production. Midges flew in such swarms at the big sawmills that their bodies were crushed in lumber during piling, and the resultant staining made resurfacing of the lumber necessary. An increase in the numbers of spiders and of blue-bottle flies followed midge concentrations.

Concurrent with the midges, vast masses of algae have appeared in Upper Klamath Lake. This suspended blue-green algae is filamentous in form *(Aphanizomenon)* and during the summer so dense as to give the water only a quasi-liquid appearance. These filaments may reach the number of 20,000,000 per cubic meter. The stench from decaying matter is often almost intolerable. Boating and swimming are impaired.

Chironomus utahensis is the most important of several species of midges in this area. Its breeding season and complete life history is, as yet, not fully known. Adult midges are common from June until cold weather in October. The true scope and enormous numbers of midge larvae on the bottoms of Upper Klamath Lake and Lake Ewauna, is best realized when compared with the numbers found by other investigators in the United States. Richardson (1928) reports more than 10,000 larvae, mostly *Chironomus plumosus*, per square yard in the Illinois River below Lake Pepira. Juday (1922) obtained an average of 2,000 larvae per square yard in Lake Mendota. Adamstone (1924) obtained an average of 293 larvae for all dredgings. Johnson (1930) reported an estimated average of 3,000 chiromid larvae per square yard in Lake Pepin. Compare these figures with Klamath's conservative minimum average of 1,000 larvae and ranging to a peak of 133,000, per square yard. Also conservatively estimated is the total population, at any given time during the summer months of the early 1930's, of over 500,000,000,000 larvae.

Description of the Area. Upper Klamath Lake, including its northward extension, Agency Lake, is one of the largest bodies of fresh water in the United States. It is roughly 35 miles in length from north to south, very irregular in outline, and varies from 2½ to 12 miles in width. Although it contains a few deeper areas of 8 to 13 meters, the bulk of the lake is very shallow and averages less than 3 meters in depth.

Sprague River, entering the Upper Lake at its north and east end, is the largest inflow. Several smaller streams and springs, notably Barclay Springs, Williamson River, and Crystal Creek, also enter the northern part. From Upper Klamath Lake, at an elevation of 4,141 feet above sea level, flows Link River, 1¼ miles in length, discharging into Lake Ewauna at an elevation of 4,080 feet. The Klamath River flows from Lake Ewauna through flat marshy country for 20 miles, to the town of Keno. There it breaks over a dam and begins its precipitous fall of 100 to 200 feet per mile on its way to the Pacific Ocean. The outflow of water from Upper Klamath Lake, via Link River, is checked by a dam. Power is used to service the industries and population of Klamath County. A portion of the water is diverted for irrigation purposes by the federal Bureau of Reclamation.

Geologically, the area is very old. The lake type is designated as eutrophic and is gradually filling up, with the area diminishing more slowly than the volume. The decreased depth has resulted in high water temperatures at all seasons except winter. The bottom, except for a few areas of shale, is largely diatomaceous ooze. The tule and lily beds and vast planktonic population of small plant and animal forms result in a rich organic deposit. The water is alkaline. The plankton population, and particularly algae, is so dense that secchi disc recordings are usually less than 1 meter during the late spring, summer and fall. Oxygen and carbon-dioxide content varies exceedingly in different areas. Winds are prevailingly NW-N.

Biology of the Klamath Midge. Adult insects appear on wing in the late afternoon, early evening, and occasionally at dawn. A swarm starts with a few individuals, increasing in size as more enter; it is long, symmetrical, and top-shaped, and often composed largely of males. Swarms do not form during winds, and a gust of wind will drive one downward until the disturbance abates. A strong screaming hum is emitted and is often audible at a distance of more than a hundred yards. Occasionally a female will dart up from vegetation into the swarm. There she seizes a male by the thorax. They remain clasped for an instant and then drop downward, separating before contacting the ground. The male returns to the swarm. The female seeks concealment in vegetation and later deposits eggs on the water.

The eggs of *Chironomus utahensis* are light brown in colour, and measure about .09 mm. by .75 mm. They are embedded in a gelatinous mass that terminates in a thread with an attached disk for adhesion to some object floating in the water. Each mass contains from 1,000 to 2,000 eggs, and the masses vary in shape from a hollow "C" approximately 18 mm. long by 5 mm. in diameter, to a hollow sphere about 9 mm. in diameter.

The newly hatched larvae are transparent and about 2.5 mm. in length. In two or three days they begin to build body tubes, utilizing silk spun from glands in the mouth, and tiny bits of debris. The tubes are open at each end, larger in diameter than the body of the larvae, and are enlarged as growth requires. Undulation of the body sets up a current, providing an inflow of oxygenated water and food. As the larvae develop they respire by blood gills and become red in colour. The number of instars for *C. utahensis* has not yet been accurately determined but observations indicate 4 as in other species of chironomids. When the larvae have obtained their greatest size they are about 18 mm. long and 2 mm. in diameter. The larval stage usually extends for about 20 days, but may be much longer depending upon water temperature and possibly other factors.

Larvae apparently choose their food with care. One may anchor its caudal end just inside the tube by means of hooks on the end of its posterior legs, and feed over a circular area, the radius of which is determined by the larval reach. Midge larvae were brought into the laboratory. (1) Those in a little detritus and clear tap water showed distress. They built tubes but some, apparently unable to find food, deserted their habitations and ranged the bottom of the jars. The water was frequently replaced but no additional detritus was added. These larvae, without exceptions died within 3 days. (2) Others in a similar situation, but which had occasional detritus offered to them, survived for 5 days with the emergence of one adult female. (3) Larvae in 10 mm. of detritus and 300 cc. of lake water, which was not changed, lived from 5 to 13 days, but without emergence. (4) Those in frequently changed lake water but without detritus had two individuals survive 19 days. These larvae were divested of their tubes before immersion in the jars. They seized upon descending algae filaments and attempted to build tubes. The larger algae filaments were left undisturbed in the bottoms of the jars. Smaller filaments were apparently consumed. A microscopical examination of the alimentary tracts of some of these larvae revealed diatoms, desmids, fragments of minute crustacea, other bits of unidentifiable algae and, in one case, a live rotifer. Algae appears to be the predominant food, the crustacean fragments being, probably, ingested only incidentally.

Some larvae were divested of their tubes and placed in fresh well-oxygenated tap water. Water from Link River was strained through many thicknesses of fine-mesh silk cloth and 25 cc. added to each jar daily. The larvae apparently thrived, with some emergences. Possibly bacteria also, are an important item of diet. All laboratory rearing was done in semi-darkness under muslin.

An examination of several hundred larvae revealed them to be free of mites and nematodes.

Pupation takes place within the larval tubes. The pupal stage lasts three or four days. At the end of this period the pupae emerge and move about in the water by a jerking motion of their bodies, finally arising to the surface. After the pupal case breaks the surface film, oxygen is taken in, causing the pupae to glisten like silver. The pupal case splits dorsally along the thorax, the adult emerges, rests a moment on the floating cast pupal skin, then flies away.

The adult midge is approximately 12 mm. in length. The males are black, the females brownish gray. So far as is known at present, the adult midges do not feed. They are ephemeral and apparently do not live more than 4 or 5 days even under optimum conditions.

Midge adults, as a general rule, do not venture far from marginal vegetation. In light trap experiments, it was noticed that flying midges were taken in much smaller numbers in traps set away from the immediate vicinity of water than in those close to the water. Traps of the same type and light intensity that were set 200 yards from the water captured only 25% as many midges as the traps immediately adjacent to the water. Traps placed upon a bluff about 75 yards higher than the water and 100 yards distant from it, took even fewer midges, indicating that height above the water is also a limiting factor. On several occasions midge swarms were observed above the waters of Upper Klamath Lake more than 2 miles from the shore. Night flight range may be considerably shorter than day flight range.

Predators. The larvae are probably preyed upon by all 18 species of fish in Upper Klamath Lake. They form an important item in the diet of *Tigoma bicolor*, the Klamath chub, and *Siphateles b. bicolor*, the Klamath roach. The larvae are also food for aquatic beetles, larval dragonflies, and hemipterous nymphs, and also small marsh birds.

Adult midges are captured in considerable numbers by dragonflies, toads, small song birds, and spiders. Dragonflies, of the family Aeschnidae, are especially active during the periods of midge swarming, darting into swarms and seizing numbers of flies. Great numbers of toads, chiefly the western toad *(Bufo b. boreas)*, gather in the evenings near lights and capture adult midges. Examination of the stomach contents of 20 toads collected near light traps, revealed that each had consumed 10 cc. or several thousand midges. Spiders also consume quantities of midges and frequently become so numerous that they and their unsightly webs are a secondary problem.

Possibility of Control. Can an adequate control, either artificial or natural, be developed to decrease the numbers of the twin nuisances of algae and midges? Algae is apparently intimately associated with the midges and must be given consideration.

Much attention was given to light traps during 1939. Several of various sizes and designs were tested and those at the Bureau of Entomology Gnat Control at Clear Lake, California, were observed. While they capture an amazing number of insects, it is doubtful if present types would constitute a control measure. It is true that if sufficient labor could be employed, traps manufactured, and miles of electric wires strung, the midge nuisance might be abated, but the area could never be completely cleared of midges, and discontinuance of the practice would allow reinfestation from adjacent waters. Light traps would be of value only to resorts and private residences.

A number of chemicals were tried, usually at the rate of one pound per 50 square yards of surface area, and then checked under field conditions. Some were applied on the surface to kill ascending pupae, and others, by tube sprayers, to the bottom to contact larvae. Midge larvae, in the experimental section of Lake Ewauna, were counted before and after application. A sub-surface apparatus was devised for preliminary chemical control.

Calcium arsenate, basic copper sulfate, Bordeaux, pyrethrum, and Paris-green all gave a fair degree of control ranging from 50 per cent to 98 per cent in different areas. Crushed salt, sown by hand gave a 100 per cent kill in the area examined. Phenothiazine and miscible oil destroyed great numbers of ascending pupae. Some of the chemicals approached laboratory expectations, particularly phenothiazine and crushed salt but at present no recommendations can be made.

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THE BLACK WITCH MOTH EREBUS ODORA (L.) IN BRITISH COLUMBIA

G. A. Hardy

Provincial Museum, Victoria, B.C.

Introduction. The capture of two specimens of this phalaenid moth in Victoria last season has led to inquiries regarding its occurrence in British Columbia. Authentic records have proved to be so few it is thought desirable to bring them together in this paper as a basis for future reference and investigation. Allusions to mysterious and elusive gigantic moths have been made from time to time; some of them may refer to the species in question, but lacking confirmation we suspect the Polyphemus or Cecropia moths, of the same size and well-known residents of British Columbia.

Description. The Black Witch, *Erebus odora,* was described by Linnaeus in 1758 as *Bombyx odora, Erebus* being assigned in 1810 by Latrelle. It early attracted the attention of naturalists, yet is sufficiently distinctive to have only one synonym, *agarista* Cramer, 1887. It is a large moth with wings extending over 6 inches and broad in proportion. The forewings suggest the clean-cut lines of a hawk; the nervures and membranes are unusually tough, and capable of much hard service. The thorax is broad and very rigid. In fact this moth has an exceptional physique, suited to long journeys.

Distribution. The Black Witch is native to the West Indies, Central and South America, where it is common. In North America it ranges in the east through the Atlantic States from Florida to Canada and in the west from Mexico through California to British Columbia, becoming scarcer and later in the season the farther north it occurs.

The species had not been known to breed north of Mexico, until Dr. John A. Comstock published a beautifully illustrated description of larvae and pupae found in southern California. It is probable that our migrants come from there, or from adjacent Mexico. The food plants are cited as belonging to the *Leguminosae* specifically *Cassia fistula*, *Pithecolobrium* sp., *Saman* sp., *Gymnocladus dioica*, and in California, *Acacia decurrens*.

Habits. The little evidence obtainable suggests that the Black Witch is more of a chance wanderer than possessed of any definite migratory instinct. As is already intimated it is a powerful flier, and no doubt of a restless disposition. Its occurrence in British Columbia is due to an exceptional combination of favourable conditions; in 40 years there are only six authentic records. All of these are from points in southern British Columbia, with a majority from Vancouver Island. These captures appear to have been in towns or cities but this may be due either to attraction to lights, or the fact that they would not be as readily observed in country districts. The two taken last year in Victoria were at rest in dark buildings and only moved when disturbed, indicating they are normally night or dusk fliers. Their wings are much frayed at the edges, and the thorax of each is denuded, but the wing pattern is still distinct.

List of known specimens of *Erebus odora* taken in British Columbia:

The Provincial Museum, Victoria, B.C.

1. Female, Victoria, V. I., August 6, 1908. E. M. Anderson.
2. Female, Oak Bay, V. I., August 25, 1915. E. M. Anderson.
3. Male, Victoria, V.I., August 12, 1941. Dr. L. J. Thompson.
4. Male, Cadboro Bay, V. I., August 28, 1941. Allan Upward.

The University of British Columbia, Department of Zoology

5. Male, St. Leon Hot Springs, Kootenay Lake, B.C., August, 1905.
6. Female, "Unlabelled, possibly caught by F. K. Auden".

Canadian Records. A search through the literature has brought to light a number of Canadian records outside of British Columbia, over the same 40 year period. These may be summarized as follows: 26 specimens are known to have been recorded, their distribution by Provinces, east to west, being—[Newfoundland, 1]; New Brunswick, 2; Quebec, 4; Ontario, 3; Manitoba, 4; Saskatchewan, 2; Alberta, 3; and British Columbia, 8.

The sexes were about equally common. One specimen was captured in July, 11 in August, and 2 in September. Some examples were taken by "sugaring", others at lights, and the rest in dark buildings by day.

Acknowledgments—I wish to express my cordial thanks to Professor G. J. Spencer of the University of British Columbia for information regarding specimens in his department, and to Mr. J. F. Gates Clarke of the Bureau of Entomology, Washington, D.C., for the trouble he has taken in looking up references for me.

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NOTES ON SOME WOOD-BORING BEETLES OF SAANICH, VANCOUVER ISLAND, B. C. (Coleoptera, Cerambycidae & Buprestidae)

G. A. Hardy

Provincial Museum, Victoria, B.C.

Introduction. The incentive for this study was the discovery of a new road allowance through a tract of forest and bush land. The resultant tangle of stumps, logs and slash afforded an ideal attraction for Cerambycids and Buprestids intent on mating and ovipositing.

The area involved is about 3½ miles north of Victoria, B.C., at the edge of the southern slope of Mount Douglas, where it merges into low-lying flats and hollows. The trend of the road is east and west; it is about a quarter of a mile in length, a convenient size for detailed examination. On the east the road has its beginning at the base of a rocky slope supporting an extensive stand of Garry oak, *Quercus Garryana*. Continuing in a westerly direction the road passes through a shallow valley, crosses a low ridge, and descends again to damp bush and meadow land.

The central ridge supports a heavy stand of first and second growth Douglas fir, *Pseudotsuga taxifolia,* and grand fir, *Abies grandis,* with underbrush of ocean spray, *Spiraea discolor,* in the few open spaces. On the lower ground, alder, *Alnus rubra,* black poplar, *Populus trichocarpa* and aspen, *Populus tremuloides* are the dominant trees, with a luxuriant growth of moisture-loving shrubs of willows, *Salix* spp., crab-apple, *Pyrus diversifolia,* black hawthorn, *Crataegus brevispina,* dogwood, *Cornus pubescens,* cascara, *Rhamnus purshiana* and others.

It was hoped that with such a variety of newly-cut wood exposed at the right season, a large number of species of Cerambycidae and Buprestidae would be found. Accordingly the place was visited as often as possible during the season from March to September, 1934. Notes and collections were made at each visit.

Annotated List of Species. The following list includes all the species of wood-boring beetles collected or observed in this study, together with brief notes on their numbers, habits and dates of collection. Species occurring in numbers exceeding 50 individuals are marked "abundant", those between 25 and 50 are designated as "common" while those between 8 and 25 are noted as "several." When fewer than 8 were collected the exact number is given. All records are confined to the area outlined unless otherwise stated. The specimens mentioned in the list are in the Provincial Museum at Victoria, B.C. The arrangement followed is according to Leng's Catalogue (1920) but with the nomenclature revised in certain cases to agree with more recent taxonomic studies.

CERAMBYCIDAE

Prionus californicus Mots. One under a board at base of oak, July 25. A common species. The adults are nocturnal. The larvae feed in the roots of decayed Douglas fir, grand fir, oak, etc.; occasionally found in the underground portion of fence posts except those of cedar.

Megasemum aspera Lec. One, crawling over Douglas fir wood at 8 p.m., July 4. This is a nocturnal species and is often found in such odd places as water barrels, window ledges, etc., attracted to the vicinity by light. It has been found breeding in Douglas fir stumps.

Tetropium velutinum Lec. One, under a slab of Douglas fir bark, 5 p.m., June 22. Nocturnal, not common. Larvae in Douglas fir.

Opsimus quadrilineatus Mann. One, at rest on Douglas fir stump, 5 p.m., April 22. Another member of the night brigade. They have been found in the base of dead Douglas and grand fir trees 4 to 6 inches in diameter, where the larval stage is passed; the outer portion of the burrows provide winter quarters for the adult.

Leptalia macilenta (Mann). One, on flower of *Rosa nutkana,* June 3. I have never taken it under any other circumstances. Breeds in alder.

Leptalia macilenta v. frankenhauseri Mann. Three, on blossoms of *Rosa nutkana,* May 26. This is the commoner form here, distinguished by the pale lines at the base of the elytra, from the all black colour of *macilenta.*

Pidonia scripta (Lec). Several, on flowers of *Rosa nutkana,* May 13-26. Common, usually seen only on flowers where they feed on the pollen by day, hiding between the overlapping petals by night.

Toxotus vestitus Hald. Four, on flowers of *Rosa nutkana* and resting on trunk of grand fir. May 26-July 4; both the red, and black-legged forms. Has been reared from the decayed roots of Douglas fir.

Centrodera spurca (Lec). One, flying to artificial light at dusk, June 22. A nocturnal species. Adults have been dug out of the ground in the vicinity of Garry oak trees among the roots of *Rosa nutkana* in February. Large larvae were found in gall-like swellings at the base of the rose bush but as I was unsuccessful in rearing them, proof as to their identity is lacking.

Anoplodera vexatrix Mann. Several, on bloom of *Spiraea discolor,* June 24. This is their favourite flower, affording both food and protection as they like to push their way into the heart of the inflorescence.

Grammoptera filicornis Csy. Common, on flowers of *Rosa nutkana,* May 6 - 26. Mating pairs were found on freshly cut branches of *Populus trichocarpa* giving an indication of their host plant, but no further developments were observed as proof of this.

Leptura obliterata (Hald). Common, usually taken in flight and resting on or crawling over Douglas fir logs, July 1-29.

Anoplodera laeta Lec. Several, August 23, flying about freshly-exposed roots of recently-felled Garry oak, in which it breeds.

Anoplodera crassipes Lec. Three, at rest on leaves etc. One, on flower of *Carum Gardneri.* Breeds in *Abies grandis, Betula occidentalis,* etc.

Anoplodera dolorosa Lec. One, on flower of *Spiraea discolor,* July. It is commonly taken feeding in flowers of *Spiraea discolor,* and breeds in Douglas fir.

Anoplodera chrysocoma Kby. One, on flower of *Rosa nutkana,* May 13. A very wide ranging species recorded from coast to coast.

Anoplodera dehiscens Lec. One, flying about Douglas fir wood, August.

Ulochaetes leoninus Lec. Five, two males and three females, taken in flight June 10 and July 1 - August 26. Flying about logs of grand fir and walking over roots and stumps of same. One of our finest longhorns. It resembles a bumblebee both in appearance and actions.

Necydalis cavipennis Lec. One, extracted from pupal cell in Garry oak stump in February. It is usually scarce, but may be seen in a small "colony" flying about an old oak stump, probably one brood emerging from that particular stump. It has a very close resemblance to an Ichneumon.

Rosalia funebris Mots. One, flying among Douglas fir stumps on which it alighted, no doubt having strayed from a nearby alder clump. July 29. Our most handsome species, typical of the Vancouveran fauna; found in numbers about alder logs in which the larvae feed. It can emit a faint rasping sound by rubbing the edge of the pronotum over a file-like process on the mesonotum.

Semanotus ligneus amplus Csy. Two, on cedar fence post, March 28. This is exclusively a cedar feeder in the larval stage. They may be taken in numbers in late winter by digging them out of their pupal cells in cedar logs a year old.

Semanotus litigiosus Csy. Six, two on Douglas fir slash, April 28, four about Douglas fir logs, April 26. They keep to the undersides of branches and are easily overlooked.

Gonocallus collaris Kby. One, at rest on Douglas fir slash, 5 p.m., June 17; no others found. First record for Vancouver Island (Hardy, 1936). Occurs across the continent in the north from Newfoundland to Alaska, south to British Columbia.

Callidium vancouverense V. D. Several on Douglas fir slash, April 28-30; they were busily running about on the underside of the branches, mating and ovipositing and occasionally flying.

This species originally described from specimens taken at Sidney, V.I., is closely allied to the western form of *C. antennatum* var. *hesperum*.

Phymatodes decussatus v. obliquus Csy. Several, Garry oak logs and slashing, June 24. Often found abundantly about dead oak trees.

Xylotrechus undulatus Say. Three, running over Douglas fir logs and on trunk of grand fir, June 10 and August 5.

Xylotrechus annosus (Say). One, flying and alighting on newly-felled *Populus trichocarpa*, April 22. The only two other known records for Vancouver Island are Sidney and Nanaimo. Breeds in *Populus*.

Neoclytus conjunctus (Lec). Several, Garry oak logs and slash, March 15-22. Nearly every dead or decaying oak tree is riddled with their borings, the smaller branches often being reduced to powder.

Monochamus obtusus Csy. One, grand fir log, July 29. This is the first record for Vancouver Island of this species. (Hardy, 1936).

Monochamus oregonensis Lec. Abundant, frequenting logs of grand fir, May 26-June 15. Flying about in the vicinity, or at rest on the sides or beneath the logs where they were noticeably in pairs.

Synaphoeta guexi (Lec). Seven, on willow logs, July 1 - August 5. This somewhat scarce species was found on the logs at the hottest time of the day. One female resting on the side of the log, was joined within five minutes by three males, no doubt arriving in response to a "wireless" call.

BUPRESTIDAE

Chrysophana placida (Lec). Seven specimens of this attractive little species were taken on newly-cut Douglas fir cordwood, June 10 and July 1. It breeds in various conifers, and the larvae sometimes mine the center of pine cones.

Chalcophora angulicollis (Lec.) Several specimens of this large species were taken. The heavy booming flight and clumsy hit or miss alightment gives a ludicrous note to the "seriousness" of collecting. May 13 - June 29.

Dicerca sexualis Cr. Eleven specimens, in flight or at rest on stumps and logs of *Abies grandis.* Very unemotional and easily picked up though ready to feign death and drop to the ground. June 10 and July 1-29.

Buprestis aurulenta L. Common, in flight or at rest or ovipositing on logs of both Douglas fir and *Abies grandis.* May 13-July 4.

Buprestis rusticorum (Kby.) Very common, on *Abies grandis,* June 10-July 29. Sluggish and easily approached.

Melanophila drummondi (Kby.) Most abundant of all the Buprestidae. Chiefly on Douglas fir and *Abies grandis.* May 26 - August.

Melanophila acuminata (Deg.) Several, on *Abies grandis.* Very active both in running over the bark and in taking wing. May 26 and June 15. A northern species extending across the continent along the coniferous belt.

Anthaxia aeneogaster Lap.-Gory. One, on Douglas fir slash, March 22. This species is often found on the dandelion and other yellow flowers.

Chrysobothris pseudotsugae Van D. Four, on Douglas fir logs. Exceedingly active and taking to flight as readily as a fly. June 3 and July 1.

Chrysobothris femorata Oliv. Two, one on *Populus trichocarpa,* the other on *Pyrus.* June 10 and 20.

Summary and Conclusion. Of the seventy or so species of Cerambycidae known to occur on Vancouver Island, thirty-one or about 37 per cent, were captured in this restricted area. Two were first records for the Island.

The most noticeable fact brought out in a study of the list of Cerambycidae is that many of the species are represented by only one or two individuals during the entire season. This apparent scarcity could be accounted for by the fact that some are crepuscular or nocturnal in habit as for example *Prionus californicus* and *Centrodera spurca.* Other species such as *Pidonia scripta* and *Grammoptera filicornis* are generally found on flowers. *Monochamus oregonensis* was one of the few common beetles met with, and from its size and the known powers of the larvae to damage timber by their extensive tunnelling in the heartwood, it might be considered the most important species from an economic aspect.

Of the family Buprestidae, ten, or nearly 50 per cent of the twenty-two species known to occur on Vancouver Island, were collected. Three of these were very common. *Melanophila drummondi* was the most abundant, equalling in numbers the combined individuals of the Cerambycidae and Buprestidae. Members of the Buprestidae are essentially sun-lovers and perhaps for this reason they were met in greater numbers than were the Cerambycidae.

This preponderance of Buprestids might also be accounted for by the fact that except for one species, *Anthaxia aeneogaster,* the members of this family spend their whole existence in the vicinity of their host trees, while the Cerambycids wander considerable distances in search of flowers or are nocturnal in habit. For these reasons a census taken under the conditions outlined will naturally show that the majority of species are those which are most attracted to newly-felled trees.

Considering the two families with reference to their host trees, Douglas fir and grand fir were by far the most attractive, 20 species being observed on or about them. Garry oak came second with 5 species, black poplar 2, aspen and willow with 1 each. No species of either family was seen to pay attention to the stumps or slash of the other shrubs mentioned, although slight evidence of their larval work was noticed in crab-apple.

Acknowledgments—I am grateful for the help received from the late Ralph Hopping of Vernon, B.C., for verifying identifications and for other related matters, to Dr. E. C. Van Dyke of Berkeley, California, for similar services and to Mr. L. S. Dillon of the Reading Public Museum and Art Gallery, Reading, Pennsylvania, for critical examination of *Monochamus obtusus.*

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THE APPLE SAWFLY HOPLOCAMPA TESTUDINEA KLUG. ON VANCOUVER ISLAND, BRITISH COLUMBIA*

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In June 1940 some small apples damaged by a boring insect were brought to the Entomological Laboratory at Victoria by the owner of a city garden. Each apple had a round hole in the side nearly one-eighth of an inch in diameter; the interior was extensively excavated and contained a black oozy pulp. In some of the apples a whitish sawfly larva was found. This type of injury was something entirely new to us and the apples were forwarded to Mr. W. A. Ross of the Vineland Station, Ontario, laboratory who tentatively identified the insect as the apple sawfly, *Hoplocampa testudinea* Klug. Later this identification was confirmed by Dr. A. M. Massee of the East Malling Research Station, Kent, England, to whom some of the larvae were sent by the Dominion Entomologist. This is the first known occurrence of this insect in North America. A brief survey showed that the species was present in parts of the city of Victoria and the adjoining municipality of Oak Bay over an area of approximately six square miles.

Distribution and economic importance: The apple sawfly is distributed over the whole continent of Europe but is more common in the north. It is the most important apple pest in many parts of Germany, Denmark, south-west France and Holland. It is found in most parts of England but appears to be only locally common and seasonal in abundance. Massee (2) states: "This insect is re-

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sponsible for much of the useless fruit grown in the apple orchards of England." The fruit is attacked as soon as it begins to form and by the time the apple is an inch in diameter the larva is full grown and ready to leave through a large hole in the side. The infested fruit falls to the ground either before or after the larva leaves it. In addition to the destruction of young fruit, a secondary injury is caused to many of the apples by surface feeding. The young larva, before it enters a fruitlet, may feed on the exterior of an adjoining one, which results in characteristic ribbonlike scars or deformity. The injury is quite different from that caused by the codling moth. Large cavities are eaten in the centre of the apple and there is always an opening to the exterior even at an early stage. The larva does not always complete its growth within a single fruit and if the first is insufficient for its use before it reaches maturity it passes to the next one and so a succession of young fruits may be destroyed. The cavities are full of black or brown messy frass which often exudes from the hole at the side. Infestation observed at Victoria varied from slight, to possibly 50 or 60 per cent.

Life History: The adults appear on the wing as soon as the apple trees come into bloom. In 1941 early apples were in flower in the neighbourhood of Victoria on April 10. The first sawflies were collected on April 18 but since they were quite numerous it is probable that they had begun to appear a week before that date. The proportion of males to females on April 18 was 4 to 1 and five days later 2 to 1. The adults are active only in bright sunlight and on dull days none could be found. They are swift in flight and not very easy to obtain, since the majority seem to prefer the blossoms on the upper branches of the trees. Only trees in full bloom were visited by them and as soon as the petals began to fall they left those trees for others. None were found on trees from which the bloom had dropped. According to our observation in 1941 the adults were on the wing for about three weeks.

Oviposition was not observed although the females were frequently watched as they crawled over the blossoms. The egg is inserted from the outside of the calyx just below a sepal, is pushed right through and may be found at the base of the filaments or near the style, the position being indicated by a small rusty-brown spot which is often partly obscured by pubescence. Those seen by us were white, glistening, oval and about 1 mm. in diameter. According to English and German authorities the average number laid is 12 or 13 with a maximum of 20 to 22. The incubation period is about 13 days. Some of the larvae remain within the calyx after hatching, while others leave the egg pocket and feed on the exterior of the young fruit, or on an adjoining one, forming a characteristic lineal scar. These lineal scars were found to be much more frequent on small-sized varieties of apple, such as crabs, with many fruits to a cluster, than on large-sized varieties.

The larva: The larva is creamy-white with a dark brown head and a black or dusky chitinous plate on the upper surface of the anal segment. When mature it is about 12 mm. in length. There are 6 abdominal and one anal pair of prolegs. On the labrum, in the middle of the two muscle attachments, there is a dark brown triangular spot. Like those of many other species of sawflies, the larvae have a most offensive odour which in this case resembles that of a pentatomid bug. They are active and capable of crawling some distance after dropping to the ground, which they do in June when mature. They then enter the soil to a depth of four to eight inches and form compact, oval, brown cocoons, 7 to 8mm. long and 3 to 4 mm. wide, those of females being the larger. During the rest of the season the insect remains as a larva within the cocoon and pupation takes place in the following spring. Velbinger (6) states that the diapause lasts 9 months where the development is annual and 21 months where it is biennial. The developmental period of the larva in the cocoon is probably dependent upon the moisture of the environment at the time of spinning and upon the temperature during the first hibernation. Moisture is all-important to the welfare of the insect during the diapause. From a considerable number of cocoons collected by us only three adults emerged, which is attributable to an insufficient moisture supply.

The adult: The adult sawfly is black on the dorsal surface except the head, which is orange yellow with a black patch between the eyes. The eyes are black. The antennae are yellow with a dusky or black mark at the base of segments 3, 4 and 5 on the upper side. The tip of the abdomen in both sexes is yellow but this is more apparent in the males. The ventral side of the abdomen and the legs are orange yellow. The wings are transparent, somewhat iridescent, with brownish or black veins and costal margin with the stigma dark except at the apical end which is yellow. The females are about 6 mm. long, the males slightly smaller.

H. testudinea reproduces both bisexually and parthenogenetically. According to Theobald (1) a second generation has been observed occasionally in England. This was not confirmed by Velbinger (6) in Germany. The second generation is said to attack large apples in July and August. It is possible that a second generation could occur where higher summer temperatures are general.

The apple sawfly was undoubtedly introduced in balled nursery stock. Even with the most careful examination of the soil it is difficult to detect the cocoons, for being covered with grains of earth they cannot be distinguished except by their symmetrical outline, from a small piece of soil. To collect many of them, even where they are known to be numerous, has been found quite a difficult matter and the most feasible method is to float them out of the soil in a tub of water.

Impracticability of extermination: The short survey carried out in 1940 showed that the sawfly had already spread over a very considerable area of city and suburban lots in which apple trees were extensively planted. The question of extermination before the pest could spread further was immediately considered, but the actual limits of the infected area were not then known nor were the means available for carrying out a campaign. It was decided at a conference of Dominion and Provincial officers that scouting should be continued in the spring of 1941. The limit of the infested area in 1941 was found at a point six miles north of the city, including the whole of the municipality of Oak Bay, the Gordon Head and Cadboro Bay districts and the greater part of the city of Victoria, an area of approximately 16 square miles. The sawfly was not found in Victoria West nor in Esquimalt, but appeared to have spread in a northerly and northeasterly direction, possibly following the general trend of the prevailing winds. It was seen at once that an extermination campaign involving the destruction of all apples over a period of 2 years would be a colossal undertaking. A census of apple trees within the affected area, including a two mile zone outside the actual limit of infestation, showed that more than 23,000 trees would have to be dealt with. The time limit during which the fruit must be stripped being only fourteen days at the most, probably 400 or 500 men would be needed for the work and the impossibility of obtaining such a force under the difficult labour conditions created by the war will readily be appreciated. Therefore, extermination of the sawfly cannot now be regarded as a possibility and recourse must be had to spraying to keep it in control.

Control by spraying: Fortunately, one spray applied at the proper time will usually give good control of this species. In England a spray of free nicotine (98%) at the strength of 8 oz. to 100 gallons, with or without lime-sulphur, applied within a week after petal-fall, is recommended (2, 3, 4). As the object is to destroy the eggs, a coarse driving spray directed at the calyces should be used. The addition of a spreader is desirable, but not essential. Lead arsenate will not control the sawfly but may be added to sprays for the purpose of controlling other pests. Velbinger (6) states that the best control of *H. testudinea* in Germany was obtained by spraying with a strong solution of quassia; or with quassia in combination with arsenic, copper, and lime, at petal-fall. Contrary to English data, he states that nicotine with lime sulphur and lead arsenate was ineffective.

At Victoria in 1941 experiments with nicotine sulphate in a 1½ per cent summer oil spray gave control equal to that obtained in England with free (98%) nicotine. The nicotine sulphate was used at a strength of 1 to 600, and lead arsenate was added at the rate of 2 lbs. to 40 gallons. As this trial was conducted in city gardens where no satisfactory check trees could be used owing to the number of different varieties of apple in the gardens, the result must be taken only as an indication. Infestation was kept down to 3.9 per cent in the case of one series of trees and to 5.2 per cent in another, while unsprayed trees in a nearby garden showed as high as 80 per cent attack. The addition of lead arsenate had a good effect in clearing the foliage of sundry other pests such as apple and thorn skeletonizer and other caterpillars.

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THE ADVANCE OF THE CODLING MOTH IN BRITISH COLUMBIA

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The codling moth, *Carpocapsa pomonella* (L.), has increased to such an extent during the last fifteen years that it has now become the chief limiting factor in apple production throughout the apple producing areas of the southern Interior of British Columbia. Until about 1915 the codling moth was practically unknown in the Interior. Although infestations were reported at Victoria in 1900 and at Kamloops and Kaslo in 1905, these infestations evidently covered only small areas. They were believed to have resulted from the importation of wormy pears from California and wormy apples from Ontario.

In 1912 codling moth was reported from Armstrong and Rutland. At Armstrong worms had evidently been imported in nursery cases from Oregon, and at Rutland in settlers' effects. Prompt eradication measures were carried out. Weather conditions were helpful for in the spring of 1913 a heavy frost practically eliminated the apple crop in these districts. No codling moths were found in a careful inspection the the following year.

An outbreak of *C. pomonella* was discovered in the north end of the town of Kelowna in 1913. It was believed to have started from infested railway cars. Orchards were banded and sprayed and all wormy fruit destroyed during the summers of 1914 and 1915 and as far as could be determined this infestation was eliminated. Within Kelowna city limits in 1915 four government power-sprayers commenced operation directly the blossoms fell. Three thorough sprayings with arsenate of lead were administered and the trees banded and patrolled. Only seventeen larvae were found during the season in the Kelowna city limits.

Just about the time it was believed no worms existed in the Okanagan, more infestations were discovered at several points in the Valley. In August 1915 codling moth was found at Westbank. Twenty-four orchards were involved, forming an area of about 200 acres. The trees were immediately sprayed and the fruit ordered packed at the packing house instead of in home orchards. Any fruits showing signs of worms were destroyed in a boiler rigged up on the beach. Trees were banded and patrolled. No apples, pears, or quinces were allowed to leave the district without first being inspected. The infestation varied in these orchards from 1 to 5 per cent.

Until 1913 codling moth control work had been in charge of the late Thomas Cunningham, chief orchard inspector for the Province, a man who took most vigorous action whenever he believed the circumstances warranted—and that was invariably so where *C. pomonella* outbreaks were concerned. In 1914 and 1915 the work was directed by W. H. Lyne. In 1916 the Horticultural Branch took over the codling moth control work in the Province. P. E. French was in charge of the North Okanagan and C. P. R. Mainline districts, the writer from Kelowna to the International Boundary. The spraying of orchards and the destruction of infested fruit in quarantined districts was continued. An area of 65 acres was found to be infested at Walhachin in the fall of that year.

Spraying, band inspection and destruction of wormy fruit was continued throughout 1917. As no worms were found in the Kelowna city area during 1917 this area was assumed to be free of codling moth. Of the work at Walhachin, P. E. French reported as follows: "Methods of eradication employed here were similar to those practised at Okanagan Landing. Very thorough work was done by Mr. Buckell, who was in charge of this work at Walhachin for the season."

In 1918, all codling moth control work in the Interior came under the supervision of the writer. H. H. Evans was in charge at Vernon, Mr. Chesbro at Westbank, and C. Barlow in the Salmon Arm area. At this time there were about five hundred acres under quarantine in the Interior of the Province. Walhachin, Vernon, and Westbank districts were involved. Two sprays of arsenate of lead were applied, the calyx spray commencing May 20, and the second spray on June 20. Twelve thousand trees were banded and the bands inspected five times during the season. On the third inspection, three worms were found. Two more inspections followed this, but with no sign of the pest.

The results of the work at Westbank are shown in the following figures: In 1916, 340 worms were found; in 1917, 58, and in 1918, 3.

On the recommendation of P. E. French and R. C. Treherne, Dominion Entomologist for British Columbia, the policy at Vernon was changed in 1918. Instead of spraying and banding the trees in the area under quarantine, the apples on about 50 acres were purchased by the government, picked before maturity and destroyed. In band inspections no worms were found. Although the worms had apparently been eradicated in this area, two new infestations were found in the Vernon area in 1918. Four properties aggregating 15 acres were infested about one mile north of the quarantined area, and a new outbreak was discovered in the town of Vernon. In all, seven additional properties were quarantined.

At Westbank the work continued during 1919. No worms were found in the district. At Vernon in 1918, 394 specimens were captured. From the same area in 1919, 195 were taken. However, in 1919 a new infested area was discovered, and from this area 178 specimens were taken, bringing the total captured in 1919 to 372. All orchards adjacent to those infested were held under quarantine.

Three hundred and seventy-eight foreign refrigerator cars were inspected for codling moth at Okanagan Landing and 88 at Similkameen during this period. At Okanagan Landing 203 specimens were taken. Twenty larvae were found in a single car.

In 1921 an outbreak of codling moth was located on the K.L.O. Benches at Kelowna and in 1922 outbreaks occurred at Kaleden and Summerland. Rewards were offered for the detection of codling moth in new areas; $20.00 for the detection of worms in an orchard located in a district where worms had already been found, but outside an actual quarantine area; $100.00 for the detection of codling moth in a section or district in the Okanagan where no quarantine existed. Two rewards were paid in 1922, $20.00 in the Kelowna district and $100.00 in the Kaleden district.

In 1922 according to the report of H. H. Evans, 990 refrigerator cars were inspected at Revelstoke, Kamloops, Penticton, Keremeos, West Summerland and Okanagan Landing. Of this total 249 were super-heated. For superheating work at Revelstoke, steam was supplied by the round-house boilers, carrying a pressure of from 80 to 100 pounds. Since the distance from boilers to cars was 300 to 600 feet, the low and variable pressure gave unsatisfactory results. Car temperature above 170° after 10 minutes heating were attained at Okanagan Landing and results in such cases were satisfactory. Moisture condensation is much more pronounced in cars treated under low temperatures and pressures than with higher pressures and temperatures. Excess moisture was found to be undesirable.

Through 1923, 1924 and 1925 the codling moth continued to survive in the Okanagan Valley and though there was considerable success in cleaning up certain areas, most of the officials in the Department came to feel that quarantine measures were becoming of less value each year. The following table shows the areas infested in 1924 and larvae and pupae captured in 1923 and 1924 in the Okanagan district:

Table 1. Status of Codling Moth in Okanagan District, 1923-1925

	Acres Sprayed 1924	Acres To be Sprayed 1925	Larvae and Pupae Found 1923	Larvae and Pupae Found 1924
Vernon:				
Swan Lake	55	0	0	0
Ok. Landing	55	35	541	14
Winfield	110	210	0	99
Kelowna:				
K. L. O.	324	324	196	88
Benvoulin	0	50	0	9
City Area	205	205	1278	2319
Glenmore	0	200	0	160
Rutland	0	60	0	8
Penticton:				
Dog Lake	291	316	283	29
Kaleden	20	0	3	0
Green Lake	7	7	0	192
Totals:	1067	1407	2301	2918

The year 1925 was the last of general quarantine areas. W. H. Robertson, Provincial Horticulturist, reported as follows in 1926: "It was decided by the government that the old system of quarantine areas and the spraying of same for the control of codling moth would be discontinued at the end of 1925. Districts were, however, given the opportunity of forming compulsory spraying zones. An Order in Council was passed which made this possible upon receipt of a petition from any district signed by 60 per cent of the growers. Your Branch also thought it advisable that there should be certain regulations as to the number of spray machines. This requirement was finally placed at one 4-horsepower machine for every 50 acres. Regulations were also drafted based upon the 'Agricultural Act,' Part II, R.S.B.C. 1924, which outlined the actual spraying requirements and penalties for non-compliance. Because of certain deficiencies in the Act under which this work would have to be carried out no spraying zones were formed. It is expected, however, that with the amendment to the Act which it is proposed to make at the next meeting of the Legislature there will be a number of zones established during the coming year."

A certain amount of work, however, was still carried on. At Okanagan Landing and Kamloops, spraying and banding were done by the provincial government in 1926 and paid for by the growers. This work was continued in 1927 at the above points and in the city of Kelowna. At Salmon Arm, growers sprayed an area in quarantine in 1925, 1926 and 1927 under supervision of the Horticultural Branch and the cost of band inspection was borne by the government. The Salmon Arm quarantine was lifted in 1927 when no further infestation was found.

In 1929, trees were sprayed throughout the Vernon City area and the cost assessed to the lot owners. This work was continued in this area until 1941, when it was done by contract under the supervision of the city.

Aside from spraying work in and around the Vernon district by the Department of Agriculture, all quarantine work was dropped in 1926 and the Okanagan Valley south of Vernon was assumed to be generally infested with codling moth. Though many sections then were commercially free of the insect, infestations were so numerous and widespread that it was conceded by officials and most growers that the codling moth had become a pest with which the apple industry had to learn to live.

EFFECT OF LIME AND LIME-SULPHUR ON THE LARVICIDAL VALUE OF CRYOLITE*[1]

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Apparently it is generally believed that because of chemical incompatibility, sodium aluminum fluoride (cryolite) should not be used in a spray mixture containing lime or lime-sulphur. So far as can be determined, however, there has been presented no evidence of incompatibility in terms of insecticidal effectiveness.

Carter (1931) mentions that sodium silicofluoride (sodium fluosilicate) and lime react to precipitate the insoluble fluoride of calcium which evidently is considerably less toxic than the more soluble salts such as sodium fluoride. Barium silicofluoride, according to Carter (1932), is likewise incompatible with lime as well as with lime-sulphur solution. Popov and Rasina (1939) report that the addition of lime to sodium fluoride and sodium silicofluoride lowers both the phytocidal properties and the insecticidal value of these compounds. On the other hand Hockenyos (1939) states that as a contact insecticide, sodium fluoride was more quickly lethal to the

1. Contribution No. 2159, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

American cockroach when used with 50 per cent by weight of calcium hydrate than when used alone. He is of the opinion that the calcium hydrate reacts with or absorbs the oily film covering the integument and the fluoride then penetrates by osmosis.

Field experiments in codling moth control carried out at Kelowna, B.C., in 1939 indicated that as an adjuvant for cryolite, casein-lime might be superior to ammonium oleate or blood albumin. Further experiments were undertaken in 1940 and 1941 to determine the effect of varying quantities of lime on the larvicidal value of the cryolite-casein-lime mixture [2]. Several plots, each consisting of 4 McIntosh, 1 Newtown and 1 Stayman tree, were sprayed with mixtures composed of natural cryolite 3.75 pounds, lactic casein 0.5 ounce and high calcium hydrated lime in amounts varying from 4 ounces to 4 pounds per 100 gallons of water. Four cover sprays were applied in 1940 and five cover sprays in 1941. Check plots adjoining the experimental plots were sprayed with lead arsenate 3.75 pounds, casein 0.5 ounce, lime 4 ounces. Each year in the single second brood spray, cryolite was substituted for lead arsenate in the check plots.

Table 1. Effect of Lime on Cryolite in Codling Moth Cover Sprays

	Average Per Cent Wormy Fruit 1940	Average Per Cent Wormy Fruit 1941
Cryolite-casein-1 oz. lime	10.4	....
Check adjoining (1)	9.4	....
Cryolite-casein-4 oz. lime	9.1	9.5
Check adjoining (2)	9.4	10.5
Cryolite-casein-16 oz. lime	8.0	15.6
Check adjoining (3)	12.5	10.5
Cryolite-casein-64 oz. lime	....	22.3
Check adjoining (4)	....	12.3

Table 1 gives results in terms of fruit infested by codling moth at harvest.

While lime used at 0.25 pound per 100 gallons of spray did not measurably lower the larvicidal value of cryolite, four pounds appeared to be detrimental. The addition of one pound of lime per 100 gallons evidently had little effect.

Table 2. Effect of Lime-Sulphur and Elemental (Ground) Sulphur on the Larvicidal Value of Cryolite

Materials Per 100 Gallons	Number of Larvae	Av. Per Cent Stings	Av. Per Cent Larval Entries
Cryolite 3.75 lb. - casein 0.5 oz. - lime 4 oz.	231	14	29
Same but with added lime sulphur 1.6 gal.	217	6	60
Same but with added elemental sulphur 4.5 lb.	229	13	35
Check—no spray	217	1	70

A laboratory experiment in which natural cryolite was used with lime-sulphur and with elemental sulphur, gave the results noted in Table 2. Newly hatched codling moth larvae were allowed to attack individual apples that previously had been sprayed with the experimental mixtures. The apples were examined for stings and entries after two weeks. The experiment comprised three replicates of each material.

Although elemental sulphur had little influence on the larvvicidal value of cryoñte, lime-sulphur at equivalent sulphur concentration apparently had a detrimental effect. The results were consistent in each of the three replicates.

2. The field experiments were co-operative with the British Columbia Horticultural Branch. Mr. B. Hoy, in charge of the Kelowna office, supplied the sprayer and did much of the spraying and fruit checking. The staff of the Vernon laboratory was responsible for the remainder of the work.

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A NOTE ON LAELIUS SP., A PARASITE OF THE CARPET BEETLE ANTHRENUS SCROPHULARIAE (L.) (Hymenoptera, Bethylidae)

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On August 3, 1941, a mass of floor sweepings containing beetle larvae was sent in to the entomological laboratory at Kamloops, from Mazama, Osprey Station, about 30 miles north-west of Penticton; Mr. G. Allen Mail very kindly handed the debris over to me. It contained dermestid larvae and the chewed-up remains of several adult *Anthrenus scrophulariae* Linn. I kept the mass caged and secured over a dozen fresh beetles of this species.

Amongst the trash were a number of old larval skins in which beetles had pupated; three of these skins contained a mass of silk enveloping four silken pupal cases lying in the same axis as the dermestid skin. Attached to one mass, and partly enveloped in the silk, was the remains of a tiny dark hymenopteron while another lay nearly detached in the rubbish. Both wasps were somewhat battered, but were obviously parasites of these beetles.

I sent the specimens to Dr. G. S. Walley who turned them over to Dr. O. Peck. In his reply, Dr. Peck says, in part, ". . . this hymenopteron (Bethylid) agrees closely with the description of *Laelius occidentalis* Whittaker although somewhat lighter in colour. *L. occidentalis* has been known, up until now, only from the type; this was taken on a window in Chilliwack, B.C., and was described in the Trans. Ent. Soc. London (1927-28): 387-8 (1 fig.) . . . nothing is known of its biology except through other species of the genus. In this regard it is perhaps well for me to draw your attention to the method of pupation. Your letter of August 19th states that there are three or four pupal cases *in* each larva, suggesting internal parasitism which is contrary to the external parasitism in this genus (Vance and Parker, 1932, Proc. Ent. Soc. Wash. **34**: 1-7). However, Mr. W. J. Brown tells me that *Anthrenus* pupates within the last larval skin so that an external parasite may well appear to be internal."

Now the last larval skins of *Anthrenus,* in which the cocoons occurred, were intact so I could not see how the *Laelius* grubs could be external feeders without destroying this exuviae; in the one specimen I have left, there is no sign of the pupal case of the beetle. In that priceless book "Entomophagous Insects", Clausen, speaking of the attacks of *Laelius* adults on their hosts, says that they sting their victims—"The females of the genus *Laelius,* which attack the larvae of Dermestidae, bite away the covering of long hairs on the venter of the abdomen before depositing their eggs (Howard, 1901) . . . "In *Laelius anthrenivorous* Trani, the female . . . . chews the throat, apparently with the object of injuring the cervical ganglion. The complete process of subduing the host may require several hours." For reference, I quote this passage from The Insect Book by Leland O. Howard, pp. 34-35, "Life History of a Parasitic Wasp":

"The Laelius is a little, black, slender, active, four-winged fly; and the female, when it finds one of these dermestid larvae, at once jumps upon its back and clings firmly, in spite of the struggles of the victim. As soon as the poor beetle larva quiets down a bit, Laelius places herself crosswise over the thorax and, curling her abdomen around under the side, inserts her sting just behind the second or third pair of legs, paralyzing the dermestid instantly, the sting apparently having entered one of the large thoracic nerve ganglia. Then the parasite relaxes its hold and begins pulling the legs and hairs of its victim with its mandibles, its antennae vibrating in a contented manner. The pulling of the legs is evidently an attempt on the part of the parasite to see if the stinging has done its work with perfect effect. Having satisfied herself by all sorts of tests that the paralysis is complete, she proceeds to lay an egg, attaching it to the skin of the dermestid on the under side of the body, first pulling out the hairs carefully so that the egg can be firmly attached to the skin. If in the course of this operation, or even before the egg is laid, another dermestid larva comes within her range of perception, she leaves the first victim, mounts and stings the second, or even a third or a fourth, each time testing the completeness of the paralysis with the utmost care. Before attaching the egg she thrusts her sting into the spot several times, apparently making an orifice through which the larva, after hatching, can thrust its head, or which it can at least enlarge easily so as to insert its head. The egg is oval, soft, translucent, about a third of a millimeter long, apparently has no peduncle, and is not very firmly attached to the skin of the dermestid. From one to six eggs are laid upon a single victim. In a few days the larvae hatch, yellow in color and very indistinctly jointed. Immediately on hatching, their mouths are closely applied to the skin of the paralyzed dermestid and they begin to grow, not so rapidly as the somewhat similar Euplectrus, which will be described in a succeeding chapter, but still rather rapidly, reaching full growth in from ten to fourteen days. When full grown, a group of these larvae with their heads inserted at a central point, look not unlike the petals of a curious flower growing out of the shrivelled dermestid larva. When only one Laelius larva occurs upon a host it sometimes enters the sucked-dry skin and spins its cocoon within it, but generally the white, rather loose, silken cocoons are spun outside the skin of the dermestid, which shows large holes where the parasitic larvae have been at work."

Now it is true, even as Mr. W. J. Brown mentioned, that *Anthrenus* pupates within the last larval skin; this skin takes on the form of a broad oval, sharply pointed at each end like a canoe very wide in the middle, with the bluntly-oval, delicately skinned pupa lying inside it. This is precisely the form of the exuviae of parasitized *Anthrenus* that I have but instead of the beetle puparium, four silken *Laelius* cocoons lie inside the split-open last larval skin which is otherwise intact. If the *Laelius* larvae had been external feeders, this last larval skin would have been shrivelled or at least, punctured; it is intact. Therefore in this instance at least, it appears as if the *Laelius* larvae had attacked the recently-formed pupa of the beetle. At first this did not seem feasible because the summer brood of *A. verbasci* (for comparison) is a rapid one and the pupa hardens quickly, but development of this beetle through this (1941) winter shows that the stage of the perfectly soft, white, helpless *Anthrenus* pupa, lying exposed in the widely-split-open last larval skin, may extend for over three weeks; at such a time a *Laelius* could do what she liked with it and her grubs could feed upon it externally, leaving the larval skin intact, and form their silken cocoons in this skin.

I am greatly indebted to Dr. O. Peck for his comments on this insect and for suggesting that this record may be worth publishing.

Agabus ontarionis Fall. This dytiscid water beetle was unknown from British Columbia until June 8, 1941, when G. J. Spencer took a series of teneral adults. His specimens are from Bachelor Swamp, between Pass Lake and Lac du Bois, high on the ranges north of Kamloops. A month or two later the meadowy swamp had dried up.—Hugh B. Leech.

INSECTS AND OTHER ARTHROPODS IN BUILDINGS IN BRITISH COLUMBIA

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This paper consists of a series of brief records of certain insects, sowbugs and mites which have come into my hands in the last ten years in this Province; the buildings mentioned are dwellings either permanently or temporarily occupied, and in a couple of instances, are greenhouses. Insects and mites infesting stored products in mills, factories and warehouses are not included; they have been written up by the late Kenneth Jacob in a paper of some length which the department of Zoology of this University hopes to publish before long.

Of the very large number of arthropods that might come into dwellings, some are indigenous, most are accidental and a fair number are introduced species infesting materials in the houses. This list is confined to those native and introduced and doubtful species about which complaints or enquiries have come to me over a period of years or those which I have intercepted myself; the common species of domestic pests attacking foodstuffs, of which we have a very large number, are omitted and mention is made only of those not hitherto recorded for the Province or of special interest otherwise, which have become established here or are accidental intruders. In a few cases some are mentioned which are conspicuous by their absence.

Of Arthropods not Insects

Acarina. Two heavy infestations of mites were sent in during the autumn of 1941, one *Aleurobius farinae* Degeer infesting a large warehouse for imported cheese, where the mites had suddenly become so plentiful that they formed a heavy dust around the bases of the cheeses. It was not possible to order fumigation and clean-up measures involved two thousand 80 to 90-pound cheeses; by experiment I found that the finest spray with the mosquito repellent "Sta-way" instantly wetted the greasy mass of dead and living mites, so I suggested that the operators try it out with all due care to its possible poisoning the cheeses or affecting their flavour. They reported entirely in its favour.

The other mite was *Glycyphagus domesticus* Degeer sent in from Nanaimo where it was reported by a medical man as producing an irritating rash on human beings. This mite is the cause of the so-called "Grocer's itch" in England; as far as I can determine, this is the first record of it in Canada.

Isopoda. Up to the present I have collected only five species of sow-bugs in buildings, though a sixth, *Lygidium gracile* (Stimpson) is common in certain lands and woods near and on the University campus.

Up to the last two or three years, the only ubiquitous sowbug that invaded homes every autumn was *Porcellio scaber* Latreille, though I recovered *Porcellio rathkei* Brandt in October 1929 at the University. Recently, however, *Oniscus asellus* Linn. has increased tremendously, is abundant in neighboring wild lands near Vancouver and last autumn (1941) occurred in gardens of West Point Grey. It is the largest sowbug to be found locally and is a very active species. I first found it here in 1929, in the Stanley Park greenhouse, and have taken it occasionally since, but it is common now and widespread. Also in greenhouses, have cropped up *Armadillidium vulgare* (Latr.) and *A. quadrifrons* Stoller; the latter is very abundant in one of the Fraser Valley greenhouses where it tunnels readily into flower pots, eats away root systems of plants and will not respond to control measures that keep down the other species, *P. scaber,* which also occurs in these houses. These two species of *Armadillidium* roll up into a ball when disturbed.

Chilopoda. The house centipede *Cermatia (Scutigera) forceps* (Raf.) has twice been brought in — once from an abattoir where there was an active colony in one of the partitions between two rooms, and the second on April 10, 1939 when a large, healthy speciment was caught in a beer parlor in the city.

The garden centipede *Scutigerella immaculata* (Newport) has also twice been reported—once in small numbers in an outdoor compost heap in Vancouver, and in January, 1942, from certain large greenhouses near Langley where it was destroying 8-inch-high tomato plants in 100 yards of hot house.

Araneida. This province is a paradise for spiders and offers a most promising field for collecting and systematic work. House spiders of several species are a curse to the housekeeper at the Coast; they invade dwellings in swarms every autumn and spin webs for the next six months. They are best detected by noting the location of the spiderless web by day, and at night, suddenly flicking on the electric light or a flashlight, when the culprit can readily be seen and killed with a fly swatter before it runs to cover. A certain restraint is necessary when hitting them because the large juicy ones leave a conspicuous mark on wallpaper or kalsomine if squashed with too much enthusiasm.

The black widow spider *Latrodectes mactans* Fab. is widely distributed in, and apparently restricted to, the dry belt of the Interior and the drier portions of south eastern Vancouver Island and the Gulf Islands. It seldom enters houses but is very common in woodsheds, outdoor toilets and machine sheds. In the Nicola area at about 2900 feet, I have found its webs completely covering the corners and back of a carriage shed. In the Kamloops area it occurs up to 3100 feet only and seems to extend down the Fraser Canyon to just below Lytton.

Of Insects

Thysanura. A house-infesting Thysanuran, the silver fish, *Lepisma saccharina* L., has turned up a few times in the last decade but seems unable to form successful colonies, while the fire brat, *Thermobia domestica* Pack., is widely but thinly distributed in Vancouver. Every now and then small colonies are reported, chiefly from apartment houses, but neither of these species attains the density of numbers acquired by them in Toronto, Ontario.

Orthoptera. Of house-frequenting Orthoptera, *Ceuthophilus agassizi* (Scud.) occurs frequently in basements in autumn, apparently coming in from gardens, but seems unable to survive the winter drying-out and soon disappears. I have one unusual record of the giant cave-cricket *Tropidischia xanthostoma* Scudder being taken in one of the upstairs draughting rooms of the engineering department of the University in July, 1941; it must have climbed up an outside wall and hopped in.

The European house cricket *Gryllus domesticus* Linn. has never materialized as a pest in this city as we thought it would do eight years ago when it was first discovered, although it still persists in small numbers in the basement of a local golf clubhouse.

Atropidae. Of the Atropidae or book lice, two species are widespread, occurring in basements of very many homes but rarely increasing sufficiently to become a nuisance. A small pale-coloured one is very general and may become a pest, but the second is more interesting, being larger, nearly black and possessing rudimentary fore wings (only). Now the world-wide *Liposcelis (Troctes) divinatorius* (Muller) is nearly black but is wingless so this local one may be undescribed or a species of *Clothilla*.

Hemiptera. I need mention only two species, *Leptocoris trivittatus* (Say), the box-elder bug which has been sent in with enquiries in increasing frequency from the Okanagan Valley in the last five years, with complaints of its invading rooms, and the big Coreid, *Leptoglossus occidentalis* Heid. which is either increasing in this vicinity or is coming more into public attention. Personally, I think it is increasing because I have collected it several times the last few years in December when it seeks shelter in the house and up to five years ago I had never taken it locally; it is also being sent in with enquiries. It either feeds upon or shelters in holly, whence it can sometimes be obtained by beating.

Lepidoptera. Only a few house-infesting moths need be mentioned. Since 1938 I have found Purina manufactured "Fox-pelting Chow" biscuits to be the best medium for raising clothes moths that I have yet come across. One large culture in a crock has been going continuously for nearly 3½ years without any additions of food; in the last 2 years it has become infested with the spider beetle *Ptinus ocellus* Brown and still produces numbers of both insects the year round. For two years the moths (*Tineola bisselliella* Hummel) were the largest and healthiest specimens I have yet raised but the food supply now seems to be running low and the size of moths is decreasing.

The scavenger bulb moth or brown house moth *Borkhausenia pseudospretella* Stainton is a very persistent but never plentiful intruder, the larva feeding usually on dried forgotten carrots in the basement but there are indications that it eats animal products such as woollens, as do the clothes moths.

The white-shouldered house moth *Endrosis lacteella* Schiff. flourishes enormously in commercial blood-meal for gardens; I have had a colony going for two seasons in this medium, which yields clouds of moths in late summer and early autumn. The caterpillars may be taken from it all through the year. This species, like the preceding, is generally regarded as a decaying-vegetable feeder so its success on blood meal seems unusual.

I have only once encountered the tapestry moth, *Trichophaga tapetiella* (Linn.) emerging in numbers from an ancient couch in a rest room in a garage at Spence's Bridge. The infestation probably came in and died out with the couch.

Conspicuous by its rarity is the meal snout moth *Pyralis farinalis* Linn.; I have encountered it only once in 15 years, in the buildings of the biological station at Nanaimo. Mr. H. B. Leech has found the larvae numerous in mangers in a horse barn at Salmon Arm.

Coleoptera. Of the large number of beetles that invade dwellings, the majority are stored product pests. Some, however, come in for hibernation and of these some seek shelter but remain active all winter. Of those merely seeking winter quarters, the weevils *Brachyrhinus sulcatus* (Fab.), the black vine weevil, and *B. ovatus* (Linn.) the strawberry root weevil, are common every year and sometimes very abundant and this last year the clay coloured weevil *B. singularis* Linn., recently recorded in Victoria by Messrs. Downes and Andison, has made its appearance in West Point Grey, entering homes for hibernation. Of stragglers that seek shelter but remain active all winter, the ground beetles *Pterostichus* sp. and *Pemphus (Scaphinotus) angusticollis* (Fischer) are the chief; the latter eats dead or disabled sowbugs and is a regular nightly attendant at the dish from which household pets are fed, coming out when the first rush is over.

An accidental intruder but one which comes into buildings in summer is the notorious Stink beetle *Nomius pygmaeus* Dej., probably the most concentratedly malodorous animal for its size in the world. For some years now I have checked up reported flights of this beetle and find that their presence in towns can be associated with forest fires; when the horizon is blotted out by smoke, these stinkers may arrive. Apparently they are forest dwellers which are driven out by the fires and may then travel long distances, scattered by the smoke. In the summer of 1938 a very extensive fire ravaged the Campbell River area on Vancouver Island and the beetles appeared again and were reported from several spots in Vancouver. They gathered under timber in one down-town lumber yard and remained there several weeks. A workman of the place told me of their potency, of their restricted area of temporary shelter and of the complete peace in which the men left them. He remarked on the fact that they did not scatter through the mill or invade nearby residences. It is possible that the particular block of lumber beneath which they sheltered happened to be in a certain degree of sap fermentation which was attractive to the beetles and held them until they either died out or returned to the woods when the fires died down. They were probably carried to Vancouver by the then - prevailing westerly winds, flying high over the pall of smoke. Dr. M. H. Hatch (1931. Monthly News Letter [Puget Sound Academy of Science] **3** (9), issue of September 1) has also recorded it as a household pest, and has given a summary of its habits.

Of the many beetles attacking stored products in this province I mention only a few, conspicuous for one reason or another.

The meal worms *Tenebrio molitor* Linn. and *T. obscurus* Fab. are relatively rare; the rice weevil *Sitophilus oryzae* Linn. occurs ten times for one infestation of *S. granarius* Linn.; the spider beetle *Ptinus ocellus* Brown and the saw-toothed grain beetle *Silvanus surinamensis* Linn. elicit more enquiries from harassed citizens than any other beetles, both of them, especially the spider beetle, flooding over an entire house, feeding on a wide range of cereal foodstuffs. I have raised the saw-toothed beetle on raisins and walnuts besides cereals. Of the flour beetles, *Tribolium confusum* J. du Val. occurs five times for one infestation of *T. castaneum* Herbst., the rust red beetle; *T. madens* Charp. I have recovered only once—from Departure Bay, Nanaimo. Along with the first two of these flour beetles, for the last three years I have had a colony of *Gnathocerus cornutus* Fab., the broad-horned flour beetle. An infestation of *Tribolium* is very hard to eradicate and requires most persistent house-cleaning. The varied carpet beetle *Anthrenus verbasci* Linn. and the buffalo carpet beetle *A. scrophulariae* Linn. have become established in Vancouver in the last 5 years; the former is becoming serious, the latter occurs very little.

Occasionally the minute cucujid beetle *Laemophloeus pusillus* (Schoen), which is usually an elevator pest, occurs in houses especially those in which old chicken feed or other broken grain is stored in the basement.

Some of these beetles need further comment. Of the Ptinidae, I have reared *Sphaericus gibboides* Boieldieu from saffron, cayenne pepper, curry powder and fish meal. With all these foodstuffs, the colonies die out in 2 to 3 years irrecpective of the amount of food present. *Trigonogenius globulum* Sol. has turned up twice in a dwelling, breeding in woollen fluff and trash. *Niptus hololeucus* Fald. was found in numbers in the basement of a hardware store at Fernie, B.C. (January 4, 1936. H. B. Leech). *Ptinus fur* Linn. the white-marked spider beetle seems to occur more in Victoria than in Vancouver; odd specimens are not infrequently found in Vancouver homes and are sent in. I have reared it on a variety of cereals but it soon dies out. *Ptinus ocellus* Brown (*tectus* Boiel.) is one of the most widespread and most complained-of pests in Vancouver. It was first sent to me from Prince Rupert in 1926 by a student, Dick Pilsbury, who reported it as occurring in devastating numbers on a fish-meal wharf; to clear the wharf and its buildings of the pest, the workmen shovelled it into the sea with their fish-meal scoops and threw a great deal of the infested meal after it. Brown reported it (Can. Ent. **72** (6): 120, June, 1940.) first from Victoria, remarking that its discovery there by Mr. W. Downes in 1927 and 1928 was the first time it was found in America. It is now painfully common all over the lower Fraser Valley having apparently been spread by shipments of infested fish or other meal from Vancouver. I have reared it in a wide range of kitchen cereals, dried casein, buttermilk powder, blood and bone-meal and in commercial garden fertilizers which contain fish meal. This latter material, stored in basements, is the greatest single breeding place of this pest, whence it spreads out all over a home. Removing the host meal carries away the infestation and stray beetles soon die out.

Within the last year I have encountered three infestations in homes, of furniture beetles. The first trouble was caused by *Anobium punctatum* Degeer, which completely riddled the back of a china cabinet and part of the sides. I have all the wood in a cage and grubs are still working in it. The citizen who brought me the wood thought the cabinet had been bought at an auction. The second and third infestations of apparently this beetle occur in New Westminster in a piano which was brought round Cape Horn 50 years ago, and in a table imported from England 18 months ago; in both cases sawdust is being pushed out from holes which are appearing one after another in the wood. In the case of the piano, the infestation is of recent origin and must have arisen locally. The beetle would appear to have become established in this area.

The drug store beetle *Stegobium paniceum* (Linn.) *(Sitodrepa panicea)* crops up now and then at intervals in spices —cayenne pepper, all-spice and curry powder. I have a strong culture nearly 2 years old, in dried ginger.

Beetles of the family Dermestidae are well represented in British Columbia; I have 24 species so far. Some are very common, chiefly in the dry interior of the Province, and some are becoming common at the Coast.

Three species of fair size are equally numerous around Kamloops, freely entering unscreened houses. In my cabin above Kamloops at 3100 feet, all three turned up frequently, namely *Dermestes talpinus* Mann., *D. signatus* Leconte and *D. lardarius* Linn.; they were much attracted to drying bacon and to bread which was apparently fermenting in the heat in the bread box. Often a couple of beetles of one or other of these three species would arrive overnight and hide away under the bread. I have reared all three from larvae feeding upon dried insects or incompletely picked skulls and especially *D. signatus* from the trash at the bottom of used and vacated swallows nests. *D. lardarius,* especially, very readily lays eggs on, and the larvae develop in, a box of insects exposed for drying.

Attagenus piceus Oliv. was reared from a supply of casein powder recently received from Australia; *Anthrenus scrophulariae* (which is very common as far north as the Chilcotin) from trash on the floor of a public dance hall and from sweepings from the corners of a room, from dead insects, and once I raised two small larvae on a piece of old cow horn and secured the adult beetles; and *Orphilus niger* (Rossi) from dry insects.

Two dermestids need special mention here: *Anthrenus verbasci* Linn. the varied carpet beetle, and *Perimegatoma vespulae* Milliron.

Concerning *A. verbasci* the varied carpet beetle. Larvae of this insect turned up in the University collections, so I assembled them and cultured them out with a supply of dried insect bodies in a 3-inch diameter glass-covered tin box, on March 24, 1934. They kept on breeding in this tin until January 20, 1937, when the food supply was exhausted and the larvae present had consumed even the dried bodies of their dead parents. So the mass was discarded and the larvae re-cultured with a supply of buttermilk powder. They throve on this medium and by April 10 many beetles had emerged from the pupae. They were allowed to increase again until May 15, 1939, when another mass of debris consisting of frass, exuviae and dead beetles had accumulated; many larvae were present so more buttermilk powder was added without cleaning out the tin. By spring 1941 the colony had died out. Apparently the last generation of beetles was infertile or the young larvae met hostile conditions because the dead bodies of many adults were present, unchewed by larvae. Thus this colony had been going in a 3-inch diameter tin for five years. This was the only trace of these beetles I had received in the Province.

Suddenly in November 1940 enquiries came in from five homes in Vancouver about large numbers of larvae which turned out to be those of the varied carpet beetle, appearing in clothes closets and in some cases all over the house. Most stringent clean-up measures were recommended and the potentiality for evil of these larvae was heavily stressed. Up to last autumn 1941, however, specimens of these larvae continued to come in from homes widely scattered over this city and from New Westminster. Apparently this beetle has become established as a household pest.

I have reared the larvae successfully on dried insects, on broken grains of wheat and chiefly on Purina Fox-chow biscuits which I use as a basic food for all household pests. The adults eat Fox-chow and raisins.

As far as a pest in insects collections is concerned, *Perimegatoma vespulae* Milliron is the worst thing I have encountered in this Province. In the summer of 1933 I was working in Upper Hat Creek valley and camping in the forestry cabin in Marble Canyon. As is my custom in summer, all insects collected were pinned out at night on cork strips and allowed to dry for one or two weeks before being transferred to store boxes. During the winter of 1933-34 I found larvae in these store boxes and on March 15, 1934, one pupal case from which a beetle emerged on April 12, 1934. I assembled all the larvae I could find and have cultured them out dozens of times since on every culture medium that I use—several cereal flours, fox-chow biscuits, casein, milk and buttermilk powders, dried lean meat, nut meats, spices of all kinds, and dried insects. They prefer perfect, fully labelled insect specimens, if possible type or paratype material or rare specimens, to everything else. They also feed upon bird skins and dried Crustacea in the museum, doing the best they can on this uninteresting food material.

In all these years of culturing hundreds of larvae, I have never yet brought one successfully to a pupa, much less to an adult. Every colony terminates with a large series of exuviae and, now and then, some dried larvae; frequently only exuviae remain and I cannot understand what happens to the larvae. The only adults I have obtained were accidentally found chiefly on the glass tops of the insect cabinet drawers and twice only in a box of bulk unpinned insects. At present I am culturing the larvae singly in glass-topped tin boxes and, in mass, in great heaps of insect bodies in tin boxes.

In 8 years I have obtained only 11 adults, 9 of them picked up accidentally where least expected and consequently few are perfect specimens.

The capacity of the larvae for entering apparently tight-sealing boxes is disheartening; they freely enter any of our own grooved and tongued cabinet drawers, any of our usual store boxes, they invade skull cabinets, bird and mammal cabinets, mailing boxes of insects, and I have repeatedly found them in ordinary drug-store tin salve boxes of unpinned insects. The larvae hatching from the egg must be infinitely small and capable of entering very small spaces. I have never captured the adults nor found the larvae in the field, either at the Coast or in the Dry Belt.

Mr. W. J. Brown of Ottawa very kindly named the species for me and referred me to Milliron's description of it (in the Annals of the Ent. Soc. of America, **32** (3): 570-574, fig. 1. September, 1939.) In this article, Dr. H. E. Milliron of University Farm, St. Paul, Minnesota, describes it as a new species, reared in 1938 from a 20 to 25 year old demonstration wasp nest—hence the specific name *vespulae*. The only previous record of it in Minnesota was a pinned specimen in the University museum labelled "University farm campus, September 10, 1934."

I submitted a specimen to the late Mr. Ralph Hopping shortly after finding the first adult and he told me it was a *Perimegatoma* but could not name it to species.

Notwithstanding my most strenuous efforts at control, the pest is still very much with us and is constantly cropping up in the collections. Milliron found the species to be parthenogentic which would account for its prevalence all over our storerooms and its success in becoming established.

Finally, in this catalogle of stray or purposive invaders of dwellings in this area, may be mentioned outbreaks that have occurred several times in the late autumn, of vast numbers of minute pale brown beetles that swarm in basements, appearing suddenly on basement windows in such numbers as to practically shut out the light. They apparently breed on and emerge from wood that is stored for fire places, chiefly alder and coast maple. A series from one house, (November, 1933) yielded the following list (identified by Mr. H. B. Leech):—

Nitidulidae	*Epuraea* spp.
	Another genus
Cryptophagidae	*Atomaria* sp.
	2 other genera
Lathridiidae	*Coninomus constrictus* Gyll.
	Coninomus nodifer Westw.

Acknowledgments—I am deeply indebted to the following specialists who have named specimens for me over a number of years: Mr. W. J. Brown, Division of Entomology, Ottawa, Ont.; the late Ralph Hopping, and Mr. H. B. Leech, of the Dominion Entomological Laboratory, Vernon, B.C.

THE RESULTS OF FURTHER WORK DONE ON THE CONTROL OF GRAIN MITES IN BRITISH COLUMBIA*

H. F. Olds

Plant Protection Division, Canada Department of Agriculture, Vancouver, B.C.

The need for conserving products vital to the well being of the British Empire and her allies is being continually stressed by our Governments. Food in all forms comes under the category of vital commodities to such an extent that at the present time some of these products are rationed, not that there is a shortage, but so that an adequate supply will always be available. Steps to conserve food products from deterioration due to insects have been taken by the Department of Agriculture from the beginning of hostilities, and the Division of Plant Protection has assisted other branches of the Service in this work. All elevators, mills, and warehouses where large stocks of grains and cereals are stored have been periodically inspected. During the past season it has been our privilege to assist Mr. Harold Gray, who is in charge of the Stored Product Insect Investigation Division and Dr. Beverley N. Smallman of the Board of Grain Commissioners for Canada,

* Contribution No. 28, Division of Plant Protection, Production Service, Department of Agriculture, Ottawa, Ontario.

who have been carrying on extensive work in the control of these stored product pests.

Mites may be found in practically any grain, and under normal conditions are not serious, but the lack of shipping has created a problem. Recently, we have had to put a large percentage of our crops in temporary storages, where turning the grain is an additional cost. Added to this, last year's harvesting weather was very poor and we have to consider a certain amount of tough or damp grain. Stored tough grains or grain where the moisture content is above normal, must be turned at regular intervals to avoid heating. Wherever the moisture content rises above fourteen percent we may expect a heavy infestation, unless the grain is stored in separate bins and turned at regular intervals.

In a well operated elevator the bins are numbered, or should be. If, for example, bins Nos. 3, 5 and 8 have a high moisture content in the grain, there is also a slight increase in the temperature. In a routine inspection the investigator should pay particular attention to these two points and draw samples from these bins first. If a bin is infested, samples should be drawn from both the top and the bottom. Where infestations are slight 'quite often the mites will be found only in the first few feet of the grain on the top of the bin and for a few feet up from the bottom. Usually grain in such bins will register a normal moisture content. Bottom samples should be drawn until there is no further evidence of infestation. Inspectors who are conversant with this work will have little or no difficulty in detecting the presence of mites since they give off a sickly sweet odour. If this odour is strong the infestation undoubtedly is heavy. Dr. Smallman stated that if the top of the bin were infested, the action of emptying it would not necessarily correct this, if the grain was simply drawn off that bin and placed in another. In drawing off the grain, that on the top of the bin settled down to about thirty or forty feet from the bottom before it coned in, and the mites on the top portion would then be deposited on the top of the new bin. To test this, I tied an eight-pound weight to a long rope, and buried it about two feet in the top surface of the wheat in a bin 26 feet wide and 100 feet deep. The bottom gate was then opened; the bin took 2½ hours to empty. Samples were drawn at intervals and showed mites in the bottom few tons and freedom from mites above that until the bin started to cone in. It was not until the grain had settled to within forty feet of the bottom that it coned in and the weight began to pull. This meant that the mites simply settled down as Dr. Smallman had stated, and would be deposited on the top of the next bin, unless that last thirty or forty tons were put over the cleaners. Re-examination of the wheat in the top of this new bin showed a decrease in the number of mites, indicating that some had perished in the transfer of the wheat, but there was still a nucleus to build up the infestation should other conditions become favourable. It is therefore suggested that where conditions of this nature exist, the wheat from the bottom and top of the bin should be put over the cleaners and driers.

Fumigation of elevators has always been a problem; it is difficult to get a gas that will penetrate through the mass of wheat and be effective in the control of mites. Some experiments have been made with chloropicrin and methyl bromide. Chloropicrin may be used under very low temperatures and at any place where the bin walls and floors are reasonably tight. A disadvantage is that this gas will not penetrate more than twenty-five or thirty feet within a thirty-six hour exposure, and so in large bins can be used only for surface fumigation. An experiment was tried out last season by Dr. Stillman: In one of our elevators he fumigated a large bin with methyl bromide, using one pound of this gas to each thousand cubic feet. The gas penetrated through ninety feet of grain in a thirty-six hour exposure, giving a very satisfactory control of the mites.

In the use of gases, certain points must be remembered. (1) Will the gas be effective? (2) Is the cost of application economically such as to be recommended for commercial uses? (3) Will there be any possibility of tainting? And (4) is it a safe gas to recommend?

(1) We know that methyl bromide is a heavy gas and under certain temperatures it will penetrate through grains to a great depth. We should note that grains which have been placed in bins during the summer months and are under normal storage conditions, do not change in temperature more than two or three degrees Fahrenheit. That is to say, grain with a temperature of around 55° to 60° F. when placed in the bin, would retain that temperature throughout the year. Grains which have been placed in a bin during the winter months and which may have been exposed to low temperatures in transit, might register as low as 30° to 35° F., which would be too low for fumigation with methyl bromide. Optimum temperature for the use of methyl bromide is around 65° F., but this gas may be used at slightly lower temperatures with good results.

(2) At the present time, the cost of methyl bromide makes the cost of application rather high. Used at the rate of two pounds per 1000 cubic feet in a bin say 26 feet wide by 100 feet deep, would cost approximately $100 and it might be cheaper to run that bin over the driers.

(3) The question of tainting food products must always be considered. Dr. H. C. Dudley of the United States National Institute of Health, Washington, D.C., has been working for several years on the problem of methyl bromide residues and in connection with this matter he has this to say: "In general fresh fruits and vegetables, dried fruits and whole grains absorb but minor amounts of the fumigant. Milled grains and fatty or oily foods absorb a great amount of methyl bromide." Dr. Dudley's tests were made from grains which had been fumigated with two pounds of methyl bromide per 1000 cu. ft. Thus from a residue standpoint, methyl bromide may be used with safety in fumigating whole grains.

(4) The question of the gas being a safe one to recommend has also been studied. Methyl bromide is now being used for the control of pests both of stored products and of green vegetables, and where it is carefully handled there should be no danger in its use. It must be pointed out, however, that the gas is practically colourless and odourless. This constitutes a real danger where it might get into the basement of a large elevator, and the basement not be properly ventilated. It is always best to use a gas mask where ventilation is poor, and the operator should see that the mask fits properly and that the canister used is suitable for that type of gas. Before entering a fumigated building a Halide light detector should be used to detect the presence of methyl bromide. If the gas is present the flame will turn from a purple to a purplish blue, and if the concentration is fairly heavy, the flame will turn entirely blue. There is also one other point that must be thoroughly understood: before entering the basement of any building, particularly if the basement has been closed for some time, the whole building should be opened up and well aired, since it would be unsafe to wear a gas mask if the oxygen content of the air in that basement were low.

Methyl formate has been used in conjunction with carbon dioxide and sold under the trade name of "Proxate", and later methyl bromide was used with carbon dioxide. The idea of the carbon dioxide was to provide a warning gas.

This feature has been studied by Mr. R. M. Jones, Entomologist, Liquid Carbonic Corporation of Chicago, Illinois. It may be possible then, to incorporate sufficient carbon dioxide to provide the necessary warning just as chloropicrin is used with HCN gas.

NOTES ON THE LABORATORY REARING OF SOME CANADIAN TICKS (Acarina) *

J. D. Gregson

Dominion Entomological Laboratory, Kamloops, B.C.

Many of the projects on ticks at the Dominion Entomological Laboratory at Kamloops are dependent, to a greater or lesser extent, on an accurate knowledge of the bionomics of these pests. This study is necessarily a lengthy one, since there are 3 or more stages of each of the 20 or so species involved, and each stage presents a problem of its own, involving a host, and a period of observation lasting for at least several months. As many ticks are highly resistant to unfavourable conditions and can withstand starvation for long periods, the accumulation of data complete with longevity observations, may involve several years' study. Frequently after a number of seasons have been spent in searching for an engorged fertile female of a certain species in order to establish a laboratory strain, progeny have died before a suitable host could be provided. Since knowledge of the host relationships and host specificity of even the more common species of ticks is still fragmentary, certain information relating to these problems gathered at the Kamloops laboratory may be useful.

One of the most important factors in the rearing of ticks is humidity. Although extremely resistant to insecticides, dips, and starvation, practically all Ixodidae require high atmospheric humidity. Species that can survive for a year or more under optimum conditions may desiccate overnight if subjected to normal room humidity. Ticks should be kept in a cool cellar in open-ended glass tubes over damp soil.

As a rule humidity is adequate while ticks are feeding on animals. Nevertheless it is advisable to keep the hosts in a reasonably humid atmosphere. Although this is particularly true for certain ticks from humid areas, it applies also in the dry Interior of British Columbia, for the early stages in the development of ticks are frequently passed either against the moist skin of the host, or in its damp burrows.

While at Kamloops all longevity tests are carried out in a tick cellar (T. 18° C., H. 100%), it has been determined that the best method for holding ticks beyond their normal life span is to store them at 5°C. in pill boxes in a sealed jar containing damp absorbent cotton. In the case of *Ixodes californicus* Banks, the combined periods of preoviposition and incubation normally require four months at 18°C. or two months at 21°C. but can be prolonged for over two years under these conditions.

During storage ticks must be kept free from condensed moisture, as they drown quite as readily as they desiccate. It is advisable to trim off the cotton plug of each vial, and slide it about a quarter of an inch into the tube, to avoid the possibility of water moving up from tray to tube by capillarity. Identification labels should be placed between plug and vial, for if left in the vial the writing soon becomes obliterated by excrement.

Dermacentor andersoni Stiles, the vec-

* Contribution No. 2155, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

tor of many serious diseases, has been studied more than any other species in North America. The techniques of rearing successfully all stages have been worked out by the Rocky Mountain spotted fever laboratory at Hamilton, Montana, where, for the production of spotted fever vaccine, the ticks are, as described by Kohls (1), literally measured by the litre. This is the least specific of Canadian ticks, and feeds readily on nearly all laboratory animals. Adults are commonly fed on sheep for which a very satisfactory infesting method has been devised at this laboratory. The ticks are placed over a clipped and washed area about the size of the tick cage which is a shallow cup of 20 mesh brass gauze about 1½ inches in diameter, with tape-bound rim. The cage is anchored to the skin by six or more opposing linen threads which are first attached to the wool by clove-hitches, then threaded through the edges of the cage and tied. The ticks are inserted before the final fastenings are made. If placed on the shoulders, these cages cannot be scratched off by the animal, and need only occasional adjustments. Nymphs and larvae, usually fed on rabbits or guinea-pigs, may be allowed to feed anywhere on the host, simply by enclosing both host and ticks overnight in a bag made of unbleached cotton, or may be confined to certain areas by means of a screw top capsule, held to the animal by an adhesive band around the belly (1), or in the case of a rabbit, by enclosing the ticks within the ears by means of adhesive tape. Rabbits' ears may also be bagged by slender sacks which tie around the base of the ear. The bags should be taped together to prevent their being torn off.

D. albipictus (Packard) normally infests deer, cattle and horses, passing all stages on the same host and feeding during the winter months. Flat adults taken from moose, however, have been found to feed readily on sheep and guinea-pigs.

Ixodes californicus Banks, is probably the most delicate of our ticks and is extremely sensitive to desiccation. It has yet to be proved that this is a short-lived tick in nature, but under no circumstances have we been able to keep flat adults alive for more than six weeks under laboratory conditions. Furthermore 100 pairs kept in a cage in their normal Coast habitat during the summer of 1941 were all dead when examined four months later. Adults of the closely related European tick *I. ricinus* have been kept alive from 15 to 27 months by Wheeler (2).

The natural hosts of adults of *I. californicus* are dogs, cats, humans and deer. At the laboratory they can be fed readily on sheep by the cage method mentioned above. They are, however, so dependent upon high humidity, that it is necessary at Kamloops to carry out infestations under a burlap tent, over which water is continually sprayed. The engorging period is about 6½ days. The early stages of this species are hardier than the adults for seeds and nymphs have been kept alive for 17 months. The main host of the early stages in nature appears to be the lizard, *Gerhonotus principis* Baird and Birard. Lizards in captivity can be maintained readily on a diet of mealworms, grasshoppers, cockroaches or crickets. These reptiles make convenient and clean laboratory hosts, although the ticks require three times as long to engorge on them as on mammalian hosts. Both early stages will completely engorge in about 7 days on rabbits and guinea-pigs, but, as pointed out in a previous paper (4) the host may be killed if infested too heavily. *I. californicus* feeds poorly on domestic chicken, and in nature has been taken in abundance on birds as seeds on grouse chicks. Rats and mice, whether domestic or wild, appear to be poor hosts. Although fair numbers of seeds have attached to laboratory rats, the fed ticks were all of a reddish color instead of black. It is presumed that these were of low vitality, as it has been found that very pale *I. texanus* seeds which have engorged on serum only, have been incapable of moulting to nymphs. *I. californicus* has not been induced to feed on fitches, tortoises, snakes or toads.

I. texanus Banks is as hardy as the preceding species is delicate, and of the strain being maintained at Kamloops, all stages are healthy after having been confined in tubes for over 3 years. The life-cycle of this tick thus may occupy a period of 9 years or even longer. It is resistant to desiccation and feeds readily in all stages on members of the ferret family. In the Interior drybelt of British Columbia, *texanus* is a common parasite of weasels and wild mink. Adults also feed well on dogs and sheep. Fitches have proved to be the best laboratory hosts, though there is a tendency for them to build up a temporary immunity after an infestation (6). No stages have been taken on the red squirrel, which in the drybelt is host to a similar but very specific tick, *I. hearlei* Gregson (3).

Because of the ease with which *texanus* may be reared, and because it is parasitized by *Hunterellus hookeri* How., this tick may prove to be a good intermediate host if that parasite should be cultured for control of *I. californicus*.

Another Drybelt tick, *I. hearlei* Gregson, closely related morphologically to *texanus* has been found only on the red squirrel, *Tamiasciurus hudsonicus* ssp. Attempts to rear specimens on other laboratory animals including flying squirrels, have failed so far. From early observations *hearlei* appears to be a hardy species of tick.

I. cookei var. *rugosus* Bishopp is rare in British Columbia. Our only live specimens were engorged nymphs from a coyote. Several of the resulting adults attached to a guinea-pig, but fed slowly and finally died. Dogs would probably be satisfactory laboratory animals for this tick.

I. dentatus spinipalpis Hadwen and Nuttall, and *I. angustus* Neumann, both Pacific Coast species, are parasites of rabbits and squirrels. They have been taken on the packrat which it is thought will be a suitable laboratory host for at least *spinipalpis*.

I. signatus Birula, is normally found on the cormorant. Though refusing to attach to domestic chicks and ducks, seeds and nymphs fed readily on a domestic goose, the engorging period being approximately 7 days. The ticks were caged over the bird's head by means of a voile hood. All attached overnight. The length of life of seeds and nymphs appears to be only about 6 months.

Haemaphysalis leporis palustris Packard and *H. cinnabarina* Koch, the rabbit and bird ticks, each feed on either of these hosts though best results have been obtained by placing *palustris* on domestic rabbits and *cinnabarina* on captured grouse. *H. cinnabarina* engorges rapidly and drops from its host in about 7 days. It is an autumn tick and since oviposition would not take place until spring it appears to have an exceptionally long preoviposition period. Seeds of *cinnabarina* and *palustris* have been kept alive for 7 months, and nymphs of the latter for 19 months.

Although none of the argasid of "soft ticks" have yet been procured for life-history studies at this laboratory, several species have been recorded in British Columbia. Both *Argas persicus* (Oken) and an *Ornithodoros* tick have been collected by Professor G. J. Spencer, the former from a golden-crowned sparrow, the latter from a bat. Both species feed rapidly except in the larval stage. It has been found that *O. turicata* (Duges), a species occurring in the United States, can be maintained easily on rats. The larvae are placed in an infesting cage on the host for about 3 days, after which the engorged ticks are collected and the cage, debris and host fumigated. The several subsequent stages are best fed at the clipped belly of a rat that is held on its back by means of tape over its legs and neck. The ticks engorge in about 30 minutes and apparently do not harm the host. Nymphs have been induced also to feed through membranes of skin on vials of warm defibrinated rabbit serum; they moulted successfully. This tick is very resistant to desiccation, and may live for many years under cool damp conditions.

Ornithodoros megnini (Duges), the spinose cattle-ear tick, is a species that has recently been taken in British Columbia by the Kamloops laboratory. It differs from all other ticks in that only the larval and nymphal stages feed. The nymphal engorgement is sufficient to enable the adult to oviposit without feeding. Since both the early stages of this species stay on the host and may feed for over 3 months, it is doubtful if any artificial method of feeding can be used in laboratory rearing.

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(2) **Nuttall, G. H. F.** and **C. Warburton.** Ticks: A monograph of the Ixodidae. Part II, p. 301. Cambridge University Press, May, 1911.

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(4) ———— 1942. Host poisoning by **Ixodes californicus** Banks. (Acarina, Ixodidae) Proc. Ent. Soc. B.C., 38:5-6.

(5) ———— The Coast Tick (**Ixodes californicus** Banks) problem in British Columbia. Canadian Ent. 74(1):3-5.

(6) ———— Host Immunity to Ticks (Acarina). Proc. Ent. Soc. B.C., 38:12-13.

Asilidae from Robson, B.C.—Dr. S. W. Bromley has sent the following names of species not included in my list in the last number of the "Proceedings" (No. **38**: 14.) *Laphria ferox* Will.; *Bombomima columbica* Walker; *Andrenosoma fulvicauda varlutea* McAtee; *Cyrtopogon praeceps* Will.; *Eucyrtopogon nebulo* O.S.; *Asilus vescus* Hine. It is possible that the following species were misidentified, and should be removed from my List: *Laphria francisana* Bigot; *Asilus auriannulatus* Hine.—H. R. Foxlee.

Hemichroa crocea (Fourcroy). Larvae of this alder sawfly were taken on *Alnus* sp. at Gleneden, near Salmon Arm, June 26, 1941, y A. M. Gilmour of the Provincial Forest Service. In British Columbia the species was known previously only from the lower Fraser Valley. A life history and illustration of the larva has been published by G. R. Hopping, 1937 (Canadian Ent. **69** (11): 243-249, plate 13).—Hugh B. Leech.

Gyrinus pectoralis Leconte. A distinctive little whirligig water beetle which has been collected at Copper Mountain, B.C. by G. Stace Smith (see 61st. Ann. Rept. Ent. Soc. Ontario, (1930), 1931, p. 88) More recently G. J. Spencer has taken it at Kamloops, 18. VIII. 37; and at Bachelor Swamp, between Pass Lake and Lac du Bois, high on the ranges north of Kamloops, 8.VI.41.—Hugh B. Leech.

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Furniss, R. L.—445 U.S. Court House, Portland, Ore. Forest ent. Coll. forest **Coleoptera**, esp. scolytids, clerids, cerambycids, buprestids.

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* At present serving with the armed forces.

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Mathers, W. G.—Box 308, Vernon, B.C. **Forest insects.**

Menzies, Thomas P. O.—Curator, City Museum, Hastings St., Vancouver, B.C. General ent., coll. exchange.

Middleton, Morrice S. — Provincial Horticultural Branch, Vernon, B.C. **Orchard insects.**

Mockridge, Miss G. I.—Surrey High School, Cloverdale, B.C.

Morgan, Cecil V. G.—Box 308, Vernon, B.C. **Forest insects.**

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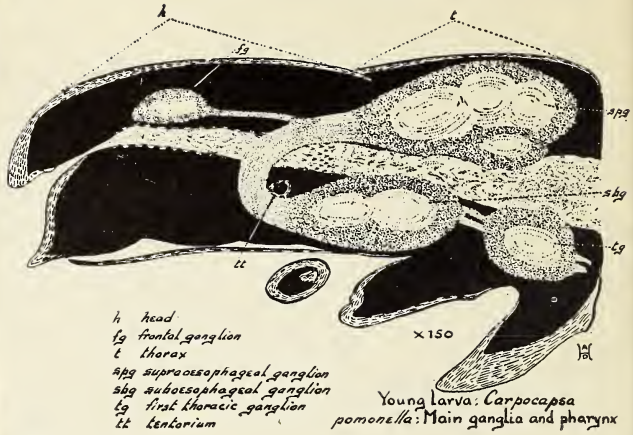

Young larva: Carpocapsa pomonella: Main ganglia and pharynx

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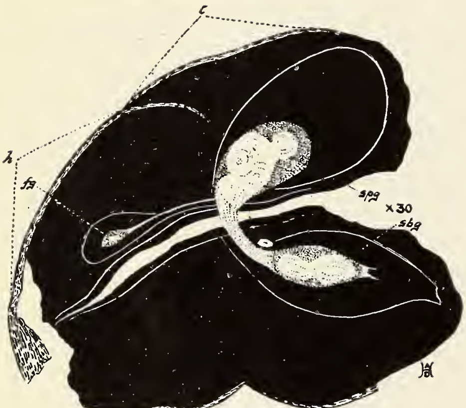

Mature larva
Carpocapsa pomonella: Main ganglia, white lines denoting proportional size of ganglia and pharynx to those of young larva

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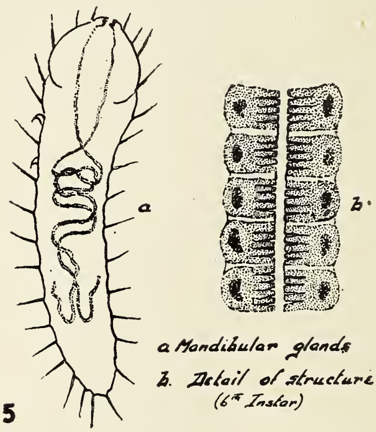

a Mandibular glands
b. Detail of structure
(6th Instar)

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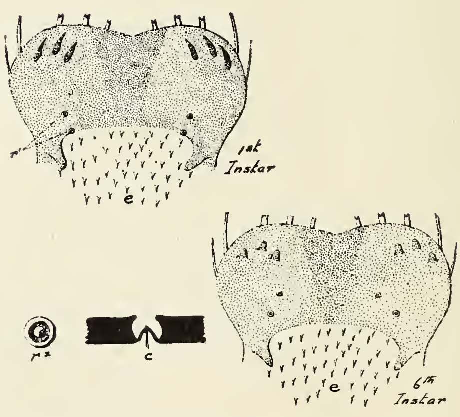
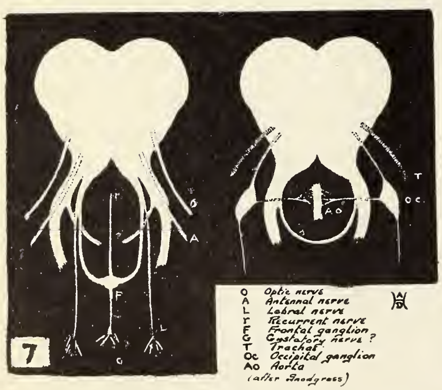


Ventral view of labrum showing e epipharynx
r' receptors r² receptor enlarged
c sensillum coeloconicum (after Weber)

6



LARVAE OF CARPOCAPSA POMONELLA—Heriot

HOW DOES LEAD ARSENATE PREVENT THE YOUNG CODLING MOTH LARVA FROM INJURING THE FRUIT?[1]

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Introduction

Information on the behaviour of newly hatched codling moth larvae on foliage and fruit has been given in previous papers from the Dominion Entomological Laboratory at Vernon; Heriot and Waddell (1942), Waddell and Marshall (1942). The following account represents an extension of these investigations. The conclusions and inferences are based partly on investigations reported in the literature and partly on original work.

Laboratory experiments with lead arsenate against first instar codling moth larvae have not, as a rule, given the degree of control that is generally attained under orchard conditions, although even in the latter case results often leave much to be desired. Nevertheless, lead arsenate still holds a prominent position in the codling moth spray schedule and it continues to be used in the field as the standard of effectiveness for experimental larvicides.

Not many years ago, it was sufficient to explain any apparent ineffectiveness of this material as being due to careless spraying. That explanation no longer suffices, since examples of poor control despite thorough application, are now commonplace in the arid or semi-arid apple-growing districts of Western North America. The reason for this lack in control, apart from the possible segregation of a race of codling moth resistant to insecticides, may become apparent when a clearer idea is obtained of how and when the action of lead arsenate takes place.

Results of Experiments, with Comments

The results of experiments bearing directly on the question under discussion, cover the period extending from the time the larva prepares to leave the egg until it enters the fruit. Where figures are given in this brief summary, experiments have been replicated many times. Where figures are omitted, the evidence is merely suggestive.

A heavy residue of lead arsenate on the chorion of the egg failed to prevent the larva from biting its way out during eclosion. This is not surprising as the chorion is generally torn open by the mandibles rather than bitten through, and to correspond with a residue on the fruit, the lead arsenate would have to be on the surface attacked, namely, the inner surface of the chorion.

After the larva leaves the egg, it must first locate the fruit and then find a suitable site for entry. On sprayed trees this generally entails crawling over a residue on the apple for 30 minutes to several hours. That this should afford ample opportunity for particles of arsenical to come in contact with the mouthparts and preoral cavity is indicated by the following experiment: 67 per cent of the larvae that crawled over a residue of finely divided graphite on Bristol board, picked up and sometimes swallowed particles of graphite in the space of 5 minutes, notwithstanding the fact that the surface was foreign to the normal environment of the larvae and presumably unattractive.

All larvae that crawled for one hour over the surface, showed particles of graphite in the ventriculus. On the other hand, when lead arsenate was added to the graphite, only 12 per cent instead of 100 per cent of the larvae were found to have graphite in the ventriculus; furthermore, less graphite was ingested by each larva. It is difficult to account for this difference if lead arsenate re-

[1] Contribution No. 2254, Division of Entomology, Science Service Department of Agriculture, Ottawa, Ontario.

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mained completely insoluble and hence inactive. It seems logical to believe that the arsenical became sufficiently soluble within the preoral cavity to be detected by the larva and that solubility was effected by the secretion of the mandibular glands ("saliva"). If lead arsenate in solution is repellent in the case of admixed graphite-lead arsenate, then it is conceivable that ingestion of graphite particles would be reduced and the lead arsenate, at least in particulate form, might be even more strongly rejected. As for solubilized arsenic, the amount inadvertently ingested would appear to be negligible, at least from the standpoint of direct lethal effect, since larvae may crawl over a lead arsenate residue for several hours without apparent injury.

It was found that larvae were much more reluctant to feed upon apple leaves that had been sprayed with lead arsenate than upon unsprayed leaves. Only 20 per cent of the larvae attacked sprayed leaves after being restricted to these for 15 hours, whereas under similar conditions, unsprayed leaves are readily fed upon. Ninety per cent of the larvae that actually fed on sprayed leaves lived for 15 hours or more although some consumed as much as 5 square millimeters of leaf. A similarly high percentage of larvae survived after successful entries through a residue of lead arsenate deposited over a puncture made in the skin of the apple with the point of a dissecting needle.

Experiments at this laboratory indicate that the repellence of lead arsenate residue may be so great that a high percentage of larvae may starve rather than bite through it, and further, when leaf tissue or apple pulp is consumed the repellence of lead arsenate is reduced. On the other hand, when sodium arsenite was substituted for lead arsenate on apples with the cuticle removed, few larvae fed and none entered. Perhaps the degree of acidity of the fruit and leaves is sufficient to maintain lead arsenate in an insoluble condition as it passes quickly into the mouth, while the more soluble sodium compound is not so affected.

Investigations show that larvae will consume particulate lead arsenate with food, and in the same way soluble arsenic may sometimes be ingested. In the case of larvae that fed upon apple pulp treated with sodium arsenite, there soon was a complete cessation of the peristaltic movements of the stomodaeum, although movement persisted for some time in the ventriculus and proctodaeum. When lead arsenate is ingested with food, peristaltic movement appears likewise to be affected though to a lesser degree. Figure 1 shows the normal distribution of food after 5 minutes of feeding on pulp dusted with graphite. Figure 2 shows the distribution of food with graphite plus lead arsenate after 2 hours. In the latter case, as in numbers of others under like treatment, clots of food were held up in the mouth, in the pharynx, and in the crop instead of normally passing on to the ventriculus.*

Voskresenskaya, whose work is discussed at some length by Hoskins (1940) records retention of food in the foregut, arising out of the use of sodium arsenite on three different insects, namely, the cutworm, the cabbage worm, and the cricket. She explains this as due to the depressing influence of arsenic on the nervous system governing intestinal movement. This produces a relaxation of the sphincter lying between the crop and midgut, presumably brought about by absorption of arsenic in the midgut. Figures 2, however, suggests a relaxation of the muscles of the pharynx governing swallowing, as well as a relaxation causing stoppage in the crop. This condition may be due to lead arsenate breaking down in the stomodaeal fluid. There appears to be no conclusive evidence that the walls of the stomodaeum are impermeable to substances in water solution. As a matter of fact, their derivation

* The crop does not appear to act as a receptacle for storage except when the insect has to be tided over a period of quiescence.

from the ectoderm and the demonstration that the ectoderm in wireworms is permeable to aqueous solutions of arsenic (Woodworth 1938) may be significant.

A symptom of what is regarded as stomach poisoning but which may be this condition of stoppage in the crop, is a clear watery exudation from the anus. A spot of the glistening residue of this excrement near the site of a larval injury is generally a sign that the larva responsible for it has died. Regardless however, of the precise manner in which death is brought about by the ingestion of lead arsenate, a most important point from the standpoint of the fruit-grower is that in the majority of cases death by ingestion apparently does not happen soon enough to prevent injury to the fruit.

Discussion

Acid lead arsenate is only slightly soluble in water and there is nothing to suggest that it affects the codling moth larva in the ordinary sense of a contact insecticide. Until the importance of the pH value of the digestive fluids was realized, it was difficult to understand how this very stable material could even act as a so-called stomach "poison". It is now generally assumed, somewhat too readily perhaps, that lead arsenate is ingested and breaks down to liberate soluble arsenic in the alkaline digestive fluids of the ventriculus, absorption then taking place and arsenic passing into the blood stream to pervade the tissues of the body with lethal effect.

This sequence of events which often requires a matter of hours or days, is known to occur in some leaf-eating lepidopterous larvae. These, when feeding on sprayed foliage, swallow the arsenical with their food. The amount of arsenic experimentally administered to such larvae has in some cases, been recovered from the excreta, blood, and tissues. (Voskresenskaya, as quoted by Hoskins 1940).

When restricted to a diet of lead arsenate-sprayed leaves, the young codling moth larva swallows the arsenical with its food. Incidentally, of course, the leaves are injured. But since in the orchard lead arsenate usually prevents the larva from injuring the fruit even by so much as a sting, it is reasonable to infer that the action of lead arsenate when on the fruit must be different in some respects from its action when on the leaves.

Possibly the situation is further complicated. Mature larvae, chiefly because of their size, have been generally used for direct experimentation with stomach insecticides. But as shown in figures 3 and 4 the young larva is not a small edition of later instars. Relatively it possesses a far greater proportion of nerve tissue. Indeed it might be aptly described as a "bundle of nerves" in contrast to the condition obtained in the mature larva. Is it too much to speculate that with such a profound change in anatomy there might go a change in physiology; that the first instar larva might be more susceptible either to the lethal effect or to the repellent effect of a compound such as lead arsenate?

If lead arsenate must pass into the ventriculus before it can be broken down, the time required for this and the subsequent chain of events leading to death, would apparently allow the larva to cause noticeable injury to the fruit. Under favourable conditions, an entry can be effected in 15 to 30 minutes, yet experiments indicate that when unaccompanied by food, ingested solids such as graphite, carmine, and lampblack require from 30 to 60 minutes to reach the ventriculus. Therefore, if lead arsenate is to prevent blemishes, it must exert action prior to arrival in the ventriculus.

It is common knowledge that preliminary to feeding, the larva removes and rejects the comparatively tough and dry cuticle of the fruit; actual feeding only taking place when the moist tissues of the cortex are exposed. In the task of penetrating the cuticle, the mouthparts of the larva are engaged in "spitting out" each fragment of cuticle laboriously chewed off by the mandibles. This procedure is therefore the very reverse of that accompanying ingestion. The removal of the cuticle is a slow process and the amount of effort expended in chewing off each fragment can be measured by the fact that this operation requires from 30 to 40 seconds for its accomplishment and has to be repeated 20 to 30 times to expose the pulp. During this time, an arsenical deposit on the cuticle would seem to have an excellent opportunity of encountering the epipharynx which is studded with spine-like projections deflected to the rear. With this equipment the labrum as shown in Figure 4, becomes an ideal instrument for removing and retaining a residue in the preoral cavity as each fragment is rejected. Under such circumstances, the deposit would be subjected to unobstructed action of a copious secretion issuing from the highly-developed glands which open at the base of the mandibles (Figure 5) and, as suggested from its alkalinity, this secretion should be capable of breaking down lead arsenate. Granting the presence of suitable chemoreceptors within the preoral cavity as delineated in Figure 6, the larva might come under the influence of soluble arsenic almost immediately an attempt was made to "sting" the fruit. Moreover, since it has been demonstrated by other workers that arsenicals may be distinctly repellent to a variety of insects, it seems reasonable to conclude that repellent action may indeed take place in the manner described. According to Ripley and Petty (1932), the greater its repellence the less the likelihood of the toxicant being ingested.

Hoskins (1940) reviews recent contributions of physiology to insect control. Practically all the experiments discussed are concerned with adult insects or well-developed larvae, and Hoskins points out that susceptibility to toxicants may vary according to age. He refers to the saliva as the first body fluid with which an ingested substance comes in contact, but goes on to state that "no data showing an effect of insect saliva upon the toxicity of an insecticide seem to have been recorded."

The only work cited by Hoskins in his wide survey that appears to have a direct bearing on this point is that of Marshall (1939). From colorimetric and potentiometric determinations of the pH values of the digestive fluids of the codling moth larva, Marshall gives the following results: neutral or slightly acid in the proctodaeum; approximately pH 8.5 in the ventriculus; and slightly more alkaline in the crop. A statement that regurgitated fluid had a pH value of 9 and over appears to be significant when consideration is given to the fact, that so far as is known, the stomodaeal fluid arises only by intermittent regurgitation from the ventriculus, and from the secretions of the mandibular glands. (The labial or true salivary glands in the codling moth larva are given over to the production of silk). If, then, the stomodeal fluid should be more alkaline than that in any other portion of the alimentary canal it is quite possible this condition is brought about by a strongly basic secretion functioning as saliva but emanating from the mandibular glands.

According to Woodworth (1938), in the case of the wireworm, repellency of an arsenical may be such that none is ingested even while the insect burrows into an arsenically-treated bait. The wireworm has no salivary or mandibular glands and Woodworth's statement that arsenicals are repellent in accordance with their solubility is of interest. Woodworth moreover, surmises that sensory control of the mechanism of the mouthparts may account for the rejection of arsenicals by the wireworm. The nature of the sensoria responsible for this is not stated. Dethier (1937) claims that caterpillars in general have a strong sense of taste which is said to reside in the preoral cavity. He identifies no specific gustatory organs.

There is the authority of Weber (1933) for the supposition that the sensilla coeloconica or pit-peg sensoria in the preoral cavity could serve as gustatory organs. How these organs are innervated does not seem to be clear. As far as can be determined from the literature, it would appear that in lepidopterous larvae, the seat of olfactory responses lies in the tritocerebrum and that of gustatory responses in the frontal ganglion (Figure 7). Sectioning of grown larvae by the writer did not reveal a connection between the frontal nerve and the epipharyngeal organs. The question arises as to whether sensoria may be innervated in the first instar larvae yet not in later instars. It is hard to conceive of the senses of taste and smell being unconnected with the stomodaeal nervous system.

It was demonstrated by McIndoo (1929) that certain responses to external stimuli are positive in the young codling moth larvae and negative in older larvae. This perhaps, is another way of saying that sense organs that are functional in the first instar may be non-functional at a later stage, a possibility indicated in Figure 6, where one pair of chemoreceptors of the final instar are vestigial and the other pair are situated some distance from the periphery of the epipharynx. Also to be borne in mind in this connection, is the super-abundance of nervous tissue in the first instar larva.

So far as has been determined, it is only when the larva is effecting an entry into the fruit that the fragments of sprayed cuticle are held in the preoral cavity for an appreciable length of time. When the larva rejects these fragments some of the residue may be retained in the preoral cavity and the "saliva" may thus have an opportunity to bring into solution a sufficient amount of arsenic to stimulate the sensoria of the epipharynx. As noted earlier, it is believed that these sensoria initiate an avoidance response.

Although repellent action may appear to explain how lead arsenate prevents the larva from injuring the fruit, it by no means follows that lead arsenate is never ingested without food or that when it is ingested with food, it does not injure the larva. If the "saliva" is capable of breaking down lead arsenate on the threshold of the mouth, it should be equally capable of acting as a solvent when lead arsenate is conducted into the foregut.

With regard to ingestion without feeding, Marshall (1937) draws attention to the aggregations of particles of lead arsenate picked up by the larva in wandering over a residue and suggests a possible relationship between particles adhering to the mouthparts, and ingestion. He demonstrates that these aggregates assume greater proportions on oily than on non-oily deposits. Experiments with inert dusts indicate that some of these accumulations adhering to the mouthparts may be forced into the buccal cavity when the larva attempts an entry. It is not known whether repellent particles are ingested in the same way or whether the larva is deterred from even attempting an entry under such circumstances. But apart from repellent or toxic action, Marshall, Strew and Groves (1939) have shown that a residue of zinc oxide, presumed inert, may exert a definite influence on control evidently by physical or mechanical means.

A concluding word regarding the apparent ineffectiveness of lead arsenate despite thorough application: In laboratory experiments with larvicides it has been customary to use 10 or more larvae per apple. Smith (1926) used as many as 25 larvae per apple. Recent research has suggested that the use of such numbers of larvae may lead to erroneous conclusions. One or more larvae may partially remove the cuticle with its residue before becoming impotent, and other larvae may then exploit these preformed sites of attack in safety, to effect entries. Repeated experiments have shown that approximately half the larvae individually applied to apples are able to find a single minute puncture made with the point of a dissecting needle, even when the larvae is deposited on the opposite side of the fruit to that on which the puncture is situated. Accordingly, it appears to be likely that in the orchard, larvae frequently and with success avail themselves of the attempted entries of predecessors. This may be a reason why inverted spray mixtures with their heavy deposits are better than non-inverted mixtures; why no residue other than one having a high contact value can be entirely effective; and why difficulty of control seems to increase more than proportionately as larval populations become greater.

Summary

Several ways are discussed in which a residue of lead arsenate may prevent young codling moth larvae from injuring fruit. Certain types of residue involving oils have been demonstrated to exert an influence on control by their physical or mechanical characteristics alone, but lead arsenate-casein-lime residue may owe its effectiveness chiefly to its repellent qualities.

Repellence is indicated by the reluctance of the larva to attack sprayed leaves and fruit; it appears to be at a maximum when the larva is removing the cuticle of the fruit prior to feeding. This task involves the "spitting out" and rejection of sprayed particles, a procedure which in part because of the structure of the labrum may result in some of the residue being retained in the preoral cavity. The strongly alkaline fluids present in the preoral cavity are believed to react quickly with acid lead arsenate and cause liberation of soluble arsenic. When soluble arsenic comes in contact with sensoria situated on the epipharynx, an avoidance response may be at once initiated.

Direct toxic action by ingestion seems to be the exception rather than the rule. Experiment suggests that it is doubtful if the various processes incident to systemic poisoning can take place with sufficient rapidity to prevent serious blemishes to the fruit.

The ordinary lead arsenate-casein-lime residue appears to become progressively less effective as a repellent as the larval population in an orchard becomes greater. This effect seems to result from the ability of the larvae to discover and to exploit previous attempted entries.

Acknowledgments—The writer is much indebted to Dr. J. Marshall for his help with regard to both the subject matter and arrangement of this paper. His published results have been freely used. Both Professor G. J. Spencer and Mr. J. J. de Gryse have been helpful in comments on the anatomical and physiological data involved and it was Mr. W. A. Ross who suggested the publication of these studies.

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A NOTE ON MITES (ACARINA) AND ASPERGILLUS (FUNGOUS) IN BALED MOULDY HAY

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In January of this year I received from a point in the lower Fraser Valley, an ounce vial of hay debris which was swarming with mites of several species; on the bottom of the vial were large numbers of very small, yellow bodies, globular in shape and of varying sizes. The message accompanying the hay stated that the sample came from baled hay which had been sold rather widely in the immediate vicinity and the farmers using it were greatly troubled over the effects of it on their cattle. Shortly after eating the hay the animals became afflicted with violent fits of coughing which became so serious that after three days this fodder was changed for another supply but it was three or four days longer before the coughing subsided. There seemed no intestinal disturbance or diarrhoea but the coughing was so violent tha the discharge of faeces from the cattle plastered the walls of the barns directly behind the cattle stalls. Farmers and two veterinary surgeons called in for consultation declared they had never seen anything like these attacks.

I promptly sent the sample of hay and the mites to the Dominion Entomologist with a plea for identifications and suggestions and he turned them over to Dr. H. H. J. Nesbitt of the Division of Entomology. Dr. Nesbitt returned me the following list of nine species of mites from that small sample of hay:

Acarus siro L. *(Tyroglyphus farinae)*

Atricholaelaps sp. (near *A. glasgowi* Ewing)

Cheyletus eruditus Latr.

Cheletomorpha venustissima (C. L. Koch)

Ctenoglyphus (Glyciphagus) plumiger (Koch)

Glyciphagus cadaverum Schr.

Sieulus sp. (near *S. plumiger* Oudms.)

Tyrophagus dimidiatus dimidiatus (Herm)

Scirus sp.

Some of these mites are vegetable feeders and some are parasitic upon the others. *Acarus siro* L. is the almost universal grain and flour mite; genus *Cheyletus* according to Banks, "contains many species; a number have been found on the skins of birds where they doubtless feed on the parasitic analgesid mites. They are very small (about 0.5 mm in length), live freely, and prey upon other mites and small insects. They seize the prey with their big palpi, insert the mandibles and suck it dry. Some have thought that there must be poison glands in the palpi, since the prey ceases movement very soon after capture." "The genus *Glyciphagus* does not appear to be as common in this country as in Europe; possibly owing to their minute size they have not been collected. One species occurs on seeds. The original species of the genus and some others have been found in sugar. The mites sometimes spread to the hands of those handling such materials and produce a skin disease known as "grocers itch." (I reported the occurrence of this mite causing "grocers itch" in a store in Nanaimo before this Society last year. See Proc. Ent. Soc. Brit. Col. **39**: 23. October, 1942). The other species of this list were apparently feeding upon the moulds in the hay or upon the fermenting hay itself.

Nesbitt remarked that he doubted whether any of the mites could have caused the effects which were reported from the cattle. And he continues: "You will notice, however, that we found the little sulphur-coloured fruiting bodies of an *Aspergillus* sp. Strasburger et al. in their text book of Botany, 1912, say that some species of *Aspergillus* are pathogenic to man and other mammals and that *Aspergillus fumigatus* which lives in fermenting heaps of hay at a temperature of 40°C. causes mycosis of the external ear, throat and lungs. The suggestion is very strong that *Aspergillus* was the cause of the bovine trouble. That the hay has been mouldy at some time is evident from the fact that there was such a large population of Acarid mites and by the additional fact that spores of another mould *Mucor* sp. were found."

Now the fungus genus *Aspergillus* contains a large number of species which are widespread, occurring in soil and on straw, grain and vegetable matter. The species in general grow best at rather high temperatures, 35°C. to 40°C. (Henrici) (4). This condition would obviously occur in fermenting, mouldy hay as was the sample submitted. Dodge (2) lists 33 species of the genus which have been reported in various parts of the world as being pathogenic to human beings, laboratory animals and to birds. Several species are reported as occurring in the human ear, others as growing in human nails and one species described in France, in the lungs of an ass. Of these 33 species, the one at first sight appearing likely to fit our case is *Aspergillus fumigatus* Fresenius (with 5 synonyms) reported from various countries in Europe and from New York State. This is the commonest species isolated from cases clinically resembling tuberculosis of the lungs in which *Mycobacterium tuberculosis* has not been found. It apparently causes severe epizootics in birds and is less fatal in man, not reaching epidemic proportions. It is pathogenic for laboratory animals (Dodge) (2).

In these pathogenic records, however, fungus in one form or another was recovered from the tissues or sputum of affected animals, indicating an actual growth in the bodies concerned. In the instance under discussion here, the effect may have been induced in either one of two ways: (1) the simple ingestion of vast numbers of perithecia affecting the nervous system probably the vagus nerve, inducing violent contractions of the diaphram with consequent coughing; or (2) which is more likely, the mouldy hay was heavily infected with actual spores in addition to the small, yellow, globular perithecia and these spores, on being inhaled during feeding, induced irritation of the lungs and respiratory passages and produced the coughing.

Under the circumstances it is quite possible that a non-pathogenic species of *Aspergillus* was concerned, since the violent symptoms in the cattle cleared away within a few days after the mouldy hay was removed. It would seem, however, that the species is not common, otherwise the symptoms of distress in the cattle would have been frequently reported in the past, since the feeding of mouldy hay in this Province is by no means unusual.

Acknowledgments—I am greatly indebted to Dr. H. H. J. Nesbitt of the Division of Entomology, Ottawa, for identifying the mites and determining the fruiting bodies of **Aspergillus** and to Dr. F. Dickson and Mr. J. A. Rattenbury of this University, for the loan of literature.

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PHENOTHIAZINE AS A CODLING MOTH INSECTICIDE

Ben Hoy

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Phenothiazine (thiodiphenylamine), an organic insecticide, was first brought into prominence as a control for codling moth by E. J. Newcomer of the U.S. Bureau of Entomology, in 1936. (Phenothiazine, a promising new insecticide for codling moth control. Wash. State Hort. Assoc., Proc. 32nd. Ann. Meeting, p. 119-120. 1937). In 1937 the British Columbia Department of Agriculture in cooperation with the Dominion Entomological Branch conducted spraying trials with phenothiazine in the Hart orchard at East Kelowna and the Ramsay orchard at Okanagan Mission. [1]

According to the manufacturers, the material used in these tests contained a wetting agent, so nothing was added at the spray tank. Control, as Table 1 indicates, evidently was not as satisfactory as with arsenate of lead.

Table 1. Codling Moth Infestation at Harvest, 1937

Material per 100 gal.	Per Cent of Fruits Stung	Wormy
Ramsay Orchard		
Phenothiazine 2 lb.	13.4	21.
Arsenate of lead 3.2 lb. "Fluxit"* 0.25 lb.	15.6	5.1
Hart Orchard		
Phenothiazine 3 lb.	2.5	7.5
Arsenate of lead 3.2 lb. "Fluxit"* 0.25 lb.	1.5	2.5

*Proprietary spreader containing casein and hydrated lime.

In 1938 spraying tests were continued in the Hart orchard and phenothiazine was used in the same concentration as arsenate of lead. Both plots received arsenate of lead for the first three cover sprays. One of the plots received phenothiazine for the last two cover sprays while the other received the lead arsenate. The infestation at harvest is shown in Table 2.

Table 2.—Codling Moth Infestation at Harvest, 1938

Material per 100 gal.	Per Cent of Fruits Stung	Wormy
Phenothiazine 3.75 lb.	3.0	2.2
Arsenate of lead 3.75 lb. "Fluxit" 0.25 lb.	6.3	2.4

Used at the same concentration as lead arsenate, phenothiazine gave equal control of worms, and a considerable reduction in the number of stings. Results in 1937 and 1938 applied equally to McIntosh, Stayman, Winesap, and Delicious. It was concluded that phenothiazine was as effective as lead arsenate for codling moth control when applied in comparable amount and uniformity. Because of high cost of material and pressure of other work, phenothiazine was omitted from our spraying experiments during 1939 and 1940. Field trials in 1941 and 1942 were conducted in the Keloka orchard at East Kelowna, in a mature McIntosh Red orchard [2].

Even at reduced concentration micronized phenothiazine with stove oil and soap gave codling moth control equal to the standard spray schedule of arsenate of lead and cryolite in 1941 and better in 1942.

Owing to heavy flocculation of phenothiazine in the spray tank some trouble was experienced in applying the mixture in the 1941 trials. In the last application 0.5 oz. casein and 4 oz. hydrated lime were added per hundred gallons. No further trouble was experienced and a heavy uniform deposit on the fruit and foliage resulted. The better cover obtained by the addition of casein-lime throughout 1942 undoubtedly was responsible for the improvement in control.

1. The late A. A. Dennys of the Dominion Entomological Branch assisted in applying all sprays and checking apples in 1937 and 1938.

2. These trials were conducted in cooperation with the Dominion Division of Entomology, Vernon. Assistance was given by Dr. J. Marshall with spray formulae and by members of the Branch in applying the spray and checking apples.

Table 3.—Codling Moth Infestation at Harvest, 1941 and 1942

Material per 100 gal.		Per Cent of Fruits Stung	Wormy
1941			
4 Sprays arsenate of lead	3.3 lb.	9.8	10.9
"Fluxit"	0.2 lb.		
2 Sprays "Alorco" synthetic cryolite	3.75 lb.		
"Fluxit"	0.2 lb.		
3 Sprays arsenate of lead as above		5.6	9.8
3 Sprays micronized phenothiazine	1.8 lb.		
Monoethanolamine oleate	0.5 lb.		
Stove oil	0.25 gal.		
1942			
Arsenate of lead and cryolite as in 1941		1.8	3.5
Phenothiazine as in 1941 throughout the season except arsenate of lead in calyx spray		.9	1.4

No check was made for differences in size or color of fruit between the phenothiazine and standard schedule plots, but general observation throughout the season and at the time of examining the fruit at harvest revealed no marked differences. Superiority in this regard lay, if anything, with the phenothiazine. An undesirable feature of phenothiazine is that it causes irritation of the skin similar to sunburn. The lips are particularly affected. In 1941, girl thinners working in Keloka orchards the day following spraying had to be removed because of irritation to arms and face. Men thinners were not affected.

PREVENTION OF FRUIT DEVELOPMENT AND ITS EFFECT ON THE SURVIVAL OF THE CODLING MOTH

H. ANDISON [1] and H. H. EVANS [2]

In recent years considerable attention has been given to the possibility of spraying apple trees to destroy the blossoms without causing other injury. This procedure has been undertaken for the following purposes: (1) to eliminate a portion of the crop and so overcome the alternate bearing habit, (2) to thin the crop and so increase the size of the fruit left on the tree, and (3) to control certain orchard insects, particularly the codling moth. The practice of blossom removal by spray applications has been referred to as "deblossoming", a term which will be used here because it is concise and expressive.

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2. District Field Inspector, Provincial Horticultural Branch, Vernon, B.C.

Review of the Literature

As yet, few definite recommendations have been made on deblossoming sprays. Holbeche (1941) found that 2 per cent "cresol" or 3 per cent tar-oil gave the most satisfactory results in removing an unprofitable crop. Gardner et al. (1939) in endeavoring to thin the apple crop by spraying at bloom period, used at 0.25 per cent to 0.5 per cent concentration, a commercial petroleum oil spray containing 4 per cent 2, 4-dinitro-6-cyclohexylphenol. The treatments were effective and appeared to cause no permanent injury to Duchess, Wealthy and Ontario apple trees. Results of five seasons' experiments by Shepard (1939) showed that 2 per cent cresylic acid and 3 per cent tar-oil were effective in destroying the blossoms of Beach, Champion, Willow Twig, York and Jonathan varieties and there was no indication of persisting injury. Read (1941) found that 1 per cent cresylic acid gave the best results. Unsatisfactory results were obtained by Auchter and Roberts (1933) using lime sulphur, copper sulphate, sodium nitrate, sodium polysulphide and zinc sulphate. Magness et al. (1939) experimenting with 2,4-dinitro-6-cyclohexylphenol and tar oil showed that one application completely killed almost all the blossoms on Winesap, Delicious and Grimes. One year's observation by Harley and Moore (1940) indicated that 2 per cent tar oil applied at the rate of 60 to 70 gallons per tree during late cluster-bud stage resulted in 96 per cent blossom removal on Delicious, Winesap, King David and Stayman.

Since it has been commonly felt that early removal of the crop would at least reduce the population of the codling moth to a very low level, it seems logical to assume that deblossoming sprays might be useful in controlling this insect. The literature on the subject suggests that the value of bloom-killing sprays in codling moth control would depend upon (1) the percentage of the larvae that live two winters before emerging as moths and (2) the importance of fruit to survival of the codling moth.

Regarding the possibility that this insect may remain in the larval state for two winters, Yothers and Carlson (1941) during the period July 6 to November 10, 1939, found thousands of larvae still alive in their cocoons in the soil at or near the base of apple trees bearing practically no crop. As some of these specimens were observed before many of the "first brood" larvae had left the fruit on adjacent trees, it was concluded that they must be non-transforming larvae remaining from the previous (1938) season. The possibility that these larvae may have matured on other tissue than fruit is not mentioned. Brodie (1906) reported that a few codling moth larvae which cocooned July 1905, remained unchanged October 1906 and stated that "moths would not emerge from these until the spring of 1907." Whether or not he succeeded in rearing the moths during 1907 is not known. Survival of a very small number of "two-year" larvae was noticed by Hammar (1912), Siegler and Brown (1928), and Longley (1921), but none of these workers succeeded in rearing moths from them. Wakeland and Rice (1932) report that "a few individuals studied required more than a year to complete their life cycle," but no data are included to support this statement. Thus as far as can be learned from the literature, there is no conclusive proof that codling moth larvae may survive two winters and subsequently perpetuate the species.

The second important point in considering the usefulness of crop removal measures in codling moth control is to know whether or not this insect can complete its life cycle in the absence of fruit. In the laboratory, Heriot and Waddell (1942) and Speyer (1932), were successful in rearing moths from larvae fed on leaves alone, but the moths derived were unusually small, short-lived specimens, and produced no eggs. Hall (1928) also succeeded in rearing larvae to maturity on apple leaves but they failed to pupate. Under field conditions, Marshall (1940) observed that large numbers of larvae developed to maturity on a caged Benoni apple tree from which the crop was removed. Newly-hatched larvae, not finding any fruit, fed on fruit buds and spurs, sap shoots, leaf bases, new breaks in twigs and small branches (4-year old wood), enlargements caused by the feeding of woolly aphids, and leaves alone. Hundreds of these larvae matured and entered bands on the tree trunk in the fall but Marshall does not say whether or not they pupated the following spring. Spur-burrowing in Anjou and Bosc pear fruit spurs by codling moth larvae is reported by Gentner (1940) as a common occurrence in Rogue River Valley, Oregon. The young larvae burrow into fruit spurs with fruit attached, during both the first and second brood periods. Larvae were found to complete their development and transfórm to moths but their capability for producing fertile eggs is not mentioned. Although it is probable that the codling moth can perpetuate the species in the absence of fruit, this point apparently has not yet been established with certainty.

To determine the feasibility of removing an apple crop by chemicals and to determine further the value of such a procedure in control of the codling moth, co-operative projects were undertaken by the British Columbia Department of Agriculture and the Vernon Laboratory of the Division of Entomology, Dominion Department of Agriculture.

Experiment on the Killing of Apple Blossoms

On April 29, 1942, a block of 121 Jonathan and Grimes' Golden trees at Okanagan Centre was sprayed in the pink stage when many blossom clusters were not separated. A portable two-gun sprayer regulated at 500 pounds pressure was used. Disc apertures were 7/64 inch. The block of trees was divided into six plots which were sprayed with the following materials:

Table 1. Plots and Spray Materials Used in Apple Deblossoming Experiment.

Plot	Materials per 100 Imperial gallons		Amount of spray per box capacity of tree
1	"Dowspray Dormant" (1) Lignin pitch (2)	1.0 gal. 4.0 oz.	0.25 gal.
2	"Dowspray Dormant" Lignin pitch	1.5 gal. 4.0 oz.	0.25 gal.
3	"Dinitro Dry" (3) Oil - 117 S.S.U., 64% U.R., (Mid-continent crude) Lignin pitch	1.2 lb. 1.0 gal. 4.0 oz.	0.75 gal.
4	"Dinitro Dry" Oil - 117 S.S.U., 64% U.R., (Mid-continent crude) Lignin pitch	1.8 lb. 1.5 gal. 4.0 oz.	0.75 gal.
5	"Dinitro Dry" Oil - 245 S.S.U., 62% U.R., (Calif. crude) Lignin pitch	1.8 lb. 1.5 gal. 4.0 oz.	0.75 gal.
6	"Dinitro Dry" Lignin pitch	1.8 lb. 4.0 oz.	0.75 gal.

(1) "Dowspray Dormant" Manufacturer's analysis: dormant oil 100-110 S.S.Ú. (Mid-continent crude) and 2,4-dinitro-6-cyclohexylphenol 4 per cent by weight.

(2) "Copacite", a by-product of the calcium bisulphite paper making process.

(3) "Dinitro Dry" Manufacturer's analysis: 4,6-dinitro-ortho-cresol 50 per cent, inert material [bentonite?] 50 per cent.

Examination of these plots on May 14, showed that the trees in plots 1 and 2, which were lightly sprayed with 2,4-dinitro-6-cyclohexylphenol - oil mixture, had less than 20 per cent of the blossoms killed and only a small amount of foliages' injury. Trees in plots 3, 4, 5 and 6, which received a thorough spray application of 4, 6-dinitro-ortho-cresol either alone in water or with oil, had 80 to 95 percent of the blossoms killed. At the same times, however, a considerable number of fruit spurs were killed, so for blossom-removal the treatments appear to be too radical. Since the lightly sprayed trees in plots 1 and 2 were evenly thinned without serious spur damage, further work with dinitrophenol derivatives is planned by the British Columbia Department of Agriculture in order to determine if chemical thinning is practicable.

Experiment on the Effects of Blossom Removal on Codling Moth Infestation the Following Year

To determine the value of deblossoming sprays in codling moth control an experiment was commenced at Oyama, B.C., during 1941. About one-half acre of 20 to 30-year old McIntosh, Wealthy, and Delicious apple trees, some 300 yards from the nearest orchard, was sprayed in the pink stage with a 2 per cet emulsion of high-boling, neutral tar oil. Emulsification was accomplished by lignin pitch. The centre McIntosh blossoms were just opening, but the Delicious and Wealthy blossom clusters were not all separated, so in view of evidence in the literature, the spray was probably applied somewhat too early for best results, with these varieties. Application was thorough, approximately one gallon of spray being applied per box of fruit that the trees were capable of bearing. About 90 per cent of the blossoms were killed by the spray. During June, fruits which set were removed by hand before any first generation larvae had matured. Dropped fruits were also collected and destroyed.

As far as could be determined, no worms developed in apples in this block of trees in 1941. Nevertheless, after half an hour's examination by three men on April 17, 1942, 7 larvae and one pupa were found beneath bark scales near the base of the trees. This material was caged in the laboratory and 7 moths emerged from it during the following May and June. While it is probable that these moths developed from two-year-old larvae, there is yet a possibility the larvae developed during the previous season (1941) on the trees devoid of fruit.

The trees were not sprayed in 1942 and when examined at harvest, the light crop was found to be heavily infested. Fruits on McIntosh, Wealthy and Delicious trees were 65, 85 and 90 per cent wormy respectively. The infestation may not have resulted entirely from hibernating larvae in the treated orchard for it is possible that moths immigrated from surrounding infested orchards. The main point is that although crop removal was more thorough than would have been accomplished by most growers, it did not prevent a ruinous attack by codling moth the following year. Accordingly, deblossoming or other means of crop removal apparently cannot be considered a procedure worthy of recommendation for control of this insect in a two-generation area such as the Okanagan Valley. Perhaps, however, it may be found feasible to employ a deblossoming spray under certain circumstances as a supplementary control measure.

Summary

Results from deblossoming sprays may vary greatly according to variety of apple, climate, date of application and thoroughness of spraying. A pink spray of 2, 4-dinitro-6-cyclohexylphenol with oil emulsion, or 4, 6-dinitro-ortho-cresol either alone in water or with oil emulsion, destroyed a considerable number of fruit spurs when used at concentrations high enough to produce satisfactory killing of Jonathan and Grimes' Golden apple blossoms. Low concentrations of these substances, however, evenly thinned the crop without obvious spur injury. So far no chemical has been demonstrated capable of completely destroying apple blossoms without the likelihood of serious injury to fruit spurs.

In codling moth control the importance of deblossoming sprays or other means of crop removal appears to depend on the percentage of larvae in an orchard that live two winters before emerging as moths and upon whether or not the codling moth can survive on tissue other than fruit. Deblossoming McIntosh, Delicious and Wealthy apple trees with a tar-oil spray and subsequent removal of any developing fruit did not prevent heavy infestation by codling moth the following year in a two-generation area of the Okanagan Valley.

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CRYOLITE VERSUS LEAD ARSENATE FOR CONTROL OF CODLING MOTH *

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In 1939, cryolite was recommended for late codling moth spray applications in the interior of British Columbia. The purpose of the recommendation was to avoid heavy deposits of lead arsenate. A number of growers who have not accomplished satisfactory control of the codling moth since that time have blamed cryolite for their failure. Their distrust of cryolite has been increased by the appearance of the diluted spray mixture, as it resembles muddy water rather than spray material. Then too it leaves a less obvious deposit than lead arsenate. But the chief reason for unfavorable opinion results from the time of application, since it is more difficult to prevent codling moth entries during July when cryolite is used than during May and June when lead arsenate is applied. Furthermore, for every larva attempting to enter the fruit in May or early June, there may be twenty-five or more attempting to enter in July and August. A review of the investigations that serve as a basis for the cryolite recommendation will therefore be timely.

First it will be well to examine some of the work that has been done with cryolite in the neighboring state of Washington. This is summarized in Table I.

* Contribution No. 2221, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

* Reset and reprinted, with slight changes, from "Country Life in British Columbia" [Vernon, B.C.] 27 (2): 23 April 1943, through the kindness of Charles A. Hayden, Editor and Manager.

TABLE I

Codling Moth Infestation Following Use of Cryolite and Lead Arsenate In Washington State

	Per Cent Infested Fruit or Worms per 100 Fruits		
Year	Cryolite	Lead Arsenate	Reference
1928-9	24.7 (Fish oil sticker)	24.1 (2 yr. ave.)	Newcomer & Carter
1932	28. (Fish oil sticker)	34. (2/3 conc. only)	Webster et al.
1935	7.2 (Non-inverted oil mixture)	5.8 (inverted oil mix)	Unpub. records, Wash. Exp. Sta.
1936	24. (Non-inverted oil mixture)	12. (inverted oil mix)	Unpub. records, Wash. Exp. Sta.
1937	8. (Inverted oil mixture)	14. (inverted oil mix)	Marshall et al.
1938	74. (Inverted oil mixture)	121. (inverted oil mix)	Marshall et al.

In the Washington investigations, which were continued intermittently from 1928 to 1938, cryolite and lead arsenate gave approximately similar results on four occasions; cryolite appeared the more effective twice, while lead arsenate appeared the more effective once. The differences are such as might occur in separate experimental plots sprayed with same material, since with inverted mixtures in particular, the nature of the solid insecticide is by no means the only factor that plays an important part in the effectiveness of the resultant spray residue. For example, in 1936 the cryolite particles in the oil-cryolite-soap mixture remained water-wetted, while the lead arsenate particles in the corresponding lead arsenate mixture became oil-wetted. The lead arsenate gained greatly in effectiveness thereby.

In British Columbia, cryolite was first compared with lead arsenate for codling moth control by B. Hoy of the British Columbia Horticultural Branch, Kelowna, in 1936. A great deal of work has been done with it since that time.

In the British Columbia experiments, all infestations were recorded as per cent wormy fruit. In no instance was there a pronounced difference in the results from the two materials. Reduced to averages, the infestations are: cryolite 6.1 per cent and lead arsenate 5.7 per cent infested fruit. Granting the suspicion with which averages should be viewed, the difference is no greater than would be expected if in each instance both plots had been sprayed with the same material. With one exception casein-lime spreader was the adjuvant.

It is worth mentioning that trees at East Kelowna, sprayed with cryolite-casein-lime throughout the season were, at the end of the third year, no more heavily infested than the adjoining trees sprayed with lead arsenate-casein-lime each season.

There has been some speculation as to whether synthetic cryolite of United States manufacture and natural cryolite are equally effective. These materials have differed somewhat in fluorine content. An investigation of effectiveness was conducted at East Kelowna and the records are assembled in Table III.

TABLE II.

Codling Moth Infestation Following Use of Cryolite and Lead Arsenate in British Columbia*

	Per Cent Infested Fruit	
Year	Cryolite	Lead Arsenate
1936	1	1
1938	2	1
1939	16	17
1940	9	9
1940	13	12
1941	9	10
1942	4	3
1942	5	4
1942	3	2
1942	8	6
1942	1	3
1942	5	4
1942	2	2
1942	8	6

* Figures for 1936 and 1938 from unpublished records, B. Hoy, B.C. Dept. of Agriculture, Kelowna; the remainder from records of the Dominion Entomological Laboratory, Vernon.

TABLE III.

Comparison of Effectiveness of Natural Cryolite and Synthetic Cryolite

Year	Per Cent Infested Fruit* Natural Cryolite	Synthetic Cryolite
1940	9	13
1941	9	22
1942	4	1
1942	3	2
1942	5	5
1942	8	8
1942	2	2
1942	3	3
1942	12	7

* The first seven comparisons from the records of the Dominion Entomological Laboratory, Vernon; the last two, from unpublished records of B. Hoy, B.C. Dept. of Agriculture, Kelowna.

Nine direct comparisons are available from this work. With three exceptions, one of which favors one product, two the other, differences are slight to nil. Averaged infestations, i.e., 6.1 per cent wormy fruit for natural cryolie and 7.0 per cent for synthetic cryolite, support the opinion that there is no essential difference in the effectiveness of the two products. The probable reason for the much higher infestation of the synthetic cryolite plot in 1941 was the greater population in this plot resulting from the high infestation of the previous season, when other spray materials had been used.

Summary

(1) Extensive investigation in Washington and British Columbia under arid or semi-arid conditions, has indicated that cryolite and lead arsenate are for practical purposes, equally effective in codling moth control. This holds whether the two compounds have been used with oils or with casein-lime spreader.

(2) Natural cryolite and synthetic cryolite have proved equally satisfactory.

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Note on Trachoma falciferella Wlshm. (Lepidoptera: Plutellidae)

This insect was not uncommon on orchard trees some years ago but is comparatively scarce today, owing no doubt to the heavy applications of arsenicals used for codling moth control, which have had a repressive effect upon a number of orchard pests. Choke cherry (**Prunus demissa** Nutt.) is its native host. Larvae were taken at Vernon, B.C., in 1931, feeding upon the terminal growth of apple and pear. The leaves are partially skeletonized and drawn together with a few silken threads to form a frail nest, within which the caterpillars remain concealed until they are disturbed. They then become exceedingly active and move over the leaf surface in a series of rapid snake-like motions.

Mature larvae measure 11-12 mm. in length, and are strongly fusiform in outline. The general colour is pale green tinged with yellow. Head pale with no markings. Dorsum pale green, with the intersegmental areas yellowish. There is a well-defined, narrow, whitish line on each side of the dorsum; these lines commence on the second thoracic segment and continue to the anal segment. Thoracic feet pale brown; prolegs concolorous with venter; the anal prolegs are extended at a wide angle with the body when the larva is at rest.

Eleven larvae which pupated between May 16 and June 13, produced adults from July 9 to 19. The pupa is formed within a silken cocoon composed of two parts: an exterior web of filmy construction and open texture, within which is a smaller case containing the pupa. The pupa, which is pale green in its earlier stages, becomes pallid and transparent prior to the emergence of the adult. —E. P. Venables, Vernon, B.C.

THE ENIGMA OF TICK PARALYSIS [1]

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Introduction

The object of this paper is to bring together observations on a series of tick paralysis experiments that have been conducted at the Livestock Insect Laboratory of the Dominion Department of Agriculture, Science Service; to compare them with the forms of tick paralysis that occur in other countries, and by these comparisons to clarify our impressions regarding the true nature of the disease. These experiements, often negative and at times apparently producing contradictory results, at least do emphasize the fascinating mystery of one of British Columbia's main livestock pests, the wood tick, *Dermacentor andersoni* Stiles.

Tick paralysis in British Columbia is a flaccid ascending motor paralysis that may be produced in livestock or humans by the feeding on them of one or more female ticks of the species *D. andersoni*. The symptoms do not occur until about the sixth day after the tick has attached, and progress from then on until the tick drops off replete, or is removed, after which there is usually a rapid recovery within half to two or three hours· Death may ensue if the respiratory center becomes paralysed before the tick leaves the host.

Tick paralysis also occurs in Australia, where man, sheep, dogs, pigs, cats and poultry have been reported by Ross (1935) as victims of *Ixodes holocyclus* Neumann, and in South Africa, where sheep have been recorded by Rensburg (1928) as having been paralysed by *Ixodes pilosus* Koch. Clark (1938) has also recorded paralysis in the same host, caused apparently by the African tick *Rhipicephalus evertsi* Neumann. In Yugoslavia, Mlinac and Oswald (1936) have described tick paralysis in ruminants, the vectors being *Hyalomma aegyptum* L. (Neumann), and *Boophilus calcaratus balanicus* (Minning). The symptoms produced by these foreign species are in a general way similar to those of the disease in this province. In America the disease is confined almost entirely to the ranching areas of British Columbia, and although the causative tick is just as abundant in southern Alberta as well as in Montana and other states to the south, tick paralysis is relatively scarce there.

Although considerable speculation on the etiology of American tick paralysis has been advanced, the fundamental cause of the symptoms still remains as much of a mystery as ever. It would seem that no theory attempting to explain tick paralysis has been put forward without arousing conflicting evidence.

Theories As to Cause of Paralysis

Briefly and in order of their probable validity, the main theories as to the cause of paralysis are here set forth.

1. *Paralysis of the nervous system by a toxin introduced by the feeding tick.*

This is the most generally accepted theory. It is substantiated by the fact that there is an almost immediate recovery following the removal of the tick, possibly due to the cessation of further injections of toxin. Also in support of this theory, assuming that Australian tick paralysis is similar to the British Columbia form, are the experiments conducted by Ross (1935). He found that the salivary glands of *Ixodes holocyclus*, ground and injected into mice, produced symptoms similar to those caused by the ticks feeding on dogs. The Australian disease, however, differs from that in Canada in that the paralysis appears to be more often fatal, and according to Ross (1934) may not even become ap-

1. Contribution No. 2260, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

parent until *after* the causative ticks are removed. Opposed to the toxin theory are the facts that not all British Columbia ticks appear to be capable of producing paralysis, and that animals capable of being paralysed by a single tick under ideal conditions can tolerate several dozen fast feeding ticks with no ill effects—a number that surely would inject far more poison than the most virulent individual tick. Ross (1935) makes no mention of *holocyclus* varying in its power to produce paralysis, other than stating that dogs were less frequently paralysed by large numbers than by single females. This would probably be due to individual resistance in the animals, for it would appear from his infesting experiments with laboratory animals that the symptoms of paralysis become increasingly severe with heavier infestations.

2. *Infection of host by some tick-borne agent.*

This is suggested by the fact that only ticks in certain territories (British Columbia as compared with Montana for example) and of these, only certain individuals, apparently are capable of producing paralysis; and by the fact that a six day period, resembling an incubation period, elapses between the time when the tick attaches and the onset of paralysis. In the dozens of observations made at this laboratory, paralysis has never been observed in which this period is less than six days, or more than eight. In the case of Australian tick paralysis, this period may be shortened to four days. Rensburg (1928) in South Africa also observes the fact that only certain ticks are capable of producing paralysis. He states "one is inclined to accept the theory that an infected tick produces paralysis in an animal by slowly injecting into it a narcotic poison which was obtained by the tick in some way or other before it got on to that animal." Mlinac and Oswald (1937) in Yugoslavia, have succeeded in killing guinea pigs by injecting them with crushed and filtered eggs of the European paralysis-producing tick, *B. calcaratus balanicus*. These experiments, but for the fact that the egg emulsions did not contain pathogenic organisms, might have suggested the passage of an infective agent through the eggs of ticks. As it is, the results appear similar to the more recent findings in America where it has been discovered by Gregson (1941) and by Steinhaus (1942) that the eggs of *D. andersoni* contain elements that are toxic to guinea pigs. Opposing the infection theory is the rapid recovery upon the removal of the tick.

3. *Mechanical injury to host by tick feeding over nervous system.*

This theory is widely credited by ranchers who have observed that ticks usually congregate along the spines of paralysed animals. Unfed ticks being negatively geotropic naturally gravitate to this region, but it is well known as pointed out by Mail and Gregson (1938) that paralysis may ensue when the causative tick is attached to any part of the body.

Discussion

Discussing the first and most logical theory as to the cause of tick paralysis, it seems fairly evident that under certain conditions a female wood tick is able to inject a toxin into the blood stream of the host which will paralyse its motor nerves. It would also appear that this toxin is injected only immediately prior to the repletion and subsequent dropping of the tick, being perhaps some form of regurgitated fluid, or possibly a glandular secretion to aid in the release of the tick's mouth parts. Incidentally, it is not understood yet how a tick, so firmly attached to its host by its immovable hypostome teeth, is able to release itself at will when replete, or even before repletion as happens when the host dies and becomes cold. The paralysing toxin probably is readily destroyed by the host, which would account for the rapid abatement of paralysis when the tick is removed. It may even be possible that the host is sometimes sufficiently resistant to cope with the toxin and thus escape paralysis entirely. This would obscure the fact that the tick might have been potentially capable of producing paralysis. While, as stated, paralysis usually is produced only by ticks on the verge of repletion, there are records of ticks only half or one third engorged having caused the symptoms. There is even a record of a lamb being paralysed when a close examination revealed no other ticks than a male.

Ross (1935) in Australia, killed mice by injecting them with crushed salivary glands of *I. holocyclus*. These experiments were repeated in the Kamloops laboratory with *D. andersoni* but the results were not the same. Even when several times as many glands as used by Ross were dissected from fast feeding ticks (frozen at the time of removal from host to prevent any possible deterioration of a labile toxin) and injected intravenously and subcutaneously into mice and lambs, and intraspinally into puppies, the results continued negative. Similarly abortive have been the attempts to produce paralysis in lambs by injecting into them the crushed bodies of ticks that have been known to have produced paralysis. The latter injections were made alongside other engorging females in case some causative virus was dependent upon the simultaneous presence of tick venom in the host animal for its survival.

That only certain ticks appear to be capable of producing paralysis is demonstrated by the fact that often a *series* of ticks, feeding at the same time, may not paralyse an animal. The theory of acquired immunity does not detract from this observation, since on several occasions the feeding of numbers of ticks on previously uninfested lambs, which obviously would have no such immunity, has produced no paralysis. Moreover, in British Columbia one attack of paralysis does not necessarily produce an acquired immunity to subsequent attacks. Ross (1935) tates that the Australian tick *I. holocyclus* may produce an acquired immunity, but that it is not inherited. Such a resistance has been produced experimentally in guinea pigs against early stages of *Dermacentor variabilis* by Trager (1939) and in fitches and guinea pigs against *I. texanus* and *D. andersoni* by Gregson (1942).

Whether an inherited immunity towards *D. andersoni* exists is debatable. It is the common belief of ranchers in British Columbia, as quoted by Mail (1942), that animals exposed for several years to attack by ticks do build up an immunity, so that later ticks attacking such animals do not feed so readily. Indirectly this may lessen the chances of paralysis by eliminating fast feeding ticks. A slowly built up and inherited immunity might explain why wild deer, mountain sheep and moose, though often heavily infested, never appear to be paralysed by ticks. Such an inherent resistance however, may not be wholly responsible for the slow feeding rate of certain ticks, as is shown by tests made on Vancouver Island sheep, untouched for generations by ticks, and on which a dozen of these parasites, in July, were unable to feed rapidly.

Individual host susceptibility to ticks has been noted on a few occasions. In one series of infestations fifteen of sixteen ticks engorged in seven days on one lamb, while the average feeding period on six other lambs was nine days, with fifty per cent of them dying before repletion. Ross (1935) has also noted a variation among hosts and states that certain individual dogs are more resistant to *holocyclus* than others.

Nevertheless, although the condition of the host may play a part in the varying rate of tick feeding, it is also a definite fact that a large degree of these variations are due to the tick. This has been demonstrated in experiments by Gregson (1937) where specimens of *andersoni* were observed to feed at different rates in close proximity, on the same host.

It would thus appear from the foregoing remarks that certain ticks, and only certain ticks, are capable of producing paralysis; and that these are usually fast feeding individuals. The condition necessary for this rapid feeding seems to be physiological, and either inherent, or produced in the tick by external stimuli. Since in the unfed condition potential paralysis producing ticks cannot be distinguished from harmless ones, an attempt was made to approximate the percentage of virulent ticks in a locality where paralysis normally occurred. Fifty week-old lambs each were infested with a pair of ticks from the same vicinity. The experiment was a failure, in that none of the ticks fed fast and no paralysis resulted. Nevertheless, a week later, ticks of the same stock *all* fed rapidly and paralysed the lamb upon which they were caged. The lamb was from the same farm as the previously infested stock. The weather, slightly warmer at the time of the second infestation, could hardly account for this difference in feeding, as experiments have shown that varying external temperatures have no effect on the feeding rate of ticks on sheep. It was thought that perhaps very young lambs might have been more resistant to ticks and thus have accounted for the slow feeding rate on the fifty lambs, but similar tests a year later on ten ewes and their twin lambs showed the parasites to feed no more readily on adult sheep than on lambs.

Perhaps the greatest hope of progress towards an understanding of the primary cause of tick paralysis lies in the fact previously stated that this disease as a rule is produced only by fast feeding ticks. One observation may prove significant and afford a clue, and that is the progressive inability of ticks in British Columbia to feed readily with the approach of mid-summer and fall. This phenomenon which, as shown by Gregson (1937), appears to be due to an inability on the part of the tick to produce sufficient disturbance within the host tissues to liberate an adequate blood supply, will probably be found to be closely connected with some climatic condition. Gregson (1938) noted that when ticks were subjected to increasing doses of ultraviolet light, their feeding powers were stimulated. Smith and Cole (1941) conclude from their recent experiments that the length of day is an important factor in controlling the activity of hibernation of larvae and nymphs of *D. variabilis*, that long photoperiods are more favorable to activity than short ones, and gradually increasing photoperiods more favorable than gradually decreasing ones of even greater absolute length. Rowan (1929) has shown that the length of light-day has an important effect on the physiology of birds. Similar light experiments on tick hosts, in which sheep were subjected to decreasing photoperiods, have shown, however, that any effect produced in them does not influence the feeding rate of the tick. Nor, according to Carrick's (1940) experiments with hedgehogs, does there appear to be any relation between the ticks' feeding rate and the presence or absence of sex hormones in the blood of the host. This theory has been suggested by MacLeod (1932) and by Rowan and Gregson (1935).

Bruce (1925) states that it is claimed that more cases of paralysis develop when there is an extreme range between the maximum and minimum temperatures, and suggests that this might induce a healthier appetite in the gorging female. At the Rock Mountain laboratory of the U.S.P.H.S., it has been noticed also that ticks feed more readily when subjected to a series of cold temperatures prior to infesting.

Thus temperature as well as light—and perhaps even humidity and other conditions not yet understood—may enter into the picture of tick behaviour, and these even may not act as stimuli until they are varied from their usual intensity in such a way as to disturb the rhythm of the individual. Considering how nebulous is our conception of such possible forces produced by fluctuations or gradual changes of external conditions, and regarding the apparently contradictory nature of the etiological evidence of tick paralysis, it will be seen that the fundamental mechanism of this disease is most intricate and perplexing.

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The Weevil Auletobius congruus (Walker) a Pest of Strawberries

In May, 1940, Mr. C. R. Barlow, Provincial District Field Inspector, drew my attention to serious damage being done to a strawberry patch at Salmon Arm, by a small dark weevil. Specimens of this insect were sent to Mr. W. J. Brown, of the Division of Systematic Entomology at Ottawa, who identified them as **Auletobius congruus** (Walker).

An examination of the patch on May 18 showed some damage over about four acres; on half an acre about 35% of the blossoms were destroyed. The weevils were seen to cut into the base of the blossoms, causing the flowers to wilt and die.

The owner of the patch had never seen this beetle on his strawberry plants before and it has not appeared since. Examination of the available literature shows no reference to this weevil as a strawberry pest, and its sudden appearance in injurious numbers in 1940 may be of interest. Professor G. J. Spencer has found adults feeding on the flowers of a native buttercup, **Ranunculus** sp., on the hills near Aspen Grove, B.C.—E. R. Buckell, Field Crop Insect Laboratory, Kamloops, B.C.

CULICOIDES GIGAS R. & H. AT VERNON, B.C. (Diptera:Ceratopogonidae). This species was recorded from the Kamloops district by Curtis (1941. Ent. Soc. Brit. Col., Proc. 37:19). At dusk on May 7, 1942, the flies were common at a small pond on the hill above Goose Lake, and adjacent to Gartrell's mine. They settled on the neck and arms, but did not bite. Specimens were identified by Mr. A. R. Brooks of the Division of Entomology at Ottawa.—Hugh B. Leech.

SOME RECORDS OF LONG-LEGGED FLIES FROM BRITISH COLUMBIA (Diptera: Dolichopodidae)

G. J. SPENCER

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In the course of collecting all orders of insects for the University of British Columbia over a period of 17 years, a number of families in various orders have now reached the point where there are enough specimens to constitute at least a skeleton list, upon which further collecting will hang a representative picture of species for this Province. A start has to be made sooner or later and when even a fragmentary list is available, it serves as an incentive for special collecting in that particular direction. I hope to be able to put out several of these preliminary lists each year from now onwards if I can get the material identified, although it seems a hopeless task for a lone worker to undertake. Even if such lists serve little purpose at the moment, they may stimulate some other members of this Society to adopt any family and to specialize in it.

The *Dolichopodidae* or Long-legged flies (not long-*headed* flies as Curran has them in his priceless monograph of the Diptera of North America) are mostly metallic-green, smooth flies, usually less than one-third of an inch in length, which are predaceous on smaller insects. Cell M and 1st M^2 are not separated by a cross vein and there is almost always a bend in vein M^1 towards R^{4+5} before it straightens out to reach the margin of the wing: this bend in M^1 is a good family characteristic.

The genitalia of the males is often adorned with long appendages which flutter pennant-like behind while the insects are in flight. These flies frequent the edges of woods or bodies of water; some species of the genus *Dolichopus* frequent spray-dashed rocks; the species of *Hydrophorus* occurs on the surface of small pools and on mud flats; those of *Hercostomus* occur chiefly on foliage, and species of *Neurigona* are found on tree trunks, chiefly of smooth-barked trees (Essig, and Curran). The tall grasses fringing alkaline pools and little lakes of the cattle ranges of the Dry Belt are good collecting sites for these flies, chiefly species of *Dolichopus*.

The list that follows is based on 132 flies, all, except two, of my collecting. I am deeply indebted to Dr. Fred C. Harmston of Logan, Utah, now Capt. F. C. Harmston of the Malaria Control Programme, Indianapolis, Indiana, for volunteering to identify these flies for me, especially in view of the fact that he undertook the work in the midst of his military duties and returned the specimens within ten days after receiving them; every collector who undertakes the identification of insects in the midst of his other duties will fully appreciate what this involves.

Dolichopus plumipes Scop.—Nanaimo Nicola.
D. bruesi Van D.—Sidney, V.I., Summerland.
D. nigricauda Van D.—Kamloops.
D. robertsoni Curran—Chilcotin.
D. renidescens M & B—Kamloops, Chilcotin.
D. obcordatus Ald.—Nicola, Kamloops, Chilcotin.
D. occidentalis Aldr.—Departure Bay (Nanaimo), Vancouver.
D. idahoensis Ald.—Nicola.
D. adaequatus Van D.—Kamloops, Chilcotin.
D. maculitarsis Van D.—Kamloops.
D. conspectus Van D.—Chilcotin.
Hercostomus tristis Lev.—Tofino, V.I
H. metatarsalis Thom.—Chapman.
Neurigona sp.—Chilcotin.
Melanderia mandibulata Aldr.—Skidegate.
Scelus monstrosus O.S.—Tofino, Nicola, Kamloops, Chilcotin.
S. avidus—Nicola.
Scelus sp.—Chilcotin.
Hydrophorus breviseta Thom.—Royal Oak (Victoria), Summerland.
Rhaphium sp.—Nicola.
Rhaphium sp.—Summerland, Kamloops, Chilcotin.
Parasyntormon occidentalis—Chilcotin.

There are apparently 2 new spp. of **Rhaphium.**

About 2,000 species of this family have been named to date. This preliminary list for nine localities of this Province includes twenty species in eight genera—the number of species being one-hundredth of the world's total. Without doubt further collecting, purposely for this family, will greatly add to this total, which shows that the *Dolichopodidae* are very well represented in British Columbia.

RECORDS OF SOME FLIES AND WASPS COLLECTED AT ROBSON, B.C. (Diptera: Tabanidae; Hymenoptera)

Harold R. Foxlee
Robson, B. C.

The following species were all collected by me at Robson, B.C. I am indebted to Dr. L. L. Pechuman for identifying the Tabanidae, and to Mr. H. D. Pratt for the names of the Hymenoptera.

DIPTERA

Tabanidae

Tabanus haemaphorus Mart.—30. VII. 39.
Tabanus laniferus McD.—21. VIII. 37; 24. VII. 38; 20. VII. 39.
Tabanus procyon O.S.—29. IV. 39; 21. IV. 40; 7. V. 40.
Tabanus rhombicus var. *rupestris* McD.—26. VII. 39.
Stonemyia californica Big.—10. VII. 37.
Silvius gigantulus Lw.—25. VI. 37.
Chrysops pertinax Will.—June to September.
Chrysops excitans Walk.—29. VI. 40.

HYMENOPTERA

Ichneumonidae

Trogus fulvipes Cress.—June 11, 12.
Hoplismanus pacificus Cress.—June 24.

Cryptinae

Acrorcius excelsus Cress. — July 16; Aug. 6.
Echthrus vancouverensis Brad. — April 24; May 23.
Cryptus altonii D. T.—May 24; Aug. 20.

Pimplinae

Rhyssa alaskensis Ashm.—July 9.
Rhyssella nitida Cress.—June 19.
Coleocentrus occidentalis Cress.—July 9.
Xorides harringtoni Roh.—Aug. 13.
Lissonota brunnea Cress.—Sept. 7.
Cylloceria occidentalis Cress.—Oct. 5.
Deuteroxorides borealis Cress.—Aug. 9.
Pimpla pedalis Cress.—April 11; Oct. 22.
Itoplectis obesus Cush.—Oct. 22.
Apechthis picticornis Cress.—Sept. 2.
Perithous pleuralis Cress.—July; August; September.

Tryphoninae

Diplazon pulchripes Prov.—Oct. 22.

Ophioninae

Campoplegidea vitticollis Norton.—Oct. 22.
Therion morio Fab.—June; July.
Cidaphus occidentalis Cush.—July 2.

Aulacidae

Neaulacus occidentalis Cress.—May 30; July 13.
Odontaulacus editus Cress.—May; June; July.
Pristaulacus montanus Cress.—July 2.

MARATHYSSA INFICITA WALKER AT OLIVER, B.C. (Lepidoptera: Phalaenidae). Mr. E. Peter Venables found an outbreak of this species in July, 1942. The only previous British Columbia record in the literature available is for Lillooet, without mention of a host plant.

On July 17 the chunky green caterpillars, close resembling sawfly larvae, were taken on sumac bushes (**Rhus glabra**) along the highway 4 miles north of Oliver. At the time only a few specimens were present, but there must have been thousands a little earlier, as for miles the sumacs were almost stripped of leaves. The caterpillars were given to the Forest Inset Survey unit, and identified by M. W. C. McGuffin of Ottawa.—Hugh B. Leech.

MISCELLANEOUS RECORDS OF BEETLES IN BRITISH COLUMBIA

(Coleoptera: Hydrophilidae, Elateridae, Buprestidae, Lathridiidae, Chrysomelidae, Curculionidae).*

HUGH B. LEECH

Dominion Forest Insect Laboratory, Vernon, B.C.

Helophorus nitidulus LeConte. This little black species may be separated from others in the genus by the almost straight sulci on its smooth, inflated pronotum. It was described from Eagle Harbor, Lake Superior, and is known from Indiana and Manitoba. British Columbia specimens before me are: Salmon Arm, 1 male from an ephemeral pond in the woods, 7. V. 39, and a pair from Norton's pond, 24. V. 39 (Hugh B. Leech); Nation River area, 1 male, 25. VI. 40 (Geof. B. Leech).

Ludius glaucus Germar. These blackish click beetles occurred in thousands on the flower heads of a species of *Lupinus* at Vernon, B.C., during late May and early June, 1942. They were eating the buds and partially opened flowers, hollowing out irregular cavities in the sides and ends. In 1911 (Ent. Soc. Brit. Col., Proc. 1: 9) Venables reported this species at Vernon (as *Corymbites inflatus)*, noting that the beetles congregated on lupine stems, and that they damaged newly planted fruit trees by eating out the buds in early summer. Brittain (op. cit. 2: 14. 1913) also mentioned damage to young apple trees, as did Ruhmann (7: 8. 1915).

Chrysophana placida LeConte. In our "Proceedings" 27:6-10, issued March 1931, G. J. Spencer gives 7 records of beetles emerging from prepared timber in buildings. The following note adds another species to the list.

At Salmon Arm, B.C., on April 5, 1932, a fresh hole was noticed in the outer wall of the north end of my father's barn. Careful digging disclosed a live *placida,* which had almost gnawed its way out from the pupal burrow. The barn was built of seasoned Douglas fir lumber in 1920, and was painted that year or the next.

Cartodere ruficollis Marsham. Taken in 1932 at Salmon Arm, B.C., where it was common on the north end of my father's barn. The species was first found on February 28, by which date various small beetles were coming out of hibernation, and a few such as *Cercyon,* flying. On April 5 the *Cartodere* were most numerous in the hayloft, where they were crawling on the floor in a dust of crushed alfalfa leaves and seeds. A single specimen had one elytron white, the other black as usual.

Donacia idola Hatch. This species was described from Chase Lake, a sphagnum bog in Snohomish County, Washington (1939. Pan-Pacific Ent. 14 (3):110-112). On July 19, 1931, I took a series of *idola* on grasses and sedges around a pond on Seymour Mountan, a few miles from Vancouver, B.C. The pond is in a meadow beside the cabin built by members of the Alpine Club of Canada.

Chrysolina vidua Rogers. Adults, eggs, and larvae in all stages, were common on a wild aster *(Aster multiflora* Ait. Det. Prof. J. Davidson) along the Commonage road at Vernon, B.C. during the first half of June, 1942. No host plant was listed by Van Dyke, in his review of the nearctic species (1938. Bul. Brooklyn Ent. Soc. 33 (2): 45-58).

Barypeithes pellucidus Boheman. The first British Columbia record for this little weevil was from Victoria, B.C., 1936, by Harry Andison and W. Downes (see Brown, Canadian Ent. 72(4):67). In June 1941 I found the adults common on mature strawberry fruits in a small

*Contribution No. 2245, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Ont.

garden at 504 James St., Vernon, B.C.

The beetles are 3 to 3.75 mm. long, shiny piceous or rufescent, with antennae, legs and abdomen reddish; the dorsal vestitute is long and sparse. Easily separated by its smooth, evenly punctuate pronotum, from the larger *Brachyrhinus ovatus* L.

Gymnetron tetrum Fab. This squat little gray-haired weevil is common on mullein *(Verbascum)* in the eastern United States and Canada, and also in parts of Europe and Siberia. It has been reported from eastern Washington. I have found it numerous at Vernon (1940) and Osoyoos (1941). In winter and early spring the adults may be found hibernating under the rosette of basal leaves on dead mulleins; the larvae are said to live in the seed pods.

SOME FOOD PLANTS OF LEPIDOPTEROUS LARVAE. List No. 9

J. R. J. Llewellyn Jones

Cobble Hill, B.C.

An asterisk (*) denotes that the species has been mentioned in these lists previously, and that the information now presented is either additional, or is an amplification of what has already been reported.

Records in this list are supplied by the author.

Rhopalocera

* *Basilarchia lorquini burrisonii* Mayn. Hardhack *(Spiraea douglasii* Hook.).

Heterocera

* *Acronicta (Apatela) funeralis* G. & R. Willow *(Salix scouleriana* (Hook.) Barr.), ornamental species of willow, Carolina poplar, and garden species of plum.

* *Acronicta illita Sm.* English oak *(Quercus robur)*, alder *(Alnus rubra* Bong.), and ornamental crab apple *(Pyrus malus floribunda)*.

* *Acronicta radcliffei* Haw. Hyslop crab apple and garden species of plum.

* *Acronicta distans dolorosa* Dyar. Alder *(Alnus rubra* Bong.).

* *Amphidasis (Lycia) cognataria* Gn. Ocean spray *(Spirea discolor* Pursh.).

* *Halisidota maculata angulifera* Wlk. Hardhack *(Spiraea douglasii* Hook.), June - berry *(Amelanchier florida* Lindl.), willows *(Salix hookeriana* Barr., *Salix scouleriana* (Hook.) Barr.).

* *Hyphantria textor* Harr. Willow *(Salix lasiandra* Benth.).

* *Malacosom disstria erosa* Stretch. Alder *(Alnus rubra* Bong.).

* *Malacosoma pluvialis* Dyar. Wild cherry *(Prunus emarginata* Dougl.).

* *Nadata gibbosa oregonensis* Butl. Spanish chestnut (Species of *Castanea)*.

* *Pheosia portlandia* Hy. Edw. Willows *(Salix lasiandra* Benth., *Salix hookeriana* Barr., *Salix scouleriana* (Hook.) Barr.), poplar *(Populus trichocarpa* T. & G.), and aspen *(Populus tremuloides* Michx.).

**Pseudothyatira cymatophoroides* Gn. English hawthorn *(Crataegus oxyacantha* L.), and garden species of plum.

Scoliopteryx libatrix L. Willows *(Salix lasiandra* Benth., *Salix scouleriana* (Hook.) Barr.), black poplar *(Populus trichocarpa* T. & G.), lombardy poplar.

* *Schizura unicornis* A. & S. English hawthorn *(Crataegus oxyacantha* L.), garden species of plum.

FIELD OBSERVATIONS ON THE FOREST TENT CATERPILLAR, MALACOSOMA DISSTRIA VAR. EROSA STRETCH

GEORGE A. HARDY
Provincial Museum, Victoria, B.C.

The following account is based on field notes made in the course of a Provincial Museum field trip in the vicinity of Lac la Hache, Caribou District, British Columbia.

A very noticeable feature of the landscape was the devastation wrought by the forest tent caterpillar on the deciduous trees and shrubs. The extent of the territory affected was not fully determined. My notes record evidence of its work from 100 Mile House to Williams Lake, a distance of over 60 miles along the highway. Side trips that took us off the main road always revealed its presence, so that it is probable that the outbreak extended laterally for an equal distance, an area of at least 50 square miles *.

The aspen trees (*Populus tremuloides* Michx.) were completely defoliated with only isolated exceptions. When no aspen leaves were left the hungry hordes then attacked the adjacent shrubs, willow, alder, birch, dogwood and rose. The odd spectacle of roses apparently suspended in mid-air became a common one, for the blossoms were left untouched. One of the willows, *Salix exigua* Nutt., presented a strange combination of juvenile and adult characters in the leaves. In the young stage the leaves are silvery pubescent, becoming glabrate in age. When the old leaves were consumed by the caterpillars, the plant put forth a secondary growth so that the silver and green were side by side in those instances where the older leaves still remained. A noticeable exception was seen in the bushes of the buffalo berry, *Shepherdia canadensis* Nutt., and the silverberry, *Elaeagnus argentea* Pursh., which though growing with the other herbage attacked, were completely ignored by the caterpillars as a food substance, though freely employed as a support for their cocoons. According to reports of the local inhabitants, the preceding year, 1941, witnessed an even more severe attack. At the height of the outbreak the fence posts and wires were continuous sheets and ropes of caterpillars. Their crushed bodies made the railroad metals at times too slippery to permit the locomotive wheels to obtain traction.

By June 24, 1942, the date of our arrival in the vicinity, the caterpillars were nearly all fully grown; already the bare wintry look of the aspen trees was rendered still more striking by the clusters of white cottony cocoons that covered every twig, giving a very effective simulation of snow, especially when viewed against a background of sombre fir trees. The cocoons were by no means confined to the food plants; everything in the neighborhood supported them. Juniper, fir and even the buffalo berry bushes were laid under tribute for their support, not to mention our tent and personal belongings. For the first few days the full-fed larvae were wandering everywhere, into and over everything, a steady stream continually ascended table, chair and other legs; even the surface of the lake bore numerous wriggling caterpillars, extending in some places far out from shore. Many never reached the cocoon-spinning stage, as a result of attack by parasites either bacterial or insect in origin; scores of empty larval skins were draped over the bushes or flattened on the tent roof and other objects in the vicinity.

At the beginning of July, an unusual and increasing number of Brewer's blackbirds and bluebirds were noticed in the aspen wood near which we were en-

* Mrs. Elsie Bowyer reported from Salmon Valley, about 15 miles north of Prince George, B.C., that in 1942 tent caterpillars were extremely numerous, and invaded her young orchard "in two-feet wide streams from several directions, in the manner of army worms." Ed.

camped, particularly at dawn and dusk. At the same time quantities of large yellow dipterous maggots were found in and among our pots and pans. This discovery gave a clue to the intermittent tattoo that had been heard on the tent roof during the night and early morning. Investigation proved the sound to be due to these maggots falling from the cocoons spun up in the over-hanging branches. Further observation led to the discovery that the blackbirds and bluebirds were feeding on the abundant and easily procured maggots before they could burrow out of sight into the ground for pupation. The blackbirds were occasionally seen to rip open a cocoon, possibly having first seen a maggot wriggling to get out, as no evidence was obtained to prove that they were deliberately consuming the pupae of the moth.

A census was taken of the cocoons in order to ascertain what percentage contained parasitized pupae or larvae. One hundred were gathered at random and carefully examined and recorded. While it is obvious that one count cannot be taken as conclusive evidence for the whole district, it gives an idea as to what might be expected. Forty-four cocoons contained parasitized larvae, each inhabited by from one to five maggots of various sizes. Twenty-six pupae were parasitized in like manner. Thirty pupae were free of large dipterous maggots, although some of them were very feeble and lifeless.

Summed up, the result of examination demonstrated that in the case of those caterpillars that spun cocoons, 44 per cent were unable to pupate, 26 per cent contained parasites after reaching the pupal stage and the remaining 30 per cent appeared to be normally healthy although in a varying degree of vigour. Unfortunately no adults were reared from the pupae which were retained hence no figures are available as to the final effect of parasitism. Examination of cocoons in situ showed many of them with the round escape holes of the mature dipterous larvae, others bore evidence of being ripped open by the blackbirds, as previously observed.

Several adult dermestid beetles were taken or seen flying about the camp and while the preserved skins of drying mammals and birds no doubt had something to do with their presence, there is the possibility that they were attracted by the large numbers of dead and rotting *Malacosoma* larvae.

ON THE OVIPOSITION HABITS OF THE AUSTRALIAN COCKROACH, PERIPLANETA AUSTRALASIAE (FAB.)

G. J. Spencer

Department of Zoology, University of British Columbia, Vancouver, B.C.

During the last week in November some years ago a firm of local grocers sent me a gravid Australian cockroach. The roach was placed in a glass-covered beechwood rearing box about 14″x10″ x3″; the box already contained a few domestic crickets with their food and shelter. It was observed for a few minutes daily during the next three months and its habits recorded; the following notes are extracted from these records:

Dec. 1. 10 a.m. carrying a partly extruded egg pod which was fully extruded by 12:30 p.m.

Dec. 3. Still carrying the egg pod.

Dec. 5. Pod deposited on the floor and later the same day partly devoured by the roach or by the crickets.

Dec. 7. 2 p.m. A 2nd pod was just appearing so the roach was removed to another similar cage which was butted up against a radiator for heat, and supplied with a variety of powdered cereals, water from a partly plugged vial lying on the floor of the cage, and dried lean meat. Beyond a small tent-shaped piece of paper, there was no cover in the box.

Dec. 8. The egg capsule started the previous day had been deposited on the floor and had been eaten out by the roach which had probably eaten the previous one also.

Dec. 17. a.m. A 3rd capsule had been deposited overnight and had been completely covered in one corner of the box with shreds of wood fibre which the roach had torn off the smooth, dry, hard side of the box, and had cemented together with salvia. This gouging of fibres from the planed wood showed greater strength and sharpness of mandibles than one would expect to find in a cockroach. The cage was supplied with a petri dish of water with a flat wad of cotton batting in it to provide moisture. Cover for the insect was added in the form of a number of muddy grass roots with chopped-off stems and leaves.

Dec. 20. 10 a.m. A 4th ootheca just appearing. In the past 3 days the roach had twice covered up the 3rd pod with tufts of grass roots and had twice uncovered it again. The humidity in the cage was at saturation point. By 5:30 p.m. the 4th ootheca was almost completely extruded.

Dec. 24 From 11 a.m. to 3 p.m. carrying a 5th egg pod which was a light red colour instead of the usual dark brown.

Dec. 26. Either the 4th or 5th pod had been eaten so the remaining one was removed to another cage to see if the eggs would hatch. They did not.

Dec. 28. A 6th pod had been laid overnight and covered with a sloping shelter alongside the paper shelter, of grass and roots.

Jan. 2. A 7th pod was banked up in a sort of lean-to up against the previous one.

Jan. 5. An 8th pod was deposited overnight, was partly covered with grass and flour from the feed dish, and was placed in the corner alongside ootheca, No. 3.

Jan. 12. A 9th pod, placed with the Nos. 6 and 7, covered with an earthen coat.

Jan. 16. A 10th pod, besides the above, covered with foodstuffs, grass and earth. All these materials for covering had been carried two to three inches. Pod No. 8 was removed and examined and proved to be shrivelled up.

Jan. 23. The 11th pod, deposited overnight and covered with adobe alongside the above.

Jan. 28. Extruding a small pod.

Jan. 30. Pod No. 12, laid, not covered; eaten later the same day.

Feb. 8. Carrying a new pod, No. 13.

Feb. 9. Pod No. 13 deposited overnight, placed away from the others and covered with adobe.

Feb. 20. The 14th pod deposited alongside No. 13 on the floor, covered with adobe.

Feb. 28. Pod No. 15 deposited loose on the floor, not covered.

March 5. Carrying the 16th ootheca. Deposited it during the day and later covered it with adobe near Nos. 6 to 12.

March 10. The 17th egg pod, a very small one, was deposited and covered with adobe, at the hot end of the cage near the radiator, at the opposite side of the cage from all the others. Shortly after this the roach died. None of the eggs hatched.

We have here an unfertilized roach depositing 17 egg pods in exactly 100 days: she may have laid eggs before being confined in this cage. The egg laying averaged 1 pod every 6 days; most of them were covered with trash.

I find that the American roach also has this habit of covering her oothecae with trash and also of eating them now and then although supplied with an abundance of food and water.

AN OCCURRENCE OF SCUDDERIA FURCATA FURCATA BRUNNER, ON THE COAST OF BRITISH COLUMBIA (Orthoptera: Tettigoniidae)

J. F. Davidson

Vancouver, B.C.

On October 11, 1937, two specimens of the Fork-tailed Bush Katydid, (*Scudderia furcata* Brunner) were taken in the Fraser River delta. Both specimens were caught on the trestle of the Canadian National Railway, where the line crosses the north fork of the Fraser River to Lulu Island. Since the insect was not immediately recognized as uncommon to this region, no further specimens were sought, but the following day, after identification, another trip to the vicinity was made.

Some search was made before any were found, but a low purring chirp led the party to a birch tree (*Betula occidentalis* Hooker) where close examination showed one of the green Katydids. It was almost indistinguishable from the leaf on which it was resting, and this, coupled with the fact that the chirping always seemed to be farther away than it actually was, accounts for the difficulty in finding the insect. After discovering the location of the singers, judicious sweeping of the lower branches yielded some twenty specimens of both sexes.

The distribution in this area appears to be very limited, since all of the insects were taken in a narrow belt extending about twenty-five yards on both sides of the railway, and within half a mile of the river. Whether or not they occur on the north bank of the river was not determined, since the railway bridge is usually kept open, and the north bank at this point is rather difficult to reach.

The distribution of this Katydid is of considerable interest because this finding of it practically on the sea-shore, extends the range right across the continent. Mr. Morgan Hebard records specimens from the following States: New Hampshire; Massachusetts; Rhode Island; New York; New Jersey; Pennsylvania; Maryland; District of Columbia; Virginia; North Carolina; South Carolina; Georgia; Florida; Michigan; Wisconsin; Ohio; Indiana; Missouri; Kentucky; Tennessee; Alabama; Louisiana; South Dakota; Nebraska; Kansas; Arkansas; Oklahoma; Texas; Idaho; Washington; Oregon; and California; in all thirty-two states, and in Canada from Ontario; Quebec, and British Columbia. Mr. Ronald Buckell of Kamloops informs me that he has collected it in British Columbia from: Kaslo, Vernon, Salmon Arm, Enderby, Oliver, Creston, Penticton, Osoyoos and Lillooet.

This makes its distribution practically as widespread as any one of the ubiquitous *Acridiinae* although its altitudinal distribution may not be so great. But whereas such specimens as *Camnula pellucida* (Scudder) and *Melanoplus mexicanus* (Saussure) are freely flying and swarming forms, this insect is secretive, very local in distribution and frequently nocturnal. This extraordinarily wide range means therefore that the species is either of very great antiquity or indulges in hitherto undetected flights of some distance, probably at night, or is distributed by man in some way, perhaps in the egg stage. In this instance, since the range of occurrence was restricted to the above-mentioned area bordering the railway, it is quite conceivable that the original parent or parents, arrived as adults via some open form of railway car.

The question of its food in the locality where I found it seemed worthy of investigation, so the stomach contents were examined microscopically. The finely comminuted plant material contained an unusual number of stomata per unit area, and many peculiar club-shaped bodies occurred everywhere. The type and distribution of the stomata indicated a marsh or aquatic plant, and the absence of stomata on one of the leaf surfaces indicated a floating water plant. The leaves of the Yellow Pond Lily *(Nymphaea polysepala* Engelm.) were examined and were found to correspond in having the same stomatal distribution, and in having club-shaped papillae on the lower surface, identical with those found in the stomach of the insects. Thus it is logical to assume that this plant constituted the food of the Katydid at the time of capture. The birch trees were apparently merely resting places, and the insects must fly down to feed on the aquatic plants, probably at night.

INSECTS ACTIVE THROUGHOUT THE WINTER AT VANCOUVER, B.C. PART II: LISTS OF THE ORTHOPTERA, DERMAPTERA, HOMOPTERA, HEMIPTERA, DIPTERA, AND HYMENOPTERA.

RAY E. FOSTER

1575 Kamloops St., Vancouver, B.C.

This report constitutes a partial list of insects collected during the period November 8, 1939 to March 28, 1940 at Vancouver, B.C. It supplements the list published in Part I of this series (Foster, 1942), and completes that portion of the study which will serve as a basis for the ecological relationships now being prepared for publication.

In Part I, lists of the Coleoptera and Neuroptera were given and brief mention was made of the Thysanura and Collembola. To these four orders, eight more are added at this time, bringing the number of orders collected during the winter survey to 12. The Lepidoptera and Corrodentia are not given specific consideration.

ORTHOPTERA

LOCUSTIDAE

Acrydium brunneri Bolivar

DERMAPTERA

FORFICULIDAE

Forficula auricularia Linn.

HOMOPTERA

CERCOPIDAE

Philaenus leucopthalmus Linn.

CICADELLIDAE

Balclutha manitou (G. & B.)
Typhlocyba commissuralis Stal.
Typhlocybini sp.
Dikraneura sp. Very common.
Helochara communis Fitch.
Idiocerus downesi B. & P. Very common.

PSYLLIDAE

Specimens of frequent occurrence. No specific determinations made.

APHIDIDAE

Myzus ligustri? Mosley. Taken in immense numbers in March.

HEMIPTERA

MIRIDAE

Lygus pratensis var. *oblineatus* Say

ANTHOCORIDAE

Anthocoris antevolens White

NABIDAE

Nabis roseipennis Reut.
Nabis alternatus Parsh.

LYGAEIDAE

Ischnorrhynchus franciscanus Stal. Very common.
Lygaeus kalmii subsp. *kalmii* Parsh.

PENTATOMIDAE

Elasmostethus cruciatus Say Very common.
Podisus modestus Dall.
Banasa sordida Uhl.
Apateticus crocatus Uhl.

DIPTERA

AGROMYZIDAE

Phytomyza spp.

ANISOPODIDAE

Anisopus fenestralis Scopoli.

BIBIONIDAE

Bibio tristes Will.

BORBORIDAE

Borborus equinus Fallen
Leptocera sp.
Sphaerocera pusilla Fallen
Scatophora carolinensis Desv.

CECIDOMYIIDAE

Monardia canadensis Felt.
Phytophaga sp.

DIXIDAE

Dixa sp.

DOLICHOPODIDAE

Hydrophorus pensus Aldrich
Hydrophorus breviseta? Thomson
Hydrophorus innotatus Lw.

DROSOPHILIDAE

Drosophila inversa Walker
Drosophila sp.

EMPIDIDAE

Rhamphomyia sp.
Hydrodromia stagnalis Hal.

EPHYDRIDAE

Scatella spp.

HELOMYZIDAE

Tephrochlamys sp.
Oecothea fenestralis Fallen
Suillia limbata Thomson

LONCHOPTERIDAE

Lonchoptera dubia Curran

MUSCIDAE

Spilaria lucorum Meigen
Musca domestica L.
Scatophaga stercoraria L. Very common.
Scatophaga furcata Say. Very common.
Scatophaga sp.
Quadrula lucorum Fallen
Anthomyiine

MYCETOPHILIDAE

Bolitophilinae

Bolitophila dubiosa Van Duzee
Bolitophila montana Coq.

Sciophilinae

Dziedzickia (*Syntemna* of Joh.). Undescribed species.
Mycomyia terminata Garrett
Mycomyia sigma Joh.
Mycomyia spp. Females and defectives.

Mycetophilinae

Boletina "*tricincta*" No. 501 of Joh.
Boletina spp. Females and defectives.
Coelosia lepida Joh.
Cordyla. Undescribed species
Exechia. Undescribed species near *E. aviculta* Shaw.
Exechia clepsydra Fisher
Exechia fusca Mg. (*fungorum* Deg. of Joh.) Very common.
Exechia spp. Females and defectives.
Phronia sp. Female.
Phronia (*Telmaphilus* of Joh.) *tenebrosa?* Coq.
Phronia. Undescribed species near *P. insula*.
Rhymosia. Undescribed species near *R. seminigra* Sherman.
Allodia sp. Defective.
Mycetophila fungorum Deg.
Mycetophila spp. Females.
Mycetophila mutica Lw.
Mycetophila fenestrata Coq. Very common.
Mycetophila lassata Joh.
Mycetophila maculosa Guthrie.
Mycetophila fatua Joh. Very common.

Sciarinae

Sciara (*Neosciara*). Undescribed species

PHORIDAE

Megaselia sp ?
Triphleba pacyneura Loew
Triphleba varipes Malloch
Triphleba sp.

PIOPHILIDAE

Piophila nigricoxa Mel. & Sp.

PSYCHODIDAE

Pericoma spp.

SYRPHIDAE

Eristalis tenax Linn.
Epistrophe mentalis Will.
Melanostroma fallax Curran
Melanostroma stegnum Thoms.

TACHINIDAE

Gonia frontosa Say
Argenteopalpus signiferus Walker
Cyrtophleba nitida Curran
Calliphora erythrocephala Meigen

TETANOCERIDAE

Dictya sp.

TIPULIDAE

Limoniini

Limonia (*Rhipidia*) *maculata* Meigen

Pediciini

Pedicia (*Tricyphona*) *diaphana* Doane
Pedicia (*Tricyphona*) *vitripennis* Doane

TRICHOCERIDAE

Trichocera columbiana Alexander. Very common.
Trichocera colei Alexander
Trichocera sp., near *T. annulata* Meigen
Trichocera sp.

HYMENOPTERA

Andrena (*Andrena*) sp. Traces to *A. harveyi* Vier. In Viereck's synopsis (Viereck, 1904).
Andrena (*Trachandrena*) sp. Traces to *A. salicifloris* Ckll. var. *a*, in Viereck's synopsis.
Andrena (*Pterandrena*) sp. Traces to couplet 8 in Viereck's synopsis.
Halictus sp. Traces to *H. crassiceps* Ellis in Sandhouse's key (Sandhouse, 1924).
Ophion sp.
Gelis keeni Hgtn.
Hemiteles ?
Aperieptus sp. Probably undescribed species.
Plectiscus orcae? Ashm.
Orthopelma californicum Ashm.
Orthocentrus sp.
Phaeogenes sp.
Pachynematus sp.
Pachynematus sp.
Dolerus neoaprilis kenowi Macq.
Xenotoma ?

The above specimens, with the exception of the following types, are in the collection of the Department of Zoology of the University of British Columbia. Specimens of *Sciara (Neosciara)* were retained by Dr. F. R. Shaw. All other undescribed Mycetophilidae are in the possession of Dr. Elizabeth Fisher. Undescribed Hymenoptera are in the Canadian National Collection, Ottawa, Canada.

Acknowledgments—I am indebted to the many persons who assisted in the identification of the insects obtained during the course of the survey: Dr. G. S. Walley, Dr. O. Peck, Dr. Carl Atwood, Dept. of Agriculture, Ottawa, Ont. (**Hymenoptera**); Dr. C. F. Adams, Jefferson City, Missouri, (**Chironomidae**); A. R. Brooks, Dept. of Agriculture, Ottawa, (**Diptera**); Mr. Geo. Steyskal, Detroit, Michigan, (**Diptera**); Dr. C. H. Curran, New York, (**Diptera**); Dr. E. P. Felt, Stamford, Conn., (**Cecidomyiidae**); Mr. W. Downes, Victoria, B.C., (**Hemiptera, Homoptera**); Mr. R. Glendenning, Agassiz, B.C., (**Aphididae**); Dr. E. G. Fisher, Roland Park, Maryland, (**Mycetophilidae**); Dr. C. P. Alexander, Amherst, Mass. (**Tipulidae**); and Dr. F. R. Shaw, Amherst, Mass., (**Sciaridae**).

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Sandhouse, Grace A. 1924. New North American species of bees belonging to the genus Halictus (Chloralictus). Proc. U.S.N.M. 65 (Art. 19): 1-43.

Viereck, H. L. 1904. Synopsis of bees of Oregon, Washington, British Columbia and Vancouver. II. Canadian Ent. 36 (6): 157-161; III, (7): 189-196; III cont'd., (8): 221-232.

IN MEMORIAM

George O. Day, F.E.S

On February 5th, 1942, there passed away at the age of 88 one of our Society's oldest and most valued members. George O. Day came to British Columbia from England in 1905 and made his home at Duncan, Vancouver Island. Prior to coming to this Province he was manager of Parr's Bank at Knutsford, Cheshire, retiring in 1905. It has been possible to gather only scanty information regarding his early life but we are informed that he was a Freeman of the city of Chester, an honour only likely to be bestowed for outstanding public service. He was a fellow of the Royal Entmological Society. Apparently he had been active in the study of other sciences also and we learn with interest that his tutor in botany was the Rev. Charles Kingsley.

Mr. Day became a member of the Entomological Society of British Columbia on April 19, 1906, and the 7th annual meeting was held at his house in April, 1908. He was elected vice-president in 1912 and was president from 1913 to 1915. His particular interest was in Lepidoptera and he had a fine collection of the Vancouver Island species. This collection is remarkable for the beautiful mounting and condition of every specimen, for its maker could tolerate nothing but the best. He had originated a method of setting Lepidoptera which was largely responsible for the beautiful condition of the specimens. The wings were held in position on the setting board by means of slips of glass hinged to the edges of the board, the weight of the glass in most cases being sufficient to hold the wings in place until dry. This collection is now in the possession of the Shawnigan Lake boy's school at Shawnigan, B.C., to which it was bequeathed, as was also a collection of British butterflies and moths, brought by Mr. Day from England, containing examples of nearly every British species.

The late Mr. Day was noted for his genial, kindly disposition, courtesy and friendliness. Visiting entomologists never failed to receive a warm welcome at his beautiful home "Sahlatston" at Duncan, and he was always eager to show his collection and enter into discussions relating to his favourite hobby. Generous in giving specimens to others and always willing to help beginners, he was perhaps the best type of amateur. He was a regular attendant at the annual meetings of the Society until infirmity due to advancing years compelled him to cease active participation. In his passing another link with the early years of the Society has been severed and those who had the privilege of knowing him intimately have lost a valued friend.

A photograph of the late G. O. Day was published in number 8 of the Society's Proceedings.

W. DOWNES.

List of articles by the late G. O. Day published in the Proceedings of The Entomological Society of British Columbia.

		Proceedings
1911*	**Bombycia improvisa**, Edw. and its congeners	No. 1, p. 30-33
1913	Notes on **Xanthia pulchella**, Smith	No. 2, p. 38-40
1913	Notes on **Schizura unicornis**, Smith and Abbot	No. 2, p. 40-41
1913	President's address	No. 3, p. 29-30
1914	President's address	No. 4, p. 39-44
1915	Notes on the early stages of **Calocampa cineritia**, Grote	No. 5, p. 86-87
1915	Notes on the early stages of **Epirrita dilutata**, Denis and Schiff	No. 5, p. 95-96
1915	Nomenclature and classification (Presidential address)	No. 6, p. 99-110
1918	Larva rearing	No. 8, p. 21-27
1919	Life-history of **Perigrapha præses** Grt	No. 12, p. 17-19
1921	Notes on **Oporinia autumnata** Gn	No. 14, p. 16
1921	Early stages of **Nepytia phantasmaria** Strecker (Lepidoptera)	No. 18, p. 30-32
1929	On the early stages of **Platyptilia punctidactyla** (Pterophoridae-Lepid.)	No. 25, p. 14-15

* Re dates of publication, see Proceedings No. 38, p. 29-36. 1942.

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Black bugs in my garden patch,
And speckled bugs and red;
A funny little striped bug
With whiskers on his head;
And green bugs, purple bugs,
And bugs of salmon hue,
And all of them seem happy,
For none of them are blue.
(Author?)

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PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY *of* BRITISH COLUMBIA

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RECENT LITERATURE[1]

STONEFLIES OF SOUTHWESTERN BRITISH COLUMBIA. By William E. Ricker. Indiana University Publication, Science Series No. 12, 1943. Sold by the Indiana University Bookstore, Bloomington, Ind., at $1.50.—This fine paper of 145 pages and 129 text figures includes keys for identification, from families down to species. The following points are fully discussed: geography and climate of the region; the streams; classification of the stoneflies; ecological distribution of the species; environmental distribution of related forms; fauna of neighbouring regions; descriptions of species. There is also a systematic check-list of species and a list of literature cited.

BRITISH COLUMBIA DRAGONFLIES WITH NOTES ON DISTRIBUTION AND HABITS. By F. C. Whitehouse. Amer. Midland Naturalist **26**: 488-557, ill. Notre Dame, Ind., 1941.—This article gives many interesting and useful data. It will be of use chiefly to those who have other means of getting their species identified, as it does not contain keys. Mr. Whitehouse may still have reprints for distribution; his address is 1109 Burnaby St., Vancouver.

THE CADDIS FLIES, OR TRICHOPTERA, OF ILLINOIS. By Herbet H. Ross, Illinois Nat. Hist. Survey, Bul. 23 (Article 1): [6 +] 1-326, frontispiece and 961 text figs., many compound; p. 290, 302, 312 are blank. Natural Resources Bld., Urbana, August 1944. $1.00.—This report, the result of 12 years of field work and study by Dr. Ross and his associates, cannot be too highly praised. Dr. Ross has long since proven himself a first rate taxonomist, and his work is here enhanced by a series of beautiful photographs and excellent drawings, the latter by Dr. Carl Mohr and Miss Kathryn Sommermann.

In addition to the keys to and technical descriptions of the species known from Illinois, the following points are discussed and illustrated: biology; habitat preference; distribution; collecting and preserving; classification; key to the families (larvae, pupae, adults. A number of new species, not from Illinois, are described in the text, p. 268-289; one is from Vancouver, B.C.

"As the work progressed it became apparent that a study of the entire North American Fauna was necessary to identify properly the Illinois species . . ." (from foreword by T. H. Frison). One result of this is a fine "Check List of Nearctic Trichoptera," p. 291-303. In this the arrangement is taxonomic; generic and specific synonyms are given, many of the latter being here announced for the first time. Each species is followed by a reference to its original description, an indication of its distribution, and the genus in which it was originally described. There is a list of literature cited and an excellent index.

COMPARATIVE EXTERNAL MORPHOLOGY, PHYLOGENY, AND A CLASSIFICATION OF THE BEES (HYMENOPTERA). By Charles Duncan Michener. Amer. Museum Nat. Hist., Bul. 82 (Article 6): 151-326, 246 text figs., 13 diagrams; p. 152, 156, 318 are blank. New York, April 10, 1944.—Here at last is a work in which one may key out to genera the North American bees. Dr. Michener published his first papers on bees while still a high school student; the present article is essentially his thesis for the Ph. D. at the University of California, Berkeley.

The paper is divided into 4 parts: (1) External morphology of **Anthophora edwardsii** Cresson. (2) Comparative external morphology of bees. (3) Phylogeny of the bees. (4) A classification of the bees. The section on morphology is thorough. The part on classification includes a (phylogenetic) key to the families, with subsequent keys down to genera and some subgenera. In addition there is an artificial key to the North American genera. Numerous references to the bees of other regions indicate the broad basis of the study. The figures are grouped on p. 303-317, and are noteworthy for the full naming of parts; one does not have to consult a list of abbreviations! The literature cited is given in full, and there is an index of taxonomic names.

BRITISH COLUMBIA PROVINCIAL MUSEUM. HANDBOOK SERIES.—Officers of the Museum at Victoria are to be congratulated on these informative booklets, which though not dealing with entomology, are of the greatest interest to naturalists of the Province. They may be obtained from the Director, price 25 cents each.

Handbook No. 1. Fifty Edible Plants of British Columbia. By G. A. Hardy. 54 p., 50 figs. December 1942. The illustrations in this are rather sketchy.

Handbook No. 2. The Amphibians of British Columbia. By G. Clifford Carl. 62 p., 27 figs. June, 1943. This and No. 3 contain simplified keys for the identification of species, and beautiful illustrations by Staff Artist Frank L. Beebe.

Handbook No. 3. The Reptiles of British Columbia. By G. Clifford Carl. 60p., 18 figs. April, 1944. An Appendix gives up to date information on the treatment of rattlesnake bite, and on the care of reptiles in capitivity.

[1] Since not all our members recive journals reviewing the literature, attention is here drawn to several recent papers which deal in whole or in part with British Columbia species, or which contain keys for the identification of genera and higher categories.—H.B.L.

CORRECTIONS, VOLS. 38 & 40

The past four volumes of the Proceedings contain several errors in spelling, all of which may be recognized and corrected by the readers. Three more serious errors in Vol. 38, and one in Vol. 40, not present in the original manuscripts, should be called to your attention.

Number (=Volume) 38

(A) Page 12, line 13: "uncovered" should be "covered."

(B) Pages 14-15. The titles for Figs. 1 and 2 were transposed; 50 copies were mailed before this was noticed. Fresh titles on glued paper were printed immediately and sent to those 50 subscribers; all stock on hand was corrected. All copies should thus have the illustration on p. 14 labelled as Fig. 2 and that on p. 15 as Fig. 1.

(C) Page 31, line 17: "September" should be "November,"

Volume 40

(D) Inside of front cover, List of Members: John Stainer's name should be preceded by an asterisk.

PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY *of* BRITISH COLUMBIA

Volume **41.** Issued December 8, 1944

PRESIDENTIAL ADDRESS

J. R. J. Llewellyn Jones, M.A., F.R.E.S.

It is my pleasure to welcome the members of our Society to the 43rd Annual Meeting, held unfortunately while still under the shadow of war, but with the increasing hope that victory and peace may not be long delayed.

Since the last Annual Meeting our Society has suffered the loss by death of three of its senior members.

Mr. M. H. Ruhmann, our Honorary President, who had been in ill health for some little time and whose passing was not entirely unexpected. He was well known to many of you and will be greatly missed by those who knew him best.

Mr. A. W. Hanham of Duncan, Vancouver Island, who also for some few years had been in failing health, was 86 years old at his death. For many years he had shown a keen interest in many branches of Natural History and was a keen collector of Lepidoptera and of other orders of insects, as well as in other fields of Natural History

Mr. W. B. Anderson at the age of 87, who in the past took an active interest in our Society.

I refrain from further comment on their work and leave that to more competent members who had the privilege of knowing them better than I.

I ask the meeting to rise as a token of respect. May their souls rest in peace, and may perpetual light shine upon them.

The Secretary-Treasurer will shortly present his Financial Statement which I think you will consider satisfactory under the present difficult conditions due to the prolongation of war. He reports a credit balance of $44.91.

The Endowment Reserve Fund shows a small increase, and I should like to take this opportunity to put forward with a view to discussion later, after you have received the Statement, certain suggestions as to the ways and means of making this fund more worthy of our Society.

We are looking forward to the day when we can publish the Proceedings without assistance from outside the Society, and it was to achieve this end that the Reserve Fund was primarily instituted some few years ago. I should like however, if I may be so bold, to indicate another use for the fund, if and when it has reached a reasonably large capital sum. I refer to a scholarship for needy students in Entomology to be valid at the University of British Columbia, or at some other University or College at the discretion of our Society. As a learned Society it should in some measure co-operate with the educational authorities in providing training for the coming generation of scientific men. It has been well said that "no man liveth unto himself" and by establishing such a scholarship the Society would be showing in practical form its interest in the youth of Canada, out of whom will spring our leaders in future years.

And now to return to the immediate task before us, namely to investigate ways and means of attaining our objective:

(1) An increase in the membership dues. I hesitate to recommend this in view of the ever heavier financial burdens both in the field of taxation and in the cost of living imposed upon us by reason of the war. But this possibility should not be overlooked as a source of increased revenue.

(2) Increase of membership to a number which would allow the dues received, together with other sources of revenue, to cover the cost of publishing the "Proceedings" and financing our Society, and yet leave a reasonable sum to be transferred to the Reserve Fund each year.

It will be necessary to go outside the ranks of the professional entomologists, remembering that anyone interested in the scientific study and collection of insects would be a welcome acquisition to the Society. Our schools and universities together with the teaching profession should form a source of supply. There are many too in the learned professions who are interested in scientific work.

DEC 13 '44

I am informed that there are nine names of candidates put forward for membership and that they will come up for election at this meeting. I extend to them, on your behalf, a hearty welcome.

(3) A contribution to the cost of publication of the "Proceedings" from those submitting papers for publication. This is in force at least in principle at the present time in that members requiring "separates" of their papers are now charged for them at a set rate.

(4) By means of bequests. For generations past this has been the means of providing endowments for schools, colleges, universities and learned Societies, and if some of our members were to leave even only a small sum to the Society in their wills, eventually our goal would be reached.

I commend these suggestions to your careful consideration and comment later.

And now to pass from the consideration of matters of concern only to our Society. Let us consider together briefly the part played by entomologists at the present time and the part that they should play in the future, after the war has been won and peace has been restored.

As is only right in such times as these economic entomology has been pressed forward and redoubled efforts made to promote the well-being both of the armed forces and the civilian population. The general public however, takes a good deal of educating and unfortunately we are still not very far remote from the attitude of mind which some years ago caused the will of a certain Lady Glanville to be disputed on the grounds that, as she was interested in butterflies, she was of unsound mind. True we have advanced a little beyond this stage, but still, in the minds of many, the entomologist is rather a curious person and certainly a little eccentric, but not to the extent of being dangerous.

Possibly we are somewhat to blame ourselves in this respect in that we have not sought sufficient publicity for our efforts in the public good. However the labours of entomologists, in co-operation with medical science, to control and cope with tropical diseases, many of which are spread by various species of insects are being more widely known and are receiving greater publicity. Also the part that entomological research plays in the protection of the farmer's crops and the preservation of his herds, all so important at the present time, is being more generally realised and appreciated. On matters of public health too, the entomologist keeps a watchful eye, and from time to time gives warning of trouble ahead to the public bodies concerned, but unfortunately city Corporations and the like do not always lend a sympathetic ear, however timely the warnings, or however tactfully they may be given. Despite these discouragements the entomologist continues his labours hoping for the co-operation of the authorities concerned, and of course in many instances getting it, and looking for the sympathetic understanding of the general public to the end that the health and well-being of the community at home may be assured and the fighting services protected abroad.

And now as to the place of entomological research after the war. Economic entomology will continue to render service as now, to the medical profession, to public health authorities, to agriculture and to forestry; the findings of entomologists will be at the disposal of the departments concerned without restriction or reserve.

There is however another side of entomological research, which ought not to be overlooked or shoved into the background, which is concerned more with the advancement of scientific knowledge for its own sake than for material results.

As a scientific society, do not neglect the purely scientific side of the picture in an eagerness for material results and the plaudits of a public which unfortunately is all too apt to judge its values by a norm of dollars and cents.

Now science is a search after truth, and truth is a fundamental element, if we are to have after the war that "better world" which many politicians and others are promising us. Men of science are seekers after truth in that they probe the laws whereby the universe and all that it contains are governed. The more science is able to tell us of the laws of nature the better we shall be fitted to face the problems which lie ahead, in that we shall possess more enlightened minds, and less narrow outlooks.

We hear much these days of international co-operation and of the greater necessity for understanding other people's point of view, if we are to have a just and lasting peace. Science and truth have this attribute in common, that they know no hindrance of race or creed and are thus truly international, and therefore can be of immense value in producing harmony between the varied peoples and races of the world. The scientist therefore has a great and important duty to discharge for the ultimate well-being of the race.

Our Society already realizes the value of international friendship and co-operation as is evidenced by the number of members from the United States of America whose names appear on its roll. This membership is highly esteemed and augurs well for the future well-being of the Society, and is indicative that its members are fully aware of the part that they may play, as messengers of good will, in bringing into being that dream of a better world.

SOME FOOD PLANTS OF LEPIDOPTEROUS LARVAE. List No. 10

J. R. J. LLEWELLYN JONES
Cobble Hill, B. C.

An asterisk (*) denotes that the species has been mentioned in these lists previously, and that the information now offered is either additional, or is an amplification of what has already been reported. Records in this list are supplied by the author.

Heterocera

***Acronicta (Apatela) fragilis fragiloides* B. & Benj. June-berry *(Amelanchier alnifolia* Nutt.), and species of plum (garden varieties).

***Acronicta (Apatela) funeralis* G. & R. Alder *(Alnus rubra* Bong.).

***Acronicta (Apatela) grisea revellata* Sm. Alder *(Alnus rubra* Bong.).

Acronicta (Apatela) lepusculina cyanescens Hamp. Willows *(Salix scouleriana* (Hook.) Barr., *Salix barclayi* Anders.).

***Amphidasis (Lycia) cognataria* Gn. English oak *(Quercus robur* L.), hazel *(Corylus rostrata* Ait.), species of huckelberry *(Vaccinium)*, species of plum and raspberry (garden varieties).

***Dicentria semirufescens Wlk. (Ianassa semirufescens)*. English hawthorn *(Crataegus oxyacantha* L.), and Judas tree (Cercis canadensis L.).

Gabriola dyari Tayl. Douglas fir *(Pseudotsuga taxifolia* (Lamb.) Brit.

***Paonias excaecata* A. & S. June-berry *(Amelanchier alnifolia* Nutt.), species of plum (garden varieties), and species of cherry (ornamental varieties).

Sarrothripus revayana lintnerana Speyer.
Sarrothripus revayana columbiana Hy. Edw.
Sarrothripus revayana cineneana N. & D.
} Willow *(Salix scouleriana* (Hook) Barr., *Salix hookeriana* Barr.) and probably on species of oak.

***Schizura unicornis* A. & S. June-berry *(Amelanchier alnifolia* Nutt.), and species of cherry (garden varieties).

***Synaxis jubararia* Hlst. Red flowered currant *(Ribes sanguineum* Pursh.).

VIRTUAL ABSENCE OF VESPINE WASPS IN THE SUMMER OF 1944 (Hymenoptera, Vespidae). Unusual number of overwintered queens of Vespula spp., both the yellow and black "yellowjackets" and the white and black "hornets", were seen visiting the flowers of cultivated currants and gooseberries in the spring of 1944. Few of tthe queens succeeded in establishing broods. The scarcity of wasps in the southern interior of British Columbia has been commented upon by entomologists, foresters and laymen. The writer has seen but a single wasp and no nests during the summer, while many persons have reported not seeing any wasps at all.—Hugh B. Leech.

THE DISTRIBUTION OF SOME PLAGUE-IMPORTANT RODENTS AND FLEAS IN WESTERN CANADA

(Mammalia: Rodentia, and Insecta: Siphonaptera)[1]

George P. Holland
Livestock Insect Laboratory, Kamloops, B. C.

Foreword.—In 1938, surveys of some of the commoner species of rodents occurring in British Columbia and Alberta were initiated, with a view to determining whether sylvatic (=bubonic) plague had become introduced to those two provinces. Gibbons (1939) stated: "Most of the observers are of the opinion that the west coast of North America became infected in the course of the plague pandemic of 1894 which originated in Hong Kong and reached America at least by 1900. Wild rodents probably became infected through contact with domestic rats and the infection spread until it is now present in nine of the western states, including Washington, Idaho and Montana, which border on the provinces of British Columbia and Alberta. The history of the progress of the infection northward and eastward through the western sections of the United States forces us to consider that the infection may have extended to Canada, or if not, may be expected to do so within the next few years."

Accordingly, surveys were organized by the Health Departments of these two western provinces, under the direction and advice of the Dominion Department of Pensions and National Health and the Livestock Insect Laboratory, of the Division of Entomology, at Kamloops, B.C. During the first season (1938), tissue and flea specimens were tested at the George Williams Hooper Foundation in San Francisco. In 1939, and subsequently, the tests were conducted at the newly constructed Laboratory of Hygiene at Kamloops.

In 1938 the attention of the Alberta crew was drawn to the case of a mink farmer of Stanmore, Alberta, who had died the previous year of an acute septicaemia resulting from an injury to his finger incurred while skinning a mink. This mink, with a number of others, had died following the use of ground squirrels (*Citellus r. richardsonii* (Sabine)) from a nearby area, as food. In 1939, *Pasteurella pestis* was demonstrated in ground squirrels and their fleas, from this particular locality, and the infection was found to be present over at least four townships, embracing an area of 144 square miles (Gibbons and Humphreys, 1941).

In 1941, plague was demonstrated in *Citellus r. richardsonii* in Divide County, North Dakota (Public Health Reports, 1942) immediately south of the Saskatchewan border. In 1942, a survey of southern Saskatchewan, based on the system used in British Columbia and Alberta, was instituted by the Health Department of that province and carried out under the supervision of the writer.

In 1943, the Royal Canadian Army Medical Corps conducted an investigation of the ground squirrels and rats occurring in the vicinity of military camps in the provinces of Alberta, Saskatchewan and Manitoba.

As a result of all these surveys, considerable data have been accumulated on the distribution of important rodents and fleas and form the subject matter of the present paper.

General Considerations.—Western Canada has been, and is, exposed to two principal avenues whereby plague might be introduced: (1) through the spreading of the disease from infected ground squirrel or other native rodent colonies in the adjoining states of Washington, Idaho, Montana and North Dakota, where it is known to be established (as has already occurred in Alberta), and (2) through the introduction of plague-infected rats, conveyed by shipboard from foreign lands

[1] Contribution No. 2315, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

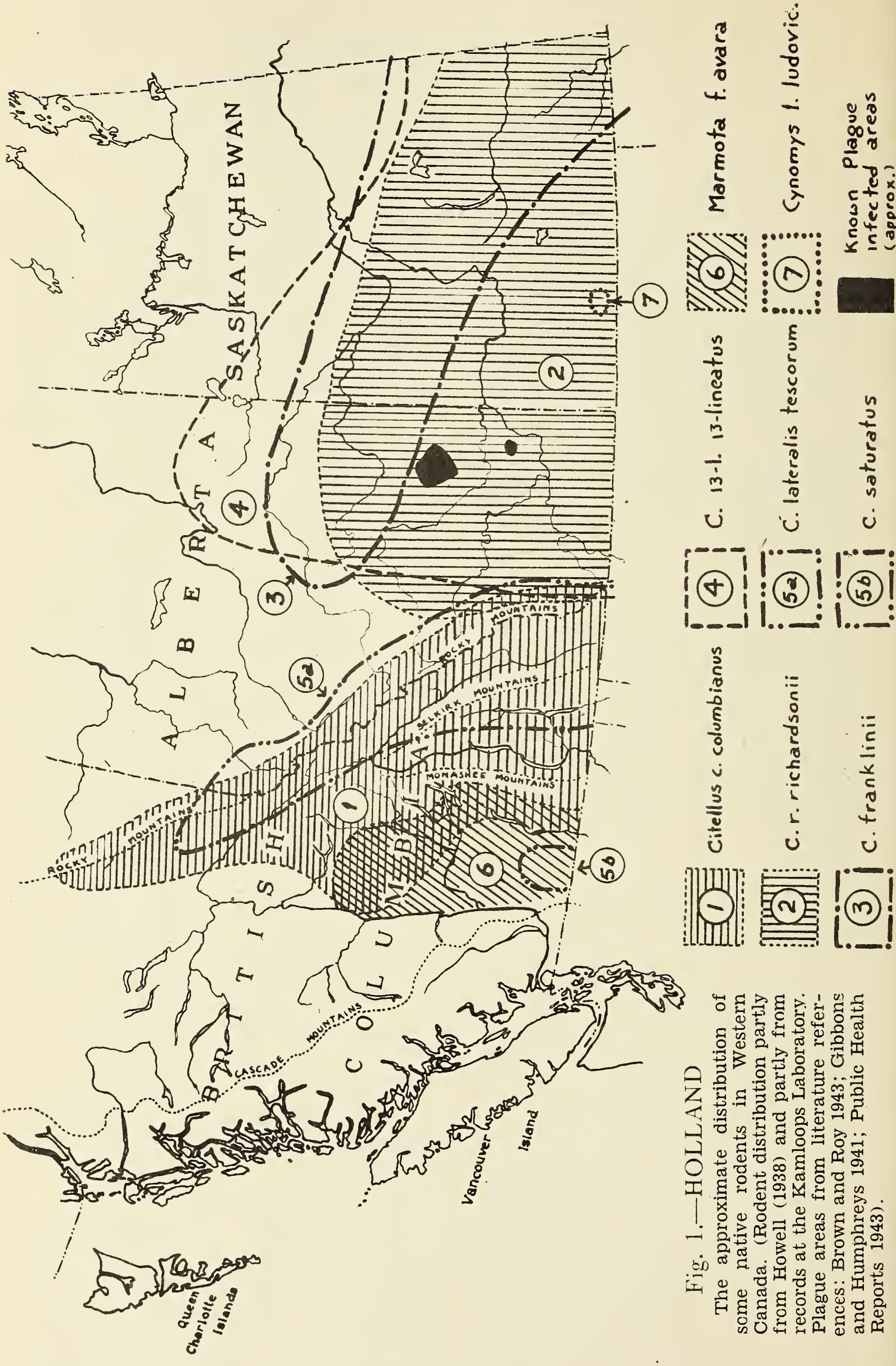

Fig. 1.—HOLLAND

The approximate distribution of some native rodents in Western Canada. (Rodent distribution partly from Howell (1938) and partly from records at the Kamloops Laboratory. Plague areas from literature references: Brown and Roy 1943; Gibbons and Humphreys 1941; Public Health Reports 1943).

to our Pacific seaports, all of which are heavily infested with rats, the natural carriers of plague.

Also to be considered is the possibility of infected rats being brought north by train from such cities as San Francisco, Tacoma and Seattle, where plague has been recorded in these rodents. Again, there is the possibility of the disease spreading from infected prairie ground squirrels to the rat populations in certain southern towns and cities.

However, the present article is concerned primarily with the distribution of the potential carriers and vectors of plague, as revealed by the results of the surveys of British Columbia, Alberta and Saskatchewan. Not sufficient data are available, as yet, for a detailed account of the situation in Manitoba.

While a fair number of rodents of both native and introduced species have been incriminated with regard to plague transmission in the United States, investigations in Canada have been restricted to comparatively few forms, such mammals as the tree squirrels (*Tamiasciurus* spp.), flying squirrels (*Glaucomys* spp.) woodrats (*Neotoma* spp.) and mice (*Peromyscus, Microtus, Mus,* etc.) being ignored, or collected only as opportunity offered. However, much attention was given to ground squirrels of several species (particularly two), introduced European and Asiatic rats, and, to a much lesser extent, marmots, prairie dogs and chipmunks.

Distribution of the Rodents

A. Indigenous Species.—Fig. 1.

(1) Columbian ground squirrel, *Citellus columbianus columbianus* (Ord).

The range of the Columbian ground squirrel covers a large area in southeastern British Columbia, and fringes the southwest boundary of Alberta. It is, in fact, rather closely confined to the Rocky, Selkirk and Monashee mountain systems, with their related foothills and valleys. Habitat types vary from open fields in the bottomlands to alpine meadows at 7,000 to 8,000 feet altitude. According to local reports it is only in comparatively recent years that these ground squirrels have been seen in any numbers west of the North Thompson River. They occur now as far west as Lac la Hache and 150 Mile House along the Cariboo Highway, and are very common in the Horsefly Lake region. In the Columbia and Kootenay valleys they frequently occur in large colonies, and in some areas constitute a serious agricultural menace.

Southward, these rodents extend into Washington, Oregon, Idaho and Montana. Eskey and Haas (1940) reported plague in this species, from tissue samples and fleas collected at Wallowa Country, Oregon.

(2) Richardson ground squirrel, *Citellus richardsonii richardsonii* (Sabine).

This mammal, locally known as the "prairie gopher" is the commonest and and most conspicuous rodent of the great plains of Alberta, Saskatchewan and Manitoba. Aside from its potentialities as a disease carrier, its depredations to crops and interference with irrigation combine to make it an economic problem of prime importance. Its distribution, and the areas where plague infection has been demonstrated are shown on Plate 1.

In the United States, plague has been shown in this rodent in Beaverhead County, Montana (Eskey and Haas) and Divide County, North Dakota (Public Health Reports, 1942). The status of this mammal in Canada has recently been treated by Brown and Roy (1943).

(3) Franklin ground squirrel, *Citellus franklinii* (Sabine).

This rodent, sometimes known as the "gray gopher," "brush gopher" or "bushytail" is widespread across the prairie provinces, but is chiefly confined to the lightly treed areas, rather than on the open plains. In the United States, it is found in North and South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Illinois and Indiana.

Very few specimens of this mammal have been collected by the Canadian survey crews, principally because plague investigations have been conducted chiefly in the extreme south of the prairie, while the Franklin ground squirrel is more abundant farther north.

(4) Thirteen-lined ground squirrel, *Citellus tridecemlineatus tridecemlineatus* (Mitchill).

This ground squirrel, usually known locally as the "striped gopher," is much more widespread in the prairie provinces than *C. r. richardsonii*, but in the areas covered by the survey crews, has not proved to be common. Only a few specimens have been collected, in scattered localities, in Alberta and Saskatchewan. *C. t. tridecemlineatus* and related subspecies occur all through the central United States.

(5) Mantled ground squirrels, *Citellus (Callospermophilus)* spp.

Plague has been demonstrated in ground squirrels of the subgenus *Callospermophilus* in several counties of California (Eskey and Haas). Flea species present were *Diamanus montanus* (Baker), *Oropsylla idahoensis* (Baker) and *Monopsyllus eumolpi* (Rothschild), the last two of which occur commonly in Western Canada on a number of hosts.

The dusky mantled ground squirrel, *Citellus saturatus* (Rhoads) is found in the east Cascades, in the extreme south of British Columbia. Hollister's mantled ground squirrel, *C. lateralis tescorum* (Hollister) is found in the Rocky and Selkirk mountain regions. Neither species has been collected in any great numbers by the survey crews.

(6) Pallid yellow-bellied marmot, *Marmota flaviventris avara* (Bangs).

The yellow-bellied marmots or "groundhogs" are confined chiefly to the "Interior Dry Belt" of British Columbia, in some localities of which they may occur in considerable numbers, especially if large rock piles are available for protection. *M. f. avara* is found in the Fraser Valley as far south as Hope, and extends to the north as far as Williams Lake. It ranges southward through the Okanagan Valley into Washington, Oregon and northern Nevada. Related subspecies are found in all the western and Pacific States, with the possible exception of Arizona. Fair numbers of *M. f. avara* have been collected by the British Columbia survey crews, and also a few individuals of *M. caligata* ssp., the hoary marmot, in areas at high altitude.

Plague has been demonstrated in marmots (probably *M. flaviventris nosophora* Howell) in Montana and Wyoming (Eskey and Haas).

(7) Black-tailed prairie-dog, *Cynomys ludovicianus ludovicianus* (Ord).

Prairie-dogs are known from one locality in Canada, in a coulee bottom, thirteen miles southeast of Val Marie, in southern Saskatchewan, where a single large colony exists. The Saskatchewan survey crey has collected a number of these mammals.

In the United States, plague has been demonstrated in *Cynomys parvidens* Allen (Garfield County, Utah), *C. leucurus* Merriam (Uinta County, Wyo.) and *C. gunnisoni zuniensis* Hollister in New Mexico and Arizona (Eskey and Haas).

(8) Chipmunks. *Eutamias* spp.

Chipmunks of many species and subspecies occur in Western Canada. A small number (mostly *E. amoenus affinis* (Allen), and *E. amoenus luteiventris* (Allen)) were collected by the British Columbia crew. While these rodents occur in Alberta and Saskatchewan (mostly *E. minimus borealis* (Allen)), very few were collected due to the fact that they occur principally in the lightly treed areas, whereas the bulk of the survey work was carried out on the open prairie.

Plague was recovered from *Eutamias* spp. in various localities in California and Nevada (Eskey and Haas).

B. Introduced Species.

(9) Norway rat, *Rattus norvegicus* (Erxleben).

The Norway rat, house rat or sewer rat, a native of the Old World, was introduced to North America in the middle of the 18th Century. Since that time, the original stock has multiplied and spread, and also there have been successive invasions of seaport towns of rats from poorly tended vessels docking there. This undesirable rodent has followed man to nearly all corners of the globe and, once established in any locality, is very difficult to eradicate. Plague is a natural disease of this and related species, and the fleas of rats are ideally adapted to the dissemination of this disease, partly because of their peculiar physiology, which renders them readily infective, and partly because of their readiness to bite man. These facts, coupled with the rats' tendencies to become established around domestic households, make the rat and rat flea situation a public health menace of grave concern.

In Western Canada, rats are localized to a certain extent. Apparently they occur in most, if not all, seaport towns from Vancouver to Prince Rupert, as well as on Vancouver, Queen Charlotte, and doubtless other islands. They are found commonly in the lower Fraser Valley, around Chilliwack, Hope, Harrison Bay, Agassiz, etc.

They occur in garbage dumps, warehouses, waterfront docks, in lanes in the residential areas where they feed on garden refuse and garbage from poorly tended tins, around stables, restaurants, abattoirs, in houses, grain elevators, and in fact, any place where an easy living may be obtained.

In the Interior of British Columbia they seem to be rare, and this apparently holds good for most of Alberta also, although we have records from Calgary.

Southern Manitoba is apparently well populated, and Saskatchewan, while virtually free of rats a few decades ago, now shows a steady increase in numbers of these rodents, and a very definite spreading westwards and northwards. The Sanitation Division of the Provincial Health Department has prepared an interesting map, showing the influx and advances of rats, year by year.

Southern cities, such as Regina and Moose Jaw, are now heavily infested, as also is Saskatoon. In Estevan, rats and Richardson ground squirrels were noted in large numbers in the same garbage dump, and this only ten miles or less from the plague focus in North Dakota! Furthermore, ground squirrel fleas *(Oropsylla rupestris* (Jordan)) were recovered from the rats. Here then is the ideal opportunity for the rats to pick up the infection from the ground squirrels!

(10) Black rat, *Rattus rattus rattus* (Linnaeus).

The black rat, a smaller and longer-tailed species is comparatively rare in this country, only a few specimens having been collected, and these usually in waterfront warehouses at the coast. It apparently has to give way before the more powerful Norway rat. They both carry the same species of fleas, but *R. r. rattus* is not now common enough to constitute a serious problem.

(11) Roof rat, *Rattus rattus alexandrinus* (Geoffroy).

This rodent, like the black rat, is comparatively rare, and known only from the coast areas.

Distribution of the Fleas

These rodents have been found to be infested with a wide variety of fleas of which fifteen species were fairly common to very common, and which are of varying importance as potential plague vectors. Their relationship to the rodent hosts is summarized in Table I.

A. Indigenous Species.

(1) *Monopsyllus eumolpi* (Rothschild).

M. eumolpi is a common and regular parasite of western chipmunks (genus *Eutamias)* and is found wherever these mammals occur. In British Columbia it is quite frequently collected on the Columbian ground squirrel when habitat association offers the opportunity. It has been proved to transmit plague experimentally in the laboratory (Eskey and Haas). We have several records of this insect biting man.

TABLE I
Species of Fleas Found, and Relationship to Rodent Hosts

	Hosts								
	Rattus spp.	Citellus c. columbianus	Citellus r. richardsonii	Citellus franklinii	Citellus 13-lineatus	Callospermophilus spp.	Marmota flaviventris avara	Cynomys l. ludovicianus	Eutamias spp.
Indigenous Species									
1. Monopsyllus eumolpi...		*							†
2. Neopsylla inopina.....		†	†	*	*				
3. Opisocrostis bruneri...			*	†	*				
4. Opisocrostis labis......			†	*				*	
5. Opiso.t.tuberculatus...		†	†	*	*				
6. Oropsylla idahoensis...		†				†			
7. Oropsylla rupestris....	*		†	* ?	* ?			*	
8. Rectofrontia fraterna..			†	*	*				
9. Thrassis acamantis....		*					†		
10. Thrassis bacchi.......			*	*	†				
11. Thrassis petiolatus....		†							
Introduced Species									
12. Ctenocephalides canis..	*								
13. Ctenocephalides felis...	*								
14. Nosopsyllus fasciatus..	†								
15. Xenopsylla cheopis....	†								

† True or typical parasites of the host concerned.
* Frequent records, but relationship due to habitat association.

(2) *Neopsylla inopina* (Rothschild).

N. inopina is a true ground squirrel flea and as it is blind it may be chiefly confined to the nests and burrows of the host. It is common on *Citellus r. richardsonii* in Alberta and Saskatchewan, and occurs on *C. c. columbianus* in the extreme southeast of British Columbia. It has not been demonstrated to be a potential plague vector—nor has it been recorded infesting man's person.

(3) *Opisocrostis bruneri* (Baker).

This flea, recently demonstrated to be an efficient plague carrier (Prince, 1943) also occurs on ground squirrels. While sometimes taken on *Citellus richardsonii* and *Citellus 13-lineatus*, it is more usually found on the Franklin ground squirrel.

(4) *Opisocrostis labis* (Jordan and Rothschild).

O. labis is a true parasite of *C. richardsonii* and is widespread and common on the Canadian prairie. It has been shown to transmit plague (Eskey and Haas). This species does not occur on British Columbia ground squirrels.

(5) *Opisocrostis t. tuberculatus* (Baker).

This, like the above species occurs on the ground squirrels of Alberta and Saskatchewan, and is capable of transmitting plague (Eskey and Haas). It is found also on *C. c. columbianus* in the Kootenay district of British Columbia.

(6) *Oropsylla idahoensis* (Baker).

This species is very common on the Mantled ground squirrel *(Callospermophilus)* and also is one of the two common and regular siphonapterous parasites of *Citellus c. columbianus*. In Canada it seems confined to British Columbia and the foothills of Alberta. According to the experiments of Eskey and Haas (1940), it seems resistant to plague infection.

(7) *Oropsylla rupestris* (Jordan).

This is the commonest flea of *Citellus r. richardsonii*, and its range is probably coincident with the distribution of that rodent. It has been taken on rats (R.

norvegicus) where the two rodent hosts are in contact (as in southern Saskatchewan). As it is capable of transmitting plague (Eskey and Haas) it is probably one of the most potentially dangerous of our native fleas, as it offers the possibility of this disease spreading from the native ground squirrels back to the rat population of the southern prairie. Although we have no records, it almost certainly occurs also on the Franklin and 13-lined ground squirrels where the ranges of these mammals overlap that of the Richardson ground squirrel.

(8) *Rectofrontia fraterna* (Baker).

R. fraterna is a small blind flea that occurs on fair numbers on ground squirrels and other rodents east of the Rockies. Like *N. inopina* it may be chiefly a nest flea, and like that species it has not been incriminated with disease transmission. It also occurs (rarely) in British Columbia, on a variety of hosts.

(9) *Thrassis acamantis* (Rothschild).

While on rare occasions this species is taken on other hosts, it is an extremely common parasite of the yellow-bellied marmot *(M. flaviventris avara)* and occurs throughout the range of this rodent in British Columbia. It has been shown to be infective under laboratory conditions (Eskey and Haas).

(10) *Thrassis bacchi* (Rothschild).

T. bacchi occurs on all the prairie ground squirrels, especially *C. 13-lineatus,* but seems to be rather rare in Canada. It is of potential significance as a plague carrier (Prince, 1943).

(11) *Thrassis petiolatus* (Baker)

T. petiolatus is an extremely common parasite of *Citellus c. columbianus* in British Columbia. Like the other common flea of this rodent *(Oropsylla idahoensis)* it is resistant to plague transmission (Eskey and Haas). In view of the fact that the two most common fleas of this rodent are not readily infected, the Columbian ground squirrel is very likely not of so much potential significance as the Richardson ground squirrel, as the latter carries at least five species of plague-important fleas.

B. Introduced Species.

(12) *Ctenocephalides canis* (Curtis).

(13) *Ctenocephalides felis* (Bouche).

These two fleas are widespread in their distribution, and commonly infest domestic pets, particularly cats, dogs and rabbits. Heavy infestations frequently occur in households, and as both these species feed readily on man, they are often a serious domestic problem.

Large numbers of these fleas sometimes occur on the rats in certain garbage dumps in Vancouver.

(14) *Nosopsyllus fasciatus* (Bosc d'Antic).

This, the European rat flea, is well established in Canada and is probably coincident in its distribution with *Rattus norvegicus.* Though not as highly significant as the next species, this flea is of definite importance as a possible disseminator of plague.

(15) *Xenopsylla cheopis* (Rothschild).

X. cheopis, the Indian rat flea or "plage flea," occurs more commonly in tropical than temperate regions. However, it does become well established in these latitudes and wherever it occurs its presence is a matter of gravest concern, as it is the most important of the flea vectors of plague.

The possibility of its occurrence in Vancouver was first suggested by Spencer (1937), and in 1938 specimens were recognized by the writer (1940). This constituted the first Canadian record. In 1941 Holland discussed the status of this flea in the coastal area in British Columbia. It was found that a significant percentage of the rat fleas in the Vancouver city garbage dump was of this species. It was also recorded from New Westminster. Continued surveys since that time have shown *X. cheopis* to be widely distributed throughout the residential area of Vancouver, where the spread of its rodent host is undoubtedly assisted by the carelessness of the residents with reference to garbage disposal. *X. cheopis* also is known at North Vancouver and Sechelt.

Summary and Discussion

The distribution and status of eleven kinds of rodents and fifteen species of fleas are briefly discussed with reference to the possible dissemination of plague in Western Canada. Both the mammals and their parasites vary considerably as to their infectivity. The host specificity, and relative tendencies of fleas to bite humans are of importance from a public health standpoint.

Undoubtedly there are other mammals in our fauna that might be considered as possible carriers of this disease, and also there are undoubtedly many other species of fleas capable of transmitting plague from host to host, or from host to man. Records at the Kamloops laboratory include at least fourteen species of fleas present in Western Canada which will bite man readily. The plague-disseminating propensities of most of these are not as yet known.

Mice of various genera have not been studied extensively in Canada with reference to plague, but, in the United States, the white-footed mouse *(Peromyscus* spp.) has been incriminated to a limited extent (Eskey and Haas). The potentialities of some of these smaller rodents should not be overlooked.

Birds, especially hawks and owls, which prey upon mice and ground squirrels are also a possible factor in the spread of infection (Jellison, 1939). Small carnivores such as weasels might be considered in a like manner.

At the present time, concentrated eradicatory measures are being taken against the rat population by various civic health authorities. Also should be mentioned, the very creditable effort at ground squirrel control in the vicinity of the known plague foci of Alberta, which has been conducted by the Health Department of that Province. It is to be hoped that these measures, and the continued careful surveying of native and introduced rodents and their fleas, will achieve the desired result of holding sylvatic plague in check to the point where it does not affect Canadian health and welfare.

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COMPARISON OF THE INJURY TO APPLE CAUSED BY SCALES AND APHIDS (Homoptera: Aphididae & Coccidae)[1]

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Both scales and aphids build up heavy infestations on apple and pear and both derive nourishment by piercing deeply into the plant tissues with their stylets and sucking up the plant juices. Although many differences connected with feeding exist between the fixed armoured scales and the more mobile aphids, it is generally assumed in the literature that injury to the tree is due in both cases to the loss of sap incurred by the mass feeding of these insects. Yet for some unexplained reason, scale infestation is much more injurious than aphid infestation.

Prior to the development of effective control measures, the ravages of the San Jose scale (*Aspidiotus perniciosus* Comstock) were notorious. Newcomer as recently as 1941 regards this scale, by reason of its rapid increase, "as potentially capable of doing more damage than any other insect occurring in the orchards of the Pacific Northwest."

A rapid increase in scale population without further qualification might imply a rapid depletion of the host plant. It is true that the San Jose scale with its 3 to 4 generations a season is the most prolific scale attacking apples and pear, but with its dependence on sexual reproduction involving a considerable proportion of males among its progeny, the scale cannot vie in potential reproductive power with the parthenogenetic apple aphid (*Aphis pomi* Degeer) which Newcomer credits with 9 to 17 generations in a single season.

Greater protection against natural enemies and adverse climatic conditions, may nevertheless sometimes enable the San Jose scale to outstrip the apple aphid in self-multiplication. This is less likely to occur in the case of the oyster shell scale (*Lepidosaphes ulmi* L.) which has only a single annual brood of 40 to 80 individuals that require 6 weeks to attain maturity. The eggs hatch several weeks later than those of the apple aphid and the adults after ovipositing die some weeks before cold weather puts a stop to aphid feeding. Moreover the scale confines its attention almost exclusively to the woody growth of the stems, while the apple aphid attacks both the leaves and stems. Yet in spite of slower development, inferior reproductive power and a much shorter feeding period, oyster shell scale infestation is definitely more injurious to the tree than aphid infestation. The outright killing of twigs and branches frequently occurs in neglected scale infested orchards and the same scale is capable of causing the death of the hardy native thorns and dogwoods of the Interior of British Columbia.

By comparison, the harm done by the apple aphid is insignificant and perhaps the worst feature of this orchard pest is the dense smutting of the foliage and fruit, indirectly due to the gross feeding of the aphid and the quantity of honey-dew excreted. The armoured scales on the other hand, utilize their comparatively small amount of waste material in the manufacture of their shells. It is possible that young trees encrusted with this scurfy material may suffer from an interference with the respiratory functions of the lenticels.

Be this as it may, it will be as well to look for other causes than the extraction of sap to account for the severity of scale injury, for it is hardly reasonable to assume that the slowly developing oyster shell scale is a greater drain on the plant than the more prolific aphid. In fact the question arises as to whether any insect can cause the death of a tree by the extraction of sap alone.

[1] Contribution No. 2325, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

It would seem in the case of the aphid that a state of equilibrium must inevitably be established between the ability of the plant to maintain the aphid and the ability of the aphid to reproduce on a diminishing food supply. In the case of the scale, this equilibrium, if ever reached, may be upset by some entirely different cause. It is therefore suggested that the severity of scale injury may be due, not as is generally assumed by what is taken out, but by what is actually put into the plant by the armoured scales. In this connection, the belief has sometimes been expressed that the San Jose scale injects a toxic substance into the plant when feeding. The red blotches on fruit and stems generally associated with the presence of this species, seems to be the foundation for this supposition. A less vivid discolouration occurs around the punctures of the oyster shell scale. Although it is quite possible that this scale spotting is indeed caused by the injection of a toxic secretion, it seems just as reasonable to suppose that it may be accounted for by something inserted that is more substantial and more readily demonstrated than a chemical agency. Perhaps the discolouration of the fruit known as "pansy spot" which has been traced by Newcomer to the insertion of a thrip's egg in the growing tissue may be an analagous injury.

In both scale and aphid infestations the presence of a multitude of stylets invading the tissues may conceivably be an encumbrance harmful to the plant. In heavy infestations, two or three young scales or aphids may settle on an area only a millimeter in diameter. As demonstrated by Weber (1930), each instar of the Hemiptera and Homoptera acquires a new set of stylets at each moult, a fact incidentally, that does not appear to have been accorded recognition in either British or American literature except by the author (1931 and 1934).

The replacement of the stylets at each moult means that the small area cited above will receive in the case of the scale with its three instars, three separate punctures from each of its occupants. The aphid with five instars, has an advantage over the scale in being able to move and distribute its more numerous punctures in less congested and probably more succulent areas of the growing stem. It is not however, in the number of punctures, but in the final disposal of the stylets when moulting that the scales differ so widely from the aphids. In the case of the free-moving aphids, the stylets are withdrawn from the tissues at ecdysis and are invariably found intact and attached to the cast skin. The scale cramped beneath its shell, is unable to withdraw its stylets. Instead, the old stylets are broken off at the base and left like tenuous rivets or stitches in the tissues of the bark and cambium. Longitudinal sections of scale-infested bark reveal the stylets of each instar in the positions they would be expected to assume when allowance is made for the slight movement permitted by the insect's confinement. The respective stylets are thus close together and are easily distinguishable by the their different diameters. Cross-sections of the infested bark show that the passage of the stylets is intra-cellular and the tips are frequently observed to extend beyond the cambium into the xylem.

Thus on a heavily scale-infested twig there are three sets of stylets implanted by every visible adult, but under conditions where the young frequently settle beneath the parent scale, the congestion of abandoned stylets may be much greater than might be estimated from the number of scale present at a given time.

The extraction of sap or the injection of a toxicant are only possible while the insect is living, but the disposal of stylets in the tissues by successive instars and generations evidently results in mechanical injury to the plant the year round.

It seems therefore reasonable to believe that this distinctive feature, namely the accumulation of abandoned stylets in the tissues hampering growth by a mat of chitinous stitches, may have much to do with the severity of scale injury in comparison to that inflicted by the aphid.

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FURTHER NOTES ON THE CERAMBYCIDAE OF VANCOUVER ISLAND (Coleoptera)

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The object of these notes is to bring together scattered records that have accumulated from time to time since the 1925-26 Museum Reports (Hardy 1926-1927).

It is by no means claimed that all the data have been examined, as the Coleoptera of Vancouver Island have possibly been investigated by students and collectors who are at present unknown to the writer. In that event, should this article result in bringing hitherto unknown collectors to light, this effort will have achieved a definite purpose.

At the best, aside from the southern and eastern coastal areas of the island, information on the Cerambycidae is very meagre. This cannot altogether be due to the absence of many species, but to the fact that comparatively little intensive research has been undertaken. It is true that the habits of the members of this family are often such as to make them exceedingly elusive in relation to our affairs, so that they may be unseen yet numerous. Hot sunshine coupled with the fallen trees or newly-cut wood at just the right stage of attraction, the synchronization of favourite plant blossoms, and time of appearance, or nocturnal habits of the species, are only some of the limiting factors.

To the ardent collector, however, all the above factors add a spicy attraction, for perseverance often brings unexpected rewards. By being perennially beetle-conscious, "windfalls" occasionally occur at most unexpected moments.

The following annotated list includes only those species that seem to be of special interest either as new records, extensions of the known range, or from a biological viewpoint.

(1) *Eumichthus oedipus* LeC. New locality records: Colwood, two specimens in a collection formed during the years 1932-36, and presented to the Provincial Museum by Hedley Peake. This is the most westerly Vancouver Island record known. 10 Mile Point near Victoria, specimens taken by the writer on July 26 and August 9, 1935, as they were running over the trunk of a newly-felled Douglas fir, *Pseudotsuga taxifolia* (Lamb) Brit.

Most other specimens so far recorded were obtained on the flowers of the ocean spray, *Spiraea discolor* Pursh., during the month of June. It would appear that this beetle has a longer period of emergence than hitherto suspected.

(2) *Pidonia quadrata* Hopping. First described and recorded for Vancouver Island from Clayoquot by R. Hopping (1931). The Clayoquot specimen is designated as a paratype and was collected by G. J. Spencer. Two additional specimens were obtained by M. L. Prebble from the Great Central Lakes area on June 27 and 29, 1941.

This very distinctive little species closely resembles *P. scripta* LeC. one of our most abundant members of the genus, but of all the hundreds collected from the eastern and southern portion of the Island, none has so far been noted to include this species. It would seem therefore to favour the more humid regions of Vancouver Island.

(3) *Pachyta armata* LeC. New locality

record: Forbidden Plateau, on the flowers of *Heracleum lanatum*, August 1943, G. C. Carl. This constitutes a northern extension of its known Vancouver Island range, previous records being from Mount Arrowsmith (Hardy 1936).

(4) *Evodinus vancouveri* Csy. New locality records: Forbidden Plateau, July 11, 1930, J. D. Gregson. Great Central Lakes, May 17, 20, 22, 1941, M. L. Prebble and K. Graham. These constitute a northern extension of the known range on Vancouver Island. Contrary to expectations none of the specimens examined from the Island include the black form, which from specimens available appears to be of more frequent occurrence on the adjacent mainland of British Columbia.

(5) *Leptura propinqua* Bland. New locality record: Beaver Creek, Alberni, July 27, 1934, W. H. A. Preece. This extends its known ranger farther to the north, Duncan being the only other Vancouver Island locality record to my knowledge. In general it is a mountain species; I have records of its occurrence on Mount Cheam, Mount McLean, Garabaldi Park and the Olympics, on the mainland.

(6) *Anoplodera nigrella* (Say). First record known to the writer for Vancouver Island: Forbidden Plateau, July 11, 1930, J. D. Gregson. This is one of those captures that give a zest to the examination of hundreds of the common *A. dolorosa* with which it might be confused in the field. The species occurs throughout western Canada and the United States from British Columbia to Nova Scotia.

Craighead (1923) records that adults were taken in pupal cells on August 20, in Oregon. It is not clear whether this indicates a very late metamorphosis or nearly a year in this condition. It breeds in *Pinus*, *Picea*, and *Pseudotsuga*.

(7) *Anoplodera tibialis* (LeC.). New locality record: Forbidden Plateau, August 28, 1943, G. C. Carl. The only other known Vancouver Island locality record is Duncan, based on one specimen in the Hanham collection. It is a mountain species having a wide distribution from British Columbia to Newfoundland. Fall (1926) records it from Skagway, Alaska. Specimens from the mainland of British Columbia are represented in the Provincial Museum from Mount McLean, Mount Cheam, Vernon and Garibaldi.

(8) *Anoplodera canadensis* (Oliv.) New locality records: Beaver Creek, Alberni, July 27, 1934, W. H. A. Preece; two males on flowers of carrot, *Daucus carota* L. Cowichan Lake, August 17, 1938, W. G. Mathers, one male. Mr. A. W. Hanham has taken it on the flowers of tansy, *Tanacetum vulgare* L.

All these examples are of the black, red-shouldered form, which seems to be the prevalent form here. I have records of but two of the black phase and none of the entirely red variety from the Island.

(9) *Anoplodera dehiscens* (LeC.). New locality record: Beaver Creek, Alberni, July 27, 1934, W. H. Preece. Two specimens on flowers of carrot, *Daucus carota* L. This is a northerly extension of the known Vancouver Island range of this decidedly scarce species. It is also very occasionally taken in flight in woodland glades.

(10) *Pyrotrichus vitticollis* LeC. This elusive cerambycid seems worthy of comment whenever it is noted on Vancouver Island, which to date has been on only four occasions, so far as I can ascertain. The first is listed by Harvey (1907) with "Victoria" as the only datum, and is probably the same specimen recorded by Hardy in 1927. The second record is from a specimen labelled "Duncan" in the collection of the late A. W. Hanham. The third, a male, was taken by W. Downes on June 10, 1929, in flight at mid-day about a maple tree. The fourth record consists of a number of specimens reared from larvae and pupae obtained by the writer from a dead maple, *Acer macrophyllum*, in January 1935.

The larvae and pupae were found in some numbers in a spot twelve feet from the ground and in the central decaying heartwood. The larvae were feeding in the adjoining solid wood, the pupal cells being constructed near the inside surface parallel to the grain of the wood. On emergence the adults would have to travel some distance within the tree until a crack or knothole provided an opportunity for gaining access to the open air.

Pupae were fully developed by January 28; the adults emerged during the following April. It was observed that the adults, all females, evinced a decided aversion to daylight; as soon as exposed to its influence they burrowed into the friable rotten wood. In reconciling the behaviour of the two sexes as just stated, it would appear that the male seeks out the more retiring female. If further acquaintance with *vitticollis* should demonstrate a preponderance of females over males this could at least in part account for the apparent rarity of this species.

(11) *Molorchus longicollis* LeC. New locality record: Goldstream, May 30, 1928, W. Downes. This is the most western extension of its range so far noted. All other records are from the east coast of the Island, from Sidney to Duncan where it was observed from the end of April until early in June. Mr. Preece has taken this species in large numbers on a species of cultivated spirea while the late A. W. Hanham reported it on one occasion as "swarming" on the blossoms of the bay laurel.

(12) *Hybodera tuberculata* LeC. New locality record: Cowichan Lake, October 8-19, 1940, M. L. Prebble. This is a western extension of its reported range on the Island, previously being taken at east coast areas from Tod Inlet to Wellington.

This is one of those elusive species that may never be seen for years and then suddenly turns up in considerable numbers at unexpected places on or about its host tree, *Acer macrophyllum*.

The specimens above referred to comprise a nice series of 20 individuals. They vary in length from 9 to 15 mm. and in colour from unicolourous brown to the marked distinction of the two gray bands across the elytra so characteristic of the species. All were taken from their pupal cells in branches of the maple, *Acer macrophyllum*. They would overwinter in the adult stage, the natural period of emergence being April and May.

Another record, Elk Lake, April 29, 1931, has been reported by Mr. Downes who took a good series in flight about four o'clock in the afternoon around a pile of maple cordwood.

(13) *Callidium hardyi* Van Dyke. Attention is drawn to this species in order to avoid any future uncertainty as to the correct type locality. This is Gordon Head, Vancouver Island, not Garden Head as it is spelled in the original description (Van Dyke 1928).

(14) *Callidium vancouverense* Van Dyke. New locality record: Cowichan Lake, May 19, 1941, M. L. Prebble. This is a westerly extension of its known Vancouver Island range. Previous records are from Duncan, Sidney and Victoria districts.

(15) *Phymatodes obscurus* LeC. New locality record: Lakehill, Saanich, July 16, 1941, W. H. A. Preece, two specimens, taken at "light." This is the second record of its occurrence on Vancouver Island. The first consisted of eleven specimens reared by the writer from *Quercus garryana* Dougl., on Mt. Tolmie, 1926. It is of interest to note that the only members of this species taken at large were night-flying.

(16) *Atimia dorsalis* LeC. New locality record: Colwood, 1932-1936, Hedley Peake. This is quite a rare species in collections. The larval stage is passed in trees belonging to the genera *Cupressus, Juniperus, Libocedrus* and *Thuja*.

(17) *Plectrura spinicauda* Mann. New locality record: Cowichan Lake, August 31, 1941 and August 3-20, 1940, M. L. Prebble.

This is perhaps the most intriguing of the Cerambycidae departing as it does from the general type to a very marked degree, resembling a spider more than anything else. It is wingless and therefore only to be found as it crouches in some crack of a tree. Many specimens in collections appear to have been dug out of their pupal cells during the latter part of July to October. With the one exception, August 3, 1940, all of these groups were taken at large, that is from the end of July to the 25th of August. I have records of others taken from February to May inclusive. This is a further confirmation of previous observations that many if not all of the adults hibernate during the winter outside their pupal cells. (Hardy and Preece 1926, Leech 1938).

(18) *Monochamus maculosus latus* Csy. This is the British Columbia form hitherto going under the name of *maculosus* Haldeman of which it is the western representative. This matter is thoroughly dealt with in a recent study of the genus (Dillon 1941).

A series of eight specimens from Cowichan Lake constitute the first positive record available to me of its occurrence on Vancouver Island. They were collected by M. L. Prebble on August 3, 1940, ovipositing on the lodgepole pine, *Pinus contorta* Dougl.

Two specimens in the Provincial Museum from the A. W. Hanham collection bearing the date of September 9, 1899, and presumed to have been taken by G. W. Taylor of Nanaimo, might possibly be the first examples of this species from the Island and in part are recorded by Harvey (1907), but lack of more definite data would give precedence to those obtained by Prebble. Of the hundreds of specimens of this genus collected in the vicinity of Victoria not one of this species has so far been detected.

(19) *Monochamus obtusus* Csy. First record for Vancouver Island by the writer in 1935. A specimen in Prebble's collection is from Lake Cowichan, August 3, 1940, which thus constitutes a northern extension of range on the Island.

There are also a couple of specimens in the Hanham collection that may have been taken by G. W. Taylor as they bear a label in his handwriting, September 14, 1899, with no indication of locality, but presumably in the vicinity of Nanaimo.

(20) *Saperda populnea* L. New locality record: Lost Lake, Saanich, May 22, 1944, G. A. Hardy. One specimen on leaf of *Salix sitchensis* Bong. Dull windy day, 4 p.m. This appears to be the second record for the Island; the first specimen was taken at Duncan by the writer on July 4, 1926.

Acknowledgments.—I have much pleasure in expressing my appreciation to the following gentlemen for their ready co-operation in giving permission to look over their material and to make use of information freely submitted: Mr. W. Downes, Mr. J. D. Gregson, Dr. M. L. Prebble, and Mr. W. H. A. Preece.

I should like to pay tribute to the late A. W. Hanham for the assiduousness and constancy with which he collected the Coleoptera of his district for a period of over 30 years. A study of his specimens, now in the Provincial Museum, gives a very good cross-section of the cerambycid fauna of the Duncan area and was an important factor in the preparation of earlier lists of the Vancouver Island species.

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SOME SUGGESTIONS FOR THOSE INTERESTED IN BREEDING LEPIDOPTERA

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Introduction.—Why breed Lepidoptera? There are several good reasons.

(1) Anyone desiring a good collection of Lepidoptera will find that breeding gives him an ample supply of specimens for his collection which are in the best possible condition.

(2) In the case of species which are liable to considerable variation, a better opportunity is afforded of obtaining a good series, which will show not only the extremes of variation, but also the intermediate stages, thus making the series of far greater interest.

(3) Breeding affords an opportunity to observe, note carefully and record the various stages in the metamorphosis of a lepidopteron and to stress any peculiarities noticed. Much of interest will be noted in regard to the life histories thus obtained, and this should be entered in the "breeding records." Hitherto unrecorded information may be obtained and the sum total of scientific knowledge enhanced.

(4) Occasionally the breeder will be rewarded for his efforts by one or more unusual forms appearing in his cages as the imagines duly emerge. As an example of this, the author records that in breeding a series of *Cosmotriche pototaria* Linn., the drinker moth, a British species, he obtained a number of females whose colour was brown rather than straw coloured, as is the case in typical females.

The cause of the variation was not ascertained, unless it was due to the fact that the larvae, which had been collected in varying degrees of maturity, were subject to near asphyxiation in tin boxes on the way home and had to be resuscitated by administering fresh air in quantity to restore the larvae to health. Could this have been the reason for the unusual female forms? Experiments of a similar nature on other larvae might furnish the answer.

(5) An opportunity is afforded for experiments in the field of hybridization. With Lepidoptera this is a somewhat difficult task, and has only been successful in some cases where closely allied species were involved.

Hybrids have been recorded as resulting from the mating of *Smerinthus populi* Linn. a British species resembling very much a small specimen of our *Pachysphinx modesta* Harris, and *Smerinthus ocellatus* Linn., also a British species, resembling very closely our *Smerinthus cerisyi opthalmicus* Bdv. The resultant moth is of an attractive appearance and may be seen in a few of the larger collections in Great Britain, chiefly those in museums.

Another example is the crossing of *Malacosoma neustria* Linn. and *Malacosoma castrensis* Linn., both British species. A figure of the resultant larva is given by South in his "Moths of the British Isles, Part I," together with brief remarks on the experiments.

A few years ago the author succeeded in crossing a male *Notolophus antiqua badia* Hy. Edw. with a female *Hemerocampa pseudotsugata* Mc D. (Ent. Soc. Brit. Col., Proc. 36: 14-15. 1940.)

Enough has now been said to indicate that the breeding of Lepidoptera is in no sense a waste of time or energy, but on the contrary possesses a very real scientific and economic value apart from its being the best method of obtaining a plentiful supply of specimens for the collection; and a good collection is in itself of considerable value educationally.

We now turn to the consideration of ways and means to successful breeding. These may best be considered under three heads:

A. Concerning ova.
B. Concerning larvae.
C. Concerning pupae.

A. Concerning Ova

The most valuable results will be obtained by rearing from the egg. It entails the expenditure of more trouble than breeding from the later stages, but the results from information and data of all kinds, also in most cases the large number of insects obtained, will well repay the care needed.

Ova may be obtained in several ways.

(1) They may be searched for in likely places, such as on foliage of trees and shrubs, on twigs and branches, or in the crevices of bark. Also they may be found on the cocoons of apterous females as in the case of *Notolophus antiqua badia* and *Hemerocampa pseudotsugata*. In fact few places should escape a search; the best requisites for success are keen eyesight and patience.

(2) It is sometimes possible to follow a female while she is engaged in laying her eggs, note where she settles and after her departure, collect the eggs. By this method the author has obtained ova of *Papilio eurymedon* Luc., *Polygonia oreas silenus* Edw. and *Vanessa cardui* L.

(3) By means of a virgin female.

A newly emerged female will often attract one or more of the opposite sex. This is a well known feature with certain species, such as the British *Lasiocampa quercus*, the oak eggar, and *Saturnia pavonia*, the emperor moth, females of which will attract males from a considerable distance; males will even enter houses to get to the lady of their choice. The apterous females of *Notolophus antiqua badia* and *Hemerocampa pseudotsugata* also have this power of attraction well developed. Some species of *Notodontidae*, the prominents, may be cited, for example, *Pheosia portlandia* Hy. Edw. A crippled female was placed on the trunk of a poplar; next day a male was found in attendance and in due course fertile ova were obtined and a fine series of imagines reared.

(4) By persuading captured females to oviposit. In some instances this is not at all easy. In others it is comparatively simple. Many moths deposit their eggs freely even when confined in a match box, chip box, or any other receptacle. This is true of many of the Arctiidae, as *Arctia caja* L., some Sphingidae as *Smerinthus cerisyi ophthalmicus* Bdv., many of the Phalaenidae and Geometridae.

Butterflies are more difficult and require a large cage attractively furnished to their liking. The old fashioned meat safe is quite useful for this purpose. Air and sunshine are essential. The former must not be overlooked, as butterflies are very subject to sun stroke, if the ventilation system of the cage is bad. Glass is a dangerous substance in the construction of cages unless good ventilation is assured. Other requirements are, the presence of the food plant, some flowers to supply nourishment to the butterflies, or failing these a wad of cotton wool soaked in sugar and water or a little honey; water too should not be overlooked. This is probably best introduced by placing on the floor of the cage a layer of moss which can be well dampened from time to time. In cases where the female is disinclined to lay, it has been suggested that the introduction of one or more males might induce the recalcitrant female to commence operations.

To sum up. Conditions should be made as natural as possible and anything which suggests itself to the lepidopterist as conducive to oviposition should be included. In the above manner *Papilio zelicaon* Luc., *Polygonia satyrus* Edw. and *Vanessa cardui* to mention only a few, may be induced to lay.

Some of the more difficult hawk moths such as *Celerio gallii intermedia* Kirby, and *Celerio lineata* Fabr. will oviposit if given plenty of room and their food plant.

Telea polyphemus Cram. and *Platysamia euryalus* Bdv. will lay fairly freely in any good sized cage or container. The ova are frequently deposited on the sides of the cage or box.

Having then obtained ova, our labours begin.

Eggs should be kept reasonably cool. A porch or veranda is very suitable or failing that, a room with a northerly aspect. This is especially important in cases where the winter months are spent in this state, as, if the ova are kept too warm, there is grave danger of the larvae hatching before the food plant is available in the spring.

Inspection should be frequent, and daily if the ova are noticed to change colour, as this often points to early hatching.

Fertile and Infertile Ova.—To determine whether ova are fertile or otherwise is not very difficult. Fertile eggs usually show a change of colour after a few days. Green eggs will turn pinkish and later perhaps become purplish or blackish, or of a leaden colour. White eggs too will frequently change to a darker hue.

Some ova are opaque. However, if there is no sign of shrinkage or distortion, the eggs are generally fertile. This applies to all ova. In some cases, where the shells are more or less transparent, the embryo larva may be seen inside and a short time before hatching the head is noticed as a dark speck.

Warnings.—(1) Do not attempt to hasten the hatching of the larva at this stage by introducing the food plant, but keep the ova subject to the same conditions as previously.

(2) Do not disturb a newly hatched larva until it has left the vicinity of the egg shell, as in many cases the first meal comprises this or a portion of it.

B. Concerning Larvae

Newly hatched larvae are best kept in tin boxes with glass tops such as are supplied by dealers in entomological supplies, or if we have a large number of larvae, in tins of a larger size (a "Crisco" tin is very suitable) with a piece of glass placed over the mouth to conserve moisture and prevent the escape of the inmates. The food keeps well under these conditions and therefore it is not necessary to handle the young larva so frequently. When this has to be done, a camel's hair brush should be used.

The first problem is the provision of suitable pabula. In many cases this will be known, but if it is not, it will be necessary either to obtain the information from books, or from some other lepidopterist, or from any lists of food plants that may be at hand. Failing the above sources try by experiment to ascertain the food required. Take a roomy tin and place in it samples of as many plants, trees, or shrubs as may be deemed likely to be acceptable to the larvae. In many cases they will quickly select one or more of the plants offered and feed satisfactorily upon them. If this does not happen, further efforts must be made and other food tendered in the hope of better success. Do not let failure discourage, but persevere.

Sleeves.—As soon as the larvae are large enough, and this must be left to the discretion of the lepidopterist, they should be placed in "sleeves" made of muslin, cheese-cloth or, if it is expected that the inmates will remain on the food plants during the winter, of some stouter material such as calico. These sleeves must be attached to the food plant in such a way as to prevent the escape of the larvae and yet be easy of access for examination from time to time. This is very necessary in order to see that no intruders such as wasps, ants, or earwigs, have gained access to the interior of the sleeves and harmed their precious contents, also to ascertain whether or not the larvae are approaching maturity, in which case it will be necessary to provide them with suitable conditions for pupation.

Flower Pots.—For mature larvae a 10-inch flower pot makes a very suitable and convenient larvarium. In the author's opinion it is quite as good, if not superior to, many of the more elaborate and more expensive breeding cages on the market. These latter cages however, are very useful for keeping the chrysalids of many of our butterflies. The glass fronts enable the appearance of the imago to be noticed before it has time to damage itself as frequently happens if left too long to its own devices. They are also useful for attracting by means of the virgin female.

The flower pots should be filled just over half full with earth of a suitable texture. In this a bottle should be inserted to contain water for the food plant; "Ketchup" bottles are very convenient both as to size and shape. The bottle should be wrapped in paper to allow of its withdrawal later lest it break in frosty weather and water therefrom harm the insects at a time when they should be kept relatively dry.

When placing the food plant in the bottle care must be taken to ensure that the stems fill the mouth of the bottle; otherwise some of the larvae may find their way into the water and perish. Larvae are very prone to commit suicide in this manner unless checked. If necessary a wad of cotton wool, or any other suitable substance may be used to block the neck.

Moss should be placed over the earth, and bark should not be overlooked. This latter is essential for certain species of *Acronicta*, for example *A. alni* Linn., a British species, and doubtless for its representative in British Columbia, *A. funeralis* G. & R. which frequently though not always chooses bark in which to make its cocoon. It would also be indicated for certain species of Notodontidae of the genera *Dicentria (Ianassa)*, *Schizura* and *Cerura*. If it is not supplied the larvae will wander and eventually die of exhaustion and fatigue.

A sleeve may be attached to the rim of the flower pot outside and tied with string or secured with a rubber band. It should be supported by a wire cylindrical frame which rests inside the pot. This sleeve forms an airy and spacious compartment and prevents the crushing and bruising of the food plant.

Generally speaking, the larvae which spend the winter months as pupae cause very little trouble. This is true also of those which pass through the stage during the spring and summer.

A plentiful and free supply of food plant is most important in order to obtain fine specimens of the imago. To put larvae on short commons results in poor and small specimens, if not in complete failure.

Hibernating Larvae.— These will require more specialized treatment. They fall into two classes.

(1) Those which hibernate when mature, not feeding again but appearing on sunny days in the spring before finally deciding to seek suitable quarters in which to pupate. To this group belong the larvae of *Isia isabella* A. & S., *Phragmatobia fuliginosa* Linn. and the British species *Macrothylacia rubi.*

These larvae, being hairy, often cause considerable trouble. They are subject to attack by fungus, and the attack is usually fatal. Preventative measures must therefore be taken. It will be noticed that these larvae take every opportunity during the early months of the year to sun themselves and in this manner to dry their long hairy coats. Therefore, sun and air would seem to be the best preventatives. Place the larvae in a large flower pot which has been filled with a generous supply of moss and stand it outdoors in a sunny position, but exposed to rain and snow. It is fatal to take these larvae indoors, for if their surroundings become dry, they will shrivel and perish. Even with the above treatment, results are likely to be disappointing.

Probably the best method for the collector to adopt is to obtain the larvae of this group on sunny days in the early months of the year and proceed as above, when the larvae will usually pupate in due course without a high rate of mortality. If however, a large number have been collected in the fall, it might be worthwhile to attempt to induce them to pupate early. Procedure as follows:

In January, bring the larvae, which have been placed in a standard breeding cage for the purpose, and which contains a copious supply of moss, into the house during a spell of cold weather and place them over a radiator, or over the fireplace in a warm room, or better still if available, over the hot pipes in a greenhouse. After a short time, possibly a few hours, they will become active and start to make their cocoons. The temperature should be between 70° and 80° F. in the cages. The moss must be kept well damped during the whole period of forcing or the larvae will dry up and die. It is of course necessary to keep the pupae in the greenhouse, or at least in a warm room, after the forcing. The rate of mortality is likely to be high, but this may be due to the fact that many of the larvae collected have previously been parasitized. The author has not yet employed this method in British Columbia but has met with fair success in England with larvae of *Macrothylacia rubi* and *Phragmatobia fuliginosa* obtaining his imagines about February, a few weeks after pupation.

For *Isia isabella* forcing is unnecessary as the larvae will winter well in a flower pot with moss. All that appears necessary is to stand the pot in the open in a sunny position. In the spring, the larvae will reappear and eventually seek quarters in which to spin up.

(2) Those which hibernate before reaching maturity.

(a) For hairy larvae in this category belonging to the Arctiidae similar conditions as those mentioned above would be indicated.

The question of forcing does not arise, as the subject must be kept dormant till sufficient food is available in the spring. Again it must be emphasized that it is a fatal mistake to bring such larvae indoors. Plenty of moss in the containers, and the inclusion of the growing food plant, if possible, is necessary. The containers should be kept in the garden in a sunny position. In the spring they should be examined frequently to ascertain whether the larvae have resumed activity, and whenever this is apparent care must be taken to ensure that a plentiful supply of food is within their reach.

Arctia caja L. has been successfully reared in the above manner. Result of an experiment with this species follows:

Out of 423 larvae obtained from ova, 212 were placed in a large breeding cage with moss and growing plants of stinging nettle. The cage was taken into the basement of a house for the winter. Only 6 larvae survived. The remaining 211 larvae were placed in a similar container and provided with the same conditions except that in this case, the cage was placed outside only slightly protected from excess of rain. In the spring, 186 larvae re-appeared and continued to feed. From these 150 pupae were obtained and a fine series of moths resulted, many of them being of the form which possesses the secondaries yellow with black spots instead of the typical red.

(b) For those which winter in a communal tent, or singly in a small hibernaculum, all that would seem necessary is to sleeve them whenever possible on their food plant. If this is not practicable, the tent or hibernaculum must be carefully removed and kept in a cool place such as a porch or outhouse until the spring, care being taken to place it amongst the food plant as soon as the shoots burst in the spring, and before the larvae return to activity.

Basilarchia lorquini burrisonii Mayn, which constructs a tiny cone-shaped hibernaculum is easily wintered in the above way, as the larva re-appears rather late in the spring, usually well after the new shoots have appeared on its food plant. Larvae of the genera *Argynnis*, *Brenthis*, *Euphydryas*, and *Melitaea* are probably best obtained in the spring, after hibernation, when they can be found either sunning themselves on banks or crawling about in the vicinity of their food plants.

Moss should always be supplied in the cages used for hibernating larvae. In support of this opinion, the author cites that while visiting the island of Capri, in the bay of Naples, during the latter part of January 1929, he observed larvae of a species of butterfly, probably of the genus *Euphydryas* or *Melitaea*, active on sunny days and nibbling freely at moss growing on stones and other places in the habitat.

(c) Geometers. Many species of the Geometridae hibernate when small, and these seem to cause no special difficulty beyond the possible necessity for a sleeve of material stouter than the cheese-cloth usually used. This is to prevent damage to the sleeve by winter conditions. Amongst others, *Campaea perlata* Gn. and *Chlorosea nevadaria* Pack. can be reared in this way. Of the latter species, out of 10 larvae obtained, six imagines resulted.

(d) Phalaenidae. These larvae, many of which hibernate, will probably cause some trouble, and the author reports many failures in this group.

The larvae in most cases burrow into the soil and remain for long periods 'resting', as the term is; during this period they should not be disturbed. Others will creep under stones and roots, or will enter moss where they are sometimes found during gardening operations. If of a species worth keeping, they may be placed in a container with earth and moss, when they will often enter the moss and in due course, pupate. The containers, preferably flower pots, should be kept outside, slightly protected from rain. Do not bring the larvae indoors.

On no account disturb larvae which are about to change their skins or pupate.

Diseases.—These include injuries, the stings of parasites and diarrhoea. For injuries little can be done. For the stings of ichneumons and the like, it is sometimes possible to remove the eggs, if they have not hatched, and thus save the life of the caterpillar. This may be accomplished by the use of a needle and a pair of tweezers. Great care however, is necessary or the larva may die as the result of the operation.

For diarrhoea: If this condition is caused, as frequently, by eating too succulent or too damp food, it may be relieved by supplying the older and tougher leaves of the plant, at the same time attending to the ventilating of the cages. If on the other hand, it is caused by some virus or epidemic infection, the author knows no satisfactory remedy. This applies too in the case of the fungus previously mentioned. The results in both these cases are usually fatal. Prevention therefore is indicated as the best course to adopt. This would include good ventilation, together with the admission of sunlight to the cages, clean and healthy surroundings and the removal of all substances likely to become mouldy, or centres of infection. Spraying with disinfectant should also help.

C. Concerning Pupae

Most of these present little difficulty. In general they should be kept cool and free from excessive moisture. For those which spend the months of winter in this stage, a north aspect on a porch, or a position at least subject to the outside temperatures and the humidity of the atmosphere, is best. Disturb as little as possible and inspect from time to time. Daily inspection will be necessary as the time for the appearance of the imagines approaches.

Butterfly pupae: Those of the papilios do well if wintered in standard breeding cages. The pupae of *Polygonia*, *Vanessa*, and *Basilarchia* which pupate during the spring and summer months are also conveniently housed in this way. CAUTION. Do not assume that a pupa is dead and throw it away because the normal time for the appearance of the perfect insect has passed. Many species "lie over" one or more winters, especially is this true of certain Sphingidae, Notodontidae and some others.

As an example of this, *Smerinthus cerisyi opthalmicus* Bdv., has been known to spend three winters in the pupal stage. During this year, 11 males and 4 females have emerged after the third winter. *Nadata gibbosa oregonensis* Butl. has also been reared after three winters as a pupa and *Paonias excecata* A. & S., *Pseudohazis eglanterina* Bdv., and *Acronicta hesperida* Sm. after two winters. In the case of the last named species, 5 adults were reared.

The case of *Pheosia portlandia* is interesting. This species would appear to be multibrooded under suitable climatic conditions. On the south part of Vancouver Island at least it appears to be partially double-brooded. From a single batch of ova, 32 imagines were obtained in August and September 1942, 4 in April and May 1943, one in August 1943, and one on May 4, 1944.

Careful examination of pupae seldom does harm. After examination they should be placed on moss and lightly covered with the same.

Damping.—This is recommended by some authorities, but it is not, in the opinion of the author, very desirable, especially in cases where the pupae have either been removed from their cocoons or dug up during gardening or by "pupa digging." The natural humidity of the atmosphere is usually all that is necessary. Mould must never be allowed to appear in any container for pupae.

A Few Difficult Species.—Some hawk moths as *Celerio lineata* and *C. gallii intermedia* frequently die in the pupal stage. To winter these therefore is difficult and Dr. H. Guard Knaggs in his valuable work "an Entomologist's Guide" recommends forcing.

The pupae are placed in a suitable receptacle on moss and lightly covered with more. This is then well damped and the container placed in a warm room, or better still over the hot pipes in a greenhouse, when the moths should shortly appear. The temperature should be about 70°F.

Some of the prominents too may be found a little difficult. It would appear that the larvae of certain species of *Dicentria (Ianassa)* and *Schizura* though making their cocoons in the fall remain "resting" during the winter months, only pupating a few weeks before the time for the appearance of the imago. Any break in the cocoon, which consists of a more or less transparent substance, seems to be fatal to the larva within. Cocoons of the species of *Cerura* must always be preserved unbroken.

Preparation for Imagines.—It is necessary to make some preparation for the safe arrival of imagines in perfect condition, otherwise disappointment will result through malformations.

(1) The inside of the breeding cages and containers should be somewhat rough to enable the newly emerged insects to crawl to a suitable place and dry their wings. A few twigs are helpful.

(2) When the larva has cocooned in a sleeve, it is often best to open the cocoon a week or two before the insect is expected to appear. The pupa may be left in the cocoon provided that free access to the outside world is assured, or may be removed and placed on a bed of moss. If this is not done, it is likely that the insect will be deformed or even fail to get free from the cocoon. This commonly happens with many species of *Acronicta*. It is sometimes advisable also to open the cocoons of *Platysamia euryalus*.

Conclusion.—The requirements for the successful rearing of Lepidoptera may be briefly summed up as follows:

(1) The careful observation of all matters of interest and the due recording of the same.

(2) A plentiful use of a somewhat rare commodity often spoken of as "common sense."

(3) An unlimited supply of patience.

Acknowledgments and Indebtedness.—The author acknowledges his indebtedness to Mr. E. F. Johns, sometime Headmaster of Winton House School, Winchester, England; to Mr. Denis H. Clark an assistant master of the aforementioned School, who gave much valuable advice and help in his early days of collecting.

Also written works by the following:

H. Guard Knaggs—The Lepidopterist's Guide for the use of the Young Collector of Butterflies and Moths. Revised and enlarged edition, 1901. Gurney & Jackson.

Richard South—The Butterflies of the British Isles. 1906. Frederick Warne & Co. The Moths of the British Isles, Part I. 1907. Frederick Warne & Co. The Moths of the British Isles, Part II. 1908. Frederick Warne & Co.

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NOTE ON DALOPIUS TRISTIS AND D. INSULANUS (Coleoptera, Elateridae). Little is known of the habits of our native **Dalopius**; the following note deals with **tristis** Brown, the commonest species in the southern interior of British Columbia, and **D. insulanus** Brown from the coast.

During the last week of September, 1943, adults of **tristis** (det. W. J. Brown) were found in numbers in the duff under western larch trees two miles south of Needles, B.C. Many of the beetles were still teneral and in their pupal cells; a majority of those fully colored and hardened were males, and some of these had already left their cells. The latter were loosely constructed, unlined, and consisted of dead needles and associated forest litter held together by a few silken threads. They were placed about two inches below the top of the duff. **D. tristis** is one of the first elaterids to appear in the spring, and at Salmon Arm is common on the flowers of Rocky Mountain maple, **Acer glabrum**, in April.

Professor G. J. Spencer found **D. insulanus** (det. H. B. L.) hibernating at Vancouver, B.C., on November 3, 1942. The beetles were between boards in the back yard of his city lot, congregated in numbers up to 30 at a time. None was found on an examination of the same area in late January, 1944.—Hugh B. Leech, Vernon, B.C.

RECORDS OF SOME FLIES AND WASPS COLLECTED AT ROBSON, B. C. (Diptera: Asilidae; Hymenoptera: Ichneumonidae)

HAROLD R. FOXLEE
Robson, B. C.

The species listed were collected by me at Robson, B.C. The asilids were identified by Dr. S. W. Bromley; the ichneumonids, all collected in 1941, were named by Dr. H. K. Townes.

Diptera

ASILIDAE

Laphria vivax Williston.
Asilus placyteras Hine.
Cyrtopogon dassylloides Will.
Dioctria sackeni Will.
Nicocles sp. (Perhaps *N. dives* Loew, at any rate so det. by Prof. Melander).

Hymenoptera

ICHNEUMONIDAE

Coleocentrus occidentalis Cr.—July 13.
Xorides californicus Cr.—June 22.
Xorides cincticornis Cr.—July 13.
Pimpla pedalis Cr.—July 20.
Pimpla sanguineipes Cr.—Aug. 24.
Lissonota montana Cr.—Sept. 1.
Lissonota frigida Cr.—Sept. 7.
Cryptus altoni D. T.—Sept. 7.
Cryptus luctuosus Cr.—Sept. 14.
Polistiphaga fulva Cr.—Aug. 17 and 31.
Ichneumon variegatus Cr. — Aug. 24, Sept. 7.
Angitia acuta Vier.—Sept. 7.
Exochus flavifrontalis Ds.—Sept. 7.
Ephialtes imperator Krb.—July 13.
Ephialtes manifestator L.—Sept. 7.
(10 additional species, apparently undescribed, were identified to genus only).

THE PARSNIP WEBWORM (DEPRESSARIA HERACLEANA) AND ITS CONTROL IN BRITISH COLUMBIA (Lepidoptera: Oecophoridae)[1]

R. GLENDENNING
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This insect became important as a pest in the lower Fraser valley in 1940, when the growing of parsnips for seed became more frequent.

It is an European insect that has long been known on that continent as a pest. It was known to Linnaeus, but was first properly described by Degeer in 1752. In North America it was first recorded by Bethune, from Ontario, in 1869, when it was described as a new species, *Depressaria ontariella*, but this has since been placed as a synonym of *heracleana*. It was recorded by C. V. Riley (1888) as first found in the United States in 1875.

The moths, which measure one half inch in length and have a wing spread of one inch, are light buff in colour, with lighter underwings margined with a thin dark line. The wings are held longitudinally over the body when at rest. The pupae measure three quarters of an inch in length, are reddish brown in colour, and are smooth and shining. The larvae are yellowish-green, about one half inch long when fully fed, and have a series of black tubercles arising from each segment, which also bear a few black hairs. The eggs are spherical, greenish-yellow in colour, and just visible to the naked eye.

LIFE-HISTORY.—This insect passes the winter in the adult stage, the moths leaving hibernation in May. They then fly to any nearby host-plant coming into flower and deposit their eggs, but they may travel considerable distances in search of host plants, as parsnip stecklings several miles from any previous infestation generally become infested during June.

The moths lay their eggs in the umbels of the small flower heads as these are de-

[1] Contribution No. 2305, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

veloping, but later emerging moths continue to lay after the seeds have begun to form, in late June and early July.

The larvae on commencing to feed, immediately web together the small umbels, and feed on the flowers, bracts and young seed heads. Feeding is completed in about three weeks, when the larvae leave the seed heads and descend to the base of the plant where they bore into the main stem, generally near the axils of the lowest two leaf stalks. Pupation chambers are then hollowed out in the stem by the larvae consuming some of the soft white pith; they pupate there, changing to moths in from ten to fourteen days. Several larvae may enter the stem by the same hole and use the same pupation chamber. The moths emerge from the stem through the holes bored by the larvae on entering. This takes place throughout July and early August, and the moths immediately fly to their hibernation quarters, which are usually the nearest sheds, woodpiles or other situations that offer dry, protected winter quarters.

In one instance, hundreds of moths were found in August sheltering between the folds of empty paper cement bags in an open shed; other favoured locations were piles of closely stacked stakes and fence rails.

The essential feature of the habitat is apparently a dry narrow crevice, one quarter inch or less in depth, which probably protects the moths from mice and other enemies. Although the temperature in the lower Fraser valley may vary from 80 degrees F. or over, to as low as zero, the moths remain quiescent for over nine months without undue mortality, until they leave these winter quarters in May.

Riley mentions that the moths have the habit of creeping into crevices in the soil, but this may have been under cage conditions, as they could hardly survive the winter in such situations.

Host Plants.—In the lower Fraser valley only cultivated parsnip, *Pastinaca sativa* L., and the wild hog-parsnip *Heracleum lanatum* Mich., have been found infested. The wild hog-parsnip is an important host however, and where it occurs in any quantity, has been found to support a large population of this insect. This plant is confined chiefly to acid bogs, and in such locations may be plentiful. It is undoubtedly responsible in large measure for the almost certain infestation of new plantings of cultivated parsnip stecklings, through the free flying habits of the moths.

Close examination of native species of umbellifers, other than *Heracleum* ,viz., *Oenanthe*, *Angelica*, *Cicuta* and *Sium*, has failed to show feeding by this insect, and cultivated carrot has been free also. Riley mentions larvae recovered from "the stem of some cruciferous plant" but there is no record of the larvae ever feeding on plants of this family, and if correctly identified, the larvae may have used it owing to the absence of its usual host. Riley also mentions an attempt to rear this insect on wild carrot, but the caged larvae declined to feed on the flower heads, turned to cannabilism or bored into the stem where they pupated.

Natural Control.—In the lower Fraser valley three natural control factors have been noted, but none was sufficiently important to prevent this insect from becoming a pest.

A mortality of 40 per cent took place amongst some moths kept under cage conditions in a natural environment throughout the winter, and undoubtedly many moths die, or are destroyed by predators during this long hibernation period.

A few parasites, both dipterous and hymenopterous have been noted in the field, but none in sufficient numbers to effect appreciable control. Several parasites have been recorded in Europe, and it may be possible for them to be introduced here with advantage in the future.

In 1941, in one location near Fort Langley, large numbers of bats were noted by an observer to be feeding in the evening on the moths as they took flight from the parsnip stems at the height of their emergence. The destruction of the moths would appear to have been almost complete, as later no hibernating individuals could be located in adjacent sheds, though at another farm, 4 miles distant, where no bats were seen, the moths were found plentifully in nearby sheds.

The hairy woodpecker, *Dryobates villosus* (L) was recorded by Bethune as feeding on the larvae and pupae in the stems.

Economic Damage.—Garden parsnips, grown for food are not attacked, the damage by this pest consisting only of the destruction of the flowers and seeds by the feeding larvae.

Infestation has reached as high as 80 per cent of the seed umbels in portions of fields adjacent to good hibernation quarters, and when an umbel is infested, practically all the seed is destroyed. Average infestations were about 30 per cent of the crop, which would represent a loss of $100.00 per acre. In one case a grower burned his entire crop owing to a severe and general infestation.

Control.—No cultural control measures that will entirely prevent serious infestation have been found practical, and the application of chemicals is necessary to protect the crop from severe loss. However, the following measures if carried out intelligently will do much to obviate a severe infestation.

Any wild hog-parsnips growing within a mile or two of the cultivated acreage should be scythed off before flowering each year. If hibernating moths are found in appreciable numbers in sheds or in piles of lumber or logs, the sheds should be cleared out of all rubbish and sprayed with diesel or stove oil, and the piles of rails, stakes or lumber re-stacked in cold, wet weather.

It is not possible to avoid infestation by any seasonal planting of the stecklings, owing to the necessity of timely harvesting.

If parsnip stecklings are raised from seed on the same farm where the seed crop is grown, they should not be nearer the seed crop than 100 yards, as larvae occasionally crawl to seedling parsnips and bore into the crown to pupate, thus injuring next year's stecklings by increasing the prevalence of rots.

In the past, arsenical sprays and dusts have been recommended against this insect, but owing to the webbing habits of the larvae this has not been found satisfactory. Dusts containing derris, pyrethrum extracts, and nicotine were tested in 1941 and 1942, but failed to show effective mortality of the larvae in the webs.

In 1942 however, preliminary tests with a proprietory barium fluosilicate dust gave surprisingly good results, which were elaborated in 1943, when cryolite-talc dusts of varying strengths were also tests.

As a result of these experiments it was found that two applications of cryolite-talc dust, 1 part cryolite to 3 parts talc, ten days apart, gave almost 100 per cent control of the larvae in the webs. The first application was made when about five or six webs were noted per plant, and the larvae were from one quarter to one half grown.

The dust was applied by means of a rotary hand duster, and good coverage was obtained by walking down the rows, moving the spout up and down so as to treat both low and high flower umbels.

From 50 to 100 pounds of dust are needed per application to treat adequately an acre of parsnips, according to the height of the plants. The cost of this is approximately from $2.50 to $5.00 per acre per application, which compared with an acreage value of $300.00 for parsnip seed, is quite practical and economical.

The actual cause of the death of the larvae when dusted with cryolite is not known. It does not seem necessary to hit the larvae in the webs, as frequently this cannot occur when they are hidden amongst the tightly folded bracts. However they appear to come in contact with the dust on, or in their webs, and death may occur within four hours of dusting, though usually from 24 to 48 hours are necessary for a 99 per cent mortality.

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RECENT EXPERIMENTAL WORK ON THE CONTROL OF THE APPLE SAWFLY, HOPLOCAMPA TESTUDINEA (Hymenoptera: Tenthredinidae)[1]

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In a previous article on the apple sawfly published in the Proceedings of this society (Downes and Andison 1942) reference was made to a preliminary trial of summer oil combined with nicotine sulphate for control of this insect. The results obtained in 1941 were encouraging and it was decided to give this method as thorough a test the following season as local conditions would permit.

The chief difficulty in carrying out experimental trials was the fact that the area infested by the sawfly was almost entirely composed of city and suburban lots and not commercial orchards. The apple sawfly shows strong preferences for certain varieties, the chief of which, among those which have been observed in our work at Victoria, in order of choice are Hyslop crab, Wealthy, Duchess, Gravenstein and King. In the presence of favoured hosts less attractive varieties may be almost entirely neglected by the sawflies and, as few backyard gardens contain more than one or two apple trees of the same variety, it was difficult to find a series of trees of any preferred variety for a critical test.

In 1942 three small suburban orchards were selected for spray trials. Two of these were adjoining properties and the third was close by, so for practical purposes they could be regarded as one. Spraying was carried out immediately after the bloom had dropped. The following formula was used:

Summer oil emulsion	2 gallons
(Union Mineral Seal, Visc. 55, S.S.U. 100° F. U.R. 80%)	
Nicotine sulphate	1¼ pint
Water	100 gallons
Lead arsenate	4½ pounds
(Oil concentration 1.21% actual oil)	
Powdered skim milk as emulsifier.	

Lead arsenate has little effect, if any, on the apple sawfly, but was included in the spray for the purpose of controlling various kinds of caterpillars. Several trees were left unsprayed as checks.

The trees were examined for results about one month after spraying when the apples were about one inch in diameter. At that stage the larvae are beginning to leave the fruit and the exit holes, which are quite large, are readily seen. In its early stages a sawfly larva frequently damages several apples in a cluster before finally entering one in which it completes its growth. Fruit scarred by external feeding is included in the injured fruits. Only susceptible varieties are included in the tabulation.

TABLE I
Results of Spraying Experiment in 1942

Variety	Total Apples	Per Cent Injury
	Sprayed Trees	
Gravenstein	2421	3.3
Gravenstein	2106	7.8
Wealthy	1274	1.6
Wealthy	1262	2.6
King	865	6.0
King	400	2.2
Gano	262	11.4
Red Astrakhan	471	1.3
Red Astrakhan	149	9.4
Average Injury		5.06
	Check Trees	
Duchess	2172	39.1
Wealthy	3165	58.7
Hyslop crab	5378	70.0
Hyslop crab	2002	22.4
Average Injury		47.5

In 1943 it was decided to increase slightly the concentration of both oil and nicotine sulphate to determine whether a higher and more uniform degree of control could be obtained than in the previous year's test. In addition to Union Mineral Seal Oil two other types of low viscosity oils were used—Imperial "Mentor 29" (Vis. 45 to 55 S.S.U. 100°F., U.R. 90%) and Shell "Helix" (Vis. 62 S.S.U. 100° F., U.R. 77%). For the trial a block of 34 trees was selected situated on adjoining lots which in former days had been part of a commercial orchard. It consisted of 8 King, 6 Duchess, 8 Alexander, 2 Gravenstein, 1 Cox's Orange, 2 Wealthy,

[1] Contribution No. 2316, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

1 Winter Banana and 6 unidentified trees. Alexander and five of the unidentified trees proved to be non-susceptible varieties or only slightly so. Several trees did not bear fruit. Oil emulsion was increased to 2½ gallons (1.50% actual oil) and nicotine sulphate to 1½ pint per 100 gallons. Arsenate of lead 4½ pounds per 100 gallons was added as before. The time of application was immediately after blossom fall. Non-susceptible varieties and trees which produced too small a crop are not included in Table II.

TABLE II

Results of Spraying Experiment in 1943

Variety	Sprayed Trees Total Apples	Per Cent Jnjury
2 Gravenstein	1269	0.17
4 Duchess	3420	0.43
6 King	1318	0.41
1 Wealthy	524	1.15
2 Unidentified	1112	0.90
Average Injury		0.61
	Check Trees	
1 Duchess	1358	35.03
2 King	1537	41.48
1 Wealthy	704	72.57
Average Injury		49.69

Trial of Quassia-Soap Spray.—In Europe the most common method for controlling apple sawfly and plum sawfly is to use a quassia spray with or without soap. An attempt made at Victoria in 1942 failed owing to the solution being made too weak. In 1943 a formula mentioned by Thiem (1937) which was used successfully against the plum sawfly, was tried with good results against the apple sawfly on a few trees in a city garden. The quassia solution is prepared as follows: Soak 3 pound of quassia chips in 3 gallons of water for 24 hours and boil for 1 hour; then add ¼ pound of soap and dilute to 10 gallons. The spray was applied on May 18 to seven trees of different varieties consisting of one each of Yellow Transparent, Gravenstein, King, Greening and three unidentified varieties. Examined one month later, the most susceptible variety, Gravenstein, showed 2.69 per cent sawfly attack; the remainder were not attacked or only slightly.

The degree of control obtained with quassia-soap compares favourably with that obtained with oil-nicotine sulphate and the slightly lower percentage of clean fruit obtained (97 per cent compared with 99 per cent) is probably not significant. One disadvantage of the quassia spray is that it is more troublesome to prepare than an oil-nicotine spray. It is also twice as expensive. The comparative costs of the two sprays per 100 gallons for materials at 1942 prices are: oil-nicotine $2.66, quassia-soap $5.78.

Conclusion.—The results of experimental work conducted by the Victoria laboratory have shown that a spray of summer oil emulsion combined with nicotine sulphate gives very satisfactory control of the apple sawfly. The best results were obtained with light petroluem oil 55 to 65 S.S.U. viscosity emulsified with powdered skim milk at the rate of 2½ gallons of emulsion to 100 gallons of water (1.50% actual oil) and 1½ pint nicotine sulphate. No apparent difference in reresults could be observed among the three different brands of light petroleum oil used. On sprayed trees rather more than 99 per cent of all apples set were free from sawfly attack, whereas unsprayed trees showed more than 49 per cent loss and in one case 72 per cent. Only one spray is necessary; this should be applied within a week after petal fall. High pressure is not required in order to get results with this spray; in our trials a bucket pump was used and good results are being obtained by residents with pint-size hand pumps. The principal requirement is to see that the nozzle is held close to the calyces and that none are missed. The addition of lead arsenate makes an excellent combination spray which will rid the trees of caterpillars and other biting insects.

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DEVICES FOR CHARTING AND OBTAINING NATURALLY EMERGED CATTLE WARBLES (Diptera: Oestridae)[1]

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With the increased attention now being paid to the problem of cattle warbles, and the need for economy in the use of derris and other rotenone-containing roots, which provide the only known practical means of control, it has been considered necessary to reconsider the life-history and ecology of these insects in order to fill certain gaps in our knowledge.

Numerous questions have been asked: What is the average length of time involved from the first appearance of the grubs in the backs of cattle to their natural emergence? Will grubs that emerge in the very early spring survive frosts? How many degrees of frost will they tolerate? If only one treatment can be given when is the optimum time? What proportion of normally emerging grubs matures to flies under natural conditions? Grubs may emerge while cattle are in the barn, while the animals are in the pasture, in a muddy lane, in sunny or shady spots, on dry hard ground, etc.; what are their chances of survival under these various circumstances? Is the puparium subject to mould and parasites? Are mice or birds factors in control? How long will warble flies live? How far can they fly? How good a cattle-finding sense do they possess? These are only some of the questions that require answers.

In attempting to find the solutions to these problems, certain difficulties have been encountered. To overcome some of these, two simple pieces of apparatus have been devised, and are here described.

[1] Contribution No. 2314, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

(1) A Method of Charting Warbles (Fig. 1).

Fig. 1.—Warble Charter in Use.

Most of our studies are conducted on local dairy herds. A row of cows is chosen for warble development studies and at intervals of a week or so, each animal is checked to see how the grubs are progressing, and whether any new ones have appeared. As there may be as many as 70 grubs in the back of a single beast it was found difficult to locate a particular warble on successive visits.

To obviate this, a measuring stick was made. This consists of a piece of thin wood five feet long, with a cross bar two feet long fastened one foot from the end. The long stick is marked at two-

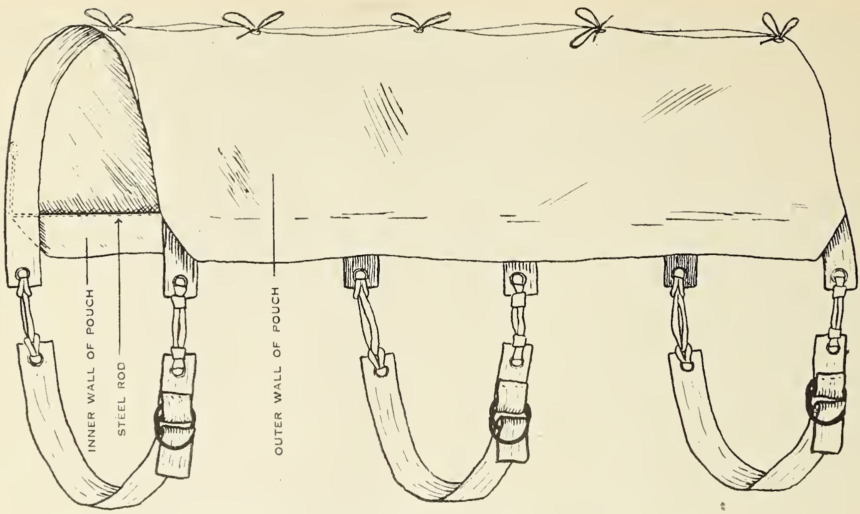

Fig. 2.—Device for Obtaining Emerged Warbles.

inch intervals with numbers from 1 to 30. The cross bar is similarly marked but the divisions are lettered A, B, C, D, etc., on each arm.

The stick is placed with the long member running along the animal's vertebral column, and with the cross piece exactly even with the projecting pelvis (hook) bones. The location of any grub may then be expressed by a number and a letter—on the right side or the left—as 8A, 10C, 17D, and so on. Furthermore, an arbitrary series of numbers from one to five indicates the relative development of the grubs as follows:

Size 1—barely perceptible to small
2—small to medium
3—half to three-quarter grown
4—mature and ready to emerge
5—empty cysts.

Cards have been printed on which to record these data. On one side is a square chart representing the cow's back, lettered and numbered in the same manner as the stick. On the other side there is space for the date, locality, name of herd, row and stall of the particular animal, its breed, colour, age and other pertinent details.

Thus a complete seasonal record may be kept for each animal, and the development of each grub traced from first appearance to maturity.

(2) A Device for Securing Naturally Emerged Grubs (Fig. 2).

In experiments using adult flies, or in determining the normal pupal period, it is necessary to have numbers of naturally emerged grubs. In 1943 rearing experiments were conducted with mature grubs that had been squeezed out very carefully and gently by hand. Due to the unavoidable mechanical injury these grubs did not survive. As it is impractical to follow a cow around, waiting for a grub to fall out of its back, some means of obtaining uninjured grubs in fair numbers had to be invented.

Officers of the United States Department of Agriculture overcame the difficulty by enveloping the body of the animals with bagging; others have applied capsules over individual warble cysts (Bishopp et al., 1926). The first method is awkward, and the capsules are apt to be scratched off.

Our apparatus consists of two canvas pouches, twenty-four inches long and three inches deep, one on each side of the animal. The inner margins of the pouches—those against the sides of the cow—are reinforced by one-eighth inch spring steel rods: the type used by upholsterers for spring work was found to be most satisfactory. At the ends of the pouches these rods are turned up at right angles for about three inches, then terminated in small loops to prevent them tearing out of the canvas into which they are sewn.

The outer walls of the pouches continue up as flaps, and are tied together over the animal's back. These canvas pockets are kept in place and are tightly compressed against the animal to which they are shaped by three webbing girdles, which are cinched around the belly. Each of these straps has an elastic insert on each side to accommodate the cow's size before and after feeding. The girdles are adjusted by double ring buckles. As the warbles emerge, they roll down from the back and are caught in the pockets, from which they may be removed daily, and set aside for rearing.

Heavily infested, long-haired beef yearlings proved ideal for our use; as many as thirty-five grubs were collected from five animals in one day under these circumstances. Tame animals are a great asset to success, for under the best of conditions the harness receives rough treatment. For this reason it should be constructed strongly, and sewn with linen thread.

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THE EUROPEAN RED MITE IN THE OKANAGAN VALLEY OF BRITISH COLUMBIA (Acarina)[1]

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This paper records certain observations regarding the economic importance of the European red mite *Paratetranychus pilosus* (C. & F.) and the effect that control measures may have upon the development of infestations in the Okanagan Valley of southern central British Columbia.

The potential importance of the European red mite has frequently been stated in terms of devitalization of the foliage resulting in loss of leaves, reduction in size and colour of the fruit, and failure on the part of the tree to produce fruit buds. The extent to which the entomologist is justified in leading the orchardist to expect such cumulative injury, should depend upon observations made in his own particular district over a period of years, rather than upon reports from other parts of the country or from obsolete literature.

In infested irrigated orchards of the Okanagan Valley, it is very doubtful if defoliation ever occurs, although yellowing and bronzing of the leaves is commonly observed where the mites are numerous. Trees in this condition may lose many of their leaves following the application of summer oil. In non-irrigated orchards on the other hand, defoliation may be of common occurrence as noted by Newcomer (1941) in Washington State. Infestations in Eastern Canada and the United States, where irrigation is not usual, are also accompanied by loss of leaves and other resulting symptoms. It is well known that the development of many orchard insects is profoundly influenced by cultural practices and there can be little doubt that irrigation has an important bearing upon injuries resulting from the attack of mites and scale insects.

The effect of foliage injury upon fruit bud formation would depend upon the stage of bud development when the mite population reaches its height. In the Okanagan Valley, the fruit buds are usually well developed by late June or early July. Heavy mite infestations during May and June would therefore be more liable to reduce bud vitality than later infestations

[1] Contribution No. 2326, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

which would rather affect the colour and size of the fruit. Irrigation during these critical periods would of course, do much to reduce such injuries.

The control of the pest has been the subject of many experiments and the literature dealing with the efficiency of various spray materials is extensive. In drawing conclusions form such experiments, consideration should be given to a number of factors the action of which often renders results conflicting and unreliable. Certain spray materials are known to have a repressive effect upon mite predators. Spray residues on the foliage in some cases, are believed to favour mite survival or render predatory forms inactive. In the Okanagan Valley, it has been observed that in certain orchards, where early sprays have been applied each season for mite control, the winter eggs frequently become sufficiently numerous in the fall to call for a repetition of control measures the following season, whereas in adjoining unsprayed orchards of the same variety, the mite population has remained at a uniformly low level from year to year.

Many years' observations in orchards throughout the Okanagan Valley have led to the following suggestions regarding the probable development of red mite infestations under local conditions. Dormant oil sprays may be relied upon to destroy most of the winter eggs, but infestations frequently develop on such trees later in the season and winter eggs may again become numerous. The application of summer sprays early in the season whilst controlling the mites for a comparatively short period are frequently followed by infestations in later summer. On trees where early sprays are used, the foliage remains green and affords an adequate food supply upon which the surviving mites increase and are able to deposit a normal complement of winter eggs. Sprays applied at midsummer, when the mite population is already declining may produce spectacular results but examination of unsprayed trees in such an orchard will often show that the mites have already disappeared. Ross and Robinson (1922) observed that depletion of the leaves may be considered as a most important natural check. It by no means follows that a heavy deposition of winter eggs will result in a mite outbreak and it has been often noticed that infestations may become serious on trees with relatively few winter eggs.

On unsprayed trees, foliage injury begins early and gradually increases in severity. The leaves on such trees become depleted and the food supply reduced, which is no doubt the cause of the progressive reduction of the mite population so commonly seen in such orchards. This condition may also result in the deposition of winter eggs which, as suggested by Cottier (1934) may be laid by a brood suffering from the scarcity of food. Lack of nourishment may also cause such eggs to be infertile and they are also exposed to the attack of predators for a considerably longer period than those on trees protected by early sprays.

Observations in three orchards in which the intensive mite control program, which had been in force for several seasons, was abandoned in 1941, have shown that whilst the population in 1941 and 1942 was negligible, a very heavy infestation of winter eggs developed in the fall of 1943 and dormant oil was resorted to the following year. The season of 1944 was evidently favorable to the mite and several orchards in different parts of the valley were heavily infested, most of these had suffered from mite attack in 1940 and 1941.

A more careful study of mite activity on unsprayed check trees over a period of years may be of more ultimate value than laborious counts to show the comparative killing qualities of various spray materials. Much information could be gained by arranging with growers who apply mite control sprays to leave a few trees unsprayed. Such trees would represent conditions in a variety of localities and should include different varieties of apples. Systematic examinations in a number of such orchards might be of greater value than the present method of confining observations to single experimental blocks in one locality and would also provide the grower with a direct comparison by which to judge the effect of his own control measures.

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In Memoriam

MAX HERMANN RUHMANN, 1880-1943

It is with deep regret that I record the death of Max Hermann Ruhmann, Provincial Entomologist of British Columbia, which occurred on December 4, 1943 at Tranquille, B.C. Having known him from the time of his arrival in the Okanagan until his death, I may claim the privilege of a long and valued friendship with one whose attainments and knowledge in the field of our own particular science was quite unique.

Max Ruhmann was born on September 9, 1880 at Hzehoe, Holstein, Germany. His early years were spent in Holland and in 1886 his family moved to England where he attended Claremont House School, Wateringbury, Kent. Subsequently moving to Ireland, he attended the Harcourt Street High School, and later studied medicine at Trinity College, both in Dublin. On the outbreak of the South African War he enlisted in the British Army and saw active service with a noted cavalary regiment. In 1902 he returned to Ireland but owing to severe attacks of malaria, contracted abroad, decided to abandon medicine and devote himself to horticulture and it was at Glasnevin Botanical Gardens, then under the direction of his friend Dr. W. Moore, that he laid the foundation of the wide knowledge in pathology and entomology which became his life's work. By that time he had made plans to become a fruit grower in British Columbia, and was already seriously interested in economic entomology.

He was married in 1904 and moved to Canada in 1907, residing in the Kootenay district until 1909 when he came to Vernon. For four years he worked on fruit ranches to gain practical experience. Then in August, 1912, he was appointed to the Provincial agricultural staff as Assistant Plant Pathologist and Entomologist, which position he held until the separation of the pathological and entomological work in 1918. He then became Assistant Entomlogist. In 1935 he was appointed Provincial Entomologist and held this office until his retirement due to ill health in December, 1942.

It is as an extension entomologist that Mr. Ruhmann will be particularly missed by the farmers and fruit growers in all parts of the Province. The many well arranged exhibits of injurious insects and plant diseases which he prepared for agricultural exhibitions were of great interest and value, and it was this phase of his work which caused him to be so widely known and so constantly referred to on all matters in which the correct identification and control of insect pests was concerned. Max was a skilled photographer; we are still using illustrations and lantern slides prepared by him when the Provincial and Dominion Entomologists shared the same rooms between 1919 and 1930.

The large and well arranged insect collection housed in the Department office at Vernon was almost entirely the result of his efforts, and bears witness to his painstaking skill. Mr. Ruhmann's personal library included a most complete collection of books and pamphlets, dealing with all phases of entomology, the bulk of which he bequeathed to the University of British Columbia at Vancouver. His attainments as a linguist enabled him to keep abreast of entomological research in various countries and here again, his help in translating and abstracting foreign literature was freely given to all. The most generous of men, one who in the goodness of his heart was always ready to give practical help and advice in matters which often covered a range quite outside of the entomological field, and whose personal interest were always held subordinate to those of his friends in all matters, professional or otherwise, he will be sadly missed.

He is survived by his parents, Mr. and Mrs. W. N. Ruhmann of Vernon, B.C., a son William of Portland, Oregon, and a daughter, Mrs. G. E. Clark of Vernon.

E. P. VENABLES

THE BEETLE MELANDRYA STRIATA IN BRITISH COLUMBIA (Coleoptera: Melandryidae). **Melandrya striata** Say, a shiny black beetle with striated elytra, is common in the eastern United States, but Carr's Alberta record (1920. An annotated list of the Coleoptera of northern Alberta; Alta. Nat. Hist. Soc. [Red Deer] 8 p.) seems to be the only one from the north-west. I took a male **striata** at Courtenay, Vancouver Island, B.C., on July 14, 1931; it was identified by Hugh B. Leech, who questioned the locality. However, another male was found at Courtenay on June 30, 1932. Both beetles are now in the collection of the Department of Zoology, University of British Columbia, Vancouver. Unfortunately, I did not keep any record of habitat but according to the literature, the species occurs under bark. There is an illustration of **M. striata** in Blatchley's Coleoptera of Indiana, page 1296, fig. 572.—J. D. Gregson, Kamloops, B.C.

EUCORETHRA UNDERWOODI AT SUMMERLAND, B.C. (Diptera: Culicidae). This chaoborid fly has been recorded from 6 localities in British Columbia by Hearle (1928. Ent. Soc. Brit. Col., Proc. 24:17-18), but only one of these, Kaslo, is east of the coast mountains. A female of **underwoodi** (det. A. R. Brooks) was taken on the wing March 31, 1942, beside Trout Creek, about 4 miles west of West Summerland, at an elevation of 2,000 ft. above sea level. Excellent figures of the larva and pupa of this species are given by Johannsen (1934. Cornell Uni. Agric. Exp. Sta., Memoir 164, fig. 158-164).—Hugh B. Leech, Vernon, B.C.

THE FLEA BEETLE ORESTIOIDES ROBUSTA IN BRITISH COLUMBIA (Coleoptera: Chrysomelidae). In 1935 M. H. Hatch recorded **robusta** LeConte from three localities in the State of Washington, two of them at elevations a little above 5,000 feet (Ent. News 46 (10): 276-278). Two specimens in the Hopping collection carry the following labels: "Midday Val., Merritt, B.C., 3. VII. 1924, K. F. Auden" [Det. F. E. Blaisdell, Sr.]; "Grouse Mt., 4,000 ft., Vancouver, B.C., 7. VI. 1931 H. B. Leech" [**teste** H. C. Fall]".—Hugh B. Leech, Vernon, B.C.

CAMPYLENCHIA LATIPES ON ASTER (Homoptera: Membracidae). W. Downes has thrice recorded **C. latipes** Say in this journal (12: 14; 14: 18-19; 23: 16), reporting it from Vernon and Penticton, B.C., on willow and goldenrod. On August 4, 1944, I found a colony of adults on wild aster, **Aster multiflorus** Ait., at Vernon. Despite the hot weather the hoppers were inactive and made no attempt to elude capture.—Hugh B. Leech, Vernon, B.C.

THE BUG CORYTHUCHA PADI ON BRACKEN FERN. (Hemiptera: Tingidae). On September 29, 1943, near Needles, B.C., adults of **C. padi** Drake were found in numbers on the underside of the fronds of brake, **Pteris aquilina** var. **lanuginosa** Bong. The bugs were feeding, and not readily dislodged. Specimens were identified with the aid of Downes' key to the British Columbian species (Ent. Soc. B.C., Proc. 22: 12-19, 9 figs. 1925), and later verified by Mr. Downes, who said that bracken had not been recorded as a host.—Hugh B. Leech, Vernon, B.C.

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NEW MEMBERS

A List of Members, as of May, 1943, was printed on the inside cover of Vol. 40. The following new members were elected at the Annual Meeting of February 26, 1944.

Barss, A. F.—Department of Horticulture, University of British Columbia, Vancouver, B.C.
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RECENT LITERATURE

AN ANNOTATED LIST OF THE SCOLYTOIDEA OF WASHINGTON. By Gordon K. Patterson and Melville H. Hatch. University of Washington (Seattle) Publications in Biology, 10 (4):145-156 (p. 146, 155 and 156 are blank). February, 1945. Price 20 cents.—An introduction names the collections and unpublished files studied, and mentions the important literature. Ninety-eight species of Scolytoidea (bark beetles) are listed, with localities and in most cases the host trees. **Anisandrus pyri** Peck. is discussed at length.

FIELD CROP INSECTS IN THE PRAIRIE PROVINCES. Bulletin No. 5, published by Line Elevators Farm Service, 763 Grain Exchange Bldg., Winnipeg, Man., 64 p., 33 figs., 2 col. plates. (p. 2 is blank). March, 1945.—This is an excellent handbook, well written and illustrated, with many fine photographs by R. D. Bird. It is "distributed free of charge to farmers and rural schools in Manitoba; Saskatchewan; Alberta; and Peace River Block, British Columbia." The text, except perhaps for the introduction, is by specialists in the laboratories of the Division of Entomology, Science Service, Dominion Department of Agriculture and in the Department of Entomology, University of Manitoba. The insects are arranged by orders, and for each species the recognition characters, life history and habits, and control are discussed. Over 50% of the pests discussed occur also in British Columbia, so the booklet should be of general interest. Note the list of sponsors on the back cover. Copies may be obtained from Line Elevators Farm Service, 503 Herald Building, Calgary, Alta.

A SOURCE-BOOK OF BIOLOGICAL NAMES AND TERMS.—By Edmund C. Jaeger. xvi+256 p., 94 text figs. American ed. by Charles C. Thomas, 220 E. Monroe St., Springfield, Ill., (pub. simultaneously in Canada by the Ryerson Press, Toronto) 1944. $3.50.—Here is a fine book for those who like to know the literal meanings of the scientific biological names and terms they use or read; fully 12,000 are alphabetically listed, usually with one or more examples. The introductory portion contains sections on "How words are built", "Types of names considered", "Transliteration", and "concerning Greek prefixes." Taxonomists will be interested in p. xiii-xxii, in which are quoted T. S. Palmer's lucid and comprehensive statements on the word-formation of generic names (from Index Generum Mammalium. 1904). For those who wish to propose new scientific names, a useful companion volume would be Roland W. Brown's MATERIALS FOR WORD-STUDY, 234 p. Van Dyck & Co. Inc., New Haven, Conn. 1927. $1.15.

CHECKLIST OF THE COLEOPTEROUS INSECTS OF MEXICO, CENTRAL AMERICA, THE WEST INDIES AND SOUTH AMERICA. By Richard E. Blackwelder. Smithsonian Institution (U.S. Nat. Museum) Bul. 185. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.—Part 3, comprising pages iv+343-550, has been issued. Like Part 2 it continues the suborder Polyphaga; species of the families from Lycidae to Tenebrionidae and Cisidae are treated. Price 45 cents.

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THE LODGEPOLE PINE NEEDLE MINER IN THE CANADIAN ROCKY MOUNTAIN PARKS (Lepidoptera, Gelechiidae) [1]

Geo. R. Hopping
Vernon, B.C.

The needle miner *(Recurvaria milleri* Busck)[2] attacks lodgepole pine *(Pinus contorta* Douglas) and Jeffrey pine *(Pinus jeffreyi* Greville and Balfour). An outbreak in lodgepole pine was noted as early as 1903 in Yosemite Park, Calif., where large areas were affected (Patterson, 1921). This infestation has continued in varying intensity up to the present time. Many trees have been killed by repeated defoliation and many others have been badly disfigured. This miner has also been recorded from the Deschutes National Forest in Oregon (Doane, Van Dyke, Chamberlin and Burke, 1936).

In Canada, a heavy infestation was first noticed by park wardens in early June of 1942 in Banff National Park, Alberta. Over large areas lodgepole pine commenced to turn reddish-yellow in a band on the slopes between the 5,000 and 6,500 foot elevations. This was in the midst of a bark beetle control area and the wardens at first thought it was a terrific increase in bark beetle attack. In 1942, intensive infestation occurred on nearly all slopes on the south side of the Bow River from Vermilion Pass eastward to Brewster Creek. On the north side of the Bow Valley discoloration was evident from Johnston Canyon, westward to Castle Mountain. A small area was also affected near Lake Louise, Alta. By 1944, the area severely affected was extended westward into Yoho Park in the vicinity of Wapta Lake, B. C., and from Vermilion Pass southward into Kootenay Park for a distance of eight to ten miles. A few specimens were also collected in the Sunwapta district of Jasper National Park, Alta., but no outbreaks have been reported from this locality.

Although the first outbreak was known in 1903, eleven years passed before the moth was described (Busck, 1914). It is a small grayish moth with a wing expanse of 12 to 14 mm. The head, fore-wings and thorax are silvery gray, irregularly sprinkled with black scales. The front of the head is silvery-white, the antennae gray and black annulated. The abdomen is mainly silvery-white, the legs more or less barred with black.

Not all details of the life-history have been observed at Banff, but the general development follows that described by Patterson (1921). The moths appear in alternate years: in the odd-numbered years in Yosemite and in the even-numbered years in Banff. In 1942 the peak of moth emergence occurred between July 19 and 24. By July 26 over 60% of the pupae had produced adults. At that time, the jarring of a young tree produced a swarm of the tiny moths like a halo about the crown.

The eggs are deposited usually at the bases of the current year's needles and are generally concealed beneath the needle sheaths. The eggs hatch in from twelve to fourteen days. The emergence of the larvae continues from early August to about September 10.

The young larva enters a needle of the current year's growth and about one-third of this needle is mined the first year before activity ceases for the winter. Feeding is resumed in early spring of the following year. After mining about two-thirds of the original needle, the larva moves to a needle of the new growth during August. By the end of the second year about one-half of this needle has been mined and the larva settles down for another winter. In the following spring the mining of this needle is completed and the larva goes to another needle of the same year's growth. After mining this one, it pupates in the gallery. In years of moth emergence the discolouration of the foliage is more pronounced due to the mining of two needles of the same year's growth

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[1] Contribution No. 2345, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Ont.

[2] This determination was not made by a specialist in the group, but was made by the writer after checking specimens with the description (Busck 1914).

by each larva. This practically disappears by the end of September because by then most of the old mined needles have fallen and the mines made by the young larvae in the new growth are too small to cause noticeable browning.

In intensified form the outbreak has been in progress for four years, 1942 and 1944 being the moth flight years. Thus far, the recovery of the trees has been satisfactory except on a small area near Lake Louise, where a few of the older trees appeared to be dying when examined in September, 1944. It is probable that older trees are less able to withstand the miner attack than young stands. In one mature stand on Brewster Creek, the needle miner attack appears to have complicated the bark beetle control work. The weakening of these trees seems to have attracted beetles from surrounding areas less affected by the miner. Consequently, it has been necessary to cruise and burn beetle-infested trees on the Brewster area on three successive years, while other areas required only two treatments.

At the present time it is impossible to predict what the final outcome of this infestation by the needle miner will be. If it should continue for another four years, mortality in mature stands probably would become severe. Fortunately, young reproduction occupies much of the affected area. A more serious consideration is the possibility of bark beetle attack on the mature trees weakened by the miner. As yet there is no indication of any material decrease in the needle-miner population. Several species of parasites have been recovered, but examination of over 12,000 needles showed parasitism to be less than 20%.

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Patterson, J. E. 1921. Life history of **Recurvaria milleri**, the lodgepole pine needleminer in the Yosemite National Park, California, Jour. Agric. Res 21 (3) :127-142.

POPULATION COUNTS OF POTATO FLEA BEETLES AT AGASSIZ AND CHILLIWACK, B.C. (Coleoptera: Chrysomelidae).—During the course of studies of the new tuber flea beetle, **Epitrix tuberis** Gentner in the lower Fraser valley, a remarkable diminution in numbers of the common western potato flea beetle, **Epitrix subcrinita** (LeConte) has been noted. Population counts of adults on potato foliage have been made each season since 1941 by means of sweeping, the beetles being then killed and counted in connection with our life history studies.

In 1941 75 per cent of those taken were **subcrinita**. In 1942 **subcrinita** out-numbered **tuberis** until June, after which the numbers were about equal. In 1943 the **subcrinita** collected in our sweepings were less than 10% of the total at any time throughout the season, and were usually so few that they were disregarded in our population estimates. In 1944 **subcrinta** was even scarcer and although it emerges from hibernation from two to three weeks earlier than **tuberis**, it was not collected in appreciable numbers even in May, before **tuberis** appears in any numbers, and throughout the season formed less than 1% of the beetle population at any time. These population counts were made both at Agassiz and Chilliwack, and the same conditions were found in both districts.

Although this reduction in numbers of **subcrinita** might be due to a natural cyclical phase, pressure of population by the great increase of **tuberis** in these years may be responsible, though it is difficult to see in what way one species could interfere with the other except during copulation. Parasitism is negligible in either species.—R. Glenndenning, Agassiz, B.C.

EROS THORACICUS IN BRITISH COLUMBIA (Coleoptera: Lycidae).—On July 6, 1934, I took a specimen of **E. thoracicus** (Rand) at Fernie, B.C., on herbage along the bank of the Elk River. W. J. Brown, who identified the specimen, advises me that G. S. Walley found a specimen at Likely, B.C., on July 7, 1938.—Hugh B. Leech.

THE WATER BEETLE AGABUS GRISEIPENNIS IN OREGON Coleoptera, Dytiscidae).—H. C. Fall in his revision of **Agabus** listed **A. griseipennis** LeConte as inhabiting the Rock Mountain and Plateau region. Localities were cited in Wyoming, Montana, New Mexico, Nevada and California (Owens Lake). C. W. Leng in his checklist of Coleoptera noted it from Nebraska and California. H. B. Leech (1942 Canad. Ent. 74(7):131, fig 11) added Utah: Far West; Skull Valley; Provo; California: Lone Pine, Inyo Co.; Bodie, Mono Co. At the same time he questioned the accuracy of the Montana determinations. I have two specimens (det. Leech) from Burns, Harney Co., Oregon, taken June 26, 1941, from a roadside ditch. This is a new record for the state and one I deem worthy of note.—Kenneth M. Fender, McMinnville, Ore.

APHODIUS ALTERNATUS IN BRITISH COLUMBIA (Coleoptera: Scarabaeidae).—On April 19, 1942, a specimen of the pretty, vittate **Aphodius alternatus** Horn (det. W. J. Brown) was found floating in a small pond on top of the Birney range, about a mile south of Vernon. Though dead, the beetle was fresh and in good condition; cattle were numerous in the vicinity, and several species of dung-inhabiting **Aphodius** were in flight at the time.—Hugh B. Leech.

NOTES ON THE LIFE HISTORY OF THE VAPOURER MOTH (NOTOLOPHUS ANTIQUA BADIA) ON VANCOUVER ISLAND (Lepidoptera, Liparidae)

George A. Hardy
Provincial Museum, Victoria, B.C.

Introduction.—The swiftly erratic gyrations of *Notolophus antiqua badia* Hy. Edw. have been abundantly evident to the most casual observer in Victoria during the autumn of 1944. While personal investigations were confined to the grounds of the Legislative Buildings and the Empress Hotel, the moths were reported to be equally common throughout the city and suburbs as well as at up-island points.

Considering the extraordinarily large numbers of the male adults it is remarkable that no prognostication of their appearance in the Victoria area was indicated by the presence of the larvae earlier in the year, which by all the signs should have amounted to a small plague at least. After a search in likely places, about a dozen cocoons of females were obtained, each with its batch of eggs, but not one from which a male could have emerged.

The Moth.—The vapourer moth is a member of the family Liparidae to which belong such notorious species as the gypsy and satin moths. It is of wide distribution and was originally described by Linnaeus in 1758 as *antiqua* from Europe. The American species was known by this name until in 1874 Hy. Edwards designated the western representative as the race *badia*.

The vapourer is a small brown moth with a conspicuous white dot on each of the forewings; the middle third of the latter has a lighter band of bay-brown, while the under side of the forewings and both surfaces of the hindwings are of an ochreous-brown colour. As already intimated the flight is very erratic, and it is about as easy to catch as a windblown leaf on a gusty day. It alights as unpredictably as is its course in flight; suddenly dodging up to the underside of a leaf where it reposes with wings held flat, the forewings concealing the hind pair in such a manner as to give a triangular outline to the resting moth. The long hairy fore-legs from which the insect will sometimes alone depend, simulating a withered leaf, are extended straight out in front. The males were flying during the end of August reaching their maximum number in September and finally dwindling to zero by the end of October.

No females were seen at large. The female averages 12 mm. in length and 5 mm. in width with the vestigial fore and hind wings measuring 3 and 1 mm. respectively. These are flattened sacs, like the collapsed finger of a glove; they, together with the rest of the body are clothed with fine hairs. In shape the newly emerged female resembles a fat grey grub tapering equally at each end and with a lateral band of pale yellow dividing the grey upper and lower surface. The eyes are well developed, antennae relatively short and mouthparts rudimentary. She does not move from the fabric of the cocoon but holds her body at about an angle of 45 degrees until fertilized; the dark chitin-tipped genitalia pulsates rhythmically in telescopic action. Egg-laying begins immediately after copulation. Firmly grasping a portion of the cocoon with her legs and using this as the centre of an arc the eggs are deposited in orderly fashion, the forceps-like ovipositor carefully exploring the place for each egg, feeling out the angle between two other eggs, never laying them off the fabric of the cocoon. When all the space within reach of her ovipositor is covered with the eggs in a single layer, she moves ahead or around the cocoon, anchors herself again and continues until all the eggs are laid. The egg-laying accomplished, she lingers on for a few days and dies without ever leaving the surface of the cocoon.

Eggs were laid at intervals of from 5 to 30 seconds, much depending on how promptly the ovipositor found the exact spot for deposition. In one case 90 eggs were laid within two hours after mating.

What with changing position and an occasional rest the complete batch of from 225 to 300 eggs was disposed of in 4 or 5 hours. The batch is not covered with froth or scales as in some species that lay overwintering eggs.

THE EGG.—The egg is shaped somewhat like a squat barrel, flattened above and below, smooth in texture and of a light beige colour with a central dot and shoulder ring of a darker shade. When first laid it is a pale jade-green, assuming its final colour almost immediately after, in 4 or 5 seconds.

The eggs from which this life-history was worked out were collected at large in September and kept at ordinary room temperature, where they hatched and the larvae were reared. Ova under observation in natural out-door conditions do not hatch nor are expected to until spring-time vegetation is available.

THE LARVA.—The caterpillars were reared on various species of rose, the leaves of *R. nutkana* being relished most. Although the food plant was past its prime and at times difficult to obtain, individuals came through their metamorphosis in perfect condition.

(1) First Instar.—Eggs hatched on November 6th. Length about 2 mm. when first emerged increasing to about 5 mm. as growth proceded. The general colour is a translucent blackish in the initial phase. Towards the end of this instar the three thoracic and the fifth abdominal segments assume a much lighter shade. The whole body is covered with long black hairs, as long as, or longer than the body. The larvae are very active, crawling rapidly and dropping readily at the slightest touch, supported by a silken thread which serves the double purpose of breaking their fall and as a guide to regain their original position. The first meal is made of the greater part of the egg-shell.

(2) Second Instar.—First moult November 21st. Length about 6 mm. Apart from size the most marked development at this stage is the intensification of the light coloured segments to a pale yellowish tinge and the appearance on each of the dorsal surfaces of the sixth and seventh abdominal segments of an orange-coloured gland.

(3) Third Instar.—Second moult December 6th. Length about 10 mm. In addition to the uniform black hairs covering the body of the preceeding instars the characteristic tufts now make their appearance. Two pencil-like ones on first thoracic directed forward, one of the same kind on the eighth abdominal pointing backward, all of black hairs. On the first and second abdominal segments the thick shaving-brush-like tufts or tussocks appear in black, while similar though shorter ones adorn each of the third and fourth abdominals but are of a white or greyish colour. Orange tubercles as before.

(4) Fourth Instar.—Third moult December 11th. Length about 15 mm. Approaching maturity is accompanied by an increasing intensity of colour and perfection of structural detail. The most conspicuous change is in the four tussocks which are now equal in size and of shades of yellow varying from gold to lemon. Most of the body hairs are of a yellowish grey colour.

(5) Full - Grown Larva.—Length 27 mm. The head is a shining jet black, the general colour a smoky drab; a broad dorsal stripe is velvet black edged with broken lines of yellow; the thoracic and fifth abdominal has a further spotting of yellow. The spiracles are black with a whitish dot just to one side of them. Until examined closely this dot could be mistaken for the spiracle itself. The body hairs grow from little raised pads, eight pads to a segment, two above and two below the spiracular line on each side; that immediately above is of an orange colour, the remainder are dusky. The longer central hairs of each pad are black, the rest yellowish.

All the hairs are barbed; on the long body hairs the barbs are short and dispersed over the greater part of their length; on the hairs of the dorsal tufts the barbs are longer and more closely disposed; while on the hairs composing the anterior and posterior "pencils" the barbs are arranged in such a manner as to give a spatulate outline to the tip of each hair.

The tubercles of the repugnatory glands are thin-walled evaginations of the body wall, thicker on the sides but very thin and membranous at the apex. They are distended by an influx of the body fluid through which the regular pulsations of the heart action can be observed. When alarmed the larva flips up the posterior segments, the tops of the glands collapse and are drawn down below the thicker side walls. In a few seconds they are re-distended. No spray could be seen, but the very moist appearance of the outer surface suggests a slight exudation of fluid that may serve some defensive purpose.

The caterpillars are not gregarious, but go their own independent ways. The restlessness of the newly hatched larvae suggests that this habit ensures a rapid dispersal away from the nursery and each other.

The Cocoon.—The cocoon is fashioned in the angle of a projecting ledge or coping or in the crevice of rough bark; sometimes among the twigs of bushes. It is a light transparent structure; the greyish silk being tinged with yellowish from the incorporation into its mesh of the larval hairs. This admixture of hairs is accidental as far as the larva is concerned and is the result of much twisting and turning during the process of cocoon making, further aided mechanically by the barbed nature of the hairs themselves. About two days elapsed between the beginning of the cocoon and the assumption of the pupal garb.

The Pupa.—First pupation December 22nd. The pupa averages 10 mm. by 4 mm. in the male, 10 by 5 in the female, with wing sheaths in proportion. It is a shining jet black in colour, sparsely greyish hirsute on the dorsal surface. In addition the dorsum of the first three abdominal segments has a small dense patch of short greyish scale-like hairs.

The first imago, a male, emerged on January 18th; from then on emergences continued until all had completed their metamorphosis by February 1st, 1945. The proportion of the sexes was about equal.

Summary.—The eggs are normally laid during the early autumn months, remaining dormant until the following spring. A batch of ova brought indoors under the influence of the higher temperature prevailing there hatched on November 6th. The larvae were fed on the leaves of *Rosa nutkana*, completing their metamorphosis in 70 days in one case, averaging 78 days for those reared through to the perfect insect.

The time required to complete each stage was observed in one case to be as follows: First instar, 15 days; second instar, 14 days; third instar, 6 days; fourth instar, 10 days; pupal stage, 25 days.

A great variation in the rate of development was evident, especially in the early stages. While all the eggs hatched in two days there was a spread of 23 days between the first and last date of pupation. On the other hand only 13 days elapsed between the first and last emergences of the imagines.

Conclusions.—The possibilities of this species becoming a serious pest could only become a fact in the absence of an active and persistent check such as appears to be the case from the known parasitic infestation. Some such reason may account for its abnormal abundance in 1944.

The number of eggs in a batch is sufficient to quickly populate any given area with larvae. Old egg masses examined showed a 100 per cent viability. Hence the means of rapid increase are present; it only needs a plentiful food supply, mild weather and freedom from parasites or disease to enable their number to reach nuisance-proportions.

Later Note.—In the field, ova hatched on May 25, 1945. Thereafter the larvae were kept in confinement in a cool room. The first adult emerged July 24 making a total period of 60 days to complete the metamorphosis as against 71 days for the first emergence in the material reared last fall. In addition an extra instar appeared with the full fed larva measuring 35 mm., as against 27 mm. in the former lot; apart from size there was no radical change in appearance.

Evidently the fresh young rose leaves

with their higher nutritive qualities as compared with the old faded leaves of the fall and early winter not only provided the means of quicker growth but a shortening of the time to complete development. Milder temperature also has some influence for the pupal period was 11 days as against 25 days in the fall rearing.

A condensed summary of the changes from egg to adult in the spring and summer is as follows: First instar, 5 days; second instar, 9 days; third instar, 7 days; fourth instar, 15 days; fifth instar, 13 days; pupation, 11 days; total, 60 days.

A PRELIMINARY LIST OF THE FLESH FLIES OF BRITISH COLUMBIA (Diptera: Sarcophagidae)

E. R. BUCKELL and G. J. SPENCER
Dominion Entomological Laboratory, Kamloops, B.C.

In the course of efforts to unravel the problems of natural control factors of grasshoppers, it was necessary to rear sarcophagid maggots that were killing hoppers and to make field collections of the flies. A paper on these flies is in course of preparation, but in the meantime it seems advisable to record the species that have been captured and those that have been reared from their acridiid hosts in the Chilcotin, near Lytton, and on the Lac du Bois ranges at Kamloops. The nomenclature is according to Aldrich's Monograph "Sarcophaga and Allies", Thomas Say Foundation, 1916, brought up-to-date through the kindness of Dr. A. R. Brooks, Division of Entomology, Ottawa.

*Indicates species recorded in literature as parasites of grasshoppers in North America.

†Indicates species reared in this Province from **Melanoplus mexicanus mexicanus** Saus.

Wohlfahrtia meigenii Schiner
**Agria affinis* Fallen
Sarcofahrtia ravinia Parker
†*Sarcophaga sinuata* Meigen
Sarcophaga latisterna Parker
**Sarcophaga atlanis* Aldrich
†*Sarcophaga hunteri* Hough
†*Sarcophaga opifera* Coquillet
**Sarcophaga caridei* Brethes
†*Sarcophaga falciformis* Aldrich
†*Blaesoxiphotheca coloradensis* (Aldrich)
Sarcophaga eleodis Aldrich
†*Acridiophaga aculeata* (Aldrich)
†*Acridiophaga aculeata* var. *gavia* (Aldrich)
†*Acridiophaga aculeata* var. *taediosa* (Aldrich)
†*Sarcophaga reversa* Aldrich
†*Sarcophaga rapax* Walker
†*Sarcophaga tuberosa* var. *harpax* Pandelle
†*Sarcophaga tuberosa* var. *sarracenioides* Aldrich
†*Sarcophaga tuberosa* var. *exuberans* Pandelle
Sarcophaga sulculata Aldrich
Sarcophaga bullata Parker
Sarcophaga nearctica Parker
Sarcophaga planifrons Aldrich
Sarcophaga lherminieri R.-D.
Sarcophaga insurgens Aldrich
†*Sarcophaga kellyi* Aldrich

A large number of female flies which key out to the *aculeata* triplet has been reared from maggots emerging from grasshoppers; without males it is impossible to assign them to a variety: males have been reared only of *S. aculeata*. Female flies of the species *Sarcophaga planifrons* and *S. lherminieri* have been frequently captured, pursuing flying grasshoppers and apparently larvipositing on them; it is possible that they also will prove to be parasites of these insects.

HISTORY OF THE USE OF BEE REPELLENTS IN ORCHARD SPRAYS IN THE OKANAGAN VALLEY OF BRITISH COLUMBIA

W. H. Turnbull
Inspector of Apiaries, Vernon, B.C.

The Okanagan Valley of central southern British Columbia is essentially a fruit-growing area; with abundance of native honey plants, orchard blossom and leguminous cover crops, it is well adapted to bee-keeping. There are some 24,535 acres of bearing orchard and 3,786 colonies of honey bees in the valley. In the past, apiarists have suffered from loss of field bees, and from poisoned brood, the result of bees imbibing insecticidal poisons applied as orchard sprays.

This paper records the first experiments with bee repellents to be carried out in the Okanagan. Chemicals were added to standard sprays in an attempt to make the liquids unattractive to honey bees. The present work has been done from the viewpoint of the bee-keeper; the farmer is not greatly interested in the fate of the bees unless it can be proven that they are a major factor in orchard pollination.

Brittain (1933:157) concluded that as far as the apple orchards of the Annapolis Valley of Nova Scotia are concerned, both native and hive bees are important, and that colonies of hive bees should be placed in orchards in case seasonal conditions are unfavorable to native solitary bees; also that "Experimental evidence regarding the value of bees for pollination purposes under controlled conditions demonstrates clearly the necessity of bees combined with a supply of suitable pollen for all varieties. Even the most self-fruitful varieties require bees in order to ensure adequate pollination."

Root (1919:338) has the following to say for the danger of using poison in orchard sprays. "The poisonous spray applied to the tree falls on the flowers of the cover crop, and the bees visiting there are destroyed in immense numbers . . . The spraying of the cover crop presents a new and serious problem . . . Unless protection can be afforded bee-keepers they will be compelled to move their bees away from orchards when the owners allow spraying to be done at a time when it may fall on cover crops which are in bloom."

In the winter of 1942, the American Bee Journal carried a report on the work being done by the Massachusetts Department of Conservation in adding bee repellents to orchard sprays. A pint of oil of creosote to 100 gallons of spray was used; 375,000 gallons of spray were applied in a certain area, and a footnote says that "beekeepers in the area covered reported no loss of bees from poison spray when the oil of creosote was used."

This paper was brought to the attention of A. W. Finlay, Provincial Apiarist, who immediately wrote to Massachusetts for a detailed report. In the meantime a bee-keeper in Vernon drew the attention of the Minister of Agriculture, Hon. K. C. MacDonald, to the article in question and he in turn instructed Morrice Middleton, District Horticulturist at Vernon, to investigate the matter thoroughly.

Upon my arrival in Vernon in the spring of 1942 with full information from Finlay, I found the Department of Horticulture all ready to co-operate on a practical test. H. H. Evans and W. Baverstock had a supply of oil of creosote ready and had conducted some experiments with different "spreaders" in order to have it evenly distributed in the sprays. We then had to find an orchard far enough from others to remove any chance of the bees getting poison from sprays that had not been mixed with repellent. We finally chose one five miles northwest of Armstrong.

Fred Bettschen of Vernon offered to supply the bees for the test. We moved 10 colonies into the orchard, and Evans and Baverstock then applied complete cover sprays of two 400 gallon tanks of standard strength arsenate of lead at the same time and at the same intervals that sprays were applied in the orchards around Vernon. The bees were examined by the writer and a committee appointed by the British Columbia Honey Producers' Association, both before and after every spray was applied. No loss of bees or poisoned brood was found in any examination, and at the close of the season Bettschen harvested 2,160 pounds of honey from the 10 colonies, and the bees had ample winter stores. In an apiary several miles distant, within flying distance of an orchard sprayed without repellents being added, the loss was very heavy, almost all the field bees being poisoned.

We then found out that Evans and Baverstock had only used oil of cresote in one tank of spray each time. In the other tank used they had substituted crude carbolic acid at the rate of two ounces to each 100 gallons of spray. This information gave us two repellents that apparently could be used with perfect safety and equally good results insofar as bees were concerned.

In 1943 the repellents were tested on a larger scale in an orchard where there was a good cover crop of alfalfa, sweet clover, alsike clover and several native honey plants. As in the 1942 tests, complete cover sprays of arsenate of lead, containing one pint oil of creosote to 100 gallons, were used. A second orchard, adjacent to this, was under test with the same number of sprays, but in this case the repellent was crude carbolic acid. A close check up of the thirty colonies of bees in the orchard failed to show any loss of bees.

The formula with oil of creosote was given to several orchardists who were also beekeepers, to be tried out under the usual growers' conditions. In every case a burning of foliage was reported, ranging from slight to severe. This seems to have been caused by the incomplete mixing of the creosote. No loss of bees was reported in any case.

In 1944 the officials conducting the tests decided to abandon the oil of creosote as being unsafe for use by growers and to continue with the more stable crude carbolic acid as a repellent. The orchard used was the one in which the creosote was tested the previous year. Four complete sprays were put on using carbolic acid two ounces to 100 gallons. The atmosphere varied from very moist to very dry during these tests. The cover crop was a heavy one and was in full bloom during at least two of the applied sprays.

The fourth spray varied from the others in that four ounces of crude carbolic acid were used in place of the usual two, to determine if there would be any burning of foliage. No burning whatever was noted.

Another test was carried out by a grower at Peachland, who was supplied with crude carbolic acid and it was applied in sprays by his own men under grower conditions. He had four colonies of bees on the edge of the 48 acres of orchard which were sprayed and the colonies were examined after each spraying. No loss whatever was noted and the bees built up to swarming strength during the time the four cover sprays were being applied.

Several other unofficial tests were carried on by orchardists and in every case "no loss of bees" was reported.

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Root, A. I. and **E. R. Root.** 1919. The ABC and XYZ of bee culture. A. I. Root Co., Medina, Ohio.

BRITISH COLUMBIA AND ALBERTA RECORDS IN E. C. LERCH'S "A LIST OF HOMOPTERA FROM ONTARIO." Lerch's paper (Bull. Brooklyn Ent. Soc., 28 (2): 76-78. April 1, 1933) lists a number of Homoptera said to have been collected by J. F. Brimley of Wellington, Ont. Actually it includes four species received by Brimley from collectors in Western Canada: **Ceresa basalis** Walker from Malakwa, B.C. (not "Malorwa"!); **Campylenchia latipes** Say, **Bythoscopus robustus** Uhler?, and **Oncometopia lateralis** Fabr., from Medicine Hat, Alta.

The Medicine Hat specimens were collected by the late F. S. Carr. The Malakwa example was taken in 1923 by J. H. Aubrey who at that time lived there and was associated with the Forest Service. Like Brimley, H. M. Speechly of Winnipeg and the late Norman Criddle of Treesbank, Man., Aubrey was a meember of the British Empire Naturalist Association. Most of the insects he took were sent to Brimley, but his collection of Coleoptera, left behind when he went to the antipodes, came into my hands in 1931.—Hugh B. Leech.

A PRELIMINARY LIST OF THE HETEROCERA OF THE NELSON-ROBSON-TRAIL DISTRICT OF BRITISH COLUMBIA (Insecta: Lepidoptera)

Harold R. Foxlee [1]
Robson, B.C.

The following list had its beginning in a small collection of Lepidoptera made at Nelson by the late Harry Cane, and now in my possession; few of his specimens show dates of capture. Localities other than Nelson represent my collecting; most of the species from Brilliant were taken at light, chiefly at a number of 1,000-watt flood lights.

The Nelson-Robson-Trail district is in the southern part of the West Kootenay region of British Columbia, adjacent to the northeastern corner of the State of Washington. The localities are as follows, and all are within the quadrilateral between the 49th and 50th parallels of latitude and the 117th and 118th meridians of longitude; Warfield is a suburb of Trail.

B.—Brilliant.	Elevation	ca.	1,550 ft.
N.—Nelson	"	"	1,774 "
R.—Robson	"	"	1,410 "
T.—Trail	"	"	1,400 "
W.—Warfield	"	"	1,900 "

The numbers preceding the names are those of the recent McDunnough "Check List of the Lepidoptera of Canada and the United States of America," vol. 1, 1938; vol. 2, 1939.

SPHINGIDAE

693 *Herse cingulata* Fabr. (R.) .....June
719 *Sphinx chersis* Hbn. (R.)
721 *Sphinx mordecai* McD. (R.B.) ....June, July
730 *Sphinx drupiferarum utahensis* Hy. Edw. (R.) ....June
740 *Smerinthus cerisyi ophthalmicus* Bdv. (B.N.R.W.) ....May, June, July
741 *Paonias excaecata* A. & S. (B.R.) 18.VI.40
742 *Paonias myops occidentalis* Clark (R.) 26.VI.39
745 *Pachysphinx modesta* Harr. (N.R.W.) ....July
770 *Hemaris thetis* Bdv. (R.) ..April, May
789 *Proserpinus clarkiae* Bdv. (N.R.) ....April, May

1 ACKNOWLEDGEMENTS: I wish to extend my grateful thanks to both Dr. J. McDunnough and Mr. T. N. Freeman of the Division of Entomology, Ottawa. Without their kindly co-operation it would not have been possible to write this list.

790 *Proserpinus flavofasciata ulalume* Stk. (R.) ....May
798 *Celerio gallii intermedia* Kby. (B.R.W.) ....June
799 *Celerio lineata* Fbr. (R.) ....May

SATURNIIDAE

807 *Platysamia euryalus kasloensis* Ckll. (R.) ....May
812 *Telea polyphemus* Cram. (N.W.) 3.VI.43
841 *Pseudohazis hera* Harr. (R.) .13.IV.41

AMATIDAE

871 *Scepsis fulvicollis pallens* Hy. Edw. (B.) 15.VII.44

NOLIDAE

891 *Celama minna* Butl. (B.) 11.IV.44
911 *Crambidia casta* Pack (N.)
958 *Hypoprepia miniata* Kby. (N.)
980 *Halisidota maculata angulifera* Wlk. (B.N.R.W.) 3.VI.43
991 *Cycnia tenera sciurus* Bdv. (N.R.W.) ....June, July
1023 *Eubaphe ferruginosa* Wlk. (N.R.) .... June, July
1039 *Apantesis ornata achaia* G. & R. (R.W.) ....May, June
1063 *Leptarctia californiae* Wlk. (N.R.) ....May, June
1065 *Diacrisia virginica* Fabr. (N.R.W.)
1066 *Diacrisia vagans kasloa* Dyar (N.R.) ....May
1069 *Isia isabella* A. & S. (B.N.R.)
1070 *Estigmene acrea* Dru. (B.N.W.) ....May, June
1092 *Parasemia parthenos* Harr. (B.N.) 12.VII.44
1096 *Platyprepia guttata f. virginalis* Bdv. (B.N.) ....June

AGARISTIDAE

1109 *Androloma mac-cullochi* Kby (N.)
1116 *Alypia langtoni* Couper (N.R.) ....May, June

PHALAENIDAE

1152 *Acronicta hesperida* Sm. (N.W.) ....June, July, Aug.
1155 *Acronicta innotata griseor* Dyar (R.) 11.VI.41
1160 *Acronicta grisea revellata* Sm. (R.) 16.V.39
1166 *Acronicta mansueta* Sm. (B.) ....June, July
1201 *Acronicta impleta illita* Sm. (N.) 8.VI.04
1211 *Acronicta perdita* Grt. (B.R.) ....May, June
1232 *Euxoa olivia* Morr. (B.).......21.IX.44
1246 *Euxoa plagigera* Morr. (B.)...30.VII.44
1251 *Euxoa* near *perolivalis* Sm. (B.) 14.VII.44
1257 *Euxoa catenula* Grt. (R.).......13.V.37
1274 *Euxoa intrinta* Morr. (R.)......2.IX.38

1282 *Euxoa* sp. in *holoberba* group
(B.) 18.VIII.44
1284 *Euxoa* sp. in *sponsa* group (B.) . 6.VII.44
1289 *Euxoa perfusca cocklei* Sm. (N.)
1310 *Euxoa messoria* Harr.
(N.R.) ....Aug., Sept.
1314 *Euxoa terrena* Sm. (B.) 31.VII.44
1341 *Euxoa tessellata illata* Wlk.
(R.) 4.VI.43
1351 *Euxoa declarata* Wlk. (R.) ..July, Aug.
1352 *Euxoa campestris* Grt. (B.)...21.VII.44
1354 *Euxoa albipennis* Grt.
(B.R.) ....Aug., Sept.
1366 *Euxoa divergens* Wlk. (B.) ..21.VIII.44
1370 *Euxoa obeliscoides* Gn. (R.) 1.IX.37
1378 *Euxoa ochrogaster* Gn.
(R.) 25.VIII.43; 3.IX.43
form *insignata* Wlk.
(B.) 21.IX.44
1379 *Euxoa excellens* Grt. (B.) ...Sept., Oct.
—— *Euxoa luteotincta* McD. (B.) 29.VIII.44
1403 *Pseudorthosia variabilis pallidior* Ckll.
(N.R.) ....October
1416 *Agrotis vetusta mutata* B. & B.
(R.) 18.VIII.44
1426 *Agrotis vancouverensis* (typical) Grt.
(B.) 24.V.44; 8.VI.44
—— *Agrotis vancouverensis semiclarata* Grt.
(R.B.) ....May, June
1432 *Agrotis volubilis fumipennis* McD.
(R.) 5.V.39
1435 *Agrotis ypsilon* Rott. (N.R.)..30.VII.44
1442 *Feltia ducens* Wlk. (R.)......18.VIII.43
22.VII.42
—— *Copablepharon*, possibly new species
(B.) 7.VII.44
1475 *Eurois occulta* Linn (N.R.)
1476 *Eurois astricta subjugata* Dyar.
(B.R.) 30.VII.44
1477 *Eurois nigra* Sm.
(B.N.R.) ..11.VIII.39; 16.VIII.44
1480 *Ochropleura plecta* L.
(N.R.) ....June, July
1494 *Metalepsis salicarum* Wlk. (N.)
1496 *Peridroma margaritosa* Haw.
(N.R.) 16.VIII.38
1499 *Pseudospaelotis haruspica inopinatus* Sm. (N.)
1510 *Diarsia rosaria* Grt. (B.R.)..May, June
1511 *Graphiphora c. nigrum* Linn.
(R.) ....June, Sept.
1512 *Graphiphora smithi* Snell
(R.) 13.VIII.37
1517 *Graphiphora oblata* Morr.
(B.N.) 31.VII.39; 27.VII.44
1544 *Setagrotis planifrons* Sm.
(B.) 16.VIII.44
1550 *Anomogyna atrata* Morr. (R.)
1569 *Anaplectoides pressus* Grt.
(B.) 31.VII.44
1570 *Anaplectoides prasina* Schiff.
(B.N.).........July, Aug., Sept.
1571 *Protolampra rufipectus* Morr. (N.)
1574 *Pseudoglaea olivata* Harv.
(R.) 19.IX.37; 16.IX.44
1575 *Cryptocala acadiensis* Beth. (N.)
1580 *Hemigraphiphora plebeia* Sm.
(B.N.) 8.VIII.43
1581 *Abagrotis erratica ornatus* Sm.
(B.) ....July, Aug.
1590 *Abagrotis sambo* Sm. (R.)....29.VII.38
1597 *Abagrotis nefascia* Sm. (N.)
1598 *Abagrotis variata* Grt. (N.R.)..22.VI.38
1599 *Abagrotis scopeops* Dyar (R.)..8.IX.38
1614 *Ufeus plicatus* Grt. (B.R.) 24.IV.40
1633 *Scotogramma trifolii* Rott.
(B.R.) ....Aug., Sept.
1660 *Mamestra configurata* Wlk.
(R.) 5.VII.38
1662 *Polia discalis* Grt. (B.R.)....July, Aug.
1669 *Polia purpurissata crydina* Dyar
(B.) 6.IX.44
1672 *Polia grandis* Bdv. (N.R.)........June
1673 *Polia subjuncta* G. & R. (R.)...12.VI.38
s. eleanora B. & McD.
(B.) 24.VI.44
1678 *Polia nevadae canadensis* Sm.
(B.R.) 9.VI.44; 7.VII.44
1679 *Polia radix* Wlk. (N.)
1680 *Polia segregata* Sm. (R.)..March, April
form *negussa* Sm. (B.) 28.IV.44
1684 *Polia tacoma* Stkr. (R.)...........May
1689 *Polia meodana* Sm. (B.)........24.V.44
1691 *Polia adjuncta* Bdv. (N.)
1694 *Polia pulverulenta* Sm. (R.)..14.VII.38
1697 *Polia cristifera* Wlk. (B.).....18.VII.44
1699 *Polia lutra* Gn. (B.W.) .Mar., Apr., May
1709 *Polia detracta* (?) Wlk. (N.)...28.V.06
1711 *Polia obscura* (?) Sm. (B.)....17.VI.44
1716 *Lacinipolia anguina larissa* Sm.
(B.) 24.V.44
1735 *Lacinipolia vicina acutipennis* Grt.
(B.) 12.VII.44
1736 *Lacinipolia pensilis* Grt. (B.)..7.VII.44
1739 *Lacinipolia stricta* Wlk.
(N.R.) ....Aug., Sept.
1744 *Lacinipolia lorea* Gn. (N.R.)...14.VI.44
1745 *Lacinipolia olivacea lucina* Sm.
(R.) 9.VIII.39; 12.VII.39
1746 *Lacinipolia comis* Grt.
(B.R.) ....July, Aug.
c. rectilinea Sm.
(B.) 3.VII.37; 4.VIII.34
1751 *Lacinipolia illaudabilis restora* Sm.
(B.R.) ....July
1800 *Sideridis rosea* Harv.
(N.R.) 25.V.38; 2.VI.44
1803 *Astrapetis sutrina* Grt. (B.)....17.V.44
1808 *Anepia ectrapela* Sm. (B.R.)......May
1841 *Orthodes curtica bostura* Sm.
(R.W.) ....Aug., Sept.
1855 *Orthodes oviduca* Gn. (R.).....16.V.38
1886 *Orthodes contrahens infidelis* Dyar
(N.R.) ....July
1890 *Orthodes furfurata uniformis* Sm.
(R.) ....July
1891 *Orthodes communis* Dyar
(B.R.) ....July, Aug.
1906 *Xylomyges hiemalis* Grt.
(B.R.W.) ....March, April
1909 *Xylomyges crucialis* Harv.
(B.R.) 1.V.39
1914 *Xylomyges dolosa* Grt. (B.N.) 10.IX.44
1915 *Xylomyges rubrica* Grt. (N.)
1916 *Xylomyges perlubens* Grt.
(B.N.R.) 12.IV.40
1920 *Stretchia plusiaeformis* ? Hy. Edw.
(B.) 21.IV.44
1923 *Acerra normalis* Grt.
(B.N.R.) ....March, April

1925 *Orthosia pulchella achsha* Dyar
(B.) 21.IV.44
1943 *Orthosia hibisci quinquefasciata* Sm.
(B.N.R.) April, May, July, Aug.
1952 *Dargida procincta* Grt. (N.R.)
1955 *Zosteropoda hirtipes* Grt. (N.R.)
1992 *Leucania insueta heterodoxa* Sm.
(B.N.) 20.V.44
1995 *Leucania luteopallens minorata* Sm.
(N.R.) ...June, July; 22.VIII.43
2026 *Pleroma obliquata* Sm.
(B.) 10.IV.44
2027 *Pleroma bonuscula* Sm.
(R.) ....March, April
2029 *Pleroma cinerea* Sm. (B.) ..September
2041 *Cucullia florea obscurior* Sm.
(B.R.) ....Aug., Sept.
2106 *Oncocnemis chorda extremis* Sm.
(B.) 6.VII.44
2122 *Oncocnemis figurata* Harv.
(B.) 24.VI.44
2133 *Oncocnemis chandleri* Grt.
(R.W.) ....Aug., Sept.
2154 *Homohadena fifia* Dyar
(B.) 4.VII.44
2184 *Feralia deceptiva* ? McD.
(B.) 24.IV.44
2205 *Bombycia rectifascia* Sm. (B.) ...July
2210 *Brachylomia populi* Stkr.
(B.) 21.IX.44
2215 *Litholomia napaea* Mor.
(N.R.) ...18.III.45; spring and fall.
2216 *Lithomoia solidaginis* Hbn.
(B.) 19.IX.44
2221 *Graptolitha innominata* Sm.
(N.R.) 20.III.38
2222 *Graptolitha petulca* Grt.
(B.) ....Sept., Oct.
—— *Graptolitha pertorrida* McD.
(R.) 22.XI.43
2244 *Graptolitha georgii* Grt. (B.R.) March
2248 *Graptolitha fagina* Morr.
(B.W.) 9.X.43; 15.X.44
2261 *Xylena brucei* Sm.
(B.) 1.III.44; 18.X.44
2263 *Xylena cineritia mertena* Sm.
(B.R.) ......March, April, May
2264 *Behrensia conchiformis* Grt.
(B.R.) ....April
2268 *Platypolia anceps* Steph. (B.) ...3.X.44
2270 *Platypolia loda* Stkr. (W.) 9.X.43
2278 *Fishia evelina hanhami* Sm.
(R.) ....Aug., Sept.
2288 *Anytus profunda* Sm. (R.) 6.IX.38
2303 *Eupsilia tristigmata* Grt.
(B.R.) ....spring and fall
2310 *Lycanades purpurea antapica* Sm.
(R.) ....Sept., Oct.
2313 *Rusina verberata* Sm. (R.) ..2.VIII.37
2315 *Rusina decipiens* Grt.
(B.R.) 13.VIII.38; 29.IX.43
2316 *Xanthia lutea* Strom.
(N.R.W.) 28.IX.43
2318 *Anathix puta dusca* Sm. (N.)
2321 *Eucirrhoedia pampina* Gn.
(N.R.) ....Aug.; 4.IX.37
2322 *Homoglaea carbonaria* Harv.
(B.R.) ....spring and fall
2323 *Homoglaea dives* Sm.
(B.W.) ....spring and fall

2342 *Septis auranticolor sora* Sm.
(N.W.) 5.X.43
2351 *Septis arctica* Frr. (R.) 9.X.43
2352 *Septis castanea* Grt. (N.R.) Aug., Sept.
2356 *Septis centralis* Sm. (B.) 12.VII.44
2362 *Septis impulsa* Gn. (B.) 1.VIII.44
2365 *Septis finitima cerivana* Sm.
(N.R.) ....May, June, July
2368 *Agroperina dubitans* Wlk.
(N.R.) ....June, July, Aug.
2375 *Crymodes devastator* Brace
(N.R.) ....July, Aug.
2393 *Luperina passer* Gn. (R.) ...30.VIII.38
2400 *Aseptis binotata* Wlk. (N.R.) 14.VII.44
2401 *Aseptis adnixa* ? Grt. (R.)
2413 *Oligia indirecta* Grt. (B.N.R.) 1.VII.44
2423 *Oligia illocata* Wlk.
(B.N.R.) 20.VI.37; 12.IX.44
2424 *Oligia mactata allecto* Sm.
(B.N.R.) 20.IX.26; 24.VII.44
2467 *Hydroecia pallescens* Sm. (R.)
2533 *Euplexia benesimilis* McD.
(B.N.R.) 10.V.38; 20.VII.44
2536 *Phlogophora periculosa* Gn.
(B.N.R.) ....July, Aug.
2557 *Chytonix divesta laticlava* Sm.
(B.R.) ....August
2584 *Amphipyra pyramidoides* Gn.
(N.R.) 3.VIII.37
2602 *Andropolia aedon* Grt. (B.R.) ....July
2603 *Andropolia theodori vancouvera*
Strand. (B.R.) ......Aug., Sept.
2609 *Hyppa indistincta* Sm. (N.R.) 1.VII.37
2640 *Neperigea niveirena* Harv.
(B.) 12.VII.44
2655 *Platyperigea multifera* Wlk.
(B.) 9.VI.44; 18.VIII.44
2656 *Platyperigea extima* Wlk.
(B.) 5.VIII.37; 11.X.44
2657 *Platyperigea meralis* Morr.
(B.) 1.VIII.37
2662 *Proxenus miranda nitens* Dyar
(B.) 15.VI.44
2685 *Enargia decolor* Wlk. (B.N.) 20.IX.44
form *infumata* Grt. (B.W. 25.VIII.43
2686 *Zotheca tranquilla f. viridula* Grt.
(B.N.W.) 22.VII.43
2715 *Pyrrhia umbra exprimens* Wlk.
(N.R.) ....June; 12.VII.39
2885 *Annaphila decia* Grt.
(N.R.B.) ....9.III.41; April
2913 *Melicleptria sueta* Grt. (R.) April, May
2931 *Heliothis phloxiphaga* G. & R.
(N.R.) 3.IX.37
3223 *Marathyssa inficita* Wlk. (B.) 9.VI.41
3235 *Sarrothripus revayana* Scop. (N.)
3254 *Autographa rect. nargenta* Ottol.
(R.) 1.IX.37; VIII.38
3256 *Autographa angulidens excelsana*
Strand (R.) 30.VI.41
3257 *Autographa alias interalia* Ottol.
(B.) 9.VIII.44
3265 *Autographa ampla* Wlk.
(B.N.R.) 28.VIII.43
3266 *Autographa selecta* Wlk.
(R.) ....Aug., Sept.
3269 *Autographa brassicae* Riley
(R.) 7.VII.37
3286 *Autographa mappa* G. &. R. (N.)
3287 *Autographa pseudogamma* Grt. (N.)

3288 *Autographa californica* Speyer
(N.R.) 29.IX.43
3291 *Autographa flagellum* Wlk. (N.)
3292 *Autographa metallica* Grt.
(N.R.) ....Aug., Sept.
3295 *Plusia aereoides* Grt.
(N.R.) ....July
3344 *Catocala relicta elda* Behr.
(R.) ....Aug., Sept.
3355 *Catocala californica* Edw.
(R.) ....Aug., Sept.
Catocala c. edwardsi Kus. (R.) August
3357 *Catocala briseis* Edw.
(B.R.) ....Aug., Sept., Oct.
3359. *Catocala pura* Hlst. (R.) ....July
3360 *Catocala nevadensis* Beut.
(R.) ....July, Aug., Sept.
form *montana* Beut. (R.) July, Aug.
3426 *Euclidina cuspidea* Hbn.
(R.) ....May, June
3431 *Caenurgina erechtea* Cram.
(B.R.W.) ....July, Aug.
3484 *Zale minerea norda* Sm.
(B.N.R.W.) ....May
3538 *Toxocampa victoria* Grt. (N.R.)
3551 *Melipotis jucunda* Hbn.
(N.R.) ....May, Aug.
3569 *Synedoida sabulosa nichollae* Hamp.
(B.) 30.V.44
3572 *Synedoida ochracea* Behr.
(N.R.) ....May
3573 *Synedoida divergens* Behr.
(B.N.R.) ....June
3574 *Synedoida hudsonica* G. & R. (N.)
3578 *Synedoida adumbrata* Behr. .. ..
(B.N.R.) ....May
3615 *Scoliopteryx libatrix* L. (R.)
3684 *Spargaloma sexpunctata* Grt.
(N.R.) 17.VI.44
3690 *Bomolocha palparia* Wlk.
(B.) 17.VI.44; 12.VII.44
3706 *Hypena humuli* Harr. (N.R.)
3734 *Camptylochila americalis* Gn.
(R.) 23.VIII.44
3735 *Camptylochila aemula* Hbn. (B.) July
3746 *Camptylochila lubricalis* Geyer.
(B.) ....July
3765 *Epizeuxis lutalba* Sm. (R.) ...23.VI.38
3766 *Chytolita morbidalis* Gn. (N.R.)
3797 *Bleptina caradrinalis* Gn. (N.R.)
3807 *Palthis angulalis* Hbn. (N.R.) ....June

PERICOPIDAE

3817 *Gnophaela latipennis vermiculata*
G. & R. (N.)

NOTODONTIDAE

3822 *Ichthyura apicalis* Wlk.
(N.R.W.) 30.IV.41; 4.VI.43
3827 *Ichthyura albosigma specifica* Dyar
(N.R.) 1.V.40
3829 *Datana ministra* Dru.
(B.N.R.) 24.VI.44
3847 *Odontosia elegans* Stkr.
(B.N.) 12.VII.44
3851 *Pheosia rimosa* Pack. (B.W.)
12.V.44 (Brill.); 4.IX.43 (Warf.)
3857 *Nadata gibbosa* Wlk.
(B.R.N.) ....May, June
3920 *Schizura ipomoeae* Dbldy.
(B.R.N.W.) ....June, July
3924 *Schizura unicornis* A. & S.
(B.) 30.V.44; 24.VI.44
3934 *Cerura occidentalis gigans*, McD.
(R.) 24.V.38
3938 *Cerura scolopendrina* Bdv.
(B.N.R.W.) ....April, May
3939 *Gluphisia septentrionalis* Wlk. (N.)
3940 *Gluphisia lintneri severa*
form *normalis* Dyar (B.N.) 23.IV.44

LIPARIDAE

3943 *Notolophus antiqua* L. (N.)
3954 *Olene vagans* B. & McD.
(B.R.W.) ....May, June

LASIOCAMPIDAE

3994 *Malacosoma pluvialis* Dyar
(B.N.R.W.) ....July, Aug.
3999 *Epicnaptera americana* Harr.
(B.N.R.W.) ....April, May

THYATIRIDAE

4004 *Habrosyne scripta* Gosse.
(B.N.R.W.) ....June, July, Aug.
4007 *Pseudothyatira cymatophoroides* Gn.
(B.R.) ....June, July
form *expultrix* Grt. (W.) ..5.VII.38
—— *Ceranemota albertae* Clke.
(B.) 21.IX.44

DREPANIDAE

4020 *Drepana arcuata siculifer* Pack. (N.R.)
4021 *Drepana bilineata* Pack. (R.) 19.IV.39

GEOMETRIDAE

4023 *Brephos infans oregonensis* Swett
(B.R.) ......March, April, May
4059 *Nemoria darwiniata* Dyar
(B.N.) 6.IX.44
4090 *Mesothea viridipennata* Hlst. (N.)
4134 *Xystrota rubromarginaria* Pack.
(B.) 3.V.44
4144 *Scopula quinquelinearia* Pack.
(B.) 17.VI.44
4153 *Scopula quaesitata* Hlst. (R.) 17.VI.38
4180 *Sterrha demissaria columbia* McD.
(B.) 15.VII.44
4195 *Sterrha rotundopennata* Pack. (N.)
4211 *Cosymbia pendulinaria griseor* McD.
(R.)
4223 *Nyctobia limitaria nigroangulata* Stkr.
(B.) 23.V.44
4229 *Lobophora magnoliatoidata* Dyar
(B.) 7.V.44
4235 *Neodezia albovittata* Gn.
(B.N.R.W.) ....May, June, July
4239 *Oporophtera bruceata* Hlst.
(B.R.W.) ....Sept., Oct.
4243 *Oporinia autumnata omissa* Harr.
(B.R.W.) ....Sept., Oct.
4244 *Triphosa haesitata* Gn.
(N.R.) 22.X.42; 10.XI.43
4248 *Coryphista meadi f. badiaria* Hy. Edw.
(B.R.) ....May, June
4267 *Eupithecia misturata* Hlst.[2]
(R.) 1.IX.37
4276 *Eupithecia castigata* Hbn. (N.)
4288 *Eupithecia columbiata* Dyar (N.)

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[2] Mr. Freeman reports that some **Eupithecia** identifications are tentative, and a few changes may result from examinations of the genitalia.

4290 *Eupithecia maestosa dyarata* Tayl. (B.) 19.V.44
4331 *Eupithecia geminata* Pack. (N.)
4335 *Eupithecia perfusca kootenaiata* Dyar (B.) 24.V.44
4338 *Eupithecia multiscripta* Hlst. (B.) 28.V.44
4341 *Eupithecia georgii* McD. (N.R.)
4378 *Eupithecia probata* S. & C. (R.B.) 14.VII.44
4383 *Eupithecia ravocostaliata Pack.* (N.R.) ....March
4393 *Horisme intestinata* Gn. (B.) ..1.VI.44
4398 *Eustroma semiatrata* Hlst. (B.N.R.W.) ..27.V.44; 25.VIII.44
4402 *Lygris propulsata* Wlk. (N.)
4407 *Lygris xylina* Hlst. (N.B.) ..13.VII.44
4412 *Plemyria georgii* Hlst. (N.)
4416 *Dysstroma citrata* Linn. (B.R.N.) ....Sept., Oct.
c. *mulleolata* Hlst. (W.) ...24.IX.43
4419 *Dysstroma ethela kasloata* Tayl. (W.B.) 6.VIII.43
4429 *Ceratodalia gueneata* Pack. (B.N.R.W.) ....July, Aug., Sept.
4465 *Hydriomena furcata* Thun. (B.N.) ....March, July
4485 *Hydriomena renunciata f. pernigrata* B. & McD. (B.N.) 16.V.39
4511 *Xanthorhoe designata emendata* Pears. (B.) 21.VII.44
4513 *Xanthorhoe munitata* Hbn. (R.) 14.IV.41
4515 *Xanthorhoe defensaria* Gn. (R.) 1.V.40
form *mephistaria* Swett (B.) 31.VIII.41
4516 *Xanthorhoe ferrugata* Clerk (B.N.R.) ....April, May
4541 *Entephria multivagata* Hlst. (N.R.) 16.VI.44
4546 *Mesoleuca ruficilliata* Gn. (N.R.)
4547 *Mesoleuca gratulata latialbata* B. & McD. (N.R.W.) April, May
4551 *Epirrhoe alternata* Mull. (N.)
4555 *Spargania magnoliata pernotata* Hlst. (B.N.R.W.) ....Sept., Oct.
4556 *Spargania luctuata* Schiff. (B.) 10.VII.44
Spargania l. obductata Moesch. (R.N.) 26.VI.38
4558 *Euphyia unangulata intermediata* Gn. (B.R.) ....June, July
4561 *Euphyia multiferata* Wlk. (B.N.R.) 16.VI.44
4574 *Eulype albodecorata confusa* McD. (N.R.) ....July
4582 *Perizoma costiguttata* Hlst. (R.) May
4587 *Earophila vasiliata* Gn. (B.N.R.) ....April, May
4589 *Venusia cambrica* Curt. (N.)
4593 *Venusia* near *pearsalli* Dyar (B.R.) ....April, May
4603 *Eudule unicolor* Rob. (N.)
4605 *Bapta semiclarata* Wlk. (B.N.R.) ....May, June
4615 *Deilinia pacificaria* Pack. (B.) 11.VI.44
4616 *Deilinia bryantaria* Tayl. (B.) 10.VI.44
4617 *Drepanulatrix rectifascia* Hlst. (R.) 24.IV.38
4622 *Drepanulatrix falcataria* Pack. (R.) 16.III.40
4628 *Drepanulatrix pulveraria* Hlst. (R.) ....April, May
4630 *Drepanulatrix litaria* Hlst. (B.R.) ....Sept., Oct.
4634 *Drepanulatrix unicalcararia* Gn. (B.R.) ....May, Aug.
4645 *Sericosema juturnaria* Gn. (B.N.R.) 1.VII.44
4688 *Semiothisa denticulata* Grt. (R.) 14.VII.38
4725 *Semiothisa neptaria sinuata* Pack. (B.R.) 5.VI.44
4757 *Itame quadrilinearia* Pack. (B.W.) ....July, Aug.
4759 *Itame anataria* ? Swett (B.) 27.VII.44
4762 *Itame* prob. *exauspicata* Wlk. (B.) ....July, Aug.
4768 *Itame plumosata* B. & McD. (B.) 15.VII.44
4799 *Elpiste lorquinaria* Gn. (N.)
4801 *Hesperumia sulphuraria* Pack. (N.W.R.) ....July, Aug.
form *baltearia* Hlst. (B.W.) ..July
4809 *Paraphia subatomaria* Wood (R.) 20.IX.37
4811 *Paraphia piniata* ? Pack. (B.) 1.VII.44
4908 *Vitrinella pampinaria* Gn. (B.N.W.) 13.V.44
4913 *Anacamptodes emasculata* Dyar (B.N.R.) ....May, June
4918 *Anacamptodes vellivolata* ? Hlst. (B.) 9.VI.44
4927 *Anacamptodes profanata* B. & McD. (B.R.) 21.IV.40
4945 *Aethalura anticaria fumata* B. & McD. (R.) ....April, May
4946 *Ectropis crepuscularia* Schiff. (N.R.) ....March, April
4955 *Coniodes plumogeraria* Hlst. (B.R.) 9.IV.44; 21.III.45
4963 *Erannis vancouverensis* Hlst. (B.R.W.) ....Sept., Oct.
4968 *Amphidasis cognataria* Gn. (B.N.W.) 26.VI.43; 10.V.44
4998 *Euchlaena mollisaria* Hlst. (B.R.) ....August
5000 *Euchlaena vinulentaria ochrearia* McD. (B.) ....May, June
5002 *Euchlaena marginata albertanensis* Swett (B.) 4.VI.44
5005 *Euchlaena tigrinaria sirenaria* Stkr. (R.)
5012 *Spodolepis substriataria danbyi* Hlst. (N.)
5015 *Campaea perlata* Gn. (N.B.W.) 8.VIII.43
5027 *Philedia punctomacularia* Hlst. (B.R.) ....September
5034 *Plagodis approximaria* Dyar (B.) 13.V.44
5042 *Anagoga pulveraria* f. *occiduaria* Wlk. (B.) ....May
5043 *Hyperetis amicaria* H.-S. (N.R.) ....May, June
5044 *Nematocampa limbata* Haw. (B.N.) ....July
5050 *Metarranthis duaria* Gn. (N.R.) 27.V.39; 21.IV.40
5058 *Selenia kentaria* G. & R. (R.) ..April
5059 *Ennomos subsignarius* Hbn. (N.W.) ....August

5073 *Pero giganteus* Grossb.
(B.N.R.W.) ....July, Aug., Sept.
5077 *Pero occidentalis* Hlst. (B.) ...30.V.44
5080 *Pero morrisonarius* Hy. Edw.
(R.W.) 9.VI.43
5083 *Phengommataea edwardsata* Hlst.
(B.W.) ....Aug., Sept.
5091 *Enypia perangulata* Hlst.
(N.W.) 11.VIII.43
5094 *Enypia moillieti* Blkmre.
(W.) 11.VIII.43
5125 *Caripeta divisata* Walk. (N.)
5158 *Neoterpes triangulifera* Pack.
(B.N.) 24.V.44
5161 *Sicya macularia agyllaria* Wlk.
(B.N.) 8.VII.44
5189 *Synaxis jubararia* Hlst.
(B.N.R.) 21.IX.44
5191 *Synaxis cervinaria* Pack.
(R.B.) ....May, June
5210 *Prochoerodes forficaria* Gn.
(N.B.) 24.VI.44

PYRALIDAE

5355 *Desmia funeralis* Hbn. (R.)
5436 *Evergestis subterminalis* B. & McD.
(B.) 18.VIII.44
5455 *Nomophila noctuella* D. & S. (N.R.)
5479 *Loxostege commixtalis* Wlk.
(B.) 17.VIII.44
5576 *Pyrausta pertextalis* Led. (N.)
5602 *Pyrausta fumoferalis* Hlst. (N.)
5625 *Pyrausta ochosalis* Dyar (N.)
5659 *Noctuelia rufofascialis* Steph.
(B.N.) 23.VII.44
5725 *Scoparia centuriella* D. & S. (N.)
5747 *Scoparia basalis fernaldalis* Dyar
(B.) 20.VIII.44
5758 *Pyralis farinalis* Linn. (B.N.R.)
5769 *Herculia florencealis* Blkmre.
(B.) 20.VIII.44
5857 *Crambus pascuellus* Linn. (N.)
5883 *Crambus hortuellus* Hbn. (N.)
5892 *Crambus vulgivagellus* ? Clem.
(B.) 6.IX.44
5907 *Crambus oregonicus* Grt.
(B.) 20.VIII.44
5919 *Crambus trisectus* Wlk. (B.) 26.VIII.44
6022 *Jocara trabalis* Grt. (B.) 12.VII.44
6042 *Tetralopha aplastella* Hlst.
(B.) 15.VII.44
6227 *Laodamia fusca* Haw. (N.)

PTEROPHORIDAE

6563 *Oidaematophorus stramineus* Wlshm. (N.)

OLETHREUTIDAE

6654 *Badebecia urticana* Hbn. (N.)
6727 *Olethreutes deprecatoria* Heinr. (N.)
6731 *Olethreutes glaciana* Moesch. (N.)
7109 *Epinotia solandriana* Linn. (N.)
7177 *Anchylopera lamiana* Clem. (N.)
7301 *Carpocapsa pomonella* Linn.
(N.R.) ....June, July

TORTRICIDAE

7369 *Platynota idaeusalis* Wlk. (N.)
7378 *Archips persicana* Fitch (N.)
7388 *Archips argyrospila* Wlk. (N.)
7405 *Archips rosaceana* Harris (N.)
7408 *Archips fumiferana* Clem.
(B.) ....July, Aug.
7442 *Eulia ministrana* Linn. (N.)
7477 *Peronea* near *caliginosana* Wlk.
(B.) 24.IX.44
7481 *Peronea variana* Fern. (N.)

COSSIDAE

7667 *Acossus populi orc* ? Stkr. (N.)

OECOPHORIDAE

8460 *Semioscopis inornata* Wlshm.
(B.) 13.V.44

AEGERIIDAE

8708 *Synanthedon tipuliformis* Linn. (N.)
8789 *Albuna pyramidalis* Wlk.
(R.) ....May, June

PLUTELLIDAE

8878 *Plutella maculipennis* Curt. (N.)

TINEIDAE

9615 *Scardia anatomella* Grt. (R.)

HEPIALIDAE

9869 *Hepialus novigannus mackiei* ? B. & B.
(R.) 27.IX.37

AGRILUS VITTATICOLLIS AT CRESTON, B.C. (Coleoptera, Buprestidae).—It is not generally known that **Agrilus vittaticollis** Randall belongs on the British Columbia list, but I have taken over 40 at Creston (det. W. S. Fisher). They are beautiful little insects, silver-grey, with bright bronzy thorax, and occur on saskatoon (**Amelanchier alnifolia**). They prefer scrub bushes, and open, rocky situations. One may collect the place for years as I did, without suspecting the presence of **vittaticollis**, as they are adepts at the old trick of falling to the ground at the slightest alarm; even to stalk the bush and glance the eyes around, the instant they are detected they drop, as though they feel our look. But remain patient for several minutes and they will return to the leaves, either by flight or climbing, usually the latter. The dates for my series are from July 9 to August 1.—G. Stace Smith, Creston, B.C.

THREE SILPHIDAE IN BRITISH COLUMBIA (Coleoptera).—The following three records based on specimens in my collection extend the ranges of the species involved. **Silpha (Thanatophilus) trituberculata** Kby.: Salmon Arm, B. C., Summer 1931 (from collection of H. B. Leech); **Nicrophorus nigritus** Mann.; Vaseaux Lake, Okanagan, B. C., 10-VIII-13; **Nicrophorus hybridus** Hatch and Angell: Kamloops, B. C., 18 Aug. 1935, G. J. Spencer, collector (given to me by the collector).—Melville H. Hatch, Seattle, Wash.

FLYCATCHER EATING THE PINE BUTTERFLY (Lepidoptera: Pieridae).—Several years ago, while collecting butterflies here, I saw a flycatcher dart out and catch three successive **Neophasia menapia** F. & F., as they came along. Such birds must be of some significance in the natural control of this forest pest.—Harold R. Foxlee, Robson, B.C.

MENTAL INSECT ATTACKS

George J. Spencer
Department of Zoology, University of British Columbia, Vancouver, B.C.

In the last eighteen years I have been consulted in connection with three cases of serious mental insect plagues. Each instance involved a middle-aged man, bachelor, in moderate or humble circumstances, living alone in a cabin or little house, afflicted with the idea that he was persecuted by small, fast-flying, tick-like insects that in one instance at least, "burrowed under the skin, causing intense irritation; the insects affected the back of the head and neck by day but at night got into bed and bit all parts of the body; they could be detected only as a streak when flying and moved too fast to be caught.". With minor variations, the symptoms of attack and the resultant hysteria, were alike in the three cases.

Two men were from Vancouver and one from the lower Fraser Valley; all three suffered from irritation and burns produced by the severity of various "dopes" with which they had rubbed themselves; none showed any spot or puncture that could be attributed to insect attack. No control measures and soothing salves that were suggested, were acceptable: the men apparently revelled in their afflictions although the hysteria and suffering were genuine enough and rather pitiable. In one case I recommended the "sweat" treatment, "that sweat induced by hard work was a sure cure against all such attacks," hoping to take the man's mind off his affliction but he did not report to me of the success or failure of this prescription.

Messrs. W. Downes and J. D. Gregson, of the Dominion Entomological laboratories at Victoria and Kamloops respectively, have kindly supplied me with additional records of this type. Mr. Downes' case concerned a lady in Victoria who, says Mr. Downes, "imagined that she was being bitten by small flies; she could see them in the air but much to her astonishment always failed to catch one. The hallucination was particularly marked at night when she imagined that she was being bitten about the arms and neck on which red spots appeared, said to be caused by the bites. She had not had much unbroken sleep for weeks on account of this and her health was rapidly deteriorating. On investigation of the premises I found a spotlessly clean house, reeking of sundry insecticides and disinfectants but not a sign of any insect. I suggested to her the use of an ordinary mosquito repellent which I assured her would keep all insects away. She used this and immediately obtained relief, getting unbroken rest for the first time for a long period. The trouble returned, however, after a fortnight and she was then placed in charge of a doctor. After a course of treatment for neurasthenia her troubles disappeared."

Mr. Gregson's record concerned a man 62 years of age, who wrote in to the laboratory from a town in Alberta, recounting in great detail his persecution by ticks which were "burrowing into his body and reproducing their kind under the skin," drilling up the neck and into the skull. He declared that he had cut out the first attackers from under the skin, bit by bit with penknife and forceps but later ones bored too deeply for cutting out although they could be distinctly felt; he was keeping some from entering his skull by scrapthem down under the skin of his neck, with a blade of a penknife. He had consulted a number of medical men and forwarded the name of one who was treating him at the moment. This doctor reported to the Kamloops laboratory, that the man's body presented no skin disturbances or constitutional troubles, that the affliction was purely mental and was yielding slowly to a mixture to be taken by mouth and to abundant reassurance that the treatment would be completely effective.

All these cases follow somewhat the same pattern and course of development. The trouble can hardly be called "Insectophobia" because the sufferer did not hate insects as such: it is a sense of being persecuted by one specific, though imaginary type of insect and constitutes a mental fixation or hallucination. All cases probably started from genuine attacks at one time or another, of lice or mosquitos or no-see-ums (*Culicoides*) and perhaps true ticks, which so worried them that the sense of suffering remained to form a mental plague when the insects themselves had passed. This was definitely so in the case supplied by Mr. Gregson, for the man had visited a mining property near Nelson, B.C., with some companions and all members of the party had been attacked by wood ticks which they had completely removed from their bodies and clothing. It was not until several days later that the mental trouble began in the man in question.

What was possibly an incipient case of this kind was encountered in Vancouver in an elderly couple, comfortably off financially, who had rented their house for the season. They returned to find it infested by a few bed bugs which bit both man and wife, and horror and disgust seized them; they rented another house and had their own home treated, cleaned and redecorated from basement to roof. The fear and loathing of the bed bugs followed them into the rented house and every speck on the walls, on the furniture or in their beds, turned into an imaginary bug and any sudden irritation or feeling on the skin developed into the intolerable itching of a bite.

At this stage I was called in by a friend who actually thought they had bed bugs. I found both people suffering from burns and irritation caused entirely by the number, variety and severity of the "dopes" they had used; the furniture, sheets and mattresses were stained by varied insect sprays including creosote washes, and the blankets had great holes burnt in them by lye. There was not a sign of a bug anywhere in the house.

It took two days of demonstration and persuasion to convince the old people that they had no bed bugs and were not being bitten and probably saved them from developing the same permanent mental delusion and suffering which affected the other people.

NAPHTHA GASOLINE IN INSECT KILLING BOTTLES.—When making population counts of grasshoppers by sweeping, it becomes necessary to kill a large number in a short time. While working on these counts we found that even a quart-size, cyanide bottle took too long so we employed a large candy jar containing a quart of methyl alcohol into which the whole tip of the net was dipped. This worked well but the alcohol soon became filthy and we substituted naphtha gasoline and have employed it ever since. It is the fastest killing substance we have used; three seconds is enough to penetrate a mass of grasshoppers as large as a baseball. Large-mouthed jars are sometimes hard to get so we now carry the gasoline in any quart bottle, from which the fluid is poured directly on to the mass of insects in the end of the net, whence it drips into a small tin can. So long as the insects are wetted they die immediately. The gasoline is poured back into the bottle from the can.

Less convenient to carry but equally convenient to use, is a one-inch diameter shell vial containing a little gasoline, with a wire gauze disc shoved half way down. Any insect caught in a net can be tapped into this bottle, which should be inverted and righted again as fast as possible and the insect removed with forceps. Too long immersion induces a rigor which is apt to snap off the legs, especially of grasshoppers whose hind legs invariably come up over their heads.

The gasoline evaporates in a matter of seconds and does not spoil the bloom on any dipteron, dragon fly or wasp on which we have used it; in fact it cleans insects by degreasing them, especially fresh bumble bees. It should not, however, be used to clean old dry bumble bees whose fur becomes matted when soaked in it.—George J. Spencer, Kamloops, B.C.

ON THE DESTRUCTION OF ALL STAGES OF INSECTS IN PULVERIZED CEREALS AND SPICES.—Within the last two years there has been put on the market a patented mechanical contrivance for sterilizing all types of pulverized cereal products and spices and possibly commercial fertilizers containing fish meal, that are subject to attack by insects infesting stored food products. It is called the "Entoleter" and consists of a relatively simple hopper-fed machine which hurls the material with forced draught through a nozzle, up against a plate, thus destroying all stages of any insect that might happen to be present.

According to the Canadian agent in Toronto, a considerable number of these machines of varying capacities has already been installed in cereal-manufacturing plants in the United States and in Canada. They should prove a boon to the industry on this coast and should reduce to a minimum, the instances of infested foodstuffs attributable to infestations prior to the goods leaving the factories and developing later inside the packages.—George J. Spencer, Department of Zoology, University of British Columbia, Vancouver, B.C.

A NEW SUBSPECIES OF MONOCHAMUS NOTATUS (Coleoptera: Cerambycidae) [1]

Geo. R. Hopping
Vernon, B.C.

Monochamus notatus (Drury) occurs in eastern Canada and northeastern United States, its range extending as far west as Lake Winnipeg and Minnesota. It has also been reported from British Columbia (R. Hopping 1922:258; Dillon and Dillon 1941:75-76). However, this western form differs consistently from the eastern one as to the elytral sculpture and pubescence, and appears to warrant subspecific status.

Monochamus notatus morgani
Hopping n. subsp.

Male: Length 31 mm.; breadth across humeri 10.5 mm.; colour brownish-grey on elytra, more cinereous on the head and prothorax, predominantly grey with black flecks beneath and on the legs; first two segments of antennae blackish-cinereous, remainder dull black, becoming brownish distally.

Head: Front with widely scattered coarse punctures, with areas of fine punctures interspersed which give rise to condensed cinereous patches of appressed short vestiture; coronal suture deeply impressed between antennal tubercles, fine and feebly impressed but entire on the occipital areas, this last fairly densely but not solidly covered with short appressed cinereous pubescence arising from patches of fine punctures; head beneath and genae moderately densely cinereous pubescent, the genae transversely carinulate laterally; antennae about two and one-half times the body length, the third segment a little more than twice the length of first and second combined and about one and one-fourth times the length of the fourth which is about equal to the fifth. *Prothorax* about as broad as long, with marginal bead and broad flat collar apically, transversely carinulate toward the sides; basal collar narrower, also carinulate laterally; disc of pronotum with median elevation devoid of condensed vestiture, but condensed cinereous vestiture nearly covering the lateral tubercles, two smaller patches anterior and two posterior on the disc. This condensed pubescence arises from groups of rather fine punctures, and in addition there are widely scattered coarse punctures; lateral tubercles large and blunt extending to nearly the breadth of humeri, strongly carinulate on the sides of pronotum beneath the tubercles. *Elytra* with side margins notably tapering from base to apex; humeri coarsely tuberculate, rather abruptly rounded; elytral sculpture rough and irregular with large and fairly dense punctures and with condensed cinereous patches interspersed with patches of black velvety pubescence of a different character, these last more scale-like and erect; apices evenly rounded to suture, where there is a very faint suggestion of prolongation. *Undersurface* including legs, mostly covered with appressed cinereous pubescence, but flecked with black where pubescence is absent; front of *prosternum* strongly transversely carinulate, *metasternum* more finely so, somewhat obscured by the grey vestiture; last ventral abdominal segment nearly straight across the hind margin at middle and with a faint suggestion of emargination.

Female: Length 26 mm., breadth across humeri 8 mm. Differs from male in having antennae more cinereous througout, only slightly longer than the body, faintly annulated; front of head proportionately broader; margins of elytra nearly parallel; front legs not longer than middle or hind pair; last ventral abdominal segment strongly emarginate with a tuft of long black bristles on each side of the emargination.

Holotype male and *Allotype* female, No. 5538 in the Canadian National Collection, Ottawa. Type locality in both cases Trinity Valley, B.C. July 31, 1942 (male) and Aug. 15, 1942 (female), C. V.G. Morgan. *Paratypes* 10: two males and two females in the Canadian National Col-

1 Contribution No. 2365, Division of Entomology, Dominion Department of Agriculture Ottawa.

lection, Ottwa; three males and three females in the Hopping Collection, Vernon, B. C.

Fifty-four specimens have been examined all from the white pine areas of the interior of British Columbia. Cyanide-killed specimens do not differ much in colour from living examples, but those preserved in alcohol lose much of the grey effect and the general colour becomes brown.

This subspecies differs from the eastern *notatus* by having notably coarser sculpturing on the elytra and more and generally larger black patches of velvety pubescence dispersed over the elytra. Actually these black tufts alternate with cinereous patches in rows between the costae. It is named for Mr. C. V. G. Morgan who has made a study (unpublished) of the biology and parasites of *M. notatus morgani.* His data suggest that it breeds only in western white pine *(Pinus monticola* Dougl.) *M. notatus notatus* breeds in *Pinus strobus* and has also been reported from *Pinus banksiana, P. resinosa, P. ponderosa,* and *Picea glauca* (R. Hopping, 1922). Discussing it under the synonymical name *M. confusor* Kirby, Craighead (1923:107) states "As far as known, it attacks only *Pinus strobus.* Packard . . . and Hopkins record this species attacking living balsam fir *(Abies balsamea)* at Brunswick, Maine, probably confusing it with *marmorator.*"

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A NOTE ON THE TANGLE-WINGED FLIES OF BRITISH COLUMBIA (Diptera: Nemestrinidae).—In 1930 I reported to this Society, the occurrence of the nemestrinid fly **Parasymmictus clausus** O.S. which I found laying eggs in telephone poles, fence posts and dried poplar trees on the cattle ranges at Riske Creek, Chilcotin. I have taken it frequently but not every year since, on the ranges at Lac du Bois, Kamloops.

The family Nemestrinidae consists of only some 150 species occurring chiefly in countries of hot dry climates with little rainfall; only 8 species have been found in Europe and 12 in North America, most being neotropical where they are well represented in Chile. Dr. Jos. Bequaert of the Harvard School of Tropical Medicine, the North American authority on these flies, informed me that **P. clausus** was a very rare fly and that its occurrence in the Chilcotin was the furthest north for any representative of the family, in the world.

Until 1943 this species was the only one of the family I had found in the Province but in that year Mr. E. R. Buckell and I found two males of a very similar species **Neorhynchocephalus sackeni** Will. on the dry cattle ranges near Kamloops and this year, 1945, it has been not uncommon.

As far as known, the larvae of the Nemestrinidae are all parasitic upon other insects. I have reared both our local species from grasshoppers, **P. clausus** chiefly from **Camnula pellucida** Scud. but very occasionally from other species of hoppers, and **N. sackeni** from **Melanoplus mexicanus mexicanus** Saus.

Larvae of both flies are so-called "tubed" maggots, breathing from the 2nd instar onwards by means of a tracheal sheath or funnel attached to the thoracic trachea of their hosts; the vortex of the funnel surrounds the posterior third of the larvae which move freely in the body cavities of their victims, as if tethered by these tubes.—George J. Spencer, Kamloops, B.C.

HOLOPLEURA MARGINATA IN BRITISH COLUMBIA (Coleoptera: Cerambycidae).—A female of this lovely crimson and black longhorn was taken at Arrowhead on May 30, by Charlie Slade. He obtained it by beating the foliage of a Douglas fir tree. When first seen by me the beetle was damaged, lacking head and prothorax, but was still fresh and relaxed. Examples of this species vary from 7 to 12 mm. in length, and the pronotum and elytra from almost entirely crimson to heavily marked with black. The beetles are rather flat, and somewhat resemble the Lycidae.—Hugh B. Leech.

AGABUS CONFERTUS EATING CHIRONOMID LARVAE (Coleoptera, Dytiscidae, Diptera).—Dissections of adults of **Agabus confertus** LeConte collected at Los Altos, Calif., in June, 1937 (E. S. Ross), showed that they had eaten large numbers of chironomid larvae, the so-called "blood worms." In each case the great amount of fine silt in the beetle's proventriculus indicated that both the larvae and the thin protective tubes in which they live had been eaten. The beetles must be able to swallow surprisingly large fragments, for the larval head capsules were found intact.—Hugh B. Leech.

ON THE INCIDENCE, DENSITY AND DECLINE OF CERTAIN INSECTS IN BRITISH COLUMBIA

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It is a well known fact, supported by many records in literature, that certain insects indigenous to this country such as chinch bugs and some species of grasshoppers, bark beetles, cutworms and several forest-defoliating caterpillars, have more or less definite rythmic cycles of abundance and decline: the factors governing this increase are less well known than those producing the decrease although a great deal of research has been done upon them.

In the case of insects which have come in from a foreign country and have become established in North America, the pattern is somewhat different; after a period of often undetected establishment and gradual or sudden rise in abundance, the insect reaches a peak and then subsides to a level which remains fairly constant except for periodic or irregular minor fluctuations which are common to both native and to foreign insects. This is the case with the Hessian fly, the Gypsy and browntail moths, the cabbage butterfly, the San Jose scale, the European corn borer and the European earwig. Insects which may be cited as not yet having reached their level after importation, are the Jananese beetle in some of the Eastern States and southern Ontario, and the codling moth in its relatively new territory, the Okanaagan Valley of British Columbia.

To repeat, while the factors producing an increase of any insect are not well understood, those bringing about the decrease may be one, or a combination of: —unfavourable weather conditions (as opposed to climate), predators, parasites, or sickness caused by fungous, bacterial, polyhedral or virus disease.

In the course of the last few years, a number of instances in British Columbia have come to attention in connection with several insect species, of the rare occurrence of one or two individuals only, of sudden rises in population followed by rapid or slow decrease, and of the invasion of an area by a species not hitherto recorded there.

In connection with the first item, namely the taking of one or two specimens only of a species in an area where systematic collecting has been conducted for nearly two decades, one is forced to ask "Why is an insect rare? If only one or two specimens are taken over a period of years, why should not more of them occur in the same place?" The rarity of an insect in any region is usually attributed to hostile weather conditions or to the presence of its natural enemies; on the other hand it may be attributable to insufficient collecting or to collecting at the wrong time, to the insect being at its extreme range in that area or to the fact that its Order or Family is dying out at this time of the world's history.

One of the criteria that I find useful for gauging the abundance or increase of any insect, is the number of letters of enquiry concerning it, that are sent in to the University; this is particularly true of insects of the household which have periods of increase and decrease in a normally very uniform though highly artificial habitat, the human home.

Instances of the rarity of one species or the fluctuation of others, can be cited in practically all Orders and are familiar to all entomologists, especially to those of this Province which has a richer and more varied insect population than any other part of Canada. At this time it is possible to select only a few outstanding instances of the many which have come to my attention.

Of the Order THYSANURA, the family MACHILIDAE is represented by some 5 species in the Dry Belt, all apparently undescribed, which either occur very rarely over a considerable area or in fair numbers in very restricted spots sometimes of only a few square yards in extent. Conditions would seem to be ideal for their increase and spread but this does not occur. At the Coast a mottled species occurs rarely on the damp forest floor. Dr. M. L. Prebble informs me that he found an arboreal form common at the Coast, and H. B. Leech reports that speciments are sent in constantly from forest rangers all over the Province in connection with the Dominion Forest Insect Survey; unfortunately the latter are too battered to be identified.

Limited to one rocky headland at Departure Bay near Nanaimo, may be found large numbers of *Machilis maritima* L. a cosmopolitan species. It is difficult to see why *maritima* does not spread up and down the coast where conditions would seem to be ideal for it.

For years I have hunted for *Japyx* of the family JAPYGIDAE but have never yet found any; in Oregon it is not uncommon under bark of dead forest trees. In February 1945 Dr. Saunders of the University of Saskatchewan told me that he found a *Japyx* at Brentwood, Vancouver Island in 1944, under the rosette of leaves of a fall dandelion; intense search revealed only one more specimen. As far as I can determine, this is a first record for this Province.

Of the COLLEMBOLA, the late Dr. J. Folsom told me that at least 100 species should occur in this Province; at least a dozen species have been abundant every autumn for many years in the trash of the forest floor at the University. They were especially abundant in October 1943, but at the same time in 1944 every last specimen seemed to have died out; not one could be found in a large number of samples treated in the Berlese funnel. The summer of 1944 was very dry at the coast and this one season's drought seems to have wiped out the entire population of these tiny insects.

Of the ORTHOPTERA, only 2 species need be mentioned. The season of 1943 saw an increase of the lesser migratory locust *Melanoplus mexicanus mexicanus* Saus.; the autumn of that year was open and fine: *mexicanus* was seen on the Nicola ranges even until the first week in December. Every female must have laid her full quota of eggs and every last egg must have been fertile because 1944 saw an outbreak of this locust unparalleled in the history of this Province and it occurred in areas where it has never been seen before. Now we have had long, mild autumns before, and *mexicanus* is widely distributed; what combination of factors produced this devastating outbreak in 1944?

The other orthopteran under consideration is the European house cricket *Gryllus domesticus* L. which appeared first in Vancouver about 1934, being suddenly reported in numbers in two widely separated apartment houses, and a few specimens only, in one house in West Point Grey; it has occurred in small numbers for years in the locker rooms of a golf club on the outskirts of the city. No measures were taken to control the 1934 populations and I feared an outbreak of the cricket but it seemed to disappear entirely until April 1944 when it turned up in swarms in the furnace room of an apartment house at the junction of Broadway and Granville Street, several miles from the previous infestations. Where did it go during those ten years and what caused the 1944 outbreak?

About 1937, J. D. Gregson found *Grylloblatta campodeiformis* Walk. at Kamloops in the talus slope of Mount Paul, at an elevation of 1,400 feet only. The face of this slope is one of the hottest spots in the Dry Belt and *Grylloblatta* seems to retreat into the cold interior of the rock pile during summer, coming out to the surface only when November cools down the countryside with sharp frosts. Its previous records were from Lakes Louise and Agnes and on Rundle Mountain, in the Rockies, Alberta, and in British Columbia, a reported record from Forbidden Plateau near Courtenay on Vancouver Island and at the top of Grouse Mountain near Vancouver. To find it in numbers at 1,400 feet at Kamloops, provides a most remarkable record of discontinuous distribution. It is probable that further collecting in this Province, in late autumn will show that *Grylloblatta* is widely distributed in locations similar to those occurring at Kamloops. The insect must have followed the skirts of the receding ice sheet 15,000 years ago and persisted in situations where it could retreat in summer time to near-frozen spots deep in rock piles.

Of the DERMAPTERA, the European earwig *Forficula auricularia* L., formed a terrible plague in Vancouver as late as 1927-28. Since then it seems to have reached an equilibrium at a rather low level and though it becomes fairly numerous some years, it is far from being the great plague it was two decades ago. Moreover its reduction cannot be attributed to the introduction of the tachinid fly *Digonochaeta setipennis* (Fallen) which is only now becoming apparent in some numbers in West Point Grey. This earwig is a good example of an imported insect increasing to outbreak proportions in a new country and then sinking to a fairly inconspicuous level. The conditions in the country remain the same: what has produced the equilibrium?

Contrast with this the case of the ring-legged earwig *Euboriella annulipes* (Lucas) which has existed for over a decade in the gardens of the Empress Hotel in Victoria without spreading out into contiguous gardens, let alone over the rest of the city.

Concerning the ISOPTERA or termites, the damp wood species *Zootermopsis angusticollis* (Hagen) which is widespread in the Vancouver region, on the Gulf Islands and on the mainland as far as Powell River, seems to be slowly increasing in the city of Vancouver where more and more complaints are coming in about its invasion of homes. One would think that with the building-up of the city this inhabitant of rotting timbers on damp ground, would decrease, but such seems not to be the case. The dry land termite *Reticulitermes hesperus* Banks occurs along the upper Fraser Valley from Lytton to Kamloops, up to the 1,800 foot level on the ranges. I have turned over literally hundreds of fallen fence posts on the ranges and know of only one post where a colony has existed for over ten years, and not in the posts on each side of it. What are the hazards which so restrict the distribution of this insect up the Fraser Valley?

Three records have come to hand in 18 years, of severe outbreaks of PSOCIDAE or book lice, originating in upholstered furniture in homes and one record of its increase from behind a damp draining board in a kitchen. Two species of these insects are common in practically every basement in Vancouver. Why do not these outbreaks become general all over the city?

Turning now to the MALLOPHAGA or bird lice, to date we have one record only of the biting cat louse *Felicola subrostratus* (Nitzsch) occurring on a kitten born and bred in Vancouver. Now cats are rather promiscuous animals, yet this louse is apparently rare in the city. The same thing goes for the dog louse *Trichodectes canis* Degeer, of which I have only two records from dogs born and raised in Vancouver and a number of records from dogs in Kamloops. It is a different matter with this louse on coyotes for on these animals it extends from the Merritt district up to the Bulkley Valley and sometimes in such immense numbers that it literally shears off all the fur from the poor beasts, leaving them almost naked with fur only on their tails so that trappers call them "flag-tails." Porcupines are widespread in the Dry Belt but though I have examined many specimens from widely scattered places, only those from Quesnel to Barkerville have harbored the louse *Eutrichophilus setosus* Giebel, a species which is specific to porcupines and which has been reported outside of this Province, from California to Alaska.

Again of the sucking lice ANOPLURA, we have the record published recently in our Proceedings (**35**: 27-28. 1939) of the yellow-bellied marmot collected by George Holland at Kamloops, when the poor beast was driven from its den in November by more lice than there were hairs on its body. Holland collected a half ounce bottleful of the insects and then threw away the animal in disgust. Why should this one marmot have had such an infestation when the scores that the Kamloops laboratory staff has collected, usually have very few on them? Another instance of almost unbelievable louse abundance occurred in 1943 when a man living in a shack in Vancouver was reported to have been killed by the human body louse which left the dead body and spread over the walls and furniture and even crept out through the cracks around the door and on to the sidewalk.

Turning to more pleasant insects, the ODONATA, we all know that dragon flies occur everywhere in this Province, sometimes in considerable numbers in one place. During the summer of 1943 there occurred a three-day flight of one species of dragon fly on the campus at the University in such immense numbers as to attract the attention of even the most unobservant; on the 4th day there was not one to be seen. Unfortunately no one thought of keeping a specimen for identification. Whence came this migrating horde and where did it go?

Of the HOMOPTERA, two records are striking. The campus of the University was landscaped and planted in 1923-24; in 1931 there occurred a most conspicuous series of colonies of the giant aphid *Pterochlorus viminalis* (Fons.) on one of two similar willow trees whose branches almost touch one another. The aphid is relatively huge, at least one half centimetre long, with a conspicuous black tubercle on the middle dorsum. Essig says that it occurs throughout parts of Europe, Africa, Asia and in North America, and in California it is common on willow, rare on poplars and occurs occasionally on apple, apricot and peach. During the winter of 1931 the colonies which were only on the trunk and larger branches of the local tree, died out. Every year since the tree has been examined but not until September 1941 did the great patches of aphids appear again and were shortly attacked by some disease which literally liquefied the bodies into black drops which fell to the ground. I have never seen the aphids on any other trees at any other time. Whence did it come in such sudden great colonies? Mr. R. Glendenning who very kindly confirmed my tentative identification has told me that he took it once, in 1925 at Agassiz, on willow.

Again concerning aphids, in the autumn of 1929 a silver-leaf *Eleagnus argentata* transplanted to the campus in 1925, showed red aphid eggs covering all parts of the trunk so closely that the entire bush looked is if it had been painted red. Something killed off the eggs during the winter and they have never appeared since.

Of the HEMIPTERA, brief mention need be made of two species only. *Leptoglossus occidentalis* Heid., the large leaf-footed bug, suddenly showed up in Vancouver around Christmas time, 1939, in people's gardens where it was apparently hibernating. Since then it has been reported in increasing numbers and in 1944 it was sent in from many parts of the city, reported as crowding into houses for hibernation. Now K. F. Auden collected a specimen of this conspicuous bug in Vancouver in 1924; for what reason is it suddenly and steadily increasing?

The box-elder bug *Leptocoris trivittatus* (Say) which feeds on Manitoba maple, has been abundant in the Okanagan for at least 15 years. In the last 3 years it has shown up at Kamloops in such great numbers as to cause considerable alarm. In the autumn of 1944 it was sent in from Spence's Bridge with the report that it was present in large numbers although it had never been seen there before.

Instances of the abundance or scarcity of many species of the LEPIDOPTERA and COLEOPTERA are well known to every entomologist present. To mention only one instance of the latter, the varied carpet beetle *Anthrenus verbasci* (Linn.) invaded Vancouver apparently for the first time in 1937 and has since spread over the whole lower mainland until it now constitutes one of the worst pests in homes in the city; many people have had their homes cyanide-fumigated against it. Yet Dr. Melville Hatch, of the University of Washington, at Seattle, informs me that it has been present in that city for many years and that it is relatively inconsequential there.

Of the HYMENOPTERA, the species of

Vespa (*Vespula*) both black and yellow wasps, were so abundant in 1943 in many parts of the Dry Belt that they proved a plague of first magnitude, especially to fruit pickers. In 1944 queens and dwarf workers appeared in spring and then disappeared. (See p. 4 of the previous volume of this journal.) In 1945, up to mid-July, only 9 specimens of *Vespa* by careful count have been seen by two of us who are collecting them especially. This is the only instance of sudden rise and disappearance of insects where I dare to offer an explanation satisfactory to me. The year 1944 was very dry, and aphids, normally so widespread and abundant, were conspicuously absent. Now wasps feed their young on chewed-up animal food, largely insects, but the adults can consume only liquid food of which honey-dew is the main item especially of the white-faced wasp *Vespula maculata* (Linn.) I suggest that the wasp plague of 1943 died out in 1944 through failure of aphids and the consequent honey-dew crop.

THE CAPTURE OF CALENDRA AEQUALIS FORM UNIVITTATA ON THE RUSH SCIRPUS ROBUSTUS (Coleoptera, Curculionidae). — On the Heron sheep ranges of the old Bulman lease north of Kamloops, at an altitude of about 1800 feet, lies an alkaline pond of some ten acres in extent. This contains from one to two feet of water each spring, but dries up in summer leaving an expanse of white alkali, deeply cracked and fissured. The pond is almost completely encircled with a belt of the rush **Scirpus robustus** Pursh. which is increasing each year forming in parts, a dense mat of roots sending up stems almost two feet in height.

Sweeping a net over the thickest part of these rushes in the third week in July, 1943, I got a specimen of the largest snout beetle I have so far collected in the Province, so I immediately beat over the area again but obtained only one more; however, on the thinner patches of rush that fringe the pond, the beetles were fairly common and I took thirty in all, roughly in the proportion of two females to one male. Both sexes vary in size from ½ to ¾ inch in length.

The beetles were feeding on the upper part of the rush stems and on the leaves, gouging out holes of considerable size. None were found mating, no eggs or egg punctures could be located, and slitting a number of stems showed no tunnels where grubs might have developed. The larvae probably live inside the rootstocks; if so, they must endure submergence in spring when the lake bed is flooded.

The adults have long and very sharp tarsal claws with which they cling so tenaciously to the smooth, polished surfaces of the rush stems that it was found necessary to grab them quickly and pull, all in one movement; if the pull was slow they tightened their grasp so effectively that they could be removed only when all tarsi broke off. If dropped, they feign death and then either dive down a crack in the mud or quickly climb another rush stem.

In a week's time they had practically disappeared, only two being found over the whole area.

ACKNOWLEDGMENTS. I am greatly indebted to Professor John Davidson of our University for naming the rush and to Mr. H. B. Leech for identifying the beetles for me.—George J. Spencer, Department of Zoology, University of British Columbia, Vancouver, B.C.

CALOSOMA LUGUBRE IN QUEBEC (Coleoptera, Carabidae).—**Calosoma lugubre** LeConte is a large carabid beetle whose metropolis is Texas, with isolated records as far north as Nebraska. I picked up one at Duparquet, Quebec (27-VIII-1936). It was identified by A. S. Nicolay, who was amazed at the record. The newness and remoteness of the locality barred out the possibility of it being introduced by man, but I have a single guess:—That summer a dark pall spread over our sky; at first it looked like smoke from distant fires, then more reminiscent of volcanic dust. Then the Press began to take notice, with reports of severe tornadoes in the States to the far south, and explained the cause of the darkened skies of our region as dust from the tornadoes. Had this powerful insect, capable of strong flight in its own right, been caught in the maelstrom of a tornado, then landed back to earth exactly where it should have—on the path of an entomologist?—G. Stace Smith, Creston, B.C.

WHERE TO LOOK FOR LUDIUS LARICIS (Coleoptera, Elateridae).—**Ludius laricis** Brown is one of the most distinctive and most localized click-beetles in our fauna. It was described in THE CANADIAN ENTOMOLOGIST for February, 1939, from a series of 30 specimens collected by myself at Creston, B.C., within an area of two acres. A few subsequent catches have been made, and all under unvarying circumstances. No other specimen is known. The field is now about exhausted, and surrounded forests and other likely places have been tested without result; but collectors in other localities where larch occurs might try their luck.

Adults of **L. laricis** are small, reddish-brown, without maculation, about 8 mm. in length; that is, slightly larger than **L. triundulatus** (Randall). They are found in the thick trunk bark of large western larch (**Larix occidentalis**), living trees only, usually about a foot from the ground, sometimes less, but never over two feet; they are well embedded in the bark, where they pupate, from 3 to 6 inches from the surface. I find no trace of them in the summer months, and the collection dates are from late October until early May.—G. Stace Smith, Creston, B.C.

PRESIDENTIAL ADDRESS

J. R. J. Llewellyn Jones, M.A., F.R.E.S.

I have pleasure in welcoming the members of our Society to the 44th Annual Meeting and trust that our deliberations will be both profitable and interesting.

You have received the annual report of the Secretary-Treasurer. It shows a credit balance of $11.34 after the payment of all bills presented up to the date of the closing of the books. However, in order to do this, it has been necessary, owing to the continued rise in the cost of publishing the PROCEEDINGS to borrow from the Reserve Endowment Fund. The accounts of this fund show a figure of $76.17 which should be available for transfer to the Reserve, but unfortunately at the moment this cannot be done. You will at an appropriate time in our deliberations, be asked to approve some measure to enable this indebtedness to be met. The present value of the Reserve Endowment Fund is reported at $85.00. We should try to increase this sum annually, if only by a small figure and so strengthen our Society's financial position.

It is reported that the increase in the cost of publishing the PROCEEDINGS is the chief factor at the moment in bringing about this somewhat unsound and certainly unfortunate situation. It will I am sure be agreed by most of us present that it is imperative that we should take measures to ensure that our publications compare favourably with similar ones put out by other societies both as regards the set up and the contents, and that we should make them as interesting and informative as our financial position will permit.

I notice that we are scheduled to hear a paper entitled "Our journal, The Proceedings" to be read by Mr. H. B. Leech and I hope that, after hearing this and after due consideration and discussion of our finances, a satisfactory motion will be passed to strengthen our position in this respect.

Let us consider during the short time at our disposal the use of scientific and popular names for insects. Being a lepidopterist, the examples which I shall give will be from the Lepidoptera, though I have no doubt that many statements will also apply equally well in the case of other orders of insects.

Scientific names, both generic and specific, are for the most part derivations of Latin and Greek and are often found to be a combination of both. There are also names from other sources, some of doubtful origin, and others which do not appear to have any meaning.

However, in many cases, the scientific names give us certain information concerning the insect under consideration. For example a certain group of butterflies has been given the name *Polygonia*, a Greek derivative signifying many pointed or many angled, and it seems very appropriate as the wings of these insects are adorned with many indentations producing an almost ragged appearance. In the case of *Vanessa cardui* L. the specific name indicates that the larva feeds upon thistles. With *Hyphantria textor* Harr. the specific name points to the web constructed by the larvae. In other cases it will be noted that the specific name points to some locality or district or to some person. As examples of this may be cited, *Leptarctia californiae* Wlk. the californian tiger, *Feltia vancouverensis* Grt. the Vancouver dart, and *Tolype dayi* Blackmore, Day's lappet. In the cases of *Agrotis c. nigrum* L., *Călocalpe undulta* L. and *Bombycia rectifascia* Sm. it is to the markings on the wings that attention is drawn. Many names however are obscure and it is difficult, if not impossible, to discover any intelligible significance and this is very regretable.

Authors should be most careful, when bestowing scientific names to ensure that the proposed name has some appropriate significance. This is important insomuch as scientific names are by international agreement unchangeable once given; the oldest name taking precedence if it is not a homonym, and all others being reduced to the status of synonyms, subspecies, etc. It follows therefore that scientific names are the same in every language and in the scientific literature of all countries and this is the strongest argument in favour of keeping them in active use.

For most people however, many of whom have not had the benefit of a "classical" education, or who know but little of science as a serious study, these names seem strange and bewildering, because they convey no intelligible meaning. They are known only to the initiated few. What then should we do with them? It is doubtful whether anyone would seriously consider the discontinuance of these names, but many might favour limitations in their use. It will be readily agreed that scientific names are appropriate during the deliberations of learned societies, in scientific literature, or in lecturing to students in scientific subjects. They should not be used, at any rate exclusively, in addresses or lectures given to the general public, in popular literature, or in general conversation with the average individual.

Consider the reaction of someone, who has brought for indentification an insect, on being informed that he has caught a specimen of *Pseudothyatira cymatophor-* been *Pseudohazis eglanterina nuttalli* Stkr. Such a person is likely to be quite disappointed because he has not been told anything that he can understand. To him the names sound strange and foreign and he will doubtless forget them very quickly. Had English names been used and the enquirer told that his specimen was the "two-toned lutestring" or Nuttall's sheep moth (though I admit that the former is not one of the best examples of a popular name), interest would probably have been maintained. Especially would this be true of the young, who very often have a distaste for any scientific names, chiefly because they do not understand their meaning, and because they sound odd and unattractive. It will be agreed that we should not neglect nor forget the young people and they should be encouraged in every possible way to become interested in scientific studies and so fill up our ranks in the future.

That a case exists for a more general use of popular names will be granted by most people, but there are certain difficulties to be faced. Popular names are sometimes rather fanciful and not always very appropriate. They are limited as to scope of circulation and possibly may vary from district to district, or province to province. Only a prolonged period of general use would correct this, the name gaining most popular favour being the one eventually accepted. This has now happened to some extent in Great Britain where English names have become standardized and are in quite general use for the macrolepidoptera at least.

As a basis for introducing popular names for the macrolepidoptera of this Province we have the check list prepared by the late E. H. Blackmore and published for the Provincial Museum in 1927. It contains, thanks to the efforts of Francis Kermode, a former Director of the Museum, popular names for nearly all the species found in this Province at that time.

Popular names are also found in W. J. Holland's "Butterfly Book" and in his "Moth Book", also in J. A. Comstock's book "The Butterflies of California." A scrutiny of these works will show a measure of agreement, though, as is to be expected, there are a few differences. For instance *Vanessa atalanta* L. generally known as the red admiral and so called by Holland and Blackmore, is by Comstock named the alderman, who states that this is an old English name for it, though at the same time admitting that it is less familiar and justifying his choice by stating that he wishes "to avoid confusion with the true admirals of the Genus Basilarchia." These he names the admirals but they are better called the white admirals as is done by Holland and Blackmore. However, *Vanessa cardui* L. is called the painted lady by all three, and this is a well established name. Among the moths *Aemelia roseata* Wlk. is named by Holland the rosy aemilia but by Blackmore the rosy tiger; the latter is to be preferred.

Speaking generally of the Blackmore list, the popular names there given follow closely those adopted by British writers in cases where either the genera or species occur in both areas and this would seem satisfactory, embodying as it does some well established names. We find the Sphingidae designated by the well known term hawk-moths. However for the genus *Hemaris* of this same family the name clearwing has been used to replace the bee hawks of British authors. This would seem regretable as it may cause confusion with another large group of lepidoptera, now relegated to a position close to the microlepidoptera, for which the name clearwings is extensively used in Britain. The name tiger has been used for the subfamily Arctiinae and this is a well established popular name. Here we find one slight variation. *Arctia caja* L. is known in Great Britain as either the garden tiger or the common tiger. Blackmore terms our local sub-species *Arctia caja americana* Harr. the great tiger, probably wishing to draw attention to the status of our insect as a sub-species. Moths of the family Notodontidae are styled prominents, also in accord with British writers, having reference to the humps and excrescences found adorning many of the larvae in this group. Species of the genus *Cerura* have been termed kittens carrying on a tradition handed down by British lepidopterists whereby a large species of moth of an allied genus *Dicranura vinula* was called the puss moth and species of the genus *Cerura*, being similar both in the larval and perfect stages but at the same time being much smaller, were called kittens. The origin of the name puss moth is thought by some to be due to the curious habit of the larva when disturbed of hunching its back much after the manner of an infuriated cat under similar circumstances. Also it may be noted that the colouring of the moths much resembles that of a pale tabby cat, in many of the species comprising this group.

Among the geometers or loopers, moths of the genus *Hydriomena* have been styled highflyers. Holland gives no popular name here. Those of the genus *Eupithecia* have been dubbed pugs. Both are well established names for these genera.

We would do well to study the popular names which we already have more carefully and try to make wider use of them, hoping that where there are diversities of name for one insect, usage will eventually decide the issue.

In cases where there are no popular names, such a name should be given. It should be a comparatively simple one and should preferably describe or point to some peculiarity or notable feature in the insect during one of its stages. As an example, the family Drepanidae were named hook-tips because in many of the species the primaries have hooked tips.

Care however should be exercised not to produce a meaningless name, which might easily happen by attempting a mere translation of the scientific one. The best popular names in use are in no way translations. There is a valuable list of over a thousand names ("Common names of insects approved by the American Association of Economic Entomologists." Jour. Econ. Ent. **35**(1):83-101. February 1942), approved by a committee of both the A.A.E.E. and the Entomological Society of America. This paper lists the insects alphabetically, first by their common names, then by their scientific ones, and is thus an excellent quick reference medium. Copies may be obtained from the business manager of the A.A.E.E., Dr. E. N. Cory, College Park, Maryland, U.S.A.

To conclude: both scientific and popular names are desirable, but care must be taken to use the appropriate one at the opportune moment and on a suitable occasion.

LIMONIUS RUFIHUMERALIS IN BRITISH COLUMBIA (Coleoptera: Elateridae).—Some specimens of the red-shouldered **Limonius** placed as **crotchi** (Horn) in collections, prove to be the recently described **L. rufihumeralis** Lane (1941. Pan-Pacific Ent. 17 (3): 133-139). Examples of this species in the Hopping Collection are labelled as follows: Vernon, June 5, 1921, and May 1, 1924 (Ralph Hopping); Aspen Grove, May 30, 1931 (H. Richmond), and June 4, 1931 (J. R. Howell); Midday Val., Merritt, June 14, 1926 (Wm. Mathers); Trinity Valley, June 25, 1929 (J. R. Howell).—Hugh B. Leech.

In Memoriam

ABDIEL WILLIAM HANHAM, 1857-1944

It is with deep regret that we record the passing, on Jan. 18, 1944, at the age of 86, of another old and valued member of our Society. Mr. A. W. Hanham became a member of the British Columbia Entomological Society in 1905.

He came to North America from England in 1881, landing at Philadelphia and from there went to Missouri. Shortly after, he joined the Bank of British North America in Montreal, but was moved almost at once to Kingston, Ont., and then to Ottawa. From there he went to Paris, Ont., then to Hamilton and Brantford, Ont., thence to Quebec City in 1891, to Winnipeg, Man., in 1893, to Victoria, B.C., in 1901, and finally to Duncan, B.C. In 1905 he was appointed manager of the Bank of B.N.A. at Duncan, in which post he continued until his retirement in 1921. He made his home at Quamichan Lake, near Duncan. From late January to May, 1905, he was in Southern California, collecting chiefly at La Jolla, near San Diego, and also at Avalon on Santa Catalina Island.

Mr. Hanham was a keen lepidopterist, but was also interested in Coleoptera and made extensive collections of both orders. The greater part of his British Columbia material was presented by him to the Provincial Museum, Victoria, B.C., shortly before his death. His interests, however, were not by any means confined to entomology and he was even better known as a conchologist, being a recognized authority on mollusca, both marine and terrestrial, and he accumulated a large and important collection of shells. On one occasion, when a collector sent some shells to the United States National Museum for identification, the specialist to whom they were sent replied: "I do not know why you send shells to me when the best authority on the subject, Mr. A. W. Hanham, is living in your own district."

While not a frequent attendant at the meetings of the Society, except in its early years, nor a contributor to its Proceedings, the late Mr. Hanham gave valuable aid to fellow members or other students of entomology or conchology. The Society's files contain many letters from him to members of the executive, and show that his interest and council were greatly appreciated. Hospitable, generous, kindly and full of unbounded enthusiasm for his favourite sciences, his knowledge and experience were always available to others, and through his extensive collecting and studies he has added much to our knowledge of Canadian mollusca and insects.

—W. Downes

Species and Subspecies of Lepidoptera Named in Honour of A. W. Hanham.

Melitaea hanhami Fletcher
Orthodes hanhami B. & McD.
Fishia evelina hanhami Smith
Eremobina hanhami B. & B.
Philometra hanhami Smith
Sterrha hanhami Hulst.
Eupithecia hanhami Taylor
Pyla hanhamella Dyar

ENTOMOLOGICAL PUBLICATIONS BY A. W. HANHAM

All in the *Canadian Entomologist* (C.E.) and the *Proceedings of the Entomological Society of British Columbia* (Proc.)

1884. Entomological notes. C.E. **16** (5) :98-99.
1886. Entomological notes, Spring, 1886. C.E. **18** (7) :137-139.
1894. Notes from my diary, Quebec, 1893. C.E. **26** (10) :294.
1894. Notes on Quebec Coleoptera. C.E. **26** (12) :350-352.
1895. List of butterflies taken at Winnipeg, Man., 1894. C.E. **27** (5) :123-124.
1897. Brephos middendorfi, Men. C.E. **29** (1) :3.
1897. A list of Manitoba moths. C.E. **29** (12) :291-297.
1898. Notes on collecting "at light." C.E. **30** (2) :33-36.
1898. A list of Manitoba moths. C.E. **30** (3) :65-69.
1898. Notes on collecting at bloom. C.E. **30** (7) :188-190.
1899. A list of Manitoba moths. Part II. C.E. **31** (3) :49-52. Part III, **31** (8) :197-206. Part IV, **31** (11) :312-320.
1900. Additions to the list of Manitoba butterflies, with notes on other species. C.E. **32** (12) :365-367.
1901. List of Manitoba moths. Part V. C.E. **33** (8) :213-220.
1914. Sunflowers as a lure for the Plusiidae. C.E. **46** (4) :145-147.
1924. Notes on collecting at flowers and blossoms. Proc. **21**:15-19.

COLLECTING NEOCLYTUS PROVOANUS AND N. BALTEATUS (Coleoptera, Cerambycidae).—In 1931 when the late Ralph Hopping identified **Neoclytus provoanus** Casey for me he noted that it may be a variety of **balteatus** LeConte. In the description Casey mentions that he at first thought it might be **balteatus.** The question is still unanswered. There are several characters separating the two and in a fairly good series of both species these characters hold. The most conspicuous difference is in the basal band of the elytra, which in **balteatus** is sharply defined, but in **provoanus** extends over most of the base. Recently C. A. Frost examined some of my material, and of **provoanus** writes: "I think it is a very good species." But there is one suspicious point: both forms are taken together on the same unexpected plant. Since, at Creston, B.C., I discovered their hide-out I have not had an opportunity to investigate if the same holds good for other localities. They are found on the underside of the large leaves of mullein (**Verbascum thapsus**) in the late afternoon and evening. In this way I have taken 10 **balteatus** (July 7-25) and 16 **provoanus** (July 13-Aug. 10). Nothing is known of the larvae. I have searched numerous plants, from the roots upwards, and am convinced that **Verbascum,** besides being an alien, is not the host.—G. Stace Smith, Creston, B.C.

NEW MEMBERS

Elected at the 44th Annual Meeting, Feb. 24, 1945.

Baverstock, William—Provincial Horticultural Branch, Vernon, B.C.

Guppy, Richard—R.R. 1, Marine Drive, Wellington, B.C.

Muir, Mrs. Margaret A.—Ganges, Salt Spring Island, B.C.

Palmer, B. F.—Kaslo, B.C.

Wisenden, Miss Grace—Box 236, Prince George, B.C.

Associate Member

Riedemann, Karl Anton—Alkali Lake Ranch, Alkali Lake, B.C.

STENICHNUS OVIPENNIS IN BRITISH COLUMBIA (Coleoptera: Scydmaenidae).—Casey described **ovipennis** from California as a species of Scydmaenus (1897. Ann. N.Y. Acad. Sci. 9: 480-481). A single specimen of this tiny reddish-brown beetle, slightly less than 1.5 mm. long, was found about 5 miles north of Lumby, B.C., September 16, 1943. It was under an old board lying on the top of a coniferous stump on the site of an abandoned mill; identified by W. J. Brown.—Hugh B. Leech.

The Proceedings of the Entomological Society of British Columbia is published annually. Individual volumes may be had for 50c. Special rates on sets. Address Secretary-Treasurer, Entomological Society of British Columbia, Box 308, Vernon, B.C.

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Volume **43.** Issued February 4, 1947

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PROCEEDINGS
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ENTOMOLOGICAL SOCIETY of BRITISH COLUMBIA

Volume 43. Issued February 4, 1947

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RECENT LITERATURE

TENTHREDINOIDEA OF SOUTH-EASTERN ASIA WITH A GENERAL ZOOGEOGRAPHICAL REVIEW. By Rene Malaise. Entomological Results from the Swedish Expedition 1934 to Burma and British India. Hymenoptera: Tenthredinoidea. Part I. Subfamily Tenthredininae. Opuscula Entomologica, Supplementum IV. p. iv+1-288, 57 text figs., 20 plates. Lund, 1945. —The first 90 pages of this paper are of great interest to zoologists and botanists, and to entomologists in particular. Under the title "Late Tertiary Geographical Changes as Base of Recent Zoogeography", a fundamental review with 17 figures is given. Wegener's "Drift Theory" is rejected, but much attention is given to Odhner's "Constriction Theory", the latter apparently almost unknown outside Sweden.

The discussion of past land bridges and climates, and of the submarine topography of the oceans, are of broad interest to entomologists. Of immediate value to hymenopterists are the sections on ecology, general affinities and zoogeography, and classification. There are illustrated keys (world fauna) to the Superfamilies of Hymenoptera Symphyta, the Families of the Tenthredinoidea, and the Subfamilies of the Tenthredinidae. On p. 14 is proposed **Eopachylosticta**, new generic name for the fossil sawfly **Amasis byrami** Cockerell. Dr. Malaise is at the Sweidsh Museum of Natural History, Stockholm 50.—H. B. L.

THE BUTTERFLIES OF WASHINGTON. By Ben V. Leighton. University of Washington Publications in Biology, 9 (2):47-63. Seattle, November, 1946. Price 45 cents.—The first part cites the collections and literature on which the list is based, gives notes on the life cycles and economic importance of butterflies, tells where and when to collect in Washington, and tabulates the location and elevation of certain localities. The list proper includes 143 species and 81 varieties; for each is given: the scientific and common name, reference to a published figure or other account, a list of localities and a symbol reference to the collections studied.—H. B. L.

THE NORTH AMERICAN CLEAR-WING MOTHS OF THE FAMILY AEGERIIDAE. By George P. Engelhardt. U. S. Nat. Museum Bul. 190. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. Price 75 cents.—This posthumous work of 222 pages contains 16 black and white plates showing wing venation and male and female genitalia, and 16 plates in full color illustrating most of the species. Seven new generic names are proposed. There is a key to the groups, based on antennae and male genitalia, a key to the North American genera, and in certain cases keys to the species and forms. Each genus and species is taxonomically described, with remarks on the synonymy, distribution, hosts, habits and economic importance. Thirteen species are recorded as from British Columbia, and the distribution of at least 6 others suggest that they will be found along the southern edge of the Province. An outstanding feature of this publication is the full listing of host plants, the results of 40 years of patient investigation by George Engelhardt and a few enthusiastic friends. Entomologists are indebted to his widow and son who have borne the entire cost of engraving and printing the colored plates, from drawings by Mrs. Wm. Beutenmuller and Mrs. M. F. Benson.—H. B. L.

NEW MEMBERS

Elected at the 45th Annual Meeting, February 23, 1946.

Ansell, Charles H.—Ansell Laboratories, Vernon, B.C.
Farris, Sinclair H.—Forest Insect Lab., Vernon, B.C.
Fender, Kenneth M.—Route 3, McMinnville, Oregon.
Godfrey, Langford M.—Agricultural Chemicals Div., C.I.L., New Westminster, B.C.
Hammer, E. Leslie—P.O. Box 339, Port Alberni, B.C.
King, Kenneth M.—Dominion Entomological Lab., Parliament Buildings, Victoria, B.C.
Nielsen, Axel H.—Kinnaird, B.C.
Parish, G. P.—McDonald & Wilson Ltd., Vancouver, B.C.
Richmond, Hector A.—Dominion Forest Insect Lab., 311 P.O. Bldg., Victoria, B.C.

THE PEAR PSYLLA IN BRITISH COLUMBIA *

James Marshall
Dominion Entomological Laboratory, Summerland, B.C.
and
H. F. Olds
Dominion Plant Inspection Office, Vancouver, B.C.

Discovery of Infestations. — The first British Columbia record of the pear psylla *Psylla pyricola* Foerst., was that of Treherne[1] who reported it from Nelson in 1918. Despite extensive scouting and trapping, however, the insect has not been taken in the Kootenay Valley since that time. Possibly this early record was a case of misidentification.

In 1939 discovery of the pear psylla in the Spokane Valley of Washington raised fears for the pear industries of the western states. Shortly after, operations were incepted by the United States Bureau of Entomology and Plant Quarantine with the object of eradicating the infestation. Concurrently, extensive scouting operations were undertaken which, with the sanction and assistance of the Dominion and Provincial Departments of Agriculture, soon carried into the fruit-growing districts of British Columbia.

Within a few years the pear psylla was found in localities far from the Spokane Valley and in 1942 captures were made in an orchard near Oliver in the Okanagan Valley of British Columbia. Rechecking indicated that in all likelihood the insect was generally distributed from Vaseaux Lake to the International Boundary in the Okanagan Valley and in the Keremeos-Cawston district of the Similkameen Valley twenty miles to the west. At that time the area known to be infested included some 500 acres of pear orchard containing approximately 50,000 trees. In order to protect their eradication operations in the neighboring state of Washington, the United States authorities undertook to bring spray equipment across the border, and the spring of 1943 thus saw a considerable number of United States Government spray crews operating in Canadian orchards.

By the fall of 1943 it was evident that three applications of nicotine sulphate—soap or nicotine sulphate—summer oil-soap had given excellent control of the psylla, but, as was anticipated, had not eradicated it. The same year, captures were made as far north as Penticton, so control operations were extended. Once again, however, the spray treatments served merely to reduce psylla populations with the result that in the fall of 1944, in addition to new records from Summerland, recurring infestations were detected in the sprayed areas. These new records, augmented later by others near Peachland and Westbank, brought about such further extension of control activities that in 1945 a fleet of United States power sprayers was operating up to the Westbank district some 75 miles north of the International Boundary. By this time, extensive scouting had included virtually all pear orchards in the Province and at the end of the season had provided evidence of the existence of the pear psylla north to Vernon, east to Midway, and west to Hedley. For practical purposes, therefore, the insect may now be considered generally distributed wherever pears are grown over an area of about 4,500 square miles in the province of British Columbia.

The methods of spread of the pear psylla are not entirely clear. Doubtless its dispersal is aided by air currents since it is a small insect given to flight when adult. It is not uncommonly observed on the clothing of individuals who have passed through infested orchards, so that the

* Contribution No. 2408, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

1 Treherne, R. C. (1918). Annual Report to the Dominion Entomologist (typewritten) Page 2.

great amount of travel between pear orchards incident to their inspection may possibly have accelerated spread of the insect. Unquestionably, however, if the pear psylla is capable of persisting in British Columbia it will merely be a matter of time until it is present in all pear orchards regardless of scouting or inspection operations.

Experiments in Chemical Control[2].—Upon discovery of the first widespread infestation at Oliver, it seemed obvious that with known control measures, eradication of the insect in British Columbia was out of the question. This view was expressed at the outset by W. A. Ross, Chief of the Fruit Insects Unit, Dominion Division of Entomology, who has had long acquaintance with the habits of the pear psylla and whose investigations on its control had led to utilization of heavy dormant oil as standard control practice in Ontario. (The effectiveness of this procedure depends primarily on the fact that heavy oil inhibits oviposition.) Three considerations justified the conclusion that the pear psylla probably would not prove a serious menace to the British Columbia orchardist; first, even in Ontario where environmental conditions are generally favourable for its multiplication, control of pear psylla is not difficult if spraying is timely and thorough; second, there were grounds for hoping that since the psylla thrives best in conditions of poor air drainage and fairly high humidity, it might not prove to be generally prolific under the arid or semi-arid conditions of the British Columbia interior fruit belt. In the third place, although no investigations on control had been carried out in Western North America, there was little doubt that in addition to the known effectiveness of heavy dormant oil, which incidentally is also highly effective against San Jose scale, a summer spray schedule could be developed for simultaneous control of pear psylla and codling moth.

[2] Investigation of control methods was done jointly with Messrs. Ben Hoy and R. P. Murray of the British Columbia Department of Agriculture.

In 1942 an orchard near Oliver, considered at that time to be the most heavily infested in the West, was selected for experiments in chemical control of pear psylla under arid conditions. As the Oliver district, with an average annual precipitation of only nine inches, frequently experiences temperatures in excess of 100° F., the check plot that did not receive any pear psylla spray treatment was of particular interest. Results of the work were: (1) Nicotine sulphate 40% 1 pint—summer oil (79 S.S.U. Vis. 100° F., 73% U.R.) 1 gal.—soap (laundry type) 1 lb., gave effective control. (2) Nicotine alkaloid 40% 1 pint—summer oil 1 gal.—VATSOL K (dioctyl sodium sulphosuccinate 33%) 1 lb., appeared approximately as effective as the nicotine sulphate mixture. (3) Derris concentrate (VISKO D-40 containing rotenone 1%, petroleum 43 S.S.U. Vis. 92% U.R., 33% pine oil, concentration unknown and a mutual solvent, composition and quantity unknown) 1 pint—summer oil 1 gal.—VATSOL K 1 lb., was comparable in toxicity to the nicotine-oil mixtures but less offensive to handle and lower in cost. (4) Pear psylla infestation on unsprayed check trees decreased markedly following a week with maximum temperatures ranging from 95° to 105° F. (5) Unsprayed trees did not show any measurable loss of crop, although some foliage injury was evident.

The investigation was continued in the same orchard in 1943. With the object of developing a grower's spray schedule, only two treatments were applied, each to an area of about two acres. By the end of the season few psyllids were present even on the check trees that neither in 1942 nor in 1943 had received a psylla spray. Evidently by substituting nicotine sulphate-summer oil for the regular first and second codling moth cover sprays of lead arsenate or cryolite, or by adding derris-oil mixture to lead arsenate or cryolite, control of pear psylla could, if necessary, be accomplished at no great extra cost and without additional labour. With this information on hand, investigation of summer control of pear psylla was discontinued until the advent of DDT, when psylla was included in the list of test insects for that compound. Experiments in Kaleden in 1945 indicated fairly clearly that in stove oil solution DDT, per unit weight of toxicant, is less effective against pear psylla than nicotine sulphate applied with summer oil and soap.

In order to utilize the Ontario recommendation of dormant oil, investigations on the effects of various petroleum fractions on orchard trees were begun in 1942. Since the time when dormant oil first became generally used in British Columbia, it had been felt that light oil of 100-110 S.S.U. viscosity at 100° F. was less likely to cause tree injury than a heavier oil of, for example, 200-220 S.S.U. viscosity as used in Ontario against pear psylla. There appears to have been little experimental evidence to support such a view. On the contrary, four years' experiments have indicated that under British Columbia conditions the heavy "psylla" oil is less likely to cause injury to pear or apple trees than its lighter counterpart.

What of the Future?—There is every indication the pear psylla is in British Columbia to stay. It is very unlikely that high temperature with low humidity will prove sufficient to eradicate it, since in many irrigated orchards there are potholes or close plantings with poor air drainage and consequently fairly high humidity. Furthermore, it is improbable that growers will take special steps to control it unless so forced by its activities. That would not be efficient orcharding; nor would it be human nature. Rather, from the standpoint of difficulty of control, the pear psylla in all likelihood will be classed with the aphids and treated accordingly. Should the insect flourish in this Province, adequate commercial control may be attained by addition of derris concentrate, for example, to one or two codling moth sprays. This would require a total outlay of five to ten dollars per acre of pear trees but no extra labour. If control of scale insects becomes necessary, simultaneous control of psylla can be effected by applying a heavy dormant oil scale spray somewhat earlier than usual. In that case there would be neither extra outlay nor extra labour. The pear psylla is certainly an unwelcome immigrant, but British Columbia fruit growers will doubtless learn to live with it at no great financial loss or inconvenience.

FEEDING PERIODS PREREQUISITE TO THE MATING OF DERMACENTOR ANDERSONI (Acarina)[1]

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In a previous paper (Gregson[2]) the author mentioned that the feeding rates of female *D. andersoni* Stiles were substantially increased by the presence of male ticks. The experiments described in the present article were planned to demonstrate whether or not copulation is necessary to promote this stimulated feeding, and, since this species of tick only mates while feeding, to determine if any initial engorging period is necessary before this act will take place.

Experiment A

On April 4, 1945, five capsules, each containing about half a dozen male and female *D. andersoni* were attached to a sheep in the manner described by the author[3]. The males were moved successively from these capusules as indicated in the following table. Another capsule containing females only, served as the control.

[1] Contribution No. 2409, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

[2] Gregson, J. D., 1944. The influence of fertility on the feeding rate of the female of the wood tick, Dermacentor andersoni Stiles. Ent. Soc. Ont., 74th Ann. Rept. (1943), 74:46-47; figs. 1-4.

[3] Gregson, J. D., 1942. Notes on the laboratory rearing of some Canadian ticks (Acarina). Ent. Soc. Brit. Columbia, Proc. 39:32-35.

TABLE I

Experiment A.—Dates of removal of male ticks from each capsule. Host infested with both sexes of ticks on April 24, 1945.

Cap. No.	Apr. 25	Apr. 26	Apr. 27	Apr. 28	Apr. 29
1	x				
2		x			
3			x		
4				x	
5					x
6	Control. Females only.				

On May 1, at the end of seven days' feeding, the surviving females were removed, weighed and photographed. They were then set aside in oviposition tubes until October 1, when the fertility of the eggs produced was checked.

Discussion. The only females which fed rapidly were those with which males had been left until the sixth day. These were also the only ones to lay fertile eggs. This appears to demonstrate that one or both sexes must feed for at least six days before copulation and subsequent acceleration in feeding can take place.

Experiment B

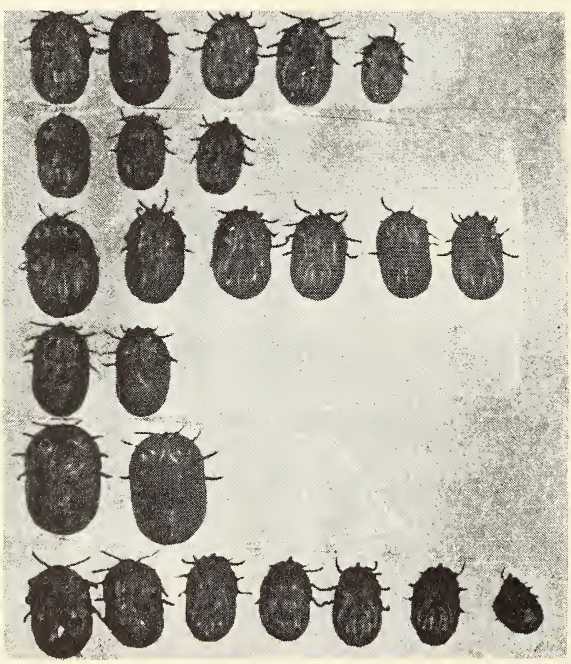
This experiment was performed simultaneously with the preceding one. Six capsules as before, but containing only females, were attached to a sheep. Males were added to five of the capusules of females at such intervals that the males of each successive group would be deprived of an additional day's feeding by the time the females were removed. In this way it was hoped that it could be shown whether male ticks require a feeding period prior to copulation.

On the eighth day only the females accompanied by males that had had the opportunity to engorge for a six day period were fully engorged.

Fertile eggs were subsequently laid by all these females, but by only two of the five females accompanied by males that had fed for five days. All the remaining females fed slowly and laid eggs which later proved to be sterile.

TABLE II

Experiment A.—State of female ticks from capsules 1 to 6 on May 1. (See Table I.)



Capsule No.	Average weight in grams of females in each group	Fertility of egg masses October 1, 1945
1.	0.209	All sterile
2.	.145	All sterile
3.	.238	All sterile
4.	.227	All sterile
5.	.667	All fertile
6.	.198	All sterile[1]

1 Control. No males present.

TABLE III

Experiment B.—Dates on which male ticks were added to each capsule. Host infested with females only on April 24, 1945.

Cap. No.	Apr. 25	Apr. 26	Apr. 27	Apr. 28	Apr. 29
1.	x				
2		x			
3			x		
4				x	
5					x
6	Control. Females only.				

Discussion. The experiment appears to demonstrate that the males must feed for at least five days before they will mate with feeding females.

Experiment C

The preliminary feeding period necessary for male sexual activity having been noted, it remained to be shown if a similar period was necessary before the female became in a receptive condition.

On May 7 a series of males was allowed to feed on a sheep. By May 14 it was assumed that all had fed sufficiently to mate, and at this date they were added to equal numbers of unfed females which were distributed under four capsules on a sheep. The males were then removed at daily intervals from each successive group. The fifth capsule contained females only as a control.

By May 19 some of the females were already engorged and dropping. Thus two days less were required than for the shortest feeding period during the preceding month. To illustrate the maximum contrast in feeding, the entire series was removed at this date, the fifth day after infestation.

Discussion. — The experiment illustrated clearly that engorgement in five days is possible if females are mated with prefed males. In this experiment, all females

TABLE IV

Experiment B.—State of female ticks from capsules 1 to 6 on May 1. (See Table III.)

Capsule No.	Average weight in grams of females in each group	Fertility of egg masses, October 1, 1945
1.	0.559	All fertile
2.	.196	2 fertile 3 sterile
3.	.264	All sterile
4.	.237	All sterile
5.	.200	All sterile
6.	.255	All sterile[1]

1 Control. No males present.

TABLE V

Experiment C.—Dates of addition and removal of male ticks from each capsule. Host infested with females on May 14, 1945.

Cap. No.	May 14	May 15	May 16	May 17	May 19
1	x [1]				1 detached
2		x [1]			2 detached
3		x [1]			4 detached
4			x [1]		2 detached
5	Control.	Females only.			0 detached

1 All males pre-fed.

fed rapidly with the exception of those of the control, where there were no males, and group one, in which the males were removed within a day of being placed with the females. In this group only one of the five females fed rapidly. As with the other experiments, the eggs of all the rapidly feeding ticks were fertile.

On May 20, an additional experiment was carried out to support this supposition that a brief feeding period is necessary before the female tick will mate. Two prefed males of the above stock were placed with two unfed females for three days, after which time the females only were placed on a sheep. At the end of five days they had become only half engorged, and so presumably had not mated prior to feeding. These results, and the fact that only one of the five ticks of group 1 of Experiment C engorged rapidly, suggests that one day is the minimum feeding period needed to produce sexual maturity in the female tick. The longer feeding period necessary in the case of the male appears to be taken care of in nature by the earlier activity and appearance of the male at the commencement of the tick season.

Summary.—Experiments involving the feeding of *Dermacentor andersoni* ticks on sheep were designed to illustrate that a preliminary feeding period for both sexes is necessary before this species of tick will mate. It is shown that males require a minimum feeding period of five days, and females, one day.

TABLE VI

Experiment C.—State of female ticks from capsules 1 to 5 on May 19. (See Table V.)

Capsule No.	Average weight in grams of females in each group	Fertility of egg masses, October 1, 1945
1.	0.179	1 fertile 4 sterile
2.	.446	All fertile
3.	.471	All fertile
4.	.427	All fertile
5.	.72	All sterile [1]

1 Control. No males present.

AN UNUSUAL RECORD OF THE WHARF BORER, NACERDA MELANURA, IN BURIED PILING AT VANCOUVER, BRITISH COLUMBIA.
(Coleoptera: Oedemeridae)

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In October, 1945, three beetle grubs were brought to me with the enquiry as to whether or not they were teredos and would prove of potential damage to new piling. They were found in old piling at the British Columbia Sugar Refinery at the edge of tidewater and were uncovered during excavations for a new powerhouse. It was reported that they had been taken from piling that had been covered for thirty years. They turned out to be the larvae of *Nacerda melanura* (Linn.) the wharf borer.

Finding it hard to believe the details that accompanied them, I hastened down to the refinery and interviewed the engineer in charge of construction, who kindly showed me the situation. Between us, we dug out a number of larvae from thoroughly soggy piling in which the centre only was of firm though very wet wood. Tunnels were all through both rotten and firm wood: no pupae were found. To my astonishment, I found that the report sent up to me was true and was only part of the story. The beetle grubs occurred in piling that had been driven thirty years ago into an area of the sea that had been filled in five years previously with furnace ashes and earth; more ashes had been dumped around and on top of the piles and on this foundation, concrete had been poured for a depth of from one to three feet to provide the floor for the erecting and sandblast shops. The heavy buildings had been torn down less than two weeks before my visit, the concrete floor dynamited out and the area was being excavated for a boiler room. The whole area had been reclaimed, reinforced, solidified and built over so long ago, that no one visiting it for the first time, as I did, would have guessed that it was not original solid ground.

The stub of piling from which I dug most grubs had been covered by a depth of fill, of four feet by actual measurement, not counting concrete. The piles in the area were from four to six feet apart and in no instance did the top of one of them protrude above the ashes and all of them contained grubs and were thoroughly riddled, and all had been covered with ashes and with concrete.

How did the grubs get into those piles and how long had they been there?

In the January 1937 number of Volume **69**, The Canadian Entomologist, R. E. Balch of Fredericton, New Brunswick, published a detailed summary of literature concerning *N. melanura*, and a careful account of his finding it in the wharf of the Atlantic Sugar Refinery at Saint John, N.B. He mentions that the beetle was recorded from Nanaimo, B.C., in 1928 and from Vancouver, no date, so it not new to this coast. His larvae when full grown were 30 mm. long whereas those I obtained were from 13 mm. to 26 mm. long and were therefore apparently not full grown. He says that the beetle is about 10 mm. long and flies during July and August; it is attracted to situations at tide level and its grubs live in damp wood.

It appears that one of two theories might account for this remarkable and extensive infestation at the British Columbia Sugar Refinery: ONE, that it started in piles soon after they were driven and that the beetles are capable of developing, mating and reproducing in tunnels, year after year, without having to come to the surface; or TWO, that the larvae either undergo a lengthy diapause or, in damp wood that is shut off from the surface, are extremely slow in developing. This second theory has some support in Balch's article wherein he quotes Laing (1936) writing in the "Entomologist's Monthly" who records an instance of living larvae being found in wood which had been entirely surrounded by concrete, for seven years. Now Balch found that full grown larvae are 30 mm. long and I found one, obviously only partly grown, that was only 13 mm. long. If damp conditions in an enclosed space induce protracted development of these larvae, how long could they remain under these conditions, without becoming beetles? Surely this constitutes a record in any beetle larvae, of delayed development, and provides material for long term experiments in physiology and metamorphosis to determine the factors that enable larvae to survive under these conditions.

THE 1945 STATUS OF DIGONOCHAETA SETIPENNIS, TACHINID PARASITE OF THE EUROPEAN EARWIG FORFICULA AURICULARIA LINN. IN WEST POINT GREY, VANCOUVER, B.C.

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For at least fifteen years I have collected earwigs every autumn around West Point Grey for student instruction and have maintained them alive in cages, taking them out as required. Up to 1943, there was no indication in this caged material of parasitism by *Digonochaeta setipennis* Fall., the tachinid fly that was introduced from Europe about fifteen years ago, to control this pest. However, in 1943, when making the usual autumn collection by placing sacking and rolled-up newspapers in the crotches of trees in the garden, one fly puparium was obtained, so in 1944 the catch was closely watched and four puparia were obtained. In early October, 1945, the usual catch of two nights' collecting was placed in a pint jar with leaves, dried grass and crumpled paper for the earwigs to hide in and in the process of collecting, sixteen fly puparia were obtained from the sacking and were placed with the earwigs in the jar.

In the next few weeks some 30 earwigs were used for class purposes and the rest, numbering 58, were stored in the jar in an unheated laboratory.

During the winter the earwigs died off at intervals, but a few were still alive by the end of January. Shortly afterwards all were dead and when the mass was counted on 16th February, 57 puparia were obtained; deducting the 16 obtained at time of collecting, 41 maggots had emerged during the winter from 58 earwigs, giving a parasitism of 70.7 per cent.

Unfortunately, the earwig collections of 1943 and 1944 were not counted, so the percentages are not available for those years. However, the sudden leap in infestation in 1945 was most conspicuous since, apart from those stored for observation, *setipennis* puparia occurred freely all over the garden wherever earwigs were sheltering, in bits of dahlia and lupin stalks, between boards and under trash where none had occurred in previous years.

The history of parasite release in Vancouver since 1936 was sent to me by W. Downes who was in charge of this work and I am greatly indebted to him for the following figures:

In May 1936, five thousand and nineteen *setipennis* puparia were placed out in five sub-equal lots in north and south Kitsilano. In July of the same year, 16,000 parasitized earwigs were released in thirteen locations all the way from Stanley Park, the West End and Kitsilano, to Central Park; of these, 1,000 were released at 8th Avenue and Tolmie, 1,000 at 10th Avenue near Sasamat Street and 1,000 at the University. These last three points are distant 666 yards, 900 yards and two miles, respectively, from where my collections were made. In August, 10,000 were released at ten locations throughout Vancouver, of which 1,000 were released near the

University, the nearest point to my collecting ground.

In August 1937, two thousand parasitized earwigs were released in two spots remote from my area and in July 1938, four thousand were released in four locations also far removed from my area.

In all, 37,019 prospective *D. setipennis* were released over a period of three years in the Greater Vancouver area.

Concerning the recovery of these parasites, seven years after 2,000 infested earwigs had been released in 1936 in my neighborhood, one puparium showed up in my garden; eight years afterwards, four puparia were found under similar collecting conditions, and nine years afterwards they had increased enormously, by October 1945 occurring freely everywhere and running up to 70.7 per cent in a given number of earwigs counted.

A second series, of 71 earwigs, collected in October 1945 in a garden at 20th Avenue and Dunbar, was maintained under similar conditions all winter and was finally counted at the same time as the above series. The collection point is 3,000 yards as the crow flies from my garden and the only *setipennis* liberations made at all near it in the past were the 1,000 parasitized earwigs released respectively at 10th and Sasamat and at 8th and Tolmie in July 1936. This second series yielded eleven puparia, giving 15.5 per cent parasitism.

Discussion:—Taking as a centre, a spot halfway between the 1936 liberation points at 10th and Sasamat and at 8th and Tolmie, in just over nine years the tachinid fly *Digonochaeta setipennis* had spread south and uphill about 1.26 miles and yielded 15.5 per cent parasitism of the European earwig; north and downhill and about 0.45 miles away, it yielded 70.7 per cent parasitism. Subtracting these percentages from 100 and considering the distances proportionately, from the liberation centre, the 15.5 per cent obtained 1.26 miles away is only 3.4 per cent decrease per mile less than that obtained 0.45 miles away.

Thus radiating out from a common centre of liberation, the fly parasitized earwigs south and uphill, only 3.4 per cent mile less than it did north and downhill, in a fairly uniformly built-over area of the city of Vancouver.

THE STATUS OF ANOBIUM PUNCTATUM, THE DEATH WATCH BEETLE, IN THE LOWER FRASER VALLEY IN 1946.
(Coleoptera: Anobiidae)

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In 1925 a round stick, apparently of alder wood, was brought to me from a farm on Lulu Island with the report that it was a piece of an old handle found lying around the barn. The wood was thoroughly perforated by borings and yielded a copious amount of fine dust. Three dead specimens of *Anobium punctatum* Degeer, the European death watch beetle, were obtained from the wood, but since I was new to the Province I did not appreciate the significance of the incident.

In a paper on Insects and other Arthropods in buildings in British Columbia (Proc. Ent. Soc. Brit. Col., **39**: 23-29) I mentioned a record in New Westminster of an insect infesting a piano which had been brought around the Horn 50 years before. Specimens of the beetle were not obtained but the account sent in of the borings and the dust extruded, suggested an infestation of *A. punctatum*. Treatment with orthodichlorbenzene was recommended and was apparently successful because no further complaints were received.

Another record mentioned in that article concerned the 3-ply hardwood back of a china cabinet which had been so riddled by borers that it collapsed and the owner had torn it off and replaced it. The cabinet had been purchased at an auction and had possibly been imported from Europe.

From that time up to 1944 no further infestations were encountered. In January and February 1945, however, three records were reported to me, two of them in one day; in two of these I obtained beetles or enough parts of beetles, to identify the insects definitely as *A. punctatum*. One record concerns massive antique carved oak chairs in a farm-house near Langley Prairie, from which the owner tapped out and sent to me a two-ounce bottle of boring dust which yielded the remains of approximately twelve beetles, all *A. punctatum*. The infestation seemed so active that I recommended fumigation with methyl bromide, which was apparently successful. The chairs were family heirlooms sent out from Germany some time ago, although the infestation became serious relatively recently.

The second of these 1945 reports concerns all of the 3-ply wooden walls of a basement room in a Vancouver home, which began to show small round holes and a little boring dust. There were relatively few holes but the owner became alarmed and began to tear out the 1/3-inch-thick plywood, only to find it a mere shell with the middle layer particularly, tunnelled in all directions and crumbling away. He sent in speciments of the damaged wood and one beetle which proved to be *A. punctatum*, but could offer no suggestion whatever as to the origin of the infestation.

The final record includes the entire basement woodwork of a house in North Vancouver where the owners noticed an increasing number of holes appearing in the 2- by 4-inch studding and shiplap and, on tapping with a hammer, found the timber a mere shell with the inside reducd practically to dust. Bit by bit, they located the worst areas of infestation and replaced them, heavily creosoting new wood and what remained of the old. Samples of wood sent in with copious boring dust and frass, showed that this same beetle was concerned.

In none of these records have the owners been bothered by adult beetles swarming around the house; only a few seem to come out of the timber and then only at odd times so that they never become conspicuous.

In the last two records involving the structural timbers, the owners declared that no antique furniture had been stored in the basements so it would appear that the infestations were of local origin and that this beetle has become established in the Lower Fraser Valley where the mild climate would seem to favour its development.

A. punctatum or the death watch beetle is an insidious insect whose damage inside timber is far greater than the small number of exit holes would indicate, and the public will have to be warned to be on the lookout for it.

ON THE OVIPOSITION HABITS OF DARGIDA PROCINCTA (Lepidoptera: Phalaenidae).—At dusk on the evening of July 10, I was watering my lawn in Vancouver with a fine mist spray, when several moths flew into the orbit of the spray and started ovipositing in the short lawn grass. Each moth hovered a little and then settled for five or six seconds with the tip of her abdomen protruded and inserted into the bases of the grass leaves and then moved to another spot a few inches away to repeat the manoeuvre, always within the limits of the falling water. By slowly shifting the hose back and forth, I was able to govern the movements of the moths which persistently followed the zone of the spray. After proving that the falling water was apparently a necessity for the act of oviposition, I pounced on one of the moths and the others flew away.

In the insect collections of the Museum of Zoology at this University, I found three specimens of this moth taken, respectively, at Princeton, July 23, and at Victoria, August 6 and September 15, and these, with my record of July 10, show a wide range in this Province, both in time and in territory.

The moth is **Dargida procincta** (Grote), the olive green cutworm of which Essig[1] says—"(it) has a wing expanse of 45 mm., is dark brown with olive tints, and with cream cross and longitudinal lines on the fore wings. The mature caterpillars are 30–35 mm. in length, dark olive green with a pale dorsal line and three greenish lateral lines separated by brownish grey. They are often serious pests to wild and tame grasses in meadows and pasturelands in Oregon, Washington and British Columbia, but are also known in California and Colorado."

Judging by my record, the moths of the olive green cutworm oviposit at dusk during rain: egg-laying seems dependent on the falling of the rain.—G. J. Spencer, Department of Zoology, University of British Columbia, Vancouver, B.C.

[1] Essig, E. O., 1926. Insects of Western North America, p. 684. MacMillans.

A LIST OF THE LEPIDOPTERA COLLECTED IN THE SHUSWAP LAKE DISTRICT OF BRITISH COLUMBIA BY DR. W. R. BUCKELL

E. R. Buckell[1]
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Nearly all the species listed below were collected by Dr. W. R. Buckell on his own small farm and orchard at South Canoe, four miles southeast of Salmon Arm, B.C. A few specimens were taken as far east as Revelstoke and as far west as Chase.

The collection also contains a few species from typical Dry-belt areas, such as the Okanagan Valley and the Nicola-Kamloops District, but these are not included in the present list as it is the author's intention to list only those found in the Shuswap Lake District, a definite biotic area typical of the humid transition zone. This area is mountainous, and fairly uniformly covered with forests which are typical of the Interior Douglas fir type and thus occupies a climatic zone that is intermediate in temperature conditions between the yellow pine of the Dry-belt and the Engelmann spruce type of the higher elevations.

All the specimens are beautifully spread even to the smallest of the micros, and many were reared from their larvae.

The list contains 773 species, varieties and forms consisting of 541 macrolepidoptera and 232 microlepidoptera[2].

The list is arranged according to the "Check List of the Lepidoptera of Canada and the United States of America," Part I, 1938, and Part II, 1939, by J. McDunnough, and the dates after the species name give the earliest and latest dates of capture.

1 ACKNOWLEDGMENTS: Determinations of material had previously been made for Dr. W. R. Buckell by Dr. J. McDunnough of the Division of Systematic Entomology, Ottawa, and by the late Mr. E. H. Blackmore of Victoria, B.C. Recently Dr. J. McDunnough and Mr. T. N. Freeman of the Division of Entomology greatly assisted me in further determinations and in correcting and bringing this list up to date, for which I wish to extend my grateful thanks.

2 As some of the groups of microlepidoptera are under revision, definite determinations were not always possible and some species will be found to be marked "?"; others recorded as "near" to a species; while others are recorded as "undetermined species."

MACROLEPIDOPTERA

Suborder RHOPALOCERA (Butterflies)
Superfamily PAPILIONOIDEA
Family PAPILIONIDAE

Papilio L.
8 zelicaon *Luc.* .... June 2-12
16 rutulus *Luc.* .... May 9, July 7
18 eurymedon *Luc.* .... May 10-30

Parnassius Latr.
27 smintheus magnus *Wgt.*.. June 6, July 7

Family PIERIDAE

Anthocharis Bdv.
34 sara flora *Wgt.* .... April 4, May 25

Euchloe Hbn.
36 ausonides *Bdv.* .... May 3-23

Colias Fabr.
47 alexandra emilia *Edw.* ... May 5, Oct. 3

Neophasia Behr.
76 menapia *F. & F.* .... Aug. 8-27

Pieris Schrank
80 sisymbrii flavitincta *Comst.* ... May 23
81 occidentalis calyce *Edw.* July 5, Aug. 25
83 napi *gen. vern.* marginalis *Scud.* .... April 28, May 5
86 rapae *L.* .... April 21, Aug. 17

Family DANAIDAE

Danaus Kluk
89 plexippus *L.* .... June 6, Aug. 8

Family SATYRIDAE

Coenonympha Hbn.
109 inornata columbiana *McD.* .... May 5, June 29

Minois Hbn.
117 alope *Fabr.* .... July 14-29
e boopis *Behr* .... June 6, Aug. 4

Oeneis Hbn.
126 nevadensis *F. & F.* .... May 23, June 20

Erebia Dalm.
150 epipsodea *Butl.* .... May 2-31

Family NYMPHALIDAE
Subfamily NYMPHALINAE

Argynnis Fabr.
165 leto *Behr.* .... Aug. 8
171 atlantis beani *B. & B.* .... July 1
178 hydaspe sakuntala *Skin.* July 6, Aug. 14
184 bremnerii picta *McD.* .. Aug. 7, Sept. 21
191 nevadensis semivirida *McD.* .... July 18
199 eurynome opis *Edw.* .... Aug. 14

Brenthis Hbn.
200 myrina *Cram.* .... May 31
212 bellona *Fabr.* .... May 24
213 epithore obscuripennis *Gund.* ... July 31

Euphydryas Scud.
222 anicia hopfingeri *Gund.* .. May 2, June 18

Melitaea Fabr.
246 palla *Bdv.* .... May 2, July 7

Phyciodes Hbn.
265 tharos pascoensis *Wgt.* .. May 30, Aug. 9
267 campestris *Behr.* ..... May 21, Sept. 29

Polygonia Hbn.
287 satyrus *Edw.* .... March 23, Aug. 17
288 faunus rusticus *Edw.* .. March 20, Aug. 21
291 zephyrus *Edw.* .... April 18, Aug. 21

Nymphalis Kluk
295 j-album watsoni *Hall* .. July 17, Aug. 21
296 californica *Bdv.* ...... June 12, Aug. 12
297 milberti furcillata *Say*. May 14, Sept. 30
298 antiopa *L.* .... April 4, Aug. 19

Vanessa Fabr.
299 atalanta *L.* .... July 1, Aug. 22
301 cardui *L.* .... June 9, Sept. 12

Basilarchia Scud.
324 lorquini burrisonii *Mayn.* .... June 6-27

Family LYCAENIDAE
Subfamily THECLINAE

Strymon Hbn.
380 titus *Fabr.* .... July 7-18
382 californica *Edw.* .... July 4, Aug. 14
392 saepium okanagana
McD. .... July 19, Aug. 26

Incisalia Scud.
404 iroides *Bdv.* .... April 11, May 21
409 polios *Cook & Wats.* .. April 18, May 16
412 eryphon *Bdv.* .... April 10 May 5

Subfamily LYCAENINAE

Lycaena Fabr.
430 mariposa *Reak.* .... Aug. 14
432 helloides *Bdv.* .... May 15, Sept. 18

Subfamily PLEBEIINAE

Everes Hbn.
448 amyntula *Bdv.* .... May 21, June 10

Plebeius Kluk
449 scudderii *Edw.*
(Atypical) ...... July 12, Aug. 14
450 melissa *Edw.* .... May 5, Aug. 5
451 anna *Edw.* .... Aug. 8
(Probably subspecies of scudderii *Edw.*)
453 saepiolus *Bdv.* .... May 5, July 3
455 icarioides montis
Blkmre. .... May 22, June 23

Phaedrotes Scud.
472 piasus daunia *Edw.* .... May 23

Glaucopsyche Scud.
473 lygdamus columbia
Skin. .... April 24, June 2

Lycaenopsis F. & F.
475 pseudargiolus
Bdv. & Lec. .... April 8, May 5
c nigrescens *Fletch.* .... April 19-26

Superfamily HESPERIOIDEA
Family HESPERIIDAE
Subfamily PYRGINAE

Thorybes Scud.
505 pylades *Scud.* .... May 30, June 17

Pyrgus Hbn.
516 ruralis *Bdv.* .... April 26, May 7
521 communis albescens *Ploetz* .... May 23

Erynnis Schr.
541 icelus *Scud. & Burg.* ... April 28, June 4
546 persius fredericki
Freeman .... April 26, May 12
549 callidus *Grin.* .... May 24

Subfamily HESPERIINAE

Ochlodes Scud.
604 sylvanoides *Bdv.* .... June 6, Sept. 5

Amblyscirtes Scud.
660 vialis *Edw.* .... May 30, June 13

Suborder HETEROCERA (Moths)
Superfamily SPHINGOIDEA
Family SPHINGIDAE
Subfamily ACHERONTIINAE

Sphinx L.
721 mordecai *McD.* .... May 19, Aug. 21
730 drupiferarum utahensis
Hy. Edw. .... July 2-7

Smerinthus Latr.
739 jamaicensis *f. norm.* geminatus
Say .... June 2, July 12
740 cerisyi ophthalmicus
Bdv. .... June 2, Aug. 18

Paonias Hbn.
741 excaecata *A. & S.* .... July 7

Pachysphinx R. & J.
745 modesta *Harr.* .... July 2-7

Hemaris Dalm.
770 diffinis rubens *Hy. Edw.* May 17, July 3

Subfamily PHILAMPELINAE

Proserpinus Hbn.
789 clarkiae *Bdv.* .... May 9, June 2
790 flavofasciata ulalume *Stkr.* ... May 5-10

Subfamily CHOEROCAMPINAE

Celerio Oken.
798 gallii intermedia *Kby.* .. June 28, July 3
799 lineata *Fabr.* .... June 24 Sept. 4

Superfamily SATURNIOIDEA
Family SATURNIIDAE

Platysamia Grt.
807 euryalus kasloensis
Ckll. .... May 1, June 6

Telea Hbn.
812 polyphemus *Cram.* .... May 18, June 13

Pseudohazis G. & R.
840 eglanterina *Bdv.* .... July 4-16

Superfamily NOCTUOIDEA
Family NOLIDAE

Celama Wlk.
891 minna *Butl.* .... April 7, May 6

Family ARCTIIDAE
Subfamily LITHOSIINAE

Lexis Wallgr.
905 bicolor *Grt.* .... Aug. 1-18

Crambidia Pack.
911 casta *Pack.* .... Aug. 10-27

Clemensia Pack.
952 albata *Pack.* .... June 30, July 30

Hypoprepia Hbn.
958 miniata *Kby.* .... July 19, Aug. 5

Subfamily ARCTIINAE

Halisidota Hbn.
980 maculata angulifera *Wlk.* .... May 5-28

Cycnia Hbn.
991 tenera *Hbn.* ....June 10-20

Eubaphe Hbn.
1023 ferruginosa *Wlk.* ....June 29
a immaculata *Reak.* ....June 1, July 27

Apantesis Wlk.
1034 intermedia *form* stretchii *Grt.*...Aug. 6
1035 parthenice *Kby.* ....July 29, Aug. 13
1047 nevadensis superba *Stretch* ..Aug. 8-30

Leptarctia Stretch
1063 californiae *Wlk.* ......April 26, May 30

Diacrisia Hbn.
1065 virginica *Fabr.* ....May 14, June 2
1066 vagans kasloa *Dyar* ...May 24, June 10

Isia Wlk.
1069 isabella *A. & S.* ....June 26

Estigmene Hbn.
1070 acrea *Dru.* ....May 4, June 18
1073 congrua *Wlk.* ....May 16, June 21

Hyphantria Harr.
1075 cunea *Dru.* ....May 28

Parasemia Hbn.
1092 parthenos *Harr.* ....June 4-25

Platyprepia Dyar
1096 guttata *Bdv.* ....June 24
form ochracea *Stretch*..June 14, July 2

Family AGARISTIDAE

Alypia Hbn.
1116 langtoni *Couper* ....June 23
1117 ridingsi *Grt.* ....May 21-June 11

Family PHALAENIDAE
Subfamily PANTHEINAE

Raphia Hbn.
1141 frater *Grt.* ....June 23

Subfamily ACRONICTINAE

Acronicta Ochs.
1152 hesperida *Sm.* ....June 13-25
1155 innotata *Gn.* ....May 20, June 13
1160 grisea revellata *Sm.* ....June 3-18
1168 funeralis *G. & R.* ......May 25, June 6
1175 furcifera *Gn.* ....June 23
1185 fragilis minella *Dyar* ..May 16, July 22
1201 impleta illita *Sm.* ....June 6-15
1206 distans dolorosa *Dyar* ....May 10
1211 perdita *Grt.*

Subfamily PHALAENINAE
(Agrotinae)

Euxoa Hbn.
1243 andera *Sm.* ....Aug. 27, Sept. 3
1250 ridingsiana *Grt.* ....Aug. 9-12
1252 flavicollis *Sm.* ....July 7
1274 intrita *Morr.* ....Aug. 1-20
form strigilis *Grt.* ....Aug. 16
form reuda *Stkr.* ....Aug. 9-21
1278 infracta *Morr.* ....Aug. 5-19
1280 infausta *Wlk.* ....July 23, Aug. 5
1284 sponsa *Sm.* ....July 24, Aug. 20
1289 perfusca *Grt.* ....Aug. 2-25
a cocklei *Sm.* ....July 28, Aug. 25
1292 perpolita *Morr.* ....Aug. 9-16
1294 stigmatalis *Sm.* ....July 19, Aug. 2
1309 mimallonis gagates
Grt. ....Aug. 19, Sept. 9
1310 messoria *Harr.* ....Aug. 1-22
form atrifera *Grt.* ....Aug. 10-28
1318 atropulverea *Sm.* ....Sept. 9
1322 ontario *Sm.* ....Aug. 7-19
1324 quinquelinea *Sm.* ....Aug. 22, Oct. 9
b incallida *Sm.* ....Sept. 3
1341 tessellata *Harr.* ....July 8-27
a atropurpurea *Grt.* ....July 11
c flaviscapula *Sm.* .....July 28, Aug. 4
d tesselloides *Grt.* .....July 18, Aug. 12
1343 esta *Sm.* ....Aug. 27
1351 declarata *Wlk* ....Aug. 6, Sept. 3
1352 campestris *Grt.* ....July 25, Aug. 27
1353 verticalis *Grt.* ....June 23, Aug. 17
1354 albipennis *Grt.* ....Aug. 24, Sept. 3
1355 lillooet *McD.* ....July 27, Aug. 22
1366 divergens *Wlk.* ....June 22, July 23
1370 obeliscoides *Gn.* ....Aug. 16-24
1371 redimicula *Morr.* ....July 21, Aug. 16
1372 costata *Grt.* ....June 25, July 25
a idahoensis *Grt.* ......June 27, Aug. 3
1378 ochrogaster *Gn.* ......July 26, Aug. 30
1379 excellens *Grt.* ....Aug. 15, Sept. 15
1383 brocha *Morr.* ....Aug. 10, Sept. 9

Chorizagrotis Sm.
1389 thanatologia *Dyar* ....Sept. 9
form perfida *Dod.* ....June 17, Aug. 18

Pseudorthosia Grt.
1403 variabilis *Grt.* ....Aug. 12-28

Agrotis Ochs.
1416 vetusta catenuloides *Sm.*
July 25, Aug. 28
1426 vancouverensis semiclarata *Grt.*
June 14-21
1432 volubilis *Harv.* ....May 12, June 7

Feltia Wlk.
1442 ducens *Wlk.* ....Aug. 10-30
1446 herilis *Grt.* ....July 18-28

Actebia Steph.
1452 fennica *Tausch* ......June 23, Aug. 28

Spaelotis Bdv.
1472 clandestina *Harr.* ....June 22, July 3
1473 havilae *Grt.* ....July 9

Eurois Hbn.
1475 occulta *Linn.* ....June 7-20
1476 astricta subjugata *Dyar*
July 23, Aug. 16
1477 nigra *Sm.* ....Aug. 13, Sept. 19

Metalepsis Grt.
1494 salicarum *Wlk.* ....Apr. 4

Peridroma Hbn.
1496 margaritosa *Haw.* ....Sept. 1, Nov. 1
form saucia *Hbn.* ......Sept. 9, Dec. 15

Pseudospaelotis McD.
1499 haruspica inopinatus *Sm.*
June 16, Aug. 1

Diarsia Hbn.
1504 cynica perumbrosa *Dyar* ......Aug. 12
1510 rosaria *Grt.* ....May 21, Aug. 18

Graphiphora Ochs.
1511 c-nigrum Linn. .. ....June 6, Aug. 15
1512 smithi *Snell* ....June 22, Aug. 27
1517 oblata *Morr.* ....June 11, Aug. 2
1522 collaris *G. & R.* ......June 20, Aug. 25

Anomogyna Staud.
1561 elimata *Gn.* ....Aug. 17
1564 vernilis *Grt.* ....July 22, Aug. 28

Adelphagrotis Sm.
1567 indeterminata *Wlk.* ..July 28, Aug. 15

Aplectoides Butl.
1568 condita *Gn.* ....June 6

Anaplectoides McD.
1569 pressus fales *Sm.* .....June 6, Aug. 24
1570 prasina *Schiff.* ....July 30, Aug. 20
Protolampra McD.
1571 rufipectus *Morr.* ......July 4, Aug. 8
Pseudoglaea Grt.
1574 olivata *Harr.* ....Aug. 26, Sept. 15
Eueretagrotis Sm.
1577 perattenta *Grt.* ....July 11
a inattenta *Sm.* ....July 14
Abagrotis Sm.
1587 apposita *Grt.* ....Aug. 8-11
1590 sambo *Sm.* ....July 24, Aug. 11
1593 placida *Grt.* ....Aug. 1, Sept. 10
1598 variata *Grt.* ....Aug. 12
1599 scopeops *Dyar* ....June 26, Aug. 19
Rhynchagrotis Sm.
1606 insularis *Grt.* ....May 10, July 16
form confusa *Sm.* ....June 17, Aug. 25
Ufeus Grt.
1610 electra *Sm.* ....Oct. 13-28
1612 hulsti *Sm.* ....Feb. 1, Nov. 7

Subfamily HADENINAE.

Scotogramma Sm.
1633 trifolii *Rott.* ....July 21, Aug. 23
1639 oregonica *Grt.* ....May 17, June 18
Mamestra Ochs.
1660 configurata *Wlk.* ....June 3, July 8
Polia Ochs.
1662 discalis *Grt.* ....June 12, Aug. 20
1663 nimbosa *Gn* ....June 6, July 28
1669 purpurissata *Grt.* ....July 2-31
b crydina *Dyar* ....July 3
1672 grandis *Bdv.* ....May 19-25
1673 subjuncta *G. & R.* ....June 12-19
1678 nevadae *Grt.* ....June 24, July 21
1679 radix *Wlk.* ....June 29, July 16
1680 segregata *form* negussa *Sm.*
April 20, May 19
1684 tacoma *Stkr.* ....May 18, July 16
1689 meodana *Sm.* ....June 9-20
1691 adjuncta *Bdv.* ....June 7, July 9
1694 pulverulenta *Sm.* ....May 19, June 22
1697 cristifera *Wlk.* ......May 19, June 18
1699 lutra *Gn.* ....June 12, July 1
1706 montara *Sm.* ....June 4
1709 detracta *Wlk.* ....June 10-28
a neoterica *Sm.* ....June 12-23
Lacinipolia McD.
1714 lustralis *Grt.* ....June 18-25
1716 anguina larissa *Sm.* ..June 12, July 23
1735 vicina *Grt.* ....July 13, Aug. 28
1736 pensilis *Grt.* ....July 24, Aug. 16
1739 stricta cinnabarina *Grt.* ....Aug. 8-21
1744 lorea *Gn.* ....June 10-26
1746 comis *Grt.* ....June 18, July 29
a obnigra *Sm.* ....June 5 Aug. 25
b rectilinea *Sm.* ....July 30
Sideridis Hbn.
1800 rosea *Harv.* ....March 18, June 3
1802 maryx *Gn.* ....June 8
Protorthodes McD.
1841 curtica *Sm.* ....Aug. 14-20
1855 oviduca *Gn.* ....May 11, June 2
Anhimella McD.
1886 contrahens infidelis *Dyar* ..June 17-21
Nomorthodes McD.
1885 hanhami *B. & McD.* ....June 11
1890 furfurata uniformis *Sm.*
June 13, July 19
1891 communis *Dyar* ......July 23, Aug. 6
1892 fractura mecrona *Sm.* ..June 2, July 1
Nephelodes Gn.
1895 emmedonia pectinata *Sm.*
June 19, Aug. 20
Xylomyges Gn.
1906 hiemalis *Grt.* ....April 19
1909 crucialis *Harv.* ....April 3, May 16
1913 candida *Sm.* ....April 23-28
1914 dolosa *Grt.* ....April 4, May 14
1915 rubrica *Harv.* ....May 1-26
1916 perlubens *Grt.* ......April 17, May 12
Stretchia Hy. Edw.
1920 plusiaeformis *Hy. Edw.* ......May 25
Acerra Grt.
1923 normalis *Grt.* ....April 2
Orthosia Ochs.
1925 pulchella achsha *Dyar* ......April 22
1940 revicta *Morr.* ....April 30, May 14
1942 pacifica *Harv.* ....April 11
1943 hibisci quinquefasciata *Sm.*
March 18, May 25
Dargida Wlk.
1952 procincta *Grt.* ......June 22, Sept. 23
Zosteropoda Grt.
1955 hirtipes *Grt.* ....June 13
Leucania Ochs.
1977 commoides *Gn.* ....June 10-26
1984 farcta roseola *Sm.* ....June 18, July 20
1992 insueta heterodoxa *Sm.* ....June 14-25
1995 luteopallens *Sm.* ....June 18, July 31

Subfamily CUCULLIINAE

Pleroma Sm.
2026 obliquata *Sm.* ....April 2-4
2027 bonuscula *Sm.* ....April 10, May 1
2029 cinerea *Sm.* ....Sept. 18, Oct. 9
Cucullia Schrank
2041 florea obscurior *Sm.* ....Aug. 10
2042 postera *Gn.* ....July 1
2043 omissa *Dod.* ....June 7, Aug. 4
Oncocnemis Led.
2073 pudorata *Sm.* ....Aug. 10
2111 columbia *McD.* ....Aug. 12
2116 piffardi *Wlk.* ....Aug. 17, Oct. 6
2132 major *Grt.* ....July 11
2133 chandleri *Grt.* ....Aug. 12, Sept. 3
Feralia Grt.
2186 comstocki columbiana *Sm.*
April 28, May 16
Bombycia Steph.
2205 rectifascia *Sm.* ....July 25-Aug. 2
Hillia Grt.
2212 maida *Dyar* ....Aug. 29, Sept. 18
Litholomia Grt.
2215 napaea *Mor.* ....March 3, Nov. 22
Lithomoia Hbn.
2216 solidaginis *Hbn.* ....Aug. 20-28
Graptolitha Hbn.
2221 innominata *Sm.* ....March 18, Sept. 3
2222 petulca *Grt.* ....Sept. 14, Oct. 8
2223 ferrealis *Grt.* ....Sept. 8-28
2235 vivida *Dyar* ....Aug. 18, Oct. 28
2241 tepida *Grt.* ....Sept. 17, Oct. 19
2244 georgii *Grt.* ....April 19, Sept. 27
b holocinerea *Sm.* ....Oct. 23

2248 fagina *Morr.* ....March 12, Oct. 27
2253 dilatocula *Sm.* ......April 26, Oct. 12

Xylena Ochs.
2260 curvimacula *Morr.* .March 17, Sept. 30
2262 thoracica *Put.-Cram.* ..Sept. 26, Oct. 11
2263 cineritia *Grt.* ....Sept. 19 Oct. 11

Xylotype Hamp.
2266 acadia *B. & B.* ....Aug. 28, Sept. 1

Platypolia Grt.
2268 anceps *form* aplectoides *Gn.* Sept. 16-20
2270 loda *Stkr.* ....Sept. 8, Oct. 2

Miniotype Francl.
2273 versuta *Sm.* ....Aug. 1, Sept. 19
2276 miniota *Sm.* ....May 8, July 30

Fishia Grt.
2278 evelina hanhami *Sm.* ..Sept. 8, Oct. 13
2281 yosemitae *Grt.* ....Oct. 12-24

Anytus Grt.
2288 profunda *Sm.* ....Aug. 28, Sept. 17

Eupsilia Hbn.
2303 tristigmata *Grt.* ......March 3, Oct. 17
2307 fringata *B. & McD.* ..Sept. 15, Oct. 13

Parastichtis Hbn.
2309 discivaria *Wlk.* ......July 29, Aug. 15

Lycanades Franc.
2310 purpurea *Grt.* ....Aug. 25-30
a antapica *Sm.* ....Sept. 18-26

Rusina Steph.
2313 verberata *Sm.* ......July 29, Aug. 28
2315 decipiens *Grt.* ....Sept. 1-8

Xanthia Ochs.
2316 lutea *Strom.* ....Aug. 22, Sept. 1

Eucirrhoedia Grt.
2321 pampina *Gn.* ....Aug. 5, Sept. 2

Homoglaea Morr.
2322 carbonaria *Harv.* ..March 31, April 18
2323 dives *Sm.* ....March 19, Nov. 1

Subfamily AMPHIPYRINAE

Septis Hbn.
2336 antennata purpurissata *B. & McD.*
June 16, July 1
2342 auranticolor *Grt.* ....June 2
b sora *Sm.* ....July 16-26
2344 vultuosa *Grt.* ....Aug. 8-21
2351 arctica *Frr.* ....June 18, July 28
2352 castanea *Grt.* ....July 14, Aug. 10
2362 impulsa *Gn.* ....July 23
2365 finitima cerivana *Sm.* May 11, June 16

Agroperina Hamp.
2366 lateritia *Hufn.* ....June 26, Aug. 1
2368 dubitans cogitata *Sm.* ..July 2, Aug. 5

Crymodes Gn.
2375 devastator *Brace* ....July 29, Aug. 22
2378 longula *Grt.* ....July 24-28

Aseptis McD.
2400 binotata *Wlk.* ....July 20-30

Oligia Hbn.
2413 indirecta *Grt.* ....June 27, July 31
2423 illocata *Wlk.* ....Aug. 25, Sept. 2
2424 mactata allecto *Sm.* ....Sept. 3-8
2557 divesta *Grt.* ....Aug. 16-21

Eremobina McD.
2430 claudens *Wlk.* ....Aug. 15, Sept. 8

Ipimorpha Hbn.
2453 pleonectusa *Grt.* ......July 16, Aug. 12

Helotropha Led.
2457 reniformis *Grt.* ......Aug. 18, Sept. 6

Euplexia Steph.
2533 benesimilis *McD.* ....June 15-21

Phlogophora Tr.
2536 periculosa *form* v-brunneum *Grt.*
July 31, Aug. 26

Achytonix McD.
2558 epipaschia *Grt.* ....Aug. 16-17

Amphipyra Ochs.
2584 pyramidoides *Gn.* ....Aug. 13-17
2585 tragopoginis *L.* ....July 20-22

Andropolia Grt.
2602 aedon *Grt.* ....July 21, Aug. 7
2603 theodori epichysis *Grt.* July 30, Aug. 16

Hyppa Dup.
2607 xylinoides *Gn.* ......June 17, July 17

Elaphria Hbn.
2647 festivoides *Gn.* .....May 16, June 23

Platyperigea Sm.
2656 extima *Wlk.* ....July 27, Aug. 12
2657 meralis *Morr.* ....July 25, Aug. 8

Enargia Hbn.
2685 decolor *Wlk.* ....Aug. 5, Sept. 6

Pyrrhia Hbn.
2715 umbra exprimens *Wlk.* L
May 27, June 12

Eutricopis Morr.
2871 nexilis *Morr.* ....June 23

Subfamily HELIOTHIINAE

Melicleptria Hbn.
2913 sueta *Grt.* ....May 22, July 31
2915 honesta *Grt.* ....May 23

Dysocnemis Grt.
2920 oregonica *Hy. Edw.* ....June 26

Subfamily ACONTIINAE

Erastria Ochs.
3119 albidula *Gn.* ....May 31, July 5

Subfamily NYCTEOLIDAE

Nycteola Hbn.
3235 frigidana *Wlk.* ....Aug. 9-15
3235a cinereana *N. & D.* .....April 22, July 4

Subfamily PLUSIINAE

Syngrapha Hbn.
3254 rectangula nargenta *Ottol.* ..Aug. 7-14
3255 celsa *Hy. Ed.* ....Aug. 8
3256 angulidens excelsana *Strand* ..Aug. 14
3257 alias interalia *Ottol.* ....June 10
3264 epigaea *Grt.* ....Aug. 24, Sept. 6
3265 ampla *Wlk.* ....July 7-19
3266 selecta *Wlk.* ....July 13, Aug. 26

Anagrapha McD.
3252 falcifera *form* simplex *Gn.* ....Aug. 22

Autographa Hbn.
3285 bimaculata *Steph.* ....Aug. 6
3286 mappa *G. & R.* ....Sept. 18
32 8 californica *Speyer* ...April 23, Aug. 21
3292 metallica *Grt.* ......June 22, Sept. 29

Plusia Ochs.
3295 aereoides *Grt.* ....July 7

Subfamily CATOCALINAE

Catocala Schrank
3344 relicta *Wlk.* ....Aug. 22, Sept. 8
3355 californica *Edw.* ......July 28, Aug. 13
3357 briseis *Edw.* ....July 25, Oct. 11

3360 nevadensis *form* montana *Beut.* Aug 2-31

Euclidina McD.
3426 cuspidea *Hbn.* ....May 15-25

Caenurgina McD.
3427 annexa *Hy. Edw.* ....May 16
3430 crassiuscula *Haw.* ......May 7, Aug. 5

Zale Hbn.
34 84 minerea norda *Sm.*...April 17, May 23
3489 benesignata *Harv.* ....May 19, June 6

Toxocampa Gn.
3538 victoria *Grt.* ....July 28, Aug. 8

Melipotis Hbn.
3551 jucunda *Hbn.* ....May 25, June 2

Synedoida Hy. Edw.
3578 adumbrata *Behr.* ....May 21, July 6

Scoliopteryx Germ.
3615 libatrix *L.* ....July 31, Aug. 21

Subfamily HYPENINAE

Bomolocha Hbn.
3690 palparia *Wlk.* ....June 17
3698 toreuta *Grt.* ....June 21

Hypena Schrank
3706 humuli *Harr.* ....April 4, Aug. 19

Subfamily RIVULINAE

Mycterophora Hlst.
3711 longipalpata *Hlst.* ......July 31, Aug. 7

Rivula Gn.
3732 propinqualis *Gn.* ....July 6

Subfamily HERMINIINAE

Epizeuxis Hbn.
3735 aemula *Hbn.* ....July 8-21

Chytolita Grt.
3767 petrealis *Grt.* ....May 28, June 28

Philometra Grt.
3770 metonalis *Wlk.* ......June 23, July 25

Bleptina Gn.
3797 caradrinalis *Gn.* ....June 24, Sept. 16

Palthis Hbn.
3807 angulalis *Hbn.* ......May 16, June 12

Family NOTODONTIDAE

Ichthyura Hbn.
3822 apicalis *Wlk.* ....May 15, June 18
3827 albosigma specifica *Dyar* May 11, Aug. 1

Datana Wlk.
3829 ministra *Dru* ....May 21

Hyperaeschra Butl.
3844 pacifica *Behr* ....May 5

Odontosia Hbn.
3847 elegans *Stkr.* ....July 6

Nadata Wlk.
3857 gibbosa oregonensis *Butl.* ..June 9-29

Schizura Dbldy.
3920 ipomoeae *Dbldy.* ....Aug. 6
3921 concinna *A. & S.* ......May 15, Aug. 9
3924 unicornis *A. & S.* ....June 24

Cerura Schrank
3938 scolopendrina *Bdv.* ....June 11

Gluphisia Bdv.
3940a severa *form* normalis *Dyar* ...May 9

Family LIPARIDAE

Notolophus Germ.
3943 antiqua badia *Hy. Edw.* Aug. 22, Oct. 17

Hemerocampa Dyar
3945 pseudotsugata *McD.* ....Aug. 19

Olene Hbn.
3954 vagans *B. & McD.* ......July 1, Aug. 8

Superfamily BOMBYCOIDEA
Family LASIOCAMPIDAE

Tolype Hbn.
3978 velleda *Stoll* ....July 6

Malacosoma Hbn.
3989 americana *Fabr.* ....July 3-14
3997 disstria *Hbn.* ....June 27, July 17

Epicnaptera Ramb.
3999 americana *Harr.* ......April 20, May 2

Superfamily DREPANOIDEA
Family THYATIRIDAE

Habrosyne Hbn.
4004 scripta *Gosse.* ....June 10, July 7

Pseudothyatira Grt.
4007 cymatophoroides *Gn.* ..June 12, July 9
form expultrix *Grt.* ..June 20, July 21

Euthyatira Sm.
4010 pudens *Gn.* ....April 20, May 19

Ceranemota Clarke
4014 tearlei *Hy. Edw.* ....Sept. 5-12

Family DREPANIDAE

Drepana Schrank
4020 arcuata siculifer *Pack.* April 28, June 6
4021 bilineata *Pack.* ....May 5, Sept. 1

Superfamily GEOMETROIDEA
Family GEOMETRIDAE
Subfamily BREPHINAE

Brephos Zinck.
4023 infans oregonensis *Swett* March 24, April 19

Subfamily GEOMETRINAE
(Hemitheinae)

Nemoria Hbn.
4059 darwiniata *Dyar* ....June 29, July 24

Synchlora Gn.
4074 rubrifrontaria *Pack.* ....July 7

Mesothea Warr.
4090 viridipennata *Hlst* ..April 11, May 10

Subfamily STERRHINAE
(Acidaliinae)

Scelolophia Hlst.
4127 hepaticaria *Gn.* ......April 21, May 15

Scopula Schrank
4144 quinquelinearia *Pack.* ......June 8-21
4147 ancellata *Hlst.* ....July 7 Aug. 3
4157 subfuscata *Tayl.* ....May 16, June 13

Sterrha Hbn.
4180 demissaria columbia *McD.* ....June 31
4195 rotundopennata *Pack.* ....June 3-25

Cosymbia Hbn.
4211 pendulinaria *Gn.* ....June 26, July 24
a griseor *McD.* ....June 29

Subfamily LARENTIINAE

Nyctobia Hlst.
4223 limitaria nigroangulata *Stkr.* Aril 17, May 14

Cladara Hlst.
4225 atroliturata *Wlk.* .....April 13, June 1

Lobophora Curt.
4228 simsata *Swett* ....May 24, June 13

Neodezia Warr.
4235 albovittata tenuifasciata *B. & McD.* June 4
Operophtera Hbn.
4239 bruceata *Hlst.* ....Oct. 21, Nov. 14
Oporinia Hbn.
4243 autumnata henshawi *Swett* Sept. 5, Oct. 25
Triphosa Steph.
4244 haesitata *Gn.* ....Sept. 13, Nov. 4
form pustularia *Hy Edw.* March 23, Dec. 3
Calocalpe Hbn.
4247 undulata *Linn.* ......June 1, July 19
Coryphista Hlst.
4248 meadi *Pack.* ....April 26, July 31
form badiaria *Hy. Edw.* May 9, July 27
Eupithecia Curt.
4267 misturata *Hlst.* ......April 10, June 29
4276 castigata *Hbn.* ....June 10-16
4287 palpata *Pack.* ....May 5
4288 columbiata *Dyar* ......May 5, June 5
4290 maestosa dyarata *Tayl.* June 30, Aug. 8
4321 terminata *Tayl.* ....June 11
4330 coagulata Gn. ....May 12, Aug. 3
4331 geminata *Pack.* ....June 26-31
4336 innotata kootenaiata *Dyar* ......June 7
4341 georgii *McD.* ....May 24, June 16
4342 sobrinata niphadophilata *Dyar* Aug. 28
4346 annulata *Hlst.* ....March 18, April 17
4347 usurpata *Pears.* ....March 28
4350 cretaceata *Pack.* .... Aug. 14
4358 agnesata *Tayl.* ....June 7
4363 tenuata *Hlst.* ....June 22
4383 ravocostaliata *Pack.* ....May 7-11
Horisme Hbn.
4393 intestinata *Gn.* ....June 11
Eustroma Hbn.
4398 nubilata *Pack.* ....May 17, Sept. 7
Lygris Hbn.
4407 xylina *Hlst.* ....June 20, Aug. 11
Plemyria Hbn.
4412 georgii *Hlst.* ....Aug. 10, Oct. 15
Dysstroma Hbn.
4416 citrata *Linn.* ....June 8, Sept. 15
b mulleolata *Hlst.* ....June 5-27
Ceratodalia Pack.
4429 gueneata *Pack.* ......July 16, Aug. 20
Hydriomena Hbn.
4465 furcata *Thun.* ....June 25, Aug. 9
4477 pluviata *Gn.* ....June 17, Aug. 16
4485 renunciata *form* pernigrata *B. & McD.* June 1-3
Xanthorhoe Hbn.
4515 defensaria *Gn.* ......April 16, Oct. 13
4516 ferrugata *Clerk.* ....April 26, May 28
4519 incursata lagganata *S. & C.* ....Aug. 4
4524 pontiaria *Tayl.* ......May 14, June 31
Entephria Hbn.
4541 multivagata *Hlst.* ....July 4 Sept. 25
Mesoleuca Hbn.
4546 ruficillata *Gn.* ....May 16-18
4547 gratulata latialbata *B. & McD.* April 19, May 2
Epirrhoe Hbn.
4548 tristata *Linn.* ....May 23
4549 plebeculata *Gn.* ....May 25
4551 alternata *Mull.* ......May 22, July 25
Sparganía Gn.
4555 magnoliata pernotata *Hlst.* June 8, Aug. 7
Euphyia Hbn.
4558 unangulata intermediata *Gn.* June 26
4561 multiferata *Wlk.* ....May 20
Eulype Hbn.
4573 hastata *Linn.* ....May 21, July 2
Perizoma Hbn.
4581 curvilinea *Hlst.* ......May 19, June 13
Earophila Gumpb.
4587 vasiliata *Gn.* ....April 9 May 25
Venusia Curt.
4593 pearsalli *Dyar* ......April 17, May 20
Hydrelia Hbn.
4597 albifera *Wlk.* ....July 1

Subfamily ENNOMINAE

Bapta Steph.
4605 semiclarata *Wlk.* ....April 28, May 16
Deilinia Hbn.
4612 variolaria *Gn.* ....June 13, Sept. 5
4614 erythemaria *Gn.* ....May 23
Drepanulatrix Gump.
4617 rectifascia *Hlst.* ......May 16, Aug. 8
4618 bifilata *Hlst.* ....March 20, July 3
4622 falcataria *Pack.* ....April 27, May 13
4628 pulveraria *Hlst.* ....May 2-15
4630 litaria *Hlst.* ....April 4, Sept. 21
4634 unicalcararia *Gn.* ....June 20, Aug. 12
Sericosema Warr.
4645 juturnaria *Gn.* ......June 20, July 16
Isturgia Hbn.
4658 truncataria *Wlk.* ....May 11-30
Philobia Dup.
4664 ulsterata *Pears* ......May 23, July 12
Semiothisa Hbn.
4675 adonis *B. & McD.* ....July 1
4680 granitata *Gn.* ....May 31, Aug. 26
46?8 denticulata *Grt.* ......May 25 July 5
4725 neptaria sinuata *Pack.* ..May 6, Aug. 5
Itame Hbn.
4757 quadrilinearia *Pack.* ..June 28, Aug. 28
4762 exauspicata *Wlk.* ....July 4-31
4768 plumosata *B. & McD.* ..July 9, Aug. 12
4771 bitactata *Wlk.* ....Aug. 13
4772 denticulodes *Hlst.* ....July 16
4782 matilda *Dyar* ....May 25, June 26
4784 hulstiaria *Tayl.* ....June 3, Aug. 31
Elpiste Gump.
4799 lorquinaria *Gn.* ......July 16, Aug .28
Hesperumia Pack.
4801 sulphuraria *Pack.* ....June 19, July 30
form baltearia *Hlst.* ....June 28
Dasyfidonia Pack.
4806 avuncularia *Gn.* ....May 23
Paraphia Gn.
4809 subatomaria *Wood* ....June 12, July 4
Melanolophia Hlst.
4859 imitata *Wlk.* ....May 2, June 15
Protoboarmia McD.
4875 porcelaria indicataria *Wlk.* May 10, July 29
Stenoporpia McD.
4900 excelsaria *Stkr.* ....May 31
4905 satisfacta *B. & McD.* ..July 24, Aug. 26

Vitrinella McD.
4908 pampinaria *Gn.* .... May 16, June 10
Anacamptodes McD.
4913 emasculata *Dyar* .... May 17, June 21
Aethalura McD.
4945 anticaria fumata *B. & McD.* April 11, June 7
Ectropis Hbn.
4946 crepuscularia *Schiff.* April 10 May 24
Coniodes Hlst.
4955 plumogeraria *Hlst.* .... March 23
Erannis Hbn.
4963 vancouverensis *Hlst.* .... Oct. 3-16
Lycia Hbn.
4966 ursaria *Wlk.* .... April 6, May 26
Amphidasis Tr.
4968 cognataria *Gn.* ...... June 11, July 11
Euchlaena Hbn.
4997 johnsonaria *Fitch* .... July 25, Aug. 11
4998 mollisaria *Hlst.* .... July 23-31
5001 astylusaria *Wlk.* .... June 11
5005 tigrinaria *Gn.* .... June 7-28
Spodolepis Hlst.
5012 substriataria danbyi *Hlst.* April 9, May 19
Campaea Lam.
5015 perlata *Gn.* .... June 21, July 17
Anthelia Hlst.
5019 taylorata Hlst. .... May 15
Philedia Hlst.
5027 punctomacularia *Hlst.* Aug. 11, Sept. 18
Plagodis Hbn.
5034 approximaria *Dyar* .... July 27
Anagoga Hbn.
5042 pulveraria *Linn.* .... May 8-29
Hyperetis Gn.
5043 amicaria *H.-S.* ...... May 16, June 26
Nematocampa Gn.
5044 limbata *Haw.* .... July 22, Aug. 24
Metarranthis Warr.
5050 duaria *Gn.* .... May 16, June 7
Metanema Gn.
5054 inatomaria *Gn.* .... June 20
Pero H. -S.
5073 giganteus *Grossb.* .... Aug. 6-8
5080 morrisonarius *Hy. Edw.* May 19 June 8
Phengommataea Hlst.
5083 edwardsata *Hlst.* .... Aug. 8-10
Enypia Hlst.
5091 perangulata *Hlst.* .... Aug. 10-11
5095 packardata *Tayl.*.............. Aug. 11
Nepytia Hlst.
5111 semiclusaria pellucidaria *Pack.* Sept. 11, Oct. 9
Caripeta Wlk.
5125 divisata *Wlk.* .... July 4-17
Besma Capps
5145 quercivoraria *Gn.* .... May 27, July 25
Lambdina Capps
5146 fiscellaria lugubrosa *Hlst.* Aug. 24, Sept. 15
Neoterpes Hlst.
5158 trianguliferata *Pack.* May 14, June 27
Sicya Gn.
5161 macularia *Harr.* ...... June 21, July 21
Deuteronomos Prout
5170 magnarius *Gn.* .... Sept. 11-21
Synaxis Hlst.
5189 jubararia *Hlst.* .... Sept. 17, Oct. 20
5191 cervinaria *Pack.* .... June 7
Tetracis Gn.
5198 lorata *Grt.* .... May 16-23
Prochoerodes Grt.
5210 forficaria combinata *McD.* June 10, July 3

Superfamily URANIOIDEA
Family EPIPLEMIDAE

Callizzia Pack.
5223 amorata *Pack.* .... June 10

MICROLEPIDOPTERA

Superfamily ZYGAENOIDEA
Family LIMACODIDAE

Tortricidia Pack.
5279 testacea crypta *Dyar* .. May 13, June 28

Superfamily PYRALIDOIDEA
Family PYRALIDAE
Subfamily GLAPHYRIINAE

Egesta Rag.
5338 eripalis *Grt.* .... July 7-21

Subfamily PYRAUSTINAE

Sameodes Snell.
5427 elealis *Wlk.* .... April 20
Evergestis Hbn.
5436 subterminalis *B. & McD.* ...... Aug. 8
5438 simulatalis *Grt.* .... Aug. 9-20
Nomophila Hbn.
5455 noctuella *D. & S.* .... May 5
Loxostege Hbn.
5462 chortalis *Grt.* ...... May 10, June 14
5478 sticticalis *Linn* ...... May 31, Aug. 26
Perispasta Zell.
5545 caeculalis *Zell.* .... June 10-24
Phlyctaenia Hbn.
5553 itysalis *Wlk.* .... Aug. 12, Sept. 18
5564 tertialis *Gn.* .... June 6, July 10
Pyrausta Schrank
5598 fumalis *Gn.* .... July 23, Aug. 21
5602 fumoferalis *Hlst.* ...... May 21, June 3
5607 unifascialis *Pack.* .... June 18-26
5609 fodinalis *Led.* .... June 2, July 7
5621 borealis *Pack.* ...... May 23, June 13
5622 subsequalis *Gn.* .... May 5, June 27
5625 ochosalis *Dyar* .... June 5
5633 signatalis *Wlk.* .... June 17-24
5647 funebris *Strom.* ...... May 31, June 19

Subfamily SCOPARIINAE

Scoparia Haw.
5728 tricoloralis *Dyar* .... July 21
5730 rectilinea *Zell* .... July 29, Aug. 10
5747 basalis *Wlk.* .... June 26, July 29

Subfamily PYRALINAE

Pyralis Linn.
5758 farinalis *Linn.* ....June 6, July 31

Subfamily CRAMBINAE

Crambus Fabr.
5857 pascuellus *Linn.* ....June 14, July 5
5861 leachellus *Zinck* ....Aug. 10-28
5863 praefectellus *Zinck.* .....May 7, June 5
5864 carpenterellus ? *Pack.* ....Aug. 21
5878 myellus *Hbn.* ....July 22, Aug. 16
5883 hortuellus *Hbn.* ....Aug. 18-23
5887 innotatellus *Wlk.* ....June 27, Aug. 10
5892 vulgivagellus *Clem.* ....Aug. 9-24
5893 plumbifimbriellus *Dyar* June 28, Aug. 2
5911 murellus *Dyar* ......May 23, June 20
5915 nevadellus *Kft.* ......May 11, Sept. 21
5919 trisectus *Wlk.* ....July 8, Aug. 14

Thaumatopsis Morr.
5942 repandus ? *Grt.* ....Aug. 22
—— 1 *undetermined sp.* ....Sept. 8

Subfamily EPIPASCHIINAE

Tetralopha Zell.
6042 aplastella *Hlst.* ....July 7, Aug. 16
—— 1 *undetermined sp.* ....July 7, Aug. 16

Subfamily PHYCITINAE

—— 1 *undetermined sp.* ....June 11-18

Myelois Hbn.
6063 obnupsella *Hlst.* ....May 24

Acrobasis Zell.
—— 1 *undetermined sp.* ....July 28

Dioryctria Zell.
6129 *near* abietella *D. & S.* ....July 30
6130 ponderosae ? *Dyar* ....Aug. 9
6131 rendiculella *Grt.* ....Aug. 10

Ambesa Grt.
6156 laetella *Grt.* ....June 17, July 21

Nephopteryx Hbn.
6163 ovalis *Pack.* ....June 28, July 21
6167 fasciolalis *Hlst.* ....Aug. 3

Meroptera Grt.
6185 nebulella *Riley* ....June 26

Laodamia Rag.
6227 fusca *Haw* ....May 24, July 25

Pyla Grt.
6235 scintillans *Grt.* ....June 17-26

Epischnia Hbn.
6254 albocostalialis *Hlst.* ..May 23, June 17

Zophodia Hbn.
6303 grossulariae *Riley* ...April 11, May 16

Euzophera Zell.
6318 ochifrontella *Zell.* ....July 24

Vitula Rag.
6324 serratilineella*Rag.* ..April 13, Sept. 30

Valdivia Rag.
—— 1 *undetermined sp.* ....May 23

Homoeosoma Curt.
6370 mucidellum ? *Rag.* ....June 23

Ephestiodes Rag.
6379 gilvescentella *Rag.* ....June 1, July 15
6380 *near* infimella *Rag.* ....July 15

Ephestia Gn.
6399 kuehniella *Zell.* ....Sept. 9
—— 1 *undetermined sp.* ....June 22

Family PTEROPHORIDAE

Pterophorus Geoff.
6471 delawaricus *Zell.* ....July 3-24

Platyptilia Hbn.
6473 fuscicornis *Zell.* ....Aug. 13
6474 tesseradactyla *Linn.* ....June 1-20
6476 pallidactyla *Haw.* ....June 1-18
6477 carduidactyla *Riley* .. May 18, Sept. 22
6482 albertae *B. & L.* ......July 31, Aug. 14
6484 punctidactyla *Haw.* .March 30, July 24
6490 edwardsii *Fish* ......June 2, Aug. 14
6491 albiciliata *Wlshm.* ....Aug. 14
6495 orthocarpi *Wlshm.* ....June 15, Aug. 4
6496 fragilis *Wlshm.* ....Aug. 14
6498 *near* maea *B. & L.* ....May 22

Oidaematophorus Wallen.
6523 occidentalis*Wlshm.* ....July 10, Aug. 2
6561 homodactylus *Wlk.* ..June 26, July 18
6563 stramineus *Wlshm.* ....July 5
6578 corvus *B. & L.* ....May 5-26
6588 monodactylus *Linn.* ....Oct. 20

Family ALUCITIDAE

Alucita Linn.
6591 huebneri *Wallen.* ....March 3

Superfamily TORTRICOIDEA
Family OLETHREUTIDAE
Subfamily OLETHREUTINAE

Badebecia Heinr.
6654 urticana *Hbn.* ....June 3, July 20

Exartema Clem.
6678 quadrifidum *Zell.* ....June 6
—— 1 *undetermined sp.* ....June 29

Olethreutes Hbn.
6716 albiciliana *Fern.* ....June 18
6719 galaxana *Kft.* ....June 18-23
6721 astrologana coronana *Kft.* .....May 5, June 18
6723 puncticostana major *Wlshm.* ..June 7
6728 cespitana *Hbn.* ....May 5, Aug. 6
6731 glaciana *Moesch.* ....June 18, July 12
6742 buckellana *McD.* ....June 11-23

Subfamily EUCOSMINAE

Thiodia Hbn.
6773 awemeana *Kft.* ....May 8
6778 formosana *Clem.* ....May 27
6810 rupestrana *McD.* .....May 12, June 20
6829 striatana *Clem.* ....May 22-29
6841 infimbriana *Dyar* ....July 31

Eucosma Hbn.
6870 ridingsana *Rob.* ....Aug. 1
6894 pergandeana *Fern.* ...May 23, June 12
6918 subflavana *Wlshm.* ....June 20
6972 dorsisignatana *Clem.* .Aug. 27, Sept. 11
6974 juncticiliana *Wlshm.* ....June 26
7004 cataclystiana*Wlk.* ....June 10-28

Epiblema Hbn.
7042 illotana *Wlshm.* .... June 9-22
7043 culminana *Wlshm.* ....July 21
7047 abbreviatana *Wlshm.* ..May 15, June 20

Gypsonoma Meyr.
7058 fasciolana *Clem.* ....May 20, June 13

Pseudexentera Heinr.
7078 improbana oregonana *Wlshm.* March 7, April 28

Rhopobota Led.
7105 naevana *Hbn.* ......June 25, July 13

Epinotia Hbn.
7109 solandriana *Linn.* ....Aug. 6-10
7115 johnsonana *Kft.* ....May 17
7130 solicitana *Wlk.* ....May 22
7132 nisella *Clerck* ....June 20, Aug. 13
7135 transmissana *Wlk.* ....July 20-26
7148 emarginana *Wlshm.* ....June 20
7149 crenana *forms* ....Oct. 23, Feb. 14
7165 medioplagata *Wlshm.* ....June 20
7167 cruciana *Linn.* ....June 22
7170 seorsa *Heinr.* ....Sept. 14, Oct. 26

Anchylopera Steph.
7175 nubeculana *Clem.* ....June 20
7178 discigerana *Wlk.* .....May 13, July 16
7184 burgessiana *Zell.* ....Aug. 17

Ancylis Hbn.
7193 comptana *Froh.* ....May 19
7201 unguicella *Linn.* ....May 3-15
7203 mediofasciana *Clem.*..April 18, May 28

Hystricophora Wlshm.
7209 stygiana *Dyar* ....July 31, Aug. 5

Subfamily LASPEYRESIINAE

—— 1 *undetermined sp.* ....June 29

Dichrorampha Gn.
7219 kana *Busck* ....Aug. 1-4
7221 britana *Busck* ....May 29, June 17
7229 sedatana *Busck* ....May 24

Grapholitha Treit.
7245 prunivora *Walsh.* .....July 1, Aug. 11
7252 lunatana *Wlshm.* ....May 8

Laspeyresia Hbn.
7275 populana *Busck* ....July 7
72 4 prosperana *Kft.* ....May 23

Carpocapsa Treit
7301 pomonella *Linn.* ......July 15, Aug. 12

Family TORTRICIDAE

Sparganothis Hbn.
7333 irrorea *Rob.* ....June 19, July 20
7336 violaceana *Rob.* ....June 2

Platynota Clem.
7369 idaeusalis *Wlk.* ....June 22, July 11

Archips Hbn.
7378 persicana *Fitch* ......June 18, July 9
7384 cerasivorana *Fitch* ....June 22, July 7
7388 argyrospila *Wlk.* ....July 23-28
7405 rosaceana *Harris* ......June 17, July 3
7407 conflictana *Wlk.* ....July 3
7408 fumiferana *Clem.* ....July 12, Aug. 20

Tortrix Linn.
7410 pallorana *Rob.* ....July 1-20
7415 alleniana *Fern.* ......June 15, July 12
7417 lomonana *Kft.* ....Sept. 26
7420 peritana *Clem.* ....July 3, Aug. 3
7439 afflictana *Wlk.* ....May 5-30

Eulia Hbn.
7442 ministrana *Linn.* ......May 5, June 6

Cnephasia Curt.
7458 osseana *Scop.* ....Aug. 6, Sept. 2
7459 argentana *Cl.* ....June 11-13
7462 ednana *Kft.* ....July 8

Argyrotoxa Steph.
7469 albicomana *Clem.* ....July 12-30

Acleris Hub.
7473 fishiana *Fern.* ....Sept. 26
7476 maximana *B. & B.* ....Aug. 28, Oct. 28
7479 schalleriana *Linn.* ....Sept. 19
7481 varianaFern. ....Sept. 1
7485 celiana *Rob.* ....Oct. 15
7493 brittania *Kft.* ....Sept. 5
7494 fragariana *Kft.* ....Sept. 26
7495 inana *Rob.* ....May 1
7497 maculidorsana *Clem.* ....Aug. 12
7501 bowmanana *McD.* ....Oct. 19
7514 semiannula *Rob.* ....March 22, Oct. 30

Family PHALONIIDAE

Phalonia Hbn.
—— 2 *undetermined spp.* June 15, July 5
7530 deutschiana *Zett.* ....July 30
7539 angustana *Clem.* ....June 8
7555 *near* voxcana *Kft.* ....July 2
7584 albidana *Wlk.* ....June 6

Pharmacis Hbn.
7608 vitellinana *Zell.* ....May 27, June 17

Hysterosia Steph.
7615 cartwrightana *Kft.* ....June 14

Family CARPOSINIDAE

Bondia Newm.
7624 crescentella *Wlshm.* ..April 19, May 22

Family COSSIDAE

Prionoxystus Grt.
7670 robiniae *Peck* ....July 13

Superfamily GELECHIOIDEA
Family COSMOPTERYGIDAE

—— 2 *undetermined spp.* ....April 7-30

Cyphophora H.S.
7738 tricristatella *Cham.* ....Aug. 25

Walshia Clem.
7743 amorphella *Clem.* ....Aug. 13

Mompha Hbn.
7758 unifasciella ? *Cham.* ....May 15

Family GELECHIIDAE

—— 10 *undetermined spp.*

Recurvaria Haw.
—— 1 *undetermined sp.* ..April 26, July 12

Gelechia Hbn.
79.0 lugubrella *Fabr.* ....July 11
7998 *near* mandella *Busck* ..June 30, July 7
8020 mediofuscella *Clem.* ....May 19

Duvita Busck
8258 nigratomella *Clem.* ....June 11-13

Compsolechia Meyr.
8272 niveopulvella *Cham.* ....July 21

Family OECOPHORIDAE

Schiffermulleria Hbn.
8364 dimidiella *Wlshm.* ....May 14, June 30

Hofmannophila Spuler
8376 pseudospretella *Staint.* ....July 14

Depressaria Haw.
—— 1 *undetermined sp.* ....June 25

Agonopterix Hbn.
—— 1 *undetrmined sp.* .....May 5, Oct. 10
8431 rosaciliella *Busck* ....March 16-23
a echinopanicis ? *Clarke* ....Jan. 14-28
8435 klamathiana *Wlshm.* ..March 2, May 10

Semioscopis Hbn.
8460 inornata *Wlshm.* ....March 31, May 5
8461 megamicrella *Dyar* ....April 11-28

Family BLASTOBASIDAE

—— 4 *undetermined spp.*

Family ETHMIIDAE

Ethmia Hbn.
8612 monticola *Wlshm.* ....May 2-23

Eumeyrickia Busck
8390 trimaculella *Fitch* ....June 9-29

Superfamily YPONOMEUTOIDEA
Family GLYPHIPTERYGIDAE

Allononyma Busck
8645 vicarialis *Zell.* ....Aug. 14

Choreutis Hbn.
8664 balsamorrhizella *Busck* .....June 5-18

Ellabella Busck
8680 editha *Busck* ....June 8

Family AEGERIIDAE

Bembecia Hbn.
8684 marginata *Harr.* ....Aug. 4-13

Albuna Hy. Edw.
8789 pyramidalis *Wlk.* ....June 13-21

Family PLUTELLIDAE

Trachoma Wall.
8842 falciferella *Wlshm.* March 13, April 20

Harpipteryx Hbn.
8845 dentiferella *form* canariella *Wlshm.* Aug. 29

Cerostoma Latr.
—— 1 *undetermined sp.* ....March 30
8847 rubrella *Dyar* ......March 15, April 14
8853 *near* radiatella *Don.* ....Jan. 14
—— radiatella *forms* ? March 13, April 19

Plutella Schr.
8875 interrupta *Wlshm.* ....May 4
8878 maculipennis *Curt.* ....Aug. 10

Family SCYTHRIDAE

Scythris Hbn.
8964 magnatella ? *Busck* ....Aug. 12

Superfamily TINEOIDEA
Family COLEOPHORIDAE

Coleophora Hbn.
9092 coruscipennella *Clem.* ....June 3

Family GRACILLARIIDAE

Parectopa Clem.
—— 1 *undetermined sp.* ? ....April 28

Gracillaria Haw.
—— pulchella *Cham. group.* ......May 3-16

Family TINEIDAE

Tinea Linn.
9644 *near* irrepta *Braun* ....June 27

Superfamily INCURVARIOIDEA
Family INCURVARIIDAE

Lamprenia Steph.
9800 piperella *Busck* ......April 26, May 19
9803 sublustris *Braun* ....May 4-10

Chalceopla Braun
—— 1 *undtermined sp.* ....May 11, June 16

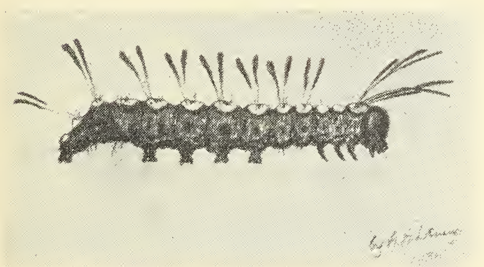
Suborder JUGATAE
Family ERIOCRANIIDAE

Mnemonica Meyr.
9853 aurosparsella *Wlshm.* ....July 25

Family HEPIALIDAE

Sthenopis Pack.
9859 purpurascens *Pack.* ....July 5, Aug. 6

Hepialus Fabr.
9868 mathewi *Hy. Edw.* ....Sept. 20



Acronicta funeralis G. and R. Mature larva from a specimen found on willow at Vernon, B.C., August, 1935, and drawn by the late Alex Dennys. Adult emerged May, 1936. From a photograph by A. A. Dennys.

REVISION OF CHECK LIST OF MACROLEPIDOPTERA OF B.C.—Any information intended to be included in this revision should be sent direct to J. R. J. LLEWELLYN JONES, "ARRANMORE," R.M.D. No. 1, COBBLE HILL, B.C., as soon as convenient. Records of localities (not previously reported), larval food plants and period of the year when imagines may be obtained, will be welcome. It is hoped to make the list as comprehensive and informative as possible. Any new records (if authentic), of species appearing in the Province will be especially welcome.

A LIST OF TWENTY SPECIES OF SPIDERS COLLECTED AT SALMON ARM, B.C.—The following species were collected at Salmon Arm, B.C., May-October 1940, by my mother, Olive R. Leech. I am indebted to Dr. W. J. Gertsch, who identified them in November, 1940, and brought the list up to date in 1946.

Pholcophora americana Banks.
Dictyna muraria Emerton.
Gnaphosa muscorum Koch.
Poecilochroa montana Emerton.
Drassodes neglectus Keyserling.
Anyphaena californica Banks.
Steatoda hespera Chamb. & Ivie.
Pityohyphantes sp.
Misumena calycina Linnaeus.
Philodromus alaskensis Keyserling.
Lycosa orophila Champ. & Gertsch.
Lycosa frondicola Emerton.
Phidippus johnsoni Peckham.
Metaphidippus aeneolus Curtis.
Paraphidippus marginatus Walckenaer.
Aranea dumetorum Villers.
Aranea solitaria Emerton.
Aranea gemmoides Chamb. & Ivie.
Aranea displicata Hentz.
Agelenopsis potteri Blackwall.

—Hugh B. Leech, Vernon, B.C.

POLLENIA RUDIS, THE CLUSTER FLY, IN VANCOUVER, B.C. (Diptera: Metopiidae).—Not until the spring of 1940, did I first find a specimen of **Pollenia rudis** (Fabr.) in Vancouver, although I had been on the lookout for it for many years. In that year one specimen was found shortly after 6 o'clock one bright morning, apparently ovipositing on or near earthworms on the lawn. Since then, several have been noted each year on the lawn between 6 and 7 o'clock in the morning, similarly engaged, on the dew-covered grass.

The species, however, has apparently been present in Vancouver for some time, since a complaint was received in 1943 from a householder on the extreme eastern boundary of the city, concerning large numbers of the flies which had come into the house and had wintered there unnoticed until spring when they crowded on the windows, seeking to escape outside. The citizen lived on a very large lot with a garden where much manure containing many earthworms, was present. The infestation was so extensive that it must have been several years in developing. In the spring of 1944 the citizen complained again of the trouble so I forwarded a 3% solution of DDT in "Varsol," a wartime cleaning fluid put out by the Imperial Oil Company, with instructions to spray it on all the woodwork of the window frames. The procedure was very successful for the woman telephoned two days later to report that a tremendous number of dead flies was on the floor below the windows, with no survivors.—G. J. Spencer, Department of Zoology, University of British Columbia, Vancouver, B.C.

REARING OF **AGROMYZA ALBITARSIS** AND ITS PARASITE **OPIUS** SP. (Diptera: Agromyzidae, and Hymenoptera: Braconidae).—On August 1, 1943, miners were noticed in the leaves of a seedling black cottonwood (**Populus trichocarpa** T. & G.) in my garden. The larvae could be seen clearly by holding a leaf up to the light. On August 11 a leaf containing two puparia was picked, and the parts containing the insects torn out and placed in a small jar on my desk. A fly emerged on August 28, and was subsequently identified by A. R. Brooks as **Agromyza albitarsis** Mg.

Mould was growing on the outside of the second puparium by September 2, so it was opened. It contained a slightly teneral but living wasp, a delicate little braconid. This specimen matured, and was identified by G. S. Walley as "**Opius** sp., probably undescribed. Runs to **amplus** Ashm. in Gahan's key." The fly and wasp are now in the Canadian National Collection.—Hugh B. Leech, Vernon, B.C.

GASOLINE FOR KILLING BEETLES.—The note by G. J. Spencer in the December, 1945, issue of our PROCEEDINGS (vol. 42, p. 16) on the use of gasoline in insect killing bottles is interesting. I recall that in World War I, during my term of service in the Imperial Camel Corps in Egypt, I amassed a small collection of beetles. Cyanide was unobtainable so other means, fair or foul, had to be employed for killing and preserving specimens. Gasoline was plentiful in army trucks and cars and by employing stealth during the hours of darkness it was a fairly simple matter to secure enough for my purpose. After being killed in gasoline the beetles were placed in tin boxes with dry clean sand, which if packed fairly tightly prevented the specimens from rolling about in the box. Unfortunately, owing to a "misplaced" Turkish shell, a camel plus this collection was destroyed. I have used dry sawdust for the storage of beetles and it is satisfactory for any but small species.—E. P. Venables, Vernon, B.C.

A FEW RECORDS OF SPIDERS FROM BRITISH COLUMBIA AND ALBERTA.—I am indebted to Dr. W. J. Gertsch of the American Museum of Natural History for identifying the following species of spiders, which were sent to him from time to time.

Amaurobius severus Simon. Steelhead, B.C., summer of 1933, in log cabin (Hugh B. Leech); common.

Antrodiaetus sp., probably **pacificus** Simon. Oliver, B.C., May 1, 1940 (A. A. Dennys).

Hyptiotes gertschi Chamb. & Ivie. An egg sac spun on a conifer needle; Brennan Creek, Adams Lake, B.C., 1942 (P. T. Muskett).

Bathyphantes pallida Banks. Vernon, B.C., March 24, 1940 (Frances O. Leech).

Tetragnatha munda Chamberlin and Gertsch. Hope, B.C., May 30, 1940. (Hugh B. Leech).

Tetragnatha laboriosa Hentz. Hope, B.C., May 30, 1940 (Hugh B. Leech).

Misumena calycina Linnaeus. Penticton, B.C., April 19, 1940 (A. A. Dennys).

Xysticus pulverulentus Gertsch. Jasper, Alta., June 14, 1940 (E. H. Brasnett).

Coriarachne utahensis Gertsch. Kelowna, B.C., April 1940.

Neoantistea agilis Keyserling. Manson River, B.C., August, 1940 (Ray Gaul).

Arctosa emertoni Gertsch. Under stones edge of alkali Buse Lake, east of Kamloops, B.C., September 11, 1945 (Hugh B. Leech).

Phidippus tyrrelli Peckham, Fernie, B.C., August, 1939 (E. A. Quail).

Paraphidippus marginatus Walckenaer. Hope, B.C. May 30,1940 (Hugh B. Leech); Seebe, Alta., June 17, 1940 (J. McLenahan).

Metaphidippus aeneolus Curtis. Kelowna, B.C., April, 1940.

—Hugh B. Leech, Vernon, B.C.

LIST OF SOME PHILONTHUS FROM BRITISH CLUMBIA (Coleoptera: Staphylinidae) [1]

Hugh B. Leech
Vernon, B.C.

In 1937 and 1938 I sent a number of specimens of *Philonthus* to the Rev. C. E. Tottenham of the Royal Entomological Society of London. He identified and returned most of the material, which included the following species (the order is alphabetical). Specimens were collected by me, unless otherwise stated; all localities are in British Columbia.

(1) *Philonthus aurulentus* Horn (?) Nicola, 10. IV. 35 (lakeshore, under log).

(2) *Philonthus cephalotes* Grav. Salmon Arm, 4. V. 30.

(3) *Philonthus concinnus* Grav. Fernie, 26. VIII. 34 (faeces of horse), Salmon Arm, May 1934 (D. H. and O. Leech, Coll.).

(4) *Philonthus cruentatus* Gmel. Salmon Arm, 9. VI. 29; 10. V. 30; 30. IV. 31; 24. IV. 32 (under faeces of cow). Vancouver, 20. IV. 31 (human faeces). Vernon, 1.XII. 35 (under stones).

5) *Philonthus debilis* Grav. Salmon Arm, April 1935 (D. H. Leech, Coll.). Vancouver, 5. IV. 33 (under stone).

(6) *Philonthus ferreipennis* Horn? Vernon, 1. XII. 34 (lakeshore, under log).

(7) *Philonthus flavibasis* Casey. Vancouver, 20. IV. 31.

(8) *Philonthus furvus* Nordm. Fernie, 28. VIII. 34 (faeces of cow). Salmon Arm, May 1929.

(9) *Philonthus fuscipennis* Mannh. *(P. politus* Horn). Agassiz, 7. III. 31. Langley Prairie, 1931 (K. Graham, Coll.). Salmon Arm, 27. VII. 34 (O. R. Leech, Coll.). Vancouver, 14. VII. 32., 28. VI. 33. Vernon, 20. VI. 38 (D. Waddell, Coll.). Victoria, 10. VI. 31 (E. E. Peden, Coll.).

(10) *Philonthus grandicollis* Horn. Enderby, 15. IX. 34. Salmon Arm, 3. V. 35. Vernon, 15. VIII. 37.

(11) *Philonthus instabilis* Horn. Haney, 22. III. 30. Nicola, 10. IV. 35 (lakeshore, under log). Loon Lake, between Salmon Arm and Enderby, 27. X. 34. Vernon, 20. X. 34 (edge of stream) 5. X. 35 (lakeshore, under log).

(12) *Philonthus lecontei* Horn. Shuswap, 1. X. 33 (shore of small alkali pond). Vernon, 30. X. 31 (lakeshore, under log); 1. XII. 35.

(13) *Philonthus lomatus* Er. (?). Vernon, 7. VIII. 29 (immature).

(14) *Philonthus occidentalis* Horn. Vernon, 30. X. 31 (under log); 13. X. 33 (under log, shore of alkali lake); 28. VII. 38 (Deep Lake, shore).

(15) *Philonthus politus* L. *(aeneus* Rossi, of Horn). Vancouver, 23-25. III. 31. Salmon Arm, 8. IV. 34 (faeces of cow).

(16) *Philonthus protervus* Casey (?) Salmon Arm, 31. III. 32 (lakeshore, in earthen cell under log).

(17) *Philonthus puberulus* Horn. Salmon Arm, 5-6. X. 33 (gravel banks of Shuswap River).

(18) *Philonthus rectangularis* Sharp. Fernie, 3. VIII. 34. Salmon Arm, 8. XI.33 (faeces of cow); 20. IV. 35 (under dead pheasant). Vancouver, 18. III., 20. IV., 10. X. 31.

(19) *Philonthus siegwaldi* Mannh. Steelhead, 19. VII. 33 (in rotting rhubarb). Vancouver, 11. VI. 31 (Stanley Park). Trinity Valley, near Lumby, 29. VI. 37 (in human faeces).

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[1] Contribution No. 2371, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

(20) *Philonthus sordidus* Grav. Kamloops, 3. II. 35 (on vegetables in cellar of house). Salmon Arm, 30. VI. 31; 1. IV. 32 (flying); 11. V. 33; 8. XI. 33 (faeces of cow). Vancouver, 4. IV. 31; 31. V. 31 (on snow, elev. 4,700 ft., Seymour Mtn.); 6. IV. 32 (in rotting cabbage). Vernon, 6. VI. 37 (in rotting vegetables in cellar).

(21) *Philonthus umbratilis* Grav. Salmon Arm, 21. III. 34 (barnyard, under board).

(22) *Philonthus varians* Payk. Vancouver, 20. IV. 31 (in human faeces).

(23) *Philonthus varius* Grav. Seymour Creek, N. Vancouver, B.C., 12. V. 31.

FURTHER RECORDS OF HETEROCERA OF THE NELSON-ROBSON-TRAIL DISTRICT OF BRITISH COLUMBIA (Insecta: Lepidoptera) [1]

HAROLD R. FOXLEE [2]
Robson, B.C.

AMATIDAE

872 *Scepsis packardii cocklei* Dyar
Robson 12.VII.45

PHALAENIDAE

1221 *Merolonche ursina* Sm.
Brilliant .... No date

1709 *Polia detracta neoterica* Sm.
Brilliant 22.V.44

1984 *Leucania farcta roseola* Sm.
Brilliant 7.VII.44

2641 *Neperigea albimacula* B. & Mc. D.
Brilliant 21.VII.44

2647 *Elaphria festivoides* Gn.
Robson 8.VI.45

3763 *Epizeuxis jacchusalis bryanti* Barnes. Brilliant 6.VII.44

GEOMETRIDAE

4147 *Scopula ancellata* Hlst.
Robson 20.VII.45

4225 *Cladara atroliturata* Wlk.
Robson 19.V.42

4515 *Xanthorhoe defensaria conciliaria* Swett. Robson 19.IX.45

4573 *Eulype hastata gothicata* Gn.
Robson 22.VII.45

LIMACODIDAE

5279 *Tortricidia testacea* Pack.
Brilliant 9.VI.44

5647 *Pyrausta funebris* Strom.
Robson 23.V.45

6178 *Tlascala* sp. near *umbripennis* Hlst. Robson 29.V.45

[1] The original list was published in this journal. See Vol. 42, p. 9-14, 1945.

[2] I wish to extend my grateful thanks to Dr. McDunnough of the Division of Entomology Ottawa for determinations.

ADDITIONAL RECORDS OF TABANIDAE FROM ROBSON, B.C. (Diptera).—The following species were collected by me at Robson, B.C. I am indebted to Dr. L. L. Pechuman of Lockport, N.Y., for the identifications.

Tabanus aeneus O.S. 18.IX.43
Tabanus sequax Will. 24.VII.45
at elev. of 4,000 feet
Tabanus rhombicus O.S. .... July
Tabanus melanorhinus Bigot .... July
Tabanus sonomensis O.S. .... July
Tabanus sp. near **haemaphorus**
Apatolestes sp. nov.?

—Harold R. Foxlee, Robson, B.C.

HABITAT OF AGABUS BJORKMANAE (Coleoptera: Dytiscidae).—On August 26, 1945, I was collecting aquatics in the Goat River, Creston, B.C., when I took my first **Agabus bjorkmanae** Hatch (det. H. B. Leech). I had just demolished a log jam under a steep bank, close to shore; the water rapidly cleared and I was attracted by a number of small springs boiling up the clean, fine sand. Suddenly a large **Agabus** (species then unknown to me) was tossed into view, then others, each frantically digging for cover into the sand. I removed a few stones, stirred the sand, and captured 40 specimens. Then I partly restored the jam for future visits which lasted until Nov. 4, with a take of over 100 specimens. In every instance they were submerged in the fine sand until disturbed.—G. Stace Smith, Creston, B.C.

ANOPLITIS INAEQUALIS ON EPILOBIUM (Coleoptera: Chrysomelidae).—The taking of **Anoplitis inaequalis** (Web.) at Creston is a new record for British Columbia. I picked up several in general sweeping on a large meadow, but eventually traced them to the true host: **Epilobium adenocaulon**; thereafter I took them in quantity (June 3-Aug. 7, 1945). The specimens are darker than eastern examples but are otherwise identical, and have been closely examined by C. A. Frost and H. B. Leech.—G. Stace Smith, Creston, B.C.

NATURAL CONTROL OF THE EUROPEAN PEA MOTH LASPEYRESIA NIGRICANA ON SUMAS PRAIRIE, B.C. (Lepidoptera Olethreutidae).

H. G. Fulton
Dominion Entomological Laboratory, Agassiz, B.C.

History of Area Involved. The area now known as Sumas Prairie was a lake before the reclamation scheme, sponsored by the Provincial Department of Agriculture, was completed in the year 1924. This area, approximately ten miles long and four miles wide was at one time covered with water for the greater portion of the year.

When dyking, draining and land clearing operations were completed and agriculture took over, it was soon learned that clover and peas were among the crops which could be grown most successfully on the sandy clay soil of the old lake bed.

Introduction of the Pea Moth. It became the common practice to use peas as a nurse crop, seeded down with clover, or quite often peas were grown two and three years in succession on the same field. Soon large areas were devoted to pea growing. This procedure proved very suitable for the multiplication of the pea moth, *Laspeyresia nigricana* Stephens, which was apparently present in a nearby pea growing district south of the International Boundary.

By 1933, when 3,000 acres or more were devoted to pea growing in the Sumas area, infestation by the pea moth had become very heavy and severe losses were suffered by the growers.

In 1934, officers of the Agassiz Laboratory began a study of the conditions. According to literature *Laspeyresia nigricana* was accidentally introduced into Canada from Europe sometime before 1893, and became established without any of its natural enemies. Since then it has spread to most of the pea growing areas on this continent. Under conditions similar to those found on Sumas Prairie the pest soon becomes epidemic. By experiments a rotation control was demonstrated to be effective and practical, but this was not adopted by the growers.

Parasite Introduction. Since this pest had several natural enemies in England, a study of the situation there was suggested by the Dominion Parasite Laboratory at Belleville, Ontario. Ewen Cameron of the Imperial Parasite Service made a study of the situation in England during the years 1936-37 and reported that *Ascogaster quadridentatus* Wesm., an egg parasite, was found in as high as 48 per cent of the pea moth larvae and *Glypta haesitator* Grav. and a species of *Angitia*, larval parasites, were attacking as high as 24 per cent. Parasite material was collected in England and sent to Canada from 1936 to 1939, when the outbreak of war caused this work to stop.

Before any imported European material was available the Belleville Laboratory propagated and made three shipments of the parasites, *Ascogaster carpocapsae* Vier. and *Macrocentrus ancylivorus* Roh., which had been reared successfully on the oriental fruit moth, *Laspeyresia molesta* Busck., a close relative of the pea moth. Total liberation of all parasites is shown in Table I.

Method of Transport. Until 1938 parasites were shipped in refrigerated cages by railway express requiring four days to make the trip from Belleville to Agassiz. Only one shipment was received in which undue mortality had occurred by this method. Time, however, became an important factor, especially with shipments of egg parasite *A. quadridentatus*, as some were received too late to be liberated during the maximum egg laying period of the pea moth, which occurs about the end of June. By using non-refrigerated cages and air express, parasites could be picked up in Vancouver twelve hours after leaving the east, and delivery from Vancouver to Agassiz required an additional twenty hours. This method was used for all shipments made in 1939 without undue mor-

1 Contribution No. 2438, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Ont.

TABLE I
Liberations of Parasites Made in the Chilliwack and Sumas Areas

Liberations of the North American Species

Year	*A. carpocapsae*	*M. ancylivorus*	Liberation Point
1936	1266	1229	Chilliwack and Sumas
1937	50	....	Sumas
Total	1316	1229	

Liberations of Imported European Species

Year	*Ascogaster quadridentatus*	*Glypta haesitator*	*Angitia sp.*	Liberation Point
1937	34	...	14	Sumas
1938	880	735	5	Sumas and Chilliwack
1939	2367	23	44	Chilliwack
1939	2010	662	..	Sumas
1939	....	124	..	Nicomen Island
Total	5291	1544	63	

tality occurring. In eight shipments mortality varied from 5 to 65 per cent with an average of only 12 per cent. The following table shows the mortality by species.

TABLE II
Mortality of Parasites During Shipment

Species	Range in %	Average %
A. quadridentatus	5-19	10
G. haesitator	19-45	25
Angitia sp.	36-65	57

One shipment of *G. haesitator* was picked up in Vancouver thus saving 20 hours from a total of 32 hours en route. Only 13 per cent of this shipment had died at the time of liberation as compared to the average of 25 per cent in the other shipments of the same species.

Recoveries of Parasites. Large numbers of pea moth cocoons were collected each year to be used in the cultivation control experiments and some were also sent to Belleville for the purpose of parasite recovery checks. In the cultural experiments cages of cheesecloth were used; constructed over plots of soil twelve feet by three feet, artificially stocked with pea moth cocoons to test the effect of various soil cultivation practices on moth emergence. A check was also kept of the parasites that emerged.

First signs of parasitism were observed in 1938 when one speciment of *Angitia* was taken on June 25 from the experimental cages at Agassiz, in which 10,000 pea moth cocoons were being used in connection with the cultivation control experiments. A second specimen of the same genus was captured in a field on Sumas Prairie in early July. These recoveries were rather surprising as only fourteen individuals of *Angitia* had been liberated the previous year.

In 1939, six specimens of *G. haesitator* and a few doubtful specimens of *Angitia* were obtained from 8,000 cocoons used in the experiments.

In 1940, one specimen of *A. quadridentatus* was obtained from 6,000 cocoons at Agassiz; and from 10,500 cocoons sent to Belleville, 1 *A. quadridentatus,* 4 *G. haesitator* and 92 *Phanerotoma* species emerged. *Phanerotoma* is apparently a native hymenopteron which occasionally attacks the pea moth. The record of *A. quadridentatus* and *G. haesitator* was most encouraging as these species are largely responsible for the control of the pea moth in England.

In 1941, 6,000 cocoons at Agassiz, yielded 1 *Glypta haesitator* and 4 *Phanerotoma,* and from 3,360 cocoons sent to Belleville, 1 *G. haesitator* and 5 *Phanerotoma* were obtained.

In 1942, 2,000 cocoons at Agassiz gave 1 *A. quadridentatus,* 2 *G. haesitator* and 3 *Phanerotoma;* and from 3,350 cocoons sent to Belleville, 7 *A. quadridentatus,* 3 *G. haesitator* and 25 *Phanerotoma* emerged.

In 1943 no further cage experiments were carried on at Agassiz, but 4 *A. quad-*

ridentatus and 6 *G. haesitator* emerged from 706 cocoons sent to Belleville.

In 1944, 3,000 cocoons were sent to Belleville and these showed approximately 7 per cent parasitism, an appreciable increase.

During the summer months of 1944, specimens of *Ascogaster* and *Glypta* were occasionally caught in the net when sweeping pea fields and roadside patches of vetch. In the fall 3,800 pea moth cocoons were sent to Belleville and it was reported that 6 per cent of these were parasitized by *A. quadridentatus* and 3 per cent by *G. haesitator*.

In the pea flowering season of 1945 the presence of *A. quadridentatus* was quite noticeable, many specimens being captured in net sweeping in several different pea fields. A large amount of pea moth material in the form of infested pods was therefore gathered in early August, from which approximately 20,000 pea moth cocoons were obtained and shipped to Belleville in the fall. Dissection of some of this material showed 77.5 per cent and 8.3 per cent parasitism by *A. quadridentatus* and *G. haesitator*, respectively. However, as the material was all obtained, from only one field, this high percentage of parasitism might not hold for the entire Sumas Prairie area. Nevertheless the outlook is very favourable. In 1946 it is probable that one of the most destructive insect pests of peas will have been checked by its natural enemies, which were originally imported from England during the years 1937, 1938 and 1939.

We note that no recoveries were made of parasites of the oriental fruit moth, liberated in 1936 and 1937. Apparently the pea moth was not suitable as a host. It is also interesting to note that *Phanerotoma* was not recovered until after 1942.

The foregoing data in tabular form, show the gradual increase in percentage of parasitism.

TABLE III
Percentage of Parasitism of the Pea Moth on Sumas Prairie

Year	No. of Cocoons	*Ascogaster quadridentatus* No.	%	*Glypta haesitator* No.	%	*Angitia species* No.	%	*Phanerotoma species* No.	%	Total Per cent
1937	10,000	0	0	0	0	1	.01	0	0	.01
1938	8,000	0	0	6	.07	?	?	0	0	.1
1939	6,000	1	.02	?	0	0	0	0	0	.6
	10,500	1	.01	4	.04	0	0	92	.88	
1940	6,000	0	0	1	.02	0	0	4	.07	.12
	3,360	0	0	1	.03	0	0	5	.14	
1941	2,000	1	.05	2	.1	0	0	3	.15	.76
	3,350	7	.2	3	.09	0	0	25	.74	
1942	706	4	.56	6	.85	0	0	0	0	1.4
1943	3,000	0	0	0	0	0	0	0	0	7.
1944	3,800	0	6.0	0	3.0	0	0	0	0	9.
1945	20,000	0	77.5	0	8.3	0	0	0	0	85.8

SUMMARY.—1. The pea moth was introduced into the lower Fraser valley of British Columbia prior to 1933; had become a serious pest by 1934. 2. Commencing in 1936 and continuing until 1939 parasites were imported from England and liberated in the affected area. 3. A steady increase in the percentage of parasitism was observed since 1937. 4. Percentage of parasitism reached 85.5 per cent in 1945; indicating that a control of this important economic pest would be effected by two of its natural enemies.

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RESULTS OF A SEASON'S STUDY OF THE EUROPEAN EARWIG, FORFICULA AURICULARIA (Dermaptera: Forficulidae)

RICHARD GUPPY
Wellington, B.C.

INTRODUCTION—The following observations were mainly made from captive earwigs. These were confined in glass jars to allow for close study. Much use has been made, largely for purposes of comparison, of the article by Geoffrey Beall (1932. The life history and behaviour of the European earwig, *Forficula auricularia*, L. in British Columbia. Ent. Soc. Brit. Col., Proc. **29**: 28-43), and of the paper by S. E. Crumb, P. M. Eide and A. E. Bonn (1941. The European earwig U.S. Dept. Agri. Bul. No. 766).

LIFE HISTORY—A short resume of the life history of the European earwig in this district may help to clarify the following discussion.

From my observation it appears that two batches of eggs from each female is the rule rather than the exception. The first is deposited during January and February, and does not hatch until warmer weather occurs. This is usually during the latter half of April.

The parents of these early nymphs then oviposit again in early June, the eggs in this case hatching in about 20 days. Both the early and late broods reproduce at about the same time the following spring.

The nymphal stage comprising four instars lasts under normal conditions between two and three months.

BROODING BY FEMALES—No doubt the habit of earwigs which provokes the most interest and discussion is the remarkable attention paid by the females to their eggs and young. It is generally assumed that the purpose is to protect the eggs from predators. I am inclined to believe, though, that very little can be accomplished in this direction by so small and weak an insect. On the other hand, it is clear that the habit must in some way benefit the species as a whole.

Crumb (p. 39) expresses the opinion that the eggs of earwigs cannot develop if deprived of the attentions of the parent insect. Before reading Crumb's work I had myself arrived at the same conclusion. Mould invariably appears on ova which are kept alone more than 5 or 6 days. Even packing them in sterile cotton in a sterilized vial does not prevent this trouble. Apparently the mould spores are present on the eggs themselves.

In nearly all cases which I was able to observe, some moving around of the ova was done by brooding females, due probably to the conditions under which they were forced to nest. For example, an earwig which at first had placed her eggs on the surface of soil in a crowded jar, later piled them on top of a small potato supplied as food. This was doubtless a desperate attempt to make the best of a bad situation, but it indicates an instinct which may sometimes enable earwigs to preserve their offspring. They might, for instance, move the eggs deeper into the soil if conditions become too dry, or to a higher spot in case of flooding. When the eggs are exposed to view the earwig will usually dig another cell for them. This is sometimes done even in rotten wood, a task requiring several days.

The mother earwigs remain in the cell with the nymphs for most of their first stadium. Whether she carries food to them or feeds them by some other means during this period, I was unable to discover. Certainly she does not leave the cell for any extended foraging trips. Crumb (p. 39) states that both mother and young were found to have full stomachs at this time, but does not offer any suggestion as to how this food was secured.

If the nymphs be deprived of their mother directly after hatching, they can fend for themselves, at least if food is readily available. In such cases they leave their cell almost at once and scatter. If the adult be replaced, she reconstructs the cell and gathers them together again.

FURTHER REMARKS ON OVA— Very moist conditions are necessary for the survival of eggs and young nymphs. The ova soon shrivel if deprived of moisture, but as a rule they will be deserted by their parents before this occurs. Even adult earwigs require moisture frequently. If kept in a dry place and not given succulent food, they will drink freely on gaining access to water.

The nesting of earwigs in paper, as described by Beall (p. 30), was likely due to overcrowding, as suggested in the preceding section. I have noticed that very little success attends the efforts of those females which are forced to nest in cages crowded with earwigs not concerned with brooding. The eggs in these cases are usually eaten, either by the other inmates of the cage, or by their own parents. The last mentioned habit is commented on both by Crumb (p. 39) and Beall (p. 32).

EFFECT OF TEMPERATURE ON THE DEVELOPMENT OF NYMPHS—My earwigs were raised in an unheated building, in which no doubt, temperatures more closely approached those of the natural environment than do those in a laboratory. In no case which I was able to check, was the duration of an instar less than 14 days. There was a distinct inclination for those nymphs which did not transform after 14 days, to continue in the same instar for 27 days. Stadia which were prolonged beyond this point, presumably because of low temperature, might continue for a very long period. Eventually, however, difficulty was experienced in casting off the exuviae. It is doubtful whether these individuals would ever survive under natural conditions.

One nymph I raised, remained in the fourth instar for a period of about 75 days, when it finally died without having moulted again. In another case the fourth instar lasted 62 days. This insect attained the adult stage but its wings were rumpled; it did not survive the winter.

A few nymphs can easily be found even at the end of summer. Whether these are a very late, possibly a third, brood, or whether they are the result of retarded moulting, as in the examples noted, I can not say. Six nymphs were taken in the field on September 12, in the second and third instars. They were not closely watched, but their cage was examined early in the following February: three were found alive, all fully developed. These, it may be assumed, reached the adult stage soon after being imprisoned.

At Tofino, on the West Coast of Vancouver Island, I found a few earwigs in several stages of growth, late in November. The youngest of these, still in the first instar, I kept alive. It attempted to transform the next day, but could not free the exuviae from its head, and shortly died. This nymph had not been in my possession long enough to suffer from unnatural conditions, such as may have affected the others under my observation.

SECOND BROOD — Female earwigs taken during May produced, in nearly every case, a batch of ova during the first half of June. Doubtless this was in most cases their second laying. The improbability, as shown above, of any examples of *F. auricularia* passing the winter in an immature state, makes it difficult to account otherwise for oviposition taking place so late.

A few female earwigs which I kept under careful observation after finding them with their first brood, all produced a second. Beall (p. 29-30), and Crumb (p. 35) mention the occurrence of second broods, but Crumb, at least, thinks that they are produced by only a small percentage of females. Possibly a dry climate would tend to prevent oviposition later in the spring.

In one case I was able to keep watch on a particular female for several months. This insect was taken May 1 in the act of copulation. Oviposition took place on May 29, and the nymphs appeared on June 19. The adult was then placed again with a male, and mating was observed on June 29. The second batch of ova was deposited July 20, but unfortunately failed to hatch.

As will be noted, the breeding of this

individual was somewhat out of season. Her first brood presumably was produced a little earlier than the usual time for the second. This fact suggests that it may have been her second brood, but definite proof is lacking.

Certainly if a third brood is ever produced it must be only in exceptional cases. A few females that I kept after they had hatched their second did not oviposit again, although some lived for a considerable time. None died before mid-July. Deaths occurred at various times up to the end of November, and one insect survived until the following April. Males are less long lived, none of mine survived until the end of July.

Beall (p. 30) assumes that both batches of eggs are rendered fertile by copulation prior to the first oviposition. Crumb (p. 35 and 41), states that the males leave the hibernation cells in January, perhaps under compulsion from their mates. I have not been able, however, to find any evidence in support of these theories.

The males are active earlier than the females, but usually do not leave their cells for some weeks after their mates have oviposited. They can easily be found, either in the cells with females, many of which have eggs, or hiding nearby. In one case I am nearly certain copulation was taking place in a cell containing ova. Unfortunately the insects moved before I could check closely. However, no attempt was made by the female to drive out her mate. Under these circumstances I see no reason why fertilization should not take place while the females are attending their first brood.

HIBERNATION—The hibernating of earwigs in this climate could perhaps be better described as a period of comparative inactivity. They seem never to become completely dormant. Those which I kept in jars were perhaps protected from the frost a little better than those under natural conditions. Caged earwigs did not even bother to construct cells in which to hide, until early January, when they were nearly ready to oviposit. On any nights when the temperature was above 40° F., they could be seen crawling around, but they fed very little if at all.

Although the cover provided was far from ideal according to Crumb's data (p. 36), very few of my adult earwigs died during the winter. The jars mostly contained an inch or so of pure sand, well moistened. In one I used fairly fine sawdust instead, but the earwigs had difficulty in constructing cells in this medium.

Under natural conditions earwigs seem to prefer as winter quarters, cells dug under partially embedded stones. I found a great many in cells under loose bark of rotting logs, and when the wood was very soft, some distance into the log itself. The fact that all these were alive and busy with oviposition when discovered during February, goes to show that they found the latter location quite suitable. On the other hand some were found dead on January 8 under loose bark on a cedar log.

Two females kept alone since September 23, and two others since December 20, passed the winter safely, and three of them, including the two former, produced fertile ova. This observation is at variance with the findings of Crumb (p. 37) who concluded that the females seldom pass the winter alive without the company of a male. Admittedly I used very few insects in my experiment but a survival of four out of four is suggestive.

FOOD—Very wide differences of opinion exist among authorities as to what constitutes the chief food of the European earwig. No doubt food preferences vary from place to place, and even among individual colonies living in close proximity. For these reasons I expect that the list of food plants following will meet with some criticism, though I have checked with several residents in this district and all agree with my conclusions.

It was not possible for me to make use of dissection in order to study the food habits of earwigs. A good deal can be accomplished, when the insects are kept in small containers, by offering them various foods and watching to see which are most readily accepted. Also earwig damage in the field can be readily recognized. Careful examination of places near which they congregate yields much information.

It does not appear to me that European earwigs are particularly adaptable to changes of food. In fact, they appear, when caged, to have a somewhat restricted diet, and can easily be starved into cannibalism, by depriving them of the plants they require. However, most common herbaceous plants will be eaten under compulsion.

Of garden vegetables, carrots and beets are the hardest to raise in earwig infested land. Legumes, potatoes, and rhubarb come in for much attention. Wild plants related to these vegetables were readily eaten by the insects. Cabbage is less susceptible and lettuce seems never to be harmed. Although wild Cruciferae and Compositae were eaten when the earwigs were not allowed other food, I could never find evidence of damage to these weeds in the field. Colonies of earwigs living on waste land seem to feed almost entirely on the narrow leaved plantain *(Plantago lanceolata)* though they also feed to some extent on clover.

Very few native trees and shrubs are attacked with the exception of Cascara *(Rhamnus purshiana)* of which they are very fond. In cases where maple and willow leaves are eaten there is usually some evidence that circumstances forced the earwigs to take to this diet. I found first instar nymphs to be fairly adaptable, but they never seem to lose their preference for the plants previously listed.

As regards animal food, earwigs eat readily any sort of dead animal matter. They seldom, if ever, kill insects, except those that are very sluggish and do not possess a hard or leathery covering. The fact that they often refuse to kill such easy game as termites and small smooth caterpillars, indicates habits very far from predatory.

I always found earwigs ready to accept crushed insects, or insect ova. Often such offerings were eaten at once, while I still held in my hand the jar containing the earwigs. I have seen them do the same with pieces of potato, after they had been starved in an attempt to make them take unfamiliar food. But ordinarily they would never eat vegetable food before nightfall.

Injury to Gardens—Under this heading I have put together a few remarks which may prove of some help to garden owners troubled by earwigs.

Mature breeding insects do not seem to do much harm. Experiments went to show that during this stage they feed little and show an increased preference for animal food. Most of the damage is done by nymphs, and the chief sufferers are newly sprouted seedlings. Often so many of these are destroyed before they can get a start, that the results are mistaken for poor germination of seeds. Earwig damage, however, is readily recognizable, due to the fact that they first eat those seedlings nearest to the cover which they use during the day. This also gives a good clue to the place where the culprits can be found.

The nymphs travel only a very short distance from their hideout. For this reason much more trouble is experienced where cover, suitable for hibernation and oviposition, and for concealment of developing nymphs, is available to them. Rockeries could well be named "Earwig Hotels". Nothing suits the breeding adults and the first instar nymphs so well as a pile of stones and soil. Shubbery, bushes, and probably concrete walks are also used. Nymphs in the later stages and non breeding adults much prefer to be off the ground, except where the surface is very dry. At this time they are found under loose bark, in cracks in fences, and such places.

Seeds sown late in the season are very liable to suffer damage. Earwigs much prefer very young plants, and even if they are of a species not usually attacked, will turn their attention to them at a time when most other herbage has made considerable growth.

LOCAL ABUNDANCE OF THE WASPS CHLORION ATRATUM AND MEGASTIZUS UNICINTUS (Hymenoptera: Sphecidae and Bembicinae)[1]

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On August 22, 1945, a small box containing live wasps was received from Frank Choveaux of Okanagan Landing, B.C. It contained two species, one a black bembicid with an orange-red band across the abdomen, the other a blackish sphecid. These were subsequently identified by G. S. Walley as *Megastizus unicinctus* (Say) and *Chlorion (Priononyx) atratum* (LePeletier), respectively.

According to an interesting account of the habits of these species by H. E. Smith (1915. The grasshopper outbreak in New Mexico during the summer of 1913. U.S. Dept. Agric. Bul. No. 293, 12 p., 2 figs.), *C. (P.) atratum* is an important grasshopper parasite, stocking its nests with nymphs. Many of the burrows are re-opened by *M. unicinctus* females, which destroy the *Chlorions'* eggs and replace them with their own. Despite extensive outberaks of hoppers in British Columbia, there is no record of the wasps occurring here in numbers.

Mr. Choveaux reported hundreds of the wasps to be congregated on heads of grain and grasses each night, and he wondered if they might damage the seeds. That evening we visited the area concerned, a field about 3 miles from Vernon, just below the upper Landing road and west of its junction with the Commonage road. Grasshoppers were abundant; 1945 was the third successive year of an outbreak of *Melanoplus mexicanus mexicanus* (Sassure) (det. I. J. Ward). Mr. Chouveaux said that though the blue *Chlorion* was present but rare in previous years, the *Megastizus* had not been on his farm before.

A few strips of tall grasses had been left when the seed crops were cut, and on the tops of these grasses black clusters of the wasps could be seen from a distance of several hundred yards. They were in groups of from six to twenty, mostly on the seed heads, but extending for some distance down the upper stem. At 7:30 p.m. they were quiet, and easily captured. When picked up in the fingers the male *Megastizus* gave a most realistic show of stinging; the long spikes of the trident at the end of the abdomen were extruded, and the center one pressed against my skin strongly enough to be felt—and what was worse, it looked just like a sting. The simulated attack was psychologically effective and I found it hard not to drop the insect hurriedly.

The wasps were often in mixed lots, though in any one group each species showed a preference for its kind, e.g., where *M. unicinctus* were present they usually made up at least 75% of the total on that grass head. However, in all, the *Chlorion* outnumbered the *Megastizus* by nearly three to one. Of several hundred *Megastizus* examined, all were males. Only a single female was present in a random sample of 230 C. *atratum*: this despite the lateness of the season, shown by the fact that the wings of many of the *Chlorion* were faded and had ragged edges. Indeed on September 5, by which time the wasps were scarce, the proportion of the two species was still nearly three to one, and again all *Megastizus* were males and only a few *Chlorion* females were found.

I did not discover where the females of the two species spend their nights. They were not on the ground or under stones and trash; neither were they roosting on grasses or bushes within a quarter of a mile of where the males congregated. Perhaps the heavy clay in the field was unsuited for burrows, and the actual nesting site was in lighter soil some distance from the roosting grounds. A few male wasps were seen in tall weeds along the fence line and roadside bordering the field, but no other roosting ground was visible.

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[1] Contribution No. 2417, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

CURRENT TREND OF THE WESTERN HEMLOCK LOOPER (LAMBDINA F. LUGUBROSA) IN THE COASTAL FORESTS OF BRITISH COLUMBIA (Lepidoptera, Geometridae)[1]

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An outbreak of the western hemlock looper *(Lambdina fiscellaria lugubrosa Hlst.)* reached serious proportions in sections of the coastal forests of British Columbia during 1945. Only in that year was damage of this present cycle particularly noticeable and as indicated below there was little evidence of any degree of natural control. Further destruction of timber is expected during 1946.

This current outbreak represents the first appearance of the looper since the large outbreak of 1930. Although records of this insect date back to 1882 (de Gryse, 1934:523-527) it is only in recent years that specific data have been recorded on the prevalence of this insect in British Columbia. While these records are not necessarily complete, they indicate past outbreaks as follows: Stanley Park 1911-13 (Swaine, 1918); Vancouver Island 1913-14 (Jaenicke, 1929); Quatsino Sound, Vancouver Island 1925 (recounted by residents); south coastal mainland 1928-30 (Hopping, 1934: 12-13); and in the Interior, the Big Bend of the Columbia River and Nakusp region 1937-38 (unpublished records).

The last coastal outbreak subsided in 1930, but records of the occurrence of the hemlock looper have been obtained each year since 1937, the year of the inauguration of the Forest Insect Survey in British Columbia.

The present cycle first came into prominence in 1944, when the looper appeared in moderate numbers in the Lens Creek valley (upper San Juan drainage) although it was undoubtedly increasing in other areas where severe defoliation occurred in 1945.

During 1945 the major infestation occurred on the south west portion of Vancouver Island extending roughly from San Juan River north to the Alberni Inlet, an area of some 900 square miles. Throughout this region severe defoliation was irregularly distributed as is typical of looper attack. Viewed from the air in March 1946, some 140 square miles of timber appeared to be almost totally stripped of foliage. The timber concerned is some of the best of the west coast hemlock and Douglas fir. The most widespread infestation occurred in the Caycuse River valley, where extremely heavy defoliation extended from the mouth of the river on Lake Nitinat to its headwaters at McClure Lake and through to the headwaters of Walbran Creek. From the Caycuse it swept into the Nitinat valley where 400 million feet of timber are infested. North of the Nitinat an infestation as serious as that in the Caycuse valley, is centred in the Klanawa River valley, and covers some 12 square miles. Further infestations occur in the Pachena valley (moderate), lower Sarita (very severe), and at Coleman Creek (heavy). Endemic looper populations were recorded at the headwaters of the San Juan River, Lens Creek, Port San Juan, and Carmanah Creek. On the mainland further attack was reported from Clowhom Lake near Sechelt Inlet and in two areas on the Greater Vancouver watershed.

Current Looper Situation.—Present indications point to a very marked increase in looper population in 1946 on the basis of overwintering egg counts. In such examinations, four areas were considered, the Caycuse valley, Nitinat valley, Pachena and Coleman Creek. While the past history of these infestations is not definite, Pachena alone appears to be of

1 Contribution No. 2442, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

1945 origin, the others are probably two years old. Egg population data were obtained through the examination of moss samples, taken from tree trunks at 20 foot intervals from ground level to the top. Old egg shells were recorded as well as sound eggs from which a ratio was obtained between remaining egg chorions of previous years, and the overwintering eggs of the current year. While there is no suggestion that such a ratio indicates the true increase for 1946, it is of interest in a relative sense in comparing one area with another. Defoliation figures were derived by examination of 1/5 acre plots adjacent to trees analyzed for egg counts. A summary of these averages follows:

aged 82% with an egg count of 226 sound eggs per square foot of moss at 80 feet elevation. At 1400 feet mean defoliation was 10% with 0.3 eggs per square foot of moss. The lack of a direct correlation between absolute elevation and looper abundance, however, eliminates any hard and fast rule in sampling a stand for mean defoliation.

There appears, furthermore, a marked variation in population according to light intensity. Dominant trees averaged 10% higher defoliation than intermediate trees and there was consistently greater feeding and more eggs in trees near forest openings adjacent to streams and swamps.

TABLE I.—Defoliation and Eggs in Moss, Western Hemlock Looper.

AREA	Per Cent Defoliation of Hemlock	AV. EGGS PER SQ. FOOT MOSS Old Chorions	Current Eggs	Ratio Between Old & Current Eggs
Caycuse	62	12.0	96.0	1: 8.0
Nitinat	51	7.5	95.2	1:12.7
Pachena	47	5.1	55.0	1:10.8
Coleman Cr.	81	22.0	96.0	1: 4.4

These figues represent conditions only at the points sampled and defoliation percentages should not be considered as typical of the entire area. There is a suggestion of a fairly serious situation for 1946, since it is felt that these indications are in no way an exaggeration of the overall picture. Nevertheless, such calculations cannot be regarded as more than approximations without extensive and adequate sampling, considering relative elevations, forest density and light intensity.

In estimating populations, the absolute elevation may not be as important as the relative height in a valley system. Thus the floor of the upper Caycuse valley, 750 feet elevation, was as severely defoliated as that of the Nitinat at 80 feet. In higher tributary valleys this characteristic was still evident in the severe attack in the gullies of small streams. That elevations are of minor importance, however, is not suggested, since in the Nitinat where 20 sampling points were selected with 92 moss samples examined, defoliation aver-

NATURAL CONTROL.—Records obtained from the Caycuse valley, the oldest apparent infested region in 1945, showed a larval parasitism of 5% and pupal parasitism somewhat less. No egg parasites were found in 1259 eggs incubated in January 1946. Of another 2000 eggs collected in March 1946, 93% hatched and no parasites were recorded. Neither de Gryse (1934) nor Watson (1934) reported parasites of primary importance in looper outbreaks in eastern Canada. Hopping (1934) recorded 14 species of parasites on the coast of British Columbia, but a high of only some 21% parasitism of larvae and pupae combined. He did, however, obtain 25% parasitism of eggs in the Seymour Arm region. In the light of the past records and in view of the trend suggested by current winter investigations, there appears to be little likelihood of any immediate slackening in the present hemlock looper situation. The eventual termination of the current cycle through the prevalence of disease is a strong possibility, since there were minor indications of the appearance of disease in 1945. It is yet too early, however, to predict the trend of insect diseases and the future of this present outbreak of the hemlock looper.

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RESUME OF INFESTATIONS AND CONTROL OF THE COLORADO POTATO BEETLE IN BRITISH COLUMBIA, 1911-1946.

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The potato beetle *(Leptinotarsa decemlineata* (Say) *)* was first recorded in British Columbia in 1911 at Newgate on the International Boundary in the extreme south-eastern portion of the Province. It appears that this infestation originated from the adjoining State of Montana.

No systematic eradication or control measures were adopted when the pest was first observed and the area of infestation grew considerably year by year. In 1922 E.C. Hunt, District Horticulturist, Nelson, B.C., and J. W. Eastham, Provincial Plant Pathologist, made a survey of the Newgate country and recommended that help be given to the growers. The following year control measures were adopted to a limited degree.

In 1926 the Dominion Entomological Branch in co-operation with the Provincial Department of Agriculture undertook to investigate the extent of the potato beetle infestation and to work out a systematic conrol program. The district then infested consisted of two areas:

(1) The larger area extended from Newgate north to Fernie and north-west through Cranbrook to Premier Lake in the Kootenay-Columbia Valley.

(2) The smaller area extended from Rykerts, B.C. on the International Boundary north to Creston and Wynndel.

It is believed that this infestation came to the Creston district, some sixty (airline) miles west of Newgate, from the State of Idaho to the south during 1923 or 1924.

The total area infested in the two districts amounted to approximately 665 square miles in which some 880 acres of potatoes were grown.

Supervised control measures were undertaken in 1927 and a total of 32,965 pounds of calcium arsenate 1-6 dust were used during the year. The late A. A. Dennys of the Dominion Division of Entomology was placed in charge. A reduction in the intensity of the infestation was noted. During the following year a spot infestation occurred 100 miles farther afield near Golden, B.C., in the upper Columbia Valley. This area was dusted thoroughly by Mr. Dennys and up until this year (1946) there has been no recurrence of the infestation.

In spite of improved and annual control, new infestations have occurred from time to time in isolated parts of southern British Columbia. In the early 1930's a spot infestation occurred in the Nelson area. Control work was undertaken by E. C. Hunt, the infestation was completely cleaned out and there has been no recurrence. During 1936 two infestations were reported at Grand Forks, B.C., on the International Boundary, and the pest spread considerably in 1937. The late M. H. Ruhmann, Provincial Entomologist, took charge of control in this area and after five years of thorough work the pest, so far as known, was completely eradicated.

In 1944 an area of infestation was found in the South Okanagan-Similkameen district just above the State of Washington. R. P. Murray of the British Columbia Horticultural staff, Penticton, carried out early control measures and a supervisor was appointed for control work in 1945 and 1946. A definite improvement in conditions has resulted.

The latest infestation in the Province occurred during 1946 in the Kootenay area between Trail and Nelson. Good control was obtained during the year and this area will be watched closely in 1947.

A check of a map will soon indicate that all infestations have originated close to the International Boundary. The neighboring states are known to be infested. It is not considered possible that the potato beetle will ever be eradicated from British Columbia, as frequent new infestations are almost certain to occur. There is every hope that the total area infested from year to year will be held to a minimum and important potato growing areas may be free of this pest for years to come. In recent years there has been no economic loss of potatoes due to the potato beetle.

British Columbia is broken up by high mountain ranges and river valleys. These serve as ideal barriers against the spread of the beetle and break up agricultural land into isolated areas. This has made it possible definitely to eradicate the pest from some areas.

New insecticides have provided improved control throughout the years. Supervised control has been carried out at a relatively low yearly cost and undoubtedly has prevented a much larger area of the Province from becoming infested.

The overall area of infestation during 1946 was less than in 1926. During 1926 a total of 33,000 pounds of poison dust was used in the East Kootenay district alone compared with less than 10,000 pounds in 1946 for the entire Province.

It is possible to check the records of this work done by the British Columbia Department of Agriculture for the past twenty years and to realize that the farmers have been spared a large annual expense and possible crop loss. This was accomplished for less than $5,000 yearly. If infestations had been ignored and the pest had become general the estimated annual control cost to the farmers would, by this time, have been well over $100,000 annually.

CALIFORNIA TORTOISE-SHELL BUTTERFLY IN BRITISH COLUMBIA, in 1945. (LEPIDOPTERA).—The California Tortoise-shell, **Nymphalis californica** Bdv., ranges throughout the Rocky mountains from sea level in southern British Columbia to California where it is more of a mountain species.

The year 1945 has been a favourable one for this notably erratic species. It occurred in large numbers in various parts of the Province where in previous years it was scarcely noticed.

John Sowerby of Tata Creek, some twenty miles north of Cranbrook, reports that during the last thirty years he has never seen them in such large numbers. They were also observed by the writer swarming about damp places along the roadside in Manning Park, about the second week in August. In the vicinity of Victoria, Vancouver Island, they were more numerous than any other species of butterfly. From time to time during the season, similar reports have come in from other sections of the Province.

A wood-pile affords an excellent hibernaculum. Throughout the cold weather several specimens were found snugly tucked between blocks of wood. One was seen flying across a busy street in Victoria on January 5, while another was disporting about a wood-pile on the 17th.

The larvae usually feed on **Ceanothus**, but sometimes they resort to alfalfa, manzanita and other shrubs.—George A. Hardy, Provincial Museum, Victoria, B.C.

TROPIDISCHIA XANTHOSTOMA FROM TOFINO, B.C. (Orthoptera: Stenopelmatidae).—During December, 1945 I took a specimen of the cave cricket **Tropidischia xanthostoma** (Scudder) at Tofino on the West Coast of Vancouver Island. E. R. Buckell, who identified the insect, advises me that this is the first record from the West Coast of the Island, and that the specimen is immature. It was found in a subterranean wooden drain used to carry off rainwater from a house.—Richard Guppy, Wellington, B.C.

COMMERCIAL APPLICATION OF PHENOTHIAZINE FOR CODLING MOTH [1] CONTROL.

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Although phenothiazine had been used experimentally since 1934, not until 1945 was it applied on a commercial scale for codling moth control either in British Columbia or elsewhere as far as can be learned. Experimental work undertaken at Kelowna in 1937 by Ben Hoy[3], District Field Inspector of Kelowna and continued by him and the Dominion Entomological Laboratory staff[4] until 1944 produced very encouraging results.

In working with phenothiazine they found that the ordinary commercial grade used as an anthelmintic was not sufficiently toxic for codling moth control. When micronized, however, it was highly effective. In fact micronized phenothiazine proved to be about five times as effective as either lead arsenate or cryolite. They also found that if applied late in the season, either as late first brood cover sprays or second brood sprays phenothiazine interfered with normal coloration of red varieties of apples. Furthermore, if applied during hot weather it was capable of causing quite serious skin burning on the spray men. Since the material is not wetted by water it is necessary first to wet it with oil, then to disperse the oil-wetted phenothiazine in water by means of a substance such as casein-lime spreader. Because ordinary summer oil resulted in a heavy deposit that could not be removed, stove oil was used as the wetting agent.

As a result of this work the writer in 1945 undertook to test the value of micronized phenothiazine on a commercial basis at Penticton, B.C. Four orchards that were heavily infested by codling moth in 1944 received early first brood sprays of three-fourths pound micronized phenothiazine per hundred gallons wetted by one quart of stove oil which, in turn, was emulsified by approximately two ounces of casein-lime spreader. About 50 acres were involved and approximately 1,300 pounds of micronized phenothiazine used in the treatment. Each orchard received a calyx spray of either cryolite or lead arsenate, and first, second and third cover sprays of micronized phenothiazine. The fourth and fifth cover sprays were of cryolite-casein-lime and second brood applications were either of fixed nicotine or cryolite-casein-lime. With the exception of one property which was improperly sprayed the orchards showed marked improvement in codling moth control. Results are summarized herewith:

Orchard	1944 Infestation Per Cent	1945 Infestation Per Cent
No. 1	60	4.3
No. 2	50	8
No.3	No record, but only portion of crop picked, due to coddling moth infestation.	12
No. 4	28	24

Because 1945 was a year during which infestation in the Okanagan Valley as a whole showed general increase in spite of the heaviest spraying on record, these results are gratifying. It is anticipated that upwards of fifteen tons of micronized phenothiazine will be used for codling moth control in British Columbia during 1946.

1 Carpocapsa pomonella L.

2 District Field Inspector, British Columbia Department of Agriculture, Penticton, B.C.

3 Hoy, Ben, 1943. Phenothiazine as a codling moth insecticide. Ent. Soc. Brit. Columbia, Proc. 40:11-12.

4 Marshall, J., 1945. Phenothiazine in codling moth control. Scientific Agriculture 25 (9):546-550.

LOCALITY LABELS.—Excellent labels in 3½ or 4 point type, may be obtained from The Nature Company, P.O. Box 403, Covinton, La., U.S.A. Two, 3 or 4-line white labels, all the same: 45c for 500; 70c for 1,000, and 45c for each additional thousand.

PRESIDENTIAL ADDRESS

J. R. J. Llewellyn Jones, M.A., F.R.E.S.
Cobble Hill, B.C.

Again it is my privilege to welcome the members of the Entomological Society of British Columbia, this time to their 45th Annual Meeting.

It is a desirable feature to hold our meetings on occasion at varying points in the Province, and it should help to diffuse a better understanding of our Society's work and activities, many of which, in the economic sphere in particular, are of value to the agriculturist, the horticulturist, the fruitgrower and those dependent on forestry for their living. It also gives an opportunity for members who would otherwise be unable to attend through difficulties of travel and other causes, to be present when the meeting is held near their home town, or place of employment. Hence the choice of Lytton this year, being, as it is, a reasonably easy journey both from the coastal areas and the interior of the Province.

Since we last met, world events have moved very swiftly and we now find ourselves in a period of transition from a world war to an era of peace, with its visions of great opportunities and progress, but also, let us not forget, beset with its attendant difficulties and problems. As touching our Society we look forward to a period of expansion both in membership and activities.

Membership—In the name of the Society I welcome all those, whose names have been put forward for nomination, and who will shortly, in due course of procedure, be elected members.

The Society extends a cordial welcome to the men and women of the services on their return to civil life and the resumption of normal activities and invites any interested in the ways and habits of insects to become members, and so give us and the Province as a whole the benefit of their discoveries, knowledge and ability.

Our universities and colleges are full to overflowing and among these many students there are some who no doubt are interested in entomological research. We should not overlook nor ignore these potential entomologists, but make them feel welcome in our midst and give encouragement to them in their work.

Young people especially react favourably when interest is shown by those of us who are older and presumably therefore possessed of greater learning and wisdom. Sound advice and constructive criticism, given in a kindly way, are valuable in helping the inexperienced student, whereas destructive criticism merely blasts earnest endeavour. With so many returned men and women in our colleges this would seem an opportune time to offer a small prize, perhaps a book or something of that nature, to be awarded to a deserving student who shows promise of distinguished achievement in entomological research. By so doing the Society would be showing in a practical way its interest in the students of our Province.

Activities—As to the Society's activities, now that peace time conditions lie ahead, equal stress should be laid upon work of a purely scientific value as upon economic research. However it is only to be expected that the latter will seem of greater importance to many, especially the general public.

There is a wide scope in both fields. On the purely scientific side, more information would be welcome on such subjects as hybridization, the causes which contribute to colour variation in species, the reasons for gynandromorphic specimens and whether this can be produced artificially, the diseases of insects, their causes and cure, if any, and many other kindred subjects. For those interested in taxonomy the compiling and revision of check lists, lists of host plants and of the geographical distribution of species, are but a few examples of much needed work. On the economic side, further experiments in the use of insecticides, such as the powerful DDT are urgently required. Decisions will have to be made in the light of available data as to the advisability of wholesale and unrestricted use of any particular insecticide. The question to be decided is whether the advantages to be gained by an intensive application of powerful insecticide in any one area with the resultant death of all but a few species of insects may be outweighed by the destruction of many beneficial insects and the balance of nature upset.

To turn to another topic, interest is being shown in some quarters of the Province in the breeding for commercial purposes of the silk-worm *Bombyx mori* Linnaeus. Information as to the best methods of breeding the larvae would doubtless be welcome. Also in districts where its primary food plant the mulberry is scarce, information as to substitute food plants would be desirable. Currant and lettuce have been tried by some and the larvae have been known to feed on these plants and spin their cocoons. Lettuce, however, is liable to cause diarrhoea and is therefore not very satisfactory. Some of our members could perhaps furnish more information on the above lines.

There is another point which should not be overlooked, that of instructing the public. For the most part the average person is very ignorant about the ways and habits of insects. One common example will illustrate what I mean. About this time of the year, or even earlier, it is not uncommon to find references in the press to the early appearance of butterflies. The insect is frequently called "Amos," and certain deductions are made of a more or less erroneous nature. This year radio commentators have joined the press in mentioning the early appearance of butterflies, and deducing from such appearances an exceptionally early spring or specially favourable weather for some place or other. There may be an element of truth in all this, but the fact is overlooked that many species of butterflies such as Commas, Tortoise-shells, the Mourning Cloaks and possibly in suitable districts Red Admirals, hibernate during the winter months in such places as barns, outhouses, basements, wood piles and thick brush. Consequently on a mild and sunny day in winter or early spring they may frequently be seen taking an airing as if enjoying a brief spell of exercise in the sun's genial rays. There is no particular significance in this. It is quite a normal habit. On the other hand a report of the appearance of a non-hibernating species such as an Orange Tip, a Blue, or Cabbage White at a very early date would be of note and worthy of press or radio comment. Members of our Society could help to correct such misconceptions as the one now under review by giving accurate and interesting information from time to time about our insects, either by articles in the press, through information supplied to the schools, or in many other ways. Erroneous ideas should whenever possible be dispelled by someone competent to do so. One thing we should remember when addressing the public is to use language which they understand so that they will benefit by the information offered and we on our part will not be misunderstood and perhaps ridiculed. It is abundantly clear then that there is a wide choice of activity open to our members in the years that lie ahead.

Finances.—The finances of the Society show a distinct improvement. They show a credit balance of about $85.00. This is very largely due to the successful advertising campaign conducted by Messrs. Ivor Ward and Ralph Cudmore and the thanks of the Society are due to them for their efforts. The fears of those who thought that the general appearance of the PROCEEDINGS would be spoiled by the presence of advertisements seem quite unjustified.

It will be noted that the amount borrowed from the Reserve Endowment Fund has been recovered, but to replace this immediately would leave only a few dollars in the general account with which to carry on. It would be unwise to take any action which would leave the Secretary-Treasurer with no adequate funds with which to start the financial year. A similar result next year and the year following should show a satisfactory credit balance after all indebtedness to the Reserve Fund has been paid up. This fund is now a separate account into which all moneys earmarked for it will be paid in future.

Now a word as to the ultimate use of the Reserve Fund. It is desirable and necessary that this fund should be augmented so that the Society may have adequate and independent reserves with which to enlarge and improve the PROCEEDINGS and possibly to publish a quarterly journal and to restore the privilege granted by many contemporaries of 25 free copies of reprints. To be independent of any outside assistance for our publications is a very worth-while objective, and one which will give complete freedom to our editorial committee in its choice of material for publication. At the present time it is under obligation to give preference to economic papers.

However we ought not to stop at the mere provision of funds for our publications. As a learned Society we should do something to justify that claim. For example we should offer prizes and scholarships. It would be much to our credit, and probably to our advantage, if we were to start some such action in the immediate future. A small prize could be offered now and a larger one later on till we could see our way clear to provide a scholarship. Such a step seems eminently desirable. So again I commend this fund to your notice, sympathetic consideration and generous support and remind you of my previous remarks on this subject (Presidential Address, in 1944 PROCEEDINGS, 41:2).

LIBRARY.—A learned society should be in possession of a good library, and we are fortunate in having a very good nucleus upon which to build one. Unfortunately, however, little use is made of it at the present time chiefly because the books are scattered, some at the Parliament Buildings in Victoria and some at the office of the Dominion Plant Inspection Department in the Federal Building at Vancouver, and also because there is no adequate catalogue. The time appears to be ripe for some action which will make the library accessible and of real use to the members.

Probably a library committee should be appointed to go into the ways and means of bringing this about. The books should be collected in to some central place where they would be available to the greatest number of our members and should be of easy access; also a suitable catalogue should be compiled. It would be unwise, however, to authorize any action which would allow our library to become the property of some other institution as a price for getting it catalogued. Such action, if taken, would probably be regretted later. This question of cataloguing has been discussed before, and various methods have been described to us and we have been urged to choose one or other method. Do we need an elaborate form of catalogue? Ours is not a public library and our membership is not large. A simple and inexpensive catalogue would seem to be all that is necessary to supply the needs of the members. With these matters attended to, members might be encouraged to donate books to the library, or to direct in their wills that their libraries of entomological books become the Society's property. Books might also be purchased with a grant from the Society's funds from time to time to complete sets of such journals as the "Canadian Entomologist" and to obtain other desirable books.

ENTOMOLOGICAL SOCIETY OF CANADA.—A proposition emanating from the Entomological Society of Ontario. It suggests formation of an Entomological Society of Canada to speak and act in the name of Canadian entomologists as a whole. You have received copies of the proposals and I trust that you have given them careful consideration. Theoretically, the idea is eminently sound and is in many respects desirable, and is in keeping with the growing importance and prestige of the Dominion. But theories do not always work when put into actual practice, and it is therefore my duty to warn members not to make any hasty or unwise decisions upon this important matter. Under the scheme, our Society remains a branch of the new society, and it is assumed that all or at least the majority of our members will wish to join the new organization. It is very doubtful if this assumption is justified. It is a matter for speculation as to whether the society will ever be anything more than one on paper. We are told that the existing societies and new ones, which it is hoped to form, will in fact constitute the new society. This is no doubt theoretically correct.

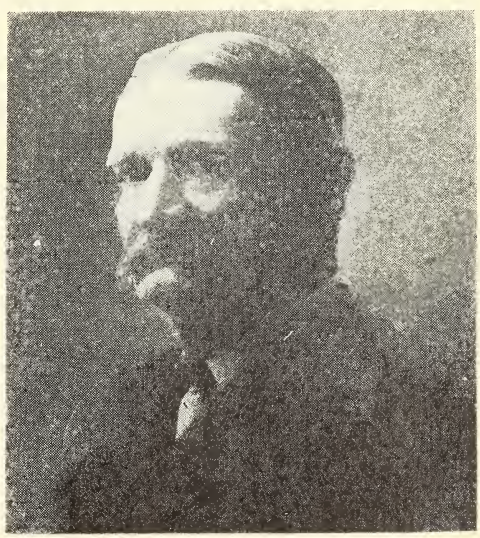
It is also questionable as to whether a truly representative number of members from each Province and district of Canada could attend the new society's meetings. This very difficulty has arisen on a smaller scale, with regard to our own society. At the Coast meetings there is usually a preponderance of Coast members present, and at meetings held in the interior of the Province the reverse prevails. There is therefore grave doubt as to whether we are justified in expecting anything very different in the case of a Dominion-wide society. Then there is the question of the status of our PROCEEDINGS under the new proposals. The proposals seem somewhat nebulous and in need of clarification. The matter calls for our careful and serious thought. However, we should take a broad-minded attitude towards the proposition and weigh the pros and cons very carefully and after having done this express our views clearly and unequivocably.

In Memoriam

WILLIAM ARTHUR DASHWOOD-JONES, 1858-1928

My father, the late William Arthur Dashwood-Jones, pioneer, and amateur entomologist and horticulturist, was born on March 25, 1858, at Kinson, Dorset, England, the only son of Captain W. A. Dashwood-Jones, Royal Artillery, and Mrs. Dashwood-Jones. He spent his childhood under the guardianship of his uncle at Upton House, Poole, Dorset. He was educated by private tutors and later went to Wimbourne Grammar school, and was in London at the University College school preparing for Cambridge, when, on the loss of his income, he decided to go to British Columbia. He left England in March, 1876, and arrived at Portland, Maine, where he took train for San Francisco, and came up the coast by boat to Victoria, landing there on April 26. He made his home at Nanaimo with his uncle, the late Archdeacon Mason, Rector of St. Paul's, later Rector of Christ Church Cathedral, Victoria and first Archdeacon of Vancouver.

Father spent some time in Nanaimo and Victoria, and ranched on Lasqueti Island and at Duncan. In 1878 he went to take charge of the Inverness cannery winter quarters on the Skeena River where he spent one winter alone but for one other white man. Leaving there he went to Yale before construction of the Canadian Pacific Railway, then returned to Victoria. He went then to Drynock, where he was attached the Resident Engineer's staff on construction of the railway. The camp had the honour of entertaining the Marquis of Lorne, Governor General of Canada, who came that far on his way to British Columbia. Father later went on to Spences



Bridge with the engineers and was with them till construction was ended. Under Onderdonk the contractor he became the first express messenger on the division which terminated at Port Moody. He stayed with this work till the Canadian Pacific Railway took over the road, and was their first express messenger on the run from Calgary to Port Moody, the end of the line.

He left the railroad in 1888 and came to New Westminster where he engaged in business, in the course of which he shipped the first salmon out of British Columbia over the Rockies. He left the business world to enter the Provincial Government service in 1894, joining the staff of the Land Registry Office and later becoming Deputy Assessor and Collector. After twenty years' service, he was superannuated in the early twenties.

During all those years he took a keen interest in horticulture and entomology. He organized the first Chrysanthemum Show in New Westminster about 1900. He was a director of the Royal Agriculture Society, and it was by his efforts the floral department became outstanding. As a boy he had been keenly interested in the out-doors and his hobbies then were birds' nesting and the collecting of wild flowers, butterflies and moths. At New Westminster he spent all his leisure hours in his garden or in pursuit of his entomological interests. He spoke the Chinook jargon fluently and often acted as interpreter in court.

The years of his retirement were spent in the enjoyment of his many interests. His garden brought visitors from all parts of the country. His big collection of butterflies, moths, etc., being too large to keep at home was kept at the Court House and it all went up in flames in the New Westminster fire. He never made such a large collection again and in later years gave most of the latter collection away to different schools and to the Westminster Club. I treasured four cases, but even with moth balls, I found it impossible to keep out pests, and they went the way of all things.

I think he was the most active in entomology during the first four years of the century. He was a charter member of the Entomological Society of British Columbia, and carried on a world-wide correspondence. Many collectors came out to New Westminster to see him, perhaps the most noted being Dr. Barnes of New York and Decatur, Ill., and the Hon. Charles Rothschild of London, England, the owner together with his brother the Hon. Walter Rothschild, of Tring Museum. To this museum which he had often visited as a boy, father sent many specimens. I have in my possession two volumes (author's copies) of "A Revision of the Lepidopterous Family Sphingidae" by the Hon. Walter Rothschild and Karl Jordan, sent to him by the authors. On page 614 of the larger volume of this work he is mentioned as having sent to the Tring Museum specimens of *Lepisesia ulalume* of which they wrote "a rare insect, of which we have not seen many specimens." These insects were caught on the blossoms of apples and white lilacs in my father's garden at 627 6th Avenue, New Westminster. When one considers the number of individuals and species of Sphingidae contained in the Tring Museum, at that time nearly 16,000 specimens belonging to some 660 species, *ulalume* was quite a catch and deserved the special mention it got.

Collectors wrote from all over the world for specimens. He sent many to the United States, and also to England and Eastern Canada. I might add that the only places in British Columbia where *ulalume* was reported by Tring Museum as being taken were Enderby, New Westminster and North Vancouver.

He died on October 8, 1928, from shock, three weeks after his elder son Laurence, a barrister at Vancouver, was killed by an automobile. The family home is still occupied by his youngest daughter, Mrs. E. G. Pearson at 627 6th Avenue, New Westminster, where the family has resided to date 52 years.

There were five children: Laurence, Victor (627 6th Ave., New Westminster), Edith (Mrs. M. M. Shore, Abbotsford, B.C.), Grace (Mrs. S. M. Green, 721

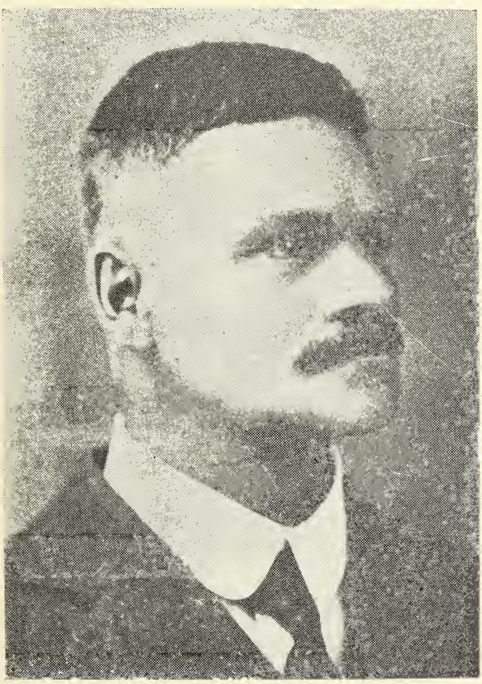
6th Ave., New Westminster), and Kathleen (Mrs. Pearson). Each has a son, i.e. Donald Dashwood-Jones, Edmund Dashwood-Jones, Kenneth Shore, Stanley Green and Ernest Pearson; three of them served in World War II. Victor, now Head Revenue Accountant in charge of all revenue of the British Columbia Electric Railway Company, Vancouver, as his father was, is greatly interested in entomological and botanical activities, and devotes all his spare time to these hobbies, at his country home, "Seven Oakes," on the south side of the Fraser River in Surrey Municipality.

—Grace Melville Green

THEODORE ALBERT MOILLIET, 1883-1935

My father, Theodore Albert Moilliet, was born at Cheyney Court, Herefordshire, England, May 11, 1883, and was educated at Felsted School, Essex. He died at Kamloops, B.C., on December 21, 1935.

Although his father was fairly well-to-do, Tam, being the youngest of five brothers, had to depend largely on his own resources. When he left school it was a toss-up whether he would go to the South African War or to Canada. He decided in favor of farming in Canada, where he arrived in 1899. At first he was a pupil at a farm near Orillia, Ont. He claimed that he worked harder there than at any time since, and learned how not to farm!



Leaving Ontario, he threshed grain in Saskatchewan until the weather became too cold, then worked his way west until he reached Trail, B.C. Here he was employed at the Smelter and became very interested in the work but fell ill with a combination of pneumonia and lead and mercury poisoning. Upon leaving the hospital he was advised to lead an out-door life. He worked on several ranches, including W. C. Ricardo's and Price Ellison's near Vernon, and Bostock's at Monte Creek. Then one day, he told me, he was sitting on a hill south of Kamloops, looking up the North Thompson River; the sight of the little known river gripped his imagination and he determined to explore it and possibly take up land.

That fall he and his uncle, Hyde Finley, went with a survey party timber cruising as far as Tete Jaune Cache. He first staked land at Cottonwood Flats, a large natural meadow just below Hellsgate. The hay they put up floated away in an unseasonable September flood. They realized there was no controlling the river, or mosquitoes, so moved down to what is now Vavenby, to a high clay bench some 300 feet above the river. This turned out to be too dry and with too little irrigation water to be developed. In 1908 he moved to the south bank of the Thompson where there were several fine creeks with good land adjacent, and pre-empted three quarter-sections. At this time Tam was joined by his brother Jack, and a store was started, there being an influx of settlers, prospectors, trappers, etc., and rumours of a railway. As it was nearly 50 miles by river or pack trail to Chuchua, the head of the wagon road from Kamloops, my father became an expert with canoe, raft and pack horse. He had several narrow escapes on the river and on one occasion was reported drowned when an Indian found his raft overturned. After Jack's death in the war (1915) the store was carried on by Mr. Finley until sold in 1925.

In 1909 he married Mary T. Stephens who came out from England. I was born the same year, my sister Madeline in 1911, and my brother John in 1919. In 1912-13 the Canadian Northern Railway was put through and our first 50 sheep were driven in over road, right-of-way, and trail from Louis Creek. In 1915, 500 more sheep were obtained from Lacombe in Alberta. Owing to inexperience, lack of good help, ravages by diseases, wood ticks and coyotes, my father was nearly ruined. However, by sheer determination he stuck to sheep and was fortunate in getting as a partner a skilled American shepherd Hiley Ladow. They were among the first in British Columbia to run sheep on the high ranges. They grazed on McCorvie Mountain (later called Mt. McLennan) at an elevation of 4,000 to 4,500 feet from 1917-22, and on Foghorn Range, south of Birch Island, at altitudes between 5,000 and 7,000 feet, from 1923 on.

It was about 1918, and partly to interest me, that my father returned to collecting Lepidoptera, a hobby of which he had been fond as a boy. He joined the Entomological Society of British Columbia in 1921. Before that he contacted E. H. Blackmore of Victoria, who agreed to set and name us a complete series of all species we sent him. A long and interesting correspondence between the two men resulted, and they became great friends though they never met, and Blackmore's premature death was keenly felt by us. We collected fairly extensively during the period 1919-24, after which I went away to school. As Blackmore was chiefly interested in "micros" we concentrated on them. There was great excitement when my father turned in a series of a minute pink creature which Blackmore at first glance took to be a new Order, but after much research, it was discovered to be an already known Fulgorid. I think we found only two species new to science, *Enypia moillieti* Blackmore and *Epinotia scorsa* Blackmore, but a number of others such as *Hemaris thysbe* form *cimbiciformis* Steph. *Basilarchia arthemis* Dru., and a certain Blue, and many others were considered remarkable either for their numbers or their range. It was noticed that some forms previously known only from the Arctic were found around timberline.

Our collection is still at Vavenby. Blackmore kept what specimens he needed, and that material is presumably still in his collection, most of which is now at the University of British Columbia.

I have mentioned the difficulties with wood ticks. So far as I know ours were among the first livestock losses from tick paralysis in the Province and led E. A. Bruce and Seymour Hadwen, then of Agassiz, to undertake a study of the situation. As early as 1930 a virulent form of of the tick-borne disease tularaemia was isolated from *Haemaphysalis leporis palustris* Banks, taken from a dying rabbit by my father and forwarded by the late Eric Hearle for testing in Montana.

A man of strong personality and physique, my father always took a keen interest in community life. He helped to organize the Upper North Thompson Farmers' Institute in 1916, and was Secretary of it and its successor, the Upper North Thompson Live Stock Association, until his death. He was Secretary of the local School Board from its beginning in 1917 until his death in 1935. In 1913 he and his brother started making meteorological observations, and the weather records have been kept here ever since. He even started a Debating Society in the early 20's, but it did not survive a discussion on the respective merits of "Cattle Ranching versus Sheep Ranching." There has always been much antagonism between the two interests, but my father succeeded in getting what range he wanted. Since the grazing land was being ruined by the growth of brush, he became one of the British Columbia sheep industry's principal proponents of the idea of improving range land by burning. This ended in a battle with the Forest Branch owing to their obdurate position on the subject. On principle, during the last few years of his life he refused to pay grazing fees to the Crown, which he contended was fast allowing the range to become overgrown and useless.

A great conversationalist and an avid reader, my father wrote many an interesting and many a strong letter. It is worthy of note that his liking for biology may have stemmed partly from his knowledge that he was directly descended from the marriage of Francis Galton's brother with Charles Darwin's sister. Incidentally, my mother is related to George Crotch who did some of the earliest insect collecting on the coast of British Columbia.

He is survived by two older brothers and a sister in England; his widow and his uncle Mr. H. Finley, both of Aveley Ranch, Vavenby; two sons, John and myself (who are carrying on the business of sheep ranching at Vavenby); and his daughter, now Mrs. E. A. Rendell of Vernon, B.C. There are five grandchildren.

—T. K. Moilliet,
Vavenby, B.C.

HARRY CANE, 1860-1935

Harry Cane was born in Slinfold, Yorkshire, England, on September 30th, 1860, the son of Henry Cane, architect, and Louisa Cane (a direct descendant of Sir Christopher Wren). He received his early education in England.

In 1877, his father, having been appointed to superintend the building of a palace for the Maharajah of Cooch Behar, young Harry accompanied his parents to India. There he studied architecture under his father and assisted him later in the designing and construction of the Normal School at Cooch Behar. During his stay in India he painted several beautiful landscapes, and made a fine collection of butterflies which he presented to a friend in England on his return there in 1888.

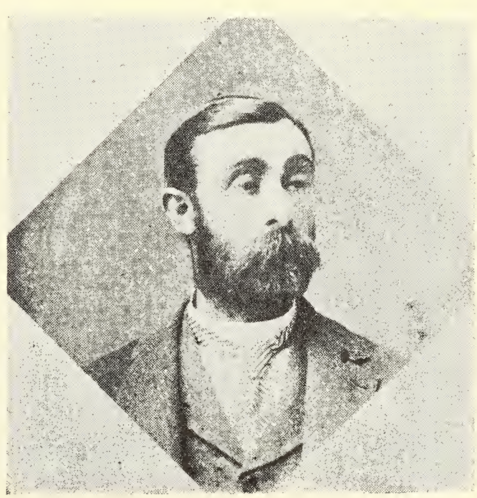
In 1892 he came to the United States and spent a few years in Oregon before coming to Nelson, B.C., where he was connected with a firm of local architects. He again utilized his spare time in making up a moth and butterfly collection, now owned by H. R. Foxlee of Robson, B.C. Though not complete, the collection gives an idea of the many varieties to be found in the Nelson district.

For many years his activities were curtailed by failing sight, but until his death in 1935, his cheerful courage, in the face of this handicap, was an inspiration to all with whom he came in contact. Always a lover of the beautiful, he found great pleasure in sketching and painting, and many of his watercolours are now prized possessions of various friends throughout the Kootenay district of British Columbia.

* * *

The above was written by Mrs. Gordon Allan of 1115 Ward Street, Nelson, from data supplied by Mrs. Harry Cane and from her own knowledge as a friend of the family.

Mr. Cane's collection was made I believe in the last decade of the last century



and the early years of the present one. The insects are well mounted, though low on the pins, in the English style; a few have faded badly. There are about 600 specimens, representing 220 species, a goodly number considering that he caught them all in the confines of his own garden. Fifteen or sixteen of the species I have not yet seen from other parts of the Nelson district.—H. R. Foxlee.

DYSLOBUS LUTEUS AS A PEST OF RASPBERRY (Coleoptera: Curculionidae).—In the summer of 1906 (date unknown) my attention was called to the ragged condition of the leaves in a patch of cultivated raspberries. The damage was distinctive and did not resemble that usually caused by lepidopterous larvae. Injured leaves had a series of long narrow areas, extending from the margin to the midrib, entirely removed; the intervening portions of the leaf blade were quite undamaged. There were usually three or four of these injured areas on each side of the mid-rib thus producing a very uniform type of damage. It was confined to the large leaves near the bases of the canes.

No cause for the injury being apparent, it was concluded that the insect responsible had deserted the plants. However, a visit after dark with the stable lantern revealed numbers of the weevils feeding on the foliage, which in some cases was quite weighted down by them. During the day they could be found hidden beneath the surface soil and under the dead leaves around the crowns of the canes. A specimen was recently identified as **Dyslobus luteus** (Horn) by Peter C. Ting, who is making a revisional study of the species of this genus. A similar type of leaf injury has been observed from time to time in raspberry plantations throughout the valley. It is probable that this beetle is quite generally distributed, although owing to its nocturnal habits it has escaped detection and avoided punishment.—E. P. Venables, Vernon, B.C.

HYDATICUS MODESTUS AT CRESTON, B.C. (Coleoptera: Dytiscidae).—In the summer of 1945 I reported to H. B. Leech the capture of several **Hydaticus modestus** Sharp at Creston, B.C. He replied that he knew of only 7 other British Columbia specimens—from 6 different localities. Mine were taken in a pond of clear water left by the rampant spring floods of the Goat River, with gravel bottom, no vegetation and only a sprinkling of small drift wood. The pond was exploited throughout the season (Aug. 12-Sept. 18), with a catch of 38 specimens. Males predominated and 3 of the females were of the immaculate phase.—G. Stace Smith, Creston, B.C.

BUPRESTIS CONFLUENTA IN BRITISH COLUMBIA (Coleoptera, Buprestidae).—**Buprestis confluenta** Say has a wide distribution in North America, being reported from British Columbia to Ontario and from California to Indiana. W. J. Chamberlin (Buprestidae of North America, 1926: 107) cites **Populus tremuloides** as its host tree.

Two specimens of this species, rare in British Columbia, have been received at the Provincial Museum in recent years. One example, taken at Lac la Hache, by George Forbes on July 18, 1943, near a stand of **Populus tremuloides** and **P. trichocarpa**, apparently constitutes the most northern record for the Province; the second specimen was collected by the writer in Manning Park, between Hope and Princeton, on August 15, 1945, as it was resting on an old fir log by the roadside near a growth of **P. trichocarpa**.

G. R. Hopping informs me that he has two specimens from Midday Valley, one from Aspen Grove and one from Nicola Lake, while G. Stace Smith reports that he has taken two individuals at Creston, on or near **P. trichocarpa**.

H. B. Leech has taken the species at Salmon Arm while I understand that G. J. Spencer has additional records.

From the available facts this species seems to be partial to the fairly dry interior plateau region of the Province.—George A. Hardy, Provincial Museum, Victoria, B.C.

A NOTE ON THE ANT CRICKET MYRMECOPHILA OREGONENSIS (Orthoptera: Gryllidae).—On December 30, 1945, I found in a cell under loose bark on a fir log, what was evidently a new colony of carpenter ants, **Camponotus** Sp. It consisted of a queen, four small workers, and a clump of very young larvae.

The interesting point is that along with these was a small, perhaps nymphal, ant cricket, **Myrecophila oregonensis** Bruner. This seems to indicate a remarkable instinct, inherent in these crickets, of attaching themselves to ant colonies at a very early stage in their formation.

I cut this log into stove wood and there was no established colony of ants therein. One other colony, more advanced in that the workers numbered possibly one hundred, was found a few feet away. I could find no crickets with these.—Richard Guppy, Wellington, B.C.

BIBLIOGRAPHY OF BIOGRAPHIES OF ENTOMOLOGISTS. By Mathilde Carpenter. American Midland Naturalist, 33 (1):1-116. January, 1945. For sale by the A.M.N., Notre Dame, Indiana, price $1.20.—The author considers her paper to be a sort of second edition, enlarged and up to date, of J. S. Wade's BIBLIOGRAPHY OF ENTOMOLOGISTS, WITH SPECIAL REFERENCE TO NORTH AMERICAN WORKERS (1928. Ann. Ent. Soc. Amer. 21 (3):489-520). Certainly it is enlarged, not only as to the number of persons listed, but also by the number of references per name. In addition it includes all entomologists of all countries and is intended to be complete through 1943. The method of citing volume and page is as in the example above. The given names when known, the years of birth and death are included for each person but all other data must of course be obtained from the references cited.—H. B. L.

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MAR 2 - 1948

SYSTEMATIC ENTOMOLOGY IN THE PACIFIC NORTHWEST

Kenneth M. Fender
McMinnville, Oregon

The possibilities open to the entomological taxonomist in the Pacific northwest are legion. This has been most forcibly illustrated by an insect survey, in its second year, conducted by the writer on Peavine Ridge, McMinnville, Oregon. Genera and species new to science have been discovered in the few groups in which authorities have been available. Of many other groups, little or nothing is known and the collector has difficulty getting his material determined even to genus.

All of the methods known to the collector have been used in this survey. Collecting has been confined to about one half to three quarters of an hour each day when the weather permitted. All of the stations are covered about once a week in this manner during most of the collecting season. To date general sweeping of the foliage has been most productive and for this reason has been most frequently used for the initial stages of the study. Later on, as determinations are received and knowledge of the species is gained, rearing studies may be taken up. Determination of the collectoins is the prime objective at this time.

Peavine Ridge is almost due west of McMinnville, Oregon. The area of the survey extends for about four miles in a general direction from the southeast to the northwest. Five major stations are getting the bulk of the work. These are numbered: 1, 2, 3, 3A, and 4 for no good reason save that station 3A was added after the project was started. Four of the stations are along small water courses, station 4 being the only dry station to date.

Station 1, at an elvation of 210 feet, has the largest stream of the lot, a stream that dries up in spots during a warm summer. The dominant tree is Oregon Ash *(Fraxinus oregona* Nutt..) with Broadleaf Maple *(Acer macrophyllum* Pursh.) and Garry Oak *(Quercus garryana* Dougl.) as subdominants. The shrub layer is largely composed of Oregon Grape *(Berberis aquifolium* Pursh.) and Salmonberry *(Rubus spectabilis* Pursh.). A fern layer consisting of Swordfern *(Polystichium munitum* Kaulf.) and rushes is present. Water Hemlock *(Cicuta douglasii* C. & K.) and grasses abound in the herb layer.

The elevation at station 2 is 600 feet. This station is rather open, most of the trees being young. The area was "cut over" about 1914. Oregon Ash and Willows *(Salix* sp.) are the dominant trees. The most abundant shrubs are Western Hazel *(Corylus californica* Rose), Poison Oak *(Rhus toxicodendron* L.) and Salmonberry. Brake-fern *(Pteridium aquilinum* v. *pubescens* Underw.), Snowberry *(Symphoricarpus albus* L.) and Swordfern comprise most of the fern layer with grasses, St. Johns Wort *(Hypericum perforatum* L.), Water Hemlock and Common Monkey-flower *(Mimulus guttatus* D.C.) the majority of the herb layer. Two small temporary streams converge at this station and form a nice small meadowland.

Station 3, only a short distance from station 2, is very different from that station. The elevation is 605 feet. A small permanent spring rises in the middle of the area. Douglas Fir *(Pseudotsuga mucronata* Raf.) and Broadleaf Maple are the predominant trees. Salmonberry and Willows are the most abundant shrubs with Swordfern, Giant Chain-fern *(Woodwardia fimbriata* Smith) and Oregon Grape dominating the fern layer and assorted grasses and Umbelliferae the herb layer. At this station is the first sign of the encroachment of the Douglas Fir subclimax forest and the best example of that forest in the area.

Station 3A, at an elevation of 980 feet was overlooked for some time as it was rather well camouflaged from the road. It is the smallest of the five and to get to it the collector has to push through a barrier of low hanging fir branches. This station, although small, has been one of the most productive in the variety of insects taken. Oregon Alder *(Alnus rubra* Bong.) and Broadleaf Maple are the dominant trees. Important shrubs are Salmonberry, Evergreen Blackberry *(Rubus laciniatus* Willd.) and Stink Currant *(Rubus bracteosum* Dougl.). The more abundant members of the fern layer are Giant Chainfern and Brake-fern. The herb layer is pretty well choked out but there is one patch of Western Wild Ginger *(Asarum caudatum* Lindl.) and occasional Smooth Woodland Violets *(Viola glabella* Nutt.) and Western Trilliums *(Trillium ovatum* Pursh.).

Station 4, at an elevation of 1085 feet, is a dry station. It was "cut over" about 1916 but it is coming back to a nice young stand of Douglas Fir and Garry Oak. The shrub layer is composed largely of Snowberry, Western Hazel and very young Garry Oak. Brakefern is the chief constituent of the fern layer. The herb layer contains grasses, English Plantain *(Plantago lanceolata* L.) and Heal-all *(Prunella vulgaris* L.)

Each of the stations is comparatively small, the combined areas covering scarcely more than five acres. Considering the restricted extent of the stations, quite a number of interesting species have been collected as indicated by the lists and notes of the determiners.

Dr. C. P. Alexander of the University of Massachusetts has discovered four or five species of *Tipulidae* that are new to science. Prior to this survey, some 50 species of *Tipulidae* were recorded from Oregon. By the end of the 1946 season, 125 species of craneflies had been taken from Peavine Ridge alone.

Dr. Frank Shaw, also of the University of Massachusetts, reports a probable new genus of *Mycetophilidae* and many interesting things. He mentions the seeming close relationship of western *Mycetophilidae* with those of the Palaearctic region.

A list of the spiders from Dr. W. J. Gertsch of the American Museum of Natural History indicates that three new genera and nine new species of *Arachnida* have been taken in the area.

Dr. H. H. Ross of the Illinois Natural History Survey, commenting on the four species of *Trichoptera* collected through 1946, mentions that one species has a wide range. Another species is a new record for the state and the second specimen taken. The remaining two species are new to science.

It would appear that as more and more groups are studied, many more new species will be discovered. In the Pacific Northwest are innumerable areas equally rich in insect life and many that are more so.

No great aptitude is required to collect insects, the essential condition being that the collector be in the right place at the right time. It is an indication of a notable lack of knowledge of the insects of the Pacific Northwest, that so many new genera, new species and new locality records are found in such a restricted area and in such a short time.

There are many things to be done in the Pacific Northwest. Local authorities in many groups, especially the more obscure ones, are needed. A central type or paratype depository should be formed for students of northwestern insects. Too many types are in eastern collections where they are not available to local students. More western type material will be represented in these eastern collections before we have the required systematists. This is a regrettable state of affairs but one that must be recognized. Frequently this loss is somewhat compensated by the return of paratypes to western collections.

More ardent general collecting and surveys similar to that of Peavine Ridge should be made of the diverse habitats; life histories should be studied; local lists of known species should be compiled and, above all, this information should be made available through publication as progress permits. There is indeed much to be done.

SOME RECORDS OF MALLOPHAGA FROM BRITISH COLUMBIA BIRDS

G. J. Spencer
Department of Zoology, University of British Columbia.

The collections of Mallophaga of British Columbia birds, belonging to the Museum of Zoology at the University, consist of two series of alcoholic material, one of over 300 collections made from 1924 to 1928 and the other of some 200 collections made from 1928 to 1947. The first series is in the hands of Professor A. W. Baker of the Ontario Agricultural College at Guelph, pending completion of identification, while the second is at the University in Vancouver. I find that there is considerable difficulty in getting material in this Order identified since but few men are working on it in North America and of these none has time to make any identifications. Moreover, essential references are scattered back over one hundred years and are very expensive so that a considerable library is necessary to identify even the most common forms. Thus Professor Baker, to whom I sent the first series in 1927-28, was able to send me only one set of identifications by 1933 and none since then. In the meantime the collections are still in his possession.

The second series is being sent in small shipments, to Mr. Gordon B. Thompson, formerly of the British Museum, but now at the Science Museum of the Institute of Jamaica. When identifications come to hand from these men, the lists will be published from time to time and eventually all the material on which the lists are based, will be deposited in the museum of Zoology at the University of British Columbia.

It is 23 years since I started this collection, which is representative of the Mallophaga of a large number of common British Columbia birds with many records from scarce or rare species, so I feel that the publication of at least a partial list should no longer be delayed. The list that follows is the one sent to me by Professor Baker in 1933 and has been held up all this time pending the publication of his monograph of the Mallophaga from Canadian birds which he has had in mind since 1911 but which his teaching duties and his services in the recent war, have prevented him from completing.

For convenience, the Mallophaga are arranged alphabetically, followed in each instance by the scientific and common names of the host, the locality, date and name of the collector. The names of the bird collectors are of importance because these men are (or were, in the case of the late Mr. R. A. Cummings) well known and reliable ornithologists of the Province and their identifications may be relied upon. In the few instances that I collected the birds myself, they were shown to an authority if there was any doubt about their identity. In some cases the lice were picked off by the men who shot the hosts and were given to me either in vials of alcohol or wrapped in cotton wool in papers inscribed with full details; in others, especially from 1940 onwards, the birds were handed to me for picking over before being made into skins. In all cases, the lice passed through my hands for washing, relaxing and final labelling.

The nomenclature of the Mallophaga is that of Harrison[1].

MALLOPHAGA AND HOSTS

Degeeriella biocellata Piaget 1880
Pica pica hudsonia (Sabine), Magpie. Lake Ellswater, Alta., 25 June, 1926. M. Y. W. Kamloops, 1934-'35. G. J. S.

Degeeriella deficiens Piaget 1885
Cyanocitta stelleri stelleri (Gmelin), Steller's Jay. Tofino, V.I., 4 July, 1926. G. J. S.

Degeeriella fusca Nitzsch 1842
Buteo swainsoni Bonaparte, Swainson's Hawk. Okanagan Landing, 25 May, 1925. K. R.

Degeeriella marginulata Harrison 1916
Ceophloeus pileatus picinus (Bangs), Western Pileated Woodpecker, Port Moody, 23 Jan., 1930. K. R.

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(1) Harrison, Launcelot, 1916. The genera and species of Mallophaga. Parasitology, Vol. IX, No. 1. Cambridge.

Degeeriella straminea Denny 1842
Colaptes auratus Linn. Flicker. No data.
Asyndesmus lewisi (Gray), Lewis' Woodpecker. Vancouver, 2 May, 1931. R. A. C.

Dennyus truncatus Olfers 1816
Nephoecetes niger borealis (Kennerly), Northern Black Swift. Vancouver, 6 Sept., 1931. R. A. C.

Esthiopterum ardeae Linn. 1758
Ardea herodias fannini Chapman. Northwestern Coast Heron. Tofino, V.I., 3 Aug., 1926. G. J. S.

Esthiopterum columbae Linn. 1758, the pigeon louse.
Columba fasciata fasciata (Say), Band-tailed Pigeon. Tofino, V.I., 26 Aug., 1926. G. J. S.; Lulu Is., 1 Jan., 1926; 28 Aug., 1929; 12 Aug., 1931. R. A. C.

Esthiopterum crassicorne Scopoli 1763. The squalid duck louse.
Clangula hyemalis (Linn.) Old Squaw Duck. Sea Island, Vancouver, Feb., 1931. R. A. C.

Glaucionetta islandica (Gmelin), Barrow's Golden-eye. Bowen Is., N.d. M. Y. W.

Mareca americana (Gmelin), American Widgeon. Sea Island, Vancouver, N.d. M. Y. W.

Spatula clypeata (Linn.), Shoveller. Sea Island, Vancouver, 5 May, 1928; Lulu Is., Oct., 1931. R. A. C.

Eureum cimicoides Nitzsch 1838
Nephoecetes niger borealis (Kennerly), Northern Black Swift. Vancouver, 16 Aug., 1930. R. A. C.

Goniodes mammillatus Rudow 1870
Lagopus leucurus leucurus (Richardson), White-tailed Ptarmigan. Alta Lake, 6 March, 1925. K. R.

Goniodes piageti Johnston & Harrison 1912
Columba fasciata fasciata (Say), Band-tailed Pigeon. Tofino, V.I., 26 Aug., 1926. G. J. S.

Laemabothrion buteonivorus Packard 1872
Buteo swainsoni Bonaparte, Swainson's Hawk. Okanagan Landing, May 1925. K.R.

Menopon giganteum Denny 1842
Columba fasciata fasciata Say, Band-tailed Pigeon, Lulu Is., 28 Aug., 1929. R. A. C.

Myrsidea subaequalis Lyonet 1829
Corvus brachyrhynchos hesperis Ridgway, Western Crow. Kamloops, April, 1926. K. R.

Ornithobius cygni Linn. 1758
Cygnus sp. probably *columbianus* Ord., Whistling Swan. Vancouver, 1 March, 1924. G. J. S.

Ornithobius goniopleurus Denny 1842
Branta canadensis occidentalis (Baird), White-cheeked Goose. Anyox, Feb., 1924. G. J. S.; Lulu Is., March, 1931. R. A. C.

Branta canadensis minima Ridgway, Cackling Goose. Pitt Meadows, 27 Oct., 1927. R. A. C.

Philopterus agelaii Osborn 1896
Agelaius phoeniceus caurinus Ridgway, Northwestern Red-winged Blackbird. Lulu Is., April, 1927. G. J. S.

Philopterus californiensis Kellogg 1896
Dryobates villosus harrisi (Audubon), Harris' Hairy Woodpecker. Seymour Mt., Vancouver, 29 April, 1929. R. A. C.

Philopterus dentatus Scopoli 1763
Anas platyrhynchos Linn., Mallard. Langley Prairie, Nov., 1926. G. J. S.

Branta canadensis occidentalis (Baird), White-cheeked Goose. Anyox, Nov., 1924. G. J. S.

Glaucionetta islandica (Gmelin), Barrow's Golden-eye. Bowen Is., 12 Jan., 1931. M. Y. W.

Philopterus gonothorax Giebel 1871
Larus sp. Gull. Tofino, V.I., July, 1926; 22 Aug., 1926. G. J. S.

Larus californicus Lawrence, California Gull, Vancouver, 1 Jan., 1929. R. A. C.

Larus hyperboreus barrovianus Ridgway, Glaucous Gull. Vancouver, 11 Feb., 1931; April, 1931. R. A. C.

Larus canus brachyrhynchus Richardson, Short-billed Gull. Vancouver, 2 Jan., 1931. R. A. C.

Larus philaelphia (Ord), Bonaparte's Gull. Sea Island, Vancouver, 18 April, 1929. R. A. C.

Larus glaucescens Naumann, Glaucous-winged Gull. Departure Bay, V.I., 1 March, 1929, 17 March, 1929, J. A. M. Tofino, V.I., 7 May, 1931. K. R.

Philopterus picae Denny 1842
Pica pica hudsonia (Sabine), Magpie. Lake Ellswater, Alta., 25 June, 1926. M. Y. W.

Philopterus platysomus Nitzsch 1838
Buteo swainsoni Bonaparte, Swainson's Hawk. Okangan Landing, May, 1925. K.R.

Philopterus pustulosus Nitzsch 1866
Stercorarius pomarinus (Temminck), Pomarine Jaeger. Lulu Is., Vancouver, April 1927. K. R.

Philopterus rutteri Kellogg 1899
Penthestes gambeli grinnelli Van Rossem, Short-tailed Mountain Chickadee. Okanagan Landing, 10 Feb., 1926. K. R.

Philopterus subflavescens Geoffrey 1762
Bombycilla garrula pallidiceps Reichenow, Bohemian Waxwing. Okanagan Landing, 14 Dec., 1926. J. A. M.

Cyanocitta stelleri annectens (Baird), Black-headed Jay. Lumby, 3 March, 1926; Okanagan Landing, 3 March, 1926. K.R.

Cyanocitta stelleri stelleri (Gmelin), Steller's Jay. Vancouver, 9 Dec., 1931. R. A. C.

Hesperiphona vespertina brooksi Grinnell, Evening Grosbeak. Vancouver, 10 April, 1926. R. A. C.

Lanius excubitor invictus Grinnell, Northern Shrike. Okanagan Landing, 17 Nov., 1925; 22 Feb., 1926. K. R.

Pinicola enucleator alascensis Ridgway, Alaska Pine Grosbeak. Okanagan Landing, 13 Feb., 1926. K. R.

Ricinus diffusus Kellogg 1896
Junco oreganus oreganus (Townsend), Oregon Junco. North Vancouver, 11 April, 1932. I. McT. C.

Trinoton anserinum Fabricius 1805
Branta canadensis minima (Ridgway), Cackling Goose. Pitt Meadows, 27 Oct., 1927. R. A. C.
Branta canadensis occidentalis (Baird), Western Canada Goose. Lulu Is., Vancouver, March, 1931; 1 April, 1931. R. A. C.
Chen hyperborea (Pallas), Snow Goose. Lulu Is., Vancouver, 5 March, 1926. G.J.S.

Trinoton lituratum Nitzsch 1838
Anas platyrynchos Linn., Mallard. Langley Prairie, Nov., 1926. G. J. S.

Trinoton querquedulae Linn. 1758
Anas acuta Vieillet, Pintail Duck. Vancouver, Oct., 1931. R. A. C.; Pitt Meadows, 10 Dec., 1929. K. R.; Lulu Is., Vancouver, Oct., 1931. R. A. C.
Anas tzitzihoa Vieillet, American Pintail. Sea Is., Vancouver, 30 Jan., 1929. R. A. C.
Anas platyrhynchos Linn., Mallard. North Vancouver, 14 Dec., 192?. I. McT. C.; Sea Is., Vancouver, 17 Jan., 1930. E. E. P.
Anas strepera Linn., Gadwall. Lulu Is., Vancouver, 20 Nov., 1926. M. Y. W.
Mareca americana (Gmelin), Baldpate Duck. Lulu Is., Vancouver, 1927. R. A. C.
Spatula clypeata (Linn.), Shoveller Duck. Lulu Is., Vancouver, Oct., 1931. R. A. C.

HOST LIST WITH PARASITES

Order CICONIFORMES

Ardea herodias fannini Chapman, Northwestern Coast Heron.
Esthiopterum ardeae Linn.

Order ANSERIFORMES

Cygnus sp. probably **columbianus** Ord., Whistling Swan.
Ornithobius cygni Linn.

Branta canadensis minima (Ridgway), Cackling Goose.
Ornithobius goniopleurus Denny
Trinoton anserinum Fab.

Branta canadensis occidentalis (Baird), White-checked Goose.
Ornithobius goniopleurus Denny
Philapterus dentatus Scop.
Trinoton anserinum Feb.

Chen hyperborea (Pallas), Snow Goose.
Trinoton anserinum Fab.

Anas acuta Vieillet, Pintail.
Trinoton querquedulae Linn.

Anas platyrhynchos Linn., Mallard.
Philopterus dentatus Scop.
Trinoton literatum Nitzsch.
Trinoton querquedulae Linn.

Anas strepera Linn., Gadwall.
Trinoton querquedulae Linn.

Mareca americana (Gmelin), American Widgeon.
Esthiopterum crassicorne Scop.
Trinoton querquedulae Linn.

Spatula clypeata (Linn.), Shoveller Duck.
Esthiopterum crassicorne Scop.
Trinoton querquedulae Linn.

Glaucionetta islandica (Gmelin), Barrow's Golden-eye.
Esthiopterum crassicorne Scop.
Philopterus dentatus Scop.

Clangula hyemalis (Linn.), Old Squaw Duck.
Esthiopterum crassicorne Scop.

Order FALCONIFORMES

Buteo swainsoni Bonaparte, Swainson's Hawk.
Degeeriella fusca Nitz.
Laemobothrion buteonivorus Packard
Philopterus platysomus Nitz.

Order GALLIFORMES

Lagopus leucurus leucurus (Richardson), White-tailed Ptarmigan.
Goniodes mammilatus Rudow

Order CHARADRIIFORMES

Stercorarius pomarinus (Temminck), Pomarine Jaeger.
Philopterus pustulosus Nitz.

Larus californicus Lawrence, California Gull.
Philopterus gonothorax Giebel.

Larus canus brachyrhynchus Richardson, Short-billed Gull.
Philopterus gonothorax Giebel

Larus glaucescens Naumann, Glaucous-winged Gull.
Philopterus gonothorax Giebel

Larus hyperboreus barrovianus Ridgway, Glaucous Gull.
Philopterus gonothorax Giebel

Larus philadelphia (Ord.), Bonaparte's Gull.
Philopterus gonothorax Giebel

Order COLUMBIFORMES

Columba fasciata fasciata (Say), Band-tailed Pigeon.
Esthiopterum columbae Linn.
Goniodes piageti Johnston and Harrison
Menopon giganteum Denny

Columba sp., Domestic Pigeon.
Esthiopterum columbae Linn.

Order MICROPODIFORMES

Nephoecetes niger borealis (Kennerly), Northern Black Swift.
Dennyus truncatus Olfers
Eureum cimicoides Nitz.

Order PICIFORMES

Colaptes auratus Linn., Flicker.
Degeeriella straminea Denny

Ceophloeus pileatus picinus (Bangs), Western Pileated Woodpecker.
Degeeriella marginulata Harr.

Asyndesmus lewisi (Gray), Lewis' Woodpecker.
Degeeriella straminea Denny

Dryobates villosus harrisi (Audubon), Harris' Hairy Woodpecker.
Philopterus californiensis Kell.

Order PASSERIFORMES

Cyanocitta stelleri annectens (Baird), Black-headed Jay.
Philopterus subflavescens Geoff.

Cyanocitta stelleri stelleri (Gmelin), Steller's Jay.
Degeeriella deficiens Piaget
Philopterus subflavescens Geoff.

Pica pica hudsonia (Sabine), Magpie.
Degeeriella biocellata Piaget
Philopterus picae Denny

Corvus brachyrhynchos hesperis Ridgway, Western Crow.
Myrsidea subaequalis Lyonet

Penthestes gambeli grinnelli Van Rossem, Short-tailed Mountain Chickadee.
Philopterus rutteri Kell.

Bombycilla garrula pallidiceps Reichenow, Bohemian Waxwing.
Philopterus subflavescens Geoff.

Lanius excubitor invictus Grinnell, Northern Shrike.
Philopterus subflavescens Geoff.

Agelaius phoeniceus caurinus Ridgway, Northwestern Red-winged Blackbird.
Philopterus agelaii Osb.

Hesperiphona vespertina brooksi Grinnell, Evening Grosbeak.
Philopterus subflavescens Geoff.

Pinicola enucleator alascensis Ridgway, Alaska Pine Grosbeak.
Philopterus subflavescens Geoff.

Junco oreganus oreganus (Townsend), Oregon Junco.
Ricinus diffusus Kell.

Key to Collectors

I. McT. C. ....Ian McTaggart Cowan
R. A. C. ....(the late) R. A. Cummings
J. A. M. ....J. A. Munro
E. E. P. ....Ernest E. Peden
K. R. ....Kenneth Racey
G. J. S. ....G. J. Spencer
M. Y. W. ....M. Y. Williams

Acknowledgments: I am deeply indebted to the various collectors who gave me the lice or the birds to examine, to Professor A. W. Baker for naming the lice mentioned in this paper and to Mr. J. A. Munro, Chief Federal Migratory Bird Officer for British Columbia, for checking over the bird list.

NOTES ON SOME DERMESTIDAE OF BRITISH COLUMBIA (Coleoptera)

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During the last 16 years in the dry belt of this province, I have collected all the Dermestidae I could lay hands on, but so far have obtained only 13 identified, and 2 unidentified species belonging to the Megatomini. The late Kenneth Auden, a most assiduous beetle collector, also obtained only 15 species so these few may be fairly representative. Over 700 species have been named in this family and Leng lists 123 for America north of Mexico, so further collecting may reveal several more for British Columbia.

The numbers in which they occur at any one time in the dry belt, vary greatly. The best sources for adults of small species are flowers such as choke cherry, wild spiraea, death camas, and water hemlock, and for adults and larvae of larger species, the hides of sheep that have died on the ranges during the winter, and any carrion.

Dermestes marmoratus Say, our largest species, may be found under animal remains on the ranges and under sheep skins that shepherds have left lying about. Both adults and larvae are most readily found in such situations although any dry carrion attracts them.

From the standpoint of numbers and ease of collecting, two species head the list, *Dermestes talpinus* Mann. and *Dermestes signatus* Lec. These come to carrion after the first wave of carrion-beetles and *marmoratus* has passed and the carcasses are drying and not so smelly.

Dermestes frischii Kug. is not common but generally occurs singly or in small numbers on carcasses that have been well picked over by bears and coyotes.

I have never taken *D. maculatus* DeGeer 1774 (=*vulpinus* Fabr. 1781) out of doors. The large series in our collections was reared from a dried wolf carcass stored in the laboratory pending cleaning up. The larvae from the dried wolf scattered in all directions, invading three adjacent rooms where they pupated in all manner of concealed places, some even wandering between the drawers of insect cabinets where they chewed out pupation chambers in the woodwork of the drawers. The infestation in the wolf apparently arose from adults that escaped from the beetle room where this species is maintained in large numbers for cleaning skeletons and skulls. The culture was imported originally from California and has been maintained in a large tin cage for several years. The species is apparently not native to this province and has not yet become established in the dry belt.

Dermestes lardarius Linn. the larder beetle, is best collected under old bacon rind or an old ham bone to which they generally arrive in pairs. In the same way, a male and female often arrive during the night to the bread box into which a freshly baked loaf has been put and has fermented or soured a little in the heat. I once reared a few adults from the bodies of dried insects in the laboratory at Kamloops where the larvae had become established naturally —a rather unusual occurrence.

Attagenus piceus Olivier, the black carpet beetle, occurs most freely under old horse or cow skeletons which are nearly dry and from which everything but shreds of tendons has been picked. Stragglers occasionally come into the cabin on the ranges in late summer and may be found on window frames. I once reared a small series from each of the following: a supply of casein from Australia; trash, consisting chiefly of particles of wool that occurred between rather widely laid floor boards in a public dance hall in the dry belt; an old insect collection in the Kamloops laboratory.

Anthrenus scrophulariae (Linn.), the notorious buffalo carpet beetle of eastern North America, apparently does not occur in this province yet. What I formerly considered to be this species turns out to be *A. pimpinellae* Fabricius, designated by Hinton as var. *occidens* Casey. In 1942 I published a note on *Laelius* sp. as a parasite of *A. scrophulariae* (Ent. Soc. of B.C. Proc. 39, 1942) from beetle material sent in from Princeton. The beetles were identified for me by the late Mr. Ralph Hopping and are so labelled in my collections, but Mr. Hopping did not have the good fortune, as I have had, to be able to consult Hinton's work and these beetles, also, turn out to be *A. pimpinellae* var. *occidens* Casey.

I have a large series of *A. pimpinellae* collected in the dry belt from Kamloops to the Chilcotin, occurring freely on flowers of yarrow and on wild, short spiraea on the ranges but never on hawthorn blossoms, on which adults of *A. scrophulariae* are sometimes so abundant in Ontario. Although adults of *pimpinellae* are so common, I have not been able to find out where the larvae develop. The one record of larvae in trash from a home in Princeton, is the only instance I have of its kind; certainly it is not a household pest as is *scrophulariae*. Full grown larvae of *pimpinellae* are armed with evenly but thinly distributed stout, black, dorsal bristles and lack the long caudal brush of brown hairs that is characteristic of larvae of *scrophulariae*. When working on the fauna of recently abandoned birds' nests, I have frequently come across dermestid larvae but have not yet reared any to adults; it is possible that they may be those of *pimpinellae*.

Anthrenus verbasci (Linn.), the varied carpet beetle, first obtained as larvae in homes in Vancouver in 1936 and reared through to adults, has become the most troublesome household pest in the lower Fraser valley and up the coast as far as Powell River. Once established in a house, the larvae are extremely hard to eradicate unless by cyanide fumigation and even then there is no guarantee that they will not turn up again next year. One householder informed me that larvae re-appeared only three months after fumigation, which would seem to indicate that cyanide does not kill the eggs. For years I have examined hawthorn and spiraea blossoms each spring but have never found *verbasci* adults out of doors on these or on any other flowers. In mid-May, 1947, however, two citizens who had consulted me about the control of these larvae, found adults out of doors and called me up to report it; one picked 13 beetles off a white blanket which she had washed and hung out to dry and the other found several on tulip and pyrethrum flowers in her next-door neighbor's garden. The adults apparently feed on white garden flowers and fly into homes to lay eggs. They breed also in feathers of discarded birds' nests for I found several larvae in a humming bird's nest which had been given me in September; the larvae were almost full grown so they must have been in the nest for several months.

That adults of *A. verbasci* do not require pollen or nectar from flowers in order to mature their eggs, is proved by the fact that I have reared a strong culture in a glass-topped tin box for 11 years, starting from the first few larvae that I received in 1936. It was from these larvae that I identified the species (which was new to me). They were fed on crushed Purina Fox Chow biscuits and generation after generation has developed in that box ever since, with food being renewed whenever necessary. For one six-month period they were fed wheat grains and for another similar period, oat grains, and apparently thrived on the change. If wheat and oat grains are nicked with a knife, all the starchy contents are soon consumed. One small larva, supplied one nicked grain of wheat, gradually ate its way into the grain as into a cave, leaving a semicircular wall of frass and cast skins behind it. Generations seem to overlap, but one wave of adults appears in March to April and a second in September to November. In one experiment some 50 beetles of both sexes were removed from this tin shortly after emergence and were placed in a similar tin on 14th March, without any food. They mated and laid eggs plentifully and gradually died. Some eggs shrivelled but most hatched and by 15th May a large brood of larvae was active in the box and had consumed the bodies of all but five of their parents without, however, having eaten the shrivelled unhatched eggs.

This means that an infestation of *A. verbasci* in a home, can maintain itself indefinitely without the adults having to fly outside to feed on flowers. Screening of windows to keep beetles out of a house would seem a hopeless task because few screens have frames sufficiently tightly fitting.

The larvae of *A. verbasci* are highly resistant to DDT powder. A number of them placed without food in a tin which had the poison dusted on the bottom, walked over it for two weeks without any of them dying and finally the lot died of starvation. A five per cent solution of DDT in Varsol (a cleaning fluid put out by the Imperial Oil Co.), sprayed on the backs of larvae seemed to have no effect on them for some hours but by next day they had become paralyzed and incapable of moving around although the legs twitched spasmodically. Some remained for 13 days in this condition before dying. However, those hit with spray on the under side of the body, died in a few hours.

A few grains of hexachlorocyclohexane (666) of 13 per cent gamma isomer content, in the same type of tin as employed with DDT powder, killed all larvae in 48 hours, apparently by fumigation.

The infestation is definitely spreading in greater Vancouver and it is difficult to see what factors will ultimately level it off.

Adults of *Orphilus niger* (Rossi) are best obtained in the Dry Belt off flowers of choke cherry; I have no idea what the larvae feed on.

Megatoma (*Perimegatoma*) *vespulae* Milliron used to be a pest in our insect, bird or mammal collections at the University from 1931 onwards until 1943, when I sprayed the outside of all our cabinets with five per cent DDT in Varsol about the third week in May. The spray has been repeated each year since, and the infestation has now died out. In rearing experiments with this species I find that larvae placed singly in tin salve boxes with a variety of foods including dead insects, invariably shrivel up and die even after six months of captivity. On the other hand I have reared them in bulk with a mass of dried insects, and they developed into beetles. As soon as adults emerge they should be removed from a culture if speciments for pinning are desired, otherwise the ensuing larvae eat the bodies of their dead parents, as do those of *A. verbasci.* All my pinned specimens were reared in the laboratory in Vancouver with the exception of one beetle which occurred on a window of the Dominion Entomological Laboratory in Kamloops. I have never captured it out of doors in the dry belt although I suspect that it came to the University originally from Upper Hat Creek where I was working in 1931 and whence I brought down much dried, pinned material, which, I think, became infested during the process of drying before the specimens were pinned away into boxes. Milliron, who described this species in 1939 from Minnesota, obtained his material from an old demonstration nest of the wasp, *Vespula arenaria.* However, I have put both adults and larvae into a glass jar containing a nest of *Vespula* which contained an abundance of wasp larval faeces and dried larvae and pupae but was not able to establish a colony in this medium. Neither will larvae develop on Fox Chow dust which has proved so successful for *A. verbasci.* The bodies of dried grasshoppers, fat moths and especially dried marine crustacea, are excellent food for this *P. vespulae.*

In addition to these listed above, I have a few specimens only of each of two further species of *Dermestidae*, near *Megatoma*, but have not been able to get them identified as yet.

Literature Cited

Hinton, H. E., 1945. A monograph of the Beetles associated with stored products. Vol. 1, British Museum, London.

Milliron, H. E., 1939. A Parthenogenetic New Species of the Genus **Perimegatoma** Horn (Coleoptera: Dermestidae). Annals Ent. Soc. of Am., 32 (3):570-574.

THE CLAY-COLOURED WEEVIL, **BRACHYRHINUS SINGULARIS**, IN WEST POINT GREY, VANCOUVER. (Coleoptera: Curculionidae).—The clay-coloured weevil, **Brachyrhinus singularis** (L.) first reported in this Province from Victoria by Mr. Harry Andison (Ent. Soc. B.C. Proc. 38, 1942) appeared in West Point Grey in October 1944, when one specimen was captured in my house. The next year, four beetles were taken on the kitchen and pantry windows, also in October. Now in the spring of 1944 I had first noticed holes eaten out of the leaves of purple iris bordering the sidewalk alongside the house and in 1945 the holes had noticeably increased until many leaves showed extensive damage: on both occasions the plants were inspected by daylight but no insects could be found on them . In the first week of May 1945, the irises were examined at night with a flashlight, at intervals from 8 o'clock onwards and several weevils were found chewing holes in the leaves. By 9 o'clock they had increased in numbers and remained fairly constant for the next half hour, so the worst infested portion of the bed, a strip some 35 feet alongside the house, was carefully swept with a net and many weevils were taken; a further strip of some 105 feet alongside the garden fence where the irises were but little damaged, yielded about a dozen more. In all, 131 clay-coloured weevils, 2 strawberry-root weevils (**Brachyrhinus ovatus** (L.) and 4 others (sp. indet.) were collected from off the iris leaves.

Apparently this sweeping removed practically all the beetles because in October 1946, only one iris leaf was found to have been recently damaged and no beetles could be located.

During the first week in May, 1947, the iris plants in these two beds and other clumps inside the garden walls, which hitherto had not been touched, showed signs of being attacked. Sweeping at 9 p.m. on May 10th yielded 23 beetles, and no subsequent damage occurred.

The garden contains a considerable range of annuals and perennials but only irises seem to be attacked and, of several varieties of these, the purple is most susceptible. The weevils apparently range widely since one was taken in May, on a limb of a sweet cherry tree, 25 feet from the trunk and 6 feet off the ground, so their damage will probably soon extend to other plants besides iris. Andison (loc. cit.) records them as extensively injuring laurel leaves in Victoria. There are no laurels in my garden but for several years I have noticed the lower leaves of several laurel bushes in the next block, to be extensively damaged: it is therefore very likely that this same insect is concerned and that its distribution in West Point Grey is far more extensive than is at present realized.—G. J. Spencer, Department of Zoology, University of British Columbia.

A PRELIMINARY LIST OF THE SPHECINAE OF BRITISH COLUMBIA (Hymenoptera)

G. J. SPENCER and W. G. WELLINGTON
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With the idea of recording for this Province, at least a few of the enormous number of species of Hymenoptera with which we are blessed, we present a first list of 3 tribes of digger or thread-waisted wasps, called also mud daubers. The solitary or aggregated mud nests of some species, resembling heavy tubes, are not uncommon under eaves of barns; others build nests in the ground. All of them provision their nests with other insects such as caterpillars (largely cutworms), well-grown nymphs of grasshoppers, or spiders. The steel-blue *Chlorion,* or *Chalybion,* or blue or black *Podalonia* are common sights on the ranges of the interior of the Province as they nervously, with short rushes, hunt their prey. The senior author once took 39 paralyzed spiders from the nest of, I think, *Sceliphron caementarium* Dr. These mud nests readily disintegrate if they become rain-soaked, hence the care with which the mother insect places them in dry, sheltered places.

The best collecting grounds for these sphecoids is a patch of umbelliferous plants in full flower, such as water parsnip, which they frequent in large numbers. The giant of this group, *Chlorion ichneumonium* Linn. is very partial to flowering heads of milkweed.

The 210 specimens upon which this paper is based are the greater part of these insects occurring in the University collections. Most of them were collected by G. J. Spencer who has written the script of this paper; the task of listing the species and arranging the names was done by W. G. Wellington. Cordial thanks are offered by Dr. Don Murray, University of Minnesota, for identifying these wasps.

Tribe CHLORIONINI

Chlorion atratum LePeletier, Kamloops, Summerland.

Chlorion bifoveolatum Taschenberg, Lytton, Kamloops, Summerland.

Chlorion aztecum Saussure, Summerland.

Chlorion laeviventris (Cresson), Lytton, Winslow.

Chlorion ichneumonium Linnaeus, Salmon Arm, Vernon, Kamloops, Summerland, Penticton.

Tribe SPHECINI

Podalonia (Psammophila) luctuosa Smith, Vernon, Summerland, Kamloops, Chilcotin.

Podalonia (Psamm.) valida Cresson, Nicola, Chilcotin.

Podalonia (Psamm.) robusta Cresson, Lytton, Summerland.

Podalonia (Psamm.) communis Cresson, Vancouver, Kye Bay, Sooke, Comox, Mt. Tolmie, Departure Bay, Newcastle Is., Milner, Salmon Arm, Vernon, Penticton, Midday Valley, Kamloops, Fairview.

Sphex mediatus Cresson, Vancouver, Haney, Lytton, Chilcotin.

Sphex pilosus pilosus Fernald, Victoria, Departure Bay, Newcastle Is., Vancouver, Osoyoos, Vernon, Summerland, Lytton, Kamloops, Chilcotin.

Sphex kennedyi Murray, Midday Valley, Kamloops, Chilcotin.

Sphex aberti Haldeman, Summerland.

Sphex politus Cresson, Chilcotin.

Sphex procerus Dahlbom, Lytton, Kamloops, Lillooet.

Sphex placidus F. Smith, Kamloops, Chilcotin.

Tribe SCELIPHRONINI

Chalybion cyaneum Klug, Salmon Arm, Walhachin, Cherry Creek, Vernon, Summerland.

Sceliphron caementarium Drury, Saanichton, Royal Oak, Cowichan, Courtenay, Departure Bay, Mt. Tolmie, Newcastle Is., Bowen Is., Vancouver, Salmon Arm, Midday Valley, Vernon, Summerland, Kamloops.

BIDESSUS LEACHI, A NEW SPECIES OF DYTISCID WATER BEETLE FROM NORTHERN CALIFORNIA (Coleoptera)[1]

HUGH B. LEECH
Vernon, B.C.

Bidessus leachi n. sp.

A large species, black broadly maculate with yellow; resembling and most closely allied to *B. plicipennis* (Crotch). Male shining above, female alutaceous. Belongs to *Clypeodytes*.

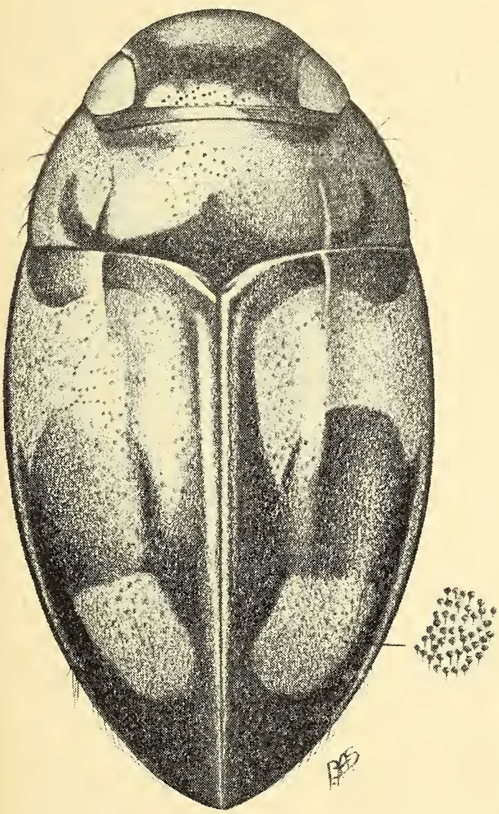

Fig. 1. **Bidessus leachi** n. sp., holotype male.

MALE. Length 2.12 mm., width 1.15 mm. Elongate-oval, widest at middle, moderately convex, disk of elytra flattened. Head dark brown, four basal antennal segments yellow, remainder infuscate. Pronotum yellow, except for a basal area between plicae (see fig. 1) which is reddish brown to piceus, and two lateral lunules indicating internal muscle attachments. Elytra black to piceous, broadly marked with yellow as in figure 1; the ante- and post-median yellow areas may be joined laterally along the elytral margin, but not discally. Underparts pale to dark brown, sides of abdominal sternites piceous.

Head faintly reticulated, finely irregularly punctate, punctures densest on sides and posteriorly; clypeus distinctly margined at middle anteriorly. *Pronotum* polished between punctures, the latter rather coarse and densely but not regularly distributed on disk, finer and sparser between plicae and sides; lateral marginal bead fine, progressively wider posteriorly; plicae extending midway across pronotum. *Elytra* flattened and depressed from base to declivity on disk, from just within plicae, giving the illusion of a carina continuing back from near each plica; plicae subequal to those on pronotum. Punctation of disk denser and a little coarser than that of pronotum, sometimes forming chains, becoming finer apically and espe-

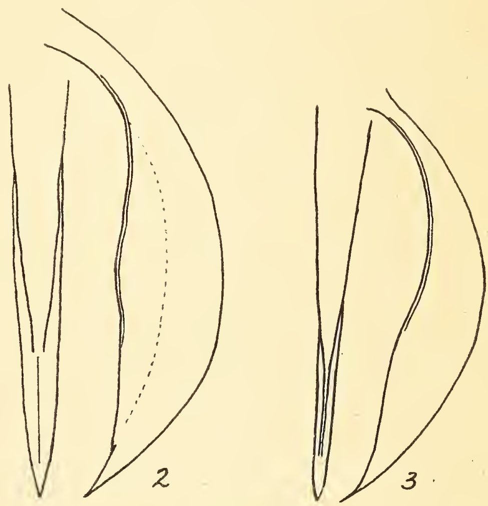

Fig. 2. Aedeagus of **Bidessus plicipennis** (Cr.), dorsal view of apical two-thirds on left, profile on right.

Fig. 3. Same, of **B. leachi** n. sp. Both figures drawn to the same scale.

[1] Contribution No. 2497, Division of Entomology, Department of Agriculture, Ottawa, Ontario.

cially toward sides; each puncture giving rise to a fine golden recumbent hair; sutural margin slightly raised and more finely punctate, suggesting a poorly defined sutural stria. *Prosternal* process slightly widening apically, sharply margined to near tip, median area depressed, sparsely pubescent, apex broadly pointed. *Metasternum* and metacoxal plates coarsely punctate, punctures separated by less than their own widths and tending to form chains; first two visible abdominal sternites coarsely punctate at sides; epipleurae finely irregularly punctate. Pro- and mesotarsi slightly wider than in female, protarsal claws simple; metacalcaria simple.

FEMALE. Differs from the male in sexual characters, in its alutaceous dorsal and ventral sculpture, and by virtual absence of any indication of a sutural stria.

Holotype male and *allotype* female from Mendocino Co., California, May 29, 1922 (E. R. Leach, collector), Nos. 5837 and 5838, Museum of the California Academy of Sciences, Entomology. One male and one female *paratype*, Mendocino Co., California, July 20, 1928 (E. R. Leach); the male paratype in the Canadian National Collection, the female in the British Museum (Nat. Hist.).

Bidessus leachi is dedicated to its collector, Mr. E. R. Leach of Oakland, Calif., in apreciation of his encouragement of entomology in California, especially with regard to the journal "The Pan-Pacific Entomologist". It is most closely allied to *plicipennis* (Crotch), *pictodes* Sharp, and *quadripustulatus* Fall. In Hatch's key (1929. Studies on Dytiscidae. Brooklyn Ent. Soc., Bul. 23 (5): 217) it runs to *plicipennis* if the elytra are considered to be carinate, which they are not in either species (vide supra) though they are truly so in *exiguus* (Aube). In *pictodes* and *quadripustulatus* the elytra are evenly inflated, not flat or carinate discally. *B. leachi* is distinguished from *plicipennis* by the fact that the margins of the depressed area start sensibly inward from the elytral plicae (fig. 1), not directly behind them; in addition the yellow areas are more extensive, the punctation less dense, and the antemedian longitudinal impression at the sides above the true lateral margin, is hardly apparent. There are obvious differences in the male genitalia, compare figs. 2 and 3. My concept of *plicipennis* is based on a series of specimens of both sexes, from Bear Creek, Indian Gulch, Mariposa Co., Calif., March 2, 1940 (B. E. White); the male whose aedeagus is shown in fig. 2 was compared with a cotype of the species in the LeConte Collections by Dr. Frank N. Young in 1940.

ACKNOWLEDGMENT. I am indebted to Mr. B. A. Sugden, of Armstrong, B.C., for the drawing of the holotype.

A PRELIMINARY ANNOTATED LIST OF ICHNEUMONIDAE COLLECTED IN THE WELLINGTON DISTRICT OF VANCOUVER ISLAND, BRITISH COLUMBIA (Hymenoptera)

RICHARD GUPPY
Wellington, B.C.

Owing to the incomplete state in which revision of this family remains at present many species could be named to genus only. Determinations are by Dr. Henry K. Townes, to whom I express my thanks. Remarks included in quotation marks and initialed H. T. are by Dr. Townes. Other notes are from my own observations. For the purpose of this preliminary list the order is alphabetical by genera.

Amblyteles ormenus Cr. (date lost).

Amblyteles subrufus Cr. 19. IV. 45.

Aplomerus n. sp. 17. IV.45. Dead in pupal cocoon in borings of Buprestidae in dry fir.

Aptesis decorata Prov. 25. V.46. On window.

Bathythrix claviger Tasch. 2. VIII.46.

Campoletis argentifrons Cr. 5. V. 46. On window.

Campoplegidea pilosa Wly. II-VIII. 46. "Common in North West" (H. T.).

Coccygomimus sanguineipes Cr. 5. VIII. 45.

Coelichneumon sp. 21. V. 46. "A new one to me" (H. T.).

Cratichneumon unifasciatorius Say. 24. V. 45, 7. IX. 46. Reared from pupa of moth, probably Arctiidae. "Common and widespread with a number of host records including several species of Arctiidae" (H. T.).

Cubocephalus ater Ash. 20. VI. 46, 14. VII. 46. On windows. "Recorded from Colorado and Victoria, B.C. Presumably parasite of Coleoptera larvae in wood." (H. T.)

Helcostizus yukonensis Ash. 2♂ 15. V. 45. Bred from pupae taken during the winter in borings of Cerambycidae in dead willow. The appearance of these borings and of larvae found in them were identical with those from which I have repeatedly reared *Plectrura spinicauda* Mann. 1♀ 20. V. 45. Bred from pupa under the same conditions except that no attempt could be made to identify the borings. "Recorded only from Fort Yukon, Alaska. No host record." (H.T.)

Megarhyssa mortoni Cr. 26. VIII. 46. A large striking insect with long external ovipositor. "Parasite on Siricidae. Recorded from B.C." (H.T.)

Metopius n. sp. 27. IX. 46. On cabbage. "Members of this genus are scarce insects." (H.T.)

Netelia macroglossa Tow. 19. IX. 46, 22. IX. 46. Both at light after dark. "The second and third specimens known. Type is from Nevada." (H.T.)

Netelia sp. ♀ 19. X. 46. On window. "Probably *macroglossa* Tow. Male is needed for certain determination." (H.T.)

Netelia deceptor Morl. 19. IX. 46. Nocturnal at light. "Recorded from B.C." (H.T.)

Netelia californica Cush. 12. VIII. 46, 31. VIII. 46, 4. IX. 45, 23. IX. 46. Nocturnal at light. "Common on the West Coast. Recorded from B.C." (H.T.)

Platylabus clarus Cr. 2. VII. 46. "Widespread but uncommon. Not recorded from the West." (H.T.)

Phygadeuon aciculatus Prov. 8. V. 45. Bred from a dipterous puparium taken from rotten log. "Recorded only from Juebec. No host record." (H.T.)

Pseudamblyteles sp. ♀ 20.V. 46, 5. VI. 46, 14. VI. 46. "Probably new, need to see the ♂." (H.T.)

Rhyssa lineolata Kby. 20. VIII. 46. A large and handsome insect with very long ovipositor. Taken while ovipositing in a dead fir sapling. "A parasite of wood boring beetles and Siricidae. Recorded from B.C." (H.T.)

Sternocryptus bitinctus Grav. II-VII. 46, 28. VII. 46. "A European species recorded in America only from Maine." (H.T.)

Therion circumflexum L. 2 specimens 8. VIII. 45. Reared from larvae of *Acronycta hesperida*, or related species (Lepidoptera, Phalaenidae). Both specimens were found dead without having escaped from the cocoon formed by the caterpillar. "A widespread species of Eurasia and North America. Taylor in 1884 reported it reared from a Phalaenid. This is the only record for B.C. and only North American rearing." (H.T.)

Xorides insularis Cr. 2 specimens 22.VIII. 46. On dead cedar. "A parasite of wood boring Coleoptera. Vancouver Island is the type locality." (H.T.)

Zabrochypus slossonae Ds. I-VI. 46. On window. "A parasite of spiders. Not recorded from B.C." (H.T.)

In addition to the above records, a number of species, apparently new to science, and belonging to the genera *Aoplus*, *Eriplanus*, *Ophion*, *Pseudambyteles* and *Pterocormus*, were collected.

THE CONTROL OF THE HOLLY LEAF MINER PHYTOMYZA ILICIS CURTIS BY MEANS OF DDT (Diptera: Phytomyzidae)

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After more than twenty years, during which many attempts were made to control the holly leaf miner (*Phytomyza ilicis* Curtis), usually with indifferent success, the problem now appears to be nearer solution than ever before through the use of DDT. Initial trials on a few trees in 1945 were encouraging and indicated that, provided proper timing was observed, a far greater measure of success was possible with this material than with any insecticide hitherto tried.

In 1946 plans were made at the Dominion Entomological Laboratory, Victoria, for large scale spray trials. A plantation containing 182 trees from ten to twelve feet high was secured for this purpose. Only one preparation of DDT was tried ,a powder containing 20 per cent DDT ground in pyrophyllite. This was used at the rate of 10 lbs. to 100 gallons of water to make a spray containing 2 lbs. of actual DDT per 100 gallons. A block of 70 trees was sprayed with this strength and a block of 56 trees with 1 lb. of actual DDT per 100 gallons. Another block of 56 trees was left unsprayed as a check. Orvus, at the rate of 110 grams per 100 gallons was used as a spreader. This amount was found excessive and caused considerable frothing which slowed down the pump and caused too much run off. Spraying was carried out on May 11th. At this date the flower buds on the majority of the trees were just beginning to open but three were a few trees of earlier blooming varieties which were in full bloom. Only one application was made.

The results from these trials were taken on February 26th, 1947. The mined leaves are scarcely noticeable until the beginning of winter and the mines do not reach their maximum size until February when they assume the form of a large irregular blotch. It is at this time of year therefore, that observations can be most accurately made.

In the block of trees sprayed with 2 lbs. per 100 gallons many trees were found showing 100 per cent control and it is probable that had the spray been applied a few days earlier the results would have been even more conclusive. At the time of spraying a few *Phytomyza* adults were observed on the wing and as oviposition occurs within a few hours after emergence it is probable that these early individuals were responsible for some of the mines which were found in the sprayed plots.

No interference with pollination appeared to be caused by the use of DDT as an excellent crop of holly was harvested. In the initail experiment carried out in 1945 some of the trees were nearly in full bloom but nevertheless a full crop of berries was produced. Bees visiting these trees did not remain long. They were observed to visit a few flowers but soon became uneasy and took flight. As they were in contact with the sprayed surfaces for only a short period, it is unlikely that the DDT would have any permanent effect on them.

CONCLUSION: From the experience gained in these experiments it is apparent the holly leaf miner can be satifactorily controlled with a single application of DDT spray. While 2 lbs. of actual DDT to 100 gallons appears to give nearly perfect results, further experimental work may show that a weaker spray is commercially practicable. The spray should be applied not later than the beginning of May in most seasons and it may be found preferable to apply it during the last week in April.

My thanks are due to Mr. Lawrence Hafer of Brentwood for the use of his holly plantation and to Mr. H. Andison who gave valuable assistance in checking the results of the experiments.

TABLE OF RESULTS

lbs. DDT per 100 gals.	Leaves counted	Mined leaves	%
2	4,000	26	.60
1	4,000	249	6.20
Check	4,000	2442	61.05

NOTES ON THE LIFE HISTORY OF SOME TABANID LARVAE (Diptera)[1]

Gwladys N. Hatton
Livestock Insects Laboratory, Kamloops, B.C.

A considerable number of tabanid larvae were collected during June and July in 1946 by the staff of the Dominion Livestock Insects Laboratory, Kamloops. These were kept alive in the laboratory by different rearing methods and detailed notes were made on the feeding habits, number of molts, and the activity, of each individual larva. In addition, a survey of local ponds was made for tabanid egg masses and pupae.

In 1934, the late Mr. Donald Cameron* reported finding four tabanid larvae on the margin of Moose Lake near Kamloops. He kept them alive for several months, remarking that "they were very resistant to dry conditions and sometimes when apparently dead and dried up, would immediately become active when moistened again".

Nineteen larvae and one pupa were collected on two trips to this lake in June 1946, and during successive trips to other likely ponds around Kamloops, a total of sixty-one larvae was found. Tabanid larvae were taken from Stake Lake on the Lac le Jeune road, Strawberry Heights (Rayleigh, B.C.), ponds on the highway near Savona, and from a slough on the Lac du Bois range.

Pupae were more difficult to find as they were usually on the surface of the ground and well protected by their brown colouring. The first evidence of pupation was on June 15, and during the remainder of June and July, seven pupae were found—of which four emerged. These were kindly identified by Dr. C. B. Philip of the Rocky Mountain Laboratory, Hamilton, Montana, as *Chrysops furcatus* Walk. ♀, *Hybomitra* sp. near *hoemaphora* Mart. ♀, *Hybomitra* sp. ♂, and *Hybomitra illotus*, O. S., ♂.

The ideal shoreline for collecting tabanid larvae is a fairly steep slope covered with moss and loose black humus soil. They are probably easier to find in a steep bank because of the concentration of larvae in a smaller area due to the moisture gradient.

Moose Lake on the Tranquille range where the larvae were most easily found in June, is a small alga covered pond in the timber, bordered with tall grasses and damp mossy hummocks. By searching steadily through the black mud with a trowel a few inches from the water's edge, and parting the clods of earth and roots with the hands, it was possible to find about three larvae an hour. Most of these were at a depth of from one to three inches, but later on some were found just under the moss on the surface of the mud and several large larvae were taken from some fairly dry moss a foot above the water. There is some evidence that the larvae usually move to a dryer area to pupate; this was also noted in the laboratory.

On July 12 a slough on the Lac du Bois range was found to provide a much easier collecting area. Along the shore line a thick mat of grass and debris had been washed up, and by turning this over, the tabanid larvae could be picked out almost at the rate of one a minute.

The first larvae collected were maintained in the laboratory under the following conditions: some in damp mud, some in damp sand as recommended by Isaac (1924), and others in large vials containing half an inch of water and a short roll of rough paper towelling, following Philip's (1928) modification of Marchand's technique. The first two methods were discarded for the third, as the larvae escaped repeatedly from the dishes of mud and sand. In the vials the larvae crawled between two layers of the paper and remained at the bottom completely

1 Contribution No. 2514, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

* Formerly of the staff at the Livestock Insects Laboratory, Kamloops, B.C.

submerged in water with their respiratory siphons extended to the surface.

Continuing to use Philip's method, the larvae were kept alive very successfully by feeding them every two or three days on fly maggots and pieces of earthworm. Each larva was fed individually between two pieces of damp towelling on the table top. It was necessary to keep them covered while feeding as they are thigmotropic and tend to refuse food in order to crawl in search of cover. Notes were kept on their feeding habits. When offered a piece of food they actually pounced on it, making a sharp clicking noise, and often they have been observed to attack one another in the same way when being fed. When collecting the larvae, each one was placed in an individual vial since, if they were all together, several would be killed by the time they reached the laboratory.

The activity and amount eaten by each larva varied considerably from day to day. One large larva which had been inactive for a week escaped from a vial through two layers of cheese-cloth, and when discovered two days later, was actively crawling along the hall two flights of stairs below. Immediately before a molt they became very active and refused any food. In one instance a larva escaped through a cheese-cloth cover, continued through a water bath and ended up in the folds of a cardboard box where it was found the next day. However, although dried out, it was still alive, and ultimately pupated.

Three of the larvae fed in the laboratory pupated and emerged. The pupal periods lasted nine, ten and thirteen days. In July and August several larvae molted, but none pupated. The majority remained active all winter, feeding every few days on earthworms.

Dr. Philip has determined these last emergences as: *Chrysops furcatus* Walk. ♂, *Hybomitra* sp., near *sonomensis*, ♀, and *Atylotus incisuralis* Walk. ♀.

The first search for egg masses was made on August 9 around the Lac du Bois slough and although the larvae were abundant around the margin, no egg masses could be found. The water plants forming a fringe about four feet wide around the slough, and growing in black mud with water three to four inches deep, to all appearances provided ideal oviposition sites. A week later, after a very thorough search of this area, two egg masses were found on the under and upper sides of the leaves of the water parsnip, seven inches above the water. They were both brown with a flat surface and 0.7 cm. and 1.5 cm. long in the shape of a triangle. The eggs were laid in a single layer.

Short pieces of plant bearing the eggs were placed in separate vials and kept on moss in a glass covered aquarium to keep them moist. Thirty larvae emerged from the larger egg mass six days after collection, and three days later, on August 23, minute parasitic flies emerged from the remaining unhatched eggs. They continued to emerge for the next four days and appeared to occupy the greater part of the egg mass.

McQueen Lake on the same range proved to be a better collecting area, and in two trips there, thirteen egg masses were found on the tall sedges along the margin. These were of at least two species, as ten were shiny coal black, built up in a rounded mass, three layers of eggs deep, and located on the under side of the blade. The other three were brown and deposited on the upper side of the blade with a flat sloping surface to their triangular shaped mass, and no distinct layers of eggs apparent. Larvae emerged from two of these egg masses, but the remaining eleven were parasitized.

The parasites were determined by Dr. C. F. W. Muesebeck of the United States National Museum as *Telenomus emersoni* (Girault). This species has been stated by Cameron (1926:38-39) to be a fairly common parasite of *Chrysops moerens* Walk. and *Chrysops mitis* O. S. in Saskatchewan.

The newly hatched larvae fed well

when placed on pieces of earthworm. The midgut showed red in the almost transparent young larvae after they had fed, and even in these minute larvae the black chitinous jaws were apparent. They were very resistant to dry conditions; a small larva left overnight on some towelling revived when moistened with a little water. However, no larvae hatched from egg masses were successfully reared through to the adult stages.

As the majority of the collected larvae have been feeding all winter, it will be interesting to note whether this forced activity in any way modifies their development, since under natural conditions they would remain dormant during the winter.

Much yet remains to be learned about the early stages of many of our tabanid species, to say nothing of such mysteries as what happens to the minute adult parasites from one fall until the following midsummer's egg supply, and further studies in this field should bring to light interesting data.

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SOME NOTES ON THE HABITS OF ARZAMA OBLIQUA ON VANCOUVER ISLAND. (Lepidoptera: Phalaenidae)

Richard Guppy
Wellington, B.C.

Arzama obliqua Walk. belongs to a group of Phalaenid moths which, though neither abundant nor conspicuous, have attracted attention because of the peculiar habits of the larvae. These mine in the stems of their food plants instead of feeding on the leaves in the ordinary manner.

The species of the genus *Arzama* are known by the common name of "cattail moths", from their usually recognized food plants, *Typha latifolia* or related "cattails".

Prof. J. H. Comstock in his "Introduction to Entomology", gives some data regarding *Arzama obliqua* which I reproduce in part on account of its bearing on my observations.

"Two or more species of noctuids infest the cat-tail plant, *Typha,* in this country. The larvae of both are at first leaf-miners, later they bore in the stalks. Our most common species is *Arzama obliqua.* According to the observations of Classen (1921) the full-grown larva overwinters in its burrow in the cat-tail plant and transforms in the spring. But the late Prof. D. S. Kellicott, who made a special study of this species, informed me in a letter written in 1882, that the larva leaves the cat-tail plant in the fall and conceals itself under bark, in old wood and even in the ground until spring when it pupates, and emerges as a moth in May. It is evident therefore, that individuals of this species differ as to the location in which they pass the winter."

I found these larvae to be quite abundant in a low lying swampy area near my home, while they were wintering under loose bark on fallen cedar logs. There are no cattails anywhere in the vicinity; later I ascertained the caterpillars were feeding in the leaf stems of skunk cabbage *(Lysichiton kamtschatcense).*

I have not been successful in rearing these larvae from the egg. Possibly it is necessary that the ova should be deposited on growing leaves of the food plant.

When taken from *Lysichiton* stems in late August of 1946 they were evidently far past the leaf mining stage, though still quite small. This however appears to have been a late season. In all stages of growth except the final instar, these larvae have a waxy semi-transparent appearance. The color at this time is a light brown, with a dark patch on the first thoracic segment. When full grown they lose the transparency and become dark gray, the mark on the thorax is still in evidence. At this stage they resemble the typical Phalaenid larvae known as cutworms, except in size, being up to 50 mm. in length.

In his description of the related genus *Bellura*, Prof. Comstock describes a modification of the hind end of the caterpillar which supposedly allows these aquatic larvae to breathe while only the caudal extremity is held against the surface of the water. Briefly, this consists of a reduction in size of the last abdominal segment which allows room for two large spiracles on the posterior part of the preceding segment.

Though Comstock does not mention this arrangement as being common to *Arzama* spp. also, it could be clearly observed in all the *A. obliqua* larvae which I examined. The extraordinarily large size of all the spiracles is also very noticeable. The *Arzama* larvae could not be described as aquatic, and the use, if any, to which this specialization is put is a matter for conjecture. It may indicate a close relationship with, and derivation from, the genus *Bellura*. The feeding of these larvae on such widely different plants as *Lysichiton* and *Typha*, indicates great adaptability, and they may on occasion take to water lilies, or other truly aquatic plants.

Their burrows in the stems of *Lysichiton* leaves extend from below the ground level, and are from 1 to 2 feet in length according to the size of the leaf. No opening can be found in the upper end of the boring. It is difficult to ascertain whether the lower end is open, owing to the leaves being bunched together and attached below the ground level to a tough rootstock. My observations lead me to believe that there is usually an opening at the lower end, which would at least account for the absence of excrement, which I never found in the borings. The insects evidently traverse the length of the burrows several times during their larval life, enlarging it each time to suit their increasing girth.

These *Lysichiton* feeding larvae must of necessity abandon their leaf stem homes on the approach of winter, since the fleshy leaves, on withering, soften and disintegrate almost at once. During winter I found the caterpillars nearly always under the loose bark on fallen cedar trees. Some digging in the soft decayed cambium is usually done in order to construct an oval hibernation cell. The material chewed out is used to plug up any space between the bark and cambium, including the aperture by which the larva entered. I have also found them under the bark of dead willows and alders, and occasionally in the wood of much decayed fir logs. My activities in stripping all the bark from cedar logs in the area under observation, must be considered as having some effect in forcing them to take to second choice locations.

I was not able to ascertain just when pupation takes place, but at least it is not until the spring, a short time before the adult insects appear. Occasionally a larva may leave its hibernation cell in order to search for a better hideout, but no feeding takes place at this time. As a rule pupation takes place in the cell in which the winter was passed.

The adult moths appear during the latter half of June in this locality. I have one record for June 10th; others are from June 27th to July 5th. Mr. J. R. J. Llewellyn Jones of Cobble Hill, to whom I sent several larvae, informs me that adults emerged on June 1st and June 8th.

From such information that I have been able to gather, it appears that the species is widespread in North America, but not abundant anywhere in Canada.

ACKNOWLEDGMENTS. I am indebted to Mr. Llewellyn Jones for determination of specimens of *Arzama obliqua*, and also for information regarding the habits of the species which led me to make the researches described above. My thanks are also due to Floyd L. Caesar for information on the habits of the moth in Eastern Canada.

A PRELIMINARY LIST OF TIPULIDAE FROM BRITISH COLUMBIA (Diptera)

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Along with collections in all orders which I have made since coming to this province, for seven years I gathered all the Tipulidae I could find and in 1932 sent some 1130 specimens to Dr. C. P. Alexander, Massachusetts Agricultural College, Amherst, the world authority on these flies, who had very kindly agreed to identify them for me. Dr. Alexander informed me that he could not name many of them without referring to the types and since the types of some fifty western species were in Pulman and San Francisco and the institutions housing them could not send them to him, the identification of my material would have to wait until he could travel to inspect them; in the meantime, the collections are still in his possession. For several reasons, namely, ill-health, bereavement, teaching load and added duties during the war years, Dr. Alexander has not been able to resume the study of this material, but when he does, it will be possible to issue a more up-to-date list and, when the specimens are returned, the University will have a basic collection of these flies for reference purposes.

For the present therefore, I can submit only the following list of 84 species which up to June 1, 1933, have been recorded from all sources, including the Canadian National Collection. I am very grateful to Dr. Alexander for generously and laboriously compiling the list which is produced herewith as he sent it to me. It will be noted that only seven records bear my name and since most of the specimens in the collection were taken by me, it means that there must be great difficulty in placing British Columbia Tipulidae.

In view of the fact that over 700 species of this family have been recorded from the Province of Quebec alone, I feel that at least that number, if not more, will eventually be found in this Province which has a far greater climatic and vegetational variation than has Quebec.

CRANE-FLIES OF BRITISH COLUMBIA

(Based on identifications of collections of Dr. C. P. Alexander, Mr. H. B. Leech and others: also printed records.)

Family TANYDERIDAE

Protanyderus vipio (O.S.)
Cranbrook, Aug. 2, 1920; 1♀.

Family PTYCHOPTERIDAE

Ptychoptera lenis (O.S.)
Hector, July 15, 1928 (Bryant). Salmon Arm, April 29, 1931; May 4, 1930 (Leech).

Bittacomorphella sackeni (Roder)
Queen Charlotte Islands. n.d. Stanley Park, Vancouver, flying beside stream, Sept. 3, 1930 Leech).

Family TRICHOCERIDAE

Diazosma subsinuata Alex.
Vancouver, July, 1931 (Leech).

Paracladura trichoptera (O.S.)
Vancouver, Oct. 9, 1931 (Leech).

Trichocera columbiana Alex. (Can. Ent. 50: 70, 1927)
Prince Rupert, June 17, 1919 (Dyar). Victoria, March 28, 1916 (Treherne). Victoria, March 8, 1920 (W. B. Anderson). Metlakatla, Nov. 9, 1908 (J. H. Keen).

Trichocera garretti Alex. (Can. Ent. 59: 71-72; 1927)
Marysville, 5,500 ft., May 11, 1919 (Garrett). Lillooet, May 3, 1916 (Tom Wilson). Cranbrook, April 5, May 5, Oct. 21, Nov. 9 (Garrett). Salmon Arm, Feb. 12, 1932 (Leech); reared.

Family TIPULIDAE
Sub-family TIPULINAE

Ctenophora angustipennis Lw.
Agassiz, May 11, 1922 (R. Glendenning). Wellington, May 11, 1898. Victoria, April 24, 1904 (Hanham). (Vancouver Island Rec. Bergroth, Vien. Ent. Zeitg. 7: 201).

Holorusia rubiginosa Lw. *(grandis* Bergr.)
Departure Bay, July 5, 1913 (J. B. Kurata); Univ. Toronto Coll. Vancouver, July 28, 1931 (Leech; 1♀. U. Brit. Col., July 2, 1931 (Leech); 1♀.

Tipula (Cinctotipula) dorsolineata Doane
New Lake, Cranbrook, Aug. 26, 1919 (Garrett). Cranbrook, Aug. 5-Sept. 4, 4,000 ft. (Garrett).

Tipula accurata Alex (Can. Ent. 59: 184-185, 1927)
Keremeos, June 26-July 15, Aug. 1-2, 1923 (Garrett).

Tipula californica (Doane, 1908) (as *Pachyrhina)*
Gordon Head, June 15, 1920 (W. Downes). Victoria, May 16 1916 (Treherne). Victoria, May 3, 1919 (W. B. Anderson). Victoria, June 28, May 5, 1919 (W. Downes).

Tipula dorsimacula Walk. (*angustipennis* Lw.)
Agassiz, May 8, 1926 (H. H. Ross). Cranbrook, May 12-20, 1933 (Garrett); May 8, June 16. Oliver, May 15, 1923 (Garrett). Douglas, June 6, 1922 (E. R. Buckell). Lillooet (A. Phair). Salmon Arm, April 29, 1931 (Leech).

Tipula imbellis Alex. (Can. Ent. 59: 186-187, 1927)
Osoyoos, May 18, 1923 (Garrett).

Tipula leechi Alex. mss.
Vancouver, July 11, 1930 (Leech); ♂ in poor shape.

Tipula pubera Lw.
Vancouver, July 7, 1931 (Leech; 1 ♂.

Tipula retussa Doane.
Gordon Head, June 14, 1919 (Downes) on strawberry.

Tipula streptocera Doane.
Nanaimo, July 1, 1925 (Spencer); 1 ♂. Departure Bay, July 24, 1913 (E. M. Walker); Univ. Toronto Coll.

Tipula trypetophora Dietz.
Victoria, July 6, 1912 (type-locality). Vancouver, May 28, 1931; June 30, 1931; July 7-23, 1931 (Leech).

Prionocera fuscipennis Lw. (*Stygeropis*)
Cranbrook, 4,000 ft., May 7-20, July 14 (Garrett).

Nephrotoma altissima erythrophrys (Will.) (*Pachyrrhina*)
Cranbrook, 3,500 ft., June 26 (Garrett). Field, 4,800 ft., July 1, 1908 (J. C. Bradley). Carbonate, 2,600 ft., July 7-12, 1908 (Bradley).

Nephrotoma excelsior (Bergr.) (Wien. Ent. Zeitg. 7: 239)
Cascade Mountains (type-locality).

Nephrotoma lineata (Scop.) (Ibid. 7: 239)
Brit. Col. (Recorded by Bergroth); identity somewhat doubtful.

Nephrotoma occidentalis (Doane) (*Pachyrrhina*)
Vancouver, July 17-Aug. 21, 1931 (Leech), abundant.

Sub-family CYLINDROTOMINAE

Phalacrocera vancouverensis Alex. (Can. Ent. 59: 180-190, 1927)
Vancouver, April 10, 1922 (W. B. Anderson). Vancouver, Nov., 1929 (G. J. Spencer).

Cylindrotoma splendens Doane (*juncta* Coq.)
Westholme, May 10, 1918 (W. Downes). Victoria, May 28, 1917 (A. E. Cameron); reared. Vancouver, May 15, 1917 (Cameron). Mt. McLean, 6,000-7,200 ft., Lillooet, July 12, 1926 (McDunnough); Can. Nat. Coll.

Sub-family LIMONIINAE
Tribe LIMONIINI

Antocha (Antocha) *monticola* Alex.
Seton Lake, Lillooet, May 28, 1926 (J. McDunnough); C.N. Coll.

Elliptera astigmatica Alex. (Psyche. 19: 164-165, 1912)
Rogers Pass, July 30, 1908 (Bradley), Kokanee Mt., 8,000 ft., Aug. 10, 1903 (Currie). London Hill Mine, 7,000 ft., July 21, 1903 (Currie). Hector, July 15, 1928 (Owen Bryant).

Dicranoptycha occidentalis Alex.
Vancouver, June 30, July 20-29, Aug. 11-12, 1931 (Leech). Cranbrook (Garrett). (NOTE: This is the *D. sobrina* OS record in Garrett's East Kootenay List, Can. Ent. 52: 108, 1920.)

Limonia (Limonia) bestigma (Coq.) (Journ. N.Y. Ent. Soc. 13: 57, 1905)
Bear Lake, July 29, 1903 (Currie).

Limonia (Limonia) californica (OS)
Vancouver, Aug. 18, 1931; feeding on molasses moth-bait (Leech).

Limonia (Limonia) concinna (Will.)
Cranbrook, 3,500 ft., April 28, 1919 (Garrett).

Limonia (Limonia) maculicosta (Coq.) (Journ. N.Y. Ent. Soc. 13: 57, 1905)
Kokanee Mt., 8,000 ft., Aug. 10, 1903 Currie).

Limonia (Limonia) nitidiuscula Alex.
Vancouver, May 7, 1932 (Spencer); Aug. 11-14; Sept. 9-16, 1931 (Spencer).

Limonia (Limonia) sciophila (O.S.)
Smith Fork, Aug. 11, 1903 (Caudell). Kaslo, Aug. 16, 1903 (Caudell). Kokanee Mt., Aug. 10, 1903 (Caudell). Powder Is., July 25, 1905 (J. M. Aldrich). Victoria, June 20, 1917 (Cameron). Roger's Pass, Aug. 9, 1914 (J. C. Bradley). Hector, July 15, 1928 (O. Bryant). Duncan, Sept. 3, 1914; Aug. 9, 1914 (J. C. Bradley). Vancouver, Sept. 16-17, 1931; July 25; Aug. 11, 1931 (Leech).

Limonia (Limonia) tripunctata (Fabr.)
Recorded from Brit. Col. by Bergroth, Wien. Ent. Zeitg, 7: 239, 1888. Identity probably O.K.

Limonia (Discobola) argus (Say)
Kaslo, Aug. 20, 1903 (Caudell and Currie).

Limonia (Geranomyia) canadensis (Westwood)
Wasa, 6,000 ft. (Date, Coll. ?). Cranbrook, 6,000 ft. (Garrett).

Limonia (Rhipidia) maculata (Meig.)
Kaslo, Aug. 20, 1903 (Dyar and Caudell).

Limonia (Dicranomyia) badia (Walk.)
Seton Lake, Lillooet, June 3, 1926 (McDunnough); Can. Nat. Coll.

Limonia (Dicranomyia) halterata (OS)
Duncan, Vancouver Is., Sept. 3, 1913 (J. C. Bradley). Cranbrook, Sept. 26 (Garrett).

Limonia (Dicranomyia) morioides (OS)
Hector, July 15, 1928 (O. Bryant).

Limonia (Dicranomyia) vulgata (Bergr.)
Bear Lake, July 20, 1903 (Currie); as determined by Coquillett.

Limonia (Alexandriaria) intermedia (Garrett)
Cranbrook, July 6, 10, 15, 1920 (Garrett); types.

Limonia (Alexandriaria) kooteniensis (Garrett)
Cranbrook, July 15, 1920 (Garrett); type.

Limonia (Alexandriaria) suffusca (Garrett)
Cranbrook, 2,950 ft., Oct. 9, 1920 (Garrett); type.

Tribe PEDICIINI

Ornithodes harrimani Coq.
Hector, July 15, 1928 (O. Bryant); (vide Bull. Brooklyn Ent. Soc. 26: 179-180, 1931).

Pedicia (Pedicia) magnifica (Hine) (as *Peditia)*
Port Renfrew, July 27, 1902 (R. C. Ozburn); type. Cypress Creek, Vancouver, Aug. 16, 1931 (Leech); 1 broken ♀.
Pedicia (Pedicia) parvicellula Alex. n. sp. mss.
Cypress Creek, Vancouver, Aug. 16, 1931 (Leech).
Pedicia (Tricyphona) ampla (Doane)
Duncan, Vancouver, Sept. 3, 1914 (J. C. Bradley). Revelstoke, Aug. 22 (H. G. Dyar). Vancouver, Aug. 2, 26, 1931; Sept. 10, 1931 (Leech).
Pedicia (Tricyphona) aperta (Coq.) (Journ. N.Y. Ent. Soc. 13: 59, 1905)
Kaslo, May 29, 1903; June 10, 1903 (Dyar); types. Hector, July 15, 1928 (O. Bryant).
Pedicia (Tricyphona) constans (Doane)
Vancouver, Aug. 4, 1931 (Leech); May 17, 1930 (Spencer). Departure Bay, May 22, 1925 (Spencer). Langley, April 16, 1931 (K. Graham). Duncan, Sept. 13, 1914 (J. C. Bradley).
Pedicia (Tricyphona) protea (Alex.)
Prince Rupert, June 17, 1919 (H. G. Dyar). Vancouver, May 7, 1932 (Spencer).
Pedicia (Tricyphona) rubiginosa Alex.
Hector, July 15, 1928 (O. Bryant); types.
Pedicia (Tricyphona) vitripennis (Doane)
Vancouver, April 16, 1931; May 4, 1931 (Leech); April 11-18, 1930, May 17, 1930 (Spencer). Campus, U. Brit. Col., Oct. 18, 1928 (M. H. Campbell). Lowe Inlet, June 3, 1897 (T. Kincaid); Coquillett Record.
Dicranota (Dicranota) montana (Alex.)
Salmon Arm, April 29, 1931 (Leech). Hector, July 15, 1928 (O. Bryant).
Dicranota (Rhaphidolabis) neomexicana (Alex)
Cranbrook, 3,500 ft., July 21 (Garrett).
Dicranota (Rhaphidolabis) subsessilis (Alex)
Hector, July 15, 1928 (O. Bryant).
Polyangaeus maculatus Doane
Alta Lake, Mons, June 11, 1926 (McDunnough); Can. Nat. Coll.

Tribe HEXATOMINI

Adelphomyia sp., near *americana* Alex.
Cypress Creek, Vancouver, Aug. 16, 1931 (Leech); 1 ♀ only, ♂♂ greatly needed.
Epiphragma (Epiphragma) picta (Fabr.)
Recorded from Brit. Col. by Bergroth (Vien. Ent. Zeitg. 7: 239, 1888). It is probable that the identity is O.K.
Pseudolimnophila badia (Doane)
Kaslo, June 11, 1903 (Dyar).
Archilimnophila subunica (Alex.)
Grouse Mt., Vancouver, 4,000 ft., June 14, 1931 (Leech).
Dactylolabis hortensia Alex. (Proc. Acad. N.S. Phila. 1914: 591-592, 1914)
London Hill Mine, Bear Lake, 7,000 ft., July 29, 1903 (Caudell); types.
Dactylolabis pteropoecila (Alex.)
Seymour Creek, Vancouver, May 12, 1931 (Leech).
Phyllolabis bryantiana Alex.
Hector, July 15, 1928 (O. Bryant); types.
Limnophila (Prionolabis) cressoni Alex.
Prince Rupert, June 17, 1919 (H. G. Dyar).
Limnophila (Phylidorea) columbiana Alex. (Proc. U.S. Nat. Mus. 72, art. 2; 12-13, 1927)
Prince Rupert, June 17, 1919 (Dyar); type.
Limnophila (Phylidorea) flavipila Doane
Vancouver, May 4, 1931 (Leech). Hollyburn Ridge, Vancouver, 3,000 ft., June 28, 1931 (Leech).
Limnophila (Phylidorea) fuscovenosa Alex.
(Can. Ent. 59: 190-191, 1927) Revelstoke, 5000-6000 ft., July 20-21, 1926 (McDunnough); type.
Limnophila antennata Coq.
Kaslo, Jun. 11-22, 1903; July 11, 1903 (Currie & Dyer); types.

Tribe ERIOPTERINI

Chionea alexandriana Garrett
Cranbrook, Feb. 22, 1921, 3500 ft.; Feb. 13, 1920 (Garrett). Canal Flats, Kootenay Valley, March, 1921; types.
Cladura (Cladura) oregona Alex.
Vancouver, Sept. 16-Oct. 6, 1931 (Leech). Langley Prairie, Nov. 2, 1930 (K. Graham).
Pterochionea bradleyi Alex. (Proc. Acad. Nat. Sci. Phila. 1916: 530-531) Roger's Pass, Aug. 9, 1915 (JC Bradley); type.
Neolimnophila ultima (OS)
Cranbrook, 3500 ft., Oct. 20 (Garrett).
Gonomyia (Ptilostena) californica Alex. (Can. Ent. 1916: 324-325)
Peachland, May 19, 1912; June 24, 1903. (The B. Col. record of *G. blanda*—Proc. Acad. N.S. Phila, 1914: 586-587—pertains to *californica.)*
Rhabdomastix (Sacandaga) monticola Alex. (Proc. Acad. N.S. Phila. 1916: 528-529, 1916)
Kokanee Mt., 8000 ft., Aug. 11, 1903 (Currie); type.
Rhabdomastix (Sacandaga) subcaudata Alex.
Hector, July 15, 1928 (O. Bryant).
Erioptera (Psiloconopa) aperta (Coq.) Journ. N.Y. Ent. Soc. 13: 59, 1905) as Gnophomyia.
Kaslo, July 11 and 18, 1903; types.
Helobia hybrida (Mg.)
Cranbrook, May 2, 1919 (Garrett).
Ormosia divergens (Coq.) (Journ N.Y. Ent. Soc. 13: 57-58, 1905).
Kaslo, Jun. 18 and 29, 1903 (Currie). London Hill Mine, Bear Lake, 7000 ft., Jul.. 21, 1903 (Caudell). Kokanee Mt., 9,000 ft. on snow, Aug. 10, 1903 (Currie).
Ormosia subcornuta Alex.
Langley, March 22, 1931 (K. Graham).
Molophilus colonus Bergr.
Hector, July 15, 1928 (O. Bryant).
Molophilus falcatus Bergr.
Prince Rupert, June 17, 1919 (Dyar & Aldrich).

SOME RECORDS OF COLLEMBOLA FROM BRITISH COLUMBIA

G. J. SPENCER
Department of Zoology, University of British Columbia.

Collembola are mostly restricted to damp situations where the sun does not strike; a few, however, occur under shelter in dry conditions during the day and wander out at night when the dew is on the ground.

The species mentioned here represent a collection made in 1933 by Mr. J. D. Gregson who very kindly presented them to the University. They were identified by the late Dr. Justus Folsom. The only specialist in this order in North America is Dr. Harlow B. Mills, Chief of the Natural History Survey of Illinois, who is too busy to determine specimens, so my further personal collections must remain unidentified for the present. Dr. Folsom informed me that at least 100 species of Collembola should occur in this Province: only 16 species are recorded here. With three exceptions (of my collecting, labelled G.J.S.) all these records were made by Mr. J. D. Gregson, whose annotations are appended in each case.

Suborder ATHROPLEONA Boerner, 1901

Family PODURIDAE Lubbock, 1870
Subfamily PODURINAE

1. *Podura aquaticus* Linn.
In colonies on leaves by edge of a rain puddle. Courtenay, V.I., 11 May, 1933. Mills (1934) says "this species is the only representative of the subfamily; it is often present in immense numbers on the surface of stagnant water."

Subfamily ACHORUTINAE Boerner, 1901

2. *Xenylla humicola* (Fabricius)
In, on and around damp moss on a rock by the water's edge; curl up when exposed to the sun. Brown's River, Courtenay, V.I. 7 May, 1933.

3. *Achorutes armatus* Nicolet
"Colour pattern extremely variable, from a dark blue to a canary yellow with various arrangements of spots and irregular stripes." (Mills).
On water, Foghorn Mt., North Thompson River valley, at 5000 feet, 5 July, 1933. Under mould, Mt. Washington, Forbidden Plateau, Courtenay, V.I., 8 Aug., 1933.

4. *Achorutes pseudarmatus* Folsom
Under debris on Mt. Washington, Forbidden Plateau. Courtenay, V.I., 8 Aug., 1933.

5. *Anurida maritima* (Linn.)
On seashore, Nanaimo, V.I., July, 1926. G. J. S.

Family ENTOMOBRYIDAE Tomosvary, 1883
Subfamily ISOTOMINAE Schaffer, 1896

6. *Folsomia fimetaria* var *dentata* Folsom
From potato cellar, Vancouver, 1 Dec., 1933. G. J. S.

7. *Isotoma viridis* Bourlet
Under wet log by a pool, Kamloops, 9 June, 1933.

8. *Isotoma viridis* var *catena* Guthrie
Damp earth floor, Brown's carnation house, Vancouver, 25 May, 1933. G. J. S.

9. *Isotoma palustris* Muller
Under dry board on swampy ground, Courtenay, V.I., 17 May, 1933.

10. *Entomobrya multifasciata* (Tullberg)
Under dry stone in dry pasture, Vavenby, North Thompson River valley, 5 June, 1933.

11. *Entomobrya triangularis* Schott.
No data.

12. *Sira buski* Lubbock
"A rather common resident of dwelling houses; occasionally under bark." (Mills) Alongside dry road, under boulders in dry conditions. Barriere, North Thompson River valley, 2 June, 1933.

13. *Lepidocyrtus cyaneus* Tullberg
"Generally extensively common." (Mills) Victoria, V.I., 16 July, 1933.

Subfamily TOMOCERINAE Schaffer, 1896

14. *Tomocerus flavescens* var. *arcticus* Schott
Under bark of big tree, Courtenay, V.I., 12 May, 1933; under bark at snowline, Courtenay, V.I., 10 April, 1933, when disturbed are active a short time then lie at various angles in snow crevices; under damp wood on Point Grey golf course, Vancouver, 22 April, 1933; under wet leaves at edge of rain pond, alder swamp, Courtenay, V.I., 14 May, 1933.

Subfamily SMINTHURINAE Boerner, 1906

15. *Bourlettiella spinata* (MacGillivray)
On lily leaves in Lost Lake, Victoria, V.I., 25 July, 1933.

16. *Phenothrix unicolor* (Harvey)
"On agarics and in humus." (Mills). Under damp stones, Camp 4, Forbidden Plateau, Courtenay, V.I., 8 Aug., 1933.

LITERATURE CITED

Mills, Harlow B., 1934. A monograph of the Collembola of Iowa. Colleg. Press. Inc., Ames Iowa.

1946 ORIENTAL FRUIT MOTH SURVEY IN THE SOUTHERN OKANAGAN VALLEY, B.C.

H. F. Olds
Division of Plant Protection, Science Service, Department of Agriculture, Vancouver, B.C.

At the 1945 Annual Meeting a paper was presented showing the extent of the Oriental Fruit Moth *Grapholitha molesta* (Busck.) in the United States and Canada. With the exception of California, which conducted its own, surveys were supervised by the United States Bureau of Entomology and Plant Quarantine and came immediately under the direction of the Domestic Plant Quarantines.

With the results of the 1945 survey known, the Bureau of Entomology felt that sufficient data had been obtained, and should any further surveys be required, they should be assumed by the States concerned.

Horticultural officials in the State of Washington communicated with our Division and informed us that they required further information relative to the spread of this insect within the State, and asked for the co-operation of our Division in determining if the insects were present in the southern portion of the Okanagan Valley in British Columbia.

Arrangements were made, therefore, whereby the Washington State Department of Agriculture would conduct surveys north and south of the town of Wenatchee, while our Division would conduct similar investigations in British Columbia. The area surveyed in British Columbia was all that portion north of the International Boundary from Osoyoos to Penticton, a distance of approximately fifty miles, thence westward to take in the Cawston-Keremeos district. Most of the traps were concentrated along the International Boundary at Osoyoos and in the peach orchards long the main highways.

Any moths collected which came within the size and colour range of *Grapholitha molesta* (Busck.) were submitted to Dr. James Marshall for identificaction. None of these interceptions proved to be the Oriental Fruit Moth.

Surveys in the State of Washington and British Columbia will continue during 1947, as it is important not only to know the annual spread of this pest in that State but should an incipient outbreak occur in British Columbia, it should be made known as soon as possible.

Preparation of Oriental Fruit Moth Bait

At the rate of one quart per trap five gallons of bait will fill 20 traps. This quantity is prepared by adding 4 pounds of sugar to 9 quarts of water, stirring until dissolved, then adding 1/3 ounce of terpinyl acetate and 1/5 ounce of saponin powder, and making up to 5 gallons with water. After the sugar has been dissolved, add 10 cc. or about 1/3 liquid ounce of terpinyl acetate, and then add saponin powder. Care should be taken in handling saponin as it is a very light powder and will be blown away if opened in a strong breeze or dropped into the solution from too great a distance above the surface. The plastic screw cap on a two ounce bottle can be used as a measure. In making up 5 gallon quantities 3 level caps are added, pour the dissolved materials into a large can, and then add water to make up five gallons. In the event that it may be desirable to make smaller quanties of bait, the following proportions are for one quart which is the quantity for one trap:

Water	472 cc.
Sugar	3.2 ounces
Terpinyl acetate	0.5 cc.
Saponin	0.25 grams
Water to make total	944 cc.

Precautionary Measures

All Customs officials at boundary ports and importers, as well as United States Department of Agriculture officials in the

[1] Contribution No. 67, Division of Plant Protection, Science Service, Dominion Department of Agriculture, Ottawa, Ontario.

State of Washington, have been advised that all fresh host fruits from known infested areas must be certified at shipping points, showing that such fruits have been fumigated with methyl bromide, with stated dosage, length of exposure, and temperature. Host fruits from free areas must be so certified—certificates to be signed by an officer of the State or Federal Department of Agriculture.

Railway companies co-operated with our Division in taking special care in cleaning cars which had previously carried host fruits of the Oriental Fruit Moth from the United States, particularly if such cars were intended to be re-allocated and sent to the Okanagan Valley for reloading.

AN ANNOTATED LIST OF COLEOPTERA TAKEN AT OR NEAR TERRACE, BRITISH COLUMBIA. PART I.

M. E. CLARK[1]
Massett, B.C.

Terrace is adjacent to the northern coast of British Columbia, on the Skeena River, at an elevation of 225 feet above sea level (latitude 54° N., longitude 128° W.). All species here listed were taken at or near Terrace, except for the following localities: Thornhill Mountain is at the head of Thornhill Creek, and most specimens were collected at about 5,000 feet elevation; Lake Lakelse, some 5 miles long, is south of Terrace; Prince Rupert is the northwestern terminus of the Canadian National Railway, on the coast 95 miles west of Terrace.

A few of the species were mentioned in my previous paper (Mrs. W. W. Hippisley, 1922. Notes on Northern British Columbia Coleoptera. Canad. Ent. **54** (3) :63-66). The fauna is undoubtedly far richer than the present list indicates, for my collecting has suffered from my having the use of but one arm. The beetles were taken as a side issue to the work about the ranch, or when I was on the way to town, for I never had the opportunity to make purely collecting trips.

I am very greatly indebted to Mr. C. A. Frost, of Framingham, Mass., for encouragement over the years. Except for a few lots sent direct to Col. T. L. Casey, all species listed here have been through his hands. The majority he identified, but many were sent to specialists for verification or naming, and their comments were forwarded to me with the returned insects.

[1] Mrs. A. H. Clark, formerly Mrs. W. W. Hippisley.

CICINDELIDAE

Cicindela longilabris Say.—Identified with the comment that it was true to type. Scarce, found on lodgepole pine flats on the 4th of June, 1920. I do not remember finding it elsewhere.

Cicindela oregona LeC.—Taken on the occasion of a walk up Green's Hill, at the back of Terrace, scarce; June, 1919.

Cicindela oslari var. *terracensis* Csy.

Cicindela repanda Dej.—Returned with the remark that it was a new record for the north and west.

Cicindela 12-guttata Dej. (=*edmontonensis* Carr)—Also a new record for the west; verified by W. Horn and H. C. Fall.

CARABIDAE

Trachypachus inermis Mots.—Returned to me marked "rare."

Brennus angusticollis Fisch. — Commonly found under loose bark in the fall of the year.

Brennus marginatus var. *fallax* Roesch.—Scarce, in rotten wood and stumps; checked by A. J. Kistler.

Brennus marginatus var. *confusor* Csy.—Examined by Kistler.

Brennus marginatus var. *fulleri* Horn—Seen by Kistler and P. J. Darlington.

Brennus gracilis Gehin—So identified by T. Casey, but called *fulleri* by Kistler; rare.

Carabus granulatus L.—Taken on a cinder walk above the fire hall in Prince Rupert. Also Terrace, 1932.

Carabus taedatus Fab.—Some typical, others non-typical, as to color; seen by Darlington. Taken on Thornhill Mountain by Fred Michaud, who kindly collected for me while pursuing his duties as a fire warden on the above mountain in 1939. He told me some were taken under loose flakes of rock, but mostly on patches of snow. I received the notice of Mr. Michaud's death on the 11th of November, of a stroke complicated by pneumonia. He was something over 70, a great personal friend and I think the quietest, kindliest gentleman I ever knew.

Calosoma sp. near *frigidum* Kby.—Only two specimens. One was taken in a clearing near a garden, the other along the railway track at Copper City, five or six miles from Terrace.

Loricera decempunctata Esch.—Scarce, on mud, edges of ponds, June; with *Elaphrus* about algal scum. Verified by E. C. Van Dyke.

Opisthius richardsoni Kby.—Common among reeds and under stones on the banks of the Skeena River in spring and fall. I have taken it among debris at Lake Lakelse, and Kalem, and my notes list a bronze form taken May 22nd, 1938.

Elaphrus clairvillei Kby.—Scarce, under bark at edges of pond.

Elaphrus clairvillei var. *frosti* Hippisley—Found with the typical form.

Elaphrus riparius L.—Common under drying algal scum, same pond.

Elaphrus punctatissimus Lec. (*riparius* L.?) Common under flakes of algae.

Elaphrus bituberosus Csy. (*riparius* L.?)—Sent to Casey by Mr. Frost, from my material.

Elaphrus pallipes Horn—Rare; one specimen at roadside by a trickle of drainage water, and one at Lake Lakelse.

Notiophilus near *sylvaticus* or *nemoralis*, or a new species.—Very scarce, mostly found in green moss just above the waters of Alwaine Creek; sometimes taken in chunks of wet, pulpy, rotten wood in November.

Leistus nigropiceus Csy. ?—Very rare.

Nebria eschscholtzi Men.—Taken under a piece of driftwood on the west bank of the Skeena River, on a large sand and gravel spit, late in October.

Nebria hippisleyi Csy.—Described by Casey from Terrace specimens.

Nebria paradisi Darl.—Verified by Darlington. A flightless species taken on Thornhill Mountain (5,000 ft., at forestry lookout station) by F. Michaud, 1939. Originally described from Mount Rainier, Wash.

Nebria crassicornis Van D.—A small variety, on Thornhill Mountain. Seen by Darlington.

Nebria sahlbergi Fisch.—With the remark "I presume," by Darlington. Thornhill Mountain.

Dyschirius aeneolus LeC.—As I remember, this was taken from a rotten stump.

Dyschirius sp.—Mr. Fall was unable to identify this.

Nomius pygmaeus Dej.

Psydrus piceus LeC.—As I remember, this was taken from a rotten stump.

Bembidion lacustre LeC.—Scarce; June to August, on mud flats.

Bembidion bifossulatum LeC.

Bembidion nitidum Kby.

Bembidion vacivum Csy.—Recorded as taken by J. H. Keen, near Terrace, near the Skeena River.

Bembidion funereum LeC.—Verified by Darlington.

Bembidion planatum LeC.—On river bank and lake shore. Checked by Darlington.

Bembidion sp. near *simplex* LeC.

Bembidion planiusculum Mann.

Bembidion maeklini Hayw., or near.

Bembidion quadrifoveolatum Mann.—Identified by Fall.

Bembidion quadrulum LeC.

Bembidion transversale Dej.—Identified by Darlington.

Bembidion speculinum Csy.—Darlington thinks that *innocuum* Csy. may be a dark *speculinum*, and that they may both be *atronitens* Csy.

Bembidion grapii Gyll.—Fall considered this to be *picipes* Kby, as "*grapii* is said to be from Greenland." Some of my specimens were identified as *nitens* LeC.

Bembidion substrictum LeC.—Compared by Frost with New Brunswick and Colorado specimens so named by Darlington.

Bembidion subinflatum Mots.

Bembidion exiguiceps Csy. — Topotypical, identified by Darlington.

Bembidion rickseckeri Hayw.—Identified by Frost.

Bembidion nigripes Kby.—Taken in garden and on lower flats. Fall agreed with Frost's identification. See note on *imitator*, below.

Bembidion umbratum LeC.—Teste Ralph Hopping.

Bembidion approximatum var. *suspectum* Blaisd.—Determined by Van Dyke, but Darlington considers Terrace specimens to be *incrematum* LeC.

Bembidion imitator Csy.—Darlington says "at best a variety of *nigripes*, which I think equals *patruele* Dej."

Bembidion intermedium Kby.—Fall remarked "Probably; not typical."

Bembidion convexulum Hayw.—Determined by Darlington.

Bembidion incrematum LeC.—Common on muddy spots, June to August.

Bembidion concitatum Csy.

Bembidion subexiguum Csy.

Bembidion terracense Csy.—Described by Casey from my material, but not returned.

Bembidion timidum LeC.—Some specimens were identified as *versicolor* LeC. Frequent about muddy ponds, June to August.

Bembidion gregale Csy.

Bembidion caseyi Leng.

Bembidion dubitans LeC.—Compared with the type by Frost.

Bembidion connivens LeC.—Some specimens were first identified as *sulcatum* LeC.

Bembidion sulcatum LeC.—Fall wrote "consider it *sulcatum*" of a specimen called *peregrinum* Csy. by Frost.

Bembidion sp. near *invidiosum* Csy.—Specimens identified by Frost, but Fall's comment was "can't separate from *cautum*."

Bembidion spp.—Several were unidentified.

Tachyta falli Hayward—Taken under the bark of fallen logs.

Trechus chalybeus Dej. — Frequent under feathers and boards,

Pterostichus terracensis Csy.—Named from my material.

Pterostichus herculaneus Mann.—Frequent under bark about poplar roots in the spring and fall; identified by Darlington.

Pterostichus brunneus Dej. — Found with *herculaneus* in rotting wood; identified by Darlington.

Pterostichus castaneus Dej.—This and the next also identified by Darlington.

Pterostichus californicus Dej.

Bothriopterus saxatilis Csy.—Frequent under boards, logs and stones, in springtime. Identified by Casey.

Cryobius sp.

Celia erratica Sturm.—Frequent among weeds in yards, under boards, and running about on roads. Identified by Fall.

Celia farcta LeC.—Scarce. This and the next two identified by Fall.

Amara littoralis Mann.—Scarce.

Amara fallax LeC.—Frequent about gardens, around turnips.

Amara sp.—Fall said "Not in Hayward's table; not *confusa* LeC."

Amara cupreolata Putz., or near.

Calathus quadricollis LeC.

Platynus sinuatus Dej.

Platynus piceolus LeC.—Taken in 1931.

Platynus sp., *lascivus* Csy., or *frigidulus* Csy., vide Casey.

Platynus melanarius Dej., or near.

Platynus metallescens LeC.—Scarce, beneath cover.

Platynus cupripennis Say—Quite rare.

Platynus placidus Say.

Platynus terracense Csy.—Named from my material.

Platynus strigicollis Mann.—Both this and the preceding may be the same as *bogemanni* Gyll.

Platynus quadripunctatus Dej. — Common early in the spring, on mossy humps.

Platynus bembidioides Kby.—Frequent about charcoal or burnt-over land; strange to say, I never found them anywhere else.

Platynus ruficornis LeC.—Taken in a swamp, 1935. Checked by Fall, who thought it a new record for B.C.

Platynus sp., unknown.

Lebia viridis Say—Rare; on willow, only three or four taken.

Dromius piceus Dej.— About rotten wood, scarce.

Metabletus americanus Dej.—Scarce; identified by Fall.

Cymindis reflexa LeC.—Checked with the type by Frost. Taken on sandy banks of river.

Harpalus herbivagus Say.—Some specimens were identified as *blanditus* Csy., which may be a synonym.

Harpalus sp. near *fugitans* Csy.

Harpalus carbonatus LeC.?

Harpalus spp.—Two unidentified species.

Catharellus cordicollis LeC.

Tachycellus nigrinus Dej.—So identified by Casey, Frost and Fall.

Trichocellus ruficrus Kby.—Found in numbers in mouse nests, in rotten grass, and under boards, in the late fall and early spring.

HALIPLIDAE

Haliplus leechi Wallis—A paratype. From backwaters of Lake Lakelse.

Peltodytes sp., unknown.

DYTISCIDAE

Bidessus affinis Say?—Identified by Fall, 1934.

Bidessus sp.

Hydroporus appalachius Sherm.?—Identified by Fall, 1934.

Hydroporus occidentalis Shp.

Hydroporus longiusculus G. and H., or near. Common. Determined by Fall, 1935.

Hydroporus despectus Shp.

Hydroporus vilis LeC.?—Identified as possibly this species by K. F. Chamberlain.

Deronectes depressus Fab.

Agabus hypomelas Mann. — Identified by Frost and Fall.

Agabus vancouverensis Leech — Taken on Thornhill Mountain, 5,000 ft. elevation, with the preceding. Identified by Frost, Fall and Leech.

Agabus austini Shp.

Agabus strigulosus Cr.

Agabus tristis Aube—Taken in roadside puddle, June and November, 1937.

Agabus erichsonii G. and H.—Determined by Frost and Fall.

Agabus phaeopterus Kby.

Ilybius quadrimaculatus Aube.

Rantus binotatus Harr.—Found with *flavogriseus*.

Rantus hoppingi Wallis—One of the mountain species I think.

Rantus flavogriseus Cr. — Scarce; in old wells, roadside puddles, small streams and sloughs, in early spring and late fall.

Colymbetes seminiger LeC.—In pools, July.

Colymbetes strigatus LeC.

Dytiscus fasciventris Say?

Dytiscus sublimbatus LeC.

Dytiscus dauricus Gebl.

Acilius semisulcatus Aube — Frequent in pools in May.

GYRINIDAE

Gyrinus bifarius Fall—One pair.

Gyrinus picipes Aube—Roadside ditches and shallow pools.

Gyrinus sp., unknown. One female.

HYDROPHILIDAE

Helophorus inquinatus Mann.? — In little ditches, muddy ponds, etc.

Helophorus linearis LeC.—Rare.

Helophorus lineatus Say—In water puddles.

Helophorus auricollis Esch.—Verified by K. F. Chamberlain who is revising the genus; he has not reported on the others.

Helophorus sp.

Hydrobius fuscipes Linn.—In ponds, everywhere frequent.

Hydrobius scabrosus Horn—In very rapid water of a cold spring, which never became warmer than 45 degrees F. If the half-submerged clumps of moss were pulled from the logs and sunken boughs and laid on the bank in the sun, these beetles struggled out of it. There were never many in one place, but always some, almost any month in the year.

Crenitis moratus Horn—Closely resembles the eastern *digestus* LeC.
Crenophilus paradigma d'Orch. — Identified by H. B. Leech, verified by A. d'Orchymont.
Paracymus subcupreus Say.
Cymbiodyta vindicata Fall—Identified by Fall.
Cymbiodyta fimbriata Melsh.—Identified by Winters, but Leech suspects a *lapsus memoriae*.
Laccobius ellipticus LeC.—Wet sand, Lake Lakelse, June, 1923.
Laccobius agilis Rand., or near.—Determined by Fall.
Laccobius sp.
Sphaeridium scarabaeoides Linn.
Cercyon quisquilius Linn.—In numbers.
Cercyon fulvipennis Mann.—Taken in 1931.
Cercyon convexiusculus Steph.
Cercyon tristis Illig.
Cercyon minusculum Melsh.—Taken in a swamp.
Cercyon analis Payk.—Checked by Fall in 1938.
Cercyon sp.
Megasternum posticatum Mann.—Taken in 1931.
Cryptopleurum minutum Fab.

LIMNEBIIDAE

Hydraena vandykei d'Orch., or a new species, fide Winters.
Hydraena pensylvanica Kies.

SILPHIDAE

Necrophorus orbicollis Say—Scarce.
Necrophorus vespilloides Hbst.—Scarce.
Necrophorus nigritus Mann.
Necrophorus pustulatus Hersch. — Under dead mouse, August.
Silpha lapponica Hbst.—Taken from under a dead salmon, and from under pig guts.
Pelatines latus Mann.
Agyrtes longulus LeC.

LEPTODIRIDAE

Catoptrichus frankenhaeuseri Mann.—Rare; taken from rotting fish and from fungus in November.
Ptomophagus sp.
Catops basilaris Say — From rotting hen feathers.
Catops egenus Horn — From rotting hen feathers.
Catops terminans LeC.
Colon magnicolle Mann.

LEIODIDAE

Hydnobius substriatus LeC.
Hydnobius sp.
Leiodes strigata LeC.—Identified by Fall, 1934.
Anisitoma spp.—Three species, one taken in a box of old hen feathers outdoors.
Agathidium californicum Horn.
Agathidium concinnum Mann.
Agathidium revolvens LeC., or near.
Agathidium spp.—Two undescribed species.

CLAMBIDAE

Empelus brunnipennis Mann.

SCYDMAENIDAE

Lophioderus n. sp.
Connophron flavitarse LeC.
Stenichnus californicus Mots. — The third specimen known; taken in 1920.

CHRYSIS SMARAGDICOLOR FROM THE NEST OF **OSMIA LONGULA** (Hymenoptera: Chrysididae and Megachilidae).—On September 5, 1945, while searching for the wasps **Chlorion (Prionyx) atratum** (LeP.) and **Megastizus unicinctus** (Say) in the upper fields of Frank Choveaux's farm near Vernon (see Ent. Soc. British Columbia, Proc. 43:32. 1947), I found a cluster of mud cells on the side of a large stone. They were sheltered by an overhang, and just out of contact with the ground (fig. 1). The warmth of my hand started a buzzing and vibration in one of the cells.

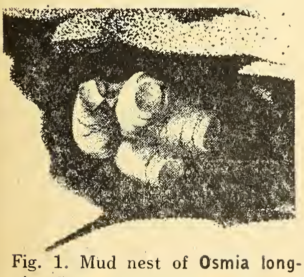

Fig. 1. Mud nest of **Osmia longula** Cresson on a large stone.

The nest was kept outside until January 30, 1946. The next day it was put in an incubator at 74°F. and 90-95% relative humidity. On February 24th a yellow-haired male bee emerged, and in the 25th a pair of chrysidid wasps. All came out through the back, where there was cocoon only, and no mud covering. On opening the remaining cell I found a male bee, dead but fresh and relaxed, with darker hair than the first specimen. The male chrysidid was more blue-green than the female, which had hardly any blue reflections.

E. G. Linsley's identification of the bees as **Osmia (Acanthoides) longula** Cresson was verified by C. D. Michener; the wasps were determined as **Chrysis (Chrysura) smaragdicolor** Walker by W. G. Bodenstein. I am indebted to these gentlemen for the identifications, and to Ben Sugden for the sketch of the nest. —Hugh B. Leech, Vernon, B.C.*

* Contribution No. 2496, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

REVISION OF THE CHECK LIST OF THE MACROLEPIDOPTERA OF BRITISH COLUMBIA—Any records intended for inclusion in the pending revision of this check list should be sent as soon as possible to J. R. J. LLEWELLYN JONES, "ARRANMORE", R. M.D. No. 1, COBBLE HILL, B.C. Information relating to date of capture of imagines, localities, and larval food plants will be especially welcome.

THE BIOLOGY OF MONOCHAMUS NOTATUS MORGANI (Coleoptera: Cerambycidae[1])

C. V. G. Morgan
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About 1940, localized infestations of bark and timber beetles appeared in the Lumby district of the interior of British Columbia. The character of the outbreaks indicated that these insects were on the increase, and in several instances officials of lumber mills expressed concern over the loss which might be incurred. Recognition of the situation led the writer to make a biological study of the timber sawyer, *Monochamus notatus morgani* Hopping at Trinity Valley, B.C., from 1940 to 1944. In 1945, *morgani* was described as a subspecies of *M. notatus* Drury by G. R. Hopping (Proc. Ent. Soc. B.C., 42:17-18).

So far as is known this timber sawyer infests only western white pine, *Pinus monticola* Dougl. In several trials where a choice of hosts was provided oviposition took place only on logs of this tree. It has been known for a long time that these beetles will attack only certain trees, especially those which have been weakened in some manner or other. Various statements have been made as to what time must elapse after trees are cut before the logs become susceptible to infestation by sawyer beetles. At the height of the flight period in 1942, *M. n. morgani* was found attacking trees two days after felling.

The life history of the beetle in western white pine logs requires two years for its completion.

Adult: The ashen-grey, square-shouldered beetle with its long antennae is a conspicuous forest insect during July, August and September. Examinations of a number of logs in 1942 revealed that emergence extended throughout a period of 30 days, from about July 9 to August 10. The first adults were formed in the pupal chambers between July 2 and July 9. On the latter date the first two emergence holes were located. The last adults emerged from heavily shaded portions of logs on August 10. Apparently the beetle lives for a considerable period of time as the last adults were seen in a weakened condition attempting to oviposit in logs on October 1. In the latter half of September the beetles were scarce and appeared only during the warmest periods of sunny days, usually between one and three o'clock in the afternoon. The majority of these were females. Adults kept under artificial conditions and provided with food lived for at least one month; many survived for 50 days or more. One female kept in a wire cage and fed on white pine branches lived for 82 days.

So far as we know the only food normally taken by the adult during its life is the outer bark and phloem of living twigs and branches of western white pine, Douglas fir, Engelmann spruce, western hemlock and western red cedar. White pine is preferred; cedar is eaten only occasionally. The xylem of attacked twigs is not eaten but it may be severely scored by the mandibles. Feeding occurs only after sunset. At that time nearly all adults fly from oviposition sites to standing trees close at hand. The height to which they fly may be 40 feet or more. In the latter part of September a small amount of feeding by old and weak adults sometimes occurs on the logs. When confined on cut logs, adults feed voraciously on the bark.

During the peak of the flight period the male is usually found in attendance with the female. Copulation occurs quite frequently immediately before and after oviposition, but once the female begins to form an egg scar, the male seldom intervenes until oviposition is completed. Males of *M. oregonensis* have been observed in copulation and in attendance with females of *M. n. morgani* while the latter were depositing eggs.

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[1] Contribution No. 2517, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

Monochamus, a sun-loving insect, prefers to lay its eggs on areas of logs exposed to sunlight. The presence of bark on the log is a prerequisite to oviposition, and thick bark rather than thin is preferred. The egg scars are not necessarily made in crevices as is often the case with other species of this genus. The type of scar made prior to oviposition is characteristic of both *M. notatus* and *M. oregonensis.* It consists of two punctures and a narrow slit, and is made as follows: selecting a place in the log where the young are likely to develop, the female begins to dig out a slit, invariably starting with the left mandible, the right mandible serving as a fulcrum which produces one puncture. Then the mandibles are switched to the left so that the left mandible forms a fulcrum (and the second puncture) while the right mandible completes the slit into which the ovipositor will eventually be placed. The depth of the punctures varies with the softness of the bark and the effort expended in digging out the slit. The slit is about 2 mm. in length, and the thickness of the mandibles in width. The bark dug from the slit is cast aside. Having completed the egg scar, the adult turns around, usually clockwise, and with the aid of tactile hairs on the end of the abdomen finds the scar into which she forces her ovipositor. Sometimes, after much effort, the egg scar is not located and she wanders off in search of other grounds to begin all over again. In most cases, the egg scar is made nearly parallel with the grain of the wood. Only one egg is deposited in each scar. It is placed in the soft succulent secondary phloem close to the cambium layer. No matter at what angle to the grain the scar is constructed, the egg is always placed with its longitudinal axis parallel with the grain of the wood. The phloem around the slit in which the egg is deposited soon turns brown making it easy to find the position of eggs when the bark, including the phloem, is peeled from the log.

Egg: The egg is elongate oval, with a tendency to be somewhat sausage-shaped. The micropyle end is slightly flattened and depressed. Close to this end, the egg has its greatest width, and then tapers slightly towards the opposite end which is more pointed. The outer surface is very lightly but profusely patterned probably as a result of the impressions of the follicular cells. The length and width of the eggs are fairly constant, averaging 4.46 m.m. and 1.22 mm. respectively. Of 26 eggs examined, the length ranged from 3.34 to 4.81 mm. and the width from 1.12 to 1.28 mm.

The eggs hatch within 9 to 15 days depending upon weather conditions and position of the egg with respect to the amount of direct sunlight. Emergence of the larva takes place at the micropyle end, but somewhat on the side. The first signs of hatching are minute swellings on the surface of the egg, these being the outer manifestation of pressure applied by the mandibles of the young larva. The chorion is soon broken and the larva emerges from a very ragged hole. As many as five hours may elapse from the first signs of hatching until the larva is completely free from the egg.

Larva: The larva is an elongate, footless, white grub. Motion is achieved through the use of dorsal and ventral ampullae which, when contracted to the anterior end of the body, serve to move the larva along its tunnel.

The size of the larvae varies considerably according to age, individual, and sex. A larva just emerged from the egg measures 4.24 mm. long, 1.28 mm. wide at the prothorax, and 1.20 mm. thick. Larvae taken from galleries on Dec. 15, 1942, approximately four months after hatching, varied from 11.5 mm. to 22 mm. in length and from 4.03 mm. to 5.72 mm. in width. At maturity some measure as much as 60 mm. or more.

Immediately upon hatching, the larva begins to feed. It soon makes its way to the cambium region, mining between the bark and sapwood, considerably scoring the latter. The chips and excrement are packed between the bark and the wood so that eventually the bark becomes separated from the wood. About two months after the first eggs are laid, the first extrusion holes are formed from which the chips are emitted. These oblong holes are approximately 4 mm. long and 2 mm. wide and occur in the majority of cases on the lower surfaces of a log. At about the time the extrusion holes are formed, the larvae begin to excavate holes in the wood. Of 23 living larvae, the progeny of two females, only eight had begun to make galleries into the sapwood on Sept. 15, 1942. During the first fall, the holes are extended into the wood to a maximum depth of about two inches. As in the case of the extrusion holes, the mouths of the wood galleries are found generally on the sides and lower surfaces of logs. Feeding continues throughout the following year and by the spring of the second year a U-shaped tunnel is formed. By this time the larvae are practically full grown.

Pupa: The pupa is formed in a chamber at the end of the larval gallery. This chamber is oblong in cross section and varies from 6.3 to 12.7 mm. in thickness and from 11.0 to 25.4 mm. in width. It may be 50.8 mm. or more in length. The pupal chamber usually extends to within about 6.3 mm. from the surface of wood; some, however, extend to within only 25.4 mm. while others have been found as close as 1.6 mm. or less. Generally the chamber is constructed on a slope so that the pupa rests on one side.

The prepupal stage must be exceedingly short, since from all galleries examined in June and July of 1942, only one specimen was taken. Minor changes occurred in this specimen during the 20 minutes between its removal from the gallery and its preservation. The first signs of pupal transformation were observed on June 5 when only one pupa could be found in many galleries examined. The duration of the pupal stage is approximately one month.

As the pupa matures, the first signs of true adult characters become evident in the eyes. These organs change colour from a yellowish-white to a bright pink and soon after assume the black pigment of the adult. Subsequently, blackening of the cuticular surfaces becomes evident, first at the extremities of the appendages such as the claws, the distal ends of the mandibles, the edges of the wings, and also around the joints of the legs. Blackening continues progressively backwards, especially on the mandibles.

Parasites: Only one parasite of *M. n. morgani* is definitely known. It has been tentatively placed in the genus *Ichneumon*. Another icheumonid belonging to the genus *Doryctes* has been found in the larval galleries of *Monochamus*, but its relationship with the host is not definite.

In 1941 a dipterous maggot was taken from a gallery in which the sawyer larva was partially destroyed. An attempt to rear this specimen was unsuccessful. Parasitism by Diptera has not been observed since that time.

Disease: Apparently *Monochamus* is relatively free from disease. Over a two-year period, only two specimens showing definite symptoms of disease were found. Both were dead adults in their pupal cells and at the time of examination (July 29, 1942) were entirely black and reeked with a strong sickly odour.

A COLONY OF **TROPIDISCHIA XANTHOSTOMA** NEAR WELLINGTON, B.C. Orthoptera: Stenopelmatidae).—On September 28, 1946, while examining a shallow well near Hammond Bay, B.C., I found it occupied by a colony of the strange spidery cave crickets, **Tropidischia xanthostoma** (Scudder). I counted six adults, and noted that there were several times as many nymphs, although I could not make an exact check of these. One pair of adults I noticed in coitu.

When alarmed the insects leaped or fell into the water, where they were evidently quite at home. They swam powerfully to the sides of the well, and remained quietly clinging to the concrete below the water level without showing any signs of anxiety to regain the surface.

Normal water level is not over six feet down. The well is completely lined with concrete, the masonry extending a foot or so above ground level, where it is covered with rough planks. Many of the immature crickets were clinging upside down to these planks when I first disturbed them.

I had descended the same well on a previous occasion, during May of 1945, but at that time no crickets were seen.—Richard Guppy, Wellington, B.C.

SOME BEETLES OF THE FAMILIES CERAMBYCIDAE AND BUPRESTIDAE FROM MANNING PARK, BRITISH COLUMBIA

George A. Hardy
Provincial Museum, Victoria, B.C.

Introduction—The following notes are the result of investigations conducted in Manning Park, B.C., during the summer of 1945, as part of a general biological survey covering the period from July 20 to August 16.

Manning Park, comprising 171,500 acres, lies across the divide of the coastal mountains where the humid western and the dry interior climatic regions overlap and merge into the alpine zones at the higher levels. It is therefore of considerable interest from a distributional and ecological point of view.

For the most part it is a mountainous and heavily forested region with western red cedar and western hemlock predominating in the western parts, and yellow pine in the eastern, while extensive tracts of the intermediate area are occupied by lodgepole pine on the drier slopes, and Englemann spruce in the moist valleys. At higher elevations alpine fir becomes more prevalent, with scattered stands of Lyall's larch and white-barked pine. Willows, poplars, alders and associated plants line the streamsides and swamp borders. Such conditions are very favourable to the development of wood-boring beetles.

The present annotated list is of necessity a provisional one, for not only were the early appearing species missed altogether, but the park area will require a more extended study in order to obtain an accurate conspectus of its Cerambycid and Buprestid fauna.

Four camps were established, each the centre of a distinct floral association.

(1) Forest Branch Cabin on the main road some 40 miles west of Princeton at an elevation of 4,000 feet and on the banks of the Similkameen River. Characteristic trees here are lodgepole pine and Englemann spruce.

(2) Allison Pass, about 6 miles west of the Forest Branch Cabin, on the divide between eastern and western flowing streams, at an altitude of 5,000 feet. Characteristic trees are, in addition to those mentioned, western red cedar and hemlock, particularly in the western part of the district.

(3) Timberline Valley, an extensive tract of alpine meadow land at the foot of Mt. Three Brothers, at an altitude of 6,500 feet, about 15 miles north of Forest Branch Cabin. Prevailing trees here are alpine fir and Englemann spruce, together with scattered white-barked pine.

(4) Goodfellow Creek, seven miles east of Forest Branch Cabin, at an altitude of 3,500 feet. Yellow pine reached its western limit here, while lodgepole pine was dominant.

At all these points willows, alders and poplars were about equally distributed along the streams and wet places, though to a lesser extent and of different species in Timberline Valley.

Species Account. The sequence of species is based on C. W. Leng's 1920 "Catalogue of the Coleoptera of America, North of Mexico," and Supplements.

Abbreviationss Forest Branch Cabin (F. B. C.), Allison Pass (A. P.), Timberline Valley (T. V.), Goodfellow Creek (G. C.). The North American distribution is briefly indicated: "B.C." includes Vancouver Island. "B.C. mainland" not, so far as known, recorded from Vancouver Island.

CERAMBYCIDAE

Tragosoma depsarium var. *harrisi* LeC. Two specimens, F.B.C., Aug. 8 and 9. Flying at dusk, one in pail of water. B.C. to eastern N. America.

Spondylis upiformis Mann. One specimen. T. V., Aug. 6. In flight by day, near newly felled *Abies lasiocarpa*. B.C. mainland, Alaska to California, and east to Labardor and Lake Superior.

Asemum moestum Hld. Four Specimens, F. B. C., July 26, A. P., July 27, T. V., Aug. 6. In flight and on newly felled *Pinus contorta* and *Abies lasiocarpa*. B.C. to eastern N. America.

Tetropium velutinum LeC. One, T. V., Aug. 6, on Abies lasiocarpa. B.C. south to California.

Stenocorus inquisitor L. One, A.P., July 27, on side of an old shack. B.C., N. America in general.

Leptalia frankenhaeuseri Mannh. One, F.B.C., July 22, on rose flower. West coast B.C., Alaska to California.

Pachyta armata LeC. Common, F.B.C., A.P., T.V., July 25 to August 13. On flowers of *Heracleum lanatum* and *Cicuta vagans*. A mountain species of the coastal range, B.C. to Washington.

Pachyta lamed Linn. Nine, A.P., T.V., July 22 to Aug. 5. Flying about newly cut *Abies lasiocarpa*. B.C., Alaska to California, east to the Atlantic.

Evodinus vancouveri Csy. Five, F.B.C., A.P., July 22 - 30. On flowers of *Heracleum lanatum* and *Cicuta vagans*. South-western B.C. This is the western representative of *E. monticola* which has a continent wide distribution.

Leptacmaeops longicornis (Kby.). Five, F.B.C., July 22 to 23. On rose flowers. Interior plateau region. B.C., south to Colorado.

Acmaeops pratensis (Laich). Abundant, F.B.C., A.P., July 25 to Aug. 13. On white flowers of the Compositae and Umbelliferae. B.C., North America in general, wherever coniferous forests occur.

Acmaeops proteus (Kby.) Nine, F.B.C., A.P., T.V., July 25 to Aug. 8. On newly felled *Abies lasiocarpa* and *Pinus contorta*, also on flowers of *Cicuta vagans*. Mainland of B.C., Alaska to California and in the north to Lake Superior. Five of these are black in colour.

Gaurotes cressoni Bland. Six, F.B.C., A.P., July 22 to 28. On rose flowers. One crawling over branch of newly cut *Pinus contorta*. Southern mainland interior of B.C. to California.

Anoplodera sexmaculata (L.) Common, F.B.C., A.P., July 23 to Aug. 12. On flowers. B.C., North America.

Anoplodera instabilis (Hald.) Four, F.B.C., A.P., July 24 to Aug. 12. Flowers of *Heracleum lanatum* and *Cicuta vagans*. B.C. mainland, east to Ontario.

Anoplodera nigrella (Say) One, G.C., Aug. 16. On driftwood, edge of stream. B.C. east to New York.

Anoplodera laetifica (LeC.) Two, A.P., July 28. Flowers of *Achillea millefolium*. B.C. to California.

Anoplodera sanguinea (LeC.) Common, A.P., F.B.C., G.C., July 24 to Aug. 12. Flowers, B.C. to California, east to Pennsylvania.

Anoplodera canadensis (Oliv.) One, G.C., Aug. 15. In flight. B.C., North America. This is the black phase.

Anoplodera crassipes (LeC.) Common, F.B.C., A.P., G.C., July 25 to Aug. 15. Flowers of *Cicuta vagans*. B.C. to California.

Anoplodera tibialis (LeC.) Three, F.B.C., A.P., July 26 to Aug. 12. Flowers of *Cicuta vagans* and *Heracleum lanatum*. B.C. east to Michigan.

Anoplodera aspera (LeC.) Common, F.B.C., A.P., July 23 to 28. Flowers of *Heracleum lanatum*. B.C. to New Mexico.

Anoplodera chrysocoma (Kby.) Very common, at all stations; July 25 to Aug. 12. Flowers of *Heracleum lanatum* and *Cicuta vagans*. B.C. to N. Mexico, east to Newfoundland. Most abundant of all the species.

Grammoptera filicornis Csy. Common, F.B.C., July 22 to 23. On rose flowers. B.C. to Mexico.

Leptura obliterata Hald. Three, F.B.C., A.P., T.V., July 26 to Aug. 6. On flowers, *Heracleum lanatum* and in flight about newly cut *Abies lasiocarpa*. B.C. to California.

Leptura propinqua Bland. Common, F.B.C., A.P., G.C., July 24 to Aug. 12. Flowers of *Heracleum lanatum*, *Cicuta vagans* and *Spiraea lucida*. B.C. to California, in the mountains.

Gonocallus collaris (Kby.) One, F.B.C., July 25. In flight by day. B.C. east to Lake Superior.

Xylotrechus undulatus (Say) Seven, F.B.C., G.C., July 26 to 31. Running over newly felled *Pinus contorta*. B.C. mainland and north to eastern N. America.

Monochamus maculosus latus Csy. Six, F.B.C., July 24 to 26. Flying about and at rest on newly cut *Pinus contorta*. B.C. to California.

Monochamus oregonensis LeC. Common, at all stations, July 25 to Aug. 5. At rest on newly felled *Pinus contorta* and *Abies lasiocarpa*. Observed ovipositing in an incision made in the bark by the jaws. B.C., Alaska to California.

There are two species of the genus *Leptacmaeops* at present undetermined; one specimen of each.

BUPRESTIDAE

Buprestis aurulenta L. One, F.B.C., July 24. Flying near *Pinus contorta*. B.C. to California.

Buprestis maculativentris var. *rusticorum* (Kby.) Two, A.P., G.C., July 28 to Aug. 15 in flight. B.C. to California. The western form of the species.

Buprestis confluenta Say. One, G.C., Aug. 15. Resting on old log by roadside, in vicinity of *Populus trichocarpa*. B.C. mainland, east to Ontario and southwards.

Buprestis fasciata Fab. One, A.P., July 28. In flight, B.C., across continent to the Atlantic.

Melanophila drummondi Kby. Common, F.B.C. T.V., July 26 to Aug. 6. On newly cut *Pinus contorta* and *Abies lasiocarpa*. B.C. to the Atlantic.

Anthaxia aeneogaster Cast. Common, F.B.C., A.P., July 22 to Aug. 8. On flowers of *Rosa nutkana*, *Achillea millefolium*, *Heracleum lanatum* and *Cicuta vagans*. B.C., transcontinental.

Chrysobothris pseudotsugae Van D. Six, F.B.C., T.B., G.C., July 26 to Aug. 6. On newly cut *Pinus contorta* and *Abies lasiocarpa*. B.C. to California.

Chrysobothris trinervia Kby. One, F.B.C., July 26. On newly cut *Pinus contorta*. B.C. mainland and transcontinental.

Agrilus politus Say. Two, F.B.C., Aug. 13. On *Salix sitchensis*. Widely distributed throughout North America, wherever willows occur.

Discussion.

CERAMBYCIDAE

The Manning Park Cerambycid fauna, so far examined, appears to contain no especially marked divergence from that of the adjoining territory, but constitutes part of a general northwest by southeast strip of a humid coastal association which for convenience of expression is known as the Vancouver strip, extending from Alaska to California and roughly includes the Cascade and Coast mountain ranges. It is, however, of local interest, in that here are to be found an intermingling of the humid coastal species with those of the dry interior forms; but with the former by far predominating. From this point of view, the park area may eventually be found to have species of the dry belt forms, which here reach their western or near western limit of distribution.

In a consideration of the species recorded for the park it is well to include or to at least take account of a list of Cerambycidae collected by Mr. G. Stace Smith at Copper Mountain, which lies just outside the eastern boundary of the park. Of the 48 species so listed 23 were found in Manning Park during our short visit, while of the remainder, the majority will probably be found there in more extended seasonal collections.

Among the 33 species taken in the park, only three are not listed in the Copper Mountain group, but may eventually be found in that area also.

As far as the park collections are concerned, about 12 per cent of the species are characteristic of the dry belt, and apparently reach their western limit within the area. This group includes *Gaurotes cressoni*, *Leptacmaeops longicornis* and *Anoplodera instabilis*. Twenty-four per cent are typically humid coastal species and include *Leptalia frankenhaeuseri*, which is also an endemic genus of the Vancouveran strip, *Leptura obliterata. Tetropium velutinum* and *Pachyta armata.* Fifty-three per cent or by far the larger proportion are of northern origin and of circumpolar or wide North American distribution. This percentage includes *Tragosoma harrisi, Pachyta lamed, Anoplodera canadensis* and *A. chrysocoma,* to mention only a few.

BUPRESTIDAE

This family has much the same relation to the adjoining territory as the Cerambycidae. The species have a wide continental range, with the exception of *Chrysobothris pseudotsugae* and *Buprestis aurulenta,* which are confined to the Pacific coast. *B. confluenta* appears to reach its western limit in the park area.

Mr. Stace Smith lists 22 species from Copper Mountain, as compared with nine Copper Mountain species will eventually from Manning Park; probably all of the be found to occur in the park area.

SUMMARY.

Thirty-three species of Cerambycidae and nine species of Buprestidae were taken in the area during the period of July 21 to August 16, 1945.

From a distributional view point the Cerambycidae constitute about 30 per cent west coast or Vancouveran strip. The remaining 70 per cent are composed, for the most part, of holarctic elements of wide distribution and of comparatively recent specific origin. One genus, *Neoclytus,* is of neotropical origin. Three species are 'dry belt" forms not, so are as known, recorded west of the park boundaries. Two species remain to be identified.

Only four species of Cerambycidae and one of Buprestidae listed here have not yet been recorded for Vancouver Island.

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Lindley, E. G. 1939. The Origin and Distribution of the Cerambycidae of North America, with special reference to the fauna of the Pacific slope. Proc. Sixth. Pac. Sci. Congress 1939.4:269-282.

THE HIBERNATION OF **NYMPHALIS CALIFORNICA** (Bdv.), THE CALIFORNIA TORTOISESHELL BUTTERFLY; A QUERY—In the summer of 1945 (as noted by Hardy, Ent. Soc. B.C. Proc. 43:36) enormous numbers of this butterfly occurred throughout southern British Columbia. They do not breed on Vancouver Island but arrive here late in the summer and remain for the winter. On May 11th, 1946, while engaged in experimental spraying at Brentwood on the Saanich peninsula, I observed thousands of these butterflies passing overhead in a north-easterly direction. They travelled in small parties of ten or a dozen, always in the direction of the southern mainland. This return migration had been continuing for at least a week or ten days previous to my observing it and was so noticeable that it was the subject of correspondence in the local press. The point that occurs to me is that it is unusual for an insect to breed in one part of the province and hiberate in another. It would be interesting to know whether the habit of hibernating in the more salubrious climate of southern Vancouver Island rather than in the region where it breeds is the usual custom of this species or whether it occurs only in years of excessive abundance. In this connection the observations of entomologists on the mainland would help to clear up the point. Have hibernating specimens of this species been found on the mainland in the regions where **Ceanothus,** the food plant, occurs? —W. Downes, 2056 Granite Street, Victoria, B.C.

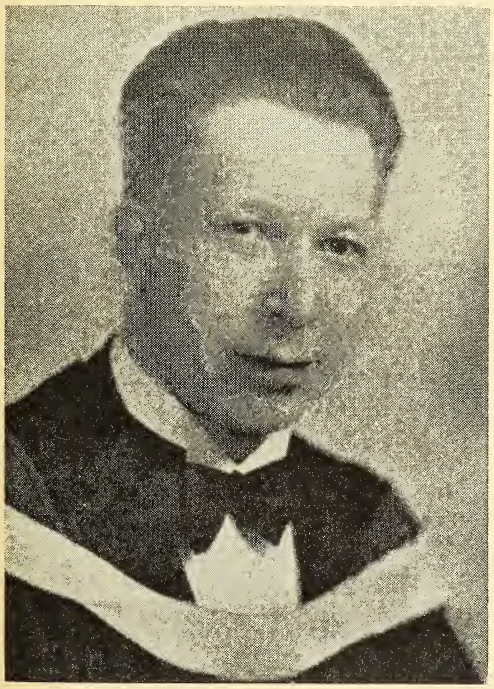
SPRING FLIGHT OF **NYMPHALIS CALIFORNICA** NEAR NELSON, B.C. (Lepidoptera: Nymphalidae).—While driving near Coffee Creek on the road between Nelson and Kaslo, B.C., April 14, 1947, I came upon a swarm of tortoiseshell butterflies. There were tens of thousands of them along the road and they seemed to be moving southward though I could not be sure of this. Every few yards there were groups of approximately 100 settled, and the air was full of them. They did not extend south beyond Queens Bay, though a few were noted across the lake, between Gray Creek and Creston. I am indebted to Dr. T. N. Freeman of Ottawa for identifying one of the butterflies as **N. CALIFORNICA** (Bdv.).—H. J. Coles, Golden, B.C.

ELM GALL APHID EATEN BY EVENING GROSBEAK (Aphididae: Eriosomatidae).—For about a week each year flocks of noisy evening Grosbeaks **(Hesperiphona vespertina)** invade the American elm trees lining some of Vernon's streets. This season (1947) they were busy by May 15, and the sidewalks were soon littered with bits of leaves. Examination showed that the birds were picking only the rolled leaf-galls filled with maturing **Eriosoma americana** (Riley), which they soon stripped out. The coxcomb galls of **E. crataegi** (Oest.), equally common on the trees, were not attacked in any of the cases observed. I am indebted to E. P. Venables for identification of the aphids.—Hugh B. Leech, Vernon, B.C.

In Memoriam

IVOR JESMOND WARD, 1908-1947

It is with deep regret that we record the death of Ivor Jesmond Ward, Provincial Entomologist for British Columbia, which occurred on February 5, 1947, at the age of 38 years. Born in England, he came out to Vernon, British Columbia, with his parents, 35 years ago. In 1926 he joined the staff of the Dominion Entomological Laboratory in Vernon, and after obtaining his Bachelor of Science degree in 1938 from the University of Alberta, was employed continuously on field crop insect investigations in Vernon and Kamloops, until, in 1943, he accepted the position of Provincial Entomologist.



With Ivor Ward's passing, the Entomological Society of British Columbia lost a member and a friend, and the Provincial and Dominion Departments of Agriculture, a valued worker. As Provincial Entomologist he might have had a long and valuable career, for few men had better ability for making friends than did Ivor Ward, and he had a personality particularly suited to the field of extension entomology.

He will long be remembered by the stockmen of the British Columbia cattle ranges for the part he played in the study of their grasshopper problems, and the organization of the grasshopper control zones.

After his appointment as Provincial Entomologist he had charge of suppression work for the Colorado potato beetle, and was interested in devising better control methods for the various fruit, vegetable, and seed insects throughout the province, and in preparing Provincial publications on insect control.

He is survived by his wife, formerly Marjorie Glover of Kamloops; his father, Fred Ward, of Vernon; and two sisters, Mrs. K. Burnham of Vernon, and Mrs. Sid Walker of Vancouver.

—E. R. Buckell, Kamloops, B.C.

JAMES DALGLEISH INGLIS, 1909-1933

How often must recognition of some potential contributor to science be lost or omitted through his untimely death. An example of such might well be James Dalgleish Inglis, whose enthusiasm in entomology showed every promise of taking him far in this field, but whose short period of membership in the Entomological Society of British Columbia left him little time to make an impression by print or person.

My first recollection of Jim Inglis dates back to 1927, when, as a newcomer to Courtenay, Vancouver Island, he contacted me one day at school and enthusiastically talked of his interest in butterfly collecting. Since that day we had many a fine collecting excursion up the Puntledge River, where parnassians, orange-tips and fritillaries abounded, and where, at a certain hidden alder swamp rhinoceros beetles *(Sinodendron rugosum)* and laurel longhorns *(Rosalia funebris)* could be collected by the dozen.

Jim was an ardent amateur naturalist

and took an infectious delight in his collections of insects, fossils, and flowers. This intense love of nature and fondness for hiking, his devotion to religion, and his keen sense of humour created in him a highly estimable personality and made him a staunch and delightful companion.

In addition to his biological interests was his appreciation of music which found expression in song or clarinet, both of which often contributed to a family circle of good Scottish melody. He was unusually thorough in anything he undertook, and this trait prevailed even in the culinary art, and it was not uncommon to find him in the midst of a fine array of freshly bottled preserves or concocting some tasty dish to help out at the table of a merry household of nine.

Following his matriculation, Jim attended the University of British Columbia in 1931 with the intention of specializing in entomology. After completing his second academic year, he spent the summer as cook in the Chalet at Lake Louise, Alberta, where his death while climbing for some biological specimens in the Rockies terminated a promising young career.

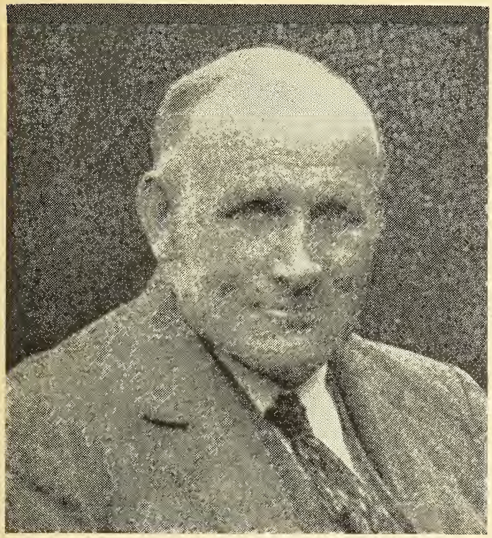
He left to mourn his death, August 9, 1933, his father, mother, four brothers and two sisters, and a host of friends who at the name "Jim" will always think of a curly headed Scottish youth, laughing and carefree as he excitedly pursued some new trophy for his collection of "wee beasties."
—J. D. Gregson, Livestock Insects Laboratory, Kamloops, B.C.

DANIEL HERBERT LEECH, 1878-1941

Daniel Herbert Leech was born at Manchester, England, on September 6, 1878, the fourth son of the late Sir Bosdin Thomas Leech and Lady Mary (Booth) Leech of Manchester. He died at his home, "Tyn-y-Coed," Salmon Arm, B.C., on May 17, 1941, in his 63rd year.

Keenly interested in natural history, and a great walker, he thoroughly covered the country around his schools, Hunstanton, Sedbergh, and the Agricultural College at Cirencester. He collected eggs, and learned the birds first hand. Much additional information he got from poachers, who would tell an eager boy of the habits, especially the night habits, of birds and animals. Insects too he collected, and fossils, mosses and ferns; one of the latter proved to be a new Country record and brought him local recognition.

He wished to be a farmer, but his father thought otherwise; so he trained first in an architect's office, then at Cirencester as a surveyor. It was as a surveyor



and draughtsman that he came to Canada in 1905, obtaining work with the Canadian Pacific Railway in Montreal. The next year he went to Alberta for the company, and returned the two following seasons; there he had charge of a survey camp of 30 men on the big irrigation project near Gleichen. In those days the prairie lakes and sloughs were full of water. Ducks and upland game birds were abundant. He told of hawks so overfed on water fowl that they could not rise from the ground, and had many photographs of these and similar subjects. Blackfoot Indians were numerous, and he obtained fine examples of their bead-work moccasins and blanket throws. Twenty years later, in Kelowna, B.C., he met his former camp cook, but that gentleman was far from cordial, for he was now a prominent citizen and had told other stories of his earlier days.

Like many another Englishman, my father had heard of the well-advertised Okanagan Valley, and planned to settle in it, despite the presence of rattlesnakes. However, his fiancee asked him to look at the Salmon Arm district first to see if it was as beautiful and fruitful as a Montreal acquaintance, Lionel B. Pangman, kept saying. As a result, in 1908, he stayed for a while with Mr. Pangman who had been in Salmon Arm for some years, and bought 10 acres from him. This was the nucleus of his farm, which at the time of his death comprised 85 acres.

In 1909 he married Miss Olive Roberta Shepherd of Montreal and "Riversmead," Como, Quebec, and settled on his bush farm, or stump ranch as he often called it. With the aid of Hindu workmen he cleared land for pasture and orchards. Always a powerful man he enjoyed clearing land, especially slashing bush, for he could daily see his fields expand. Apiaries were added, and a well-known herd of registered Jerseys, a number of which won silver medals in R.O.P. tests. Interested in scientific farming, he paid more attention to production than show-ring types in his cattle. In 1928 he was one of the delegates representing Canada at the World's Dairy Congress in London. This trip was combined with a needed vacation, and gave opportunity to visit his brothers and sister, for though he twice returned to England prior to his marriage, he had not stayed long.

In 1939 and 1940 he operated his farm as an Illustration Station, in conjunction with the Dominion Experimental Farms. Time and service were given to local organizations. His knowledge of surveying and road building was valuable to the district, especially in the early days. His abilities as a mathematician were also put to good use. I well remember the excitement at home when, from an annual statement, he discovered that the manager of a local co-operative store was falsifying the books. With a clear handling of facts and figures, father was able to prove his suspicions to the shareholders.

He was a member of the Entomological Society of British Columbia from 1914 to 1922. His boyhood interest in nature persisted, and though he made no formal collections in Canada, other than of prairie water fowl eggs, he could identify all local birds and plants, and had a remarkably broad yet detailed knowledge of the families and habits of insects. To him, and to my mother with her love of flowers, books and the beauty of the countryside, my geologist brother Geoffrey and I owe constant encouragement in our studies.

Father's hobbies were fishing and stamp collecting. Farm life did not leave much time for the former, but long winter evenings and Sundays were happily spent with his albums, adding rarities, or puzzling over shades, surcharges, and water marks.

He is survived by two brothers and a sister in England, Ernest of Manchester, William of Falmouth, and Lady Rachel Fraser of Peaslake; by his widow at Salmon Arm; and by two sons and four grandchildren.—HUGH B. LEECH, California Academy of Sciences, San Francisco.

NEW DISTRIBUTIONAL RECORDS FOR **DERONECTES SPENCERI** (Coleoptera: Dytiscidae),—In February, 1947, I had the pleasure of meeting J. B. Wallis in Winnipeg, and of seeing his collection of water beetles. Amongst some unidentified material I noted a specimen of **D. spenceri** Leech, labelled "Atlee, Alta. 25.IX.24. Carr". Later the same month I had the privilege of spending several days examining the aquatics in the Canadian National Collection, to which W. J. Brown generously gave me free access. In it I saw a **spenceri** labelled "Lethbridge, Alta., 20.V.1930. J. H. Pepper." Professor G. J. Spencer took a series in Round Lake at the foot of Opax Mt., about 10 miles northwest of Kamloops, B.C., on July 22, 1945.

—Hugh B. Leech, Vernon, B.C.

SERICA SERICEA AND **S. ANTHRACINA** DEFOLIATING WILD ROSE (Coleoptera: Scarabaeidae)—In the last week of April, 1947, J. Grant and A. B. Robinson found **Serica sericea** (Ill.) by the thousand on Butters' Range five miles north of Lumby, B.C. The beetles were defoliating various small shrubs, but chiefly **Rosa** spp. On June 18 B. A. Sugden found **S. anthracina** LeC. to be equally common at Round Lake, about two miles northeast of O'Keefe, B.C., where the adults were completely stripping wild rose bushes, and on June 26 he and D. K. Campbell found them less numerous but also defoliating roses, near Chase, B.C. —Hugh B. Leech, Vernon, B.C.

ANOPLODERA CARBONATA (Coleoptera: Cerambycidae).—On June 28, 1931, I discovered a host tree of **Anoplodera carbonata** (Lec.) at Creston, B.C. It was a stub of some 30 feet of a large, dry **Populus trichocarpa**, and 5 specimens were found under the loose bark. I returned the next day to hack the tree into chips, and another 18 adults were taken from pupal-cells, and a vial of larvae from the burrows. This is still the only record for the Province. The female is entirely black; the elytra of the male are reddish brown and abdomen is red. This latter fact I have not seen mentioned in the literature.—G. Stace Smith, Creston, B.C.

SWARMS OF CONFLUENT SHARPSHOOTER, **CICADELLA CONFLUENS** (UHL.) ANNOYING WORKMEN (Homoptera: Cicadellidae).—During the construction of a new tower and lookout building at the Elk Falls Forest Lookout site, Campbell River, B.C., November 13th, 1946, the progress of the work was interrupted by swarms of hoppers. G. S. Walley has kindly identified spcimens as **Cicadella confluens** (Uhl.). They settled on the new tower construction in numbers sufficient to obscure the timbers and in addition molested the men by getting in their eyes, nostrils and mouths. As daylight faded and temperatures dropped to freezing they clustered in swarms similar to those of bees. The following day they were not seen.—D. B. Taylor, District Foresters Office, Vancouver, B.C.

NOTICE

The Annual Convention of the Pacific Coast Division of the AMERICAN SOCIETY OF ECONOMIC ENTOMOLOGISTS will be held in 1948 in Vancouver, B.C. Dates are June 16-18 inclusive; place, Hotel Vancouver. The Divisional Committee includes Mr. James C. Barr of Commercial Chemicals, Mr. Lang Godfrey of C.I.L., Mr. Arthur Laing of Buckerfield's and Mr. Walter Leckie of Harrison and Crosfield's. All amateur and professional entomologists, or others that may be interested, are cordially invited to attend these meetings.

ANTHIDIELLUM ROBERTSONI AND ITS NEST (Hymenoptera: Megachilidae).—While splitting part of my winter's wood supply on September 15th, 1945, I found a curious little waxen cell on the underside of a piece of Douglas fir. It was 13 mm. long, including the ventral spike (fig. 1), warty, greenish black with a vitreous surface. Thin flakes of some yellowish white material stuck to the surface formed two irregular bands.

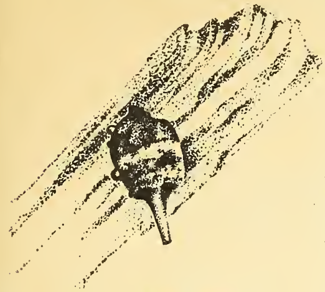


Fig. 1. Nest of **Anthidiellum robertsoni** (Cockerell) attached to the underside of a piece of wood.

The nest was left outside until January 30, 1946; the next day it was placed in an incubator operating at 74°F. and 90-95% relative humidity. A pretty black and yellow bee emerged on March 19, and was subsequently identified as a female of **Anthidiellum robertsoni** (Ckll.) by O. Peck of Ottawa. I am indebted also to Mrs. D. K. Campbell (nee Rita Beckingham) for the illustration of the bee and to Ben Sugden for that of the nest. —Hugh B. Leech, Vernon, B.C.*

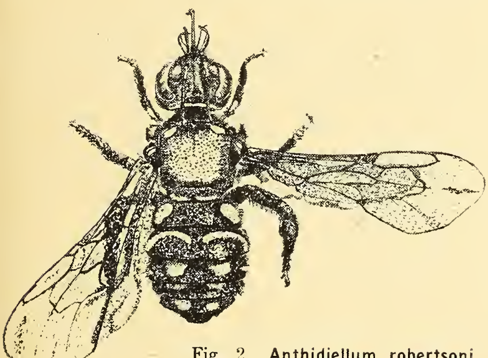


Fig. 2. **Anthidiellum robertsoni** (Cockerell), Vernon, B.C.

* Contribution No. 2495, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

SECOND SUPPLEMENT TO A LIST OF THE HETEROCERA OF THE NELSON-ROBSON-TRAIL DISTRICT OF BRITISH COLUMBIA (Lepidoptera)

AGARISTIDAE

1117 **Alypia ridingsi** Grt. Robson 29.V.46

PHALAENIDAE

2025 **Pleroma apposita** Sm. Robson 26.III.46

GEOMETRIDAE

4680 **Semiothisa granitata** Gn. Robson ...12.V.46
4687 **Semiothisa sexmaculata incolorata** Dyar.......
Robson 24.V.46

AEGERIIDAE

8693 **Sanninoidea graefi** Hy. Edw. Robson 25.VII.45
8724 **Thamnosphecia americana** (Beut.)
Robson 11.V.41, 24.V.46

I am much indebted to Dr. T. N. Freeman of the Division of Entomology, Ottawa, for making the identifications.—Harold R. Foxlee, Robson, B.C.

CYCHRUS RICKSECKERI (Coleoptera: Carabidae).—The first British Columbia record of **Cychrus rickseckeri** Lec. was on May 20, 1923, when Chas. Lallamand took a few (3?) specimens of this rare beetle at Creston. Then I took one at Sanca on May 17, 1933. In 1946 I discovered a small "patch" of them at Wynndel. It was in a deep, wooded ravine, on one side only of a mountain stream, a strip of about 500 feet that had been run over by fire and grown up to weeds and grass. Here, under loose stones and driftwood, they were found. Frequent visits were made, collecting them again under stones I had turned before, with a total catch of 19 between May 3 and June 16. Several individuals were observed feeding on snails, crushing the shells with their great jaws.—G. Stace Smith, Creston, B.C.

THE W. H. A. PREECE COLLECTION OF **CERAMBYCIDAE**, containing many British Columbia specimens, is now in the Canadian National Collection at Ottawa, through the kindness of W. Downes. Mr. Preece was a member of our Society for some years, and did much of his collecting in company with George A. Hardy. Some of their findings were published in the "Pan-Pacific Entomologist" and in the Annual Reports of the Provincial Museum of Natural History, Victoria. —H.B.L.

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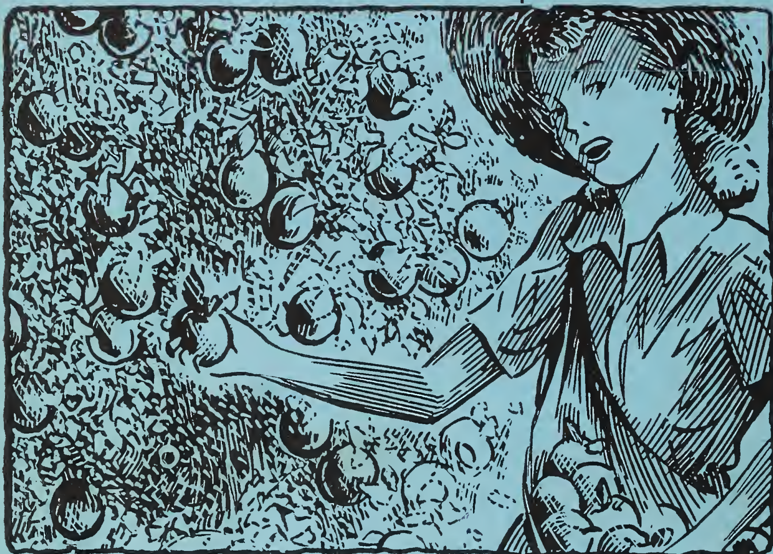

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NOTES ON GRYLLOBLATTA AT KAMLOOPS

By the late Matthew Geddes Campbell, presented by G. J. Spencer
University of British Columbia, Vancouver, B.C.

In the autumn of 1938 it was my good fortune to get into correspondence with Mr. M. G. Campbell who worked in the post office at Kamloops. Mr. J. D. Gregson of the Dominion Entomological Laboratory had told me that Campbell was a keen amateur entomologist who had become interested in *Grylloblatta,* which Gregson had recently found at the foot of Mount Paul, Kamloops, so I wrote to him in connection with this insect. For one reason and another, the correspondence lapsed until September, 1940, when Campbell happened to listen to a broadcast in which I had mentioned *Grylloblatta,* and wrote again, this time from New Westminster where he had been transferred for over a year. A letter came from him on October 7th and in the evening paper of that day, appeared a notice of his death. The notice read: "New Westminster, Oct. 7.—Fatally injured in a traffic accident shortly after midnight Saturday at Sixth Street and Eighth Avenue, Matthew Geddes Campbell, 47, postal clerk, of 1009 Fourteenth Ave., Burnaby, died in the Royal Columbian Hospital at 6:55 a.m. Sunday."

Shortly afterwards I wrote to his widow concerning his observations and notes on *Grylloblatta,* but received no reply; I wrote again in autumn 1947 to the same address, and since there has been no answer, it is possible that Mrs. Campbell has moved elsewhere. Because his letters to me in 1938 contained interesting records on *Grylloblatta,* I feel that they should be published, especially since he gave me permission to do so. From his correspondence I have picked out sections to make a fairly consecutive narrative, with a little editing.

"Last Sunday (6 Nov. 1938) I was successful in capturing a number of *Grylloblatta campodeiformis* on the slopes of Mount St. Paul and brought them home alive. (The bottom edge of Mount St. Paul, Kamloops, where *Grylloblatta* occurs, is only about 1,400 ft. above sea level. G. J. S.) I have prepared a case for them and will ship them to you. . . . As you know, these insects are very susceptible to changes of climate and can live only between 30°F. and 40°F. . . . There are 15 or 20 specimens. I had about 25 originally but some may have been killed or injured by larger ones or by jolting on the way over. A friend of mine, Mr. Consett Davis of the University of Sydney, Australia, who is at present studying at the University of California, Berkeley, will be returning to Australia on the 'Niagara' leaving about 20 Dec. I promised him some time ago that I would try to get him some live *Grylloblatta,* so if you do not mind taking care of them until his arrival, I would suggest that you divide them equally.—There is a bare possibility that Mr. Davis may have time to come up here but we may get a cold spell and then *Grylloblatta* goes away down under tons of rock and is difficult to find. Snow or zero weather may drive them down before I can make another raid. If they reach you in good condition, I would suggest that you keep them in soft rotted humus, between 30°F. and 40°F. They will freeze at about 26°F.

(19 Nov. 1938). "I was much relieved on receiving your letter of 16th inst., to know that the *Grylloblatta* arrived safely. I probably shot them at you rather suddenly and it requires a little preparation to receive such guests properly. . . . I intend to go out tomorrow (Sunday) afternoon. . . . . Mr. Davis will be in Montreal for a few days before the 28th Nov. and I am planning to send him two lots, one by express and one by air mail. I understand that they can keep them at about the right temperature on the fish rack in the express cars. . . . I have a batch in my basement that I can send Mr. Davis if I am unsuccessful in my hunt

AUG 16 1949

tomorrow. Usually I go out hunting in the morning but for your purpose (to examine the stomach contents soon after a meal) it will be better if I catch one in the evening and send it on the night train. . . . no use examining the gut of those two large females I sent you because one or other devoured a good big male nearly as large as they are, just before I sent them off."

(21 Nov. 1938). "I am sending to you by this mail, two specimens of *Grylloblatta* which I caught about 10 a.m. this morning and killed in 70% alcohol. . . they are not quite as big as I would have liked. . . . . Had a busy morning and caught about 25 though they were mostly small. About 20 of these, I am sending off tonight by air mail, special delivery to Mr. Davis at Montreal. It is a long chance but worth the risk. I could not go out on Sunday as planned; the train wreck delayed me at my work but I made good this morning. Mr. Gregson and three others were out Saturday afternoon but drew a complete blank. I still have a number of specimens on hand."

(5 Dec. 1938). "I have handed my remaining specimens over to Gregson. . . . as I work in the post office I will be very busy for the next two or three weeks. . . Mr. Davis sent me word from Montreal that he had received the batch I sent him. Some perished on the trip and not relishing the responsibility of looking after them on an 18,000 mile trip, he "dunked" the lot in Carnoy's fixative. (The Shirker).

"As you know, I am very interested in this strange insect and have collected quite a file (of notes) on him. Last winter I kept a number in captivity, some of which died and were pickled and sent to Davis. Gregson also kept a few but I understand they too died when the weather became hot. Therefore I hope you will not mind my offering some suggestions from the experience I gained last winter. I have made many trips to Mount St. Paul and must have collected more than a hundred specimens. . . . I trust you will find my observations of some value. . . . You are quite at liberty to use or quote any of this (material) you wish. It is merely my hobby, something I play at and I have had a lot of fun and interest out of *Grylloblatta* and expect (to have) lots more.

"A great deal of sheer bunk has been written about this poor creature. I am thinking of a picture of him that appeared in an Alberta paper, showing the insect on a block of ice and stating that if removed from the ice he would have convulsions and die in a few hours. Some I caught early last March survived until the end of June with never a bit of ice, just in a glass biscuit jar in my basement. I had difficulty in persuading even Gregson that they would perish if exposed to five or six degrees of frost, at the same time as the newspapers were making quite a song about the poor things 'roasting' to death in a refrigerator. I lost all of a dozen specimens before the truth dawned on me. Or, as I explained to Davis, it does NOT need to be cold enough to freeze the appendages of a brazen simian, in order to suit *Grylloblatta*. Altogether too much has been made of this temperature angle, ever since he was badly misnamed 'Ice Bug,' A 'Rock Louse' would be a much more appropriate term. Give them lots of well-rotted humus to prowl in, a few rocks to hide under and you will have no more trouble with them than with a bunch of earthworms. Here (in Kamloops), we have sub-zero temperatures to protect them from as well as temperatures over the century mark, but down there (in Vancouver), with the exception of a little ice in July and August, they should live in your normal, outside, temperatures. Mine were alive and active when the thermometer on the verandah showed 75°F., but the temperature in the basement [where they were kept. (G.J.S.)] was about 60°F. I am convinced that if they had had more humus to protect them, they would have survived [all summer. (G.J.S.)]. I did not give them more humus because I could not then have observed their reactions.

"I will put the remainder of this on

separate sheets so that you can file, or refer to them apart from this letter."

Mr. Campbell's "NOTES ON GRYLLOBLATTA" (Transcribed with a few changes, and translocations of sentences, by G. J. Spencer).

On Habits of Grylloblatta.—

"Since most of the work hitherto done on this insect has been of a laboratory nature, and as I have no equipped laboratory, I have concentrated more on his habitat and plant and insect associations. Much may be learned about him from a study of his extraordinary habitat. Here (in Kamloops), he occupies a range of rock slides about a mile in length and I have found *Grylloblatta* all along these slides from one end to the other; amongst large boulders so big as to require a crowbar to turn them over and amongst gravel the size of a small pea. Generally speaking, the large ones are found amongst the large rocks and small ones amongst the small rocks but I find it more convenient to divide his habitat into three zones.

A. "The front part or edge of the slide (farthest from the talus slope), where vegetation begins amongst the large, loose, scattered boulders. This is where the large, amber-coloured adults are to be found. Sage brush is here the dominant plant (*Artemisia tridentata*) and sage seeds are scattered all through the humus (duff). Here also occur several species of grasses, Saskatoon bushes (*Amelanchier*), Oregon grape (*Berberis* prob. *nervosa*) and an occasional Jack pine (yellow pine, *Pinus ponderosa*).

B. "Area about one foot in from the edge of the slide where winds have blown in a light covering of leaves and humus (has formed amongst the rocks). This is the home of the medium-sized, grey ones and, in springtime, of white (nymphs in) early instars.

C. "In area deeper down amongst the older, deeper humus, are found little white nymphs of early instars.

"When disturbed, *Grylloblatta* always goes UPWARDS, that is, towards the mountain, further into the shelter of the rocks. Even when trapped with a spoon, they will not turn outwards but will climb over the spoon in their attempts to get into the shelter of the hill.

"After searching in one place for a little time, even though several specimens may have been found there, further search is generally fruitless; the disturbance caused by moving rocks, alarms them and they scatter deeper into the hill. Here I quote Dr. Norma Ford: 'The next morning I *expected* to take at least forty specimens, and literally no stone was left unturned in the swampy ground as I worked in ever increasing circles from the point of the first capture. But not a specimen was found.' Dr. Ford seemed to obtain hers in boggy, wet soil; most of my captures have been made under conditions of drizzly 'Scotch mist.'

"This autumn I was due for another surprise. Thinking that I was really clever, I decided that since the summer had been very dry, *Grylloblatta* would be found in the little gullies that run down from the tops of the cliffs where water would trickle down and settle (in temporary low spots). Strangely enough I had no luck in these places, but found him away out on 'bone dry' spurs under exceedingly dry, dusty conditions. Moreover, while prowling over the hills on the west side of the North Thompson river in the spring (of 1938) I found one specimen, about two miles west of Mount St. Paul and on the other side of the river. [Note: this would be on the east slope of the Batchelor hills which drop abruptly to the North Thompson Valley; there is little or no talus on these hills which are extremely dry. (G.J.S.)]. However, I was foolish enough to put him into a can with a large silver fish [Machilidae (G.J.S.)] and when I got home there was only one very fat silver fish. I never found him in a high, either hot or cold wind, nor when the thermometer was above 50°F. although I have found him when it was as low as 15° or

20°F., buried in a deep bed of humus. That was cold hunting.

"That he can survive and get along nicely when temperatures are below zero, (as sometimes happens at Kamloops), does not surprise me much. An inch or two of snow and a few inches of humus give him all the protection he needs.

"But where does he go in summer, when there isn't a drop of rain for months and the rocks at the foot of the talus slope sizzle in temperatures up to 120°F. for 12 or 14 hours a day? He must have certain selected places deep down, covered with two or three feet of rock, with a layer of humus available and a means of retaining moisture. That he goes into a sort of dormant state (aestivation) in summer, I have no doubt.

"Of the insects that occur in the *Grylloblatta* association (may be mention), a small green fly; the aeroplane moth that folds itself up to look like a monoplane or like a cross of two pieces of dry stick [Pterophoridae. (G.J.S.)]; a few centipedes, an occasional nest of termites [*Reticulitermes hesperus* (G.J.S.)], the occasional silver fish and several species of spiders. I have not seen any true ants in his direct neighborhood but in the autumn, plenty of grasshoppers, wasps and bees crawl amongst the rocks for shelter from the cold nights. While adult *Grylloblatta* are out hunting grasshoppers stiffened by cold, the large, swift-moving spiders are in turn, hunting *Grylloblatta*; spiders are really the most dangerous enemies of adult *Grylloblatta* until the weather gets too cold even for them. . . . Full-grown, adult *Grylloblatta* are distinctly carnivorous, and are fiercely combative prowlers and hunters . . . although the earlier stages *may* eat decaying vegetable matter . . . as of moss and other primitive plants . . . However there is hardly any moss on Mount St. Paul and I have not noticed any where *Grylloblatta* is found; higher up the mountain where there is some moss, I have never found him.

"We know that even medium-sized ones will devour grasshoppers, wasps, bees and cockroaches. I tried some ants on them and also ant pupae but *Grylloblatta* was not interested after the first smell. (However) on several occasions I have found adults (apparently) waiting at the top of a burrow of termites. Whenever I found a termite run I would turn over a couple of rocks above it and usually found one or two *Grylloblatta*. Although Dr. Ford claims she found three adults under one flat stone, I have rarely found more than one at a time.

"I wish I could get over to the mountain about this season (6 December). After devouring all the frozen (autumn) insects, *Grylloblatta* will undoubtedly go on to reproduction. I feel sure that in this locality, this is his mating season."

CARE OF GRYLLOBLATTA IN CAPTIVITY.

"My temperature records are not in any sense scientific, but I did observe (the creature) under many and varied conditions, summer and winter, in captivity and in his (natural) habitat. . . . I feel certain that a study of his life would add much to biology. How I regret now the opportunities I passed up of qualifying myself to make such a study. . . I do not see how I, an untrained man, can add much to the work that has been done by Drs. Walker and Mills and Pepper. However, if anything I can do will benefit science in the smallest degree, you are more than welcome to it.

" . . . In simulating natural temperature conditions here (in Kamloops) the range would approximate: October to April, day 80°F. to 0°F.; night, 50°F. to —20°F. May to September, day 120°F. to 50°F.; night, 75°F. to 40°F. . . . (To meet these conditions) I would suggest that the insects be stored in two chambers:

(1) A large bucket (of wood) or a can, for general storage. (This should have on the bottom) a layer of clay, then a layer of stones of about one inch diameter, 3 or 4 deep, and on top of this, a deep layer of moist, loose humus. This large container can be stored in a cool dark basement and provided with a per-

forated tin lid for holding ice in summer, and will provide shelter from excessive heat or cold. If ice is used, a drainage hole should be provided in one side just below the rocks, above the layer of clay. (Paraphrased. G.J.S.).

(2) An observation chamber. A glass-sided box, 12 inches square and 2 inches wide, with wooden or metal ends and bottom, open at the top. This should contain two layers of stones of one inch diameter, continued up one side; on top of the stones, a layer of clay an inch thick to hold the stones in place, especially those up the side. Then another layer of inch-diameter stones with several layers of small pebbles on top (and finally, the narrow chamber should be) filled up with loose, damp humus.

"The stones up one side of the chamber are for summer use; on them should be placed a small perforated can containing ice whose dripping can leak down the stones and along the bottom to keep the whole chamber cool and moist without making the humus marshy. A draining hole on one end, at the rock level and below the clay, will let out excess water. This observation chamber should be kept on a solid bench or on a table where slamming doors or other vibrations will not disturb the insects, and should be sprayed at intervals with a fine mist of water to simulate rain. Since this chamber is so narrow, the insects can be observed through the glass sides as they move up and down. As they are very sensitive to light, a red light should be used for observations. (Paraphrased by G.J.S.)

CONCERNING FOSSILS.—

"That fossil forms of *Grylloblatta* have not been found to date, is not very surprising since *Grylloblatta* himself has been known to science only since 1913. Most of our fossils are 'split out' from layers of sedimentary rock. But *Grylloblatta* will not be found in such layers; he will be found in a hard conglomerate since he was swept down the hillsides by slides and avalanches and buried. I have been working a little on that angle during the summer but with so little time to do it in, of course I have little success to report. I found no *Grylloblatta* (in the rocks), only leaves and twigs."

POSTSCRIPT BY G. J. SPENCER.—

In his last letter to me written on October 4, 1940, Mr. Campbell said . . . "Since I came down here (to New Westminster) I have had a notion to explore the foothills near the Lions and Grouse Mountain or the hills north of a line (drawn from) Sardis to Chilliwack where I believe *Grylloblatta* may be found, or even around Yale and Hope. If you have any students keen enough and possessing a car, I wouldn't mind making a two- or three-day trip, sharing the expenses, when I get my holidays. If you have any enthusiasts along this line I would be glad to hear from them and make arrangements." He was killed three days later.

We have here a remarkable series of observations by a man, who, while deploring his lack of education, had sufficient enthusiasm and enterprise to spend many hours of his limited free time, combing the Kamloops hills for an insect which fascinated him. Never once in his original notes does he call *Grylloblatta* an "insect" or speak of it as "it"; it was always "he," "him," or "*Grylloblatta*," a real personality, and he maintained cultures in his basement in the face of some slight hostility from his family.

Mr. Campbell's notes bring up many points for discussion, but I would emphasize only two at this time; *one*, that the Kamloops *Grylloblatta* is apparently a separate race from the Banff-Jasper high-altitude, snow or ice-edge form, and one which can tolerate temperatures far above those of the mountain form, and, if Mr. Campbell's records are correct, it is a form that freezes to death with only 6 degrees of frost, and *two*, that precise and detailed studies of the Kamloops *Grylloblatta* are long overdue.

AN EXPERIMENT WITH LARVAE OF LAMBDINA FISCELLARIA SOMNIARIA HULST

J. R. J. LLEWELLYN JONES
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As long ago as 1905 it was recognized that there was a close connection between the oak looper, then known as *Therina somniaria* Hulst, and the hemlock looper, *Therina fiscellaria* Guenee.

In the Bulletin of the British Columbia Entomological Society, 1906, No. 3, September, page 3, in an article entitled "*Therina somniaria* at Victoria," Dr. J. Fletcher is quoted as saying that, during an outbreak the previous year, larvae of *somniaria* were observed feeding on western hemlock, spruce and Douglas fir. Also the Rev. G. W. Taylor is reported as considering *somniaria* Hulst, to be a variety of *fiscellaria* Guenee.

More recently a paper has been published by H. W. Capps entitled "Some American Geometrid moths of the subfamily Ennominae heretofore associated with or closely related to *Ellopia* Treitschke" (Proc. United States Museum, 93 (3159):115-150, Washington, 1943) in which the writer regards *somniaria* Hlst., as a regional race of *fiscellaria* Guenee and places them in a new genus *Lambdina* Capps. He states that examination of the genitalia confirms his arrangement. The oak looper therefore becomes *Lambdina fiscellaria somniaria* Hlst., and the western hemlock looper *Lambdina fiscellaria lugubrosa* Hlst.

In support of this view, I submit the following notes on an experiment carried out last season with larvae of *somniaria*, obtained during a severe but local outbreak in the Saanich District of Victoria on Garry oak, *Quercus garryana* Douglas.

Eleven hundred larvae were obtained in varying stages of growth. Of these two hundred were placed in a container and fed with western hemlock, *Tsuga heterophylla Sargent.* The larvae readily accepted this and fed to maturity. Sixty-three imagines were obtained during September and October, a percentage of 31.5. Of the remaining 900, which were allowed to continue feeding on Garry oak, 473 imagines were obtained, a percentage of 52.5.

Both groups of insects showed the same range of colour variation, but there was an appreciable difference in the size of the imagines. Those which had been given hemlock were smaller and more close the normal size of *fiscellaria lugubrosa* Hlst.

Average measurements were as follows:

1. Fed on oak 1.75 inches.
2. Fed on hemlock 1.50 inches.

The converse experiment was not so successful due chiefly to the lack of healthy specimens. Some 70 larvae of the hemlock looper, *L. fiscellaria lugubrosa* Hlst., were received from Mr. G. R. Wyatt, early in August from the Sarita River area on Vancouver Island. They were heavily parasitized and also were suffering from a virus infection, consequently mortality was great. Only one imago was obtained, a rather small sized male. The larvae survived long enongh however to satisfy me that they would readily accept oak as a food plant. About 20 larvae were supplied with oak, which they promptly ate.

In conclusion, it would seem reasonable and, I deem, desirable, to accept H. W. Capps' re-arrangement of this group, about which, in the past, there has been some disagreement and speculation.

A REVISED CHECK LIST OF THE FLEAS OF BRITISH COLUMBIA*

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Harvey (1907) gave the first published account of the fleas of this province, listing six species, three of which had recently (1896-1904) been described from the Queen Charlotte Islands, B.C., by Dr. Carl F. Baker. Over the period 1902-1933 many other species from British Columbia were described by the Hon. N. Charles Rothschild and/or Dr. Dr. Karl Jordan of the Zoological Museum, Tring, Herts., England. The type series of most of these were collected in the Fraser Delta, the Okanagan Valley, the Upper Columbia River and the Rocky Mountains. Spencer (1936) presented to this Society a briefly annotated list of 61 species offleas known to occur in British Columbia, based partly on his own extensive collections of these insects (identified by Dr. Julius Wagner of Belgrade, Yugoslavia) and partly on information received through correspondence with Dr. Jordan. Subsequent papers by Spencer, Wagner and the present writer in various journals have improved our knowledge of British Columbia fleas by adding records and descriptions of new species on one hand, and by subtracting proved synonyms on the other. In a paper entitled "The Siphonaptera of Canada" (not in print at the time of writing) the writer discusses 127 species and subspecies of fleas, of which 89 were collected within the political boundaries of British Columbia. While this paper gives all available data on the siphonapterous fauna of British Columbia as well as other provinces, up to December 31, 1946, the following account is presented here for convenience of reference, and following the useful policy of this journal of publishing lists of various groups of insects occurring within the provincial boundaries. In addition, some supplementary data and four new records are included, bringing the British Columbia list up to 93 species and subspecies, of which 88 are indigenous, and five evidently introduced within historic times.

The fleas constitute a small order, Costa Lima and Hathaway (1946) recording only 1193 known species and subspecies for the World—and their list contains many synonyms! It will be seen then, that British Columbia is well endowed, supporting about one-thirteenth of the total known flea fauna. Of course, future collecting in the more remote and inaccessible parts of the World may well alter this proportion.

There are now 134 species and subspecies of fleas known from the whole of Canada. Seventy percent of these are recorded from British Columbia. This relatively extensive proportion is in part a reflection of the tremendous variety of mammal, and especially small mammal, life of the west. This again is a product of the numerous climatic and altitudinal regions of this rugged province, which, coupled with other factors, have had such a profound influence in developing the diversity of plant cover on which all animals depend, directly or indirectly. Munro and Cowan (1947) define and trace 13 terrestrial and 2 marine biotic areas, distinguished by readily demonstrable peculiarities of weather, vegetation, animal life, etc., from contiguous areas. Thus the tremendous size, range of latitude, mountainous topography and variable climatic regions of the province, as well as its recent geological history, including land connections with Asia, have brought us an enviable botanical and zoological heritage, and this exceptional richness of indigenous flora and fauna is traceable even in the lowly fleas.

The following account of the fleas of British Columbia gives all known synonyms, aside from changes in generic assignment, of the various indigenous spe-

* Contribution No. 2569, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

cies. These details are not included with the introduced species. The preferred host or hosts, where known, are indicated, and brief statements relating to the known range in British Columbia. References to biotic areas follow Munro and Cowan. Data on the "type host" (frequently not significant in any case), "type locality" and literature citations relating to original descriptions of the species are not provided, this information being readily available in one or more of the publications listed in the short bibliography at the end of this article. Host records refer to British Columbia only. Subspecific names of hosts are not included in this list.

Order SIPHONAPTERA
Family PULICIDAE

1. **Hoplopsyllus glacialis lynx** (Baker)
   True host: Varying hare, *Lepus americanus* group.
   Recorded hosts: *Lepus americanus, Lynx canadensis, Lynx fasciatus.*
   Range: General, through most of province.
2. **Ctenocephalides canis** (Curtis) (Introduced)
   True host: domestic dog (?).
   Recorded hosts: domestic dogs and cats, tame rabbits, monkeys, man, *Procyon lotor*, rats, *Rattus norvegicus, R. rattus.*
   Range: Limited records at hand from south of province, but probably widespread on dogs and cats.
3. **Ctenocephalides felis felis** (Bouché) (Introduced)
   True host: domestic cats.
   Recorded hosts: same as for *C. canis.* Also *Spilogale gracilis.*
   Range: Probably same as for *canis.*
4. **Pulex irritans irritans** Linnaeus
   True host: unknown; Artiodactyla (?).
   Recorded hosts: man, *Rattus norvegicus, Odocoileus hemionus, Speotyto cunicularia.*
   Range: Fairly general.
5. **Xenopsylla cheopis** (Rothschild) (Introduced)
   True host: domestic rats, *Rattus* spp.
   Recorded hosts: *Rattus norvegicus, Rattus r. rattus, Rattus r. alexandrinus.*
   Range: Confined at present to extreme southwestern mainland of province (Puget Sound lowlands).

Family VERMIPSYLLIDAE

6. **Arctopsylla ursi** (Rothschild)
   True host: grizzly bears, *Ursus* spp.
   Recorded hosts: *Ursus* spp.
   Range: Probably general, especially in Alplands, and northern B. C.
7. **Chaetopsylla setosa** (Rothschild)
   True hosts: various large carnivores.
   Recorded hosts: *Canis latrans, Euarctos americanus, Ursus* spp., *Lynx canadensis, Gulo luscus.*
   Range: Probably general.

Family HYSTRICHOPSYLLIDAE

8. **Atyphloceras artius** Jordan
   True host: Cricetidae.
   Recorded host: *Peromyscus maniculatus.*
   Range: Known only from Kelowna.
9. **Atyphloceras multidentatus** (C. Fox)
   True host: various Cricetidae.
   Recorded hosts: *Spilogale gracilis, Peromyscus maniculatus, Microtus oregoni, Microtus townsendii, Rattus norvegicus.*
   Range: Puget Sound Lowlands, Vancouver Island.
10. **Hystrichopsylla dippiei** Rothschild
    True host: small Rodentia.
    Recorded hosts: *Sorex* sp., *Mustela vison, Spilogale gracilis, Citellus columbianus, Tamiasciurus hudsonicus, Eutamias* sp., *Peromyscus maniculatus, Clethrionomys gapperi, Microtus longicaudus, M. montanus.*
    Range: Fairly general. Not common.
11. **Hystrichopsylla** n. sp.
    A new species, to be described from western B. C. in "Siphonaptera of Canada."
12. **Hystrichopsylla** n. sp.
    A new species, to be described from Vancouver, B. C., in "Siphonaptera of Canada."
13. **Hystrichopsylla schefferi** Chapin
    (=*H. mammoth* Chapin)
    True host: mountain beaver, *Aplodontia rufa.*
    Recorded hosts: *Mustela vison, Spilogale gracilis.*
    Range: Southwest mainland.
14. **Catallagia charlottensis** (Baker)
    (=*C. motei* Hubbard)
    True host: white-footed mouse, *Peromyscus maniculatus.*
    Recorded hosts: *Scapanus orarius, Neurotrichus gibbsii, Peromyscus maniculatus, Clethrionomys gapperi, Microtus townsendii, M. oregoni, M. pennsylvanicus, M. longicaudus, Rattus norvegicus, Tamiasciurus hudsonicus.*
    Range: Coastal islands, and Pacific slopes, west of the Coast Range.
15. **Catallagia decipiens** Rothschild
    (=*C. moneris* Jordan)
    True host: White-footed mouse, *Peromyscus maniculatus.*
    Recorded hosts: *Mustela frenata, Citellus columbianus, Tamiasciurus hudsonicus, Peromyscus maniculatus, Neotoma cinerea, Microtus longicaudus, M. pennsylvanicus, M. montanus, Phenacomys intermedius, Clethrionomys gapperi, Eutamias* sp., *Thomomys talpoides, Ochotona princeps.*

16. **Catallagia sculleni** Hubbard
(=*C. chamberlini* Hubbard, *C. vonbloekeri* Augustson, *C. rutherfordi* Augustson).
True host: Cricetidae, especially *Peromyscus maniculatus.*
Recorded hosts: *Scapanus orarius, Eutamias* sp., *Microtus richardsoni, Clethrionomys gapperi, Peromyscus maniculatus.*
Range: Southern Coast Range; parts of Fraser Valley; Vancouver Island.

17. **Delotelis telegoni** (Rothschild)
True host: Cricetidae.
Recorded hosts: *Microtus pennsylvanicus, M. longicaudus, M. townsendii, M. oregoni, Clethrionomys gapperi, Peromyscus maniculatus.*
Range: Southern part of province, from Rockies to coast. Rare.

18. **Epitedia scapani** (Wagner)
(=*E. jordani* Hubbard, *E. stewarti* Hubbard).
True host: White-footed mouse, *Peromyscus maniculatus;* also common on Insectivora.
Recorded hosts: *Scapanus orarius, S. townsendii, Neurotrichus gibbsii, Sorex* spp., *Mustela* sp., *Microtus oregoni, Peromyscus maniculatus, Rattus norvegicus, Aplodontia rufa.*
Range: Puget Sound Lowlands.

19. **Epitedia wenmanni** (Rothschild)
(=*Neopsylla similis* Chapin).
True host: White-footed mouse, *Peromyscus maniculatus.*
Recorded hosts: *Microtus pennsylvanicus, Peromyscus maniculatus, Neotoma cinerea, Tamiasciurus hudsonicus.*
Range: Coast Range to Rockies, but not Pacific slopes.

20. **Neopsylla inopina** Rothschild
True host: ground squirrel, *Citellus* spp.
Recorded host: *Citellus columbianus.*
Range: Southern Kootenays, through Crow's Nest Pass.

21. **Phalacropsylla allos** Wagner
True host: woodrat, *Neotoma cinerea.*
Recorded host: *Neotoma cinerea occidentalis.*
Range: Probably restricted to Osoyoos-Arid biotic area.
New record: 12 miles west of Hedley, B.C., on banks of Similkameen River, 23.IV.48, coll. G. P. Holland.

22. **Meringis shannoni** (Jordan)
True host: pocket mouse, *Perognathus* spp.
Recorded hosts: *Perognathus parvus, Peromyscus maniculatus.*
Range: Okanagan Valley, from Vernon, south to border.

23. **Micropsylla sectilis sectilis** (Jordan and Rothschild)
(=*Micropsylla peromyscus* Dunn)
True host: white-footed mouse, *Peromyscus maniculatus.*
Recorded hosts: *Citellus columbianus, Tamiasciurus hudsonicus, Peromyscus maniculatus, Mus musculus.*
Range: Southern B.C., east of the Coast Range.

24. **Micropsylla sectilis goodi** Hubbard
True host: white-footed mouse, *Peromyscus maniculatus.*
Recorded hosts: *Mustela erminea, Spilogale gracilis, Tamiasciurus douglassi, Microtus oregoni, Peromyscus maniculatus, Rattus norvegicus.*
Range: Southern B.C., west of the Coast Range.

25. **Rectofrontia fraterna** (Baker)
(=*Neopsylla hamiltoni* Dunn)
True host: small Rodentia.
Recorded hosts: *Martes americana, Tamiasciurus hudsonicus, Phenacomys intermedius, Neotoma cinerea, Ochotona princeps.*
Range: Scattered over southern B.C. Rare.

26. **Trichopsylloides oregonensis** Ewing
(=*Phaneris hubbardi* Jordan)
True host: mountain beaver, *Aplodontia rufa.*
Recorded host: *Mustela vison.*
Range: Puget Sound Lowlands.

27. **Corrodopsylla curvata curvata** (Rothschild)
True host: shrew, *Sorex,* spp.
Recorded hosts: *Sorex obscurus, Sorex* spp.
Range: East of Cascade Mountains.

28. **Corrodopsylla curvata obtusata** (Wagner)
(=*Doratopsylla jellisoni* Hubbard)
True host: shrew, *Sorex* spp.
Recorded hosts: *Sorex spp., S. trowbridgii, S. vagrans, Neurotrichus gibbsii, Microtus oregoni.*
Range: West of Cascades, including Vancouver Island.

29. **Callistopsyllus terinus** (Rothschild)
(=*Callistopsyllus paraterinus* Wagner)
True host: white-footed mouse, *Peromyscus maniculatus.*
Recorded hosts: *Citellus columbianus, Peromyscus maniculatus.*
Range: Columbia Forest.

30. **Megarthroglossus divisus divisus** (Baker)
(=*Pulex longispinus* Baker)
True host: squirrel, *Tamiasciurus;* woodrat, *Neotoma.*
Recorded hosts: *Microtus longicaudus, Neotoma cinerea.*
Range: Southern B.C., east of Selkirks.

31. **Megarthroglossus divisus exsecatus** Wagner
True host: red squirrel, *Tamiasciurus hudsonicus.*
Recorded hosts: *Tamiasciurus hudsonicus, Glaucomys sabrinus, Peromyscus maniculatus.*
Range: Southern B.C., Cascades to Selkirks.

32. **Megarthroglossus procus** Jordan and child
   True host: Chickaree, *Tamiasciurus douglassi.*
   Recorded hosts: *Spilogale gracilis, Tamiasciurus douglassi, Glaucomys sabrinus, Rattus norvegicus.*
   Range: Coast Forest (southern mainland only).

33. **Megarthroglossus pygmaeus** Wagner
   True host: probably woodrat, *Neotoma cinerea.*
   Recorded host: *Neotoma cinerea.*
   Range: Known only from Nicola.

34. **Megarthroglossus sicamus** Jordan and Rothschild
   True host: unknown, probably woodrat, *Neotoma.*
   Recorded hosts: *Canis latrans, Lynx fasciatus, Neotoma cinerea.*
   Range: Probably restricted to Dry Forest biotic area.

35. **Megarthroglossus similis** Wagner
   True host: probably woodrat, *Neotoma.*
   Recorded host: *Neotoma cinerea.*
   Range: Known only from Beaverdell.

36. **Megarthroglossus spenceri** Wagner
   True host: unknown.
   Recorded host: *Ochotona princeps.*
   Range: Known only from Nicola.

37. **Corypsylla ornata** Fox
   True host: mole, *Scapanus* spp.
   Recorded hosts: *Scapanus orarius, S. townsendii, Microtus oregoni, M. townsendii.*
   Range: Puget Sound Lowlands, north and south of Fraser River.

38. **Corypsylla jordani** Hubbard
   True host: shrew-mole, *Neurotrichus gibbsii.*
   Recorded host: *Neurotrichus gibbsii.*
   Range: Puget Sound Lowlands. *New record:* Silver Creek, 15.III.48, coll. G. P. Holland.

39. **Corpsylloides kohlsi** (Hubbard) (=*C. spinata* Fox)
   True host: shrew, *Sorex* spp.
   Recorded host: *Sorex obscurus.*
   Range: Puget Sound Lowlands. *New record:* Silver Creek, 11.X.47, coll. G. P. Holland.

40. **Nearctopsylla brooksi** (Rothschild)
   True host: unknown, probably *Sorex;* possibly *Mustela.*
   Recorded hosts: *Mustela erminea, M. frenata, M. vison, Martes americana.*
   Range: Widespread over province.

41. **Nearctopsylla hyrtaci** (Rothschild)
   True host: shrew, *Sorex* spp.
   Recorded hosts: *Sorex obscurus, S. cinereus, Mustela vison, M. frenata, Martes caurina, M. americana, Clethrionomys gapperi.*
   Range: Southern half of province, including Vancouver Island.

42. **Nearctopsylla jordani** Hubbard (=*N. hygini columbiana* Wagner)
   True host: mole, *Scapanus* spp.
   Recorded hosts: *Scapanus orarius, Neurotrichus gibbsii.*
   Range: Puget Sound Lowlands.

FAMILY CERATOPHYLLIDAE

43. **Ctenophyllus terribilis** (Rothschild)
   True host: pika, *Ochotona* spp.
   Recorded host: *Ochotona princeps.*
   Range: Southern Alplands, and some contiguous areas. Coincident with host.

44. **Dolichopsyllus stylosus** (Baker)
   True host: mountain beaver, *Aplodontia rufa.*
   Recorded host: *Aplodontia rufa.*
   Range: Puget Sound Lowlands.

45. **Oropsylla arctomys** (Baker) (=*Aetheopsylla septentrionalis* Stewart and Holland)
   True host: woodchuck, *Marmota monax.*
   Recorded hosts: *Marmota monax, M. caligata.*
   Range: Boreal Forest, Columbia Forest.

46. **Oropsylla idahoensis** (Baker) (=*Ceratophyllus poeantis* Rothschild, *C. bertholfi* Fox)
   True host: ground squirrel, *Citellus* spp.
   Recorded hosts: *Mustela frenata, Citellus columbianus, C. lateralis, Ochotona princeps.*
   Range: Coincident with ground squirrels in southern half of province.

47. **Thrassis acamantis** (Rothschild)
   True host: yellow-bellied marmot, *Marmota flaviventris.*
   Recorded hosts: *Mephitis* sp., *Marmota flaviventris, Citellus columbianus, Eutamias* sp., *Tamiasciurus hudsonicus.*
   Range: Dry Forest, Cariboo Parklands.

48. **Thrassis petiolatus** (Baker)
   True host: Columbia ground squirrel, *Citellus columbianus.*
   Recorded hosts: *Citellus columbianus, Eutamias* sp., *Thomomys talpoides.*
   Range: Coincident with range of *C. columbianus* from Shuswap Lake south, especially in areas at low elevation.

49. **Thrassis spenceri** Wagner
   True host: Alpine marmot, *Marmota caligata* group.
   Recorded hosts: *Gulo luscus, Ursus* sp., *Marmota monax, M. caligata, M. vancouverensis.*
   Range: Alplands and some contiguous areas.

50. **Amphalius necopinus** (Jordan)
   True host: pika, *Ochotona* spp.
   Recorded host: *Ochotona princeps.*
   Range: Southern Alplands.

51. **Dactylopsylla comis** Jordan
   True host: Pocket gopher, *Thomomys* spp.
   Recorded host: *Thomomys talpoides.*
   Range: Known only from Okanagan Landing.

52. **Foxella ignota recula** (Jordan and Rothschild)
True host: pocket gopher, *Thomomys* spp.
Recorded hosts: *Mustela frenata, Citellus columbianus, Thomomys talpoides.*
Range: Dry Forest.

53. **Opisocrostis tuberculatus tuberculatus** (Baker)
True host: ground squirrel, *Citellus* spp.
Recorded host: *Citellus columbianus.*
Range: Southern Kootenays, through Crow's Nest.

54. **Opisodasys keeni** (Baker)
True host: white-footed mouse, *Peromyscus maniculatus.*
Recorded hosts: *Mustela* sp., *Microtus* sp., *M. townsendii, Clethrionomys gapperi, Peromyscus maniculatus, Zapus* sp.
Range: Apparently general, through province.

55. **Opisodasys pseudarctomys** (Baker)
(=*Ceratophyllus acasti* Rothschild)
True host: flying squirrel, *Glaucomys* spp.
Recorded hosts: *Tamiasciurus hudsonicus, Glaucomys sabrinus.*
Range: Scattered; southern B.C. east of Coast Range.

56. **Opisodasys vesperalis** (Jordan)
True host: flying squirrel, *Glaucomys* spp.
Recorded hosts: *Mustela* sp., *Lynx* sp., *Glaucomys sabrinus.*
Range: Dry Forest and southern Coast Forest.

57. **Orchopeas caedens caedens** (Jordan)
True host: red squirrel, *Tamiasciurus hudsonicus.*
Recorded host: *Tamiasciurus hudsonicus.*
Range: (Roughly) north of 53°.

58. **Orchopeas caedens durus** (Jordan)
True host: red squirrel, *Tamiasciurus hudsonicus.*
Recorded hosts: *Mustela frenata, M. erminea, Lynx canadensis, Tamiasciurus hudsonicus, Glaucomys sabrinus, Eutamias* sp.
Range: (Roughly) south of 53°.

59. **Orchopeas leucopus** (Baker)
(=*Ceratophyllus aeger* Rothschild)
True host: white-footed mouse, *Peromyscus maniculatus.*
Recorded host: *Peromyscus maniculatus.*
Range: Probably northern half of province.

60. **Orchopeas nepos** (Rothschild)
True host: Chickaree, *Tamiasciurus douglassi.*
Recorded hosts: *Mustela vison, M. erminea, Spilogale gracilis, Tamiasciurus douglassi, Glaucomys sabrinus.*
Range: Coast Forest (southern mainland only).

61. **Orchopeas sexdentatus agilis** (Rothschild)
True host: woodrat, *Neotoma cinerea.*
Recorded hosts: *Mustela frenata, Spilogale gracilis, Clethrionomys gapperi, Neotoma cinerea, Ochotona princeps, Sylvilagus nuttalli.*
Range: Through most of province.

62. **Tarsopsylla coloradensis** (Baker)
(=*Opisodasys jellisoni* Fox)
True host: squirrel, *Tamiasciurus* and *Glaucomys.*
Recorded hosts: *Martes americana, Tamiasciurus hudsonicus, Glaucomys* sabrinus.
Range: In mountains, and probably throughout much of northern part of province.

63. **Ceratophyllus adustus** Jordan
True host: unknown. A bird?
Recorded host: *Erethizon dorsatum.*
Range: Known only from Atlin.

64. **Ceratophyllus celsus celsus** Jordan
True host: bank swallow, *Riparia riparia.*
Recorded host: *Riparia riparia.*
Range: Known only from Kamloops and Okanagan Falls.

65. **Ceratophyllus diffinis** Jordan
(=*C. rileyi* Liu)
True host: many birds.
Recorded hosts: *Bonassa umbellus, Melospiza melòdia.*
Range: Probably southern half of province.

66. **Ceratophyllus garei** Rothschild
(=*C. utahensis* Chapin, *C. quebecensis* Fox)
True host: ground-nesting birds.
Recorded host: *Erismatura jamaicensis.*
Range: Probably widespread. One record available, from Kamloops.

67. **Ceratophyllus idius** Jordan and Rothschild
True host: tree swallow, *Iridoprocne bicolor.*
Recorded hosts: *Asio otus, Iridoprocne bicolor.*
Range: Known only from Okanagan at present.

68. **Ceratophyllus niger** Fox
(=*C. niger inflexus* Jordan)
True host: various birds.
Recorded hosts: *Phalacrocorax pelagicus, Gallus gallus, Otus asio, Cryptoglaux acadica, Acridotheres cristatellus, Vermivora celata, Turdus migratorius, Passer domesticus, Tamiasciurus hudsonicus.*
Range: Common in southern half of province.

69. **Ceratophyllus petrochelidoni** Wagner
True host: cliff swallow, *Petrochelidon pyrrhonata.*
Recorded host: *Petrochelidon pyrrhonata.*
Range: Known only from Chilcotin and Kamloops.

70. **Ceratophyllus riparius** Jordan and Rothschild
True host: bank swallow, *Riparia riparia*.
Recorded host: *Riparia riparia*.
Range: Known only from Kamloops and Okanagan Valley.

71. **Dasypsyllus gallinulae perpinnatus** (Baker)
True host: Passeriformes.
Recorded hosts: *Thryomanes bewicki, Sphyrapicus ruber, Cyanocitta stelleri, Vermivora celata, Lanivireo solitarius, Pheucticus melonacephalus, Hylocichla guttata, H. ustulata, Pipilo maculatus, Parus atricapillis, Piranga ludoviciana, Regulus calendula, Empidonax difficilis, Turdus migratorius, Junco oreganus, Zonotrichia coronata, Melospiza melodia, Tamiasciurus douglassi*, man.
Range: Coast Forest (west of Cascades only).

72. **Dasypsyllus stejnegeri** (Jordan)
True host: unknown. A sea bird?
Recorded host: *Hylocichla guttata nanus*.
Range: Probably northern Coast Littoral. *New record:* Langara Island, Queen Charlottes, 20.V.47, coll. C. J. Guiguet.

73. **Malaraeus euphorbi** (Rothschild)
True host: white-footed mouse, *Peromyscus maniculatus*.
Recorded host: *Peromyscus maniculatus*.
Range: Widespread, though rare, in southern half of province.

74. **Malaraeus penicilliger** ssp. (**dissimilis** Jordan?)
True host: Microtinae.
Recorded hosts: *Clethrionomys gapperi, Peromyscus maniculatus*.
Range: Northern part of province, and southern Alplands.

75. **Malaraeus telchinum** (Rothschild)
True host: white-footed mouse, *Peromyscus maniculatus*.
Recorded hosts: *Sorex* sp., *Citellus columbianus, Microtus longicaudus, Clethrionomys gapperi, Peromyscus maniculatus*.
Range: General, throughout southern half of province.

76. **Megabothris abantis** (Rothschild) (=*Megabothris adversus* Wagner)
True host: Microtinae.
Recorded hosts: *Mustela erminea, M. frenata, Vulpes fulva, Citellus columbianus, Microtus longicaudus, M. pennsylvanicus, M. oregoni, Clethrionomys gapperi, Phenacomys intermedius, Synaptomys borealis, Peromyscus maniculatus, Neotoma cinerea, Rattus norvegicus, Zapus princeps, Z. trinotatus, Lepus americanus, Ochotona princeps*.
Range: General over province, especially in humid areas.

77. **Megabothris asio megacolpus** (Jordan)
True host: meadow mouse, *Microtus pennsylvanicus*.
Recorded host: *Microtus pennsylvanicus*.
Range: Probably occurs throughout most of province.

78. **Megabothris lucifer** (Rothschild)
True host: gray vole, *Microtus montanus*.
Recorded hosts: *Mustela frenata, Microtus montanus*.
Range: Dry Forest.

79. **Megabothris quirini** (Rothschild)
True host: Microtinae.
Recorded hosts: *Tamiasciurus hudsonicus, Microtus p. drummondi, Clethrionomys gapperi, Peromyscus maniculatus*.
Range: General, east of Coast Range.

80. **Monopsyllus ciliatus protinus** (Jordan)
True host: squirrel, *Tamiasciurus*.
Recorded hosts: *Mustela erminea, Martes caurina, Spilogale gracilis, Tamiasciurus douglassi, T. hudsonicus, Glaucomys sabrinus, Eutamias townsendii, Peromyscus maniculatus, Lepus americanus*.
Range: Southern part of Coast Forest, including Vancouver Island.

81. **Monopsyllus eumolpi eumolpi** (Rothschild)
True host: chipmunk, *Eutamias* spp.
Recorded hosts: *Mustela frenata, Citellus columbianus, Tamiasciurus hudsonicus, Eutamias amoenus, E. minimus, Clethrionomys gapperi*.
Range: Throughout province, east of Coast Range.

82. **Monopsyllus vison** (Baker) (=*Ceratophyllus lucidus* Baker)
True host: red squirrel, *Tamiasciurus hudsonicus*.
Recorded hosts: *Mustela frenata, Martes americana, Citellus columbianus, Tamiasciurus hudsonicus, Glaucomys sabrinus, Ochotona princeps*.
Range: Throughout province, east of Coast Range.

83. **Monopsyllus wagneri wagneri** (Baker) (=*Ceratophyllus peromysci* Stewart)
True host: white-footed mouse, *Peromyscus maniculatus*.
Recorded hosts: *Mustela frenata, Microtus longicaudus, Clethrionomys gapperi, Peromyscus maniculatus, Phenacomys intermedius, Reithrodontomys megalotis*.
Range: Southern B.C. from Cascades to Rockies.

84. **Monopsyllus wagneri ophidius** (Jordan)
True host: white-footed mouse, *Peromyscus maniculatus*.
Recorded hosts: *Sorex* sp., *Spilogale gracilis, Peromyscus maniculatus*.
Range: Southern B.C., from Cascades, west, including Vancouver Island.

85. **Nosopsyllus fasciatus** (Bosc d'Antic) (Introduced)
True host: rat, *Rattus* spp.
Recorded hosts: *Sorex sp., Tamiasciurus douglassi, Mus musculus, Rattus rattus, R. norvegicus.*
Range: Apparently pretty well restricted to lower coastal region.

86. **Leptopsylia segnis** (Schonherr) (Introduced)
True host: house mouse, *Mus musculus.*
Recorded host: *Mus musculus.*
Range: One record, from Kelowna.

87. **Peromyscopsylla hesperomys** ssp.
A new subspecies, to be described from southern Coast Forest, in "Siphonaptera of Canada."

88. **Peromyscopsylla ravalliensis** (Dunn)
True host: woodrat, *Neotoma cinerea.*
Recorded hosts: *Neotoma cinerea, Peromyscus maniculatus, Ochotona princeps.*
Range: Rare in southern part of province.

89. **Peromyscopsylla selenis** (Rothschild)
True host: Microtinae.
Recorded hosts: *Sorex* sp., *Mustela frenata, Microtus longicaudus, M. oregoni, Clethrionomys gapperi, Phenacomys intermedius, Peromyscus maniculatus, Eutamias* sp., *Rattus norvegicus.*
Range: General, throughout province, especially in mountains and humid forests.

Family ISCHNOPSYLLIDAE

90. **Eptescopsylla vancouverensis** (Wagner)
True host: silver-haired bat, *Lasionycteris noctivagans.*
Recorded host: *Lasionycteris noctivagans.*
Range: Known only from Vancouver.

91. **Myodopsylla gentilis** Jordan and Rothschild
True host: little brown bat, *Myotis lucifugus.*
Recorded hosts: *Myotis lucifugus, M. yumanensis.*
Range: West of Selkirks.

92. **Myodopsylla insignis** (Rothschild) (=*Ceratopsyllus crosbyi* Baker, *Myodopsylla subulata* Chapin)
True host: little brown bat, *Myotis lucifugus.*
Recorded host: *Myotis* sp.
Range: Known only from Cariboo Parklands in B.C.

93. **Myodopsylloides palposus** (Rothschild) (=*M. piercei* Augustson)
True host: big brown bat, *Eptesicus fuscus.*
Recorded host: *Eptesicus fuscus.*
Range: Scattered records from southwest B.C.

Erroneous Records

1. **Ceratophyllus gallinae** (Schrank)
Recorded by Harvey, 1907, ex poultry. The specimens Harvey had were presumably *Ceratophyllus niger* Fox 1909, now known as the "western hen flea." *C. gallinae* is restricted to eastern North America, having been introduced from Europe.

2. **Diamanus montanus** (Baker)
Recorded by Holland 1941 from Eagle River, B.C., ex *Gulo luscus.*
Erroneous determination — the specimens were *Thrassis spenceri* Wagner.

ALPHABETICAL INDEX OF HOSTS

Parus atricapillis—Black-capped chickadee
Passer domesticus—English sparrow
Perognathus parvus—Pocket mouse
Peromyscus maniculatus—White-footed mouse
Petrochelidon pyrrhonata—Cliff swallow
Phalacrocorax pelagicus—Pelagic cormorant
Phenacomys intermedius—Lemming mouse
Pheucticus melanocephalus—Black-headed grosbeak
Pipilo maculatus—Spotted towhee
Piranga ludoviciana—Western tanager
Procyon lotor—Raccoon
Rattus norvegicus—Norway rat
Rattus rattus alexandrinus—Roof rat
Rattus rattus rattus—Black rat
Regulus calendula—Ruby-crowned kinglet
Reithrodontomys megalotis—Harvest mouse
Riparia riparia—Bank swallow
Scapanus orarius—Coast mole
Scapanus townsendii—Townsend mole
Sorex cinereus—Cinereus shrew
Sorex obscurus—Dusky shrew
Sorex trowbridgii—Trowbridge shrew
Sorex vagrans—Vagrant shrew
Speotyto cunicularia—Burrowing owl
Sphyrapicus ruber—Red-breasted sapsucker
Spilogale gracilis—Spotted skunk
Sylvilagus nuttalli—Cottontail rabbit
Synaptomys borealis—Bog lemming
Tamiasciurus douglassi—Douglas chickaree
Tamiasciurus hudsonicus—Red squirrel
Thomomys talpoides—Pocket gopher
Thryomanes bewicki—Bewick wren
Turdus migratorius—Robin
Ursus sp.—Grizzly bear
Vermivora celata—Orange-crowned warbler
Vulpes fulva—Red fox
Zapus trinotatus—Northwest coast jumping mouse
Zapus princeps—Rocky Mountain jumping mouse
Zonotrichia coronata—Golden-crowned sparrow

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NOTE ON LONGEVITY OF CERTAIN TICKS (Ixodoidea).—Among the tragedies of the flood of 1948 were the premature deaths of several dozen aged ticks. These represented the survivors of several species and stages undergoing longevity tests at the Dominion Livestock Insect Laboratory, Kamlooups, B.C. Each group had been kept within unopened, cotton plugged, shell vials since they had emerged from eggs or their preceding instars. Except for brief periods, they were always kept in the dark below ground level under one of the laboratory buildings. Since observations have now come to an end, it is fitting to publish the records as they stand. **Ixodes texanus** Banks nymphs and adults, while commencing to die of senility, were 103 and 101 months old respectively. Larvae of this species had previously died at the age of 96 months. This makes a total life cycle of at least 300 months, though this period must be theoretical since these various stages may not have had the vigor to perpetuate themselves beyond a certain age. **Ixodes hearlei** Gregson adults and **Ornithodoros turicata** (Dugas) third nymphs were drowned at the ages of 80 and 100 months.—J. D. Gregson, Kamloops, B.C.

UNUSUAL RECORD OF IXODES SORICIS (Ixodoidea: Ixodidae)—An intresting new host (?) record for **Ixodes soricis** Gregson has occurred in the collection from Silver Creek, Hope, British Columbia, March 29, 1948, of a male of this tick attached to a female of its own species! The hypostome of the male (yet undescribed) was firmly embedded in the integument of an engorged female, ex **Sorex obscurus**, the site of the male's attachment being slightly laterad to the hind coxa.—J. D. Gregson, Kamloops, B.C.

ANTHAXIA PRASINA Horn (Coleoptera:Buprestidae).—**Anthaxia prasina** is recorded from California, but we can add British Columbia to its range. I found them once only, at Copper Mountain in 1930, on flowers of **Rosa nutkana**, when 35 speciments were collected: July 12-13. The stem species, **A. aeneogaster**, was common in the region, usually on various yellow flowers, but was not associated with this colony. A **prasina** is a beautiful blue-green insect; the individuals of my series vary considerably in size, but are constant in colour and other respects.—G. Stace Smith, Creston, B.C.

NOTES ON THE OCCURRENCE OF ORNITHODOROS HERMSI IN BRITISH COLUMBIA, AND ITS PROBABLE RELATION TO RELAPSING FEVER. ARGASIDAE, IXODOIDEA.*

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A new distributional and host record has been established by the recent discovery of the soft tick *Ornithodoros hermsi* Wheeler, Herms and Meyer, at Summerland, British Columbia. Two engorged adult specimens of the tick were forwarded to the Dominion Livestock Insect Laboratory at Kamloops on August 4th, 1948, by Mr. C. V. G. Morgan of the Dominion Fruit Insect Laboratory, Summerland, who, in turn, had received them from a local resident. This person had been bitten some dozen times in bed since April by nocturnal creatures which she believed to be bedbugs. Finally she captured two of the culprits and opened the way for this interesting discovery.

Investigation by the writer revealed her residence to be an old building situated in an orchard on a West Summerland benchland. The occupant and her mother kept no animals and knew of no rodents being present, with the exception of a packrat that had visited her basement the previous fall, and a mouse that she had caught there recently. There was, however, a bluebird nest in an old woodpecker hole in the eaves over an upper verandah. This was examined, and yielded, besides five fledgling bluebirds, a large number of avian bedbugs, *Oeciacus vicarius* Horv., and twenty-six specimens of *Ornithodoros hermsi.* The majority of the ticks had recently fed, and were found in the main nesting material. Since this was without doubt the source of the infestation it is of interest to note that the initial specimens captured had migrated over a distance of two storeys, including accents up wooden and steel bed legs. After the contents of the nest were removed, the enclosure was sprayed with DDT and sealed. However, it is expected that the occasional specimen may still appear in crevices in the well kept but old residence. To date, several feedings on laboratory mice have failed to reveal spirochetes. The human bites produced no effects other than a severe and prolonged local reaction.

This tick record bears two points of considerable interest. Firstly, the biotope records of *O. hermsi*, as stated by Cooley and Kohls, (1935), consist of chipmunk nests in either fir snags, stumps or hollow logs or cabins, but never ground burrows. These observations, together with the marked localization of observed infestations would suggest a possibility that the tick is primarily spread and maintained by an avian host. Secondly, this species is known to bite man, and because of known cases of relapsing fever originating from infested areas, with subsequent isolation of spirochetes from specimens captured there, it has been proven a vector of this disease in California, Colorado, Nevada, Oregon, northern Idaho and Washington (Davis 1942, 1945). In 1930 and 1932 there occurred a series of six human cases of relapsing fever in the Kootenay District of British Columbia, (Palmer and Crawford 1933). Considerable speculation arose as to what the vector could be. Hearle (1934) advanced the theory that one of the Argasid ticks must be involved, though a careful search by staff members of this laboratory failed to find any indications of these parasites. Again, in 1937 this laboratory was informed by Dr. Campbell Brown of Vernon, British Columbia, that two loggers from Okanagan Centre had been suffering from a series of relapses. A further search for vectors once more proved futile. Thus it is seen that an Argasid tick has long been suspected as oc-

*Contribution No. 2575, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

curring in British Columbia, and as pointed out by Davis (1945), the presence of *O. hermsi* in the contiguous areas of northern Idaho and eastern Washington suggested that this species may have been responsible for the above cases. While attempts to find it had failed, the search had been directed only towards rodent hosts and ground burrows. The final discovery of *O. hermsi* in a bird's nest in the province consequently throws an interesting light on the whole picture.

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PARASITIC COLEOPTERA

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Parasitism in the Coleoptera is so rare that when a parasitic species is discovered it is an event of considerable note. There are five known species of beetles parasitic, or suspected of being parasitic on birds and mammals. The collection of the University of British Columbia contains four of these species which is rather remarkable and a tribute to Professor G. J. Spencer who has persistently and assiduously built up this collection.

The species of parasitic Coleoptera represent three families and four genera in the super-family *Staphylinoidea*. The family *Platypsillidae* contains one species only, *Platypsyllus castoris* Ritsema. This curious insect has been known since 1869 and has been taken a considerable number of times both in Europe and America, on beaver, where it is a permanent, obligate parasite.

The head of the adult is provided with a comb-like row of spines near the hind margin. There are no eyes, and the mandibles are vestigial. The maxillae are well developed and are similar to those of other Coleoptera. This insect was placed in a separate order by Westwood, but the larval characters are unmistakably coleopterous Its place within the order is somewhat in doubt. A careful, morphological study of all stages might yield a permanent solution to the problem.

In the family *Leptinidae* there are two genera and three species. *Leptinus testaceus* Mull., often has been recorded from the nest of bumble bees and once has been recorded as occurring on mice and once from shrews. More recently J. D. Gregson took it on a species of *Sorex* from Silver Creek, B.C., April 26, 1940. This species if correctly determined, is about 2.5 mm. long, reddish brown in colour, with 11 segmented antennae and 5 segmented tarsi. There are 6 visible abdominal segments. The entire body is covered with short setae, sparsely and uniformly distributed. The mouth parts were difficult to distinguish but obviously the maxillae are well developed while the mandibles appear to be vestigial and the eyes are wanting. The front coxae are contiguous, the intercoxal piece acuminate. The elytra completely or nearly cover the abdomen, and there are no hind wings.

The genus *Leptinillus* is represented by two species, *L. validus* Horn and *L. aplodontiae* Ferris. The former species was described in 1872 and has been recorded from Alaskan beaver skins by C. V. Riley

(Insect Life 1, 1888). Recently this species has been received from Mr. O. French of Lempriere, B.C. These specimens also were taken from beaver skins.

The mandibles appear to be vestigial but the maxillae are well developed with a fringe of recurved spines around the margin of the galea. The antennae are 11 segmented, the abdomen with 6 visible segments as in *Leptinus* but the intercoxal piece of the prosternum separates the front coxae and the tip is blunt, not acuminate as in *Leptinus*. There is also a long tuft of hairs projecting from the tip. This species is nearly 5 mm. long. It is apparently blind as is *Leptinus*.

L. aplodontiae was described by Ferris in 1918. It was taken from a species of *Aplodontia* or mountain beaver, a genus of rodents peculiar to the Pacific Coast. The type locality is Fallen Leaf Lake, Plumas Co., California, the host animal being taken in August, 1917, by W. R. Fisher. The fifth species here dealt with is in the family Silphidae with only one member of the genus, *Lyrosoma opaca*. Mann. It resides in the nests of certain maritime birds and may not be parasitic in the strict sense although it apparently utilizes the birds for transportation purposes. This species does not have the extreme modifications of the other forms such as excessive flattening, blindness, and vestigial mandibles. The compound eyes are well developed but the facets are rather coarse and there are only about 200 to each eye. It is suggested that this may be a species in process of acquiring a parasitic habit, but as yet not strictly parasitic.

I am indebted to Professor Spencer for making certain records available to me in connection with some of these species of parasitic Coleoptera.

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NOTES ON THE LIFE HISTORY OF XANTHORHOE DEFENSARIA GN.
(Lepidoptera: Geometridae)

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Several specimens of the geometrid moth, *Xanthorhoe defensaria* Gn., were taken at light on September 19-21, 1947 in the Municipality of Saanich, Vancouver Island, B.C. From one of the specimens a batch of eggs was obtained and half of the resulting caterpillars were reareed to maturity. Since no account of the life-history of this species was available, it is thought that the following notes may be of interest as a confirmation or supplement to what may already be known about this species.

Ovum. Laid on September 20, 1947, in a glass phial in ones and twos, or in small, irregular groups promiscuously disposed on the sides or in the angles of the container. A total of 25 eggs was deposited. They were subsequently kept at a cool room temperature.

The egg is oval, smooth and whitish in colour with a pearly lustre, becoming darker towards hatching time. It is attached to the substratum by an adhesive substance at the small end. Length 0.75 mm. Width 0.5 mm.. The shell is not consumed by the newly emerged caterpillar.

Larva. Eggs hatched on October 8, after an average incubation period of 18 days. As I was not aware of the food plant, and little choice being available at this season of the year, recourse was made to chickweed (*Stellaria media*) which was reluctantly accepted by the caterpillars. Twelve out of tweny-five were succeess-fully reared; the remainder died during their first instar from unknown causes.

1st Instar. October 8. Length on emergence from egg, 2 mm. General appearance, translucent with a tinge of green. Head oval, light pinkish cinnamon; oceilli conspicuously black; thoracic and prolegs colourless. Each segment with a few very short, slightly knobbed setae, less noticeable on the anterior and posterior segments. Towards the end of this instar a tinge of cinnamon stains the first six abdominal segments. When disturbed, the caterpillar raises the body vertically, curling the anterior portion in a loop, head uppermost. Stadium, 13 days.

2nd Instar. October 21. Length 6 mm. Apart from an increase in size, the colour is more definite, though not pronouncedly so. A light translucent green, tinged as before with pale cinnamon, prevails, with more distinction in shade between dorsal and ventral surfaces. Stadium, 7 days.

3rd Instar. October 27. Length 12-17 mm. Development is irregular, some moulting a few days ahead of others of the same instar. Color still somewhat indecisive; head mottled brown on greenish background and furnished with short depressed hairs; the thoracic and last abdominal segments green, the remainder pale cinnamon, which now shows a definite pattern of small black spots on the dorsum of the second to fifth abdominal, inclusive. These spots mark the outline of an X and are in the form of four black dots with a central longitudinal black dash between them. The X mark is most distinct on the fifth abdominal segment, becoming progressively less toward the second, where it is represented by only two dots.

A loose epidermal fold is now discernable along each side just below the spiracles. Spiracles, almost invisible whitish dots. Stadium, 7 days.

4th Instar. November 4. Length 20-22 mm. In addition to the same general pattern as noted in the previous instar there is a noticeable increase in opacity. An interrupted wavy lateral line of dark brown is now evident, becoming continuous on the last three abdominals. Numerous, very fine longitudinal whitish lines appear on both dorsal and ventral surfaces. These lines are grouped in threes and fours, each group bounded by a more strongly marked line. Spiracles whitish with a faint dusky outline, set on a lighter ground colour. Some caterpillars are more strongly marked than others, or have a more greenish tone throughout. The green, in all cases, prevails to a greater or lesser extent in the thoracic and anal segments. When disturbed, the caterpillars still adopt the curled attitude, but also have developed a habit of straightening and remaining quiet in the typical twig-resembling characteristic of geometrid larvae. If forcibly knocked off the food plant, they feign death by lying stiffly straight like bits of sticks.

They feed at night, and at all times show a decided avoidance of daylight, keeping well to the base of the food plant during the day. Just before pupation, the greatest length of the caterpillars was 23 mm. Stadium, 7 days.

Pupa. Pupated November 11th-18th. Length 10 mm. Width 3 mm. A very slight silken cocoon is made, either among the leaves of the food plant, which are lightly drawn together to form a small cubicle, or as in one case observed, by burrowing just beneath the surface of the soil and spinning a cocoon of grains of soil held together by silken strands. When the cocoon is completed the caterpillar remains quiescent for a period of four days, as noted specifically in one case and assumed to be so in others. The pupa is green at first, changing to a dark mahogany colour in five hours' time. The pleura of the pupa are much lighter in colour. Abdominal segments are finely punctate. The cremaster is composed of two long and several very short bristles, each with a strongly recurved hook at the tip. These hooked bristles allow the pupa to hold on to the silken strands of the cocoon. Period of pupal stage averages 25 days.

Adult. Emerged December 6-12. The reared specimens average a wing expanse of 27.88 mm. as compared with 24.55 mm. for those taken under natural conditions. These measurements include both sexes, which were approximately equal in numbers.

Remarks. No doubt the temperature of the room was responsible for the unexpected hatching of the eggs, laid so late in the season. It is presumed that under normal conditions these would not have hatched until the following spring, or if the larvae emerged in the fall they would have hibernated in the early stages. No adults have been observed under natural conditions, at or since the emergence of the reared specimens, which would suggest that overwintering in the egg or young larval stage is the rule.

I am indebted to Mr. J. R. Llewellyn Jones for a list of the food plants known to him. These are *Salix* spp., *Alnus rubra, Ribes sanguineum* and *Acer macrophyllum.* He adds that the species probably feeds on a wider range of food plants than indicated above, a surmise substantiated in the present instance. All these plants had shed their leaves before the larvae could have utilized them this season, further evidence against normal hatching of the eggs in the fall.

The fact that the bred specimens were larger than their parents is of some significance, for they closely match the form *gigantaria* Swett. which is the normal spring brood. As this species is said to be many brooded, the three other named forms, all from the same district and named by the same authority, may be seasonal varieties. Further breeding along these lines would be interesting and might test the theory that all the forms could be produced from one set of parents in succession during the course of the year. The several variations of this species were pointed out by Blackmore (1917) and described by Swett (1916). Blackmore suggested that they may be seasonal forms of the same species, a status that can only be proved by life history and genitalia studies. The present life history is submitted as a contribution towards a solution of the first of these objectives.

Summary. A female of *Xanthorhoe defensaria* Gn. captured in the Municipality of Saanich, Vancouver I., B.C., on September 20, 1947, laid 25 eggs. These hatched 18 days later and half of the resultant larvae were brought to maturity on the common chickweed (*Stellaria media*). Food plants hitherto recorded are all shrubs. The first instar lasted 13 days; second, 7 days; third, 7 days; fourth, 7 days; a total of 34 days. Pupation took place on December 6-12, and lasted for 25 days. The complete life history from oviposition to adult is therefore 77 days. The reared adults averaged larger than their parents.

Under natural conditions it is assumed that the egg is the overwintering stage and that those laid in confinement developed prematurely owing to the artificial stimulus of ordinary room temperature.

The theory is advanced that all the named forms of this species are seasoned variations, and could be produced in one season by successive breeding from one set of parents.

Literature Cited

Blackmore, E. H., 1917. Proc. Ent. Soc. B.C., Syst. Ser. 10:17.
Swett, L. W., 1916. Can. Ent. 48(10):349.

SCAPHINOTUS (NEOCYCHRUS) ANGULATUS SUBSP. MARITIMUS FROM DEPARTURE BAY, B.C. (Coleoptera, Carabidae).—During October 1946, I found by chance at Departure Bay a specimen of that rather scarce carabid beetle **Cychrus tuberculatus** Harr. While this in itself was a worthwhile find, it led to a still more notable discovery.

Being anxious to secure a series of **C. tuberculatus,** I returned shortly to the spot and conducted an extensive search. Although unable to find any more **Cychrus,** I came across two examples of **Scaphinotus (Neocychrus) angulatus** subsp. **maritimus** Van Dyke.

Several ensuing searches over the same area produced no further results of note. However, just about a year later, the discovery of remnants of **C. tuberculatus** in an empty beer bottle gave me the idea of trying out traps. Small pickle jars, sunk in the ground, and baited with fermented quince jelly and honey, proved extremely effective. I kept the traps going for about a month, visiting them as a rule once in two or three days. In this time they yielded a large number of beetles of the genera **Scaphinotus, Pterostichus,** and **Holiciophorus,** among which were twenty-one examples of **Scaphinotus angulatus,** all of the rare black phase **maritimus.**

Only over a very small area were the traps effective in securing **S. angulatus.** If set more than a few yards from an old maple stump, which apparently harbored a colony of these beetles, only common species were taken.

Dr. Van Dyke writes, [1] "The typical phase of the species is listed from Vancouver Island, Western Washington, east of Puget Sound and Portland, Oregon. Numbers were at one time found by Professor O. B. Johnson near Seattle, though it is quite rare in collections."

"The subspecies is but a color phase of the preceding though all specimens found within its area of distribution are similar. It is entirely black and shining and seems to be confined to the Olympic Peninsula of Washington. My type, I collected near Port Angeles. Others seen, are from Melbourne, Hoquiam and the Olympic National Forest. It is also very rare."

Acknowledgments: I am deeply indebted to Mr. H. B. Leech and Dr. Edwin C. Van Dyke for determination of material and also to Dr. Van Dyke for sending me the literature from which the above extracts were taken.—Richard Guppy, Wellington, B.C.

[1] A review of the subgenera **Stenocanthoris** Gistel and **Neocychrus** Roeschke of the genus **Scaphinotus** Dejean—Entomologica Americana 24(1):1-19, 1944.

POECILONOTA MONTANUS Chamb. (Coleoptera:Buprestidae).—In 1945 I discovered a host tree of **Poecilonota montanus** at Creston, B.C. It was a large living tree of **Populus trichocarpa,** with the trunk bark riddled with fresh and old exit holes, and 19 specimens were collected on the trunk: July 22 to August 14. Hoping the next season to discover the earliest date of appearance, the tree was closely watched, but no specimens were seen. This suggested a two-year cycle, so the same watching was followed in 1947, and 13 specimens were gathered: July 13 to August 17. **P. montanus** is larger than **californica,** and much scarcer, and in color exactly matches the bark of the host tree.—G. Stace Smith, Creston, B.C.

THE EGG-POTENTIAL OF **ERGATES SPICULATUS** Lec. (Coleoptera: Cerambycidae).—On August 1, 1944, I was given a large, heavily-gravid specimen of **Ergates spiculatus** Lec., the long-horned fir stump borer which a citizen had picked up in Riverside Park, Kamloops. The beetle was sluggish on account of the tremendous distension of its abdomen. After cyaniding it, I dissected out the eggs, of which there were 494 in all. They were remarkably uniform in size, averaging 4 mm. in length and 2 mm. diameter at the middle; a very few were slightly smaller, being 3.6 mm. by 1.9 mm. They were uniformly cream colored, shaped like a rugby football but proportionately broader in the middle, with more pointed ends. The micropilar end was slightly indented like a minute crater. The whole surface of the chorion was coarsely and uniformly beaded like the surface of a beaded projector screen.

Since the beetle had been captured and not reared, it was impossible to tell whether or not it had already laid any eggs; certainly the abdomen was so distended that it could not have laid very many, if any at all. The condition of the acrotrophic ovarioles indicated that in this species, all the eggs mature at about the same time because there were no smaller ones developing in the germaria as occurs in the panoistic ovarioles of our common grasshoppers which lay their eggs at intervals, in pods.—G. J. Spencer, Department of Zoology, University of British Columbia, Vancouver, B.C.

GASTRALLUS MARGINIPENNIS Lec. (Coleoptera: Anobiidae).—A new record for British Columbia is **Gastrallus marginipennis,** though two specimens have been in my collection since 1932, but only recently identified by H. B. Leech. Before spring of that year I discovered a host plant, **Clematis ligusticifolia,** on the banks of the Kootenay River at Creston. The stems were riddled with small holes containing larvae. I tried to rear these but only one adult emerged (March 19); later (July 5), the second specimen was taken on the same bush. They are small, compact, brown beetles, resembling **Throscidae,** and have been recorded from California and Colorado.—G. Stace Smith, Crestin, B.C.

HUMMING BIRDS VISITING APHIDS.—In July, 1947, I was watching a red-throated humming bird visiting the flowers in my garden and noted one individual which left the flowers and hovered up and down the large limbs of a nearby apple tree. As no leaves or blossoms occurred on the limb, I made a closer examination and saw the bird introducing its beak among the colonies of woolly apple aphids which were present around the stubs where side shoots had been cut from the main limbs.

The colonies were small, but the bird visited each in turn, being evidently attracted by the drops of honey-dew which are always plentiful on colonies of the aphid. On the other hand, it may have been feeding on the aphids themselves, but I could not determine this point. The waxy covering of the aphids was much torn and disturbed by the activities of the bird.—E. P. Venables, Vernon, B.C.

AN ANNOTATED LIST OF THE COLEOPTERA TAKEN AT OR NEAR TERRACE, BRITISH COLUMBIA. PART 2[1]

M. E. CLARK
Massett, B.C.

ORTHOPERIDAE

Sacium lugubre LeC.—Vidit H. C. Fall.

STAPHYLINIDAE

Micropeplus costatus LeC.—Vidit H. C. Fall.
Micropeplus sp.—On fungus. Unknown to Fall, and not in his collection.
Emalus nigrella LeC.—Taken under pine bark, from tunnels of bark beetles.
Proteinus basalis LeC.—Near one in the LeConte collection; November 3, 1923.
Proteinus n. sp.—Taken June and July, 1931. Probably now in the Fall collection.
Megarthrus sinuatocollis Boisd.—Taken June and July, 1931; vidit H. C. Fall.
Megarthrus sp.—Unknown species, taken in rotten leaves, March 19, 1937.
Anthobium pothos Mann.—June 12, 1920; vidit H. C. Fall and E. C. Van Dyke.
Anthobium sp.—An unknown species.
Acrulia tumidula Makl.—Vidit H. C. Fall.
Phyllodrepa sp. near *megarthroides* Fauv.; det. H. C. Fall.
Phyllodrepa n. sp.
Omalium rivulare Payk.—June and July, by sifting and in fungus; vidit H. C. Fall.
Omalium humerosum Fauv.?—Vidit H. C. Fall, who said "vicinity of."
Omalium n. sp., near *longulum* Makl.; det. H. C. Fall.
Omalium spp.—Four unknown species.
Phloeonomus lapponicus Zett.
Porrhodites fenestralis Zett.—Vidit H. C. Fall.
Lathrimaeum pictum Fauv.
Lathrimaeum humerale Csy.—Taken November 3, 1923.
Lathrimaeum reflexicolle Csy.—From mouse nest, March 19, 1935; vidit H. C. Fall.
Lathrimaeum sp.—An unknown species from Thornhill Mountain; vidit H. C. Fall.
Arpedium sp.—Three specimens, November 3, 1923, and in 1927; unknown to H. C. Fall.
Acidota sp.—An unknown species taken in 1931.
Amphichroum maculatum Horn—On spathes of skunk cabbage.
Pelecomalium testaceum Mann.—June, 1928, on skunk cabbage; vidit E. C. Van Dyke.
Tilea rufitarsis Csy.—From Thornhill Mountain; vidit R. E. Blackwelder.
Ancyrophorus biimpressus Makl.—Taken on November 24, 1923.
Trogophloeus sp.—An unknown species.
Aploderus linearis LeC.—Taken March 15, 1937; det. H. C. Fall.
Oxytelus fuscipennis Mann.
Oxytelus nitidulus Grav., or possibly *suspectus* Csy.—Collected March 18, 1937; det. H. C. Fall.
Platystethus americanus Er.
Bledius mysticus Fall.
Bledius sp.—An unknown species.
Stenus vexatus Csy.—From muddy puddle of drainage on flat.
Stenus insularis Csy.—From moss on flats.
Stenus corvus Csy.—Taken at Lakelse Lake.
Stenus convictor Csy.—Taken at Lakelse Lake, and in moss, November 5, 1923.
Stenus sp., near *convictor*.—Taken February, 1940.
Stenus nanulus Csy.—Taken at Lakelse Lake, March, 1927, and in rotten leaves.
Stenus sp.—Undescribed species; Lakelse Lake.
Stenus maritimus Mots.—In moss, March, 1935.
Stenus pterobrachys G. & H.—Scarce, June, 1931, and February, 1940.
Stenus alpicola Fauv.—In moss, March 21, 1937.
Stenus egenus Er.—Taken in 1927.
Stenus n. sp.—Collected February, 1940.
Stenus n. sp., nearest *curtus* Csy.—Taken in 1933.
Stenus punctiger Csy.—Taken while sifting, August, 1927.
Stenus sectator Csy.
Stenus sp., near *sectator*.—Vidit H. C. Fall.
Stenus mammops Csy.—Taken in June, 1931.
Stenus reconditus Csy.
Stenus rugifer Csy.
Stenus austini Csy.—In moss, March 18, 1935.
Stenus juno Fab.—Two females and one male; June, 1938.
Stenus pollens Csy.—Taken in 1939.
Stenus sp.—A new species near *monticola* Csy.
Euaestethus sp.—"Species seems new"; det. M. W. Sanderson. Taken by sifting, June and July, 1931.
Paederus pugetensis Csy.—Rare.
Lathrobium rigidum Csy.?—Or near *rigidum;* taken in 1933 and 1938.
Lathrobium sp.—Species near *simile* LeC. Taken in 1938.
Tetartopeus finitimus LeC.—Collected June 1, 1920; one sent to Casey.
Lathrotropis sp.—An unknown species.
?Medon sp.—"Or near"; March 4.
Orus punctatus Csy.—Vidit H. C. Fall.
Stilicus oregonus Csy.—Rare; taken in 1931.
Astenus longiusculus Man.
Nudobius cephalus Say.—Rare.
Nudobius spp.—Two unknown species.
Gyrohypnus fusciceps LeC.
Gyrohypnus sp. near *fusciceps*.
Gyrohypnus obsidianus Melsh.—Rare, taken in 1931; vidit H. C. Fall.
Gyrohypnus obscurus Er. — Species vera, teste H. C. Fall.

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[1] Part I appeared in the previous issue of this journal, pp. 24-27. I am again greatly indebted to Mr. C. A. Frost, who has checked the manuscript, and who in past years submitted many of my beetles to the late Dr. H. C. Fall and others for identification or verification.

Leptacinodes nigritulus LeC.—February 6, 1926.

Hesperolinus piceus Csy.—One pair taken in 1933.

Hesperolinus brunnescens LeC.

Parothius californicus Mann.—Vidit H. C. Fall.

Baptolinus macrocephalus Nordm.

Philonthus—(All species passed on by H. C. Fall).

Philonthus furvus Nordm.

Philonthus sp., near *politus* Linn.

Philonthus sp., near *atratus* Grav.—Under grizzly bear bones.

Philonthus varians Payk.

Philonthus sp.—Unknown to C. A. Frost and H. C. Fall.

Philonthus sordidus Grav.

Philonthus crotchi Horn, or near.

Philonthus nigritulus Grav.—Scarce.

Philonthus nigritulus Grav., or near.—In numbers in old sacks, March, 1937.

Philonthus longicornis Steph.—Rare.

Philonthus aurulentus Horn.

Philonthus tetragonocephalus Notman.—Scarce.

Philonthus agilis Grav.—Taken in 1931.

Philonthus punctatellus Horn. — Taken in 1937.

Philonthus microphthalmus Horn. — Taken in 1937.

Philonthus quadricollis Horn. — Taken in 1937.

Philonthus debilis Grav.—Taken in 1937.

Philonthus sp., near *quadricollis*.—Taken in 1937.

Staphylinus fossator Grav.—About stables.

Staphylinus pleuralis LeC.—On dung, and under boards.

Staphylinus caesareus Cederhj.

Ontholestes cingulatus Grav.—Frequent, on cow and horse dung.

Creophilus villosus Grav.—Scarce; on carrion.

Heterothops californicus LeC. — Taken in 1931; vidit H. C. Fall.

Heterothops carbonatus Fall.—Vidit H. C. Fall.

Quedius sp., near *marginalis* Makl.—Taken in 1931.

Quedius laevigatus Gyll.

Quedius mesomelinus Marsh.

Quedius aenescens Makl., or near — Under grizzly bear bones.

Tachinus maculicollis Makl.—From fungus, November, 1919.

Tachinus basalis Er.

Tachinus crotchi Horn.

Tachinus circumcinctus Makl. — Taken in August, 1927.

Tachinus nigricornis Mann.—Taken by sifting in 1927 and 1931.

Tachinus instabilis Makl.—Taken in 1931.

Tachinus tachyporoides Horn. — Taken in 1931.

Tachyporus acaudus Say.—Under bits of wood, loose bark, etc., frequent in spring; det. Blackwelder.

Tachyporus nitidulus Fab.—Det. Blackwelder.

Tachyporus rulomus Blkwr.—Taken March 9, 1927; det. Blackwelder.

Tachyporus jocosus Say.?

Bolitobius cincticollis Say.

Bolitobius poecilus Mann.

Bolitobius obsoletus Say., or near.—H. C. Fall remarked "No concusion."

Bolitobius n. sp., near *intrusus* Horn.

Bolitobius intrusus Horn.

Bryoporus rufescens LeC.

Mycetoporus flavicollis LeC.—Taken by sifting; June and July, 1931

Mycetoporus humidus Say.—In rotting fungus, June and July, 1931.

Mycetoporus splendidus Grav.—According to H. C. Fall.

Deinopsis spp.—Several unidentified species.

Myllaena sp.—Not identified.

Datomicra zosterae Thoms.

Acrotona fungi Grav.—Taken on decayed soft fungus.

Aleochara bimaculata Grav.

Aleochara sp.—Taken in 1938. Species not known to H. C. Fall.

PSELAPHIDAE

Sonoma corticina Csy.—Rare; found under a board in April.

Sonoma parviceps Makl.—Rare; taken by sifting in June and July; vidit A. S. Nicolay.

Cupila clavicornis Makl.—Very rare; det. A. S. Nicolay.

Actium retractum Csy. — Two specimens; vidit A. S. Nicolay.

Actium pacificum Csy., "or near".—Det. H. C. Fall.

Reichenbachia spp.—Two undescribed species; vidit H. C. Fall.

Tychus tenellus LeC.—Rare; shaken from moss, November, 1920.

Tychus cognatus LeC.—Rare; taken by sifting, June and July, 1931.

Pselaphus bellax Csy.—Rare; taken by sifting, June and July, 1931; vidit H. C. Fall.

PTILIIDAE

Ptenidium pullum Makl., "or near; legs lighter" (note by H. C. Fall). From a squirrel's nest, February 4 and March 18, 1935.

Acratrichis spp.—A large and a small species in moss in November, both unidentified.

Ptiliidae—A dozen specimens of an unidentified species, from a mouse nest.

SCAPHIDIIDAE

Scaphium castanipes Kby.—Taken in 1932.

Scaphisoma convexum Say?—Taken under bark.

Scaphisoma castaneum Mots.—Vidit H. C. Fall.

Scaphidiidae—An unidentified species.

SPHAERITIDAE

Sphaerites politus Mann.—Rare; taken beside Alwynne Creek, on bleaching bear bones.

HISTERIDAE

Hister umbilicatus Csy.—"Not quite typical," T. L. Casey said of one sent to him.

Hister umbrosus Csy.—Found about the stable. Fall called this a synonym of the above.

Hister immunis Er.—On sand near the river, 1934. Vidit H. C. Fall, but called *fidelis* Csy. by C. G. Siepmann.

Isolomalus mancus Csy.—In numbers under spruce bark, August, 1927.

Plegaderus sp.—Unknown species; vidit H. C. Fall. Very rare under hemlock bark on fallen trees from which bark is stripping.

Saprinus estriatus LeC.—Scarce, sand bank on slough near Skeena River, August, 1927.

Saprinus oregonensis LeC.

Saprinus bigemmeus LeC.—Mr. Frost wrote "Not quite like some from California sea coast."

LYCIDAE

Eros simplicipes Mann.—Frequent in the woods; May 25, 1929; June; det. E. C. Van Dyke.

Eros aurora Hbst.—Scarce; in the woods, June.

Eros nigripes Schaeff.—Scarce; in flight, first week of May; det. by C. Schaeffer and E. C. Van Dyke.

Eros thoracicus Rand.—Scarce; vidit H. C. Fall.

Plateros sp.—An unknown species.

Plateros californicus Van Dyke?—Vidit H. C. Fall.

LAMPYRIDAE

Lucidota corrusca Linn.—Common on flowers and herbage in the spring, and on wild everlasting flowers in the fall.

Lucidota lacustris LeC.—One of my specimens was compared with the type.

CANTHARIDAE

Podabrus piniphilus Esch.—Scarce; flying in May, June and July.

Podabrus comes LeC.

Silis pallida Mann.—June 14, 1920.

Malthodes sp.—May have been *humidus* Fender or *oregonus* Fender.

MELASIDAE

Melasis rufipennis Horn.—Rarely found, but was breeding in numbers in a confined spot in punky hemlock.

Isorhipis ruficornis Say.—"New record for the west." Taken in 1933.

Microrhagus pectinatus LeC.—"New record for the west."

Epiphanis cornutus Esch.

THROSCIDAE

Pactopus hornii LeC.—Scarce; flying; under moss in November, under cover in June; vidit H. C. Fall.

Throscus carinicollis Schaeff.—Det. H. C. Fall.

HETEROCERIDAE

Heterocerus brunneus Melsh.?—H. C. Fall's note: "runs to, but not the true one."

DASCILLIDAE

Macropogon piceus Horn?—"May be *dubius* Brown." Scarce; under dry moss flakes in May; on rocks of Little Canyon, Terrace.

Araeopidius monachus LeC.

Eucinetus terminalis LeC.—"New record for the west"; det. H. C. Fall, 1937.

Eucinetus sp.—An undescribed species; in Mr. C. A. Frost's collection.

HELODIDAE

Cyphon variabilis Thunb.

Cyphon concinnus LeC.

BYTURIDAE

Byturus bakeri Barber?—Vidit H. S. Barber; a bad pest on the wild blackcaps and raspberries.

DERMESTIDAE

Dermestes lardarius Linn.—A common pest; also taken on Thornhill Mountain.

Dermestes signatus LeC.—Scarce; a specimen compared with the type by C. A. Frost.

Dermestes talpinus Mann.

Orphilus subnitidus LeC.?

Orphilus aequalis Csy.?

BYRRHIDAE

Tylicus subcanus LeC.

Listemus acuminatus Mann. — By sifting moss.

Simplocaria tessellata LeC.

Cytilus alternatus Say.—Along roadsides, and on flats.

Byrrhus concolor Kby.—May, 1920.

Byrrhus difficilis Csy. — From Thornhill Mountain.

Byrrhus americanus LeC. — Found among grass roots, and on flats.

Byrrhus cyclophorus Kby.—From Thornhill Mountain.

Curimopsis setulosa Mann.—Vidit H. C. Fall.

Lioligus striolatus Csy.—Vidit H. C. Fall.

OSTOMIDAE

Ostoma pippingskoeldi Mann. — Rare; on pine, and from Thornhill Mountain.

Ostoma nigrina Csy.—December 10, 1920, on rotten wood, spruce and hemlock. Rare.

Ostoma columbiana Csy.

NITIDULIDAE

Cercus pennatus Murr. — Scarce on elder bark and bush; vidit Parsons.

Colopterus truncatus Rand.—Under edges of bark on freshly cut brush, June, 1931.

Nitidula nigra Schfr. — A subspecies of *rufipes* L.; teste Parsons.

Nitidula rufipes L.—Rare under edges of bark on freshly cut brush, June, 1931.

Omosita discoidea Fab.—Frequent on bones, March 13 to June; vidit C. T. Parsons.

Omosita colon L.

Epuraea planulata Er.—(All species of this genus vidit Parsons.)

Epuraea truncatella Mann.

Epuraea spp.—Two new species, one near *avara* Rand.

Epuraea terminalis Mann.

Epuraea adumbrata Mann.

Epuraea integra Horn.

Cryptarcha ampla Er.

Glischrochilus quadrisignatus Say. — Found on stale bread.

Glischrochilus vittatus Say. — Vidit C. T. Parsons.

Glischrochilus moratus Brown.—Vidit C. T. Parsons.

RHIZOPHAGIDAE

Rhizophagus sculpturatus Mann. — Vidit H. C. Fall.

Rhizophagus remotus Lec.—Rare; in sap on cedar stump.

Rhizophagus dimidiatus Mann.—Vidit H. C. Fall.

Rhizophagus brunneus Horn.—Vidit H. C. Fall.

MONOTOMIDAE

Monotoma picipes Herbst.—Taken on a barn window in July, 1931.

CUCUJIDAE

Oryzaephilus surinamensis L. — Beneath bark.

Cathartus sp.—An unknown species.

Cathartus advena Waltl.—Det. C. A. Frost.

Pediacus fuscus Er.

Pediacus depressus Hbst.—Rare, under hemlock bark.

Cucujus clavipes var. *puniceus* Mann.—Under bark.

Dendrophagus glaber LeC.—Frequent under loose bark.

EROTYLIDAE

Triplax thoracica Say.

Triplax californica LeC.—Vidit H. C. Fall.

DERODONTIDAE

Derodontus trisignatus Mann. — On white fungus in November.

CRYPTOPHAGIDAE

Salebius octodentatus Makl.

Cryptophagus lepidus Csy.—Taken by sifting.

Cryptophagus bidentatus Makl.

Cryptophagus cellaris Scop.—March 6, 1937; vidit A. S. Nicolay.

Cryptophagus sp.—An unknown species, on cabbage in the cellar, March 18, 1937.

Cryptophagus brevipilis Csy., or near.

Cryptophagus spp.—Two unknown species; vidit H. C. Fall. One occurred on cabbage in the cellar, March 8, 1937.

Cryptophagus saginatus Sturm., or near.

Henoticus serratus Gyll.

Caenoscelis ferruginea Sahlb.—Taken when sifting fermenting grass in June and July, 1931; vidit H. C. Fall.

Atomaria fallax Csy. (In the catalogue as *Anchicera fallax* Csy.—Eds.)

Atomaria sp.—An unknown species, taken in June, 1931.

Atomaria vespertina Makl.—Vidit H. C. Fall.

Anchicera n. sp.—Taken on February 4 from a squirrel dump. Now in C. A. Frost's collection.

Anchicera ephippiata Zimm.

Anchicera ochracea var. *pennsylvanica* Csy. —Compared with type by Nicolay.

MYCETOPHAGIDAE

Mycetophagus californicus Horn.—Taken in 1933, and on Thornhill Mountain.

LATHRIDIIDAE

Lathridius costicollis LeC.

Lathridius liratus LeC.

Lathridius lardarius Deg.—In flight at windows.

Coninomus constrictus Gyll.—November 3, 1923; also by sifting, June and July, 1931.

Enicmus tenuicornis LeC.

Enicmus protensicollis Mann.—On cabbage in cellar, March 17, 1934; vidit H. C. Fall.

Enicmus fictus Fall.—On cabbage in cellar, March 6, 1937; vidit H. C. Fall.

Enicmus cordatus Bel.—June, 1931, rare.

Enicmus minutus L.—Taken while sifting, June and July, 1931; also on cabbage in cellar, March 18, 1937; vidit H. C. Fall.

Enicmus suspectus Fall.—Sifted from fermenting grass, 1937.

Corticaria ferruginca Marsh.—Sifted from moss.

Corticaria sp.—An unknown species, but "not *similata* Gyll."; vidit H. C. Fall.

Corticaria dentigera LeC.—"*columbia* Fall a possibility"; vidit H. C. Fall.

Corticaria serrata Payk.

Melanophthalma sp.—An unidentified species.

Melanophthalma gibbosa Hbst.—A female.

Melanophthalma americana Mann.—Vidit H. C. Fall.

Melanophthalma cavicollis Mann.

Melanophthalma sp., near *distinguenda* Com.?

ENDOMYCHIDAE

Mycetina idahoensis Fall.—Taken from birch root, September, 1920, and June, 1931.

COCCINELLIDAE

Hyperaspis dissoluta Cr.—Rare; taken in May.

Microweisea misella LeC.?—On poplar.

Microweisea marginata LeC.—Taken in 1933 and 1934; det. H. C. Fall.

Scymnus n. spp.—Two new species.

Scymnus marginicollis Man..

Scymnus monticola Csy.—Taken while sifting, June and July, 1931; det. Wilson.

Scymnus sp. near *nanus* Csy.—Fall says eastern and western specimens are probably different.

Psyllobora viginti-maculata Say.

Hippodamia tredecimpunctata tibialis Say.—Scarce, on alder.

Hippodamia glacialis var. *lecontei* Muls.—On everlasting flowers.

Coccinella perplexa Muls.—On wild everlasting flowers.

Coccinella transversoguttata Fald.

Coccinella transversoguttata var. *nugatoria* Muls.

Coccinella transversoguttata var. *californica* Mann.

Coccinella monticola Muls.

Coccinella perplexa var. *juliana* Muls.

Adalia bipunctata var. *quadrimaculata* Scop. According to C. Schaeffer.

Adalia frigida Schn., near var. *disjuncta* Rand.

Adalia annectans Cr., var.

Neomysia subvittata Muls.

THE OCCURRENCE OF A HOLLYHOCK-SEED EATER, NOCTUELIA RUFOFASCIALIS, AT VERNON, BRITISH COLUMBIA (Lepidoptera:Pyralidae)

Hugh B. Leech
California Academy of Sciences, San Francisco

Day after day in June, 1945, attractive red and white moths (Fig. 1, *Noctuelia rufofascialis* Stephens) were seen in my garden in Vernon. Some sat on the leaves of hollyhocks, others on the walls of adjacent buildings. They were not easily disturbed, and at rest held the wings in a typically pyralid manner, the whole insect having a triangular outline.

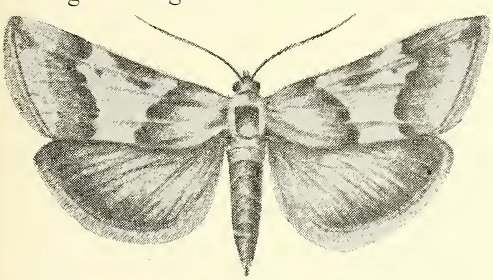

Fig. 1. Noctuelia rufofascialis Stephens.

No particular attention was paid to the moths, other than to admire the live specimens. By mid-July damage to the buds of hollyhocks (*Althaea rosea* Cav.) was obvious, and many of the seed heads showed an exudation of messy brown frass. On July 21 a number of infested buds and heads were examined. Each contained a fine caterpillar, white with wine-red bands. The almost continuous series from youngsters 4.5 mm. long to apparently mature larvae of 15 mm., suggested either an overlapping of broods or a long egg laying period.

A few heads were kept in a jar; from them two fully grown larvae emerged on July 26, and entered the damp soil provided. Three days later each had formed a silken cocoon, thin and somewhat irregular, but commodious. They pupated on August 2, and the moths emerged on the tenth, both females. On the same day a freshly transformed male was caught in the room, no doubt originating from the mass of flower and seed heads thrown into the waste-basket on July 21.

An adult was seen in the garden on August 12, and infested plants were noticed in other gardens in Vernon.

Either my collecting in 1945 was too thorough, or the following winter was unsuited to the species. During the period from May to August, 1946, not a single larva was found on the 20 or more hollyhock plants at my house. However, on September 8, Miss Glorianne Stromberg, a neighbour, found one mature larva in her garden, and kindly gave it to me. Mr. Ben Sugden sketched it the next day (Fig. 2).

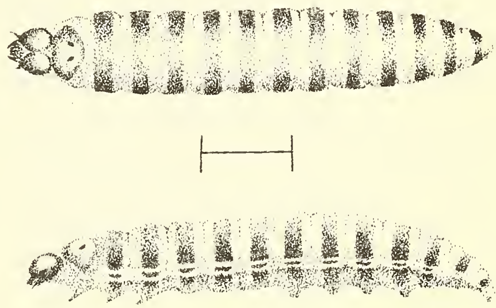

Fig. 2. Mature larva of Noctuelia rufofascialis.

In the hollyhock there is an almost regular progression of flowering, from the lower to the upper part of the main stem, and along each lateral branch. The first sign of the presence of caterpillars is that many of the young flower buds, those of about 10 mm. long, turn brown and are obviously dead. Small larvae can be found in most of them, feeding on the flower parts, especially near the bases. Later, by the time some buds are ready to open, they leave the dead ones, crawl under the bracts of fresh buds, and bore inwards. Here again they feed chiefly on the lower parts, indeed not always preventing the flowers from opening. Later still, many are found to have migrated to the seed heads, choosing those in which the bracts still tightly close the tops. There they tunnel in the green seeds, going completely around through the ring of them, hollowing the head out and leaving only a tube. It is at this time, when the larvae are nearly mature, that the untidy blotches of faeces pushed from the entrance hole are most obvious.

With one exception, all the larvae seen had these habits. The individualist was in the open, during the day, feeding on the upper surface of a hollyhock leaf.

At Vernon, hollyhock was the only observed host. Heinrich (1921. Some Lepidoptera likely to be confused with the pink bollworm. Jour. Agric. Research **20** (11):807-836, pls. 93-109. *Noctuelia*, p. 829-830), recorded *N. rufofascialis* larvae from the pods of *Abutilon*, *Malvastrum*, *Wissadula*, and *Sida*, all malvaceous plants, at Brownsville, Texas. He reported that the larvae pupate in a thin cocoon, either in the empty seed pod or on the outside of the plant. He gave no figures of the insect, but it is possible he was dealing with the typical subspecies. All the specimens seen at Vernon were smaller and more brightly colored than the typical form, white and red instead of ash gray and reddish brown. The larval colors were almost exactly those of the adults.

ACKNOWLEDGMENTS—I am indebted to Dr. T. N. Freeman of Ottawa, Ont., for identifying the reared moths and citing Heinrich's paper; and to Mr. Ben Sugden of Armstrong, B.C., for the illustrations.

INTRODUCTION INTO BRITISH COLUMBIA OF TWO SPECIES OF JAPANESE CERAMBYCIDAE (Coleoptera).—**Semanotus japonicus** Lacordaire.—On April 3, 1917, the late Max H. Ruhmann collected a fine cerambycid at the outskirts of Vernon, B.C., on the flowers of a native shrub. This specimen was given to the late Ralph Hopping of Vernon, specialist on the Lepturini, who marked it as a new species but remained suspicious and did not describe it. While examining materials in the collections of the California Academy of Sciences recently, I recognized it as **S. japonicum**. Dr. E. C. Van Dyke tells me that in Japan the species breeds in a cupressine tree, **Cryptomeria japonica**. Since there are a number of Japanese farmers in the Vernon district, it is probable that the Ruhmann specimen emerged from furniture or crating lumber in some settler's effects.

Callidium rufipenne Motschulsky. Professor G. J. Spencer has kindly allowed me to record that in March, 1927, at Vancouver, B.C., he reared a series of small reddish cerambycid from some wood of Japanese origin. One of these beetles is now in the Linsley Gressitt collection in the California Academy of Sciences, and agrees perfectly with Japanese examples of **C. rufipenne**.—Hugh B. Leech, Calif. Acad. Sci., San Francisco, Calif.

NEW LITERATURE

CATALOGUE OF THE ODONATA OF CANADA, NEWFOUNDLAND AND ALASKA.—Francis C. Whitehouse. Reprinted from the Transactions of the Royal Canadian Institute, Vol. XXVII, No. 57, October, 1948.

* * *

In the author's words in his introduction, "this is a recapitulation of the recorded data on the odonate fauna occurring north of the international boundary; giving distribution; life zones within the territory covered; a list of the papers from which the records are taken, or are cited, in the text; flight periods, and selected references to descriptions and figures . . . for full bibliographies of species described prior to 1910, the reader is referred to the indispensable pages of Muttonski's Catalogue, to which the second numbers in this list refer." The first numbers are presumably the author's own, since he does not state their source.

One hundred and eighty-six species are recorded from Newfoundland and Labrador, every province and the Northwest Territories, to the Yukon and Alaska; British Columbia is represented as the Mainland, Vancouver Island and the Queen Charlotte Islands. The zones used are those of Merriam. "Capitals are used where the species finds optimum conditions in the zone indicated; lower case where the species extends only part way into the zone or is scarce there." This last feature constitutes a very useful item in any catalogue and so do the flight periods which have been taken from all records; where these "are too scant to represent the flight period fully, then first and last dates are given in suggestion that the imago life centres upon these."

The list of references includes over 156 titles, the latest distributional lists of the various specified areas being printed in heavy type. At the end of the catalogue is an index containing genera alphabetically arranged with species in each genus also alphabetically arranged.

Beyond a couple of trifling typographical errors, the compiling, editing and printing is perfect to the last punctuation mark, which is a real achievement in so detailed an undertaking. The paper is heavy and serviceable as it would need to be, or it would be worn to shreds in the hands of any working odonatist.

The author pays a glowing tribute to Dr. E. M. Walker, Dean of Canadian students of Dragon flies, whose past efforts constitute at least 80 percent of the material in this Catalogue. In the opinion of the reviewer, all entomologists in Canada owe an equally heavy debt of gratitude to Mr. Whitehouse for this extremely painstaking and inclusive piece of work.

—G. J. SPENCER

RECORD OF BEES FROM BRITISH COLUMBIA (Andrenidae)[1]

E. R. BUCKELL
Dominion Entomological Laboratory, Kamloops, B.C.

This list of 56 bees of the family Andrenidae has been compiled from a collection in the Field Crop Insect Laboratory, Kamloops, and material loaned by Professor G. J. Spencer of the University of British Columbia.

The Andrenidae, or acute-tongued burrowing bees, are solitary, constructing their burrows and cells in the ground. Although solitary, some species congregate in regular colonies. Sometimes a clay or silt cliff will contain innumerable burrows in close proximity. Their cells are stocked with nectar and pollen and these bees are beneficial plant pollinators. Willow blossoms are particularly attractive to Andrenidae, and a majority of the specimens collected in April and May by the author were taken visiting willow.

The names are arranged alphabetically and the collection points are listed, numbered, and placed on the accompanying map. Some localities have been heavily collected, while other areas, particularly in northern British Columbia, have had little or no attention, and the distribution record therefore, is far from complete.

The collectors are designated by initials only in the text, but a list of their names is included at the end of the paper.

The author wishes to thank Mr. P. H. Timberlake, Agricultural Experiment Station, University of California, Riverside, and Mr. U. N. Lanham, University of California, Berkeley, California, for the determination of material; and Professor G. J. Spencer for the loan of his collection.

Family ANDRENIDAE
Subfamily ANDRENINAE
Genus **ANDRENA** Fabricius

Andrena albihirta (Ashmead)
KASLO, April 7, 1907, 1♂; April 13, 1913, 1♂ (L.W.C.). PENTICTON, April 12, 2♀, 21, 1♂ 1♀, 30, 1♂, 1919; April 9, 6♂, 24, 18♀, 1929 (E.R.B.). VERNON, April 17, 1930, 2♀, April 5, 1939 1♀ (E.R.B.): April 9, 1925, 1♀ (M.H.R.). MINNIE LAKE, May 19, 1943, 1♀ (E.R.B.). CHILCOTIN, May 4, 1921, 1♂ (E.R.B.). VANCOUVER, March 22, 1♂, April 4, 1♂, 1903; March 25, 1906, 1♂ (R.C.T.).

Andrena amplificata Cockerell
PENTICTON, May 2, 1919, 1♀; April 24, 1929, 1♀ (E.R.B.): April 8, 1920, 1♀ (M.H.R.). KELOWNA, April 8, 1930, 1♂ (E.R.B.). VERNON, April 29, 1930, 3♀ (E.R.B.): April 20, 1920, 1♀ (R.C.T.). MINNIE LAKE, May 19, 1943, 2♀ (E.R.B.). DOUGLAS LAKE, April 23, 1930, 4♀ (E.R.B.). CHILCOTIN, June 15, 1920, 2♀; May 15, 1921, 1♀; May 28, 1929, 2♀ (E.R.B.).

Andrena bella Viereck
KASLO, April 16, 1907, 1♀ (L.W.C.).

Andrena binarea Viereck
VERNON, May 19, 1928, 1♀ (P.N.V.).

Andrena buckelli Viereck
PENTICTON, May 5, 1920, 1♂ (M.H.R.): April 24, 1929, 1♀ (E.R.B.). VERNON, May 1, 1929, 1♀; April 25, 1932, 1♀ (E.R.B.). KAMLOOPS, April 18, 1929, 1♀ (E.R.B.).

Andrena candida Smith
PENTICTON, April 9, 1♂; 24, 2♀, 1929 (E.R.B.). KAMLOOPS, April 18, 1929, 2♀ (E.R.B.).

Andrena chlosura Cockerell
NANAIMO, May 11, 1930, 1♀ (G.J.S.).

Andrena cleodora (Viereck)
KASLO, June 10, 1906, 1♀ (L.W.C.). PENTICTON, June 5, 1920, 1♀ (M.H.R.).

Andrena colletina Cockerell
CHILCOTIN, April 16, 1921, 2♀ (E.R.B.).

Andrena crataegi Robertson
PENTICTON, May 9, 1919, 1♀ (E.R.B.). VERNON, June 5, 1923, 2♀ (M.H.R.): May 16, 1927, 1♀ (D.G.G.): May 31, 1929, 1♂; April 29, 1930, 1♀ (E.R.B.). SALMON ARM, May 1, 1922, 2♂; July 4, 1943, 1♀ (E.R.B.).

Andrena cressonii Robertson. **subsp.**
VERNON, May 20, 1904, 1♂; May 16, 1920, 1♀ (E.P.V.): April 22, 1929, 1♂ (I.J.W.): May 1, 1929, 1♂ (E.R.B.). SALMON ARM, July 4, 1943, 6♀ (E.R.B.). VANCOUVER, May 23, 1930, 1♀ (H.B.L.).

Andrena epileuca Cockerell
KASLO, May 22, 1910, 1♀ (L.W.C.). CRESTON, May 17, 1926, 1♀ (A.A.D.). VERNON, June 1, 1913, 1♀ (E.P.V.). KAMLOOPS, June 13, 1943, 1♀ (E.R.B.). VANCOUVER, June 3, 1943, 1♀ (E.R.B.).

Andrena errans Smith
OLIVER, May 4, 1943, 1♀ (E.R.B.). PENTICTON, April 30, 1♀; Oct. 30, 1♀, 1920 (E.R.B.). VASEAUX LAKE, June 14, 1919, 1♀ (E.R.B.). NARAMATA, May 2, 1920, 1♂ (M.H.R.). VERNON, April 25, 1932, 1♂ (E.R.B.). SALMON ARM, May 14, 1929, 1♀ (H.B.L.). KAMLOOPS, June 13, 1943, 1♀ (E.R.B.). MINNIE LAKE, June 19, 1930, 1♀;

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1 Contribution No. 2566, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

May 19, 1943, 1♂ 1♀ (E.R.B.). CHILCOTIN, June 13, 1921, 3♀; May 28, 1♂ 6♀; June 14, 1♀, 1929; June 5, 1♂ 3♀, June 14, 1♀, 1930; April 28, 1944, 1♀ (E.R.B.). YALE, May 30, 1943, 1♀ (E.R.B.). MILNER, May 25, 1930, 1♀ (K.G.). VANCOUVER, May 22, 1930, 1♀ (G.J.S.): May 23, 1930, 1♀ (H.B.L.): June 3, 1943, 1♀ (E.R.B.). LADYSMITH, June 18, 1♀; June 30, 1♀, 1930 (G.C.C.).

Andrena erythrogaster (Ashmead)
CHILCOTIN, May 27, 1929, 8♀; May 3, 1930, 1♀ (E.R.B.). VERNON, April 18, 1929, 1♂ (I.J.W.).

Andrena extensa Viereck
VERNON, May 9, 1930, 2♀ (E.R.B.).

Andrena flavoclypeata Smith
VERNON, April 18, 1923, 1♂ (M.H.R.).

Andrena forbesii Robertson
KASLO, May 2, 1906, 1♂ (L.W.C.). KELOWNA, May 28, 1921, 1♀ (M.H.R.). VERNON, May 1, 1♂; June 4, 1♀, 1929 (E.R.B.).

Andrena sp. near **fulvinigra** Viereck & Cockerell
OKANAGAN FALLS, April 24, 1920, 1♀ (M.H.R.). PENTICTON, April 24, 1929, 1♀ (E.R.B.).

Andrena gibbiris (Viereck)
PENTICTON, April 11, 1919, 1♀; April 24, 1929, 1♀ (E.R.B.). KAMLOOPS, April 17, 1943, 1♀ (E.R.B.). CHILCOTIN, May 27, 1929, 1♀ (E.R.B.).

Andrena grandior Cockerell
CHILCOTIN, June 14, 1929, 1♀ (E.R.B.).

Andrena harveyi Viereck
VICTORIA, June 14, 1917, 1♀.

Andrena indecisa Cockerell
CRANBROOK, Aug. 15, 1928, 1♂ 3♀ (A.A.D.). INVERMERE, July 18, 1928, 1♀ (A.A.D.).

Andrena medionitens Cockerell
CHILCOTIN, June 13, 1929, 1♀ (E.R.B.).

Andrena melanochroa Cockerell
SALMON ARM, April 19, 1919, 1♂ (W.R.B.).

Andrena microchlora subalia Cockerell
OLIVER, May 4, 1943, 1♀ (E.R.B.). VERNON, April 26, 1920, 2♀ (R.C.T.); April 6, 1925, 1♀ (M.H.R.).

Andrena milwaukeensis Green
PENTICTON, May 9, 1919, 3♀ (E.R.B.).

Andrena miranda Smith
KASLO, May 14, 1906, 1♀ (L.W.C.). VERNON, May 1, 1929, 19♀ (E.R.B.): May 3, 1907, 1♀; May 6, 1913, 1♀ (E.P.V.); May 5, 1921, 1♀ (M.H.R.).

Andrena montrosensis Viereck & Cockerell
OKANAGAN FALLS, June 3, 1919, 1♀ (E.R.B.). PENTICTON, April 6, 1♀; May 15, 1♂; June 4, 1♀; June 5, 1♂, 1919 (E.R.B.). SUMMERLAND, June 4, 1919, 1♀ (E.R.B.). VERNON, May 1, 1908, 1♀ (E.P.V.): May 1, 1929, 1♂; May 9, 5♀; May 25, 1♀, 1930; May 17, 1937, 1♀ (E.R.B.). KAMLOOPS, June 13, 1943, 1♂ 7♀ (G.J.S.). CHILCOTIN, May 28, 1921, 1♀; June 13, 1929, 5♀ (E.R.B.). AGASSIZ, Sept. 11, 1925, 1♂ (G.J.S.).

Andrena nivalis Smith
KASLO, May 28, 1♂ 1♀; June 2, 1♀, 3, 1♀; July 17, 1♀, 1906 (W.L.C.). SAANICH, June 25, 1917, 2♀ (W.D.).

Andrena nubicula Smith
VERNON, Aug. 14, 1942, 1♀ (E.R.B.).

Andrena pallidifovea Viereck
VERNON, May 3, 1♂, July 20, 1♂, 1912 (E.P.V.). YALE, May 30, 1943, 1♀ (E.R.B.).

Andrena perarmata Cockerell
PENTICTON, April 24, 1929, 7♀ (E.R.B.). VERNON, March 31, 1930, 2♂ (E.R.B.).

Andrena placida Smith
KASLO, May 15, 1910, 1♀ (L.W.C.). OSOYOOS, May 8, 1928, 1♀ (E.R.B.). PENTICTON, April 11, 1919, 1♀ (E.R.B.). VERNON, May 3, 1907, 1♀; May 1, 1913, 1♀ (E.P.V.): April 22, 1929, 1♀ (I.J.W.): May 31, 1929, 1♀ (E.R.B.). CHILCOTIN, May 15, 1921, 1♀; May 24, 1929 (E.R.B.).

Andrena sp. near **politissima** Cockerell
PENTICTON, April 6-21, 1919, 4♂ 2♀ (E.R.B.). KELOWNA, April 8, 1930, 2♂ (E.R.B.). VERNON, April 17, 1929, 1♂ (I.J.W.); April 17, 1930, 1♀ (E.R.B.): April 13, 1907, 4♀ (E.P.V.). KAMLOOPS, April 18, 1929, 3♂ 2♀; April 17, 1943, 1♂ 1♀ (E.R.B.). NICOLA, May 3, 1943, 1♂ 2♀ (E.R.B.). MINNIE LAKE, May 19, 1943, 1♂ 1♀ (E.R.B.). CHILCOTIN, June 13, 1921, 1♀; May 27, 2♀; May 28, 1♀, 1929 (E.R.B.).

Andrena prunorum kincaidii Cockerell
KASLO, May 24, 1905, 1♂; June 5, 1♀, 10, 1♀, 30, 1♂, 1906 (L.W.C.). CRANBROOK, May 12, 1926, 1♀ (A.A.D.). OSOYOOS, May 8, 1928, 1♀ (E.R.B.). OLIVER, April 25, 2♂; May 4, 1♂, 1919 (E.R.B.). PENTICTON, April 11, 1♂, 17, 1♂; May 5, 1♂, 1919; April 24, 1929, 1♀ (E.R.B.). VERNON, June 15, 1918, 1♀, May 14, 1♂, June 6, 1♂, 1921; July 6, 1922, 1♀ (D.G.G.).: May 31, 2♂ 1♀; June 4, 3♂ 1♀, 1929; April 29, 1♀; May 9, 8♂, 1930 (E.R.B.). SALMON ARM, July 4, 1943, 3♀ (E.R.B.). KAMLOOPS, July 23, 1939, 1♂ (G.J.S.): April 17, 1943, 1♀ (E.R.B.). NICOLA, May 2, 1943, 1♂ (E.R.B.). WALHACHIN, July 10, 1♀, 16, 3♀, 23, 1♀, 1918 (E.R.B.). CHILCOTIN, April 16, 1921, 1♂; June 13, 1929, 1♀ (E.R.B.). AGASSIZ, June 6, 1939, 1♂ (A.B.D.). VANCOUVER, May 23, 1930, 1♀ (H.B.L.). VICTORIA, June 8, 1916, 1♀; June 17, 1917, 1♀ (R.C.T.): April 8, 1916, 1♀ (H.H.). SAANICH, June 15, 1917, 1♀ (W.D.).

Andrena pyrrhacita Cockerell
PENTICTON, April 4, 1♀, 8, 1♀, 12, 3♀, 1919 (E.R.B.). KAMLOOPS, April 17, 1943, 5♀ (E.R.B.). NICOLA, May 3, 1943, 4♀ (E.R.B.). CHILCOTIN, May 4, 1♀, 9, 3♀, 1921; May 27, 1929, 1♀ (E.R.B.).

Andrena regularis Cockerell
YALE, May 30, 1943, 1♀ (E.R.B.).

Andrena runcinatae Cockerell
KASLO, Aug. 19, 1906, 1♂ (L.W.C.). INVERMERE, July 18, 1928, 1♀ (A.A.D.).

Andrena saccata Viereck
KASLO, May 4, 1905, 1♀; May 6, 1♀, 10, 1♀, 30, 1♀; June 3, 1♀, 1906 (L.W.C.). PENTICTON, May 9, 1919, 1♀ (E.R.B.). CHILCOTIN, June 13, 1929, 1♀ (E.R.B.).

Andrena salicifloris Cockerell
KASLO, May 18, 1905, 1♂; May 5, 1908, 1♂; May 1, 1910, 1♂ (L.W.C.). VERNON, April 13, 1907 (E.P.V.): April 24, 1929, 1♀; April 17, 1930, 3♂ 2♀ (E.R.B.). SALMON ARM, April 26, 1943, 1♂ (E.R.B.).

Andrena salictaria Robertson
VERNON, April 4, 1904, 1♀ (E.P.V.): April 22, 1929, 1♀ (I.J.W.). DOUGLAS LAKE, April 23, 1930, 1♀ (E.R.B.).

Andrena seneciophila Cockerell
VERNON, May 20, 1904, 1♀ (E.P.V.): May 4, 1♀, 31, 1♀, 1929 (E.R.B.). SALMON ARM, May 26, 1943, 1♀ (E.R.B.). CHILCOTIN, May 28, 1921, 1♀; May 28, 1929, 1♀ (E.R.B.).

Andrena sladeni Viereck
PENTICTON, April 24, 1929, 3♀ (E.R.B.). VERNON, May 9, 1930, 2♀; May 17, 1937, 1♀ (E.R.B.).

Andrena sola Viereck
PENTICTON, April 24, 1929, 1♀ (E.R.B.).

Andrena striatifrons Cockerell
FAIRVIEW, May 4, 1919, 1♀ (E.R.B.). PENTICTON, April 7, 1♂, 17, 1♀, 21, 3♂, 23, 1♀; April 24, 1929, 1♀ (E.R.B.). KELOWNA, April 8, 1930, 1♂ (E.R.B.). VERNON, April 14, 1907, 1♂ (E.P.V.): April 17, 1929, 1♂ 1♀ (I.J.W.): April 17, 1930, 4♀ (E.R.B.). KAMLOOPS, April 18, 1929, 3♂ 2♀; April 17, 1943, 4♂ (E.R.B.). NICOLA, May 3, 1943, 2♂ 4♀ (E.R.B.). MINNIE LAKE, May 19, 1943, 1♂ 4♀ (E.R.B.). CHILCOTIN, May 9, 2♀, 13, 7♀, 1921; May 27, 1929, 3♀ (E.R.B.).

Andrena subaustralis Cockerell
KAMLOOPS, April 17, 1943, 1♀ (E.R.B.).

Andrena subtilis Smith
KASLO, May 6, 1910, 1♂ (L.W.C.). OLIVER, May 4, 1943, 3♂ 4♀ (E.R.B.). FAIRVIEW, May 18, 5♀, 19, 1♀, 1919 (E.R.B.): April 20, 1♀; May 18, 5♀, 1920 (M.H.R.). OKANAGAN FALLS, May 13, 1920, 1♀ (M.H.R.). KELOWNA, May 28, 1921, 2♀ (M.H.R.). PENTICTON, April 24, 1929, 1♂ (E.R.B.). VERNON, April 22, 1904, 1♂; 15, 1906, 3♂; May 3, 1907, 3♂; May 27, 1913, 2♂ (E.P.V.): April 26, 2♀: May 1, 1♂, 1920 (R.C.T.): April 14, 1921, 1♂; May 7, 1921, 1♂ (M.H.R.): April 18, 1♂, 22, 3♂, 24, 1♀ (I.J.W.): May 31, 3♀; June 4, 1♀, 1929 (E.R.B.). KAMLOOPS, June 13, 1943, 4♀ (G.J.S.). NICOLA, May 2, 1943, 2♀ (E.R.B.). LYTTON, May 30, 1943, 1♀ (E.R.B.). 100 MILE HOUSE, June 14, 1943, 1♀ (E.R.B.). VANCOUVER, June 3, 1943, 1♀ (E.R.B.).

Andrena surda Cockerell
INVERMERE, July 29, 1926, 1♀ (A.A.D.). OLIVER, July 10, 1929, 1♀ (E.R.B.).

Andrena swenki Viereck & Cockerell
VERNON, May 1, 1920, 1♀ (M.H.R.). CHILCOTIN, May 15, 1921, 1♀; June 13, 1929, 1♀ (E.R.B.).

Andrena transnigra Viereck
KASLO, June 5, 1906, 1♀ (L.W.C.). OLIVER, May 4, 1943, 1♀ (E.R.B.). KAMLOOPS, June 13, 1937, 1♀ (G.J.S.). MINNIE LAKE, May 19, 1943, 1♀ (E.R.B.). SALMON ARM, May 17, 1914, 1♀; April 11, 1915, 1♀ (W.R.B.). CHILCOTIN, June 13, 1921, 2♀; May 28, 1929, 4♀; June 5, 1930, 1♀ (E.R.B.).

Andrena trevoris Cockerell
DEPARTURE BAY, June 9, 1♂, 24, 1♂, 1925 (G.J.S.). NEWCASTLE IS., NANAIMO, June 1925, 1♂ (G.J.S.).

Andrena vicina Smith
KASLO, May 14, 1906, 1♂ (L.W.C.). FAIRVIEW, May 18, 1919, 3♀ (E.R.B.); May 19, 1920, 1♀ (M.H.R.). PENTICTON, April 6, 1919, 1♀ (E.R.B.): April 30, 1♂ 1♀; May 10, 1♂, 1920 (M.H.R.). KELOWNA, May 28, 1921, 1♀ (M.H.R.). VERNON, May 20, 1904, 1♀ (E.P.V.); June 14, 1921, 2♀; May 20, 1924, 1♀; May 1, 1925, 1♀ (M.H.R.); May 10, 1927, 1♂ (D.G.G.): May 31, 1929, 5♀ (E.R.B.). LYTTON, May 30, 1943, 15♀ (E.R.B.). SALMON ARM, May 3, 1♀, 14, 1♀, 1914 (W.R.B.). CHILCOTIN, May 24, 1929, 1♀ (E.R.B.). VANCOUVER, May 22, 1930, 6♀ (G.J.S.).

Andrena walleyi Cockerell
VERNON, May 12, 1920, 1♀ (M.H.R.). KAMLOOPS, June 13, 1943, 1♀ (G.J.S.). CHILCOTIN, June 13, 1929, 1♀ (E.R.B.).

Andrena washingtoni Cockerell, var.
KASLO, June 2, 1905, 1♀; May 17, 1906, 1♀ (L.W.C.). CHILCOTIN, May 28, 1♀; June 13, 1♀, 14, 1♀, 1929 (E.R.B.). ALEXIS CREEK, June 30, 1943, 1♀ (E.R.B.).

Genus DIANDRENA Cockerell

Diandrena nothoealaidis Cockerell
OLIVER, May 4, 1943, 1♀ (E.R.B.).

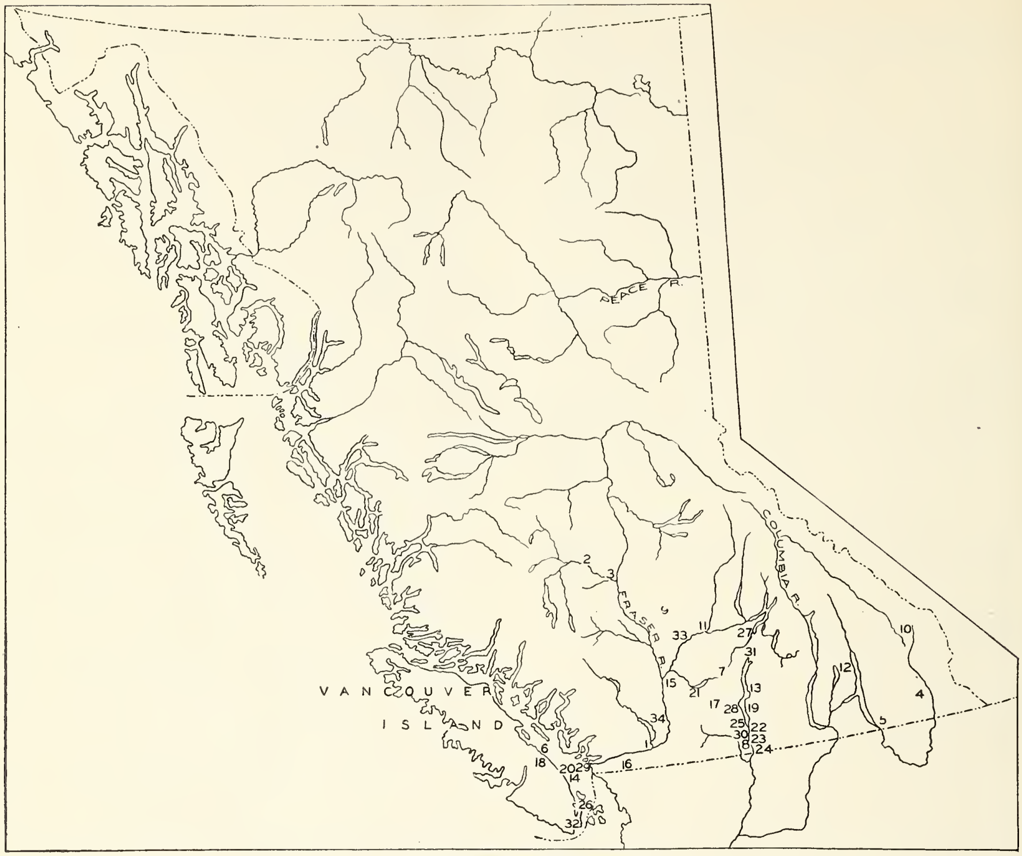
Genus PARANDRENA Robertson

Parandrena triangularis (Viereck)
KAMLOOPS, April 18, 1929, 1♀ (E.R.B.). NICOLA, May 2, 1943, 1♂ (E.R.B.).

LIST OF COLLECTORS

Mentioned by initials in the text.

A.A.D.—Dennys, A. A.
A.B.D.—Dickson, A. B.
E.P.V.—Venables, E. P.
E.R.B.—Buckell, E. R.
D.G.G.—Gillespie, D. G.
G.C.C.—Carl, G. C.
G.J.S.—Spencer, G. J.
H.B.L.—Leech, H. B.
I.J.W.—Ward, I. J.
K.G.—Graham, K.
L.W.C.—Cockle, L. W.
M.H.R.—Ruhmann, M. H.
P.N.V.—Vroom, P. N.
R.C.T.—Treherne, R. C.
W.D.—Downes, W.
W.R.B.—Buckell, W. R.



LIST OF LOCALITIES

Arranged alphabetically: the numbers corresponding to those on the accompanying map (V.I.: Vancouver Island).

1. Agassiz
2. Alexis Creek
3. Chilcotin
4. Cranbrook
5. Creston
6. Departure Bay, V.I.
7. Douglas Lake
8. Fairview
9. 100 Mile House
10. Invermere
11. Kamloops
12. Kaslo
13. Kelowna
14. Ladysmith
15. Lytton
16. Milner
17. Minnie Lake
18. Nanaimo, V.I.
19. Naramata
20. Newcastle Is., V.I.
21. Nicola
22. Okanagan Falls
23. Oliver
24. Osoyoos
25. Penticton
26. Saanich, V.I.
27. Salmon Arm
28. Summerland
29. Vancouver
30. Vaseux Lake
31. Vernon
32. Victoria
33. Walhachin
34. Yale

A FURTHER NOTE ON THE WHARF BORER, **NACERDA MELANURA** (L.) (Coleoptera: Oedemeridae).—In the Proceedings of our Society, Vol. 43, 1947, I recorded an unusual occurrence of **Nacerda melanura** (L.) in long-buried piling at Vancouver. At the time of investigating this infestation, in October, 1945, I saved a few pieces of riddled wood, apparently still infested, from the buried piles and placed them in a glass battery jar in my laboratory with coarse gravel all around them and wetted the whole mass with tap water so as to make it uniformly damp. The culture was examined in the autumn of 1946 and again in 1947 and, when fresh boring by a larva was noted, the wood was buried again in the damp gravel.

On March 10, 1948, the culture was examined again and one or two pieces of wood were broken open. In one of them occurred a fairly large tunnel containing an apparently healthy, full-grown larva and alongside of it, a female beetle which had died in the tunnel and was somewhat soft but intact enough to be successfully mounted on a card. The wood was reburied and will be examined again at intervals to see if the larva has transformed. Even under the harsh conditions of being removed from piling surround by brackish water and then buried in sand moistened with fresh water, one larva at least survived and completed its development, two years and five months after being first disturbed.—G. J. Spencer, Department of Zoology, University of British Columbia, Vancouver, B.C.

THE EFFECT OF DDT EMULSIONS ON TROUT FRY

L. C. Curtis
Victoria, B.C.

During the past year, the staff of the Dominion Livestock Insect Laboratory at Kamloops achieved success in the control of *Simuliid* larvae in running water by the addition of a DDT emulsion. The terial used was a stock solution of 10% DDT, 10% Triton X100*, and 80% Xylene, which was added to the running water at a controlled rate. Effective control of the pest was obtained by a final dilution of one part DDT to 20,000,000 parts water.

As always in work of this nature, there arose the question of the effect of this treatment upon other fresh water life, particularly game fish, and this the writer attempted to determine during a brief visit to Kamloops.

The apparatus used consisted of a sheet metal trough, divided by a partition into two parallel channels, provided with a flow of running water from Cold Creek. At the upper end of the trough was situated the dropping apparatus which delivered the DDT solution beneath the surface of the water at a controlled rate. Below this, the water passed through a series of baffles to ensure thorough mixing of water and larvicide, while further down the trough, removable screens of fine mesh formed pens in which were held the fish under test. The reserve supply of fish was held in screened troughs in the nearby bed of the creek, which also served as the source of an unlimited supply of *Simuliid* larvae. The fish were one-inch trout fry, obtained from the Provincial Hatchery at Pinantan Lake.

Test No. 1

A batch of 100 fish was penned in the trough, together with a stone covered with *Simuliid* larvae, and subjected to a flow of water containing one part DDT to 30,000,000 of water.

*Triton X100 is an emulsifier, product of P. N. Soden & Co., Montreal and Toronto.

After twenty minutes, the larvae showed signs of distress, and in less than an hour they had all become detached from the substratum and carried away. The fish appeared to be unaffected, but were removed to a trough in the stream bed for observation. After twenty-four hours they still showed no sign of distress.

Test No. 2

The strength of the emulsion was increased to one part DDT in 5,500,000 of water. All other conditions were as before. Ninety-five percent of the larvae became detached at the end of one hour, and 100 percent after 1½ hours. The fish remained lively, and showed no mortality after a period of 48 hours, when placed in the creek.

Test No. 3

A one percent DDT emulsion was used, giving a final dilution of one part DDT in 2,700,000 of water. The effect upon the larvae was as before, and the fish showed no immediate effect. However, they showed a mortality of ten percent after 24 hours in clear water, and fifteen percent after 48 hours.

Test No. 4

A dilution of one part DDT in 5,500,000 was maintained for three hours. At the end of that time, all the fish were active. After 24 hours, however, there was a mortality of 50 percent.

Test No. 5

In this test, a 5 percent DDT emulsion was added, to bring about a concentration of one part DDT in 550,000 of water. This was sufficient to bring about a marked cloudiness. After fifteen minutes, fifty percent of the fish were in distress, and were held by the current against the lower net. After one hour, all the fish were rendered helpless. The emulsion was turned off, and clear water allowed to run over the fish. After thirty minutes, eighty percent of them were again active, but at the end of 24 hours, all were dead.

TEST NO. 6

The appearance of the fish used in the previous test, particularly during their temporary recovery, suggested mechanical clogging of the gills rather than DDT poisoning as the immediate cause of their stupefaction. To test this theory, equal batches of fry were placed in parellel troughs. Group A were treated with the same concentration of DDT as in Test No. 5, while Group B were subjected to a straight Xylene-Triton mixture without DDT, at the same rate. At the end of one hour both groups were rendered senseless, although the DDT emulsion appeared to act a little more slowly. After the dropping of the emulsion had been discontinued, Group A showed the more rapid recovery, eighty percent of them being active after thirty minutes, compared with sixty percent for Group B. Both groups were left in clear water overnight. After 24 hours, all of Group A were dead, while ninety percent of Group B were alive and active.

SUMMARY:

It has been found that DDT is effective for the control of *Simuliid* larvae at a concentration of one part in 20,000,000, and it was demonstrated that small trout are able to withstand the effect of a dosage nearly four times as strong without harmful effect and one nearly eight times as strong with but slight mortality.

A very heavy concentration of Xylene causes immediate distress, which is relieved by prompt return of clear water conditions. Actual DDT poisoning occures at higher concentrations, but is slower in its action than the Xylene.

In conclusion, I very much appreciate the courtesy of Mr. J. D. Gregson of the Dominion Livestock Insect Laboratory, Kamloops, who made available the facilities for carrying out this series of tests, and that of the officer in charge of the Pinantan hatchery, who supplied the trout fry used in the experiment.

In Memoriam

L. E. MARMONT, 1860-1949

Lindsay Edgar Marmont, a native of Gloucestershire, England, came to Canada when 20 years old, and farmed in Manitoba for a number of years.

In 1907 he came to British Columbia, taking up residence at Maillardville, serving that community as a justice of the peace, and reeve of Coquitlam for many years. He was a life member of the Westminster Club, and a prominent Elk.

As an entomologist, Marmont specialized in lepidoptera including the so-called "micros." He was a member of our parent body in Ontario around the turn of the century, and transferred his membership to this society upon its resuscitation in 1911, and took a keen and steady interest in its welfare, as can be realized by reading his "Presidential Addresses" in years gone by. President from 1921 until 1925, he filled the chair with distinction, dry humour, sound advice, and tolerance of other members' opinions.

He was the last of the old brigade—the Aurelians of B.C.—who did so much for the society in its early days, and the gap will not now be filled.

R. GLENDENNING, Agassiz, B.C.

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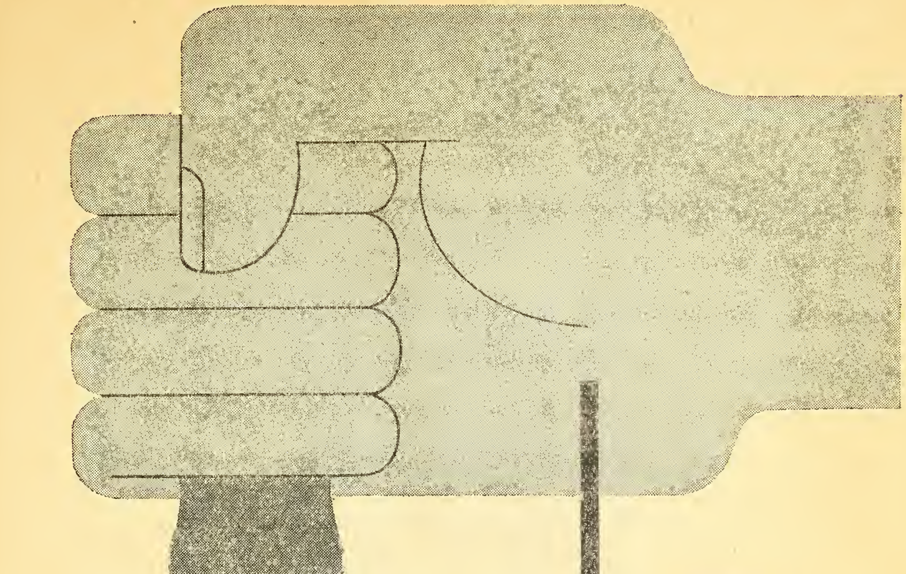

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*Re-elected.

SOME PRELIMINARY OBSERVATIONS ON THE LIFE-HISTORY OF CUTEREBRA TENEBROSA COQUILLET[1]

T. K. Moilliet[2]

Livestock Insect Laboratory, Kamloops, B. C.

On August 23, 1934, E. P. Venables, Vernon, B. C., captured a large, dark blue oestrid in a cabin at Sugar Lake, near Vernon, B. C. The writer has since compared this fly with specimens of warble flies of various rodents, in the reference collection established at Kamloops by the late Eric Hearle, and identified it as a female of *Cuterebra tenebrosa* Coq. During the next two days the fly laid over 400 eggs in its cardboard container, and on September 10 Mr. Venables sent the two largest egg masses, numbering 395 eggs in all, to the Kamloops laboratory in the hope that some rearing could be attempted.

The eggs had been laid in two patches covering unevenly about four or five square inches. No particular care seems to have been taken in their arrangement by the female, except that each was securely cemented, along its entire ventral surface, to the cardboard and overlapping of the eggs had been almost entirely avoided. The colour of eggs and adhesive material is light yellow. As in most oestrids, the egg is equipped with a "lid" which the larva forces open like a trap door when ready to emerge.

The eggs were kept in the laboratory at 70°F. and about 25 per cent relative humidity. By September 20 no hatching had occurred. On September 27 several eggs had hatched. Some half-dozen of the tiny maggots, 1 ¼ mm. in length, were seen erect upon the cardboard and egg-shells, waving their heads to and fro. The larvae are very quick to stick to any object with which they come in contact, and are able to move about by looping, as both head and tail appear to be sticky. The larva is transparent except for series of black spines on each segment. When an egg was opened with a needle it was observed that the larva usually squirmed out, although in many cases when not sufficiently developed it either died or waited a day or two before emerging.

By October 31, 43 eggs had hatched, about half of these artificially. During the next two weeks about one-quarter of the remaining eggs hatched. Natural hatching reached its peak about the second week of November and practically ceased by the middle of December, when about 80 per cent of the eggs had hatched. One larva, which emerged naturally on December 3, lived until December 13 at an average room temperature of 60°F. and a relative humidity as low as 15 per cent.

To determine whether or not the eggs would survive below-freezing temperatures, the larger egg mass was placed out of doors between December 11 and 31, during which period temperatures went considerably below freezing. The minimum recorded temperature was —5.5°F. on December 25. On December 31, eight of these eggs were opened at room temperatures. At first the grubs were inactive, but after exposure to the warmth of a desk lamp for 30 minutes, six showed normal activity which was maintained for an hour, when they were placed on a host. Eggs opened at this time from the uncooled mass yielded active larvae. On February 8, 1935, five eggs from the previously cooled mass were opened. Two immediately yielded normal, active larvae, which lived three days in an incubator at 75°F. and 70 per cent relative humidity. By February 9, 90 per cent of all the eggs had hatched and 4 per cent had shrivelled.

Infestations: The following is an account of such rearings as have been attempted up to the time of writing (1935). To infest an animal, the maggots were simply lifted with a needle and placed on the hair of the back and sides of rats. Chloroform was used to quiet the rats because of the danger of infection from rat bites.

Rat No. 1 (brown female, half-

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1 Contribution No. 2634, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

2 Resigned 1936.

JUN 26 1950

grown). — This rat was infested on September 28 with 12 larvae from eggs mechanically opened. The animal was very uneasy and scratched herself incessantly the same day. By October 5 the rat was hiccoughing continually and was little interested in food (oats). Weakness and distress increased and by October 14 the animal had gnawed half its tail away and was paralyzed in one hind leg. On October 15 the rat was in a coma all day and died about 5 p.m.

Necropsy was made at 11 p.m. Emaciation was extreme; several matted patches of hair when pulled off revealed holes in the skin one mm. in diameter. Skinning revealed ten such holes, and eight grubs, varying in length from one-quarter to one-half of an inch, were removed from the muscles of the legs, back, and diaphragm. In some cases they had pierced into the coelom. These grubs do not form true cysts, as do ox warbles, but lie between the layers of muscle.

Rat No. 2 (brown female, mature). —This rat was infested on October 16 with four artificially hatched grubs. On October 21 she was scratching herself and seemed in pain. On October 23 it was apparent that one grub had established itself on the neck, just in front of the left shoulder. On November 16 the grub was nearly full-grown, and in anticipation of it's dropping the rat was isolated. The rat was found dead on November 17 and the grub was cut out from under the skin and placed in a jar of damp earth, in which it immediately buried itself.

Rat No. 3 (white female, mature).— This rat was infested on October 16 with four grubs, two naturally and two artificially hatched. When the rat was examined under chloroform on October 31, no grubs were found. Three very small scabs on the neck may have been caused either by fighting or by ineffectual entry of the maggots.

Rat No. 4 (white female, half-grown).—This rat was infested on October 18 with six grubs, three naturally and three artificially hatched. It was examined under chloroform on October 31 and no grubs were found. The rat was re-infested on December 3 with six artificially hatched maggots. It was examined under chloroform on December 20 and found to have two grubs, one behind each front leg. The rat was chloroformed on January 7 and the grub removed from under the left front leg. That under the right shoulder dropped on January 11, but was lost and perished. In this case the grub, unable because of a hard scab to leave its host through the breathing hole, bored its way out head first about half an inch in front of the original hole.

Rat No. 5 (brown and white male). —This rat was infested on December 4 with six grubs. By December 20, five grubs were embedded, four in the back and one on the right side of the breast. The rat died on December 31, and three well-grown grubs were removed from the body, which was already badly decomposed in the areas of infestation. One grub was found in the tray, as well as the remains of another which had been bitten out by the rat. The live grubs were placed in a jar of damp sand for pupation.

Rat No. 6 (white female, mature).— This rat was infested on December 4 with five grubs which hatched from eggs opened the previous day. The rat was examined under chloroform on December 20 and no infestation was found.

Rat No. 7 (brown male, half-grown). — This rat was infested on January 8 with four grubs artificially hatched. It was examined under chloroform on January 20 and only a small black spot was noted on the back. By January 30 it was noticeable that two well-grown grubs were established in the back; these were nearly mature by February 8.

Rat No. 8 (brown female, mature). —This rat was infested on January 8 with three grubs artificially hatched from the egg mass which had been subjected to below-freezing temperatures. The rat was examined under chloroform on January 20; there was no sign of infestation.

From these rearings no information was secured on the duration of the pupal stage. One of several fairly well matured larvae taken by the writer at Nicola, August 25, 1932, in a pack rat, was allowed to pupate in earth in the out-of-doors insectary at Kamloops, and emerged in mid-August, 1933.

Conclusions: Some of the foregoing observations suggest the following deductions regarding the habits of *C. tenebrosa*.

It is usually assumed that the female fly lays her eggs on the hair of the host animal. The extreme viability of the egg and the longevity and motility of the unfed maggot are specializations which would seem unnecessary were the above assumption true. It seems, therefore, more probable to suppose that the eggs are laid among the rocks, logs, nests, or burrows frequented by pack rats, chipmunks, and ground squirrels, the commonest hosts. In support of this, H. B. Leech has told the writer that he captured in 1929 a female of this species in the mouth of a burrow of a ground squirrel or groundhog at Vernon, B. C.

The growth in the host is amazingly rapid, little over a month being required for larval development. The pupal stage, on the other hand, is extraordinarily long and may last a year, but in order for the life-cycle to be completed in a year, the average duration of this stage cannot be more than 10 or 11 months. A two-year cycle, however, does not seem impossible when the viability of the eggs, even in cold weather, is considered. It may have been because of room temperatures, about 70°F., that so many eggs hatched within three months, although the humidity of the room, about 20 per cent, may have been an adverse factor. According to our records of grubs taken from rodents, flies of this group thrive best in localities such as Nicola, Salmon Arm, and Vernon, which have a relatively heavy snowfall. They are rare at Kamloops.

The mortality of rats in the foregoing experiments suggests that this fly may cause the death of small mammals in nature in certain localities, although a general infection may be induced by the grubs less easily in mountain rats than in those used in the laboratory. If they do constitute a factor in reducing populations of wild rodents, then they become a factor in the control of wood ticks, and deserve further study.

Acknowledgments. — The writer is indebted to E. P. Venables, Vernon, B. C., for the material for these experiments. Thanks are also due to H. B. Leech, California Academy of Science, San Francisco, for his record, and to George J. Spencer, University of British Columbia, for reading this manuscript.

ADDITIONAL NOTES ON THE LIFE-HISTORY OF CUTEREBRA TENEBROSA COQUILLET[1]

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At the 1935 meetings of the Entomological Society of British Columbia, T. K. Moilliet read a paper entitled "Notes on the life-history of *Cuterebra tenebrosa* Coquillet." In that paper, which is being published concurrently with this one, he reported his observations on some 400 eggs laid by a fly captured on August 23, 1934. Larvae commenced hatching from these eggs on September 27, reaching a peak in November. Some of the remaining unhatched eggs yielded active larvae when mechanically opened in February. Numbers of these larvae were used to infest rats, in which they matured in about a month. Since none of these were followed through their pupal period to emergence of adults, the following notes may prove of value in further studies of this parasite.

The material for these subsequent observations was provided by a batch of 850 eggs deposited by a fly on July 26, 1943. The first of these hatched on

1 Contribution No. 2635, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

August 20. Further larvae did not appear normally until the following May. By June 15 all remaining eggs had hatched. Larvae kept in the damp cellar of the insectary lived for about three weeks after hatching. After the appearance of the first larva, it was found that eggs could be readily induced to hatch by pricking open the operculum with a sharp needle, or even by merely dislodging the egg from its attachment.

In September, 1943, 43 white rats were each infested with from one to four larvae which had been obtained by mechanical hatching. Of the 89 cuterebrid larvae planted on these hosts, 23 matured and dropped out after an interval of about five weeks. The mortality of the infested rats was approximately 30 per cent, although it must be admitted that some of these animals were the victims of as many as four grubs at once. Most of the grubs were localized in regions about the head and shoulders.

Upon being placed on loose soil the mature grubs burrowed, pupated, and remained quiescent until August 1, 1944, when the insects of the earlier infestations commenced to emerge as adults. With a pupal period of nearly 11 months, the life-cycle of this cuterebrid is just the opposite of those of the cattle warbles, as the periods spent within the host as a larva and in the ground as a puparium are approximately reversed. The fact that up to nearly a year after oviposition the eggs may remain viable and even hatch with the mechanical aid of a host brushing by suggests that the cycle of the warble fly of this rodent may on occasion last as long as two years.

As surmised by Moilliet, it appears probable that this fly does not oviposit on the hairs of its host but deposits its eggs upon debris about the entrance of its burrow. From evidence gained at this laboratory that mice readily eat puparia of cattle warbles, and the fact that gnawed shells of cuterebrid puparia are frequently seen about pack rat nests, it seems likely that this stage of the fly is particularly vulnerable to this means of natural control.

SOME RECORDS OF PARASITIC DIPTERA FROM WELLINGTON, B. C.

BOMBYLIIDAE

Villa alternata, Say Aug. 10, 1946. Bred from a large phalaenid larva, species unknown.

TACHINIDAE

Bombyliopsis abrupta (Wied.), June 8, 1945. Bred from larva of **Diacrisia virginica** (Lepidoptera, Arctiidae). 14.VI.45. Taken on woodland path.

Rileymyia n. sp., Mar. 3, 1945. Bred from larva of **Halisidota argentata** (Arctiidae). The adult form of **H. argentata** appears in the summer, after a very short period as a pupa. Thus the parasite in this case does not follow the life cycle of its host, but must attack the partly grown larvae in spring. Mr. A. R. Brooks advises me that the same species has been bred from **Malacosoma** sp., which passes the winter in the egg stage.

Peleteria obsoleta Cn., Aug. 18, 1946. Taken on flowers of **Anaphalis margaritacea**, Aug. 5, 1947. Bred from the larva of an unknown phalaenid moth on grassy foreshore.

Peleteria campestre, Cn., Aug. 18, 1946. Taken on flowers of **Anaphalis margaritacea**.

Bonellimyia tessellata, Brooks, Sept. 26, 1946. This specimen taken in the house during early autumn, was probably seeking a place for hibernation. I am indebted to Mr. Brooks for the following information on the taxonomy of **B. tessellata**—"**Bonellimyia** is a segregate of the old genus **Linnaemyia** Des. and **tessellata** is one of three species which were formerly known as **Linnaemyia haemorrhoidis** Fall."

Uromacquartia halisidotae (Tns.), two specimens, June 6, 1946. Bred from larvae of **H. argentata**. The caterpillars were taken the previous August while very small and kept in a cotton sleeve over winter. In this case infestation must take place soon after the host larvae are hatched, the parasite following nearly the same life cycle. The emergence date is somewhat earlier than is common for the moths.

Lydella nigrita Tns., June 24, 1946, also two specimens, May 28, 1947. Both bred from larvae of **Arzama obliqua** (Phalaenidae). The caterpillars infested with this parasite die in the autumn without pupating, and the maggots leave the body of the host to pupate. Emergence dates in spring coincided with the appearance of the host adults.

Tachinomyia variata Cn., April 24, 1947. Bred from pupa of **Malacosoma pluviale** (tent caterpillar). This species also over-winters as a pupa.

Argentoepalpus significus (Wlk.), April 27, 1947.

All the above determinations were kindly made by Mr. A. R. Brooks, Ottawa.—Richard Guppy, Wellington, B. C.

A WINTER CRANE-FLY, TRICHOCERA ANNULATA, AT VERNON, B. C. (Diptera: Trichoceridae) — In Volume 44 of this journal, G. J. Spencer listed two species of **Trichocera** as occurring in the province. In the late fall of 1944 my wife and I took a series of a third species, dancing in a swarm about four feet above our lawn at Vernon, B. C.

Examples were sent to C. P. Alexander, who replied in a letter dated February 23, 1945: "Your species is Trichocera annulata Meigen, which has been known to me in North America only from Bergroth's record from Sitka, Alaska. Strange to say, since receiving your specimens, it has turned up in California. The species has been carried by commerce to many parts of the world . . ."—Hugh B. Leech, Calif. Acad. Sci., San Francisco, Calif.

NOTES ON SOME BRITISH COLUMBIAN FLEAS, WITH REMARKS ON THEIR RELATIONSHIP AND DISTRIBUTION*

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Any attempt to piece together the sequence of post-Pleistocene repopulations of life in the area now called British Columbia will require the concerted knowledge of the geologists, palaeontologists, botanists and zoologists, an impressive array of which are assembled here today. The contribution that a discussion of fleas will make to the theme of this symposium will be but small. However, I am pleased indeed to have this opportunity of presenting some generalities on these parasites, with some notes which I hope will be of interest, and have some bearing on the general discussion.

While, for centuries, the butterflies and other conspicuous forms have attracted the attention of amateur naturalists and professional investigators, the lowly and despised fleas have been woefully neglected. Only since the turn of the twentieth century has serious attention centred on these insects, over 90 per cent of the known species having been described since that time. This belated appreciation has stemmed partly from recognition of their role as disease vectors, and partly from the intensive studies of Rothschild and Jordan, and, to a lesser extent, Baker and Wagner. These men were not moved primarily by economic considerations, but loved the fleas for themselves alone! To the ardent siphonapterologist, no insect, however gaudy, can compare with a flea, under the microscope, especially when full justice has been done the specimen by proper preparation in mounting. As Dr. Karl Jordan is reported to have said "They are indeed the jolliest of all insects."

Now, although a succession of taxonomists has provided names by the hundreds for these jolly insects, and while their unsavoury association with such diseases as plague and murine typhus, has prompted exhaustive analyses of the bionomics of certain species, little has been published on the phylogeny of the order, its origin, and the history of its association with mammals and birds. Actually, only now is knowledge of the world fauna approaching the point where the data on which such research would be based could be considered representative.

My own studies of fleas, during the last few years, have related principally to their taxonomy and distribution in Canada. It became apparent at the commencement, of course, that an adequate understanding of the geographical distribution of these insects would not be achieved without serious attention being given the host animals. However, investigation soon revealed that the presence of preferred hosts was not necessarily the sole factor governing the range of flea species. Thus, consideration of geographical restriction by selective host requirements or circumstances independent of these has complicated the study of nearctic fleas, and drawn attention to numerous problems which await solution. The immediate need is for more material. An accurate understanding of the story these little parasites have to tell will require access to long series of specimens from representative localities, and from all hosts. This should be acompanied by biological studies of the species, with critical analysis of microclimatological conditions in the larval habitat. At the present time this ideal abundance of material and information is not available, although possible lines of investigation are suggested.

The fleas, or Siphonaptera are fundamentally mammalian ectoparasites, with a few forms now associated with some birds. Not all mammals have fleas. Apparently the prime criterion governing the suitability of a particular mammal as a potential flea host concerns the

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stability and type of its dwelling place. As a general rule, fleas are parasites of terrestrial mammals of nesting habits. There are exceptions, but in most instances mammals living in burrows, dens, or other confined quarters, tend to be more or less populated with these insects. This is to be explained by the fact that it is only the adult flea which is an animal parasite feeding upon the blood of the host, the larvae being legless, maggot-like creatures which live upon a variety of organic materials, including the faeces of adult fleas; such materials, in fact, as are to be found in greatest abundance in the hosts' permanent bedding. The presence of a nest then, or reasonable alternative, is a fundamental requirement, the larvae, normally, never occurring upon the host. Nearctic fleas are found in greatest number and variety on the Insectivora, Rodentia and Lagomorpha, nearly all of which are of nesting habits. Chiroptera, or bats, also have fleas, and while these flying mammals do not make nests in the accepted sense, they do tend to congregate in caves, attics or other places where suitable conditions (of humidity?) exist, and where the availability of organic substances for larval sustenance, and hosts for the freshly emerged adults assure opportunity for completing and repeating the life cycle.

Certain Carnivora such as bears (which live in "nests" at least during the winter) have their own fleas, but as a rule, true carnivore-fleas are rare.

The host specificity of fleas varies considerably. Some are very selective in this respect, and are rarely collected from any but a particular genus or species of host. Any occurrences recorded from other hosts are explainable by predation or other secondary or accidental association. Other species of fleas are able to exist upon a variety of hosts, and (presumably) to reproduce in their nests. Several genera of mouse-fleas appear to fall into this category, as they are collected equally commonly on various genera of Cricetidae and Zapodidae. Some of these exhibit interesting limitations in geographical range which apparently have nothing to do with the lack of availability of particular hosts. With these, it must be presumed that other ecological factors restrict the distribution of the flea, probably by affecting the larva.

It must not be presumed that one kind of animal harbours only one species of flea, although sometimes this is so. Our pocket mice (*Perognathus parvus*), groundhogs (*Marmota flaviventris*) and chipmunks (*Eutamias* spp.) for example, have but one species each, but the mountain beaver (*Aplodontia rufa*) has three, and white-footed mice (*Peromyscus maniculatus*) may have as many as eight species occurring upon a single individual! The coast squirrel (*Tamiasciurus douglassii*) has three, while the red squirrel (*Tamiasciurus hudsonicus*) has another three, belonging to the same genera, and a fourth occurring in the mountains and farther north. Some of these species are chiefly nest fleas, and are rarely collected upon the host, while others seem to enjoy touring the outside world as passengers.

In British Columbia, 88 species of fleas are known. Of these, 70 are regarded as monotypic, and 18 polytypic, with 23 subspecies represented, making a total of 93 forms recorded at present in the province (Holland, 1949:7-14). Five have been introduced within historic times, so that the total of indigenous species and subspecies of British Columbian fleas now stands at 88. It seems likely that future studies will tend to equalize the present disparity between monotypic and polytypic species, partly through the reduction of some named species to subspecific rank, and partly through recognition of the advisability of splitting other species, which show consistent geographical variation. However, there are a number of species of very stable character, and sometimes of wide distribution, *e.g.*, *Monopsyllus vison* (Baker), which occurs without apparent geographical variation over much of the range of red squirrels, *Tamiasciurus hudsonicus*, which will probably retain their monotypic status.

The 88 species and subspecies mentioned belong to 41 genera, only 5 of which remain monotypic. Among the others, sympatry may be demonstrated by species of a common genus, occurring on a single host (as various species of *Megabothris* which may be taken on, or collected from the nest of, a single *Microtus*) and species of a common genus occurring in the same geographical territory, but ecologically isolated by very selective host preferences (as *Corypsylla ornata* Fox which occurs on moles, *Scapanus, and C. jordani* Hubbard, a true parasite of shrew moles, *Neurotrichus*). Typical examples of allopatric species are the various species of *Catallagia*, parasites of white-footed mice, *Peromyscus maniculatus*, which replace each other geographically.

The indigenous flea fauna of British Columbia is at present most satisfactorily classified into five families and about 12 subfamilies, although there is wide disagreement among siphonapterologists as to the definition and scope of these categories. Because of the peculiar structural modifications of fleas, resulting from a highly specialized parasitic existence, their phylogenetic relationships with each other and with other orders of insects are difficult to interpret. Further, and for obvious reasons, the fossil record of fleas is so scanty as to be almost non-existent. None-the-less, there is ample evidence that the fleas are an ancient group, and that their association with mammals dates back to the early history of that Class. The prime evidence for this contention lies in the fact that today, divergent groups of host animals are usually infested by fleas of widely different character, suggesting that the fleas have evolved with the hosts. However, during the Cenozoic epochs, when certain groups of mammals evolved, flourished, declined and became extinct, leaving at least a fossil record, the fleas associated with them are almost completely unknown. Simpson (1945:34-35) points out that of the 32 recognized orders of mammals, 14 are now extinct; also that 54 per cent of the families and 67 per cent of the known genera of mammals are extinct. Thus the modern flea fauna, bereft of genera and families which must have depended upon these vanished mammals constitutes a number of tag ends of evolutionary lines, and leaves but an irregular, disjointed picture of the story of the Order. To make matters even more difficult, inferences and analogies which might be drawn are fraught with pitfalls in the form of complications arising from habitat associations and transference of hosts, which have occurred at various times in the more recent past. Thus, although we may postulate that fleas evolved with the mammals so that, in general, modern primitive mammals are infested with relatively unspecialized fleas, and some of the higher mammals with fleas which may be regarded as more highly specialized, there are inter-relationships, resulting from contacts amicable or otherwise, between the ancestors of the host animals, which obscure the clarity of the picture. For example, there are at least two genera of fleas occurring on certain burrow-inhabiting sea birds which show obvious affinities with the rabbit-fleas. On the other hand, bats are infested by a special family of fleas (Ischnopsyllidae) no species of which is to be found on members of any other order of hosts. Thus, while it is, perhaps, reasonable to speculate that the Ischnopsyllidae are of ancient lineage, originating at the time when the bats themselves were splitting from the primitive mammalian trunk, the sea-bird fleas are almost certainly to be explained by the practice of some birds taking over the burrows of fossorial mammals for nesting purposes, with subsequent opportunity for transfer of ectoparasites. Evidently, some of the rabbit-fleas found the birds an adequate substitute for their normal hosts, and while the processes of evolution, perhaps accelerated by the new environment have brought about their present generic distinctions, the ancestral affinities remain obvious today. Other bird-fleas, including two genera known from British Columbia, are as obviously derived from rodent-fleas (Ceratophyllinae).

Orchopeas sexdentatus (Baker) a packrat (*Neotoma*) flea frequently occurs on pikas (*Ochotona*) in talus slopes occupied by both mammals. Given sufficient time, it is possible that a form of *Orchopeas* peculiar to the pikas might evolve. Mice and insectivores, which frequently use each others' runways and burrows are regularly found to be temporary hosts to each others' fleas.

At the present time there are at least three species of fleas occurring on nearctic weasels or mink and which belong to genera most of the species of which occur on groups of animals forming the normal prey of these small carnivores. These fleas are *Nearctopsylla brooksi* (Rothschild) (the other species of *Nearctopsylla* occur on shrews), *Ceratophyllus tundrensis* Holland (the genus associated with birds) and *Megabothris atrox* (Jordan) (the genus ordinarily associated with the Microtinae). Thus far, none of these fleas has been recorded from the type of host that one would expect. This may be explained by the fact that collections are yet limited, but it is possible that these fleas, or their ancestral representatives, originating on the prey, have now transferred their entire attention to the genus *Mustela.* Future study should reveal the answer. An interesting fact is that all three species are larger and more deeply pigmented than others in their respective genera, and this may have some relation to conditions on the new host, conditions which have brought about this evolutionary modification in three unrelated genera.

Continuing with general discussion, it may be noted that fleas, like other parasitic forms, evolve more slowly than do their mammalian hosts. Local proof of this statement is provided by the known flea fauna of some islands off the coast. Although nearly all the small mammals of the Queen Charlotte and Vancouver Islands are regarded as racially or specifically distinct from corresponding forms on the adjacent mainland I have been able to detect no morphological difference in the small series of fleas (about 16 species from Vancouver Island; 3 from the Queen Charlotte Islands) available for study from these regions.

As Jellison points out (*in litt.*) fleas appear to be approximately one taxonomic category behind their hosts in evolution. Although zoological subspecies and species have a demonstrable actuality in Nature, other taxonomic categories, while attempting to demonstrate natural groups, are in general only concepts, facilitating development of the classifications, sometimes rather arbitrary, by means of which we pigeon-hole animal life. Nevertheless, on the basis of classifications now existing, it appears that species of fleas are frequently associated with genera of mammals; genera of fleas with families of mammals; families with orders, and finally, the order Siphonaptera with the class Mammalia! For example, the fleas *Monopsyllus vison* (Baker) and *Monopsyllus eumolpi* (Rothschild) infest the genera *Tamiasciurus* and *Eutamias* respectively. Thus, the genus *Monopsyllus* is associated with the family Sciuridae. The Ceratophyllidae, to which *Monopsyllus* belongs, includes many genera, mostly associated with the order Rodentia. In the same manner, the genus *Corypsylla* is associated with the Talpidae and the family Hystrichopsyllidae with the order Insectivora. Similarly *Arctopsylla* is a genus associated with Ursidae, and the Vermipsyllidae with Carnivora.

A survey of holarctic mammalian fauna reveals that many of the British Columbian forms have closely allied Asiatic counterparts. Many of these indeed, are regarded as congeneric, and are accepted as definite evidence of intercontinental migrations and countermigrations which have occurred across the intermittent Siberian-Alaskan land bridge from Miocene times to as recently as only a few thousands of years ago. As might be expected, many of the fleas infesting western Canadian and Alaskan mammals too have close Asiatic relatives, and occur on the corresponding hosts. Some of these fleas are regarded as only racially distinct, and are apparently attributable to late Pleistocene contacts.

Of the 41 genera of fleas recorded from British Columbia, 20 also occur in Asia (see Tables 1 and 2). These genera occur principally upon the shrews, bats, bears, marmots, ground-squirrels, tree-squirrels, meadow voles, red-backed mice, hares and pikas, which correspond closely in the New and Old Worlds. Two of the holarctic genera are restricted to birds, and some of the species of these fleas are circumpolar. Of the 21 genera not recorded from the Palaearctic region (Table 2), 6 at least are very closely allied to Old World forms, and only owe their present identity to recent generic splittings.

The remaining 15 genera are somewhat more remote, and, not surprisingly, are associated principally with strictly nearctic genera of mammals. Notes on a few of these follow.

Corypsylla is associated with western nearctic moles, *Scapanus* and *Neurotrichus,* and the related *Corypsylloides* and *Nearctopsylla* are found on New World *Sorex.* At present no palaearctic equivalents of these fleas are known, so it may be that the group originated on some nearctic Talpidae, subsequently spreading to the ubiquitous *Sorex.* *Sorex* also has fleas of the genus *Corrodopsylla,* common in Asia and North America.

Most of the species of *Opisocrostis* are associated with the mammalian genus *Citellus.* As *Opisocrostis* is not known from palaearctic ground-squirrels, it may be (as Jellison suggests, 1947:65) that the genus originated on prairie dogs (*Cynomys*), a group of nearctic fossorial rodents which also harbour two species of *Opisocrostis,* the fleas spreading to *Citellus* in the New World in comparatively recent times. However, a representative of *Opiscrostis tuberculatus* (Baker) has recently been collected from *Citellus parryi* (a relict species, and not now in contact with more southerly populations of *Citellus* or with *Cynomys*). A similar situation occurs with the genera *Orchopeas* and *Opisodasys,* also apparently strictly nearctic and with no close palaearctic relatives. Most of the species of *Orchopeas* occur on arboreal squirrels, *Sciurus* and *Tamaisciurus,* which have close relatives in the Old World. However, the two remaining species, *Orchopeas leucopus* (Baker) and *O. sexdentatus* (Baker) are true parasites of the nearctic mammalian genera *Peromyscus* and *Neotoma,* and it appears likely that the genus *Orchopeas* originated on nearctic Cricetinae, spreading subsequently to the squirrels. It should be noted that northern New World tree-squirrels also have the fleas *Monopsyllus vison* (Baker) and *Tarsopsylla coloradensis* (Baker) which show obvious affinities with the palaearctic squirrel fleas, *Monopsyllus sciurorum* (Schrank) and *Tarsopsylla octodecimdentatus* (Kolenati).

The genus *Megabothris* is associated primarily with the Microtinae, and a sequence of the described species, arranged to show the progressive evolution of the spiniform setae on the male clasper processes shuttles us back and forth between the Old and New Worlds in a manner that suggests a succession of contacts and dispersals.

Anomiopsyllus, Callistopsyllus, Stenistomera and *Megarthroglossus* belong to a group of primitive nest-fleas, all the genera of which appear to be entirely Nearctic. Again the prime association seems to be with white-footed mice and pack rats, with some species of *Megarthroglossus* having spread to tree-squirrels.

The nearctic genus *Meringis* is entirely restricted to pocket mice (*Perognathus*) and pocket rats (*Dipodomys*). The related *Phalacropsylla* occurs on pack rats (*Neotoma*).

Trichopsylloides and *Dolichopsyllus* (both monotypic genera) are found only on the "mountain beaver" (*Aplodontia*) and like their host, are without close relatives.

Foxella and *Dactylopsylla,* blind ceratophylline fleas, are restricted to pocket gophers (*Thomomys* and *Geomys*).

Some of the fleas of certain northern Microtinae (*Microtus, Clethrionomys,* and presumably *Lemmus* and *Dicrostonyx,* although from the lemmings, but little material is available as yet) show closer affinities with the Asiatic fauna than they do with the fleas of temperate North America. *Malaraeus penicilliger dissimilis* Jordan and *Amphipsylla sibirica pollionis* (Rothschild) are considered only as nearctic races of palaearctic species. Recently, nearctic representatives of *Megabothris calcarifer* (Wagner) and *Catallagia dacenkoi* Ioff have been collected from microtines in Alaska and the Mackenzie delta of Canada.

A further note of interest concerns

the New World representatives of *Malaraeus penicilliger* (Grube) which occur on red-backed mice, *Clethrionomys*, and other microtines, across sub-Arctic North America from Alaska to Labrador. Although *Clethrionomys* ranges well to the south and may be found in woodland habitats at low altitude as well as high, there is a representative of this flea which (apparently) is restricted to that part of the mouse's range which occurs in alpland and subalpine forest. Records are available from Maligne Lake in the Rockies and Tenquille Lake, and Anahim Lake, in the Coast Range. It is not known as yet if the species is of continuous distribution from the Arctic to the southern mountain ridges or whether the northern and southern populations are separated. In any case, it illustrates the general situation, that the fleas of Arctic and sub-Arctic Alaska and Yukon show closest affinity with the modern flea fauna of northeastern Asia, and are followed next by those of the mountains and then the great Boreal Forest of British Columbia. However, many of the fleas of the bottomlands and valleys of the southern part of the province, even on holarctic genera of hosts, represent strictly nearctic genera, and are obvious intrusions from the south. A single example may suffice. *Oropsylla idahoensis* (Baker) is the dominant flea of *Citellus columbianus*, but only in the northern part of its range, and in localities at high altitude in the southern part. In the low valleys of the Okanagan and the Kootenays, where Columbian ground-squirrels also occur, the dominant flea is *Thrassis petiolatus* (Baker), belonging to a purely New World genus, which has its greatest centres of abundance and variety on marmots and ground-squirrels in the Western United States. In areas where *Thrassis petiolatus* occurs, *Oropsylla idahoensis* is rare to absent, and *vice versa*.

Diamanus presents an interesting example of a flea genus which, in times prior to the last ice inundation probably was represented in Canada. The genus is quite distinct, and associated with ground-squirrels of the genus *Citellus*. Two species are known today. One, *Diamanus montanus* (Baker) is recorded from California, Oregon, Nevada, Utah, Arizona and Mexico, where it occurs most commonly on *Citellus beecheyi* ssp. and *C. variegatus* ssp. The other, *Diamanus mandarinus* (Jordan and Rothschild) is known only from China, where it occurs on *Citellus dauricus mongolicus*. *Diamanus* is not known from any of the ground-squirrels now occurring in Canada, and we must presume that while Western Canada has become populated by *Citellus* since the ice retreated, certain factors now preclude the re-establishment of *Diamanus*. The nature of these cannot be stated with certainty at this time, but ecological factors of a climatic nature, the time element and perhaps some aspect of species competition all may have had contributory effect. The element of competition in fleas is one concerning which virtually no information is available. Little or nothing is known of the interrelationships between the flea species themselves, and the manner or means whereby certain species might be crowded out either as larvae or adults.

The genus *Geusibia* provides another example. *G. torosa* Jordan, the genotype, was described from China where it was collected on pikas, *Ochotona cansa*. Another species, *Geusibia ashcrafti* Augustson has now been described from California and Colorado from *Ochotona schisticeps*. Although pikas are common in the British Columbian mountains, the genus *Geusibia* has not come to light, and it may be that it no longer occurs there. The Rocky Mountain pika, *O. princeps* does carry characteristic fleas of two genera, *Amphalius* and *Ctenophyllus*, both of which are found in Eastern Asia today.

Of interest too, among the fleas which apparently do *not* occur in British Columbia are representatives of *Ctenophthalmus*, *Stenoponia*, *Saphiopsylla*, *Odontopsyllus* and *Doratopsylla*, genera associated with various mice, rabbits and insectivores. These five genera occur also in the Palaearctic region, and are undoubted evidence of former faunal contacts. In Canada, they are restricted to the southern part of the Eastern Provinces with the exception of two which range westward into Alberta. If one subscribes to theories of recent Atlantic continental connections, the present distribution of these genera, perhaps, constitutes no particular problem. If, however, as seems probable, the ancient avenue whereby the ancestors of these fleas were exchanged (either way) was the Alaska-Siberian land bridge, then we must deduce that the fleas, with their hosts, were exterminated across most of "Canada," with a residual fauna remaining in the southeast, and the Middle and Eastern "United States" and that (as with *Diamanus* and *Geusibia*) they have been unable to re-establish themselves over their entire former range. Certainly these genera appear now to be completely lacking from the whole of British Columbia and most of the rest of Canada.

According to Jellison and Kohls (1939:2022) and Jellison (1945-96) Alaskan specimens of the Parry groundsquirrel, *Citellus parryi*, were infested with *Oropsylla idahoensis* (Baker), which, in typical form is common on our *Citellus columbianus*. However, the Alaskan fleas they ascribe to this species were stated to be somewhat larger, darker and with slight differences of vestiture, characters indeed which might well be considered of subspecific value.* If *Citellus parryi* and *C. columbianus* have a common ancestry, or a history of former contiguity such similarity in their fleas might readily be explained. There is no contact between these rodents today, but in the past, it seems there must have been. Another example showing that the progenitors of the mammals now separated into the northern and southern alplands of Munro and Cowan (1947) had a point of contact prior to the last glaciations is *Amphalius necopinus* (Jordan), a flea recorded by Hubbard (1947:172) from the northern collared pika, *Ochotona collaris* and well known from the Rocky Mountain pika, *O. princeps*. Munro and Cowan (1947:32) explain their definition of northern and southern alpland biotic areas on the basis of repopulations of the two areas from northern and southern residual faunae, subsequent to the melting of the Pleistocene ice cap. The mammals, and others, in the time that has elapsed since, have evolved good specific distinctions, but the relative recentness of their contact is suggesed by the possession of common species of fleas.

Other interesting examples of flea distribution and relationship might be cited, but time does not permit. In closing, I should like to stress the desirability of saving fleas in the course of mammalogical studies. Careful collections from territories recognized as the sites of Pleistocene refugia may readily bring to light fleas of great importance as phylogenetic missing links. Although many of the known fleas are of wide distribution, there are others that are extremely local, and a search over the vast northern part of this continent (practically virgin territory insofar as fleas are concerned) and especially from isolated species of mammals such as the Vancouver Island marmot, *Marmota vancouverensis* and the Sitka white-faced mouse, *Peromyscus sitkensis*, which may themselves be pre-Pleistocene relicts, should bring to light valuable material.

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* Study of this situation might indicate the advisability of reinstating **bertholfi** Fox 1927 (synonymized by Jordan 1933:74), described from **Citellus plesius nebulicola**, Nagai Island, Alaska, as a subspecies of **idahoensis.**

TABLE 1

A List of Holarctic Genera of Fleas

(Genera known from B. C. marked with an asterisk*)

FAMILY	GENUS	PREFERRED HOST
PULICIDAE	***Pulex**	Man? Artiodactyla?
	***Hoplopsyllus**	Hares *(Lepus)*
VERMIPSYLLIDAE	***Arctopsylla**	Bears *(Ursus)*
	***Chaetopsylla**	Carnivora *(Euarctos, Lynx, Felis, Canis, Gulo, Procyon)*
HYSTRICHOPSYLLIDAE	***Hystrichopsylla**	Insectivora, Mice
	Saphiopsylla	Insectivora, Mice
	Stenoponia	Insectivora, Mice
	***Catallagia**	Mice
	***Neopsylla**	Ground-Squirrels *(Citellus)*
	***Rectofrontia**	Small Rodentia
	Ctenophthalmus	Insectivora, Mice
	Doratopsylla	Shrews *(Sorex, Blarina)*
	***Corrodopsylla**	Shrews *(Sorex)*
CERATOPHYLLIDAE	**Amphipsylla**	Microtinae *(Microtus, Clethrionomys)*
	Odontopsyllus	Rabbits *(Sylvilagus, Oryctolagus)*
	Geusibia	Pikas *(Ochotona)*
	***Ctenophyllus**	Pikas *(Ochotona)*
	***Amphalius**	Pikas *(Ochotona)*
	***Ceratophyllus**	Many birds
	***Dasypsyllus**	Many birds
	Mioctenopsylla	Arctic gulls
	***Monopsyllus**	Rodentia *(Sciurus, Tamiasciurus, Eutamias, Peromyscus)*
	***Megabothris**	Microtinae *(Microtus, Clethrionomys, Lemmus, Dicrostonyx)*
	***Malaraeus**	Cricetidae *(Microtus, Clethrionomys, Peromyscus, Apodemus, Lemmus)*
	***Tarsopsylla**	Sciuridae *(Sciurus, Tamiasciurus, Glaucomys)*
	Diamanus	Ground-Squirrels *(Citellus)*
	***Oropsylla**	Sciuridae *(Marmota, Citellus)*
	***Peromyscopsylla**	Cricetidae *(Microtus, Clethrionomys, Peromyscus, Neotoma, Apodemus)*
ISCHNOPSYLLIDAE	***Myodopsylla**	Bats *(Chiroptera)*

TABLE 2

A List of Purely Nearctic Genera of Fleas Occurring in B. C.

FAMILY	GENUS	PREFERRED HOST
HYSTRICHOPSYLLIDAE	**Atyphloceras**	Cricetidae *(Peromyscus, Microtus)*
	Delotelis	Cricetidae *(Peromyscus, Microtus)*
	Epitedia	Small rodents and insectivores
	Phalacropsylla	Woodrats *(Neotoma)*
	Meringis	Pocket mice *(Perognathus)*
	Micropsylla	White-footed mice *(Peromyscus)*
	Trichopsylloides	Mountain beaver *(Aplodontia)*
	Callistopsyllus	White-footed mice *(Peromyscus)*
	Megarthroglossus	*Neotoma* and *Tamiasciurus*
	Corypsylla	Moles *(Scapanus* and *Neurotrichus)*
	Corypsylloides	Shrews *(Sorex)*
	Nearctopsylla	Shrews *(Sorex)*
CERATOPHYLLIDAE	**Dolichopsyllus**	Mountain beaver *(Aplodontia)*
	Thrassis	Sciuridae *(Citellus* and *Marmota)*
	Opisocrostis	Ground-squirrels *(Citellus)*
	Foxella	Pocket gophers *(Thomomys)*
	Dactylopsylla	Pocket gophers *(Thomomys)*
	Opisodasys	Mice *(Peromyscus)*; squirrels *(Glaucomys)*
	Orchopeas	Sciuridae and Cricetidae *(Tamiasciurus, Neotoma* and *Peromyscus)*
ISCHNOPSYLLIDAE	**Eptescopsylla**	Bats *(Lasionycteris)*
	Myodopsylloides	Bats *(Eptesicus)*

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NOTES ON THE LIFE-HISTORY OF THE GARRY OAK LOOPER, LAMBDINA FISCELLARIA SOMNIARIA Hlst.

(Lepidoptera Geometridae)

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The following notes on the life history of this notorious species which has caused such devastation to the Garry oak, *Quercus garryana* Dougl. in Victoria and vicinity during the past two years, were made from reared specimens.

Ovum. Laid September 18, 1947, in a jar in which pieces of lichen and moss-covered bark were placed together with bud-bearing twigs. Two pairs of moths each taken in coitu were put into separate jars. One female laid 115 eggs, scattered indiscriminately on the lichen, moss, twigs and sides of jar, singly or in small groups and clusters without any evident order or sequence. The other female deposited 78 eggs in like manner. The ova were kept throughout the winter in an equably cool room temperature.

The egg is elongate, oval, slightly flattened at the end by which it was fixed to the substratum by an adhesive fluid. It is quite smooth and shiny. Colour a pastel shade of blue or green matching that of the lichens or moss on which the eggs are commonly laid. Towards hatching time the egg assumes a dark leaden hue. Size 1 mm. by 0.75 mm.

1st Instar. Ova hatched May 2, 1948. Length of larva, 3 mm. Head, black or fuscous; body, alternately ringed with fuscous and light bluish bands; egg-shell not eaten. When disturbed the larva spins a light silken thread to which it clings. Stadium, 6 days.

2nd Instar. May 8. Length 6 mm. Similar in every way but size to the preceding instar, but with the bands showing a tendency to break up into a different pattern. Stadium, 10 days.

3rd Instar. May 18. Length 10 mm. General colour a pale blue-grey. The fuscous bands now resolve into a more restricted and definite pattern; head, fuscous. Most of the segments are blue-grey with four small blackish spots arranged on the dorsal surface in the form of a square; underside of each abdominal segment 2 to 6 bearing large dark central spot. Three dark parallel interrupted lateral lines give the appearance of 10 black hyphens or dashes on each side of body. Stadium, 13 days.

4th Instar. May 31. Length 25 mm. General colour and pattern as in third instar, but with markings more decided. There is a certain amount of variation in the size and intensity of the black markings on the dorsal surface and especially the lateral hyphens which are sometimes fused to form solid black lines but slightly interrupted between segments. Head pale sea-green, with small black dots arranged in four vertical rows, two on each side. The larva ceased feeding on June 19, three days before the pupal stage was assumed and spins a very thin webbing either between two leaves, among the moss on the trunk, or on the ground at the base of the tree. Length of larva just before pupation, 40 mm. Stadium, 22 days.

Pupa. Pupation June 22. Length of pupa 28 mm., width 4 mm.; wing cases fuscous; abdominal segments beige with small black dots; anal segment black; cremaster consisting of two stout terminal hooked setae and two to six smaller ones at the base. The pupa is held in place chiefly by the entanglement of the cremaster among the fibres of the web spun by the larva. Pupal period, 24 days.

Imago. First emergence on July 16. There was considerable variation in length of instars among individuals. Under natural conditions the larvae averaged 25 mm. on July 22 or about the same stage of development which had been reached on May 31 by those under control. The larvae remain very quiet except when feeding; they rest along the midrib on the underside of the leaves or on moss and bark often with the head shielded from daylight.

Summary. Ova laid under confined conditions on September 18, 1947, were kept in an equably cool room temperature throughout the winter. The larvae emerged May 1, 1948, and were fed on Garry Oak, *Quercus garryana*, completing their life cycle in 75 days from time of emergence from the egg. The first instar was completed in 8 days; second instar, 10 days; third instar, 13 days; fourth instar, 22 days and pupa, 24 days. Each instar was progressively longer than the preceding one. The last instar, however, included three or four days devoted to spinning and lying quiescent prior to pupation.

BIOLOGY OF ANISOLABIS MARITIMA (GENE) THE SEASIDE EARWIG, ON VANCOUVER ISLAND (Dermaptera, Labiduridae)

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Introduction — *Anisolabis maritima* (Gene), a large and fearsome appearing apterous earwig, inhabiting a restricted zone at the line of highest tides, is not likely to escape notice for very long where it occurs in settled districts. E. R. Buckell has given a resumé of its known range, and an account of its discovery on Vancouver Island by Professor G. V. Spencer in 1926[1], and it will not be necessary to go over this information here. The species in 20 years or more does not seem to have become very generally distributed on the British Columbia coast. It is now very abundant on the shore of Vancouver Island from Departure Bay where it was reported first to at least as far as the cove beyond Neck Point, a distance of only six or seven miles along the tortuous shore line.

After fairly careful search at several points along the coast, I found specimens in only one other locality, a few small islets known as Dayman Id. lying close to Kuper Id. I made unsuccessful searches at Separation Point, near Cowichan Bay; Dodd Narrows, south of Nanaimo; and French Creek, near Qualicum Beach. It is interesting to note that Professor Spencer found them on a small island, possibly Snake Id., three miles from Departure Bay. It appears that these earwigs are more apt to travel by water than along the shore. There is a record in the Report of the

Provincial Museum for 1947 of two examples of "seaside earwigs" found near Vancouver. I am indebted to G. H. Hardy for the information that these specimens were taken at Tsawavassen Beach by Mr. F. Goertz. Unfortunately they were not preserved, but the record must be accepted as fairly definite proof that *Anisolabis* is now also established on the British Columbia mainland.

Resume of Life History—A study of the life history of *Anisolabis* leaves little doubt that it is a species adapted for life in tropical regions. Due to its ability to endure long periods of suspended development it survives in temperate climates, where the winters are not too long or severe. In this respect it differs strongly from *Forficula*, which grows rapidly at rather low temperatures and so appears much better suited for northern conditions.

On Vancouver Island seaside earwigs mature in two years. Ova are deposited during spring or summer as soon as temperature is suitable. This is seldom earlier than July, although unusually warm weather in the spring may result in oviposition taking place before the end of May. Under normal summer temperature on Vancouver Island ova will hatch after 30 to 45 days. C. B. Bennett[2] reported that on the New York coast ova hatched in 17 days, but he did not mention what temperature was required to produce this result. The nymphs attain only the first or second instar by the time winter conditions force them into hibernation. The remaining three or four stadia are usually completed during the second summer, but many pass a second winter as fifth instar nymphs.

One of my captive seaside earwigs, kept under constant high temperatures, oviposited 43 days after reaching maturity. This evidence shows that individuals which winter during their fifth stadium would reproduce next summer, the dormant period being unnecessary. It also indicates that *Anisolabis* under tropical conditions may maintain a continuous and quite rapid cycle of growth and reproduction.

Brooding by Females—As is usual with Dermaptera, female *Anisolabis* watch over and care for their eggs and young nymphs. An elaborate cell is prepared by the insect when she is nearly ready to oviposit, several nights being devoted to the task. This chamber appears to the observer much larger than necessary, plenty of room is allowed for the insect to move around and to spread out her eggs. A favorite location for cells is under the bark of rotten logs, though they are often in sand under driftwood. The earwigs show a strongly developed instinct in selecting suitable sites which will remain constantly moist, and yet be above the reach of ordinary summer tides. The brooding females are very aggressive in protecting their ova, much more so than *Forficula*. They will not permit others of their own kind to enter the cell. The forceps are used as weapons, the insect striking over her back with such force as to throw herself completely on end. They have, however, a sense of proportion. The hand of an observer approaching the cell causes immediate retreat.

Two female seaside earwigs have hatched their ova under my observation. The first batch, deposited on July 13, hatched without artificial aid in 30 days. At this time I did not keep a record of temperatures but fairly constant warm weather prevailed. Another lot deposited August 18 were kept without artificial heat until September 18. Average temperature during this period, arrived at by taking readings twice daily, was 63°F. By this time well-developed embryos could be seen in the eggs. As progress seemed to be very slow the temperature was increased to 75°F. or higher, which resulted in the first nymph appearing on October 4, an incubation period of 47 days. Several more days were required to complete the hatching, and a total of 62 days elapsed before the parent insect was seen to leave the cell to search for food. The nymphs did not appear on the surface of the soil until they were four or five weeks old. They remained in seclusion in a system of burrows constructed by their mother, and into which she dragged all the food provided for her use.

During 1947, when unusually warm weather occurred both in April and May, I found on June 30 females with ova nearly ready to hatch. None of the earwigs which I kept in captivity that year oviposited before mid-August. At that time a period of cool weather set in but artificial heat was not provided and after periods ranging from 45 to 60 days all the parent earwigs ate their own eggs, even though well-developed embryos could be seen in some cases. This must be a common occurrence under natural conditions on Vancouver Island.

I have found no evidence to indicate that female *Anisolabis* oviposit a second time, as is the case with *Forficula*. The former are long-lived insects, especially the females. Two which had oviposited in captivity were kept through the winter and up to July of the following year, when they died at an age of approximately three years.

Growth of Nymphs — As indicated above, *Anisolabis* pass through five nymphal instars, instead of only four as with *Forficula*. The length of each stadium varies greatly according to the temperature. My observations indicate that the rate of growth increases very rapidly as the temperature is raised. Below 60°F. little or no progress seems to be made. Unfortunately I was not able to keep heat steady enough to make any exact calculations. A nymph kept at temperatures ranging from 55°F. to 70°F. completed its second stadium in 90 days, its third in 37 days at slightly higher temperature and the fourth in 19 days with temperatures from 85°F. to 105°F.

My observations of the life cycle of seaside earwigs under natural conditions showed clearly that if a five-month hibernation period is disregarded, the average stadium is of two calendar months' duration. Thus an individual hatched, as is usual, early in August will reach the adult stage during October of the following year, after the lapse of fifteen months. Of this period five months, November to March inclusive, are too cool for any growth to take place. Except for size the external appearance of *Anisolabis* nymphs alters very little during their entire development. Tegmina and wings are absent even in the adult. The forceps are well formed in the first instar, differing in this respect from those of *Forficula*, which are straight and threadlike at birth.

Although the antennae of *Forficula* show an increase in the number of segments with each moult, those of a few exuviae of *Anisolabis* nymphs of unknown instars which I examined numbered 17 in nearly every case. Two specimens known to be of the first and last nymphal instars had 15 and 17 antennal segments respectively. Buckell stated that the antennae of adult *Anisolabis* carry from 20 to 24 segments, so some variation must be expected in the nymphs also. The adults can be easily distinguished from immature forms with the unaided eye. Adult females have only six abdominal sterna visible, instead of eight as with nymphs and adult males. The forceps of adult males are distinctive.

Behaviour of Adults—The dependence of seaside earwigs on damp conditions and their strict confinement to a narrow belt at high tide level, has been somewhat exaggerated by writers. I have found many of the insects under bark of logs and amongst trash even well above the line of winter tides. Here they were associated with many European earwigs. If able to find water when abroad at night *Anisolabis* are evidently able to stand dry conditions as well as *Forficula*, but they do not so persistently avoid damp situations as the latter species. The zone which *Anisolabis* normally inhabits is also the home of spiders, oniscoids, several species of beetles and other common terrestial arthropods. During mild weather, even in winter, seaside earwigs may be found below the tide level, but near freezing temperature will drive them into complete dormancy. At such times they invariably seek cover well above the line of highest tides. I have found many individuals in all stages of growth, hibernating under logs and boards in company with European earwigs and various beetle larvae.

The chief occupation of adult *Anisolabis* seems to be the digging of burrows. Two inches of damp sand in a quart jar will be converted into such a maze of tunnels that it is difficult to understand what prevents the whole affair from collapsing. Digging is accomplished with the mandibles alone, grains of sand and small stones being dislodged and carried to the surface. Food is often taken into these tunnels, by non-brooding adults, as well as those with young. It thus appears that the feeding of young nymphs by their mother may be by chance rather than design. Nevertheless their is no doubt that the habit is of great use in providing a supply of food for the nymphs during the first part of their lives.

Food—*Anisolabis maritima* must be considered a carnivorous species. Any vegetable food they take is so little as to be negligible. In captivity they ate any sort of dead animal matter. I fed them chiefly on crushed tiny crabs and dead flies. I have never noticed them killing any active insects, though they ate ova and sluggish larvae. As a result of many tests, I have concluded that they never eat herbage or seaweed of any kind. They are fond of wheat softened by soaking, and hollow out the grains until a neat shell remains. On rare occasions I have seen them eat potato. Their natural food is doubtless gleaned from the shore where small crustaceans and drowned insects are thrown up by the waves. The eggs and larvae of Diptera which breed in decaying seaweed may provide them with a great part of their sustenance.

Methods of Rearing and Observation — Seaside earwigs will thrive in glass jars with nearly tight covers. They are unable to climb out of ordinary jars, but if these are left uncovered when rearing at high temperatures, constant attention must be paid to replenishing moisture. I provide the nymphs with very little cover, a quarter inch of sand is sufficient, but care must be taken to keep this moist as the insects will soon die if it becomes quite dry. Excessive litter makes it impossible to keep a close check on ecdyses.

For the purpose of recording moults, three methods may be considered. First, since earwigs are absolutely white immediately after ecdysis, and do not recover full pigmentation for some hours, checking twice daily is nearly certain to result in nymphs being noticed while still pale. Second, as earwigs do not as a rule eat the exuviae, these can be found without difficulty if litter is kept to a minimum. Third, the most positive method is to clip off part of one of the forceps. If this is done soon after a moult, the part will be found partly or wholly restored after the next transformation. It is necessary to quieten the insects in order to perform this operation, or when counting abdominal segments. This is most easily done by exposing them to low temperature. A temperature of 35°F. will in a few hours render them quite immobile. Failing this, they can be placed in a cyanide killing vial, and taken out immediately they become quiet.

When observing brooding females, an inch or more of packed sand or soil must be provided. If unable to construct a proper cell the earwigs will eat their eggs. With luck, the cell may be built against the side of the jar, which was the case with the insect whose family life is described in this paper. These insects seem to know by instinct when night has fallen, and pay little or no attention to artificial light. For this reason their habits are easily observed. With a hundred watt light bulb not over ten feet from the jars, I have frequently watched them feeding, and constructing cells or burrows. Even by daylight they are quickly able to detect the presence of food in their cages. A few moments after a dead fly is dropped in, the sensitive antennae will be seen at the burrow entrance, waving slowly as their owner decides whether the coast is clear. If all remains quiet the earwig comes into the open and seizes the fly with its mandibles. I have never seen the forceps used for this purpose. The food may be carried at once into the burrow, or tucked under any convenient stone or chip.

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1 Buckell E. R. 1930 Ent. Soc. B. C., 27: 22-23, also, Spencer G. J. 1926 Can. Ent. 58 (8): 183-184.

2 Bennett C. B. 1904 Psyche, II (3): 47-53.

NOTES ON VANCOUVER ISLAND AND WEST COAST COLEOPTERA

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The following notes concern certain coleoptera belonging to the families Carabidae, Lucanidae and Cerambycidae and include references to new locality records and to matters of biological or ecological significance.

CARABIDAE

Zacotus matthewsii LeC. As this handsome species is comparatively rare in collections, its occurrence is worth passing mention, particularly as in the present instance, when it was found in the crop of a screech owl taken on Goose Island, B. C., by G. J. Guiguet during the summer of 1948. Three specimens were extracted from the crop, all sufficiently well preserved to make identification certain. The crepuscular habit of this species is no doubt one reason why it is not more common in collections. Evidently the owl, whose appearance abroad coincides with that of the beetle, had no difficulty in finding it in numbers.

Z. matthewsii was originally described by LeConte in 1868 from specimens collected on Vancouver Island by Mr. Matthews, for whom the species was named. So far as I am aware the above is the first record for Goose Island and provides a considerable northern extension of the known range for the species. Goose Island lies off the mainland just south of parallel 52° and some 80 miles to the north of Cape Sutton, Vancouver Island.

LUCANIDAE

Ceruchus striatus LeC. Two specimens of this characteristic species were taken from the crop of the same screech owl. While common, the mode of capture is somewhat unique. This is also a first record for Goose Island.

CERAMBYCIDAE

Plectrura spinicauda Mann. A wing case and head of this unusual Cerambycid were found in the crop of another screech owl collected at the same time and place. This species is reported along the coast from Alaska to California, though not known formerly from Goose Island.

Eumichthus oedipus LeC. A single specimen of this scarce beetle collected at Buttle Lake, Vancouver Island, on July 22, 1948, by E. G. Harvey of the Victoria Forest Insect Laboratory establishes a new locality record.

Dicentrus bluthneri LeC. One individual of this apparently very local British Columbia species was obtained on Valdez Island by E. G. Harvey, May 14, 1948. This constitutes a new locality record and to my knowledge, only the third for British Columbia. All three places are quite close together, Duncan, Valdez Island, and Pender Island. In connection with the last-named place, I have a note made from a conversation with G. R. Hopping, to the effect that he took it in numbers at Pender Harbour in May, 1926, where it was running about and pairing on poles of recently cut hemlock *Tsuga heterophylla*.

SHIP INSPECTION IN THE PORT OF VANCOUVER

Cyril R. Cunningham
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Each day ships of many nations arrive at Vancouver and New Westminster to load grain and cereal products for export to the United Kingdom, India, South America, the Orient, and many other parts of the world. Each day thousands of citizens view these ships steaming majestically up the harbour to their allotted berths without giving a thought to the fact that the application of entomological knowledge is an increasing necessity before loading of these products can be commenced.

A few years ago the British Ministry of Food were very much concerned over the fact that a number of cargoes of grain were arriving in Britain badly infested with granary weevil, *Tribolium*, Cadelle, and other grain insects. Some cargoes were so badly damaged that the grain could not be used for human consumption. The shortage of grain in Europe at that time, combined with the terrific losses, prompted the Ministry to request that the Canadian Government inspect all ships' holds prior to loading, to make sure that cargo areas were insect free and in fit condition to carry wheat. The government consented to carry out this suggestion and a marked difference in the condition of grain cargoes on arrival at destination was immediately evident. Consequently, it was decided to extend this service to all ships loading cereal products for any part of the world. Inspectors of the Division of Plant Protection, Science Service, Dominion Department of Agriculture, board each vessel as soon as docking operations are complete. Vital information regarding previous cargoes, loading areas, construction details, prior fumigations, and many other facts are obtained from the captain or chief officer before actual inspection of the ship. Armed with this knowledge, each hold is entered and a thorough examination is carried out. Most of the trouble has been found to be due to improper cleaning of holds. It is quite common for a ship to load wheat in, say, Australia, and to carry this cargo to Britain, then to proceed to Canada and carry a similar cargo back to the United Kingdom. This process may be continued for possibly two years, each time a residue of wheat being left in the holds eventually to become infested. Unless meticulous cleaning is carried out after each cargo, especially between the ribs of the ship, box beams, bilges, etc., trouble is sure to develop.

An actual inspection is carried out thus: Hold No. 1 is normally entered first and a careful examination made of bilge bays, areas between ribs of ship, fore and aft bulkheads and ceiling square in the centre of the lower hold. The tween-deck area is then entered and box beams, hatch coamings and rib areas are scrutinized. The same procedure is carried out in holds 2 and 3. Holds 4 and 5 vary considerably by virtue of the fact that the tunnel which houses the propeller shaft penetrates both these holds, necessitating a very careful inspection of both sides and top of same. The average time required to complete an examination of a ship varies from one to four hours, depending largely on the cleanliness of the ship and the prevalence of insects or grain residue in particular. In winter the operation is considerably lengthened due to the dormant condition of any insect life that may be discovered. Should very light evidence of insects be found, a good physical cleaning is ordered. Sometimes rather heavy evidence is found in one or two remote corners. This type of infestation is taken care of by spot spraying with a combination of DDT and 5 per cent pyrethrum mixture. Of course, in cases where heavy or general infestations occur, a "Detention Notice" is given to the ship's captain or chief officer and fumigation ordered. However, should the holds be found insect free a "Release Certificate" is issued. The release certificate must be presented

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to the elevator operator before grain may be loaded. This procedure eliminates the danger of any ship being loaded without inspection.

Until recently hydrocyanic acid gas was used exclusively as a ship fumigant, and about a year ago methyl bromide was tested at Montreal, giving results which proved it to be superior to HCN, and thus the adoption of its use in Vancouver seemed a certainty. During September, 1948, the writer visited Montreal to view the work being conducted with methyl bromide in that port. Instruction was given by H. A. U. Monro, in charge of the Fumigation and Research Laboratory operated by the Division of Plant Protection in that city. Fortunately, eight ships were fumigated during the visit, so that ample opportunity was given to become familiar with the procedure. Test insects (granary weevil) were used on each ship and some interesting data were obtained.

Upon return to Vancouver, fumigation companies were instructed in the use of methyl bromide as a space fumigant. They were, however, rather reluctant to change to a gas 3.1 times heavier than air, in view of the aeration problem. Further to this, it meant a considerable outlay of money for expensive equipment such as blowers and fans. But this reluctance was soon dispelled and the first ship was fumigated with methyl bromide on November 20, 1948.

Granary weevil cultures were started in Vancouver to provide test insects for most fumigations carried out. Four sets of these test insects, comprising new and old eggs, 1st, 2nd, 3rd and 4th instar larvae and adults were placed in each hold. In order to get an indication of the effectiveness of the gas at any given level, adults were inserted in small capsules which were tied at five-foot intervals to a wire forty feet in length. After fumigation, test insects were removed and mortality counts of adults completed, the immature stages and eggs, with controls, being forwarded to Montreal for incubation. The Cadelle, due to its resistance to HCN and methyl bromide, is an excellent test insect, but due to the difficulty in rearing is limited in its use. The above procedure, together with the collection of infested wheat from ships' holds prior to and after fumigation, gives a complete cross section of the entire operation and provides material on which to base future recommendations.

Before gas is released into the ships' holds, temperatures are recorded, and from 1 to 2 lb. of gas used according to the following table:

			Fan circulation
Above 60°F.	1 lb. per 1,000 cu. ft.	10 hr.	Desirable
51°F. to 60°F.	1 " " " " "	10 "	Essential
32°F. to 50°F.	1½ " " " " "	12 "	"
Below 32°F.	2 " " " " "	12 "	"

A few statistics round out the general picture of vessel inspection at Vancouver:

Number of ships inspected for the 1948-49 fiscal year, to date	310
Number of ships fumigated with HCN	37
Number of ships fumigated with methyl bromide	18
Total number of ships fumigated with both gases	55
Number of ships spot sprayed	21
Number of ships requiring treatment, either spraying or fumigation	76
Number of ships free of infestation	234

Regarding insect interception, the granary weevil still appears to retain its position as the worst offender, with *Tribolium* running a close second. It is hoped that by constant instruction, ships' officers will eventually realize that "good housekeeping" in relation to ships' holds will pay big dividends in cutting to a minimum the chances of infestation, thereby saving thousands of dollars and endless trouble to everyone concerned.

RECORDS OF BEES FROM BRITISH COLUMBIA: Megachilidae[1*]

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This list of 115 species and subspecies of the family Megachilidae has been compiled from collections in the Field Crop Insect Laboratory, Kamloops, the University of British Columbia, Vancouver, and the National Collection at Ottawa.

A map is included showing the locations of collection points. It should be realized that the scarcity of records from the northern half of the province does not necessarily denote the absence of these bees in that area, but is due to the fact that it is practically uninhabited and without transportation facilities. There are doubtless interesting distribution records to be obtained in the north, when transportation becomes available.

(*C.N.C.*) placed before the locality records denotes that all the specimens for that particular locality are to be found in the Canadian National Collection at Ottawa. The collector is designated by initials only in the text, but a list of collectors' names is included at the end of the paper.

The author wishes to thank Dr. T. B. Mitchell, University of North Carolina, and Dr. C. D. Michener, American Museum of Natural History, for the determination of material; Dr. O. Peck, Systematic Entomology, Ottawa, for supplying the records of British Columbia material in the genus MEGACHILE and COELIOXYS, in the National Collection, and Professor G. J. Spencer for the loan of the University collections.

1* Contribution No. 2565, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

Family **MEGACHILIDAE**
Subfamily MEGACHILINAE

To the *Megachilidae* belong the mason-bees, as well as the leaf-cutter bees with the bees parasitic upon them.

Their nests are built in solid, or in rotten wood, in hollow plant stems, attached to stones or twigs, or in the soil.

Tribe ANTHIDIINI
Genus DIANTHIDIUM Cockerell

The species of this genus use resin in cementing the linings of their nests and are known as "resiniers."

Dianthidium pudicum (Cresson)
LYTTON, July 19, 1931, 1♂ (G.J.S.).

Genus ANTHIDIELLUM Cockerell

Anthidiellum robertsoni (Cockerell)
VERNON, March 19, 1945, 1♂ (H.B.L.). Reared from a pupal cell. Leech (1948).

Anthidium divisum Cockerell
CHILCOTIN, June 26, 1930, 1♂ (E.R.B.); July 29, 1930, 1♂ (G.J.S.). ALEXIS CREEK, June 30, 1943, 1♂ (E.R.B.). KASLO, June 3, 1♀, 21, 1♀, 1906 (L.W.C.). OSOYOOS, July 5, 1920, 1♂ (E.R.B.). PENTICTON, June 29, 1919, 1♀ (E.R.B.). CRANBROOK, May 12, 1939, 1♂ (E.R.B.).

Anthidium tenuiflorae Cockerell
CHILCOTIN, July 20, 1930, 1♂; June 12, 1931, 1♀ (G.J.S.). LYTTON, July 19, 1931, 1♀ (G.J.S.). WALHACHIN, June 29, 1918, 1♀. MT. MCLAINE, July 12, 1926, 1♀. MINNIE LAKE, Aug. 4, 1942, 1♂. ALEXIS CREEK, June 30, 1943, 1♂ (E.R.B.).

Anthidium mormonum Cresson
KASLO, May 28, 1906, 1♂ (L.W.C.).

Anthidium nebrascense Swenk
KASLO, June 11, 1905, 1♂; June 3, 1906, 1♂ (L.W.C.).

Anthidium wallisi wallowana Schwarz
KASLO, June 3, 1910, 1♀ (L.W.C.).

Anthidium palliventre Cresson
PENTICTON, June 29, 1919, 1♀ (E.R.B.).

Anthidium emarginatum Say
KASLO, June 11, 1905, 1♀ (L.W.C.).

Anthidium banningense Cockerell
KASLO, May 28, 1♂; June 23, 1♀, 1906; June 24, 1913, 1♀ (L.W.C.). PENTICTON, May 30, 1919, 1♀; June 3 and 7, 1919, 2♂ (E.R.B.).

Anthidium wyomingense Schwarz
KASLO, June 5, 1906, 1♀ (L.W.C.).

Genus STELIS Panzer

Stelis *(Chelynia)* **rubri** Cockerell
CHILCOTIN, June 5, 1930 1♀ (E.R.B.). KASLO, June 3, 1906, 1♀ (L.W.C.).

Stelis *(Chelynia)* **monticola** Cresson
HAT CREEK, June 27, 1943, 1♀ (E.R.B.).

Stelis *(Pavostelis)* **montana** Cresson
OLIVER, June 9, 1943, 2♀ (E.R.B.).

Tribe *MEGACHILINI*
Genus HERIADES Spinola

Heriades *(Neotrypetes)* **variolosa** Cresson
KASLO, July 23, 1906, 1♂ 2♀ (L.W.C.).

Heriades *(Physostetha)* **carinata** Cresson
LYTTON, July 19, 1♀, 26, 4♀ (G.J.S.). KAMLOOPS, June 13, 1943, 1♂ (G.J.S.).

LILLOOET, July 27, 1943, 11♂ (E.R.B.). CRANBROOK, June 21, 1926, 1♂ (A.A.D.). INVERMERE, July 29, 1♀, 1926 (A.A.D.). VERNON, July 10, 2♂, 23, 5♀, 1920 (N.L.C.); July 23, 1♀, 25, 1♂ (M.H.R.). PENTICTON, June 21, 1919, 1♂ (M.H.R.).

The 11♂ taken at Lillooet were caught from a swarm of these little bees flying low over the soil around a plant of Russian thistle, *Salsola kali* Linn.

Genus ASHMEADIELLA Cockerell

Ashmeadiella curriei curriei Titus

Michener (1939) records that typical *curriei* occurs from British Columbia to California and Colorado and that the type ♀ in the U.S. Nat. Museum, was from Kaslo, B. C. This would no doubt have been collected by Mr. L. W. Cockle.

Ashmeadiella bucconis denticulata (Cresson)
VERNON, July 6, 1929, 4♂ 3♀ (H.B.L.); June 12, 1936, 1♂ (I.J.W.). PENTICTON, July 21, 1916, 1♀ (R.C.T.). WALHACHIN, July 21, 1917, 2♀ (E.R.B.).

Ashmeadiella cactorum cactorum (Cockerell)
KASLO, July 23, 1906, 1♀ (L.W.C.).

Ashmeadiella californica californica (Ashmead)
CRANBROOK, June 21, 1926, 1♀ (A.A.D.). VERNON, July 6, 1929, 1♂ (H.B.L.).

Genus HOPLITIS Klug

Hoplitis albifrons Kirby
CHASE, June 6, 1937, 2♂ (E.R.B.). ALEXIS CREEK, June 30, 1943, 1♀ (E.R.B.). PENTICTON, June 7, 2♂, 21, 1♂ (E.R.B.). KAMLOOPS, June 13, 1♀; Aug. 8, 4♂, 1943 (E.R.B.); June 12, 1943, 1♂ (G.J.S.). CHILCOTIN, June 13, 1929, 3♂ 1♀; June 5, 2♂, 26, 3♂ 1♀, 1930 (E.R.B.). June 7, 1931, 1♂ (G.J.S.). CRANBROOK, June 15, 1♂ 1♀, 21, 1♂, 1926 (A.A.D.). VICTORIA, V. I., June 10, 1916, 2♀ (R.C.T.). KASLO, May 30-July 1, 1905, 1♂ 3♀; May 6-June 30, 1906, 5♂ 7♀ (L.W.C.).

Hoplitis fulgida (Cresson)
CHILCOTIN, June 5-14, 1929, 1♂ 5♀; June 26, 1930, 3♂ (E.R.B.). PENTICTON, June 5, 1♂, 29, 1♀, 1919; July 4, 1930, 2♂ (E.R.B.). VERNON, May 1, 1929, 1♀ (E.R.B.). KASLO, June 20, 1905, 1♀ (L.W.C.).

Hoplitis louisae Cockerell
CHILCOTIN, May 28, 1929, 1♂ (E.R.B.).

Dr. C. D. Michener, who determined this bee, stated that it had hitherto been unknown north of Oregon and Idaho. The specimen was collected at an elevation of 3,500 ft. Lat. 52.

Hoplitis producta subgracilis Michener
CHILCOTIN, June 13, 1929, 1♀ (E.R.B.). VERNON, July 7, 1930, 1♀ (I.J.W.).

Hoplitis grinnelli septentrionalis Michener
CRANBROOK, May 12, 1926, 1♀ (A.A.D.).

Hoplitis sambuci Titus
OLIVER, June 9, 1937, 1♂ (E.R.B.). KEREMEOS, June 20, 1943, 1♀ (E.R.B.).

Genus ANTHOCOPA Lepeletier and Serville

Anthocopa copelandica Cockerell
PENTICTON, July 4, 1930, 1♀ (E.R.B.).

Genus OSMIA Panzer

The bees of this genus are known as mason-bees. They construct nests of clay and sand in holes in fence posts, trees, walls, etc.

Osmia *(Osmia)* **lignaria** Say
VERNON, May 1, 1920, 1♂ 4♀ (R.C.T.); April 25, 1♀; May 8, 1♀, 1920; May 14, 1921, 1♀ (M.H.R.).; April 15, 1906, 3♂ (E.P.V.); June 4, 1929, 1♀ (E.R.B.); April 22, 1♂ 1♀, 24, 2♂; May 6, 2♂, 1929 (I.J.W.); May 10, 1♀, 16, 1♂, 1927 (D.G.G.). SALMON ARM, April 25, 3♀; May 1-8, 2♀, 1929 (H.B.L.); April 26, 1943, 1♂ 2♀ (E.R.B.); Aug. 9, 1920, 1♀; April 5, 1925, 1♂ (W.R.B.). NANAIMO, V. I., May 11, 1930, 13♀ (G.J.S.); June 23-24, 1920, 2♀ (E.P. Van Duzee). PENTICTON, April 10-13, 1919, 2♂ 1♀; April 24, 1929, 11♂ 23♀ (E.R.B.). KASLO, April 20, 1904, 1♀; April 7-June 11, 1905, 1♂ 3♀; April 28-June 5, 1906, 1♂ 7♀; April 26, 1♂; May 9, 1♀, 1908; May 6-June 24, 1910, 2♂ 2♀ (L.W.C.). KAMLOOPS, April 18, 1929, 3♂ 3♀; April 17, 1943, 2♂ 2♀ (E.R.B.). NICOLA, May 2, 1♂ 1♀, 3, 1♂ 1♀, 1943 (E.R.B.). CHILCOTIN, May 28, 2♀; June 13, 1♀, 1929 (E.R.B.); July 23, 1♂, 1929; June 9, 1931, 1♂ (G.J.S.). COURTENAY, V. I., April 2, 1931 (J.D.G.). MILNER, May 4, 1930, 1♀ (K.G.). GOLDEN, May 17, 1915, 1♀ (F.W.L.S.). GRINDROD, May 27, 1927, 1♀ (D.G.G.). OKANAGAN FALLS, April 24, 1919, 1♀ (E.R.B.); May 24, 1920, 1♂ (M.H.R.). VANCOUVER, May 22, 1930, 1♀ (H.B.L.).

This is by far the most numerous species of Osmia found in British Columbia.

Osmia *(Chalcosmia)* **coerulescens** Linnaeus
(C.N.C.) CHILCOTIN, May 15, 1920, 1♀ (E.R.B.). KEREMEOS, June 18, 1919, 1♂ (E.R.B.). VICTORIA, May 20, 1906, 1♂ (R.C.T.). ROYAL OAK, May 13, 1917, 1♂ (R.C.T.).

Osmia *(Chalcosmia)* **coloradensis** Cresson
SALMON ARM, May 10, 1928, 1♀ (H.B.L.); May 26, 1943, 1♀ (E.R.B.). CHILCOTIN, July 8, 1931, 1♀ (G.J.S.). OLIVER, July 9, 1943, 1♀ (E.R.B.). KASLO, June 20, 1905, 1♀; June 30, 1906, 2♀; June 18, 1910, 2♀ (L.W.C.). VERNON, July 23-28, 5♀; Aug. 3, 1♀, 1920 (M.H.R.); July 27, 1920, 1♀ (R.C.T.). PENTICTON, April 23, 1920, 1♂ (M.H.R.). INVERMERE, May 19, 1915, 4♀ (F.W.L.S.). GOLDEN, May 17, 1915, 1♀ (F.W.L.S.). REVELSTOKE, May 16, 1915, 1♀ (F.W.L.S.). FAIRVIEW, May 18, 1919, 1♀ (E.R.B.). LILLOOET, June 10, 1920, 1♀ (A.W.A.P.). SHAWNIGAN LAKE, June 7, 1914, 1♀ (F.W.L.S.).

Osmia *(Chalcosmia)* **texana** Cresson
OLIVER, July 9, 1943, 2♀ (E.R.B.).

Osmia *(Cephalosmia)* **montana** Cresson
VERNON, May 15, 1920, 1♀ (R.C.T.); May 14, 1921, 3♀ (M.H.R.).; April 25, 1932, 1♂; May 31, 1929, 1♀ (E.R.B.). CHILCOTIN, May 28, 1929, 1♀ (E.R.B.). PENTICTON, June 7, 1919, 1♀ (E.R.B.). OKANAGAN FALLS, June 3, 1919, 1♀ (E.R.B.). KELOWNA, May 20, 1917, 1♀ (R.C.T.). INVERMERE, May 30, 1914, 1♀ (F.W.L.S.). OLIVER, July 9, 1943, 1♀ (E.R.B.).

Osmia *(Cephalosmia)* **subaustralis** Cockerell
CHILCOTIN, June 15, 1920, 1♀ (E.R.B.). INVERMERE, June 30, 1914, 1♀ (F.W.L.S.).

Osmia *(Cephalosmia)* **pascoensis** Cockerell
CHILCOTIN, June 14. 1929, 1♀ (E.R.B). KALEDEN, April 14, 1919, 1♂ (E.R.B.). OLIVER, May 4, 1943, 1♀ (E.R.B.). KAMLOOPS, May 11, 1935, 1♂ (E.R.B.). PENTICTON, April 13, 1♂, 23, 1♀, 1919; April 24, 1929, 10♂ 2♀ (E.R B.); April 12, 1♂, 23, 2♂, 30, 1♂, 1920 (M.H.R.). VERNON, April 17-25, 2♂; May 31, 2♀; June 4, 1♀, 1929 (E.R.B.); April 25, 2♂; May 9, 1♀, 15, 1♀; July 20, 1♀, 1920; May 14, 1921, 1♂ 1♀ (M.H.R.).; April 24, 1929, 1♂ (I.J.W); April 14, 1♀, 15, 1♂, 1906 (E.P.V.). VASEAUX LAKE, April 9, 1921, 2♀ (F.W.L.S.). LILLOOET, May 28, 1917, 1♀ (A.W.A.P.).

The male taken at Kamloops (11.V.35) was found in a cell in a dead jack-pine, *Pinus contorta* Loud.

This appears to be an early species and most of the collection dates are in April and May.

Osmia *(Cephalosmia)* **californica** Cresson
(C.N.C.) OKANAGAN LAKE, April 23, 1914, 2♀ (T.W.). LYTTON, July 6, 1913, 1♀ (T.W.).

Osmia *(Cephalosmia)* **marginipennis** Cresson
KEREMEOS, May 5, 1943, 1♂ (E.R.B.). PENTICTON, April 30, 1919, 1♂ (E.R.B.). VASEAUX LAKE, April 19, 1921, 2♂ (F.W.L.S.). SUMMERLAND, April 7, 1921, 1♂ (F.W.L.S.). VERNON, May 25, 1919, 1♂ (W.B.A.). KAMLOOPS, Aug. 8, 1943, 1♀ (E.R.B.). NICOLA, May 16, 1922, 1♂ (P.N.V.). CHILCOTIN, May 12, 1920, 1♂ (E.R.B.).

Osmia *(Melanosmia)* **nigriventris** (Zetterstedt)
KAMLOOPS, Aug. 8, 1943, 1♀ (E.R.B.).

Osmia *(Melanosmia)* **bucephala** Cresson
CHILCOTIN, July 12, 1921, 1♀ (E.R.B.). KASLO, May 10, 1905, 1♀ (L.W.C.). DEPARTURE BAY, V. I., June 27, 1925, 1♂ (G.J.S.). PRINCE GEORGE, Aug. 12, 1946, 1♀ (G.J.S.). INVERMERE, May 8, 1915, 1♀ (F.W.L.S.).

Osmia *(Acanthosmioides)* **odontogaster** Cockerell
VICTORIA, May 6, 1919, 5♂ (W.D.); April 6, 1916, 1♀ (R.C.T.). SIDNEY, May 8, 1915, 1♂ (F.W.L.S.). SAANICH, May 4, 1914, 1♀ (T.W.). SALMON ARM, May 10, 1930, 1♂ (H.B.L.). KAMLOOPS, May 13, 1943, 1♂ (E.R.B.).

Osmia *(Acanthosmioides)* **longula** Cresson
CHASE, June 6, 1937, 1♀ (E.R.B.). NICOLA, June 29, 1922, 1♀ (P.N.V.). VERNON, May 24, 1946, 1♀ (H.B.L.). INVERMERE, June 30, 1914, 3♀ (F.W.L.S.). ROYAL OAK, May 24, 1917, 1♀ (R.C.T.).

Osmia *(Acanthosmioides)* **hicksi** Sandhouse
OSOYOOS, June 10, 1919, 1♂ (E.R.B.). Sandhouse (1939).

Osmia *(Acanthosmioides)* **physariae** Cockerell
CHILCOTIN, June 13, 1929, 1♂ (E.R.B.). VICTORIA, V. I., May 5, 1919, 1♂ (W.D.).

Osmia *(Acanthosmioides)* **nifoata** Cockerell
(C.N.C.) PENTICTON, June 5, 1919, 1♂ (E.R.B.). VICTORIA, May 5, 1919, 2♀ (W.D.). CHILCOTIN, June 9, 1920, 1♂ (E.R.B.).

Osmia *(Acanthosmioides)* **integra** Cresson
KAMLOOPS, May 26, 1935, 1♂ (G.J.S.). REVELSTOKE, May 16, 1915 (F.W.L.S.). CHILCOTIN, May 14, 1920, 1♀ (E.R.B.).

Osmia *(Acanthosmioides)* **hendersoni** Cockerell
CRESTON, May 28, 1926, 1♀ (A.A.D.).

Osmia *(Acanthosmioides)* **kenoyeri** Cockerell
(C.N.C.) ROYAL OAK, May 20, 1917, 2♀ (R.C.T.).

Osmia *(Acanthosmioides)* **nigrifrons** Cresson
PENTICTON, May 7, 1919, 1♀ (E.R.B.). VERNON (White Man's Creek), July 1, 1920, 1♀ (N.L.C.). SALMON ARM, May 21, 1915, 1♀ (W.R.B.). CHILCOTIN, July 29, 1930, 1♀ (G.J.S.). VANCOUVER, April 15, 1920, 1♀ (G.J.S.). NANAIMO, V. I., June 24, 1920, 1♀ (E. P. Van Duzee; Sandhouse, 1924). INVERMERE, May 19, 1915, 1♀ (F.W.L.S.). OSOYOOS, June 10, 1919, 1♀ (E.R.B.).

Osmia *(Acanthosmioides)* **sedula** Sandhouse
NANAIMO, V. I., June 4, 1920 (Mrs. E. P. Van Duzee; Sandhouse, 1924). PENTICTON, April 5, 1920, 1♀ (M.H.R.).

Osmia *(Acanthosmioides)* **giliarum** Cockerell
ALEXIS CREEK, June 30, 1943, 1♀ (E.R.B.).

Osmia *(Acanthosmioides)* **pellax** Sandhouse
LILLOOET, June 16, 1929, 1♀ (E.R.B.).

Osmia *(Nothosmia)* **brevis** Cresson
KAMLOOPS, June 13, 1943, 1♀ (E.R.B.). CRANBROOK (St. Mary's Lake), July 12, 1926, 1♀ (A.A.D.). KASLO, July 3, 1916, 1♀ (F.W.L.S.). MARA, June 15, 1920, 2♀ (R.C.T.). VERNON, May 20, 1907, 3♀ (R.C.T.). PEACHLAND, July 21, 1909 (J.B.W.). PENTICTON, June 29, 1♀, July 5, 1♀, 1919 (E.R.B.). VICTORIA, May 27, 1915, 1♀ (R.C.T.). SIDNEY, July 6, 1914, 2♀ (F.W.L.S.). NANAIMO, July 21, 1917, 1♀ (F.W.L.S.).

Osmia *(Nothosmia)* **penstemonis** Cockerell
(C.N.C.) KASLO, July 3, 1916, 1♀ (F.W.L.S.).

Osmia *(Nothosmia)* **universitatis** Cockerell
(C.N.C.) PENTICTON, June 5, 1919, 1♂ (E.R.B.).

Osmia *(Nothosmia)* **integrella** Cockerell
NICOLA, May 2, 1943, 1♂ (E.R.B.).

Osmia *(Nothosmia)* **pagosa** Sandhouse
VERNON, May 25, 1930, 1♀ (I.J.W.).

Osmia *(Nothosmia)* **simillima** Smith
CHILCOTIN, May 24, 1♂, 27, 1♂, 1929 (E.R.B.). VERNON, July 2, 1920, 2♀ (M.H.R.); July 28, 1920, 1♀ (R.C.T.). PENTICTON, June 21, 1919, 1♂ (E.R.B.).

Osmia *(Nothosmia)* **seclusa** Sandhouse
VANCOUVER, June 16, 1896 (Livingston). Sandhouse (1924).

Osmia *(Nothosmia)* **nemoris** Sandhouse
VASEAUX LAKE, June 14, 1919, 1♂ (E.R.B.). FAIRVIEW, May 18, 1919, 1♂ (E.R.B.). Sandhouse (1924).

Osmia *(Nothosmia)* **densa** Cresson
KASLO, May 30, 1905, 1♀; June 3, 1906, 2♀; May 10, 1909, 1♀ (L.W.C.). KAMLOOPS, July 25, 1943, 1♀ (E.R.B.). OLIVER, May 4, 1943, 1♂ (E.R.B.). PENTICTON, April 24, 1929, 2♂ (E.R.B.). LYTTON, June 28, 1931, 1♀ (G.J.S.). TOFINO IS., May-July, 1926, 1♀ (G.J.S.). CHILCOTIN, June 13, 1929, 1♀ (E.R.B.); July 15, 1♀, 29, 2♀, 1930 (G.J.S.). VERNON, June 6, 1903, 1♀ (E.C.V.D.).; May 25, 1919, 1♂ (W.B.A.). NANAIMO, June 24, 1920, 1♀ (E.C.V.D.); July 18, 1912, 1♀ (W.B.A.). NEWCASTLE, July 18, 1913, 1♀ (W.B.A.). INVERMERE, June 30, 1916, 8♀ (F.W.L.S.). GOLDEN, May 17, 1915, 4♂ (F.W.L.S.). REVELSTOKE, May 16, 1915, 1♀ (F.W.L.S.). SICAMOUS, May 16, 1916, 1♂ (F.W.L.S.). SALMON ARM, July 4, 1914, 1♀ (F.W.L.S.). PRINCETON, June 7, 1916, 1♀ (W.B.A.). OKANAGAN FALLS, June 3, 1919, 1♀ (E.R.B.). LILLOOET, June 11, 1916, 1♀ (E.M.A.).

Osmia *(Nothosmia)* **juxta** Cresson
VERNON, July 26, 1920, 1♀ (R.C.T.); June 23, 1926, 1♀ (I.J.W.); May 13, 1930, 1♀ (A.A.D.). CHILCOTIN, June 15, 1920, 1♀; May 28, 1929, 1♀; June 5, 1930, 1♀ (E.R.B.); July 29, 1930, 2♀ (G.J.S.). KASLO, July 1, 1905, 2♀; June 3, 1906, 1♀ (L.W.C.). PENTICTON, April 24, 1929, 3♂ (E.R.B.). KAMLOOPS, June 13, 1943, 1♂ (E.R.B.). NANAIMO, June 24, 1920, 1♀ (E.C.V.D.). KEREMEOS, June 18, 1919, 1♀ (E.R.B.). LILLOOET, May 21, 1916, 1♂ (E.M.A.). CRANBROOK, May 16, 1922, 1♂ (C.B.G.).

Osmia *(Nothosmia)* **atrocyanea** Cockerell
VERNON, July 23, 1920, 1♀ (M.H.R.). KASLO, Aug. 3, 1916, 2♀ (F.W.L.C.). ROYAL OAK, May 13, 1917, 1♂ (R.C.T.). SHAWNIGAN LAKE, July 7, 1914, 1♀ (F.W.L.S.).

Osmia *(Nothosmia)* **vallicola** Cockerell
(C.*N*.C.). CRANBROOK, May 18, 1922, 3♂ (C.B.G.).

Osmia *(Nothosmia)* **cyanella** Cockerell
(C.*N*.C.) VICTORIA, May 20, 1918, 1♂ (R.C.T.). VANCOUVER, April 12, 1934, 1♀ (W.M.).

Osmia *(Nothosmia)* **tersula** Cockerell
BRITISH COLUMBIA, Sandhouse (1939).

Osmia *(Nothosmia)* **trevoris** Cockerell
VERNON, May 25, 1930, 1♀ (I.J.W.). WALHACHIN, July 8, 1918, 1♀ (E.R.B.).

Osmia *(Nothosmia)* **albolateralis** Cresson
CLINTON, Aug. 10, 1943, 1♀ (E.R.B.). ALEXIS CREEK, June 30, 1943, 1♀ (E.R.B.). VERNON, May 31, 1929, 1♀ (E.R.B.); May 26, 1923, 1♀ (M.H.R.); July 17, 1926, 1♀ (D.G.G.). PENTICTON, April 5, 1920, 1♀ (M.H.R.). CRANBROOK, May 12, 1926, 1♂ (A.A.D.). VICTORIA, V. I., June, 1916, 1♀ (R.C.T.). DEPARTURE BAY, V. I., June 10, 1925, 1♀ (G.J.S.). NEWCASTLE IS., June 10, 1925, 1♀ (G.J.S.). KAMLOOPS, June 12, 1943, 2♂ (G.J.S.). KASLO, May 6, 3♀, 28, 1♀; June 3, 3♀, 1906 (L.W.C.). INVERMERE, May 27, 1915, 1♂ (F.W.L.S.).

Osmia *(Nothosmia)* **dolerosa** Sandhouse
Sandhouse (1939) gives the following records for British Columbia: KASLO, 1903, 4♀ (R.P.C.). BON ACCORD, May 10, 1909, 1♀ (R.). REVELSTOKE, July 4-6, 1905, 4♀ (J.C.B.). HOWSER LAKE, June 24, 1905, 1♀ (J.C.B.). HOWSER, Selkirk Mountains, June 22, 1905, 1♀ (J.C.B.). DOWNIE CREEK, Selkirk Mountains, Aug. 14, 1905, 1♀ (J.C.B.). GOLDSTREAM, Selkirk Mountains, Aug. 7-11, 1905, 1♀ (J.C.B.). CARBONATE, Columbia River, July 7-12, 1908, 1♀ (J.C.B.). VANCOUVER, June 26, 1896, 1♀ (L.).

Osmia *(Nothosmia)* **atriventris** Cresson
(C.*N*.C.). SIDNEY, April 23, 1915, 1♂ (F.W.L.S.).

Osmia *(Nothosmia)* **inurbana** Cresson
(C.*N*.C.). VERNON, June 18, 1917, 1♂ (R.C.T.). VICTORIA, May 6, 1919, 3♂ (R.C.T.): May 16, 1916, 1♂ (W.D.). ROYAL OAK, May 20, 1917, 1♂ (R.C.T.). SIDNEY, April 23, 1915, 1♂ (F.W.L.S.).

Osmia *(Nothosmia)* **nanula** Cockerell
(C.*N*.C.). KASLO, July 3, 1916, 1♀ 1♂ (F.W.L.S.). OSOYOOS, June 10, 1919, 1♀ (E.R.B.). PENTICTON, July 21, 1919, 1♀ (E.R.B.). SALMON ARM, July 4, 1914, 1♀ (F.W.L.S.). VICTORIA, June 3, 1916, 1♀ (R.C.T.). SIDNEY, May 8, 1915, 1♀ (F.W.L.S.). SAANICH, June 3, 1919, 1♀ (W.D.). NANAIMO, June 23, 1920 (E.C.V.D.). Sandhouse (1924).

Osmia *(Nothosmia)* **proxima** Cresson
KASLO, May 3, 1906, 1♂ (L.W.C.). CHILCOTIN, June 7, 1920, 1♀ (E.R.B.). SIDNEY, June 18, 1916, 1♀ (F.W.L.S.). SHAWNIGAN, July 8, 1914, 1♀ (F.W.L.S.).

Osmia *(Nothosmia)* **tristella** Cockerell
(C.*N*.C.). INVERMERE, June 30, 1914, 3♀ (F.W.L.S.). KASLO, July 3, 1916, 2♀ (F.W.L.S.). AGASSIZ, May 11, 1915, 1♀ (F.W.L.S.).

Osmia *(Nothosmia)* **mertensiae** Cockerell
(C.*N*.C.) LILLOOET, May 3, 1916, 1♂ (E.M.A.).

Osmia *(Nothosmia)* **bruneri** Cockerell
KEREMEOS, May 5, 1943, 1♂ (E.R.B.). KASLO, May 6, 1906, 1♂ (L.W.C.). VASEAUX LAKE, June 14, 1919, 1♀ (E.R.B.). PENTICTON, April 30, 1919, 1♂ (E.R.B.). ARMSTRONG, May 20, 1915, 1♂ (F.W.L.S.). LILLOOET, May 25, 1916, 1♂ (E.M.A.).

Osmia *(Nothosmia)* **cobaltina** Cresson
KASLO, May 6-June 23, 5♂ 7♀, 1906; May

14, 1905, 1♂ 1♀ (L.W.C.); July 3, 1916, 4♀ (F.W.L.S.). OLIVER, June 4, 1943, 1♀ (E.R.B.). PENTICTON, June 7, 1919, 1♀; July 4, 1930, 2♀ (E.R.B.). PEACHLAND, July 24, 1909, 1♀ (J.B.W.). VERNON, July 9, 1920, 1♀ (M.H.R.). WALHACHIN, June 27, 1918, 2♀ (E.R.B.). LYTTON, June 30, 1931, 1♀ (G.J.S.). LILLOOET, May 3, 1916, 1♀ (E.M.A.). CHILCOTIN, May 29, 1♀, 30, 1♀, 1921 (E.R.B.). SHAWNIGAN LAKE, July 7, 1914, 1♀ (F.W.L.S.).

Osmia *(Nothosmia)* **calla** Cockerell

VERNON, July 10, 1920, 1♀ (N.L.C.).

Osmia *(Nothosmia)* **kincaidii** Cockerell

VERNON, June 6, 1903, 1♀; April 21, 1906, 1♂ (E.P.V.); May 6, 1907, 1♀; May 14, 1921, 2♀ (M.H.R.). OLIVER, May 4, 1943, 1♀ (E.R.B.). PENTICTON, April 30, 1919, 1♂; April 30, 1919, 1♂; April 24, 1929, 1♂ (E.R.B.). KASLO, June 1, 1♀, 2, 1♀, 1905 (L.W.C.); Aug. 3, 1916, 2♀ (F.W.L.S.). CRANBROOK, May 16, 1919, 1♀ (C.B.G.). SUMMERLAND, Aug. 10, 1916, 1♀ (F.W.L.S.). LYTTON, May 21, 1919, 1♂ (W.B.A.). VICTORIA, June 3, 1916, 2♀ (R.C.T.). ROYAL OAK, May 5, 1917, 1♂ (R.C.T.).

Osmia *(Nothosmia)* spp.

In addition to the above named species Dr. T. B. Mitchell marked three as new species, and several others were undetermined.

Genus MEGACHILE Latreille

The bees of this genus are leaf-cutter bees that make tubular cells out of semicircular pieces of leaves which they cut out of various plants.

Some of the species are of great economic importance to farmers as they are among the few insects that are able to trip and pollinate the flowers of alfalfa, thereby increasing the seed yield.

Sladen (1918) observed these bees tripping the flowers of alfalfa at an average rate of 17 per minute. In observations made at Summerland and Keremeos, B. C., he found that *M. perihirta* Ckll. was by far the most valuable species in this respect, but that *M. melanophoea calogaster* Ckll. and *M. brevis* also were active in alfalfa fields and assisted in the tripping of blossoms.

Megachile *(Xanthosarus)* **perihirta** Cockerell

VERNON, Aug. 13-20, 1923, 4♀; Aug. 6-23, 1926, 1♂ 2♀ (D.G.G.); July 9-27, 5♂ 25♀; Aug. 3-9, 6♀, 1920 (R.C.T.); Aug. 28, 1♂ 1♀; Sept. 9-10, 1♂ 1♀, 1926 (I.J.W.).; Aug. 8-24, 1♂ 10♀, 1904 (E.P.V.).; July 11, 1929, 1♀ (H.B.L.); July 7-24, 3♀; Aug. 5, 1♀, 1920 (N.L.C.); Aug. 13, 1918, 1♀; July 21-28, 12♀; Aug. 2-23, 10♀, 1920; July 19-27, 8♀; Aug. 1, 1♀, 1921; July 26, 4♀; Aug. 13-23, 4♀, 1922 (M.H.R.).; July 13-25, 4♂ 5♀, Aug. 25, 4♀, 1917 (F.W.L.S.). KAMLOOPS, July 4, 1937, 1♂; June 26, 1938, 1♂ (G.J.S.); July 25, 2♂, Aug. 8, 1♂, 1943 (E.R.B.). NICOLA, Aug. 28, 1923, 1♀; July 26, 1925, 1♂ 1♀ (P.N.V.). MERRITT, July 20, 1918, 1♀ (W.B.A.). OSOYOOS, June 10, 1919, 2♂ (E.R.B.). OLIVER, June 3, 1923, 1♀ (C.B.G.); July 9, 1943, 1♂ (E.R.B.). FAIRVIEW, July 8, 1919, 3♀ (E.R.B.). WALHACHIN, June 27, 1917, 2♀; July 17, 1918, 1♂ (E.R.B.). MINNIE LAKE, Aug. 12, 1942, 1♀ (E.R.B.). SALMON ARM, July 4, 1928, 1♀ (H.B.L.); June 4, 1943, 1♂ (E.R.B.). PENTICTON, June 7-19, 1♂ 1♀; Aug. 7, 1♀; Sept. 3-7, 6♂ 3♀, 1919 (E.R.B.); Aug. 7, 1916, 1♀ (F.W.L.S.). SUMMERLAND, Aug. 10, 1916, 1♂ 7♀; Aug. 20, 1919, 2♂ 6♀ (F.W.L.S.); Aug. 22, 1914, 1♂ (T.W.). KEREMEOS, July 2, 1917, 1♂ (F.W.L.S.). CRESCENT, July 14, 1916, 1♂ (F.W.L.S.). INVERMERE, Aug. 11, 1914, 1♂ (F.W.L.S.). VANCOUVER, Aug. 15, 1916, 1♂ (F.W.L.S.). LILLOOET, June 9, 1921, 2♂ (A.P.); June 28, 1926, 2♂ (J.D.McD.). VASSEAUX LAKE, June 19, 1919, 1♂ (W.B.A.); June 13, 1919, 1♂ (R.C.T.). OKANAGAN FALLS, July 21-24, 1917, 2♂ 2♀ (F.W.L.S.); June 16, 1919, 1♀ (W.B.A.). PEACHLAND, Aug. 21, 1904, 1♀ (J.B.W.). AGASSIZ, July 24, 1922, 1♀ (R.G.); July 22, 1926, 1♀ (H.H.R.). ENDERBY, Aug. 3, 1918 (W.B.A.). CHILCOTIN, June 20, 1♂; July 12, 1♂ 1920 (E.R.B.); July 1, 1929, 1♂; July 29, 1930, 4♀ (G.J.S.). HAT CREEK, Aug. 26, 1933, 1♀ (R.D.B.). CRANBROOK, June 12, 1926, 1♂ (A.A.D.). KASLO, June 25, 1905, 1♂; July 10, 1906, 1♀ (L.W.C.). LYTTON, June 21-28, 2♀; July 5, 1♂, 1931 (G.J.S.). QUESNEL, Aug. 12-19, 1♂ 1♀, 1946 (G.J.S.). VICTORIA, V. I., July 17, 1909, 1♀ (J.B.W.); Aug. 13, 1916, 1♂ 5♀ (F.W.L.S.); Sept. 16, 1♂ 3♀; 30, 1♂ 1♀, 1917 (W.B.A.); Aug. 3, 1938, 2♂ (G.S.W.); July 5, 1927, 2♀ (G.J.S.). DEPARTURE BAY, V. I., June 4, 1925, 1♀ (G.J.S.). SIDNEY, V. I., July 22, 1925, 1♂ 12♀ (G.J.S.); Aug. 15, 1916, 1♀ (F.W.L.S.).

This bee is probably the commonest of the genus *Megachile* in British Columbia and is found on Vancouver Island, the dry southern interior, the Kootenay district, and as far north as collecting has been done. As it has been taken at Fort Simpson, at the junction of the Liard and Mackenzie Rivers, Northwest Territories, July 14, 1946, A. G. Dustan), it no doubt occurs also throughout northern British Columbia. The elevation of the collection points varies from sea level to 4,000 ft. It nests in colonies in gravelly places and is the most valuable alfalfa pollinator of this genus in British Columbia.

Megachile *(Litomegachile)* **texana** Cresson
MINNIE LAKE, July 4, 1♀; KAMLOOPS, July 19, 1♀, 1942; July 25, 1♂, 1943 (E.R.B.); July 3, 1938, 1♂ (G.J.S.). WALHACHIN, Aug. 10, 1943, 1♀ (E.R.B.). PEACHLAND, July 24, 1907, 1♀ (J.B.W.). SUMMERLAND, July 20, 1917, 1♀ (F.W.L.S.). PENTICTON, June 19, 1918, 1♀ (W.B.A.).

Megachile *(Litomegachile)* **texana** var. **cleomis** Cockerell
VERNON, July 25, 1920, 1♂ (R.C.T.); July 5, 1943, 1♂ (E.R.B.); July 11, 1923, 1♂ (M.H.R.); July 26, 1929, 1♀ (H.B.L.). SUMMERLAND, July 20, 1917, 2♀ (F.W.L.S.). OKANAGAN FALLS, July 21, 1917, 1♀ (F.W.L.S.). OLIVER, July 10, 1929, 2♀ (E.R.B.). WALHACHIN, July 12, 1918, 1♀; Aug. 10, 1943, 1♀ (E.R.B.). KAMLOOPS, July 3, 1938, 2♂ (G.J.S.); July 19, 1942, 1♂ (E.R.B.). LILLOOET (Seton Lake), June 25-28, 1926, 3♂ (J.D.McD.). SIDNEY, V. I., July 22, 1925, 1♀ (G.J.S.).

Megachile *(Litomegachile)* **texana** var. **lippiae** Cockerell
SUMMERLAND, July 20, 1917, 2♀ (F.W.L.S.). LILLOOET (Seton Lake), June 2-28, 1926, 3♀ (J.McD.).

The locality records for *M. texana,* and its varieties *cleomis* and *lippiae,* are all from the interior dry-belt with the exception of Sidney, which is on Vancouver Island.

Megachile *(Litomegachile)* **coquilletti** Cockerell
KASLO, June 11, 1905, 1♂ (L.W.C.). OKANAGAN FALLS, July 21, 1917, 2♂. VERNON, July 25, 1917, 1♂ (F.W.L.S.).

Megachile *(Litomegachile)* **gentilis** Cresson
OKANAGAN FALLS, July 21, 1917 (F.W.L.S.).

Megachile *(Litomegachile)* **brevis** Say
OSOYOOS, June 10, 1919, 1♂ (E.R.B.). FAIRVIEW, Aug. 21, 1919, 1♂ 1♀ (E.R.B.). VASEAUX LAKE, June 14, 1919, 1♀ (E.R.B.). PENTICTON, June 22, 1919, 1♂ (E.R.B.). WALHACHIN, June 29, 1918, 1♂ (E.R.B.). SUMMERLAND, Aug. 10, 1916, 2♂ 3♀; July 20, 1917, 2♀ (F.W.L.S.). OKANAGAN FALLS, July 20-24, 2♂ (F.W.L.S.).

Megachile *(Litomegachile)* **brevis** var. **onobrychidis** Cockerell
LYTTON, June 28, 1♂, Aug. 16, 2♂, 1931 (G.J.S.). WINSLOW, Sept. 14, 1925, 1♀ (G.J.S.). VERNON, Sept. 10, 1926, 1♀ (I.J.W.). OSOYOOS, Aug. 13, 1942, 1♀ (E.R.B.). FAIRVIEW, Aug. 7, 1919, 2♀ (E.R.B.). OKANAGAN FALLS, July 21, 1917, 1♂ (F.W.L.S.). SUMMERLAND, July 9, 1916, 1♀; July 21, 1917, 3♀ (F.W.L.S.). KEREMEOS, July 16, 1923, 1♂ (C.B.G.). NARAMATA, June 21, 1919, 1♂ (E.R.B.).

All the locality records for *brevis* and var. *onobrychidis* are from hot, dry, interior points, with the exception of Winslow, which is in the Lower Fraser Valley.

Megachile *(Anthemois)* **nivalis** Friese
VERNON, Aug. 1, 1923, 1♀ (D.G.G.). CRANBROOK, June 21, 1926, 1♀ (A.A.D.).

Megachile *(Anthemois)* **centuncularis** Linnaeus
NICOLA, Aug. 28, 1923, 1♀ (P.N.V.).

Megachile *(Anthemois)* **montivaga** Cresson
VERNON, July 26-28, 1920, 1♂ 13♀; July 21, 1♂, Aug. 1, 1♀, 1921 (M.H.R.); July 26-27, 16♀, Aug. 9, 2♀, 1920 (R.C.T.); Aug. 2, 1923, 1♀ (D.G.G.); July 21-25, 1917, 2♂ 7♀ (F.W.L.S.). PEACHLAND, Aug. 2, 1907, 1♀ (J.B.W.). SIDNEY, V. I., 1♂, no data; July 22, 1925, 1♂ (G.J.S.). OLIVER, Aug. 9, 1943, 1♂ 2♀ (E.R.B.). ARMSTRONG, July 25, 1913, 1♀ (T.W.). SALMON ARM, June 26, 1925, 1♂ (A.A.D.). LYTTON, July, 1913, 1♀. AGASSIZ, July 8, 1914, 1♂ (F.W.L.S.). PRINCE GEORGE, Aug. 12, 1946, 1♀ (G.J.S.). ROLLA, July 23, 1927, 1♀ (P.N.V.).

This species, from the locality records available, has a wide distribution in British Columbia. It has been recorded from the southern Okanagan, through the dry interior north to Prince George, and from Rolla, on the banks of the Peace River north of latitude 56°, as well as from Agassiz, in the Fraser River delta, and Sidney on Vancouver Island.

Megachile *(Anthemois)* **relativa** Cresson
SICAMOUS (Shuswap Narrows), Aug. 31, 1943, 1♀ (G.J.S.). REVELSTOKE, July 17, 1931, 2♀ (A.W.G.).; REVELSTOKE MT., 6,000 ft., Aug. 12, 1923, 1♀ (P.N.V.). SALMON ARM, July 4, 1914, 3♂ (F.W.L.S.). KASLO, May 14-July 24, 1906, 7♂ 1♀ (L.W.C.); Aug. 3, 1916, 2♀ (F.W.L.S.). CRESTON, Sept. 10, 1923, 2♀ (C.S.L.); Aug. 11, 1927, 2♂ (A.A.D.). LARDO, Sept. 26, 1913, 1♀ (C.G.H.). FORT STEELE, June 20, 1922, 1♂ (W.B.A.). INVERMERE, June 30, 1914, 6♂ (F.W.L.S.). KAMLOOPS, July 19, 1942, 1♂ (E.R.B.). ARMSTRONG, July 3, 1914, 1♂ (F.W.L.S.). VERNON, July 28, 1923, 1♀ (M.H.R.); July 24, 1917, 1♂ (F.W.L.S.); July 31 and Aug. 2, 1923, 2♂ (D.G.G.). PEACHLAND, Aug. 2-7, 1909, 2♀ (J.B.W.). PENTICTON, June 7 and 21, 1919, 3♂ (E.R.B.). KEREMEOS, June 18, 1919, 2♂ (E.R.B.). OLIVER, June 3, 1923, 1♂ (C.B.G.). FAIRVIEW, May 18, 1919, 2♂ (E.R.B.). OSOYOOS, June 10, 1919, 1♂ (E.R.B.). AGASSIZ, June 27, 1923, 1♀ (R.G.). MILNER, May 26, 1930, 1♀ (K.G.). VANCOUVER, Aug. 12, 1916, 2♀ (F.W.L.S.). VICTORIA, V. I., Aug. 28, 1924 (W.B.A.). SIDNEY, V. I., July 15, 1916, 1♂. SHAWNIGAN, V. I., July 7, 1914, 2♀ (F.W.L.S.). HAZELTON, June 20, 1925, 1♂ (W.B.A.). ROLLA, Aug. 2, 1927, 1♂ 1♀ (P.N.V.).

M. relativa occurs throughout British Columbia from the East Kootenays and southern interior north to Rolla, in the Peace River District (north of latitude 56°) and on Vancouver Island. On Revelstoke Mountain it was taken at an elevation of 6,000 ft.

Megachile *(Anthemois)* **inermis** Provancher
CRESTON, Aug. 11, 1927, 1♀ (A.A.D.). SAANICHTON, V. I., June 27 1937, 1♀ (Univ. B. C. Coll.). CHILCOTIN, July 16, 1921, 1♀ (E.R.B.). SMITHERS, Aug. 4, 1944, 2♀ (E.R.B.). ROLLA, July 2-21, 1927, 3♀ (P.N.V.).

While the records of *inermis* are few, they are widely distributed; extending from the West Kootenays and Vancouver Island in the south, through central B. C., to Rolla in the northeastern corner of the Province.

Megachile *(Sayapis)* **fidelis** Cresson
VERNON, July 26, 1929, 1♂ (H.B.L.); Aug. 13, 1904, 1♂ (E.P.V.); July 27 and Aug. 3, 1920, 1♂ 3♀ (R.C.T.); Aug. 31, 1943, 1♀ (D.G.G.). SICAMOUS (Shuswap Narrows), Aug. 31, 1943, 1♀ (G.J.S.).

Megachile *(Sayapis)* **mellitarsis** Cresson
WESTBANK, July 20, 1919, 1♀ (E.R.B.).

Megachile *(Sayapis)* **pugnata** Say
VANCOUVER, Aug. 25, 1902, 1♀. INVERMERE, June 30, 1914, 1♂ 1♀ (F.W.L.S.). KASLO, June 23, 1905, 1♀; June 23, 1♀; July 10, 2♀, 1906; July 4, 1916, 1♂ (L.W.C.); Aug. 3, 1916, 1♀ (F.W.L.S.). CRANBROOK, June 21, 1926, 1♀ (A.A.D.). CROWS NEST, July 23, 1926, 1♀ (A.A.D.). KAMLOOPS, July 25, 1♀, Aug. 24, 1♀ 1943 (E.R.B.). WALHACHIN, June 17 and 27, 1918, 2♂ (E.R.B.). SALMON ARM, June 30, 1♀, July 4, 2♀, 1914 (F.W.L.S.); June 14, 1913, 1♀ (W.R.B.). ARMSTRONG, July 8, 1931, 1♀ (A.W.G.). VERNON, June 20-27, 1920, 8♀ (R.C.T.); June 23-28, 4♀; Aug. 3, 1♂ 1♀, 1920 (M.H.R.); July 25, 1917, 2♂ 1♀ (F.W.L.S.); Aug. 6, 1920, 1♀ (N.L.C.). PEACHLAND, July 21 and 29. 1♂ 1♀; Aug. 6, 2♂ 1♀, 1909 (J.B.W.). SUMMERLAND, Aug. 9 and 10, 1916, 3♀: July 20, 1917, 1♀ (F.W.L.S.). NARAMATA, June 21, 1919, 2♂ (E.R.B.). PENTICTON, June 19 and 21, 1♂ 1♀; Sept. 7, 1♂, 1919 (E.R.B.). LILLOOET, June 9, 1921, 1♂ (A.P.); July 11, 1938, 1♂ (J.K.J.). WILLIAMS LAKE, July 11, 1928, 1♀ (J.K.J.). QUESNEL, Aug. 12, 1946, 4♀ (G.J.S.). SMITHERS, Aug. 4, 1944, 1♂ 1♀ (E.R.B.). ROLLA, July 21 and 23, 1927, 2♀ (P.N.V.).

M. pugnata is another of the commoner species having a wide distribution throughout the Province.

Megachile *(Chelostomoides)* **angelarum** Cockerell
PENTICTON, Aug. 7, 1916, 1♂ (F.W.L.S.).

Megachile *(Chelostomoides)* **subexilis** Cockerell
SUMMERLAND, Aug. 10, 1916 1♀ (F.W.L.S.). KEREMEOS, July 21, 1917, 1♀ (F.W.L.S.). OKANAGAN FALLS, July 21, 24, 1917, 7♂ (F.W.L.S.). KASLO, Aug. 3, 1916, 2♀ (F.W.L.S.).

Megachile *(Argyropile)* **parallela** Smith
KAMLOOPS, July 27, 1937, 1♂ (E.R.B.). WALHACHIN, Aug. 16, 1942, 3♀ (E.R.B.).

Megachile *(Xeromegachile)* **wheeleri** Mitchell
KAMLOOPS, July 1, 1929, 3♀ (E.R.B.). NICOLA, Aug. 3, 1923, 1♂ (E.R.B.). MINNIE LAKE, Aug. 26, 1925, 1♀ (E.R.B.). VERNON, July 21, 1923, 1♂ (D.G.G.). PENTICTON, Sept. 3, 1919, 1♀ (E.R.B.).

Megachile *(Xeromegachile)* **subnigra** Cresson
PENTICTON, June 7, 1919 1♀ (E.R.B.).

Megachile *(Delomegachile)* **frigida** Smith
KASLO, June 11 and 20, 2♂; July 1, 1♂ 2♀, 1905; May 3-Aug. 26, 7♂ 2♀, 1906; Aug. 24, 1♀, 1907; June 11, 1♂, 1910 (L.W.C.). INVERMERE, June 30, 1914, 3♂ (F.W.L.S.). FAIRVIEW, Aug. 7, 1919, 1♀ (E.R.B.). VASEAUX LAKE, June 14, 1919, 1♀ (E.R.B.). OKANAGAN FALLS, June 3, 1919, 1♂ 1♀ (E.R.B.). SUMMERLAND, July 20, 1917, 1♂ (F.W.L.S.). VERNON, Aug. 28, 1920, 1♀; June 18, 1923, 1♀ (M.H.R.). REVELSTOKE, July 15, 1931, 1♂ 1♀ (A.N.G.). SICAMOUS, July 11, 1914, 2♂ (F.W.L.S.). SALMON ARM, Aug. 2, 1914, 1♀ (W.R.B.); July 6, 1925, 1♂ (A.A.D.). CHASE, July 30, 1943, 1♂ (E.R.B.). MONTE CREEK, July 7, 1929, 2♀ (I. McT-C). KAMLOOPS, June 13, 1♂; July 25, 1943, 1♀ (E.R.B.). NICOLA, July 25, 1925, 1♂ (P.N.V.). AGASSIZ, Sept. 10, 1926, 1♀ (R.G.). STEELHEAD, May 29, 1934, 1♀ (K.G.). VANCOUVER, Aug. 10-15, 1916, 3♂ 2♀ (F.W.L.S.); July 2, 1903, 1♂ (Univ. B. C. Coll.). VICTORIA, V. I., Aug. 13, 1916, 1♀ (F.W.L.S.). GOLDSTREAM, V. I., May 17, 1915, 1♂ (J.D.G.). LILLOOET (Mt. McLaine), Aug. 20, 1920, 1♀ (R.G.); July 4, 1916, 1♀ (F.W.L.S.); June 12, 1926, 1♂ (E.R.B.). CHILCOTIN, July 17, 1920, 1♂ (E.R.B.); July 29, 1930, 1♂ (G.J.S.). FRANCOIS LAKE, July 5, 1924, 1♂ (E.R.B.). SMITHERS, Sept. 1, 1915, 1♀ (H.S.). ROLLA, July 14-23, 1927, 2♂ 1♀ (P.N.V.).

The distribution records given above for *frigida* would indicate that it is a common species, frequenting wooded and high mountainous areas more frequently than is the case with other common species. Its distribution covers the whole of the Province and Vancouver Island.

Megachile *(Delomegachile)* **giliae** Cockerell
INVERMERE, May 27, 1915, 1♂ (F.W.L.S.).

Megachile *(Delomegachile)* **gemula** Cresson
GOLDEN, May 17, 1915, 1♂ (F.W.L.S.). INVERMERE, May 27, 1915, 1♂ (F.W.L.S.). KASLO, June 10, 1906, 1♂ (L.W.C.). KAMLOOPS, Aug. 8, 1943, 1♂ (E.R.B.). ARMSTRONG, July 3, 1914, 1♂ (F.W.L.S.). VERNON, May 28, 1904, 1♂ (E.P.V.). KELOWNA, July 14, 1943, 1♂ (G.J.S.). SUMMERLAND, June 4, 1919, 1♂ (E.R.B.).

Megachile *(Delomegachile)* **gemula** var. **fulvogemula** Mitchell
CHILCOTIN, June 13, 1929, 1♀ (E.R.B.). VERNON, July 23, 1920, 1♀ (N.L.C.). KELOWNA, July 9, 1918, 1♀ (R.C.W.).

Megachile *(Delomegachile)* **melanophoea** Smith
KASLO, May 7-June 5, 1906, 5♂ 4♀; June 11, 1910, 1♀ (L.W.C.). INVERMERE, May 30, 1♂; June 30, 1♂, 1914; May 19, 1♂; June 1, 1♀, 1915; June 30, 1919, 1♀ (F.W.L.S.). VASEAUX LAKE, June 12 and 14, 1♂ 1♀, 1919 (E.R.B.). SUMMERLAND, July 20, 1917, 1♂ (F.W.L.S.). VERNON, May 28 and 31, 1904, 2♂ (E.P.V.); May 31, 1929, 1♂ (E.R.B.); July 2, 1930, 1♀ (C.B.LeB.); May 25, 1930, 1♂ (I.J.W.); June 21, 1903, 1♀ (M.H.R.). MARA, July 12, 1920, 1♂ (R.C.T.). SALMON ARM, July 4, 1914, 1♂ (F.W.L.S.); June 27, 1925, 1♂ (A.A.D.). CHASE, June 6, 1937, 1♀; June 19, 1946, 1♀ (E.R.B.); July 11, 1931, 1♂ (G.J.S.). HAT CREEK, June 26 and 27, 1943, 4♂ 1♀ (E.R.B.). PRINCETON (Copper Mt.), July 21, 1928, 1♂ (G.S.S.). VANCOUVER, Aug. 18, 1916, 1♀ (F.W.L.S.); April 15, 1920, 1♂ (G.J.S.). VICTORIA, V. I., June 17, 1917, 1♀ (E.P.V.). SHAWNIGAN, V. I., July 7, 1914, 1♂ (F.W.L.S.). NEWCASTLE, V. I., June 29, 1926, 1♂ (G.J.S.). 100 MILE HOUSE, July 1, 1943, 1♂ (E.R.B.). CHILCOTIN, June 16, 1920, 1♂ (R.C.T.); May 30, 1921, 1♀; June 20, 1926, 1♂ 1♀; June 13 and 14, 1929, 2♂; June 3-26, 1930, 4♂ (E.R.B.); July 29, 1930, 3♀ (G.J.S.). ROLLA, July 23, 1927, 1♂ (P.N.V.).

Megachile *(Delomegachile)* **melanophoea** var. **calogaster** Cockerell
INVERMERE, June 30, 1914, 1♂ 1♀ (F.W.L.S.). ARMSTRONG, July 3, 1914, 2♀ (F.W.L.S.). SIDNEY, V. I., July 7, 1914, 1♀ (F.W.L.S.). PRINCE GEORGE, Aug. 11, 1917, 1♀ (W.B.A.).

Megachile *(Delomegachile)* **melanophoea** var. **wooteni** Cockerell
INVERMERE, June 1, 1915, 1♀ (F.W.L.S.). OKANAGAN FALLS, June 3, 1914, 1♀ (E.R.B). PENTICTON, June 19, 1918, 1♀ (W.B.A.); June 7, 1919, 3♀ (E.R.B.). SALMON ARM, June 25, 1925, 1♀ (A.A.D.). LILLOOET, July 2, 1920, 1♀ (A.B.B.). VANCOUVER, Aug. 12, 1916, 1♀ (F.W.L.S.).

M. melanophoea, with its colour forms *calogaster* and *wooteni*, is one of the commonest and most widespread of the genus in British Columbia. Locality records show that it occurs from the southern interior and the Kootenays to Vancouver Island and north through Central B. C. to the Peace River District at Rolla.

It also occurs in the Northwest Territories, where it was collected by Mr. A. G. Dustan (July 14, 1946) at Fort Simpson, north of latitude 60°.

Dr. T. B. Mitchell states that a number of colour forms have been distinguished, but that their limits are obscure. According to Sladen (1918) this species is a valuable alfalfa pollenizer in British Columbia.

Genus COELIOXYS Latreille

The bees of this genus are parasitic on species of *Megachile* and appear later in the season than their hosts.

Coelioxys sayi Robertson (*rufitarsus* Sm.)
KASLO, Aug. 10, 1909, 1♀ (L.W.C.). OSOYOOS, June 10, 1919, 4♂ (E.R.B.); July 26, 1925, 2♂ (F.W.L.S.). FAIRVIEW, Aug. 7, 1♂ 1♀; 21, 1♀, 1919 (E.R.B.). KEREMEOS, July 21, 1917, 1♂ (F.W.L.S.). VASEAUX LAKE, June 14, 1919, 1♂ 1♀ (E.R.B.). OKANAGAN FALLS, July 21, 1917, 1♂ (F.W.L.S.). PENTICTON, Aug. 7, 1916, 1♂ 4♀ (F.W.L.S.); June 19, 1♀; Sept. 7, 1919, 2♂ (E.R.B.). SUMMERLAND, Aug. 10, 1916, 3♀; July 20, 1917, 2♀ (F.W.L.S.). VERNON, Aug. 9, 1903, 1♂; Aug. 8 and 13, 1904, 1♂ 1♀; July 28, 1920, 1♂; Aug. 10, 1921, 2♂ 1♀ (M.H.R.); July 24, 1913, 4♂; Aug. 25, 1914, 1♀; July 25, 1917, 5♂ 1♀ (F.W.L.S.); July 27, 1920, 1♂ (R.C.T.); July 7, 1920, 1♀ (N.L.C.); July 31, 1923, 1♀ (D.G.G.). ARMSTRONG, Aug. 25, 1923, 1♀ (T.W.). SALMON ARM, June 25 and 26, 2♂; July 6 and 27, 1♂ 1♀, 1925 (A.A.D.). KAMLOOPS, July 7, 1936, 1♂; July 25, 1943, 1♂ (E.R.B.). WALHACHIN, June 27, 1918, 1♂ (E.R.B.). NICOLA, Aug. 3 and 25, 1923, 1♂ 2♀ (E.R.B.). LYTTON, June 21, 1931, 2♀; July 26, 1939, 1♀ (G.J.S.). LILLOOET, May 31, 1926, 1♂ 1♀ (J.McD.). AGASSIZ, June 5, 1925, 1♀ (R.G.). VANCOUVER ISLAND, 1♂ (G.W.T.). VICTORIA, V. I., July 14, 1916, 8♀ (F.W.L.S.); Sept. 25, 1916, 1♀ (H.H.); June 21, 1928, 1♂ (W.D.); Sept. 12, 1937, 1♀ (Univ. B. C. Coll.). DUNCAN, V. I., July 26, 1902, 1♀; July, 1939, 1♀ (Univ. B. C. Coll.). SIDNEY, V. I., Aug. 15, 1916, 2♂ (F.W.L.S.). COMOX, V. I. (Point Holmes), July 5, 1933, 3♂ 1♀ (J.McD.). SAANICH DISTRICT, V. I., Aug. 2, 1917, 1♀ (W.D.). ROLLA, July 2, 1927, 1♂ 1♀ (P.N.V.).

This bee is far more plentiful than any of the other species of *Coelioxys* in British Columbia, and has been taken throughout the southern interior and on Vancouver Island. The only northern record is from Rolla, in the B. C. Peace River District.

Coelioxys ribis Cockerell
EDGEWATER, July 16, 1939, 1♀ (I.J.W.). KASLO, June 5, 1906, 1♂ 2♀ (L.W.C.). CRESTON, June 29, 1924, 1♀ (C.S.L.). PENTICTON, June 19, 1919, 1♀; April 24, 1929, 1♀ (E.R.B.). VERNON, June 6, 1900, 1♂ (M.H.R.); Aug. 7, 1920, 1♀ (N.L.C.); May 28-31, 1904, 3♂ (E.P.V.). MARA, July 12, 1920. 1♀ (R.C.T.). SALMON ARM,

July 4, 1914, 1♀ (F.W.L.S.); July 20, 1925, 1♂ (A.A.D.). CHASE, June 6, 1937, 1♂ (E.R.B.). NICOLA, Aug. 3, 1923, 3♂ (E.R.B.). KAMLOOPS, June 13, 1943, 1♀ (G.J.S.). CHILCOTIN, June 13, 1929, 1♂; June 26, 1930, 1♀ (E.R.B.); Aug. 10, 1930, 2♂ (G.J.S.). VICTORIA, V. I., June 21, 1928, 1♀ (W.D.). SHAWNIGAN, V. I., July 7, 1914 (F.W.L.S.). COMOX, V. I., July 5, 1933, 1♀ (J.McD.). FITZGERALD, V. I., June 25, 1922, 1♀ (W.R.C.).

Coelioxys ribis kincaidi Cockerell
NANAIMO, V. I. (Biological Station), June 28, 1♂ (Van Duzee). Cockerell (1925).

Coelioxys octodentata Say
PENTICTON, Aug. 22, 1920, 1♀ (W.R.B.). WALHACHIN, June 27, 1918, 1♂ (E.R.B.).

Coelioxys lucrosa Cresson
KASLO, Sept. 1, 1909, 2♀ (L.W.C.). PEACHLAND, Aug. 7, 1909, 1♂ (J.B.W.). VERNON, July 21, 1923, 1♀ (D.G.G.); Aug. 25, 1925, 1♀ (M.H.R.). SICAMOUS (Shuswap Narrows), Aug. 31, 1943, 1♀ (G.J.S.). LILLOOET, Aug. 25, 1921, 1♀ (A.P.).

Coelioxys moesta Cresson
FT. STEELE, Aug. 15, 1921, 1♀ (W.B.A.). PEACHLAND, Aug. 4 and 9, 1909, 2♀ (J.B.W.). VERNON, Aug. 25, 1919, 1♀ (F.W.L.S.). VANCOUVER, Aug. 21, 1932, 1♀ (H.B.L.). FITZGERALD, V. I., Aug. 21, 1921, 1♀ (W.R.C.). SHAWNIGAN, V. I., July 7, 1914, 1♀ (F.W.L.S.).

Coelioxys alternata Say
KASLO, July 24, 1906, 1♀ (L.W.C.). OLIVER, July 22, 1923, 1♂ (E.R.B.). VERNON, July 25, 1919, 1♀ (F.W.L.S.). SALMON ARM, July 4, 1914, 1♀ (F.W.L.S.). LILLOOET, July 9, 1921, 1♀ (A.P.). CHILCOTIN, July 14, 1920, 1♂ (E.R.B.). DUNCAN, V. I., Aug. 4, 1920, 1♀ (W.D.). FITZGERALD, V. I., Aug. 7, 1921, 1♀ (W.R.C.).

Coelioxys grindeliae Cockerell
NICOLA, Aug. 3, 1923, 1♂ (E.R.B.). OKANAGAN VALLEY, 1♂.

LIST OF COLLECTORS

Mentioned by initials in the text

A.A.D.—Dennys, A. A.
A.B.B.—Baird, A. B.
A.P.—Phair, A.
A.W.G.—Gartrell, A. W.
C.B.G.—Garrett, C. B.
C.B.LeB.—LeBlond, C. B.
C.G.H.—Hewitt, C. G.
C.N.C.—Canadian National Collection
C.S.L.—Lallamande, C. S.
D.G.G.—Gillespie, D. G.
E.C.V.D.—Van Dyke, E. C.
E.M.A.—Anderson, E. M.
E.P.V.—Venables, E. P.
E.R.B.—Buckell, E. R.
F.W.L.S.—Sladen, F. W. L.
G.J.S.—Spencer, G. J.
G.S.S.—Stace Smith, G.
G.S.W.—Walley, G. S.
G.W.T.—Taylor, G. W.
H.B.L.—Leech, H. B.
H.H.—Hugh, H.
H.H.R.—Ross, H. H.
H.S.—Smith, Harlan
I.J.W.—Ward, I. J.
I.McT.-C.—McTaggert-Cowan, I.
J.B.W.—Wallis, J. B.
J.C.B.—Bradley, J. C.
J.D.G.—Gregson, J. D.
J.D.McD.—McDunnough, J. D.
J.K.J.—Jacob, J. K.
K.G.—Graham, K.
L.—Livingstone
L.W.C.—Cockle, L. W.
M.H.R.—Ruhmann, M. H.
N.L.C.—Cutler, N. L.
P.N.V.—Vroom, P. N.
R.—Russell
R.C.T.—Treherne, R. C.
R.C.W.—Woodward, R. C.
R.D.B.—Bird, R. D.
R.G.—Glendenning, R.
R.P.C.—Currie, R. P.
T.W.—Wilson, T.
W.B.A.—Anderson, W. B.
W.D.—Downes, W.
W.M.—Mathers, W.
W.R.B.—Buckell, W. R.
W.R.C.—Carter, W. R.

LIST OF LOCALITIES

Arranged alphabetically: the numbers corresponding to those on the accompanying map. (V. I. = Vancouver Island).

1. Agassiz
2. Alexis Creek
3. Armstrong
4. Carbonate
5. Chase
6. Chilcotin
7. Clinton
8. Courtenay, V. I.
9. Cranbrook
10. Crescent
11. Creston
12. Comox, V. I.
13. Crows Nest
14. Departure Bay, V. I.
15. Downie Creek
16. Duncan, V. I.
17. Edgewater
18. Enderby
19. Fairview
20. Fitzgerald, V. I.
21. Fort Steele
22. Francois Lake
23. Golden
24. Goldstream
25. Goldstream, V. I.
26. Grindrod
27. Hat Creek
28. Hazelton
29. Howser Lake
30. 100 Mile House
31. Invermere
32. Kaleden
33. Kamloops
34. Kaslo
35. Kelowna
36. Keremeos
37. Lardo
38. Lillooet
39. Lytton
40. Mara
41. Merritt
42. Milner
43. Minnie Lake
44. Monte Creek
45. Mount McLaine
46. Nanaimo, V. I.
47. Naramata
48. Newcastle, V. I.
49. Nicola
50. Okanagan Falls
51. Oliver
52. Osoyoos
53. Peachland
54. Penticton
55. Prince George
56. Princeton
57. Quesnel
58. Revelstoke
59. Rolla
60. Royal Oak, V. I.
61. Saanich, V. I.
62. Salmon Arm
63. Shawnigan Lake, V. I.
64. Sicamous
65. Sidney, V. I.
66. Smithers
67. Steelhead
68. Summerland
69. Tofino, V. I.
70. Vancouver
71. Vaseaux Lake
72. Vernon
73. Victoria, V. I.
74. Walhachin
75. Westbank
76. Williams Lake
77. Winslow

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ENTOMOLOGICAL NOTES FROM THE DIVISION OF PLANT PROTECTION

W. D. TOUZEAU

Division of Plant Protection, Science Service, Department of Agriculture, Vancouver, B. C.

The following scientific notes are presented as being of interest to the members of the Entomological Society of British Columbia.

The Oriental Fruit Moth survey was carried on during the summer of 1948 in the lower Okanagan Valley. The method of approach and the results were the same as the three years previous, and we are happy to report that up to the end of the survey there had been no interception of the moth in British Columbia. The survey will be carried on in 1949, due largely to the outbreak of the moth that has occurred in the Lombard Loop district, near Yakima, Washington. San Jose and European Scale have been receiving a great deal of attention by the Dominion and Provincial Departments of Agriculture, as well as the B. C. Fruit Growers' Association. Through the co-operation of these three bodies, and as a result of winter spraying, a grader inspection of apples from Kelowna south to Osoyoos and into Keremeos has shown a considerable decrease in the amount of scale. Some 50 per cent reduction was noted in 1948 over 1947. While inspecting the Greek ship s.s. "Olga" on February 26, 1949, C. R. Cunningham was told by members of the crew that in warm weather Hold No. 2 was filled with constant chirping. Investigation led to the finding of a slight infestation of crickets along the forward bulkhead. The ship had arrived from the Orient. It is thought that the crickets came aboard ship in the Philippines. The s.s. "Orato" was examined on February 4, 1949, by C. R. Cunningham, prior to loading from the port of Vancouver. Her previous cargoes had been maize from the Argentine, followed by sulphate from Chile. A collection of resident insects was examined by P. Zuk, and among them were found a few false scorpions, apparently feeding on mites.

Contribution No. 74, Division of Plant Protection, Science Service, Dominion Department of Agriculture, Ottawa, Ontario.

ACHATINA FULICA (FER.)—AN INTERESTING INTERCEPTION FROM THE PHILIPPINES (MOLLUSCA, STENOGYRIDAE)

PETER ZUK
Division of Plant Protection, Science Service, Department of Agriculture, Vancouver, B. C.

On February 4, 1949, R. D. Clemens, of the United States Department of Agriculture in San Diego, California, wrote to H. F. Olds, of the Division of Plant Protection in Vancouver, and to the men in charge of plant quarantine work in San Francisco, Portland, and Seattle, informing all of them of the interception of one live giant African snail, *Achatina fulica,* in one hold of the s.s. "Julia Luckenbach." The ship contained copra, sugar, war surplus machinery, and general cargo from the Philippines. The snail was found among used generators unloaded from the lower 'tween deck of No. 2 hold. No snails were found in the other cargo and no further information was received from San Francisco, where the general cargo was discharged.

The ship arrived in Vancouver on February 15 and the next day it was thoroughly inspected when surplus tractors and copra were discharged. Six snails, one crushed, were found on the floor and on the tractors in the two forward deep tanks of No. 2 hold. No snails were found in any other part of the ship, although the copra contained the usual infestation of red-legged ham beetle, *Necrobia rufipes.* The tractors were loaded into a barge and the barge placed under quarantine until further inspection and precautionary steps were taken. Two more snails were found, one very small, in the soil adhering to the tractors. Samples of the soil were inspected but they revealed nothing more than one sow bug. A crane lifted the tractors and they were sprayed with a fire hose to wash away attached soil into the sea, then the barge was sprayed clean of soil. The tractors had been loaded in Manila about the middle of December, 1948, so the snails were sealed in the deep tanks for two months. Fortunately, all the snails found here were dead. On further inspection of the ship by U. S. officials in Seattle and Portland no evidence of the pest was found.

The most widely travelled of the many species of *Achatina* is *Achatina fulica.* It is native to the lowlands of tropical East Africa, including Zanzibar Island, twenty-five miles off the coast of Tanganyika. The shell is cone-shaped and grey, streaked with brown. The largest shell found on the ship was about three and one quarter inches long. During the past hundred years or more, *Achatina fulica* has been carried, in general deliberately, by human beings as food for themselves and their poultry, to most of the tropical lands of the Indian and Pacific Oceans. In 1900 it caused great damage in Ceylon. Similar reports came from Malaya in 1923, Singapore in 1928, and Hawaii in 1938. The Japanese spread *Achatina fulica* throughout their mandated islands in Micronesia. Now these snails are reported also from Java, Borneo, Amoy (China), the Philippines, Formosa and for a short time, California. In each new, lush, tropical region this snail has increased rapidly, far from its natural enemies. Imported for food, it soon eats up more food — growing young food plants—than it could ever supply, even to those with a taste for snails. Control of snails is by the use of poison bait but this method is an expensive and never-ending procedure. Great attention is now focused on the use of biological control and men are being sent to Africa to discover the enemies that keep down the numbers of the snails in their native habitat. In Africa a carabid, *Tefflus dispar,* and a drilid beetle help to keep the snails in check. According to Dr. Williams, of the Experiment Station of the Hawaiian Sugar Planters' Association, two other enemies of this snail in the same continent are the carnivorous snails *Gonaxis* and *Eduntulina.* Although it is doubtful whether *A. fulica* would become a pest in Canada, all necessary precautions were taken by the Division of Plant Protection to ensure that it would not become a hazard to agriculture.

Contribution No. 76, Division of Plant Protection, Science Service, Dominion Department of Agriculture, Ottawa, Ontario.

THE SOCIAL WASPS (VESPIDAE) OF BRITISH COLUMBIA[1*]

E. R. BUCKELL
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AND G. J. SPENCER
University of British Columbia, Vancouver, B. C.

This paper on the social wasps of British Columbia has been prepared from the collections in the Field Crop Insect Laboratory, Kamloops, and the University of British Columbia, Vancouver. The majority of the specimens were collected by the authors who are greatly indebted to Dr. J. Bequaert, Museum of Comparative Zoology, Harvard College, Cambridge, Massachusetts, for their determination. Frequent use has been made of Dr. Bequaert's publications on the *Vespidae* (1931-1942), and many points of interest therein have been included in this paper.

The localities from which material has been recorded have been listed and marked by a number on the accompanying map.

Family **VESPIDAE**

Subfamily *VESPINAE*

Genus VESPULA C. G. Thomson

The genus *Vespula*, with its two subgenera, *Vespula* and *Dolichovespula*, includes the well known and pugnacious yellow-jackets and hornets.

The paper nests of yellow-jackets and those of the large black and white, baldfaced hornet are well known objects. The nesting habits of the species vary. They may be placed below ground, hanging from ceilings or between the walls of buildings, or suspended from the limbs of shrubs or trees from ground level up to considerable heights. They contain several horizontal strata of cells enveloped by an outer covering of paper layers made of pulp gnawed from dry wood by the worker wasps. There is usually but one entrance hole placed terminally or slightly laterally.

Wasps vary in abundance from year to year and may sometimes occur in such numbers as to be a serious pest of fruit and a great nuisance to people, as they are quick tempered and their stings are painful.

Subgenus *Vespula*

Vespula vulgaris (Linnaeus)

Vespa vulgaris Linnaeus, 1758, *Syst. Nat.*, 10th Ed., I, p. 572.

Vespa communis H. de Saussure, 1857, *Stettin. Ent. Zeitg.*, XVIII, p. 117 (♀; North America).

Vespa alascensis Packard, 1870, *Trans. Chicago Ac. Sci.*, II, p. 27, Pl. II, fig. 10 (♀; (Lower Yukon, Alaska).

Vespa westwoodii Shipp, 1893, *Psyche*, VI, p. 450 (Boreal America).

LOCALITIES — Vernon, Salmon Arm, Celista, Squilax, Adams Lake, Chase, Kamloops, Douglas Lake, Minnie Lake, Bridge Lake, 100 Mile House, Canim Lake, Chilcotin, Alexandria, Quesnel, Barkerville, Prince George, Burns Lake, Yale, Skidegate.

MATERIAL EXAMINED—24♀, 67☿, 5♂.

A nest of *V. vulgaris* was found on September 26, 1943, in the ground on a grassy slope in a stand of big timber on Wheeler mountain near Kamloops. It had originally been as big as a man's head but had been dug out by a bear and only a portion of the nest wall remained with a few wasps still present on it.

The paper of this nest had been made from the bark of the western yellow pine and was a beautiful golden yellow colour with rich brown markings. It differed considerably from the ordinary tough, grey paper of nests made by other species, and was quite brittle and flaky.

J. Bequaert (1931) in discussing nests of this species, records that a nest dug up at Cold Spring Harbour, N. Y., by Mr. R. P. Dow, contained pupae of the ichneumonid, *Sphecophaga burra* (Cresson) in some of the cells. "Before pupating, the larva of this parasite closes the cell, some distance below the top, with a brownish, silken partition, showing a slightly depressed, translucid circle in the centre."

At Lac du Bois, Kamloops, during the last week in August, 1946, a small

1* Contribution No. 2567, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

nest of *Vespula* spp., only some 6 inches in diameter was poisoned at night with calcium cyanide dust from a hand duster. It was a very weak colony and the few wasps present fell out into long grass when the nest was cut down from a low trembling aspen. The combs were examined shortly afterwards and nearly 20 cells contained brownish-yellow partitions, exactly like those described above. The tiers near the top of the nest were honeycombed by small lepidopterous larvae which had spun a small amount of loose silk. As far as possible, all the cyanide was at once shaken out and the nest was well aired and retained in a cage to secure emergence of the parasites and the moth scavengers but no adults of any kind were obtained. It was noted that all of the silken parasite cocoon caps were slightly obliquely placed; none was at right angles to the axis of the cell.

Vespula pensylvanica (H. de Saussure).

Vespa pensylvanica H. de Saussure, 1857, *Stettin Ent. Zeitg.*, XVIII, p. 117 (♀; North America, Canada and the mountains of Mexico). R. du Buysson, 1905, *Ann. Soc. Ent. France*, LXXIII, 4, (1904), p. 615 (♀ ☿ ♂).

Vespa occidentalis Cresson, 1874, *Trans. Amer. Ent. Soc.*, V, p. 100 (♀ ☿, erroneously described as ♀ ♂; Nevada and New Mexico). Not *Vespa occidentalis* Olivier, 1791.

LOCALITIES — Kaslo, Oliver, Penticton, Summerland, Vernon, Salmon Arm, Celista, Adams Lake, Squilax, Chase, Prichard, Kamloops, Douglas Lake, Minnie Lake, Lytton, Lillooet, Bridge Lake, Chilcotin, Quesnel, Barkerville, Vancouver, Grantham's Landing, Victoria, Cowichan Lake, Sidney, Departure Bay.

MATERIAL EXAMINED—62♀, 154☿, 59♂.

Six nests of this species were examined in 1943, four of which were in the ground and two between the walls of wooden houses.

Of the nests in the ground, one was in a ditch bank, and contained on August, many ♂ and ☿ but only one ♀, whose wings had been chewed off. The second was under a rotten birch stump and had been torn out and eaten by a bear. The few remaining wasps were busy repairing the nest and building again although fully exposed to the sunlight. The third nest had also been dug out and eaten by a bear and the remaining wasps had built up small nest areas at the side of the open hole. The fourth ground nest had a well-defined mud collar at the entrance and was at the base of a large rock on open rangeland. When dug up on September 14 it contained mainly queens and males.

Between the walls of houses where it is completely dark, appears to be another favorite nesting site for this species. Two such nests were found in 1943 at Salmon Arm. In the first instance the nesting site was entered through a crack in a window casing some 12 feet from the ground and in the second instance the wasps were entering through a narrow crack under the eaves.

Bequaert (1931) states that in G. W. Taylor's account (1898), he mentions capturing 23 males and 4 females of an interesting parasitic wasp, *Trigonalys canadensis* Harrington, at the entrance of *V. pensylvanica* nests in British Columbia.

Vespula rufa var. **atropilosa** (Sladen)

Vespa atropilosa Sladen, 1918, *Ottawa Naturalist*, XXXII, p. 72 (♀ ☿; Lethbridge, Alberta; Vernon, Keremeos and Okanagan Landing, British Columbia).

LOCALITIES — Fairview, Keremeos, Okanagan Landing, Vernon, Salmon Arm, Adams Lake, Kamloops, Douglas Lake, Minnie Lake, Lytton, Vancouver.

MATERIAL EXAMINED—43♀, 62☿, 35♂.

Two nests of this wasp were examined on August 17, 1943; they were built well below ground in a ditch bank.

One nest was small, and contained only queens and workers, but the other one was large and contained at least 50 queens, as well as many workers and males.

The queens and workers in this nest showed very little variation in colour pattern but the males had two distinct colour patterns on the second tergite, i.e., similar to the queens, and with the black area enclosing yellow spots. Two males were unusual, one being very heavily marked with black as in var. *sladeni*, and the other very light as in the queens. Two queens were wingless, the wings having failed to form.

This is a bright yellow and black wasp of large size.

Vespula rufa var. **sladeni** Bequaert.

LOCALITIES—Revelstoke, Chase, Douglas Lake, Kamloops, Minnie Lake, Quesnel, Tyee, Prince Rupert, Vancouver.

MATERIAL EXAMINED—19♀, 10☿, 10♂.

This is a western form described by Bequaert (1931) as an extreme melanistic variation of var. *atropilosa*, and often resembles the two eastern varieties, *acadica* (Sladen) and *vidua* (H. de Saussure).

This wasp appears to be far less common than the other varieties of *V. rufa* which occur in British Columbia, namely, *atropilosa* and *consobrina*. It is to be found more frequently in the humid coastal areas around Vancouver and Prince Rupert than in the dry interior.

The queens may be found visiting the flowers of certain ornamental shrubs in Stanley Park, Vancouver, in April and May; later in the season the workers may be seen entering and leaving their nests, which are placed underground.

Vespula rufa var. **consobrina** (H. de Saussure)

Vespa consobrina H. de Saussure, 1853, *Et. Fam. Vesp.*, II, p. 141 (☿; Newfoundland).

Vespa arenaria H. de Saussure, 1853 *Et. Fam. Vesp.*, II, p. 134, (☿; North America). Not *Vespa arenaria* Fabricius, 1775.

Vespa scelesta McFarland, 1888. *Trans, Amer. Ent. Soc.*, XV, p. 298. Cresson, 1928, *Mem. Amer. Ent. Soc.*, No. 5, p. 57.

Vespa sulcata L. O. Howard, 1901, *The Insect Book*, Pl. VI, fig. 18.

LOCALITIES — Kaslo, Vernon, Beavermouth, Revelstoke, Salmon Arm, Celista, Squilax, Adams Lake, Chase, Kamloops, Douglas Lake, Minnie Lake, Bridge Lake, Chilcotin, Quesnel, Prince George, Smithers, Terrace, Hazelton, Hope, Vancouver, Victoria, Royal Oak, Sidney, Courtenay.

MATERIAL EXAMINED—45♀, 86☿, 57♂.

This is a rather small, black wasp with pale white or ivory white markings in marked contract to var. *atropilosa*, a large, brightly marked, yellow and black insect. The var. *sladeni* is intermediate in general coloration between *atropilosa* and *consobrina*, and it is hard, at first sight, to realize that these three wasps belong to one and the same species. This is the commonest of the varieties of *V. rufa* found in British Columbia.

In the specimens examined the colour pattern is extremely uniform in *consobrina*, while *sladeni* and *atropilosa* show considerable variation.

Vespula austriaca (Panzer).

Vespa austriaca Panzer, 1799, *Faun. Ins. German*, VI, p. 63, Pl. II (♂; Vienna, Austria).

Vespa borealis F. Smith, 1843, *The Zoologist*, I, p. 170. Not *Vespa borealis* W. Kirby, 1837, nor of Zetterstedt, 1840.

Vespa arborea F. Smith, 1849, *The Zoologist*, VII, Appendix, p. 1x (substitute name for *Vespa borealis* F. Smith, 1843).

Vespa tripunctata Packard, 1870, *Trans. Chicago Ac. Sci.*, II, p. 26, Pl. II, fig. II (holotype ♀ of Kutleet, Alaska, only). Not *Vespa tripunctata* Fabricius, 1787, nor of Schenck, 1861.

Vespa infernalis H. de Saussure, 1853, *Et. Fam. Vesp.*, II, p. 139.

LOCALITIES—Bridge Lake, Kamloops. Bequaert also records this species from Beavermouth, Field, and Kaslo.

Of this species Bequaert (1931) states: "*V. austriaca* has no worker phase. It is a so-called social parasite or inquiline wasp, which builds no nest of its own, but has its brood raised by the workers of other species of *Vespula*. In the Palearctic Region the host-species is *Vespula rufa* (Linnaeus), in the nests of which the females and males of *V. austriaca* have been found repeatedly. In North America, the host is as yet unknown, but since typical *V. rufa* does not exist here, I suspect that it must be one of the most common American forms of *V. rufa (vidua, atropilosa* or *consobrina*)."

The queen of *austriaca* is very similar in general appearance to *rufa* var. *consobrina*, both having a peculiar black-and-yellow pattern on the second abdominal segment, but may be distinguished from the queen of all forms of *V. rufa* in the long pilosity on the outer side of the tibiae and in the pointed apical angles of the clypeus.

Subgenus *Dolichovespula* Rohwer

Vespula maculata (Linnaeus).

Vespa maculata Linnaeus, 1763, *Cent. Insect Rar.*, p. 30. Not *Vespa maculata* Scopoli, 1763; nor of Drury, 1773.

Vespa maculata americana Christ, 1791, *Naturgesch. Insekt. vom Bienen, Wespen and Ameisengeschl.*, p. 239.

LOCALITIES—Fairmont, Kaslo, Vernon, Salmon Arm, Squilax, Adams Lake, Chase, Kamloops, Douglas Lake, Walhachin, Lytton, Bridge Lake, Chilcotin, Quesnel, Prince George, Prince Rupert, Vancouver, (♀ flying in mid-March), Buccaneer Bay, Grantham's Landing, Vancouver Island.

MATERIAL EXAMINED—56♀, 66☿, 19♂.

This is the common, and well known, black, or bald-faced hornet, and it occurs everywhere throughout British Columbia. It is particularly common in fruit growing areas, and causes much annoyance by building its paper nest in apple trees, to the great discomfort of the apple pickers at harvest time, as its sting is very severe and painful.

The bald-faced hornet nests above ground and its nests, often of large size, may be found hanging from the boughs of trees, sometimes high above the ground, or low down in the base of a bush almost touching the ground.

Bequaert (1931) reports that the ichneumonid parasite, *Sphecophaga burra* (Cresson) (=*Sphecophagus praedator* Zabriskie), has been bred from the cells of this species.

Vespula arenaria (Fabricius).

Vespa arenaria Fabriius, 1775, *Syst. Entom.*, p. 365 (no sex; America). Not of most American writers.

Vespa (Dolichovespula) arenaria J. Bequaert, 1928, Bull. *Brooklyn Ent. Soc.*, XXII, p. 54 (☿; holotype).

Vespa borealis W. Kirby, 1837, *Fauna Boreali-Americana*, IV, p. 264. Not *Vespa borealis* Zetterstedt, 1840; F. Smith, 1843; Lewis, 1897.

Vespa diabolica H. de Saussure, 1853, *Et. Fam. Vesp.* II, p. 138 (♀ ☿; North America).

LOCALITIES—Kaslo, Nelson, Osoyoos, Vernon, Glacier, Salmon Arm, Celista, Squilax, Adams Lake, Chase, Kamloops, Douglas Lake, Minnie Lake, Clinton, Bridge Lake, Chilcotin, Gang Ranch, Quesnel, Barkerville, Prince George, Smithers, Prince Rupert, Vancouver, Victoria.

MATERIAL EXAMINED—92♀, 180☿, 40♂.

This is the commonest of the yellow-jackets of British Columbia. From the specimens collected and the nests examined *V. arenaria* far outnumbers its xanthic variation *V. arenaria* var. *fernaldi*, although both can frequently be found mixed together in the same nest.

A large number of *arenaria* nests have been taken and the inhabitants identified. They have been found in every type of environment from nests well below ground and in house walls in complete darkness to semi-dark locations, such as in mouse nests, broken down root-houses, wells, and old buildings, to aerial nests hanging down from the boughs of trees at considerable heights, as well as in low bushes.

A short description of the following nests will illustrate this point.

In 1943, a year of great wasp abundance, three nests of typical *arenaria* were dug out of a ditch bank at Kamloops on August 17; on July 4 a nest was found in complete darkness, between the walls of a house. The wasps were entering through a knot hole and 14☿ were taken, all typical *arenaria*. Nests in semi-darkness were found in an old deserted building, hanging from the rafters, and another was hanging from the end of a log which had slipped down the mouth of an old well and was completely obscured from direct light by thick bushes. On July 20 a nest hanging from a birch limb, 8 ft. from the ground, was taken which contained many workers and two males but no queens and on August 8 another nest on a birch limb, 6 ft. from the ground was knocked down and some wasps caught in a net. They consisted of one male and 29 workers, all typical *arenaria*. From observations to date, it would seem that in British Columbia, this wasp nests in underground, or dark positions, very nearly as often as in open, exposed locations. J. Bequaert (1931) reports that it is questionable whether *V. arenaria* ever builts its nest actually underground or inside old stumps or logs. He also records that W. M. Wheeler and L. H. Taylor (1921) found that *Vespula adulterina* var. *arctica* Rohwer was an inquiline in the nests of *V. arenaria*.

This little yellow-jacket is particularly pugnacious and liable to sting when its nest is approached, and well deserves the name *diabolica* given by Saunders.

Vespula arenaria var. **fernaldi** (Lewis)

Vespa fernaldi Lewis, 1879, *Trans. Amer. Ent. Soc.*, XXIV, pp. 171 and 173 (♀ ☿; Colorado).

LOCALITIES — Vernon, Squilax, Adams Lake, Kamloops, Douglas Lake, Cedarvale, Vancouver, Courtenay.

MATERIAL EXAMINED—28♀, 35☿, 4♂.

As Bequaert (1931) states, this is merely a xanthic variation of *V. arenaria*, especially notable for the presence of two yellow spots on the propodeum.

The remarks concerning the nesting habits of *V. arenaria* apply equally well to the var. *fernaldi* and, as a matter of fact, no nests containing only *fernaldi* have as yet been seen by the authors.

The following descriptions of nests containing *fernaldi* which were taken and examined, will show the range of nesting sites.

On August 20, 1943, a nest was dug out of a ditch bank containing a large number of *arenaria,* of which about one third were var. *fernaldi.* On the same day another nest was taken from a beam in an old root-house, whose roof had caved in admitting some light. This nest contained many queens and workers and a few males, the great majority being var. *fernaldi.* On July 29, 1943, a small wasps' nest was found in a mouse nest on the surface of the ground under a pile of bark. It contained 5 workers of typical *arenaria,* and one queen and 26 workers of var. *fernaldi.* On September 18, 1943, a nest hanging from a dead poplar bough, eight feet from the ground, was examined. The wasps had been killed off by frost and only 1♀, 1☿ and 1♂ were found in the nest. The male was a typical *arenaria* and the queen and worker typical var. *fernaldi.*

So far very few var. *fernaldi* males have been seen, but whether this is the usual situation or mere coincidence, we do not know.

Vespula norwegica var. **norvegicoides** (Sladen).
Vespula norvegicoides Sladen, 1918, *Ottawa Naturalist,* XXXII, p. 71, (♀ ♂; Nova Scotia to British Columbia).

LOCALITIES—Revelstoke, Kamloops, Birch Island, Minnie Lake, Bridge Lake, Quesnel, Hazelton, Kitwanga, Tyee, Prince Rupert, Mt. Cheam, Agassiz, Vancouver, Courtenay.

MATERIAL EXAMINED—26♀, 15☿, 4♂.

As far as can be ascertained this is the only variety of *norwegica* so far recorded from British Columbia, but var. *albida* (Sladen) may occur in extreme northern B. C. as it has been recorded from Alaska and Yukon Territory as var. *marginata,* a synonym of *albida* (J. Bequaert, 1935).

Vespula adulterina (R. du Buysson).
Vespa norwegica var. *adulterina* R. du Buysson, 1905, *Ann. Soc. Ent. France,* LXXIII, (1904), pp. 600 and 628.
Vespa saxonica var. *adulterina* Bischoff, 1927, *Biologie der Hymenopteren,* p. 404, (suggests that it is a distinct species, parasitic upon *V. saxonica*).
Vespa adulterina Bischoff, 1931, *Mitt Deutsch. Ent. Geo.,* II, p. 6.
Pseudovespa adulterina Bischoff, 1931, *Sitzungsber, Ges. Naturf. Fr. Berlin,* (1930), pp. 330-334.
Vespula norvegica saxonica natio *colchica* Birula, 1930, *Ann. Mus. Zool. Ac. Sci. U.R.S.S.,* XXXI, 2, p. 314.

LOCALITIES — Summerland, Vernon, Minnie Lake, Bridge Lake, Vancouver.

MATERIAL EXAMINED—8♀.

Of this wasp J. Bequaert (1931) states: "*V. adulterina* and its var. *arctica* are inquilines or social parasites, which lack the worker phase and have their brood reared by other social species of *Vespula.* They are, in the subgenus *Dolichovespula,* the exact counterpart of *V. austriaca* (Panzer) in the subgenus *Vespula,* proper."

On July 21, 1944, a small wasps' nest about the size of a golf ball, was found on the ground under a piece of board, near Minnie Lake in the Nicola Valley. A cyanide jar was placed over this nest before any of the inmates could escape. On examination it was found to contain four very small workers of *V. arenaria* and a female *V. adulterina* with its wings gnawed off at their bases, but no *arenaria queen.* It is assumed that when the *adulterina* entered so small a nest the *arenaria* queen had gnawed off the intruder's wings, but had herself been killed in the ensuing fight, or driven away.

Vespula adulterina var. **arctica** Rohwer.
Vespula (Dolischvespula) arctica Rohwer, 1916, in Viereck, *Guide to the Insects of Connecticut,* III, Hymenoptera, p. 642 (new name for *Vespa borealis* Lewis).
Vespa borealis Lewis, 1897, *Trans. Amer. Ent. Soc.,* XXIV, pp. 171 and 174. Not *Vespa borealis* W. Kirby, 1837.

LOCALITIES—Kaslo, Minnie Lake, Prince Rupert.

MATERIAL EXAMINED—2♀, 1♂.

This wasp, var. *arctica,* is said to be a permanent social parasite in the nests of *V. arenaria* where its brood, consisting only of males and fertile females, are reared by the *arenaria* workers.

Subfamily POLISTINAE

"The *Polistinae* are a cosmopolitan group consisting of a single genus, *Polistes,* with many, rather closely allied species. In the Nearctic Regina this genus comprises not more than half a dozen species distinguishable by peculiarities of structure; but some of these species vary tremendously in color (Bequaert, 1932). In all social species of *Polistes* with which I am acquainted, the workers (when present) and fertile females (or queens) are alike, both in structure and color and often also in size. It is generally assumed that the smaller females, sometimes found in the colony, are workers. Moreover, even unmated females (or workers) may occasionally lay eggs, which develop by parthenogenesis into male wasps." (Bequaert, 1940).

Only one species, *Polistes fuscatus* (Fabricius), occurs in Canada. This species has been divided into some 18 colour forms (Bequaert, 1940), of which, only *Polistes fuscatus* var. *aurifer* de Saussure and *Polistes fuscatus* var. *montanus* Bequaert, and intermediates between these forms, are found in British Columbia.

One specimen of *Polistes fuscatus* var. *pallipes* Lepeletier was collected by Mr. L. W. Cockle (27.X.1907) at Kaslo, on Kootenay Lake. The determination was made by Dr. J. Bequaert, who states that it was no doubt an accidental introduction from the Eastern (Atlantic) area. As it was taken in late October, it could easily have reached Kaslo in a packing case or parcel into which it had crawled for hibernation.

Genus POLISTES Latreille

Polistes fuscatus var. **aurifer** de Saussure.

LOCALITIES — Cranbrook, Kitchener, Creston, Kaslo, Oliver, Penticton, Vernon, Salmon Arm, Kamloops, Walhachin, Victoria, Shalalth, Vancouver, Lytton, Lillooet, Chilcotin (G. J. Spencer, 26.V.1929, 1♀, 52°N.), farthest north for any American *Polistes* (Bequaert, 1940).

MATERIAL EXAMINED—61♀☿, 20♂.

Bequaert (1940) records *aurifer* as the common form of the species throughout California, Oregon and Washington, extending well into southern British Columbia, as well as into Idaho and Nevada. The collection records show that this colour form occurs from the Alberta boundary westward through the Kootenay district, the Okanagan Valley, the southern interior to the Pacific coast and Vancouver Island, and north up the Fraser River to Lytton, Lillooet and Chilcotin.

Polistes fuscatus var. **montanus** Bequaert.

LOCALITIES — Fairmont, Creston, Keremeos, Summerland, Vernon, Salmon Arm, Kamloops, Walhachin, Lillooet, Powell River, Victoria, Departure Bay, Cowichan Lake.

MATERIAL EXAMINED—23♀☿, 10♂.

Bequaert (1940) recorded *montanus* from Montana, Idaho and Oregon. In southern British Columbia it has been taken by the authors from the Alberta boundary to Vancouver Island.

Transitional between **aurifer** and **montanus**

LOCALITIES—Oliver, Summerland, Vernon, Salmon Arm, Kamloops, Walhachin, Lillooet.

MATERIAL EXAMINED—62♀☿.

Polistes fuscatus is a very common wasp in southern British Columbia and is particularly conspicuous in early spring, as it is one of the earliest of all hibernating insects to appear. At this time it may be seen crawling sluggishly about on pavements and walls, and appears in buildings where it has been hibernating. The overwintering queens will be active a month or six weeks ahead of any of the yellow-jackets or hornets.

In temperament, it is the reverse of the yellow-jackets, being a slow-moving, friendly insect, whose nest may be approached without much chance of being attacked.

It is very fond of attaching its uncovered, single layer of cells, to the ceiling of sheds, where the light is subdued. Sometimes a number of *Polistes* nests may be seen in close proximity under the same roof.

Subfamily POLYBIINAE

The *Polybiinae* are essentially a tropical subfamily. Only three species are known to occur within the United States, and of these, only one, *Mischocyttarus flavitarsis* (H. de Saussure) extends into Canada (Bequaert, 1932).

Genus MISCHOCYTTARUS H. de Saussure

Mischocyttarus flavitarsis var. **idahoensis** Bequaert.

LOCALITIES — Victoria, Goldstream, Nanaimo, Newcastle, Saanich, on Vancouver Island; Pender Harbour, Vancouver, Lytton, Walhachin, Kamloops, Salmon Arm, Vernon, Kelowna, Westbank.
Bequaert (1932) records Sooke Rock and Danby on Vancouver Island and the following additional mainland localities:

Osoyoos, Oliver, Keremeos, Summerland, Westbank, Okanagan Falls and Lillooet.

MATERIAL EXAMINED—22♀☿, 7♂.

This wasp is not as common as *Polistes fuscatus* but is generally distributed over southern British Columbia and Vancouver Island, and is the only form of the species occurring in the Province.

It is similar in appearance and habits to *Polistes fuscatus,* but may be distinguished by the first abdominal segment being much narrower than the remainder of the abdomen, forming a long and slender petiole.

The nests of *M. flavitarsis* are said to be small, single-combed, un-enveloped paper nests, usually smaller than *Polistes,* placed under rocks, logs, caves, banks and in buildings, and its food to consist largely of insects. (Bequaert, 1932).

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Arranged alphabetically: the numbers corresponding to those on the accompanying map. (V. I. = Vancouver Island.)

1. Adams Lake	20. Departure Bay, V. I.	39. Lytton	58. Saanich, V. I.
2. Agassiz	21. Douglas Lake	40. Minnie Lake	59. Salmon Arm
3. Alexandria	22. Fairmont	41. Mt. Cheam	60. Shalalth
4. Barkerville	23. Fairview	42. Nanaimo, V. I.	61. Sidney, V. I.
5. Beavermouth	24. Field	43. Nelson	62. Skidegate
6. Birch Island	25. Gang Ranch	44. Newcastle, V. I.	63. Smithers
7. Bridge Lake	26. Glacier	45. Okanagan Falls	64. Squilax
8. Buccaneer Bay	27. Goldstream, V. I.	46. Okanagan Landing	65. Sooke, V. I.
9. Burns Lake	28. Grantham's Landing	47. Oliver	66. Summerland
10. Canim Lake	29. Hazelton	48. Osoyoos	67. Terrace
11. Cedarvale	30. Hope	49. Pender Harbour	68. Tyee
12. Celista	31. 100 Mile House	50. Penticton	69. Vancouver
13. Chase	32. Kamloops	51. Powell River	70. Vernon
14. Chilcotin	33. Kaslo	52. Prichard	71. Victoria
15. Clinton	34. Kelowna	53. Prince George	72. Walhachin
16. Courtenay, V. I.	35. Keremeos	54. Prince Rupert	73. Westbank
17. Cowichan Lake, V. I.	36. Kitchener	55. Quesnel	74. Yale
18. Cranbrook	37. Kitwanga	56. Revelstoke	
19. Creston	38. Lillooet	57. Royal Oak, V. I.	

BOOK REVIEW

"A Century of Entomology in the Pacific Northwest," by Melville H. Hatch, University of Washington Press, Seattle 5. $1.50.

In this little book of 43 pages Dr. Hatch has brought together for the first time the facts relating to the development of entomology in the States of Oregon, Washington and the Province of British Columbia. The work of assembling this information has obviously entailed considerable research and the author has succeeded very effectively in synchronizing the events leading to the gradual development of entomological work in the different parts of the Pacific Northwest.

The book is divided into five chapters dealing with periods of development; first, the period of itinerant collectors, then the period of resident collectors who laid the foundation of our entomological societies; then the period of established laboratories, showing the growth of applied entomology in this region from small beginnings to gradual broadening of the work in recent years. We regret that, in this chapter, mention has not been made of the names of Dr. W. H. Brittain and his assistant Mr. M. H. Ruhmann, the first entomologists to be appointed by the Government of British Columbia. Dr. Brittain held the dual position of Provincial Entomologist and Plant Pathologist at Vernon from 1912 to 1913 when he resigned on accepting the post of Provincial Entomologist for Nova Scotia. Mr. Ruhmann was appointed assistant to Dr. Brittain in 1912 and, when the direction of entomological work was taken over by R. C. Treherne under the Dominion Government, after Dr. Brittain's departure, he continued in the position of Assistant Provincial Entomologist until his death in 1943.

In other respects we find that full recognition has been given to the work of British Columbia entomologists. Chapter four describes the expansion of entomological work from 1930 until the present time and a short chapter is devoted to enumeration and description of the insect collections in the Pacific Northwest. The book is illustrated with portraits of several noted men who played a prominent part in founding the structure of our present day entomological organizations and many facts of historical interest are recorded. For reference purposes Dr. Hatch's book will be of value and interesting to all who are presently engaged or who have taken part in entomological work in the Pacific Northwest.—W. Downes.

A NOTE ON REARING, FROM LARVAE, SARBENA (ROESELIA) MINUSCULA ZELL

On three occasions while "beating" Garry Oak **Quercus garryana** Dougl., in the Uplands District of Victoria, B. C., the writer obtained larvae which proved to be **Sarbena minuscula** Zell. The first time was on August 1, 1946, when 11 larvae were secured. These were "sleeved" on Oak in the writer's garden, but although they showed evidence of feeding, they failed to mature. The next occasions were on July 3, 1947, when 39 larvae were taken, and on July 17, 1947, when 14 more were added to the batch.

Slightly different treatment for rearing the larvae was used. A ten-inch flower-pot was prepared, with about six inches of earth at the bottom into which a small glass bottle for water was firmly fixed to supply the food plant with moisture. Moss mingled with bits of lichen was then placed loosely over the earth in the pot together with lichen-covered branches of oak and a good supply of fresh oak foliage.

The larvae were observed to feed on the foliage to a considerable extent, and they reached maturity and cocooned amongst the lichen, chiefly that upon the small pieces of branch supplied. The cocoons were wintered in the same flower-pot, on a porch with a northerly aspect, where they were exposed to cold and wind, but sheltered from rain or snow. Twenty-two imagines were obtained the following season between May 30 and June 4, 1948.

It would appear that successful breeding depends on the presence of lichen together with the food plant, though the foliage of the oak is undoubtedly eaten by the larvae to a considerable extent. Possibly they require the lichen only when near maturity, and chiefly as a medium in which to construct their small and cleverly concealed cocoons. It may also afford some moisture, necessary to the safe appearance of the imagines the following season. — J. R. J. Llewellyn Jones, Cobble Hill, B. C.

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ACARICIDE TRIALS IN BRITISH COLUMBIA ORCHARDS, 1950[1]

R. S. DOWNING[2]
Dominion Entomological Laboratory, Summerland, B. C.

Although the two acaricides parathion and monoethanolamine dinitro-o-cyclohexylphenolate, presently being recommended for British Columbia orchards, are reasonably effective, each has shortcomings that mark it for replacement as soon as possible. Parathion, first recommended for the control of orchard mites in 1949, has a serious disadvantage in its high toxicity to mammals. Furthermore, it lacks specificity and it is not sufficiently effective against the Willamette mite, *Tetranychus flavus* Ewing. Monoethanolamine dinitro-o-cyclohexylphenolate, commonly called mono-DNP by British Columbia growers, may cause some foliage injury. Although it seems to be a selective acaricide, largely innocuous to parasites and insect predators, it can no longer be used generally because most of the spraying is done by automatic concentrate sprayers and these machines increase phytotoxic effects. A second weakness of mono-DNP is its relatively weak acaricidal effect in cool weather. Hence it cannot be used in the "pink"[3] application, which, in British Columbia, is the most favoured spray against the European red mite, *Metatetranychus ulmi* (Koch). Furthermore, mono-DNP is sometimes injurious to the tender young foliage of the early part of the season even when applied by conventional spray gun.

During the season of 1950, field experiments were undertaken with promising new acaricides against the most troublesome orchard mites in the Okanagan Valley of British Columbia. The new acaricides and their performance in the orchard are discussed herewith.

Acaricides under Trial[4]

C-1006 (50 per cent p-chlorophenyl p-chlorobenzene sulphonate; Dow Chemical Co.).—This compound has a low human toxicity rating but a high phytotoxicity rating. Applied to apples in the pink stage at a concentration of 1.5 pounds[5], it caused severe foliage injury to McIntosh, Delicious, Newtown and Winesap. When applied in August at 1 pound it injured Newtown but not Delicious and Winesap.

EPN 300 (27 per cent ethyl p-nitrophenyl thionobenzene phosphonate; E. I. DuPont Co.).—Although EPN 300 has a lower human toxicity rating than parathion, it is, nevertheless, very poisonous. When applied to apple in the pink stage at 0.75 pounds, it injured foliage of McIntosh but not of Delicious, Newtown or Winesap.

KARATHANE (25 per cent dinitro capryl phenyl crotonate; Rohm and Haas Co.).—As a pink application to apple at 1.5 pounds, this dinitro compound has not caused foliage injury to Delicious, McIntosh, Winesap, Jonathan or Newtown, but applied to Newtown in August at the same concentration it caused a slight amount of foliage injury.

R-242 (50 per cent p-chlorophenyl phenyl sulphone; Stauffer Chemical Co.). — This compound has a low human toxicity rating and as a pink or summer application to apple, at 2 pounds, has not caused injury to Delicious, McIntosh, Newtown, Winesap or Jonathan.

ARAMITE (15 per cent beta-chloroethyl beta-(p-tertiary butylphenoxy) alpha methyl ethyl sulphite; Naugatuck Chemicals).—Aramite is rated low in toxicity to humans; and as a pink or summer application, at 2 pounds, has not injured Delicious, McIntosh, Newtown, Winesap or Jonathan.

Effects of Acaricides on Orchard Mites

European Red Mite, *Metatetranychus ulmi* (Koch).—Since the introduction of DDT, this mite has been one of the

[1] Contribution No. 2746, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

[2] Technical Officer.

[3] The term pink is used to denote that period of development when the floral buds have just separated in the cluster and before the first flower has opened.

[4] All acaricides were used in the wettable powder form.

[5] All concentrations are for 100 imperial gallons (approximately 120 U.S. gallons).

OCT 16 1951

most troublesome orchard pests in the Okanagan Valley. Experimental work carried out by officers of the Summerland laboratory has shown that parathion applied at the pink stage of apple development is highly effective against the red mite. In 1950, several of the newer acaricides were applied at that stage for comparison with parathion. No further acaricide applications were made until the first week in September, when acaricides had to be applied for the control of the two-spotted spider mite. Mite populations were sampled two weeks, one month, and two months after spraying. The results from three orchards are averaged and summarized in Table 1.

TABLE I

Effects of pink application of acaricides on the European red mite; materials applied by a conventional hand-gun sprayer.

Acaricide	Amount per 100 gal.	Average number of mites per leaf during season
C-1006 (50%)	1.5 lb.	0.17
Parathion (15%)	1.0 lb.	0.34
EPN 300 (27%)	0.75 lb.	0.40
R-242 (50%)	1.5 lb.	0.44
Karathane (25%)	1.5 lb.	1.88
Check—no treatment		6.74

Two-Spotted Spider Mite, *Tetranychus bimaculatus* Harvey; and Pacific Mite, *Tetranychus pacificus* McG.—These mites are considered together because they generally coexisted in 1950 and occurred together in the trial plots.

The two-spotted spider mite was not a major pest of Okanagan Valley orchards until August, 1950, when it became most troublesome and widespread. The Pacific mite was also more abundant than for several years past. In fact, as pests these two mites replaced the European red mite in importance.

An experiment was carried out to compare several new acaricides with parathion for control of these two species of mites on Delicious, Newtown, Winesap, Jonathan and Yellow Transparent apple trees. The results are summarized in Table II.

TABLE II

Effects of acaricides on the two-spotted spider mite and the Pacific mite; materials applied by a conventional hand-gun sprayer in August, 1950.

Acaricide	Amount per 100 gal.	Average mites per leaf: Before spraying Aug. 29	After spraying Sept. 8	Sept. 13
Aramite (15%)	2 lb.	13.7	0.2	0.4
Parathion (15%)	1 lb.	22.3	0.3	0.6
C-1006 (50%)	1 lb.	39.4	1.8	0.5
R-242 (50%)	2 lb.	30.3	2.3	2.9
Karathane (25%)	1.5 lb.	46.4	3.4	3.3
Check—no treatment		8.0	13.4	18.5

Willamette Mite, *Tetranychus flavus* Ewing.—This pest, first reported in the Okanagan Valley in September, 1949, at Summerland, has been found since then at Oliver, Penticton, and Kelowna.

Early in 1950, before the mite had an opportunity to do a great deal of damage, a few materials, some of which were available to the grower, were applied to single limbs of Delicious apple trees in a preliminary experiment. Before and after the materials had been applied, 10 leaves were picked at random from each of the treated limbs. The leaves were examined for mites under a microscope. Results are summarized in Table III.

TABLE III

Effects of acaricides on the Willamette mite; materials applied by a conventional hand-gun sprayer in July, 1950.

Material	Amount per 100 gal.	Average number mites per leaf Before spraying July 5	After spraying July 10
Parathion (15%)	1 lb.	2.3	0
Dinitro-o-cyclohexyl phenol (40%)	5 oz.		
Parathion (15%)	1 lb.	5.3	0
Stove oil[6]	1 qt.		
Parathion (15%)	2 lb.	14.9	0.2
Dinitro-o-cyclohexyl phenol (40%)[7]	5 oz.	9.2	0.2
EPN 300 (27%)	1.5 lb.	19.1	0.5
Check—Water		5.4	10.1

6 34 S.S.U. Vis. 100°F., over 75% U.R.

7 DN-Dry Mix No. 1. Dow Chemical Co., Toronto, Ont.

As an outcome of this experiment, a mixture of 15 per cent parathion, 8 pounds per acre, and 40 per cent dinitro-o-cyclohexylphenol, 2 pounds per acre, was applied to Delicious apple trees by an automatic concentrate sprayer. Excellent control was achieved; the Willamette mite remained at a very low level for seven weeks. Spray injury was confined to sucker growth. In another orchard heavily infested with the Willamette mite, two parathion-dinitro mixtures were applied with an automatic concentrate sprayer. In one plot parathion was maintained at 8 pounds per acre and in a second plot it was reduced to 3 pounds per acre. There was little difference in degree of control between the two plots.

In another experiment three of the new acaricides were compared with parathion alone. Four trees were sampled in each plot of 15 to 20 trees. Samples from each tree consisted of 100 leaves, and an estimation of effectiveness was made from the number of infested leaves. The toxicants were applied with an automatic concentrate sprayer in August, 1950. Results are summarized in Table IV.

TABLE IV

Effects of acaricides on the Willamette mite; materials applied by an automatic concentrate sprayer in August, 1950.

Acarcide	Amount per acre	Percentage infested leaves Before spraying Aug. 24	After spraying Aug. 31	Sept. 1
Aramite (15%)	12 lb.	84.2	1.7	0
Karathane (25%)	12 lb.	97.5	0.5	0.2
R-242 (50%)	12 lb.	99.2	39.0	41.7
Parathion (15%)	8 lb.	90.5	60.2	61.5
Check—no treatment		99.2	96.2	97.0

Summary

(1) During 1950, five new, promising acaricides were compared with parathion for control of various mites in orchards of British Columbia. These were:

C-1006 (50 per cent p-chlorophenyl p-chlorobenzene sulphonate).

EPN 300 (27 per cent ethyl p-nitrophenyl thionobenzene phosphonate).

KARATHANE (25 per cent dinitro capryl phenyl crotonate).

R-242 (50 per cent p-chlorophenyl phenyl sulphone).

ARAMITE (15 per cent beta-chloroethyl beta-(p-tertiary butyl phenoxy) alpha methyl ethyl sulphite).

(2) C-1006 has a low human toxicity rating but a rather high phytotoxicity rating. At 1.5 pounds per 100 gallons, it was the most effective acaricide used in the pink application for control of the European red mite. When used as a summer spray at 1 pound, it

gave excellent control of the two-spotted spider mite and the Pacific mite.

(3) EPN 300 has a high human toxicity rating and a medium phytotoxicity rating. When applied in the pink stage at 0.75 pounds it gave good control of the European red mite although it was somewhat inferior to 1 pound of parathion. At 1.5 pounds it gave considerably better control of the Willamette mite than 1 pound of parathion.

(4) KARATHANE applied at the rate of 1.5 pounds was not so effective as 1 pound of 15 per cent parathion when used as a pink application for control of the European red mite, or when used in summer applications for control of the two-spotted spider mite and the Pacific mite. When applied in the summer by an automatic sprayer at 12 pounds per acre, however, it gave excellent control of the Willamette mite. Although it caused a very slight amount of damage to Newtown apple trees in August, it has a low phytotoxicity rating.

(5) R-242 has a low human toxicity rating and a low phytotoxicity rating. At 1.5 pounds, it was slightly less effective than 1 pound of parathion (15 per cent) when used as a pink application for control of the European red mite. When used in the summer at 2 pounds it was not so effective as 1 pound of parathion for control of the two-spotted spider mite and the Pacific mite. When used at 12 pounds per acre in a concentrate sprayer, however, it was slightly more effective against the Willamette mite than 8 pounds of parathion.

(6) ARAMITE has a low human toxicity rating and low phytotoxicity rating. When applied in the summer at 2 pounds, it gave excellent control of the two-spotted spider mite and the Pacific mite. Also, when applied by a concentrate sprayer at 12 pounds per acre, it gave excellent control of the Willamette mite.

NOTES ON THE SPRING ACTIVITY OF THE ROCKY MOUNTAIN WOOD TICK, DERMACENTOR ANDERSONI STILES (ACARINI: IXODIAE)[1]

J. D. GREGSON

Livestock Insect Laboratory, Kamloops, B. C.

One of the remarkable features in the life-cycle of the Rocky Mountain wood tick, *Dermacentor andersoni* Stiles, in British Columbia is the annual appearance of adults at the beginning of spring and their regular disappearance about the middle of May. Such seasonal periodicity is natural for most insects, of which the adult stage is generally of short duration. However, ticks usually live longer than insects, and it would be expected that adults of the Rocky Mountain wood tick, which are herewith shown to be capable of living for at least 1 year, which continue to be active as long as the weather remained favourable. Such is not the case, however, and though in Alberta and in the damper regions of British Columbia adults of this species may be active as late as June, in the British Columbia dry-belt they disappear regularly in May, regardless of how moist or cool the prevailing atmospheric conditions are. It is suggested that some form of diapause must take effect, releasing its hold only after another winter has passed.

In the Interior of British Columbia the Rocky Mountain wood tick is distributed throughout the greater part of the dry bunch-grass open-land. Its peak abundance may vary, depending on the locality, from sparse populations to heavy concentrations. The latter occur in scattered parts of the Province where host and climatic conditions are apparently particularly ideal for tick development and survival. One such site is at Rayleigh, 10 miles north of Kamloops, B. C., where there is an extensive talus slope backed by a rocky bluff 200 feet high. The narrow belt of vegetation at the base of the cliff, besides harbouring a variety of rodent life, seems regu-

1 Contribution No. 2717, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

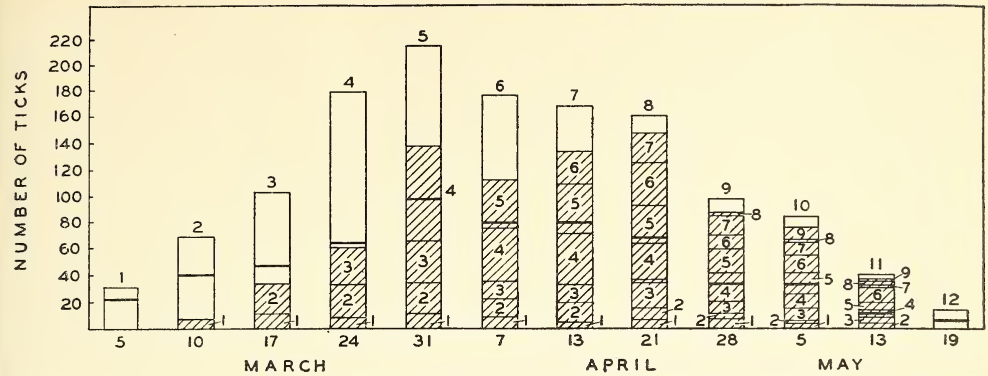

Fig. 1. Weekly collections of the Rocky Mountain wood tick, **Dermacentor andersoni** Stiles, at Rayleigh, B. C., during the spring of 1949. The hatched portions represent the numbers of marked ticks recaptured, the numerals indicating those of the various weeks. The dark horizontal lines indicate the numbers of males.

larly to have a copious supply of adults of *andersoni*, despite large annual collections for laboratory use. For the past 6 years their earliest appearance has been recorded on the following dates: 1945, Feb. 24; 1946, Feb. 26; 1947, Feb. 19; 1948, Mar. 17; 1949, Feb. 25; 1950, Feb. 27.

During 1949 and 1950 an attempt was made to show their rise, peak and decline of activity by counting and releasing all specimens as soon as they were collected on the drag, i.e., a square yard of flannelette that is swept over the vegetation in the manner of a flag. In addition, to determine whether the earliest ticks would be the first to disappear, each week's collections in 1949 were marked with a different colour of Fleet-X automobile enamel, a slow-drying Duco-like paint. The results of these observations are illustrated in Fig. 1, in which the number of marked ticks for each week is indicated. The activity of the ticks is shown to be equally late, regardless of when they appeared.

It must be noted that the data for the weekly periods of activity cannot be entirely accurate, for only a fraction of each week's marked specimens was recaptured. The recoverable portion appeared to be rather constant and in the neighbourhood of 40 per cent. Accordingly it is reasonable to assume that some 60 per cent of each week's active ticks, both old and new, are not recovered, and that the following week's unmarked specimens have not all recently hatched or emerged from hibernation. This incomplete recovery is explained by the fact that the ticks do not constantly present themselves in favourable positions for transference to a host or may have already attached themselves to hosts. Casual observations during sunny days have revealed that they very actively run about on the ground, and climb up twigs, only to descend again. Such individuals would not be readily available for capture on the drag and would account for the fact that often when one sits for a few minutes he or his drag picks up several specimens not otherwise detectable. This activity, which is contrary to the impression gained from the usual appearance of ticks waiting motionless at the tops of grass stems, leads to a certain amount of dispersal, and marked specimens were recovered nearly 20 feet from their point of liberation 2 weeks previously. Other individuals showed no tendency to roam, and week after week were observed at the same clump of grass.

Collections of ticks in the same area the following spring (Fig. 2) have shown nearly 8 per cent of the previous season's marked ticks still active, this figure being the percentage for the greatest number (40) of marked ticks taken at one time (April 17, 1950) of the total number (530) of ticks marked in the previous year. Since no attempt was made to re-mark the 1950 captures, it is not known how many others were collected on other days and it is likely that this percentage is even higher. The

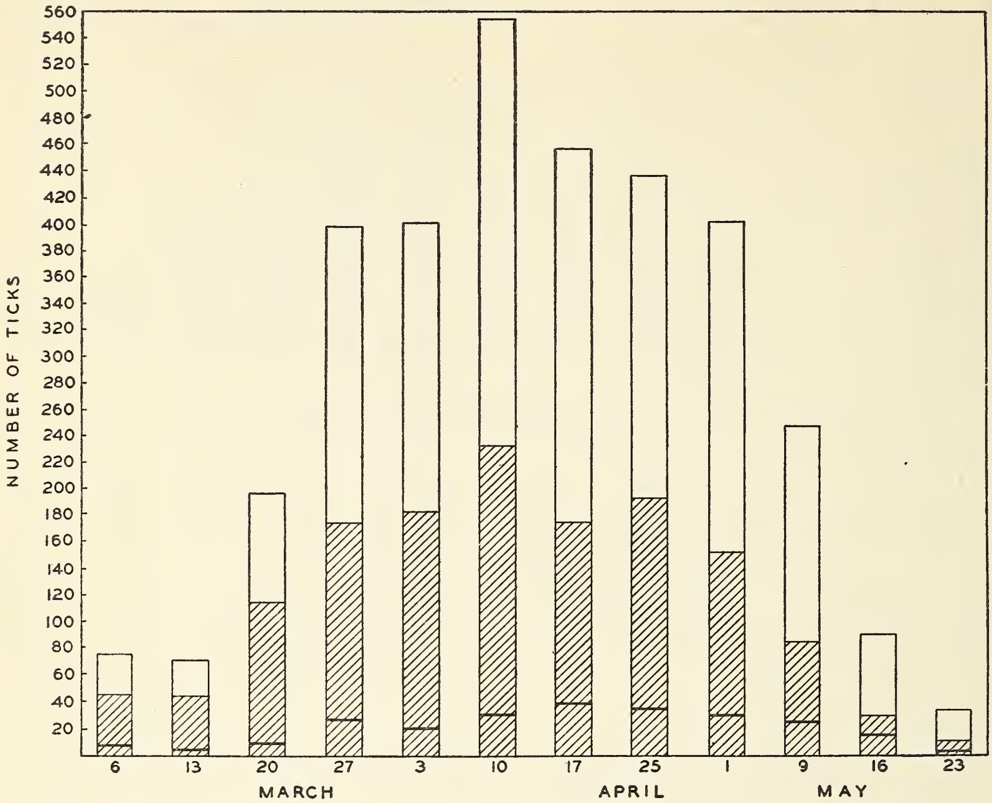

Fig 2. Weekly collections of the Rocky Mountain wood tick at Rayleigh, B. C., during the spring of 1950. The dark horizontal lines indicate the numbers of 1949 marked ticks recaptured. The hatched areas represent the numbers of males.

year-old ticks were virile enough to persist to the end of the tick season. That the remaining 1950 adults were new stock moulted from nymphs that had fed during the previous summer is suggested by the early appearance of the males, a phenomenon common in the first appearance of various species of insects.

The nearly equal ratio of the sexes and the earlier appearance and disappearance of the males are shown in Figs. 1 and 2. The peak of tick activity fell approximately at the end of March in 1949 and on April 10 in 1950. This is in keeping with the relative earliness of the two seasons, the spring of 1950, as indicated by phenological observations, being approximately a week later than that of 1949. The main period of tick activity lasted from the height of the flower season of the common dry-belt buttercup, *Ranunculus glaberrimus* and of the johnny-jump-up, *Fritillaria pudica,* to the appearance of blossoms of saskatoon, *Amelanchier* sp. and of Oregon-grape, *Mahonia nervosa.* Activity ceased with the blooming of the chokecherry, *Prunus demissa.* The reason for the apparent great increase in the tick population at Rayleigh in 1950 is unexplained.

What causes the ticks to disappear toward the middle of May is not known. A study of the temperature and humidity fluctuations recorded during their activity reveals no striking change that could account for their sudden decline. Disappearance due to a gradual aging or depletion of energy is ruled out by their reappearance the following year without having had a meal in the interim.

Observations were made to determine the fate of these ticks after activity. A number of adults were enclosed in a cage over talus 3 feet deep from the time they became active in 1949 until the following spring. All that were recovered (15 per cent) were found dead in the upper inch of leaf mould, suggesting that the ticks do not seek protection from winter by descending to any depth in loose rock. Because of the presence of the cage, the ground surface was not protected by snow, with the result that it was exposed to a temperature of –40° F. However, temperature readings taken at a depth of 1 foot in the talus beneath the cage did not go below 32° F. The only adult found in its apparently natural site of hibernation was an unengorged female, located by accident in November under a small rock at ground level. Careful search during summer months in the areas where concentrations of ticks had been liberated the previous spring has, however, revealed specimens among the decaying roots of bunch grass, *Agropyron* sp., substantiating the theory that adult aestivation and hibernation are spent at shallow levels.

In conclusion, it has been shown that a portion of these ticks are capable of living more than 12 months as unfed adults, passing the winter under the protection of snow. The disappearance of all the ticks in late spring is apparently due not to normal aging but to some form of diapause, the cause of which is not known.

RECORDS OF BEES FROM BRITISH COLUMBIA: BOMBIDAE[1]

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This paper records 26 species, 14 named varieties, and 10 colour variants of *Bombus* and 4 species of *Psithyrus* from British Columbia. Of the 5326 specimens here recorded, 4641 belong to *Bombus*, and 685 to *Psithyrus*.

These records have been compiled from the collections in the Dominion Entomological Laboratory, Kamloops, B. C.; the University of British Columbia, Vancouver, B. C.; and the Provincial Museum, Victoria, B. C.; and from the Canadian National Collection, Ottawa, Canada, as well as from some records in publications by Franklin and Frison, and some unpublished notes by Frison. Almost all of the records obtained from the Canadian National Collection were from specimens determined by Frison.

These bumble bees were collected by 97 collectors during 50 years from 142 localities; except F. W. L. Sladen, E. R. Buckell, and G. J. Spencer, they paid little attention to taxonomy of bees, and their material was obtained in the course of general collecting. The localities are listed and their corresponding numbers placed on the accompanying map.

The collection points are mainly in the southern half of the Province, and vast areas in the north have not yet been visited by collectors. This, of course, is due to the fact that there are no roads, railways, or other ready means of entering these areas.

There are no collection records from the Queen Charlotte Islands, but several species must occur there as they have been taken on the adjacent mainland and on islands off the Alaskan coast.

After the name of each species the number of localities in which it has been taken, the number of each sex, and the total number of specimens recorded are indicated, e.g.: (26: 80♂ 39♀ 83☿—202).

The author wishes to thank all those who have helped in the preparation of this paper, either by the loan of material or in providing species determination or locality records. Thanks are particularly due to Mr. K. V. Krombein, Division of Insect Identification, Bureau of Entomology and Plant Quarantine, Washington, D. C., for the determination of material, and to Dr. O. Peck, Division of Entomology, Department of Agriculture, Ottawa, Canada, for the British Columbia records in the Canadian National Collection.

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2 Retired November 1, 1949.

TABLE I

Localities from which Bombidae have been recorded in British Columbia. The numbers correspond to those on the accompanying map. (V. I.=Vancouver Island.)

1. Adams Lake
2. Agassiz
3. Alberni, V. I.
4. Alexis Creek
5. Armstrong
6. Arras
7. Ashcroft
8. Aspen Grove
9. Atlin
10. Barkerville
11. Bella Coola
12. Boston Bar
13. Boswell
14. Bridge Lake
15. Buccaneer Bay
16. Burns Lake
17. Canim Lake
18. Carbonate
19. Cedarvale
20. Celista
21. Centurian
22. Chapmans
23. Chase
24. Chilcotin
25. Chopaka
26. Clinton
27. Comox, V. I.
28. Copper Mountain
29. Courtenay, V. I.
30. Cowichan, V. I.
31. Cranbrook
32. Crescent
33. Creston
34. Crows Nest
35. Departure Bay, V. I.
36. Duncan, V. I.
37. East Pine
38. Fairview
39. Fernie
40. Field
41. Fitzgerald, V. I.
42. Forbidden Plateau, V. I.
43. Fort Steele
44. Fraser Lake
45. Glacier
46. Golden
47. Goldstream, V. I.
48. Hat Creek
49. Hazelton
50. Hedley
51. Hope
52. Hope Mountain
53. Hudson Hope
54. 100 Mile House
55. Invermere
56. Inverness
57. Jesmond
58. Jordan Meadows, V. I
59. Kaleden
60. Kamloops
61. Kaslo
62. Kelowna
63. Keremeos
64. Kitchener
65. Kitwanga
66. Ladysmith, V. I.
67. Langley
68. Lardo
69. Lillooet
70. Lumby
71. Lytton
72. Macalister
73. Manning Park
74. Merritt
75. Metlakatla
76. Midday Valley
77. Milner
78. Minnie Lake
79. Mission
80. Mount Arrowsmith, V. I.
81. Mount Cheam
82. Mount McLean
83. Nanaimo, V. I.
84. Nelson
85. Newcastle Is.
86. Newgate
87. New Westminster
88. Nicola
89. Okanagan Falls
90. Okanagan Mission
91. Oliver
92. Osoyoos
93. Oyama
94. Pacific
95. Peachland
96. Pender Harbour
97. Penticton
98. Pouce Coupe
99. Powell River
100. Premier Lake
101. Prince George
102. Prince Rupert
103. Quesnel
104. Quick
105. Radium
106. Revelstoke
107. Rogers Pass
108. Rolla
109. Royal Oak, V. I.
110. Saanich, V. I.
111. Sahtlam, V. I.
112. Shawnigan, V. I.
113. Salmon Arm
114. Salvus
115. Savona
116. Shuswap
117. Sicamous
118. Sidney, V. I.
119. Smithers
120. Soda Creek
121. Sooke, V. I.
122. Stanley
123. Stikine
124. Sugar Lake
125. Summerland
126. Terrace
127. Tofino, V. I.
128. Trinity Valley
129. Tyee
130. Ucluelet, V. I.
131. Vancouver
132. Vanderhoof
133. Vaseaux Lake
134. Vernon
135. Victoria, V. I.
136. Walhachin
137. Wellington, V. I.
138. Westbank
139. Westholme, V. I.
140. White Lake
141. Williams Lake
142. Yale

The Province of British Columbia, 355,855 square miles in area, is approximately the same size as the Pacific States of Washington, Oregon, and California. It is a land of mountains, valleys, and lakes, with a wide altitudinal range and extending over 11 degrees of latitude.

These topographical features have a marked influence on climatic conditions, and the vegetation varies from the humid luxuriance of the southern coastal region to the semi-arid, cactus, and sagebrush areas of the interior plateau. The close succession of markedly different geographical features has produced a wide variety of plant and animal associations, and many species of insects, including the bumble bee, are often confined to widely scattered but similar habitats.

MAIN GEOGRAPHICAL AREAS

For the purposes of this paper, the following are the main geographical areas of British Columbia, with a brief description of ecological conditions in each.

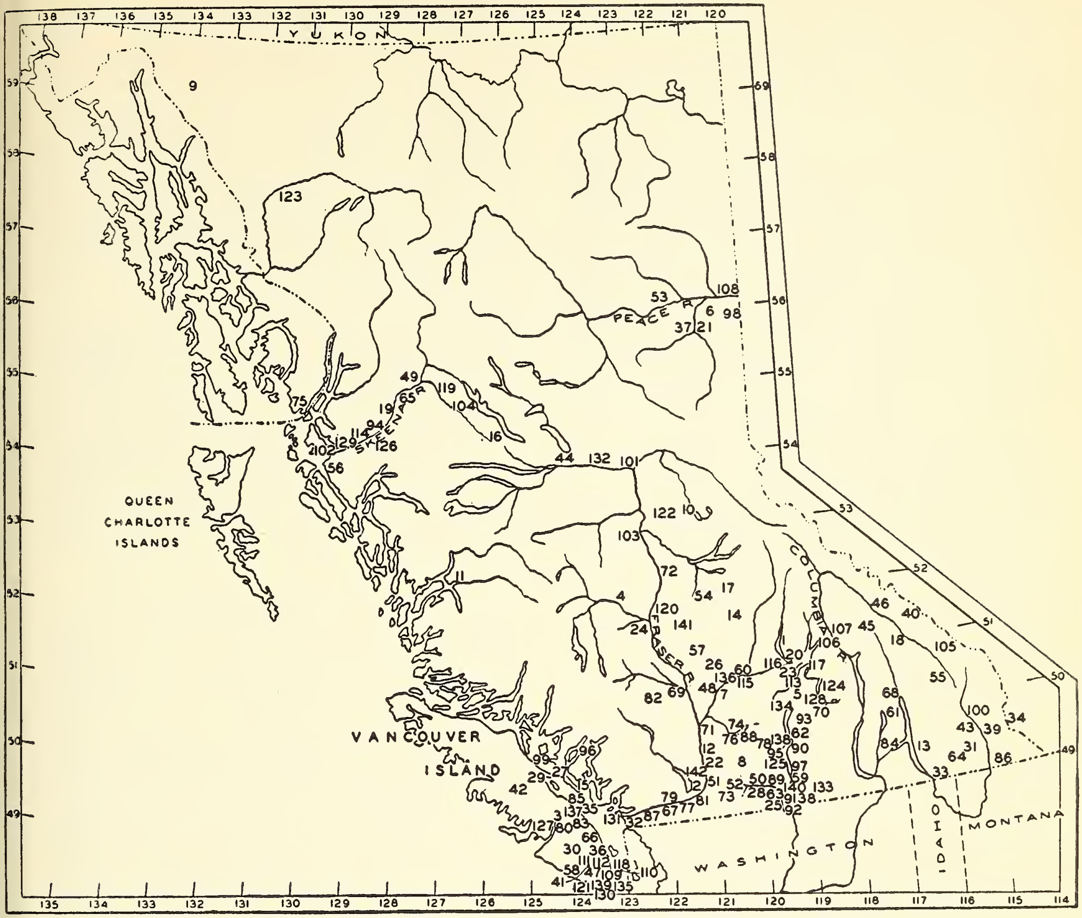

Fig. 1. Map of British Columbia showing the 142 localities mentioned in the text.

Southeastern British Columbia (Area No. 1)

This is a comparatively small, triangular region, of particular interest in that both the flora and fauna sometimes bear a closer relationship to those of Alberta and northwestern United States than to the remainder of the Province. Insects can enter this region from Alberta with little difficulty, through the low, dry Crows Nest Pass; from Montana and Idaho through the valley of the Kootenay River; and from northeastern Washington up the valley of the Columbia River.

This region is bounded on the east by the British Columbia-Alberta boundary, which is the summit of the main range of the Rocky Mountains; on the west by the almost impenetrable mass of high, snow-capped, heavily timbered Selkirk Mountains; and on the south by the International Boundary between British Columbia and the northwestern states of Montana, Idaho, and Washington, which, of course, presents no physical barrier.

The following localities are included in this area: Carbonate, 18; Radium, 105; Invermere, 55; Premier Lake, 100; Fort Steele, 43; Crows Nest, 34; Fernie, 39; Cranbrook, 31; Newgate, 86; Kitchener, 64; Creston, 33; Boswell, 13; Kaslo, 61; Lardo, 68; Nelson, 84.

Southern Interior (Area No. 2)

For the purpose of this paper the southern interior extends from the International Boundary, bordering the

State of Washington, north to latitude 52°, and from the western boundary of southeastern British Columbia west to the eastern slopes of the Coast Mountains.

The eastern and western boundaries are excellent natural geographical barriers. The southern boundary presents more of a barrier to insects than is indicated by a glance at the map, for the eastern and western mountain masses form a definite bottleneck, through which the Okanagan and Similkameen rivers flow south in narrow, hot valleys.

Latitude 52° has been chosen as the boundary line between the southern and central interior regions. There are no very definite geographical barriers along latitude 52°, but the collection records of a number of species definitely show that at about this latitude there is a marked distributional change, probably because the mountainous terrain of the southern interior gives way at this point to an undulating plateau, from 2500 to 4000 feet in elevation.

The following localities are included in this area: Osoyoos, 92; Oliver, 91; Fairview, 38; White Lake, 140; Vaseaux Lake, 133; Okanagan Falls, 89; Kaleden, 59; Penticton, 97; Keremeos, 63; Chopaka, 25; Hedley, 50; Copper Mountain, 28; Summerland, 125; Peachland, 95; Westbank, 138; Kelowna, 62; Okanagan Mission, 90; Oyama, 93; Vernon, 134; Lumby, 70; Trinity Valley, 128; Sugar Lake, 124; Armstrong, 5; Field, 40; Golden, 46; Glacier, 45; Rogers Pass, 107; Revelstoke, 106; Sicamous, 117; Salmon Arm, 113; Celista, 20; Adams Lake, 1; Chase, 23; Shuswap, 116; Kamloops, 60; Merritt, 74; Midday Valley, 76; Nicola, 88; Minnie Lake, 78; Aspen Grove, 8; Savona, 115; Walhachin, 136; Ashcroft, 7; Hat Creek, 48; Lytton, 71; Lillooet, 69; Mt. McLean, 82; Clinton, 26; Jesmond, 57; Bridge Lake, 14; Canim Lake, 17; 100 Mile House, 54; Williams Lake, 141; Soda Creek, 120; Chilcotin, 24; Alexis Creek, 4.

Central Interior (Area No. 3)

This region extends north from latitude 52° to latitude 55° 30′, and from the Alberta boundary and the Rocky Mountains on the east to the Coast Mountains on the west. As in the southern interior region, the eastern and western boundaries are natural geographical barriers of high, unbroken mountain chains. The northern boundary presents no geographical features to limit the distribution of insects. It has been chosen only because it encloses the northernmost records found in the central interior region.

The following localities are included in this area: Macalister, 72; Quesnel, 103; Stanley, 122; Barkerville, 10; Prince George, 101; Vanderhoof, 132; Fraser Lake, 44; Burns Lake, 16; Quick, 104; Smithers, 119; Hazelton, 49; Kitwanga, 65; Cedarvale, 19; Pacific, 94; Terrace, 126; Salvus, 114; Tyee, 129.

Northern Interior (Area No. 7)

This region extends north from latitude 55° 30′ to the Yukon boundary, latitude 60°, and from the Rocky Mountains on the east to the Coast Mountains (boundary of Alaskan panhandle) on the west. As in the southern and central interior regions, the mountains of the eastern and western boundaries are natural geographical barriers. The boundaries on the north and south present no obstacles to insect distribution.

This region is entirely without roads or railways and the only collection records are from Stikine, 123, and Atlin, 9, both in the extreme northwestern corner of British Columbia.

Northeastern British Columbia (Area No. 6)

This triangular area lies entirely to the east of the Rocky Mountains and is geographically part of the northwestern parkland area of Alberta. It is bounded on the west by the Rocky Mountains, which constitute its only natural geographical boundary. To the north, the Yukon boundary and to the east, the Alberta boundary present no hindrance to the spread of insects.

Collections have been made only in the southern tip of this region, close to the Peace River, and include the following localities: Rolla, 108; Pouce Coupe, 98; Arras, 6; Centurian, 21; East Pine, 37; Hudson Hope, 53.

Mainland Coast (Area No. 4)

This region consists of precipitous mountains descending to the sea, and innumerable inlets and small islands. The only extensive area of agricultural land is situated in the extreme south, in the delta of the Fraser River; there is a much smaller area in the extreme north, at the mouth of the Skeena River. This region is sharply separated from the interior of the Province by the high, rugged Coast Mountains, the northern boundary being the southern tip of the Alaskan panhandle, and the southern boundary the British Columbia-Washington line, south of the Fraser River.

The following localities are included in this area: Boston Bar, 12; Chapmans, 22; Yale, 142; Hope, 51; Hope Mountains, 52; Agassiz, 2; Mt. Cheam, 81; Milner, 77; Langley, 67; Mission, 79; Crescent, 32; New Westminster, 87; Vancouver, 131; Buccaneer Bay, 15; Pender Harbour, 96; Powell River, 99; Newcastle I., 85; Inverness, 56; Prince Rupert, 102; Metlakatla, 75.

Vancouver Island (Area No. 5)

Bumble bees have been collected extensively on Vancouver Island. The records are from the southern end of the Island and for some distance up the east coast. The west coast and the northern half of the Island are areas of very heavy rainfall and dense coniferous forests, and what small settlements there are consist mainly of coastal logging camps.

The following localities are included in this area: Victoria, 135; Westholme, 139; Ucluelet, 130; Sooke, 121; Goldstream, 47; Royal Oak, 109; Saanich, 110; Sidney, 118; Fitzgerald, 41; Shawnigan, 112; Duncan, 36; Jordan Meadows, 58; Sahtlam, 111; Cowichan, 30; Ladysmith, 66; Nanaimo, 83; Departure Bay, 35; Wellington, 137; Alberni, 3; Tofino, 127; Mt. Arrowsmith, 80; Comox, 27; Courtenay, 29; Forbidden Plateau, 42.

Table II gives the distribution and the altitude range of Bombidae in British Columbia; the species, which include the varieties and colour variants, are listed in order of abundance, *Psithyrus* spp. being listed separately from *Bombus* spp. In determining this order the number of localities in which a species had been taken (column 2) was given preference over the number of specimens recorded (column 3), as the writer believes this gives a much more reliable indication of the status of the species. The altitude range is the range in which the species is most commonly found and not necessarily its extreme limits. Further extensive collecting would undoubtedly result in some changes, but for the data on hand the table gives a very fair indication of the general prevalence, distribution, and altitude range of the species in the Province.

TABLE II

Distribution and altitude range of Bombidae in British Columbia.

Genera and species in order of abundance in collections	Localities	Total Specimens	Distribution by areas* in order of abundance in collections	Approximate altitude range; feet
Bombus				
bifarius	83	677	2, 1, 3, (4, 5), *7, 6	0-7000
occidentalis	77	430	(1, 2, 3), (4, 5), 7, 6	0-7000
flavifrons	74	400	(2, 3, 5), 4, 1, 7	0-7000
mixtus	64	445	(1, 2, 3, 4, 5), 7, 6	0-6000
melanopygus	56	353	(4, 5), (1, 2), 3, 6, 7	0-6000
vagans	49	398	(2, 3), 1, 7, 6, 4, 5	1000-4000
californicus	49	237	(2, 3, 4, 5), 1, 6	0-2000
sitkensis	42	344	(4, 5), (1, 2, 3)	0-6000
appositus	34	182	2, 1, 4	1000-2000
centralis	26	202	2, 1	1000-2000
terricola	23	191	3, 2, 6, 7, 4	2000-3000
nevadensis	21	71	2 north, 5, (1, 3), 6	0-2000
rufocinctus	20	98	2, 1, 5	2000-3000
fervidus	17	122	2	1000-2000
ternarius	11	243	3, 1, 2	1000-3000
sylvicola	7	153	2, 3, 1, 4	2000-7000
griseocollis	7	28	2 south	1000
morrisoni	7	12	2	1000-2000
frigidus	7	5	(1, 2), 5	1000-2000
perplexus	6	7	3, 4	0-2500
huntii	4	3	1	1000-3000
kirbyellus	2	29	3, 2 north	6000-9000
hyperboreus	2	3	2 north	3500-8000
auricomus	2	2	(5, 6)	0-1000
vosnesenskii	1	3	2	1000
pleuralis	1	3	2	1000
Total 26		—4641		
Psithyrus				
insularus	57	262	(1, 2, 3, 4, 5), 6, 7	0-5000
suckleyi	51	253	(1, 2, 3, 4, 5)	0-5000
fernaldae	21	80	(1, 2, 3, 4, 5, 7)	3000-7000
ashtoni	10	90	3, 2 north	3000-5000
Total 4		— 685		
Grand Total 30	142	5326		0-9000

* Brackets enclose the numbers for areas in which the species is equally abundant. See text.

Genus BOMBUS Latreille

Section *Boopobombus* Frison

Subgenus **Fraternobombus** Skorikov

No species of this subgenus have as yet been recorded from British Columbia.

Subgenus **Nevardensibombus** Skorikov

Bombus nevadensis Cresson (21: 1♂ 54♀ 16☿—71)

LOCALITIES—Invermere, Kaslo, Vernon, Trinity Valley, Salmon Arm, Chase, Kamloops, Nicola, Minnie Lake, Walhachin, Williams Lake, Chilcotin, Macalister, Quesnel, Rolla, Victoria, V. I., Sooke, V. I., Royal Oak, V. I., Sidney, V. I., Fitzgerald, V. I., Departure Bay, V. I.

The 71 specimens of *nevadensis* recorded from 21 localities indicate that it is a fairly common bumble bee in British Columbia, and that it is widely dispersed in areas of temperate climate. It has been taken frequently on Vancouver Island and throughout the timbered regions of the interior, from the southeastern corner of the Province to the Peace River at latitude 56°, but not in the dry, hot sagebrush areas of the Okanagan Valley or in high mountain localities.

Bombus auricomus Robertson (2: 0♂ 2♀ 0☿—2)

LOCALITIES—Centurian, Aug. 4, 1921, 1♀. Departure Bay, V. I., May 24, 1925, 1♀.

This is apparently a rare species in British Columbia, and little is as yet known of its distribution. Centurian is in the Peace River district north of latitude 56°, and Departure Bay on the southeast coast of Vancouver Island.

Subgenus **Separatobombus** Frison

Bombus griseocollis (DeGeer) (6: 1♂ 11♀ 6☿—18)

[=B. *separatus* Cresson]

LOCALITIES — Osoyoos, Oliver, Fairview, Vaseaux Lake, Okanagan Falls, Penticton.

Bombus griseocollis var. **mormonorum** Franklin (5: 3♂ 4♀ 3☿—10)

LOCALITIES — Osoyoos, Fairview, Okanagan Falls, Penticton, Vernon.

B. griseocollis and its variety *mormonorum* have been taken only in the Okanagan Valley, and, with the exception of the worker from Vernon, all were collected in the Upper Sonoran Zone, which extends up the Okanagan Valley as far as Penticton. It is probable that this species occurs also in the Similkameen River Valley from the Washington border to Keremeos. It has a wide range in the United States, and Scullen (1927) records it from Alaska.

Bombus morrisoni Cresson (7: 1♂ 4♀ 7☿—12)

LOCALITIES—White Lake, Kamloops, Nicola, Walhachin, Ashcroft, Lillooet, Chilcotin.

B. morrisoni is one of the rarer species in British Columbia and has been taken only in hot, dry locations in the southern interior and at Chilcotin, where an extension of sagebrush dry-belt conditions extends up the valley of the Chilcotin River.

This bumble bee could easily be confused with *B. nevadensis* or *B. griseocollis* var. *mormonorum* in the field, as they are very similar in coloration. It is a large and handsome species with dense yellow pile covering the entire dorsum of the thorax, and the dorsum of the abdomen to the basal centre of segment four; the apex of the abdomen is black.

Subgenus **Cullumanobombus** Vogt

Bombus rufocinctus Cresson (10: 17♂ 6♀ 28☿—51)

LOCALITIES—Fernie, Kaslo, Kaleden, Okanagan Mission, Vernon, Lumby, Kamloops, Walhachin, Hat Creek, Chilcotin.

Bombus rufocinctus var. **albertensis** Cockerell (5: 0♂ 4♀ 7☿—11)

LOCALITIES — Crows Nest, Oliver, Keremeos, Vernon, Chilcotin.

Bombus rufocinctus var. **prunellae** Cockerell & Porter (8: 3♂ 3♀ 6☿—12)

LOCALITIES — Vernon, Armstrong, Revelstoke, Kamloops, Merritt, Chilcotin, Saanich, V. I., Fitzgerald, V. I.

Bombus rufocinctus var. **iridis** Cockerell & Porter (1: unknown)

LOCALITY—Glacier (Frison unpublished notes).

All other bumble bee records from Glacier are by Sladen (17.V.1915), and it is assumed that he was the collector in this instance.

In addition to the three named varieties listed above, the Kamloops collection contains material of other colour variants described by Franklin (1913). These are listed below.

Colour variant 4. (4: 1♀ 8☿—9)

LOCALITIES — Crows Nest, Fernie, Vernon, Kamloops.

Colour variant 5. (1: 1♀ 0☿—1)

LOCALITY—Kaslo, July 30, 1906, 1♀.

Colour variant 6. (3: 0♀ 7☿—7)

LOCALITIES—Crows Nest, Fernie, Chilcotin.

Male colour variant 5. (1: 2♂—2)

LOCALITY—Vernon.

Male colour variant 8. (4: 5♂—5)

LOCALITIES—Kaleden, Summerland, Kamloops, Chilcotin.

B. rufocinctus, with the three varieties (*albertensis, prunellae,* and *iridis*) and the five colour variants here recorded, is represented by 98 specimens from 20 localities. They have been collected at widely separated points in the southeastern part of the Province, as well as throughout the southern interior north to Chilcotin, latitude 52°, and there are records of two queens from southern Vancouver Island. There are no records of *rufocinctus* from the central or northern interior or from the northeastern section of the Province. The collection records indicate that its extreme altitude limits are from sea level to 3000 feet, with an optimum altitude range from 2000 to 3000 feet. The varieties and colour variants collected to date appear to indicate no geographical preference, but variety *prunellae* is the only form of *rufocinctus* as yet recorded from Vancouver Island. It is extremely variable in colouration and the majority of specimens on hand show a lack of contrasting colours. In the field it is readily overlooked as a badly faded specimen of some common species, and it may be commoner than the number of records indicates. Further extensive collecting is needed to determine accurately the distribution and altitude range of *rufocinctus* in British Columbia.

Section *Anodontobombus* Krüger

Subgenus *Alpinobombus* Krüger

Bombus hyperboreus Schnönherr (2: 0♂ 3♀ 0☿—3)

[=B. *arcticus* Kirby]
(See Frison, 1919, p. 456)

LOCALITIES—Mt. McLean, July 12, 1926, 1♀, Chilcotin, July 14, 1921, 1♀; July 12, 1931, 1♀.

This species occurs in the northern regions of Europe and Asia and in Greenland and arctic Canada (Franklin, 1913; Frison, 1919, p. 456). It is indistinguishable from *B. kirbyellus* in the field.

The collection of two queens of *hyperboreus* in 1926 and 1931 by the author at Chilcotin, elevation 3500 feet, is unusual, as one would not expect to find this bee at such a low elevation and in such a warm location. Further search on numerous occasions throughout the Chilcotin area, as well as on high mountains farther north, has not yielded any specimens of this species. The queen taken on Mt. McLean, although considerably farther south, was taken well above timber line, near permanent snow-fields, at an elevation of 7500 feet.

The determinations of the specimens have been confirmed by Dr. Krombein, of the United States National Museum. Further material must be collected before the abundance and distribution of *hyperboreus* in British Columbia can be determined.

Bombus kirbyellus Curtis (2: 6♂ 10♀ 13☿—29)

LOCALITIES—Chilcotin, Aug. 12, 1921, 1♀. Barkerville, June 29, 4♀; July 17, 6♂ 5♀ 13☿, 1948.

The record of *kirbyellus* from Chilcotin by the author was obtained in the same field as that in which *hyperboreus* was collected and is another record which is puzzling, as no further specimens have been found there. These specimens of *kirbyellus* and *hyperboreus* were taken during general collecting before the author became interested in bumble bees. Obtaining these in a general collection would indicate that both of them were fairly common species, but repeated search at Chilcotin has not yielded any more specimens. It was not until 1948 that a small series of *kirbyellus* was obtained on Mount Murray, near Barkerville (lat. 53°), at an elevation of 6500 feet.

B. kirbyellus is said to be a strictly boreal species and has been taken at high elevations as far south as New Mexico. It very probably occurs on mountain tops above 7000 feet, in various parts of British Columbia, but the difficulty in reaching such elevations makes its collection difficult. It does not appear to occur on the summit of Mount Revelstoke, 6500 feet, where the author has frequently made collections. At the latitude of Revelstoke (51°), the elevation of 6500 feet may be too low.

As for *hyperboreus*, further extensive collecting is needed to determine accurately the distribution and altitude range of *kirbyellus* in British Columbia.

Subgenus **Terrestribombus** Vogt

Bombus occidentalis Greene (75: 152♂ 108♀ 132☿—392)

LOCALITIES — Carbonate, Radium, Invermere, Fort Steele, Crows Nest, Fernie, Cranbrook, Newgate, Kitchener, Kaslo, Oliver, Fairview, Okanagan Falls, Kaleden, Penticton, Keremeos, Hedley, Summerland, Kelowna, Okanagan Mission, Vernon, Sugar Lake, Armstrong, Field, Golden, Glacier, Rogers Pass, Revelstoke, Sicamous, Salmon Arm, Chase, Shuswap, Kamloops, Merritt, Nicola, Minnie Lake, Walhachin, Clinton, Chilcotin, Bella Coola, Burns Lake, Smithers, Hazelton, Kitwanga, Cedarvale, Terrace, Salvus, Tyee, Prince Rupert, Lillooet, Mt. McLean, Lytton, Boston Bar, Yale, Hope, Hope Mts., Agassiz, Mt. Cheam, Milner, Vancouver, Buccaneer Bay, Newcastle I., Victoria, V. I., Royal Oak, V. I., Saanich, V. I., Sidney, V. I., Fitzgerald, V. I., Duncan, V. I., Ladysmith, V. I., Nanaimo, V. I., Departure Bay, V. I., Wellington, V. I., Alberni, V. I., Mt. Arrowsmith, V. I., Comox, V. I.

Bombus occidentalis var. **proximus** Cresson (8: 9♂ 3♀ 1☿—13)

LOCALITIES — Kaslo, Penticton, Vernon, Lytton, Hazelton, Atlin, Agassiz, Vancouver.

Bombus occidentalis var. **nigroscutatus** Franklin (1: 0♂ 0♀ 1☿—1)

LOCALITY—Kaslo, July 1, 1905, 1♀.

The following male colour variants of Franklin (1913) have been taken in British Columbia.

Male colour variant 3. (9: 11♂—11)

LOCALITIES — Fairview, Kaleden, Penticton, Westbank, Kamloops, Nicola, Tyee, Vancouver, Saanich, V. I.

Male colour variant 5. (5: 6♂—6)

LOCALITIES — Vernon, Kamloops, Smithers, Terrace, Tyee.

Male colour variant 7. (1: 1♂—1)

LOCALITY—Hazelton, Aug. 20, 1947, 1♂.

Male colour variant 8. (4: 4♂—4)

LOCALITIES — Kaslo, Kaleden, Chase, Walhachin.

Male colour variant 9. (2: 2♂—2)

LOCALITIES — Kaslo, Sept. 2, 1906. Salvus, Aug. 17, 1946.

B. occidentalis is a very common bumble bee in British Columbia and is exceeded in numbers only by *B. bifarius* Cresson. With its varieties and colour variants it has been taken in 77 localities, and as far north as collections have been made. As it is recorded from Alaska, Yukon and Northwest Territories, it is no doubt distributed throughout the Province. It appears to be equally at home in the dry interior valleys, on the sea coast, and in mountain meadows up to elevations of 6500 feet. It is a very abundant species in late summer along the Skeena River from Hazelton to Prince Rupert, where it may be found visiting the flowers of fire-weed, *Epilobium* sp.

The varieties *proximus* and *nigroscutatus* are rare, but males often show some variation, and 5 of Franklin's 9 male colour variants were found among the material on hand. Franklin (1913) records that this is one of the most variable of North American bumble bees, but the material from British Columbia does not appear variable, except the males to some extent. Out of 273 ♀☿ all were typical specimens of *occidentalis* except for 3♀ 1☿ of var. *proximus* and 1☿ of var. *nigroscutatus*, and the latter specimen was not at all definitely marked.

The writer has examined a very brilliantly marked worker color variant from Aklavik, at the mouth of the Mackenzie River, Northwest Territories, collected by Mr. A. G. Dustan (11.VII. 1946), in which the anterior part of the dorsum of the thorax was bright lemon yellow, the remainder entirely black; segment one of the abdomen entirely black; segment two, bright lemon yellow; segment three, black; segments four to six, clothed with long, pure white pile. A queen from Valdez, Alaska, collected by Mr. J. D. Gregson (15.VII.1948) also shows a brightly contrasting colouration, having the dorsum of the thorax, except for the interalar band, bright lemon yellow; abdominal segments one and two, black; segment three, lemon yellow; segment four, black; and segments five and six, with short, ferruginous-white pile—in some respects resembling var. *nigroscutatus*. It may be that colour variants of *occidentalis* are not uncommon in arctic America.

Bombus terricola Kirby (23: 75♂ 58♀ 58☿—191)

LOCALITIES—Vernon, Salmon Arm, Kamloops, Minnie Lake, Savona, Walhachin, Bridge Lake, Canim Lake, 100 Mile House, Williams Lake, Chilcotin, Quesnel, Prince George, Burns Lake, Quick, Smithers, Hazelton, Kitwanga, Cedarvale, Terrace, Rolla, Pouce Coupe, Vancouver.

B. terricola is the commonest of all the bumble bees in the central interior. It is particularly common from Williams Lake north to Prince George, and west through the Nechako and Bulkley valleys to Hazelton, and in diminishing numbers along the Skeena River to Terrace. It has not been recorded from the canyon of the Skeena or from the coast at Prince Rupert. Its range probably extends well beyond these areas into the northern interior, as it has been taken in the northeastern section of the Province. at Rolla and Pouce Coupe in the Peace River district, considerably north of latitude 56°. The altitude range of the localities listed above is from sea level to 3500 feet, but its habitat of maximum abundance, lying between latitudes 53° and 55°, has only an altitude range of 2000 to 3000 feet. To the south of Williams Lake, latitude 52°, it rapidly becomes less abundant, and is a distinctly uncommon species throughout the southern interior. It has not been recorded from southeastern British Columbia or from the southern Okanagan valley. There is one record of its capture on the coast at Vancouver, but there are no records from Vancouver Island.

This is a very distinctive species, readily identified in the field, and its relative abundance and scarcity north and south of latitude 52° is very striking. The series of 191 specimens from

23 localities shows a remarkably uniform colouration. Franklin (1913) records that the scutellum may be more or less yellowish and occasionally entirely yellow. In this series very few show any yellow hairs on the scutellum, and only one has the scutellum entirely yellow: a queen from the northernmost locality, Rolla.

This is a bumble bee of considerable economic importance in the central interior, where an alsike clover seed industry is rapidly developing. When these alsike fields are in flower *terricola* may be seen in great numbers working on the blooms in association with smaller numbers of *flavifrons, occidentalis,* and *melanopygus.*

B. terricola is closely related to *B. terrestris* L., which ranges throughout the greater part of Europe and Siberia. Franklin (1913) records *B. terrestris* var. *moderatus* Cresson from several localities in Alaska and considers that it probably occurs also in Yukon Territory. It is therefore possible that *terrestris* s. lat. may be found in the extreme northwestern corner of British Columbia.

Subgenus **Pratobombus** Vogt

Bombus ternarius Say (11: 56♂ 47♀ 140☿—243)

LOCALITIES — Crows Nest, Fernie, Golden, Chilcotin, Quesnel, Barkerville, Prince George, Vanderhoof, Fraser Lake, Burns Lake, Smithers.

This bumble bee is fairly common in the central plateau region of British Columbia from Chilcotin (latitude 52°), north to Prince George and northwest through the Nechako and Bulkley river valleys to Smithers (latitude 55°); it has been taken also in the Rocky Mountains at Crows Nest, Fernie, and Golden. It appears to be absent from the southern interior and coastal regions.

B. ternarius cannot be distinguished in the field from typical specimens of *bifarius* Cresson, and both occur together in the same rather restricted locations, where their queens may be seen in considerable numbers visiting dandelion flowers in June. *B. ternarius* is readily distinguished from *bifarius* on close examination by its having corbicular hairs black rather than bright ferruginous. When freshly emerged this is a very pretty species; but, as in typical specimens of *bifarius,* the bright salmon-red colour of the second and third abdominal segments soon fades and becomes yellowish.

Bombus huntii Greene (4: 0♂ 1♀ 2☿—3)

LOCALITIES—Crows Nest, Aug. 11, 1927, 1♀ 1☿. Fernie, July 27, 1946, 1☿. Vancouver I.; Fort McLeod; Franklin (1913).

B. huntii is a mountain form, and the only material seen by the author was collected in the Crows Nest Pass through the main range of the Rocky Mountains. Scullen (1927, 1930) records it as a very common species in the mountains of eastern Oregon. Franklin (1913) records *huntii* from Vancouver Island and from Fort McLeod, which is at latitude 55°, but does not give any data on the material collected. It may occur in fair numbers at moderate elevations in the Rocky Mountain regions of British Columbia.

Bombus vosnesenskii Radoszkowski (1: 1♂ 0♀ 2☿—3)

LOCALITY—Osoyoos, July 20, 1925, 1♂ 2☿.

This bumble bee is very rare in British Columbia. Scullen (1927) gives its range as "British Columbia to Southern California and east to Nevada" and states that it is by far the most common species in the lower altitudes of western Oregon; and Frison (1923) records it from Montana.

Osoyoos (elevation 913 ft.) is at the extreme southern end of the Okanagan Valley and on the border between British Columbia and the State of Washington. It is unlikely that *vosnesenskii* will be found much farther north but it may occur at Victoria, on the extreme southern tip of Vancouver Island, as it is considered by Franklin to belong to the Pacific Coast portion of the Transition Zone.

This is a species that might be confused with typical specimens of *californicus* in the field.

Bombus bifarius Cresson (32: 36♂ 64♀ 38☿—138)

[=B. *edwardsii* Cresson]
(Franklin, 1913, p. 328)

LOCALITIES—Fort Steele, Crows Nest, Okanagan Mission, Vernon, Field, Golden, Kamloops, Merritt, Nicola, Minnie Lake, Walhachin, Hat Creek, Clinton, Jesmond, 100 Mile House, Chilcotin, Alexis Creek, Soda

Creek, Quesnel, Prince George, Vanderhoof, Fraser Lake, Burns Lake, Quick, Smithers, Kitwanga, Agassiz, Vancouver, Victoria, V. I., Saanich, V. I., Fitzgerald, V. I., Alberni, V. I.

Bombus bifarius var. **vancouverensis** Cresson (38: 15♂ 69♀ 26☿—110)

[=B. *edwardsii* var. *vancouverensis* Cresson] (Franklin, 1913)

LOCALITIES — Invermere, Kaslo, Fairview, Okanagan Falls, Penticton, Keremeos, Kelowna, Okanagan Mission, Vernon, Golden, Revelstoke, Salmon Arm, Celista, Shuswap, Kamloops, Nicola, Minnie Lake, Clinton, Lillooet, Hazelton, Boston Bar, Buccaneer Bay, Pender Harbour, Victoria, V. I., Westholme, V. I., Goldstream, V. I., Royal Oak, V. I., Saanich, V. I., Sidney, V. I., Fitzgerald, V. I., Shawnigan, V. I., Duncan, V. I., Jordan Meadows, V. I., Sahtlam, V. I., Courtenay, V. I., Nanaimo, V. I., Departure Bay, V. I., Alberni, V. I.

Bombus bifarius var. **nearcticus** Handlirsch (55: 150♂ 95♀ 184☿—429)

[=B. *edwardsii* var. *nearcticus* Handl.] (Franklin, 1913)

LOCALITIES — Radium, Invermere, Premier Lake, Fort Steele, Crows Nest, Fernie, Cranbrook, Creston, Kaslo, Nelson, Oliver, Fairview, Vaseaux Lake, Okanagan Falls, Kaleden, Penticton, Keremeos, Hedley, Copper Mountain, Summerland, Peachland, Kelowna, Okanagan Mission, Vernon, Armstrong, Golden, Glacier, Revelstoke, Sicamous, Salmon Arm, Celista, Adams Lake, Kamloops, Merritt, Nicola, Minnie Lake, Clinton, Burns Lake, Quick, Smithers, Hazelton, Kitwanga, Atlin, Lillooet, Mt. McLean, Lytton, Boston Bar, Yale, Hope Mts., Agassiz, Victoria, V. I., Duncan, V. I., Alberni, V. I., Mt. Arrowsmith, V. I.

B. bifarius Cresson, with its two varieties, *vancouverensis* and *nearcticus*, is by far the commonest bumble bee in British Columbia, and this paper records 677 specimens from 83 localities, with an altitude range from sea level to at least 7000 feet in the southern interior. It undoubtedly occurs everywhere in the Province as far north as, or well beyond, latitude 55°.

B. bifarius has two very distinct and constant colour varieties, *bifarius* Cresson and *nearcticus* Handlirsch, and a third, *vancouverensis* Cresson, definitely intermediate in colouration between the other two. The distribution of these three forms in the Province is also sharply defined.

In the southern interior, south of latitude 51°, var. *nearcticus* is the dominant form and occurs in far greater numbers than the other varieties in their respective areas. Only a very light, but widespread, scattering of the other two forms is found in the southern interior. In var. *nearcticus* the pile of the thorax, other than the black interalar band, is pure white or nearly so, and the dorsum of the abdomen is black and white, with no trace of ferruginous markings. In the male the light pile is pale yellow. There is no other bee recorded from British Columbia that is likely to be confused with *nearcticus*.

In the central interior, north of latitude 51°, var. *bifarius* (described by Franklin, 1913, as *edwardsii* Cresson; see Frison, 1923, p. 317) is the dominant colour form, and only a very light scattering of *nearcticus*, and still less of *vancouverensis*, is found in this area. The colouration of var. *bifarius* is such a striking contrast to that of *nearcticus* that it is difficult to realize that they belong to the same species. In var. *bifarius* the light pile of the thorax is bright lemon yellow instead of white as in *nearcticus* and *vancouverensis*, and segments two and three of the abdomen are rich salmon-red. In the field, var. *bifarius* is readily confused with *B. ternarius*, which has an identical colour pattern, but black corbicular hairs, whereas those of *bifarius* are ferruginous.

On Vancouver Island and on the coastal areas of the mainland, var. *vancouverensis* is the dominant form. In the northern interior, where var. *bifarius* is dominant, *vancouverensis* appears to be very scarce; but it is not at all unusual to find occasional specimens throughout the range of *nearcticus* in the southern interior. Both var. *bifarius* and var. *nearcticus* are found also, in small numbers, on Vancouver Island and on the adjoining mainland, but these areas are mainly populated by var. *vancouverensis*. It is remarkable how these three colour forms of one species occur so constantly in separate geographic areas with so little intermingling.

B. bifarius var. *vancouverensis* is a strikingly handsome bee, with its sharply contrasting patchwork of white, black, and red. It is definitely intermediate between the other two forms, having the light pile of the thorax pure white as in *nearcticus;* and abdominal segments two and three with salmon-red pile, sometimes completely so, as in var. *bifarius,* or in varying amounts.

Considerable confusion, both in literature and named specimens in collections, has resulted from Franklin's (1913) placing *B. bifarius* Cresson as a synonym of *edwardsii,* and describing the real *edwardsii* under the name of *fernaldae* Franklin (see Frison, 1923, p. 317).

Bombus sylvicola Kirby (7: 107♂ 32♀ 14☿—153)

LOCALITIES — Kaslo, Revelstoke, Kamloops, Walhachin, Barkerville, Vanderhoof, Mt. Cheam.

B. sylvicola is the most difficult of all British Columbia bumble bees to determine with certainty, some specimens being very difficult to separate from *B. melanopygus.* Typical specimens of *sylvicola,* in which there is no admixture of black hairs with the yellow pile of the anterior portion of the thorax, are easily distinguished. But in material from British Columbia there seems to be every gradation up to a condition almost comparable to that of typical specimens of *melanopygus.*

The material collected from Kaslo, Revelstoke, Barkerville, and Mt. Cheam was taken at an elevation of 6000 feet or over, whereas that from Kamloops, Walhachin, and Vanderhoof was from much lower elevations. The optimum altitude range for *sylvicola* is apparently from 6000 to 8000 feet. Though the localities where *sylvicola* has been collected are few, they are well distributed over the Province: Kaslo being in the southeastern corner; Revelstoke, Kamloops, and Walhachin in the southern interior; Barkerville and Vanderhoof in the central interior, and Mt. Cheam in the coastal area. Further collecting of this species is needed before any really satisfactory statement can be made as to its distribution and altitude range in British Columbia.

Mountain bumble bees have a short life, and are subjected to such violent winds and storms that they very quickly become faded and battered. It is very difficult to find time to visit such locations on a sufficient number of good collecting days to secure first the queens, then the workers, and lastly the males.

Bombus melanopygus Nylander (56: 116♂ 111♀ 126☿—353)

LOCALITIES—Radium, Invermere, Crows Nest, Boswell, Kaslo, Osoyoos, Vaseaux Lake, Okanagan Falls, Penticton, Copper Mountain, Summerland, Okanagan Mission, Vernon, Field, Golden, Glacier, Rogers Pass, Revelstoke, Sicamous, Salmon Arm, Celista, Merritt, Nicola, Clinton, Jesmond, Quesnel, Stanley, Barkerville, Salvus, Prince Rupert, Metlakatla, Rolla, Lillooet, Hope Mts., Manning Park, Agassiz, Mt. Cheam, Milner, New Westminster, Vancouver, Buccaneer Bay, Pender Harbour, Newcastle I., Victoria, V. I., Ucluelet, V. I., Royal Oak, V. I., Saanich, V. I., Sidney, V. I., Fitzgerald, V. I., Duncan, V. I., Cowichan Lake, V. I., Ladysmith, V. I., Nanaimo, V. I., Departure Bay, V. I., Tofino, V. I., Mt. Arrowsmith, V. I.

The 353 records of *B. melanopygus* from 56 localities indicate that this is a very common species, with a Province-wide distribution. It has a wide altitude range: from sea level to 8000 feet, with an optimum range of 0-6000 feet. It is particularly common on Vancouver Island, and on the coast of the mainland, and in the mountain meadows of the interior, where this species is readily confused with the strictly boreal species *B. sylvicola. B. melanopygus* occurs as far north as collecting has been done in British Columbia, and Franklin (1913) mentions that it is the commonest species in Alaska.

It is a strikingly handsome species which few entomologists would refrain from taking; this may account in some measure for the number of specimens in collections.

Bombus centralis Cresson (26: 80♂ 39♀ 83☿—202)

LOCALITIES—Invermere, Fernie, Kaslo, Osoyoos, Oliver, Fairview, Vaseaux Lake, Okanagan Falls, Kaleden, Penticton, Keremeos, Chopaka, Summerland, Peachland, Westbank, Kelowna, Vernon, Field, Salmon Arm, Kamloops, Merritt, Nicola, Minnie Lake, Walhachin, Chilcotin, Lillooet.

B. centralis has been recorded from 26 localities in the southern interior and southeastern regions of British Columbia. It occurs sparingly north to Chilcotin, latitude 52°, but does not appear to be present on Vancouver Island or the mainland coast.

In the field it closely resembles *B. flavifrons* but has a far more restricted range, occurring only in valleys with an altitude range of 1000 to 2000 feet.

Bombus flavifrons Cresson (66: 128♂ 79♀ 141☿—348)

LOCALITIES — Radium, Crows Nest, Fernie, Cranbrook, Kaslo, Oliver, Fairview, Okanagan Falls, Kaleden, Penticton, Summerland, Vernon, Field, Golden, Glacier, Revelstoke, Sicamous, Salmon Arm, Chase, Kamloops, Midday Valley, Nicola, Minnie Lake, Walhachin, Hat Creek, Bridge Lake, Canim Lake, Chilcotin, Quesnel, Barkerville, Prince George, Vanderhoof, Fraser Lake, Burns Lake, Quick, Smithers, Hazelton, Kitwanga, Cedarvale, Salvus, Metlakatla, Atlin, Lillooet, Mt. McLean, Lytton, Hope Mts., Agassiz, Milner, Vancouver, Buccaneer Bay, Powell River, Victoria, V. I., Royal Oak, V. I., Ucluelet, V. I., Saanich, V. I., Sidney, V. I., Fitzgerald, V. I., Shawnigan, V. I., Sahtlam, V. I., Cowichan, V. I., Nanaimo, V. I., Departure Bay, V. I., Wellington, V. I., Alberni, V. I., Mt. Arrowsmith, V. I., Courtenay, V. I.

Bombus flavifrons var. **dimidiatus** Ashmead (20: 14♂ 7♀ 25☿—46)

LOCALITIES—Invermere, Kaslo, Glacier, Hazelton, Inverness, Metlakatla, Centurian, Lytton, Hope, Hope Mts., Agassiz, Mt. Cheam, Crescent, Vancouver, Buccaneer Bay, Victoria, V. I., Westholme, V. I., Sidney, V. I., Fitzgerald, V. I., Tofino, V. I.

Bombus flavifrons var. **ambiguus** Franklin (3: 0♂ 0♀ 6☿—6)

LOCALITIES — Agassiz, Vancouver, Nanaimo, V. I.

B. flavifrons is one of the commonest species in the Province, and with its varieties, *dimidiatus* and *ambiguus*, has been represented by 400 specimens from 74 localities; only *B. bifarius* and *B. occidentalis* exceed it in numbers. It appears to be equally at home at sea level, in hot, dry locations, and in mountains up to 7000 feet. The typical form, *flavifrons* Cresson, is represented by 348 specimens from 66 localities; var. *dimidiatus*, by 46 specimens from 20 localities; and *ambiguus*, by 6 specimens from 3 localities. Both *dimidiatus* and *ambiguus* are readily confused with *B. sitkensis* and *B. mixtus* in the field, and are therefore hard to collect.

B. flavifrons has been observed to be of considerable economic importance in aiding in the pollination of alsike clover, in association with *B. terricola* and *B. melanopygus*.

Bombus pleuralis Nylander (1: 0♂ 2♀ 0☿—2)

LOCALITY—Vernon, May 15, 1920, 2♀.

Frison (1926, p. 135) gives the above record from Vernon, and also records this species as collected by Dyar and Caudell at Laggan, British Columbia; however, Laggan, now called Lake Louise, is in Alberta.

Bombus pleuralis var. **clarus** Frison (1: 0♂ 1♀ 0☿—1)

LOCALITY—Vernon, May 15, 1920, 1♀.

Frison (1926, p. 139) records this variety also from Laggan, British Columbia; this, as noted above, should be an Alberta record.

Except for these three queens, two being typical specimens of *pleuralis* and one a specimen of var. *clarus*, nothing is known of this species in British Columbia. Franklin (1912) records it only from Alaska.

Bombus sitkensis Nylander (42: 133♂ 67♀ 144☿—344)

LOCALITIES—Radium, Invermere, Fernie, Kaslo, Summerland, Vernon, Field, Golden, Revelstoke, Salmon Arm, Kamloops, Quesnel, Barkerville, Burns Lake, Smithers, Cedarvale, Salvus, Tyee, Prince Rupert, Inverness, Metlakatla, Boston Bar, Yale, Agassiz, Mt. Cheam, Hope Mts., Manning Park, Vancouver, Buccaneer Bay, Pender Harbour Newcastle I., Victoria, V. I., Ucluelet, V. I., Royal Oak, V. I., Sidney, V. I., Jordan Meadows, V. I., Nanaimo, V. I., Departure Bay, V. I., Alberni, V. I., Tofino, V. I., Comox, V. I., Courtenay, V. I.

B. sitkensis is a common species, easily confused with *B. mixtus* in the field. It has a Province-wide distribution and a wide altitude range. It is particularly common on Vancouver Island and the mainland coast and occurs in all sections of the Province where relatively cool, timbered areas occur. It is not found in any numbers in the arid, dry-belt regions of the southern interior. It is a common bumble bee in mountain meadows up to 7000 feet, and its optimum altitude range is from sea level to 6000 feet.

Bombus mixtus Cresson (64: 105♂ 130♀ 210☿—445)

LOCALITIES—Radium, Invermere, Crows Nest, Fernie, Cranbrook, Kaslo, Okanagan Falls, Penticton, Hedley, Copper Mountain, Summerland, Peachland, Okanagan Mission, Vernon, Field, Golden, Glacier, Revelstoke, Sicamous, Salmon Arm, Celista, Adams Lake, Kamloops, Midday Valley, Nicola, Minnie Lake, Bridge Lake, Canim Lake, Chilcotin, Quesnel, Stanley, Barkerville, Prince George, Burns Lake, Smithers, Hazelton, Cedarvale, Salvus, Tyee, Prince Rupert, Metlakatla, Atlin, Rolla, Lillooet, Mt. McLean, Lytton, Yale, Hope Mts., Agassiz, Milner, Mission, Vancouver, Buccaneer Bay, Victoria, V. I., Westholme, V. I., Royal Oak, V. I., Saanich, V. I., Sidney, V. I., Fitzgerald, V. I., Ladysmith, V. I., Nanaimo, V. I., Departure Bay, V. I., Alberni, V. I., Courtenay, V. I.

B. mixtus is very common in British Columbia, and 445 specimens are here recorded from 64 localities. It is very evenly distributed over the Province. The northernmost record for British Columbia is Atlin, latitude 59°.

It prefers cool, wooded situations, and is equally at home on the coast or in the mountains of the interior; it is not found in any numbers in the dry-belt regions of the southern interior. Together with *B. sitkensis*, which it closely resembles, it is one of the commonest bumble bees in Vancouver. It has a wide altitude range, from sea level to at least 8000 feet in the mountains of the southern interior; its optimum range is from sea level to 6000 feet.

Bombus frigidus F. Smith (7: 2♂ 1♀ 2☿—5)

LOCALITIES — Invermere, Crows Nest, Kaslo, Kamloops, 100 Mile House, Chilcotin, Victoria, V. I.

This species is evidently rare in British Columbia, but the locality records show it to be widely distributed throughout the southern portion of the Province, including Vancouver Island. It is one of several bumble bees that cannot be distinguished in the field from some common species; this may account for the small number of specimens in the collections studied.

Bombus perplexus Cresson (6: 3♂ 1♀ 3☿—7)

LOCALITIES — Prince George, Burns Lake, Smithers, Salvus, Prince Rupert, Buccaneer Bay.

The locality records of *perplexus* indicate that it does not occur in the southern interior of the Province, but it is found in the central interior; in the Nechako, Bulkley, and Skeena river valleys, between Prince George and Prince Rupert; there is also one record from Buccaneer Bay, north of Vancouver.

B. perplexus cannot be distinguished from *B. vagans* in the field, and as *vagans* is particularly common in the territory where *perplexus* is found it is difficult to obtain a good series of the latter without killing large numbers of the former—something one dislikes to do.

Careful examination of several hundred specimens of *vagans* from all sections of the Province has revealed no specimens of *perplexus* except from the localities recorded above.

Bombus vagans F. Smith (47: 129♂ 82♀ 187☿—398)

LOCALITIES — Invermere, Fort Steele, Crows Nest, Creston, Kaslo, Lardo, Oliver, Westbank, Penticton, Summerland, Kelowna, Okanagan Mission, Vernon, Sugar Lake, Armstrong, Golden, Glacier, Revelstoke, Sicamous, Salmon Arm, Adams Lake, Shuswap, Kamloops, Merritt, Nicola, Minnie Lake, Canim Lake, Chilcotin, Quesnel, Stanley, Barkerville, Prince George, Fraser Lake, Burns Lake, Smithers, Hazelton, Kitwanga, Cedarvale, Terrace, Salvus, Metlakatla, Rolla, Hudson Hope, Hope Mts., Agassiz, Vancouver, Victoria, V. I.

B. vagans is one of the commonest species of bumble bees in the interior of British Columbia, and 398 specimens are here recorded from 49 localities. It prefers comparatively cool, timbered locations of moderate rainfall, and has not been taken in any numbers in the hot, arid regions of the southern Okanagan Valley or in extreme southeastern British Columbia. It is rare also in regions of heavy rainfall such as Vancouver Island and the mainland coast. It is found in maximum numbers from Vernon, in the North Okanagan Valley, northward through the southern and central interior regions, and is particularly abundant in the Nechako and Bulkley valleys from Prince George west to Terrace. It has also been taken at Rolla and Hudson Hope on the Peace River in northeastern British Columbia. Its abundance and distribution in the northern interior of the Province are unknown, and there appear to be no records of *vagans* from Alaska or Yukon Territory. Its optimum altitude range in British Columbia is from 1000 to 4000 feet.

Section *Odontobombus* Krüger

Subgenus **Subterraneobombus** Vogt

Bombus appositus Cresson (34: 88♂ 57♀ 37☿—182)

LOCALITIES — Invermere, Crows Nest, Cranbrook, Newgate, Kaslo, Nelson, Okanagan Falls, Penticton, Keremeos, Hedley, Summerland, Vernon, Glacier, Armstrong, Salmon Arm, Chase, Shuswap, Kamloops, Nicola, Minnie Lake, Walhachin, Hat Creek, Clinton, 100 Mile House, Chilcotin, Quesnel, Lillooet, Mt. McLean, Lytton, Chapmans, Yale, Hope, Agassiz, Vancouver.

The records of 182 specimens from 34 localities indicate that this is a fairly common species in the valleys of southeastern British Columbia and the southern interior. It occurs sparingly on the coast, and has not as yet been recorded from Vancouver Island. It is rare in the central interior but has been taken occasionally as far north as Quesnel (latitude 53°).

B. appositus is partial to dry open areas, where it may often be seen visiting thistles in company with *B. fervidus*, which it closely resembles in appearance, habits, and distribution.

Subgenus **Fervidobombus** Skorikov

Bombus fervidus (Fabricius) (16: 16♂ 39♀ 56☿—111)

LOCALITIES—Osoyoos, Oliver, Fairview, Kaleden, Penticton, Summerland, Peachland, Okanagan Mission, Vernon, Salmon Arm, Kamloops, Nicola, Minnie Lake, Walhachin, Ashcroft, Williams Lake.

Bombus fervidus var. **dorsalis** Cresson (7: 5♂ 4♀ 2☿—11)

LOCALITIES—Kaleden, Penticton, Salmon Arm, Kamloops, Nicola, Walhachin, Chilcotin.

B. fervidus, as well as its variety *dorsalis*, closely resembles *appositus*, but is less common. The records of the 111 specimens from 16 localities indicate that it is confined to the warm valleys of the southern interior. It has not been taken in southeastern British Columbia or to the west of the Coast Mountains. With the exception of two specimens from Chilcotin and Williams Lake (latitude 52°), all the records are from south of latitude 51°.

Bequaert (1932) gives some interesting notes of this species building their cells and rearing their broods in old birds' nests in trees.

When collecting insects in the Okanagan Valley in 1919, near the present townsite of Oliver, the author on several occasions placed his finger in the nests of the western marsh wren, *Telmatodytes palustris plesius* (Oberholser), to see whether they contained eggs, and was startled to have the nest vibrate violently and emit angry bumble bees. As he was not particularly interested in bees at that time, he did not determine the species. As *fervidus* is common in this district, it may have been this species that was making use of the wrens' nests. These little birds have the curious habit of building several spare nests, hanging them high up in the cat-tails; and these nests were evidently used by the bumble bees.

Bombus californicus F. Smith (24: 9♂ 23♀ 20☿—52)

LOCALITIES — Invermere, Creston, Penticton, Peachland, Westbank, Vernon, Armstrong, Salmon Arm, Chilcotin, Lytton, Hope, Agassiz, Langley, Crescent, Vancouver, Victoria, V. I., Royal Oak, V. I., Saanich, V.I., Sidney, V. I., Shawnigan, V. I., Nanaimo, V. I., Departure Bay, V. I., Alberni, V. I., Comox, V. I.

Bombus californicus var. **dubius** Cresson (9: 4♂ 8♀ 2☿—14)

LOCALITIES—Creston, Okanagan Falls, Westbank, Vernon, Agassiz, Vancouver, Victoria, V. I., Saanich, V. I., Nanaimo, V. I.

Bombus californicus var. **consanguineus** Handlirsch (35: 37♂ 71♀ 63☿—171)

LOCALITIES—Crows Nest, Fernie, Oliver, Fairview, Okanagan Falls, Kaleden, Penticton, Keremeos, Summerland, Vernon, Salmon Arm, Adams Lake, Kamloops, Walhachin, Clinton, Canim Lake, Chilcotin, Quesnel, Prince George, Quick, Smithers, Rolla, Arras, Centurian, East Pine, Agassiz, Mt. Cheam, Crescent, Vancouver, Victoria, V. I., Royal Oak, V. I., Saanich, V. I., Sidney, V. I., Fitzgerald, V. I., Wellington, V. I.

B. californicus, with its varieties *dubius* Cresson and *consanguineus* Handlirsch, is represented by 237 specimens from 49 localities. It is not a mountain bumble bee, but extends in the valleys over a wide area of the Province at an altitude range of 0-2000 feet.

B. californicus F. Smith, with the scutellum black, is represented by 52 specimens from 24 localities, and reaches its maximum abundance on Vancouver Island and the coast of the mainland. The variety *consanguineus*, with the scutellum yellow, is represented by 171 specimens from 35 localities and is the commonest of the three forms in British Columbia, ranging north to the central interior and Peace River district. The variety *dubius*, with an admixture of black and yellow pile on the scutellum, is represented by 14 specimens from 9 localities. Though these definitely have some yellow pile, in varying amounts, mixed with the black on the scutellum, they are, in general, far more like the typical form than like var. *consanguineus*.

This is a fairly distinctive species in the field although the queens resemble those of *Psithyrus insularis*, but far more active.

Genus *PSITHYRUS* Tepeletier

This genus contains a small number of inquilinous, or "guest," bumble bees, without workers; the females utilize the nests of true bumble bees, their young being raised by the host workers.

Specimens of *Psithyrus* spp. are easy to collect, as they are sleepy and sluggish in their movements and often congregate in large numbers on flower heads of thistle, aster, and other attractive plants. This is particularly the case of males in late summer.

Psithyrus spp. may be readily distinguished from *Bombus* spp. by the absence of corbiculae, or pollen baskets, in the queens, and by the black, hairy faces of the males, the males of *Bombus* spp. having a conspicuous amount of yellow pile.

Seven species are known from America north of Mexico; and four of these, *insularis*, *ashtoni*, *suckleyi*, and *fernaldae*, are recorded from British Columbia. Of the remaining three species, *crawfordi*, described from Oregon, may well occur here; but *variabilis* is more southern in distribution and is less likely to be found. *P. laboriosus* has not as yet been recorded from British Columbia, but from its distribution in the U. S. it should be found here.

The species of *Psithyrus* closely resemble one another in size and in their black and yellow colouration, and in the field it is difficult to distinguish them. As *insularis* and *suckleyi* are exceedingly common and *ashtoni* and *fernaldae* are comparatively rare in British Columbia, it is difficult to secure good series of the latter two without collecting all specimens of *Psithyrus* seen.

Subgenus **Laboriopsithyrus** Frison

Psithyrus insularis (F. Smith) (56: 131♂ 131♀—262)

LOCALITIES — Carbonate, Radium, Invermere, Crows Nest, Fernie, Newgate, Kaslo, Osoyoos, Fairview, Okanagan Falls, Penticton, Hedley, Summerland, Okanagan Mission, Oyama, Vernon, Field, Golden, Glacier, Revelstoke, Sicamous, Salmon Arm, Kamloops, Merritt, Nicola, Aspen Grove, Walhachin, Hat Creek, Jesmond, Chilcotin, Quesnel, Stanley, Prince George, Vanderhoof, Burns Lake, Smithers, Kitwanga, Salvus, Lillooet, Lytton, Boston Bar, Hope, Hope Mts., Agassiz, Vancouver, Buccaneer Bay, Newcastle I., Victoria, V. I., Sidney, V. I., Fitzgerald, V. I., Duncan, V. I., Nanaimo, V. I., Departure Bay, V. I., Wellington, V. I., Mt. Arrowsmith, V. I., Forbidden Plateau, V. I.

This appears to be the only species of *Psithyrus* of which there are definite records of occurrence in the nests of *Bombus* spp. in British Columbia.

Frison (1921) records that Sladen (1915) found *P. insularis* in a nest of *B. flavifrons* at Agassiz on July 7, 1914. The author also received a queen of *insularis* and four workers of *B. mixtus* taken from a nest in a compost pile by H. B. Leech at Vernon on June 2, 1946. Mr. Leech stated that there was no sign of the *mixtus* queen which had evidently been killed or driven away by the *Psithyrus* sp.

This is the commonest species of *Psithyrus* in British Columbia, and this paper records 262 specimens from 56 localities widely and evenly distributed in the Province, at least as far north as latitude 56°, and with a considerable altitude range.

Subgenus **Ashtonipsithyrus** Frison

Psithyrus ashtoni (Cresson) (10: 75♂ 15♀—90)

LOCALITIES — Chilcotin, Quesnel, Barkerville, Prince George, Vanderhoof, Fraser Lake, Burns Lake, Quick, Smithers, Lillooet.

This is one of the rare species in British Columbia; and of the 10 localities recorded above, 9 are situated in the northern half of the Province, north of latitude 52°. The specimen from Lillooet, a little south of latitude 51°, was probably taken on Mt. McLean (altitude, 7600 ft.).

Psithyrus suckleyi (Greene) (51: 168♂ 85♀—253)

LOCALITIES—Carbonate, Invermere, Cranbrook, Kaslo, Nelson, Osoyoos, Oliver, Kaleden, Penticton, Keremeos, Peachland, Westbank, Okanagan Mission, Vernon, Golden, Revelstoke, Sicamous, Salmon Arm, Adams Lake, Kamloops, Merritt, Nicola, Jesmond, Chilcotin, Quesnel, Prince George, Vanderhoof, Burns Lake, Smithers, Hazelton, Kitwanga, Cedarvale, Pacific, Terrace, Tyee, Lillooet, Lytton, Boston Bar, Yale, Hope Mts., Manning Park, Agassiz, Mt. Cheam, Vancouver, Buccaneer Bay, Victoria, V. I., Royal Oak, V. I., Duncan, V. I., Sahtlam, V. I., Ladysmith, V. I., Departure Bay, V. I.

P. suckleyi is similar to *insularis* in having a Province-wide distribution and a considerable altitude range. It is a common species, and the 253 specimens recorded were collected from 51 localities, ranging from latitude 49° to north of latitude 55° and from the Alberta border to Vancouver Island.

Subgenus **Fernaldaepsithyrus** Frison

Psithyrus fernaldae Franklin (20: 63♂ 15♀—78)

LOCALITIES — Invermere, Kaslo, Summerland, Vernon, Field, Revelstoke, Hat Creek, Jesmond, Chilcotin, Barkerville, Metlakatla, Stikine, Hope Mts., Manning Park, Agassiz, Mt. Cheam, Vancouver, Newcastle I., Departure Bay, V. I., Nanaimo, V. I.

P. fernaldae is a comparatively rare species but is more widely distributed than *ashtoni*, and the 80 specimens recorded were collected in 21 localities from latitude 50° to the Yukon boundary. The Kamloops collection also contains 7 males collected on July 15, 1948, at Valdez, Alaska, by J. D. Gregson. It has been taken at several points at sea level on the coast, but the specimens from the interior are mainly from mountain locations as high as 7000 ft. Further collecting is needed to determine its distribution and altitude range in British Columbia.

The Canadian National Collection, at Ottawa, contains 2 males of *fernaldae* var. *wheeleri* Bequaert and Plath, collected at Revelstoke on August 12, 1923, by P. N. Vroom. These were evidently mislabelled, as a check with specimens of *fernaldi* s. str. and a comparison with the type of *wheeleri* kindly undertaken by Dr. J. Bequaert, Museum of Comparative Zoology, Cambridge, Mass., clearly reveal that these two males are typical specimens of *fernaldae* and not of var. *wheeleri*.

In some unpublished notes, kindly loaned by Dr. H. H. Ross, Illinois State Natural History Survey, Frison also records var. *wheeleri* from Vancouver, B. C. But the writer has not obtained any data on this record, and as it might have been in error as in the case of the Revelstoke material, var. *wheeleri* is not being recorded here as occurring in British Columbia. It may, however, be found in the Province, as it occurs in both Oregon and California.

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AN UNUSUAL CUTWORM OUTBREAK[1]

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Early in August, 1948, a report was received at the Dominion Entomological Laboratory, Agassiz, B. C., of a serious cutworm outbreak on Nicomen Island. This island, composed entirely of alluvial land, lies on the north side of the Fraser River east of Mission and is some 7 miles long. It was almost entirely covered with water to a depth of many feet during the disastrous flood in June, 1948, and all crops were destroyed.

Investigation showed a large, striped, greenish caterpillar to be present in epidemic numbers, feeding on the scanty vegetation that was then springing up as the land dried. The larvae were in various instars, but the majority were fully fed.

As the insect was not recognized, material was collected for rearing. The adults emerged throughout September, 1948 and were identified as *Dargida procincta* (Grote).

Search of literature showed no record of this insect as a pest in British Columbia, but W. Downes, lately in charge of the Dominion Entomological Laboratory at Victoria, has since informed me that, in 1928, a serious outbreak occurred in the Alberni, Comox, and Cumberland areas, where, chiefly on bottom lands, clover, alfalfa, young oats and couch grass were severely injured. J. R. J. Llewellyn Jones of Cobble Hill, Vancouver Island, also told me that he captures an occasional adult in most years.

Later in August, outbreaks were also reported in the Glendale, Matsqui, and Hatzic areas, where similar flood conditions had obtained. The total area covered by the outbreak of this uncommon species was therefore some 200 square miles.

The larvae were found to feed on a variety of plants, chiefly grasses, oats, and corn; but the new growth of dandelion, plantain, and other weeds that had survived a three-week submergence were fed upon until the newly sown grain crops came through the mud. In some fields 25 per cent of the oat and corn seedlings were devoured. Feeding was general during daylight hours, this species having somewhat the habits and appearance of an armyworm.

A 3 per cent D.D.T. dust proved an effective and practical control.

Two interesting facts concerning the life-history of this species were noted. The first is the sudden and unexplained appearance of the larvae in numbers sufficiently large to give rise to an epidemic, for this species is seldom seen in an average year. The second is the complete confinement of the outbreak to flooded lands. It was particularly noticeable on Nicomen Island that even small ridges above flood level were not infested. In the latter connection it is interesting to refer to the observations made by Professor Spencer (1947), when it was noted that the moths of this species oviposited only in soil being soaked by a garden hose and were uninterested in the garden beds not being watered. Evidently only water-soaked land is chosen by the adults for egg-laying.

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[1] Contribution No. 2622A, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

NOTES ON THE LIFE HISTORY OF FEBRUARY HIGHFLYER HYDRIOMENA NUBILOFASCIATA PACK. F. VULNERATA SWETT (Lepidoptera: Geometridae)

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The species of the genus *Hydriomena* are very variable yet difficult to separate and since any facts concerning the life-histories may be useful in determining their true status, the following notes on *Hydriomena nubilofasciata* Pack. f. *vulnerata* Swett. are presented.

The February highflyer is quite common and in some years very abundant about trees of the Garry oak, *Quercus garryana* Doug., in the vicinity of Victoria, B. C. During the flight period, February and March, the moth is readily attracted to artificial light. By day it rests on tree trunks, the underside of branches, copings, or any place that will provide seclusion away from direct sunlight. It is very alert and is not easy to approach when at rest, for it takes flight quickly and usually before it can be seen by a would-be captor.

As the intention was to investigate the details of its life-history, females were particularly sought in order to obtain a supply of eggs. It was found that those individuals that came to light, especially during the early part of the season, were males; females were taken more commonly towards the end of the flight period, although by that time most of them had already deposited their eggs. After a few futile attempts to obtain gravid females it was discovered that the best method was to search the bushes and adjacent herbage or low hanging branches of the oaks, with a torch or lantern, when it was possible to find an occasional specimen either in copulation or quietly resting.

The following observations were made during the spring of 1949. Partly due to the elusive habits of the larvae the exact sequence of the moults was not precisely ascertained, hence a more or less chronological account has been adopted.

Ovum. Laid on March 26, 1949. Length 1 mm., width .05 mm. Elongate oval, slightly flattened at one end, surface minutely pitted or recticulated, smooth, shining. Colour white, turning to a light cinnamon towards hatching time.

The eggs were laid indiscriminately on the sides of the jar or over oak twigs inserted for the purpose. One female taken under natural conditions had packed her eggs into the dried and empty capsule of a garden *linaria*, far removed from any oak twigs. The number of eggs obtained from each of several females was 10 to 18. These were laid between March 5 and 26.

Larva. April 17: emerged from egg. 1st instar, length 1 mm. Head black, body dull green, smooth. The larva does not eat the egg shell, but immediately seeks a bud that is just breaking and burrows into the centre where it remains concealed in a little cell hollowed out by eating into the substance of the bud.

April 26: Length 4 mm. Head black, body drab fuscous brown, smooth, shining. The only external evidence of life in the bud is the accumulation of frass between the incipient leaves. Judging by the size of the larvae this may be the 2nd or 3rd instar. Some larvae were just undergoing a moult.

April 29: Moult completed. Length now 6 mm. Colour and appearance as before. Some of the larvae show signs of leaving the bud which is rapidly opening into leaf.

May 1: Evidently another and unobserved moult has been effected. Length now 8 mm. Head brown with black flecks, body dull black with three indefinite longitudinal dorsal lines of small beige-coloured spots. Ninth abdominal segment pale beige. The larvae are still feeding concealed between base of leaves of the young shoot.

May 2: Length 12 mm. Head brown with black flecks, body black with four milky-white interrupted lines on dorsum and similar lateral lines, ventral surface lighter in colour.

May 4: As the leaves grow the larvae resort to folding over the leaf tip or hiding between two leaves where they lie concealed, usually curled up. They feed on the parenchyma, leaving the upper surface of the leaves intact. When disturbed they snap the fore part of body back and forth.

May 6: Evidently the 4th or 5th instar. Length 15 mm. Head light brown as before, body *creamy green* with interrupted dorsal and lateral lines dusky. Spiracles black. The larvae continue to feed under cover of folded leaves. If violently disturbed they escape from the leaves and suspend themselves by a silken thread.

May 8: Length 20 mm. Colour and markings as before but more decided in tone.

May 11: Length 24 mm. This may be the 5th or 6th instar. Colour as before but richer and markings more pronounced. The larvae consistently seek cover between folded portions of the leaves.

Pupa. Pupation May 21 in fold of leaf or in a light silken cocoon spun in the sand at bottom of cage. Particles of sand adhered to the cocoon rendering it almost invisible. Length 11 mm., width 3 mm. Colour light brown turning to dark brown in 24 hours, smooth, shining. Cremaster with two long hooked setae and several very short ones at base. The pupae were kept throughout the summer at average room temperature.

Imago. Emerged January 19, 26 and February 8, 1950. Two males and one female. The first recorded emergence under natural conditions was February 18.

Remarks. There are several interesting features in the life-history of this species. *First,* the larva is completely a bud feeder in the early stages, completing its growth concealed in folded leaves. *Second,* the change of colour from black to green may be significant as the colour matches the green leaves on which growth is completed, thus rendering the larvae less conspicuous. *Third,* from the unusual length of the pupal period, it might be expected that a second brood would intervene between the spring of one year and that of the next, but the newly opened bud seems to be an essential requirement for the young larvae.

Summary. The February highflyer, *Hydriomena nubilofasciata* f. *vulnerata* feeds in the larval stage on Garry oak, *Quercus garryana.* The adult is on the wing in the months of February and March. The eggs are assumed to be laid on or near the buds, in which the larvae feed. The larvae change colour from black to green as the leaves develop. The pupal stage which is passed in the ground lasts for about nine months or until the opening buds are ready for the newly hatched larvae. The life cycle as here observed is divided between the stages as follows, ova—22 days, larvae —34 days, pupae—243 days, imagines —over a period of 60 days.

A FURTHER NOTE ON BREEDING LAMBDINA FISCELLARIA SOMNIARIA HIST.

Supplementary to my previous experiment with the larvae of **Lambdina fiscellaria somniaria Hist.**, reported in the Proceedings of the Entomological Society of British Columbia, Volume 45, page 6, this note is now submitted.

On June 2, 1949, while "beating" Garry oak, **Quercus garryana** Douglas, in the Uplands District of Victoria, B. C., 21 very small larvae of this species were obtained. On June 26, when about half an inch in length, the larvae were sleeved on western hemlock, **Tsuga heterophylla.** The small larvae readily accepted this food and thrived and by August 22, 18 of them had pupated in the folds of the sleeve. Three larvae were in their rudimentary cocoons in a dormant state. They were transferred to a ten inch flower-pot, in which some soil had been placed and on which a generous layer of moss was spread. The pupae, after removal from their cocoons, together with the three "resting" larvae which were left in their flimsy cocoons, were placed on the moss.

Sixteen imagines were obtained between August 3 and October 3, 1949. The imagines were of normal size and in colouring were very similar to typical **somniaria,** though possibly a trifle greyer than is generally the case when the larvae have fed exclusively on Garry oak.—J. R. J. Llewellyn Jones, Cobble Hill, B. C.

BIOLOGICAL CONTROL INVESTIGATIONS IN BRITISH COLUMBIA[1]

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Since the initial introduction of natural enemies of insects into British Columbia in 1917, 42 species of parasites and predators have been released against 21 species of pest insects. This comparatively large-scale importation of beneficial insects was undertaken in an effort to control the important insect pests that have become established in the Province without their natural enemies. The geographic location and topography of British Columbia presented barriers that prevented these enemies from reaching the area unassisted.

The topography and climate of British Columbia separate it ecologically from the rest of Canada, and subdivide it into a number of more or less clearly defined ecological islands. The mountains form natural physical barriers that restrict the movement and distribution of insect species and through their effect on climate produce a wide range of temperature and precipitation that places a further restriction on distribution. This increases the number of problems in biological control of insects, but also provides many advantages for the application of this method of control that are not found in less restricted areas.

An indication of the wide range of climate in British Columbia is given in the following records provided by the Meteorological Division of the Department of Transport. The statistics are annual averages:

	Maximum	Minimum
Precipitation	Northern coast, 112.11″	Interior, 9.02″
Snowfall	Eastern interior, 390.2″	Vancouver Island, 6.3″
Extreme High Temperature	Central interior, 103° F.	Northern coast, 75° F.
Extreme Low Temperature	Northern interior, –45° F.	Vancouver Island, 20° F.
Sunshine	Vancouver Island, 2207 hrs.	Northern coast, 1053 hrs.

These extremes of climate are responsible for great variation in the flora in the different areas, and this has an important effect on the insect species through restricting them to the areas where their host plants grow. The number of plant species has been greatly increased through the introduction of new crops that are continually being added to the diversified agricultural areas. Many of the economically important insect pests accompanied the original or later importations of their host plants before the Division of Plant Protection reduced this hazard to the minimum. There are still ways by which new insect pests may be introduced and become established in the Province in spite of the most careful inspection at ports of entry. Evidence of the continued increase in the number of insect pests that have become established in British Columbia is contained in Table I, which includes a partial list of the species that have been recorded since 1900.

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2 Officer-in-Charge.

TABLE I

A partial list of insect pests recorded for the first time in British Columbia since 1900.

COMMON NAME	SCIENTIFIC NAME	DATE FIRST RECORDED
Codling moth	*Carpocapsa pomonella* (L.) (Vancouver Island)	1900
	(Interior)	1905
Greenhouse whitefly	*Trialeurodes vaporariorum* (Westw.)	1907
Apple mealybug	*Phenacoccus aceris* (Sign.)	1913
Pea weevil	*Bruchus pisorum* (L.)	1915
European earwig	*Forficula auricularia* L.	1916
Satin moth	*Stilpnotia salicis* (L.)	1920
Lecanium scale	*Lecanium coryli* (L.)	1923
Larch sawfly	*Pristiphora erichsonii* (Htg.)	1930
Cabbage seedpod weevil	*Ceutorhynchus assimilis* (Payk.)	1931
Pea moth	*Laspeyresia nigricana* (Steph.)	1933
Carrot rust fly	*Psila rosae* (F.)	1936
Soft scale	*Coccus hesperidum* (L.)	1938
Lodgepole needle miner	*Recurvaria milleri* (Busck)	1942

The first introduction of natural enemies of insects into British Columbia occurred in 1917, when the predacious mite *Hemisarcoptes malus* (Shimer) was obtained in New Brunswick and released on Vancouver Island, on the lower mainland, and in the Okanagan Valley against the oystershell scale.

A few additional parasite species were introduced before 1929, but prior to that time there were no suitable facilities in Canada to provide pure parasite cultures for release. After the establishment of the Dominion Parasite Laboratory at Belleville, Ontario, in 1939, a modern laboratory with quarantine facilities was constructed, and under the direction of A. B. Baird, Officer-in-Charge, Biological Control Investigations, the importation, propagation, and distribution of parasites proceeded rapidly. The distribution and successful establishment of many of the species that have been introduced into British Columbia would not have been possible, however, without the active co-operation of the local entomologists. The method by which a parasite of the European earwig, i.e., *Bigonichaeta setipennis* (Fall.), was established provides a good example of this co-operation. Colonies of this parasite obtained from England through the Belleville laboratory and released at New Westminster between 1920 and 1931 did not give evidence of becoming established. Arrangements were made by A. B. Baird in 1933 to procure breeding stock from the city of Portland, Oregon, where propagation and distribution of the parasite was then in progress. A breeding station was set up at the Dominion Entomological Laboratory at Victoria, and R. W. Smith of the Belleville laboratory assisted W. Downes in the development of suitable facilities and the establishment of propagation routine. The work was continued for several years by W. Downes and H. Andison, and more than a quarter of a million parasites were released during the period 1934 to 1939 with the result that the species became established over a wide area.

Reports concerning the establishment of many of the introduced parasites have been published by a number of entomologists including Venables (1923, 1931), Glendenning (1931), Downes and Andison (1941), Hopping, Leech, and Morgan (1943), Wishart (1947), Spencer (1947), and Baird and McLeod (1949).

An alphabetical list of all species of parasites and predators introduced and the pest species against which they have been released is given in Table II.

TABLE II

Species of parasites and predators introduced into British Columbia during the period 1917 to 1949.

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Allotropa sp.	Apple mealybug, *Phenacoccus aceris* (Sign.)	Nelson	1938	Nova Scotia	2,080
Allotropa utilis Mues.	Apple mealybug, *Phenacoccus aceris* (Sign.)	Boswell	1939	Nova Scotia	44
		Boswell	1940	"	190
		Creston	1940	"	240
		Long Beach	1940	"	17
		Kelowna (Okanagan Mission)	1941	"	21
		Okanagan Mission	1942	"	106
		Robson	1942	"	252
		Bonnington & S. Slocan	1943	"	1,340
		Gray Creek	1943	"	1,535
		Queen's Bay	1943	"	777
		Boswell & Dist.	1944	N. S., through B. C.	628
		Queen's Bay	1944	"	427
		Willow Pt. & Nelson	1944	"	762
		Okanagan Mission	1945	"	2,732
		Royal Oak (Victoria)	1948	"	133
Apanteles solitarius (Ratz.)	Satin moth, *Stilpnotia salicis* (L.)	Nicomen Is.	1933	Europe, through U. S. A.	737
Aphelinus mali (Hald.)	Woolly apple aphid, *Eriosoma lanigerum* (Hausm.)	Vernon	1929	Ontario	516
		Vancouver	1921	"	?
Aphelinus sp.	Aphids	Victoria	1938	Belleville	2,500
Ascogaster carpocapsae (Vier.)	Codling moth, *Carpocapsa pomonella* (L.)	Kelowna	1933	Ontario	1,097
		Winfield	1934	"	421
		Kelowna	1935	"	599
		Penticton	1935	"	622
		Victoria	1935	"	1,739
		Winfield	1935	"	1,043
		Victoria	1936	"	1,144
		Kamloops North	1937	"	1,156
		Keating	1937	"	871
		Kelowna	1937	"	3,295
		Oyama	1937	"	572

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SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Allatropa sp.	Apple mealybug. *Phenacoccus aceris* (Sign.)	Nelson	1938	Nova Scotia	2,080
Allatropa utilis Mues.	Apple mealybug. *Phenacoccus aceris* (Sign.)	Boswell	1939	Nova Scotia	44
		Boswell	1940	"	190
		Creston	1940	"	240
		Long Beach	1940	"	17
		Kelowna (Okanagan Mission)	1941	"	21
		Okanagan Mission	1942	"	106
		Robson	1942	"	252
		Bonnington & S. Slocan	1943	"	1,340
		Gray Creek	1943	"	1,535
		Queen's Bay	1943	"	777
		Boswell & Dist.	1944	N. S., through B. C.	628
		Queen's Bay	1944	"	427
		Willow Pt. & Nelson	1944	"	762
		Okanagan Mission	1945	"	2,732
		Royal Oak (Victoria)	1948	"	133
Apanteles solitarius (Ratz.)	Satin moth. *Stilpnotia salicis* (L.)	Nicomen Is.	1933	Europe, through U. S. A.	737
Aphelinus mali (Hald.)	Woolly apple aphid. *Eriosoma lanigerum* (Hausm.)	Vernon	1929	Ontario	516
		Vancouver	1921	"	?
Aphelinus sp.	Aphids	Victoria	1938	Belleville	2,500
Ascogaster carpocapsae (Vier.)	Codling moth. *Carpocapsa pomonella* (L.)	Kelowna	1933	Ontario	1,097
		Winfield	1934	"	421
		Kelowna	1935	"	599
		Penticton	1935	"	622
		Victoria	1935	"	1,739
		Winfield	1935	"	1,043
		Victoria	1936	"	1,144
		Kamloops North	1937	"	1,156
		Keating	1937	"	871
		Kelowna	1937	"	3,295
		Oyama	1937	"	572

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Ascogaster carpocapsae (Vier.)		South Okanagan	1937	"	291
		Vernon	1937	"	725
		Victoria	1937	"	560
		Winfield	1937	"	2,845
		Victoria	1939	"	570
		Vernon	1939	"	33,250
Ascogaster quadridentata Wesm.	Pea moth, *Laspeyresia nigricana* (Steph.)	Chilliwack	1936	Ontario	300
		Sumas Prairie	1936	"	966
		East Chilliwack	1937	"	50
Bessa harveyi (TT) *selecta* Mgn. of American auth.)	Pea moth, *Laspeyresia nigricana* (Steph.)	Sumas Prairie	1937	England	34
		Chilliwack	1938	"	127
		Musselwhite	1938	"	753
		Chilliwack	1939	"	4,377
		Cloverdale	1947	"	3,592
Bigonichaeta setipennis (Fall.)	European larch sawfly, *Pristiphora erichsonii* (Htg.)	Edgewood	1942	New Brunswick & Ontario	3,750
		Vernon	1942	"	2,245
	European earwig, *Forficula auricularia* (L.)	New Westminster	1928	England & U.S.A.	165
		New Westminster	1929	"	212
		New Westminster	1930	"	326
		New Westminster	1931	"	373
		Sidney	1934	"	200
		Chemainus	1935	"	2,000
		Victoria	1935	"	17,500
		Alberni	1936	"	1,000
		Courtenay	1936	"	1,000
		Cumberland	1936	"	1,000
		Forbes Landing	1936	"	1,000
		Gordon Head	1936	"	1,000
		Keating	1936	"	1,000
		Ladysmith	1936	"	1,000
		Little Qualicum	1936	"	1,000
		Nanaimo	1936	"	5,000
		New Westminster	1936	"	5,000
		North Vancouver	1936	"	4,000
		Parksville	1936	"	1,000
		Port Alberni	1936	"	1,000
		Powell River	1936	"	4,000
		Qualicum	1936	"	1,000
		Royston	1936	"	1,000

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
		Salt Spring Is.	1936	"	1,000
		Vancouver	1936	"	32,019
		Victoria	1936	"	4,200
Bigonichaeta setipennis (Fall.) [1]		Agassiz	1938	Europe, through U. S. A. (Victoria) [2]	5,000
		Campbell River	1938	"	3,000
		Cloverdale	1938	"	1,000
		Cobble Hill	1938	"	2,000
		Comox	1938	"	2,000
		Courtenay	1938	"	4,000
		Craig's Crossing	1938	"	1,000
		Duncan	1938	"	4,000
		Errington	1938	"	2,000
		Haney	1938	"	5,000
		Horseshoe Bay	1938	"	1,000
		Ladysmith	1938	"	1,000
		Langford Lake	1938	"	1,000
		Lantzville	1938	"	1,000
		Milner	1938	"	1,000
		Nanoose	1938	"	1,000
		Nelson	1938	"	8,000
		New Westminster	1938	"	1,000
		Parksville	1938	"	1,000
		Port Coquitlam	1938	"	5,000
		Powell River	1938	"	8,000
		Qualicum Beach	1938	"	2,000
		Quathiaski Cove	1938	"	1,000
		Salt Spring Is.	1938	"	3,000
		Sandwick	1938	"	1,000
		Saseenos	1938	"	1,000
		Sooke Village	1938	"	2,000
		Squamish	1938	"	1,000
		Ten Mile Point	1938	"	2,120
		Union Bay	1938	"	1,000
		Vancouver	1938	"	3,000
		Vernon	1938	"	2,000
		Victoria	1938	"	15,775
		West Bay	1938	"	1,000
		Westview	1938	"	1,000
		Wildwood Heights	1938	"	1,000
		Brentwood	1939	"	1,000
		Cowichan Lake	1939	"	1,000
		Esquimalt	1939	"	1,893

[1] Comprised of parasitized earwigs and parasite puparia.
[2] European earwig parasites propagated at the Dominion Entomological Laboratory, Victoria, B. C., from breeding stock obtained in Portland, Ore.

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Ascogaster carpocapsae (Vier.)		South Okanagan	1937	"	291
		Vernon	1937	"	725
		Victoria	1937	"	560
		Winfield	1937	"	2,845
		Victoria	1939	"	570
		Vernon	1939	"	33,250
Ascogaster quadridentata Wesm.	Pea moth, *Laspeyresia nigricana* (Steph.)	Chilliwack	1936	Ontario	300
		Sumas Prairie	1936	"	966
		East Chilliwack	1937	"	50
Bessa harveyi (TT) *selecta* Mgn. of American auth.)	Pea moth, *Laspeyresia nigricana* (Steph.)	Sumas Prairie	1937	England	34
		Chilliwack	1938	"	127
		Musselwhite	1938	"	753
		Chilliwack	1939	"	4,377
		Cloverdale	1947	"	3,592
Biganichaeta setipennis (Fall.)	European larch sawfly, *Pristiphora erichsonii* (Htg.)	Edgewood	1942	New Brunswick & Ontario	3,750
		Vernon	1942	"	2,245
	European earwig, *Forficula auricularia* (L.)	New Westminster	1928	England & U.S.A.	165
		New Westminster	1929	"	212
		New Westminster	1930	"	326
		New Westminster	1931	"	373
		Sidney	1934	"	200
		Chemainus	1935	"	2,000
		Victoria	1935	"	17,500
		Alberni	1936	"	1,000
		Courtenay	1936	"	1,000
		Cumberland	1936	"	1,000
		Forbes Landing	1936	"	1,000
		Gordon Head	1936	"	1,000
		Keating	1936	"	1,000
		Ladysmith	1936	"	1,000
		Little Qualicum	1936	"	1,000
		Nanaimo	1936	"	5,000
		New Westminster	1936	"	5,000
		North Vancouver	1936	"	4,000
		Parksville	1936	"	1,000
		Port Alberni	1936	"	1,000
		Powell River	1936	"	4,000
		Qualicum	1936	"	1,000
		Royston	1936	"	1,000

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
		Salt Spring Is.	1936	"	1,000
		Vancouver	1936	"	32,019
		Victoria	1936	"	4,200
Biganichaeta setipennis (Fall.)[1]		Agassiz	1938	Europe, through U. S. A. (Victoria)[2]	5,000
		Campbell River	1938	"	3,000
		Cloverdale	1938	"	1,000
		Cobble Hill	1938	"	2,000
		Comox	1938	"	2,000
		Courtenay	1938	"	4,000
		Craig's Crossing	1938	"	1,000
		Duncan	1938	"	4,000
		Errington	1938	"	2,000
		Haney	1938	"	5,000
		Horseshoe Bay	1938	"	1,000
		Ladysmith	1938	"	1,000
		Langford Lake	1938	"	1,000
		Lantzville	1938	"	1,000
		Milner	1938	"	1,000
		Nanoose	1938	"	1,000
		Nelson	1938	"	8,000
		New Westminster	1938	"	1,000
		Parksville	1938	"	1,000
		Port Coquitlam	1938	"	5,000
		Powell River	1938	"	8,000
		Qualicum Beach	1938	"	2,000
		Quathiaski Cove	1938	"	1,000
		Salt Spring Is.	1938	"	3,000
		Sandwick	1938	"	1,000
		Saseenos	1938	"	1,000
		Sooke Village	1938	"	2,000
		Squamish	1938	"	1,000
		Ten Mile Point	1938	"	2,120
		Union Bay	1938	"	1,000
		Vancouver	1938	"	3,000
		Vernon	1938	"	2,000
		Victoria	1938	"	15,775
		West Bay	1938	"	1,000
		Westview	1938	"	1,000
		Wildwood Heights	1938	"	1,000
		Brentwood	1939	"	1,000
		Cowichan Lake	1939	"	1,000
		Esquimalt	1939	"	1,893

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SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Bigonichaeta setipennis (Fall.) [1]		Gibson's Landing	1939	"	2,000
		Mt. Douglas	1939	"	1,000
		North Galiano Is.	1939	"	1,000
		Royal Oak	1939	"	1,000
		Westholme	1939	"	1,000
Blastothrix sericea (Dalm.)	Lecanium scale, *Lecanium coryli* (L.)	Vancouver	1928	England	263
		Vancouver	1929	"	779
Bracon sp.	Cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.)	Victoria	1944	British Columbia	443
		Gordon Head	1945	"	133
		Blenkinsop Rd.	1946	"	55
		Mattick's Farm	1946	"	610
Calosoma sycophanta (L.)	Oak looper, *Lambdina somniaria* (Hulst)	Vancouver Is.	1917-1918	Europe, through U. S. A.	?
Chrysocharis gemma (Wlk.)	Holly leaf miner, *Phytomyza ilicis* (Curt.)	Victoria	1936	England	3,166
		Victoria	1937	"	10,331
		Victoria	1938	"	21,067
		Burnaby	1939	"	2,136
		Essondale	1939	"	2,550
		Vancouver	1939	"	4,696
		West Vancouver	1939	"	2,011
Chrysocharis syma Wlk.	Holly leaf miner, *Phytomyza ilicis* (Curt.)	Victoria	1936	"	469
		Saanich (Finnerty Bay)	1937	"	1,035
		Victoria	1938	"	474
		Vancouver	1939	"	179
Coccophagus scutellaris (Dalm.)	Soft scale, *Coccus hesperidum* (L.)	Victoria	1942	U. S. A.	139
Compsilura concinnata (Meig.)	Satin moth, *Stilpnotia salicis* (L.)	Coquitlam	1929	Europe, through U. S. A.	526
		Agassiz	1930	"	834
		Agassiz	1931	"	589
		Agassiz	1932	"	242
		Seton Lake	1933	"	694
		Agassiz	1934	"	45
		Lillooet	1934	"	662
Cryptus sexannulatus Grav.	Codling moth, *Carpocapsa pomonella* (L.)	Kelowna	1942	Europe (Belleville) [3]	54
		Kelowna	1946	"	2,185
		Penticton	1946	"	2,014

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Cryptus sexannulatus (Grav.)		Brilliant	1947	"	23
		Salmon Arm	1947	"	193
Cyrtogaster vulgaris Wlk.	Holly leaf miner, *Phytomyza ilicis* (Curt.)	Saanich	1937	England	148
		Victoria	1938	"	2,079
		Vancouver	1939	"	332
		West Vancouver	1939	"	139
Dacnusa gracilis (Nees)	Carrot rust fly, *Psila rosae* (F.)	Cloverdale	1949	"	1,153
Dahlbominus fuscipennis (Zett.)	Hemlock sawfly, *Neodiprion tsugae* Midd.	Yale	1941	Europe (Belleville)[3]	100,000
		Sugar Lake region 40 mi. from Vernon	1941	"	300,000
Drino (Prosturmia) bohemica Mesnil	Hemlock sawfly, *Neodiprion tsugae* Midd.	Kwuna Point	1946	Europe (Belleville)[3]	201
		Welcome Point (Skidegate Inlet)	1946	"	314
Encarsia formosa Gahan	Greenhouse whitefly, *Trialeurodes vaporariorum* (Westw.)	British Columbia	1934	Belleville	119,700
		British Columbia	1935	"	126,400
		British Columbia	1936	"	77,145
		British Columbia	1937	"	194,600
		British Columbia	1938	"	410,400
		British Columbia	1939	"	415,300
		British Columbia	1940	"	394,000
		British Columbia	1941	"	472,000
		British Columbia	1942	"	275,000
		British Columbia	1943	"	172,000
		British Columbia	1944	"	217,000
		British Columbia	1945	"	337,000
		British Columbia	1946	"	223,000
		British Columbia	1947	"	101,000
		British Columbia	1948	"	191,500
		British Columbia	1949	"	135,000
Ephialtes caudatus Ratz.	Codling moth, *Carpocapsa pomonella* (L.)	Vernon	1941	Europe (Belleville)[3]	160
		Kelowna	1946	"	1,265
		Penticton	1946	"	1,369
		Brilliant	1947	"	44
		Creston	1947	"	35
		Salmon Arm	1947	"	157
Eupteromalus nidulans (Thoms.)	Satin moth, *Stilpnotia salicis* (L.)	Boston Bar	1933	Europe, through U. S. A.	30
		Chilliwack	1933	"	2,500
		Rosedale	1933	"	1,783

[3] Parasites propagated at the Dominion Parasite Laboratory, Belleville, Ont., from imported breeding stock.

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Bigonichoeta setipennis (Fall.)[1]		Gibson's Landing	1939	"	2,000
		Mt. Douglas	1939	"	1,000
		North Galiano Is.	1939	"	1,000
		Royal Oak	1939	"	1,000
		Westholme	1939	"	1,000
Blostothrix sericeo (Dalm.)	Lecanium scale, *Lecanium coryli* (L.)	Vancouver	1928	England	263
		Vancouver	1929	"	779
Bracon sp.	Cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.)	Victoria	1944	British Columbia	443
		Gordon Head	1945	"	133
		Blenkinsop Rd.	1946	"	55
		Mattick's Farm	1946	"	610
Colosoma sycophanta (L.)	Oak looper, *Lambdina somniaria* (Hulst)	Vancouver Is.	1917-1918	Europe, through U. S. A.	?
Chrysochoris gemmo (Wlk.)	Holly leaf miner, *Phytomyza ilicis* (Curt.)	Victoria	1936	England	3,166
		Victoria	1937	"	10,331
		Victoria	1938	"	21,067
		Burnaby	1939	"	2,136
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		Saanich (Finnerty Bay)	1937	"	1,035
		Victoria	1938	"	474
		Vancouver	1939	"	179
Coccophogus scutellaris (Dalm.)	Soft scale, *Coccus hesperidum* (L.)	Victoria	1942	U. S. A.	139
Compsiluro concinnoto (Meig.)	Satin moth, *Stilpnotia salicis* (L.)	Coquitlam	1929	Europe, through U. S. A.	526
		Agassiz	1930	"	834
		Agassiz	1931	"	589
		Agassiz	1932	"	242
		Seton Lake	1933	"	694
		Agassiz	1934	"	45
		Lillooet	1934	"	662
Cryptus sexonnulotus Grav.	Codling moth, *Carpocapsa pomonella* (L.)	Kelowna	1942	Europe (Belleville)[3]	54
		Kelowna	1946	"	2,185
		Penticton	1946	"	2,014

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		Salmon Arm	1947	"	193
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		Victoria	1938	"	2,079
		Vancouver	1939	"	332
		West Vancouver	1939	"	139
Docnuso gracilis (Nees)	Carrot rust fly, *Psila rosae* (F.)	Cloverdale	1949	"	1,153
Dahlbominus fuscipennis (Zett.)	Hemlock sawfly, *Neodiprion tsugae* Midd.	Yale	1941	Europe (Belleville)[3]	100,000
		Sugar Lake region 40 mi. from Vernon	1941	"	300,000
Drino (Prosturmio) bohemico Mesnil	Hemlock sawfly, *Neodiprion tsugae* Midd.	Kwuna Point	1946	Europe (Belleville)[3]	201
		Welcome Point (Skidegate Inlet)	1946	"	314
Encarsio formosa Gahan	Greenhouse whitefly, *Trialeurodes vaporariorum* (Westw.)	British Columbia	1934	Belleville	119,700
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		British Columbia	1936	"	77,145
		British Columbia	1937	"	194,600
		British Columbia	1938	"	410,400
		British Columbia	1939	"	415,300
		British Columbia	1940	"	394,000
		British Columbia	1941	"	472,000
		British Columbia	1942	"	275,000
		British Columbia	1943	"	172,000
		British Columbia	1944	"	217,000
		British Columbia	1945	"	337,000
		British Columbia	1946	"	223,000
		British Columbia	1947	"	101,000
		British Columbia	1948	"	191,500
		British Columbia	1949	"	135,000
Ephialtes caudotus Ratz.	Codling moth, *Carpocapsa pomonella* (L.)	Vernon	1941	Europe (Belleville)[3]	160
		Kelowna	1946	"	1,265
		Penticton	1946	"	1,369
		Brilliant	1947	"	44
		Creston	1947	"	35
		Salmon Arm	1947	"	157
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		Lillooet	1934	"	4,900
Glypta haesitator Grav.	Pea moth, *Laspeyresia nigricana* (Steph.)	Chilliwack	1938	England	734
		Chilliwack	1939	"	809
		Cloverdale	1947	England, through B. C.	371
Habrocytus sp.	Cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.)	Sardis	1949	Europe	183
Hemisarcoptes malus (Shimer)	Oystershell scale, *Lepidosaphes ulmi* (L.)	Agassiz	1917	New Brunswick	1000+
		Mission	1917	"	1000+
		Royal Oak	1917	"	1000+
		Vernon	1917	"	1000+
Horogenes spp.	Pea moth, *Laspeyresia nigricana* (Steph.)	E. Chilliwack	1937	England	14
		Chilliwack (sp. A.)	1939	"	3
		Chilliwack (sp. B.)	1939	"	18
Leptomastidea abnormis (Gir.)	Citrus mealybug, *Pseudococcus citri* (Risso)	British Columbia	1940	Sicily, through U. S. A. (Belleville) [3]	400
		British Columbia	1941	"	1,300
Leptomastix dactylopii How.	Citrus mealybug, *Pseudococcus citri* (Risso)	British Columbia	1939	South America, through U. S. A. (Belleville) [3]	600
		British Columbia	1940	"	450
		British Columbia	1941	"	6,500
		British Columbia	1942	"	1,000
Macrocentrus ancylivorous Rohw.	Pea moth, *Laspeyresia nigricana* (Steph.)	Sumas Prairie	1935	U. S. A. (Belleville) [3]	175
		Chilliwack	1936	"	402
		Sumas Praisie	1936	"	324
Mantis religiosa L.	Grasshoppers, *Melanoplus* and other spp.	Kamloops	1937	Europe, through U. S. A. (Belleville) [3]	38
		Vernon	1937	"	123
		Salmon Arm	1938	"	175
Mantis religiosa L.[4]	Grasshoppers, *Melanoplus* and other spp.	Vernon	1937	Europe, through U. S. A. (Belleville) [3]	491
		Vernon	1938	"	175
Mesoleius aulicus (Grav.)	European larch sawfly, *Pristiphora erichsonii* (Htg.)	Fernie	1934	England, through Que., Ont. & N. B.	673
		Hosmer	1935	"	1,861
		Rosen Lake	1935	"	335
		Fernie	1936	"	49
		Kitchener	1936	"	388

[4] Egg masses.

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Mesoleius aulicus Grav.		Lumberton	1936	"	105
		Rosen Lake	1936	"	239
		Edgewood	1941	"	330
		Inonoaklin River	1941	"	294
		Edgewood	1942	"	302
		Vernon	1942	"	400
Metaphycus stanleyi (Comp.)	Soft scale, *Coccus hesperidum* (L.)	Victoria	1942	U. S. A.	40
Meteorus versicolor (Wesm.)	Satin moth, *Stilpnotia salicis* (L.)	Lillooet	1934	Europe, through U. S. A.	520
Opius ilicis Nixon	Holly leaf miner, *Phytomyza ilicis* (Curt.)	Victoria	1938	England	33
		Vancouver	1939	"	10
Pristomerus vulnerator Panz.	Pea moth, *Laspeyresia nigricana* (Steph.)	Chilliwack	1938	England	5
Protodexia australis Bl.	Grasshoppers, *Melanoplus* and other spp.	Kamloops	1947	Argentina	280
Sphegigaster flavicornis Wlk.	Holly leaf miner, *Phytomyza ilicis* (Curt.)	Victoria	1936	England	1,795
		Saanich	1937	"	1,306
		Saanich	1938	"	70
		Victoria	1938	"	3,188
		Vancouver	1939	"	852
Triaspis thoracicus Curt.	Pea weevil, *Bruchus pisorum* (L.)	Armstrong	1942	Europe	2,850
		Salmon Arm	1942	"	914
Trichomalus fasciatus (Thoms.)	Cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.)	Dewdney	1949	"	108
		Sardis	1949	"	90
Xenocrepis sp.	Cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.)	Dewdney	1949	"	1,063
		Sardis	1949	"	208
Zarhopalus corvinus (Gir.)	Grape mealybug, *Pseudococcus martimus* (Ehrh.)	Victoria	1939	U. S. A. (Belleville)[3]	88
		British Columbia	1940	"	1,707
Zenillia nox Hall.	Larch sawfly, *Pristiphora erichsonii* (Htg.)	Hosmer	1935	Japan	1,112
		Rosen Lake	1935	"	153

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Eupteromalus nidulans (Thoms.)		Seton Lake	1933	"	2,470
		Lillooet	1934	"	4,900
Glypta haesitatar Grav.	Pea moth, *Laspeyresia nigricana* (Steph.)	Chilliwack	1938	England	734
		Chilliwack	1939	"	809
		Cloverdale	1947	England, through B. C.	371
Habracytus sp.	Cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.)	Sardis	1949	Europe	183
Hemisarcoptes malus (Shimer)	Oystershell scale, *Lepidosaphes ulmi* (L.)	Agassiz	1917	New Brunswick	1000+
		Mission	1917	"	1000+
		Royal Oak	1917	"	1000+
		Vernon	1917	"	1000+
Harogenes spp.	Pea moth, *Laspeyresia nigricana* (Steph.)	E. Chilliwack	1937	England	14
		Chilliwack (sp. A.)	1939	"	3
		Chilliwack (sp. B.)	1939	"	18
Leptomastidea abnarmis (Gir.)	Citrus mealybug, *Pseudococcus citri* (Risso)	British Columbia	1940	Sicily, through U. S. A. (Belleville) [3]	400
		British Columbia	1941	"	1,300
Leptamastix dactylopii How.	Citrus mealybug, *Pseudococcus citri* (Risso)	British Columbia	1939	South America, through U. S. A. (Belleville) [3]	600
		British Columbia	1940	"	450
		British Columbia	1941	"	6,500
		British Columbia	1942	"	1,000
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		Chilliwack	1936	"	402
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		Vernon	1937	"	123
		Salmon Arm	1938	"	175
Mantis religiasa L.[4]	Grasshoppers, *Melanoplus* and other spp.	Vernon	1937	Europe, through U. S. A. (Belleville) [3]	491
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Meteorus versicalar (Wesm.)	Satin moth, *Stilpnotia salicis* (L.)	Lillooet	1934	Europe, through U. S. A.	520
Opius ilicis Nixon	Holly leaf miner, *Phytomyza ilicis* (Curt.)	Victoria	1938	England	33
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Pratadexia australis Bl.	Grasshoppers, *Melanoplus* and other spp.	Kamloops	1947	Argentina	280
Sphegigaster flavicornis Wlk.	Holly leaf miner, *Phytomyza ilicis* (Curt.)	Victoria	1936	England	1,795
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Xenacrepis sp.	Cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.)	Dewdney	1949	"	1,063
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		British Columbia	1940	"	1,707
Zenillia nax Hall.	Larch sawfly, *Pristiphora erichsonii* (Htg.)	Hosmer	1935	Japan	1,112
		Rosen Lake	1935	"	153

In addition to the importation of beneficial insects into British Columbia, the Biological Control Investigations Unit has obtained 21 parasite species in the Province for distribution against 8 pest species in other provinces. Many of the parasites obtained in British Columbia for distribution elsewhere in Canada were native species, but 5 of them were imported species that had become established and were sufficiently numerous to warrant collection for redistribution. The 5 species are listed in Table III.

TABLE III

Parasites imported into British Columbia and redistributed to other provinces of Canada.

Parasite	Year of Release in B.C.	Number of Release Points	Size of Colonies	First Date of Redistribution	Province
Apanteles solitarius (Ratz.)	1933	1	737	1940	Nfld.
Meteorus versicolor (Wesm.)	1934	1	520	1942	Nfld.
Mesoleius aulicus (Grav.)	1934-36 1941-42	11	49-1861	1944	Nfld., Ont., Man., Sask.
Ascogaster quadridentata Wesm.	1937-39	5	34-4377	1945	P.E.I., N.S., N.B., Que., Ont.
Glypta haesitator (Grav.)	1938-39	3	734-809	1945	P.E.I., N.S., Que.

There has been a considerable amount of theorizing by those who are interested in biological control problems regarding the optimum size of parasite colonies necessary to ensure establishment and the length of time required to build up an effective parasite population. Table III indicates that for some species at least, the release of small colonies under favourable conditions may result in the establishment and reasonablly rapid increase of parasites. It is significant that only one colony of *Apanteles solitarius* and of *Meteorus versicolor* was released in British Columbia, and from the single colony of 737 specimens of *Apanteles solitarius* and 520 specimens of *Meteorus versicolor* the former had increased sufficiently in 7 years and the latter in 8 years to warrant collection for redistribution in other provinces of Canada. This indicates that the original colonies were effective species well suited to climatic conditions in the new environment, and that they were properly handled prior to and during their release in the field. Probably the most important factor was that there was an abundant host supply and their release was timed to synchronize with the right stage of development of the host for parasitism.

Further evidence of the establishment of a small colony of parasites was obtained in 1949. A survey of the holly leaf miner in Vancouver and the surrounding districts revealed that the parasite *Opius ilicis* Nixon was present at 13 collection points. This parasite was originally released in the area in 1939 and the single colony consisted of only 4 males and 6 females.

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COLEOPTERISTS AND COLEOPTERA COLLECTIONS IN THE PACIFIC NORTHWEST

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(Read before the Entomological Society of British Columbia, March 18, 1950)

Last May I finished the first draft of the text of Part I, the first 650 species, of my **Coleoptera of the Pacific Northwest.** The manuscript was based primarily on a study of my own collection together with some correspondence with Mr. Gordon Stace Smith of Creston, B. C., Mr. Kenneth M. Fender of McMinnville, Ore., and Mr. Merton C. Lane of Walla Walla, Wash. My next job was to check my account against as much additional Northwestern material as possible, to accomplish which I proposed to visit the various Northwestern collections, check off the readily verified Northwestern species, and borrow for identification the unnamed or doubtfully named species. My paper today is a brief account of my travels in the furtherance of this objective, and is offered in the hope that it may throw some light on the status of one aspect of Northwestern entomology in the year 1949.

My first trip was into northwestern Oregon, and my first visit was to Oregon State College in Corvallis, June 16 and 17. The beetle collection is housed in trays in about 150 glass topped drawers. It is in charge of Dr. W. J. Chamberlin, who has taught forest entomology at the College since 1916 and is the author of several important entomological books, the most recent being a text on **Insects Affecting Forest Products and Other Materials.** He has specialized on Buprestidae and Scolytidae, his Buprestidae having recently been sold to the California Academy of Sciences. Oregon specimens in the College's collection are only moderately numerous, and I came to feel that my own collection of Oregon beetles is virtually as representative as theirs. The individual specimens are, however, curated with great care, each specimen bearing a determination label together with the name of the determiner. Elsewhere in the Northwest I found this procedure employed only at the University of Idaho and by Stace Smith.

In Corvallis I stayed with Frank Beer, who took a Master's degree under my direction in 1939, and, after teaching high school for a number of years at Grants Pass and Salem, has been instructing in general science at the Oregon State College. Beer has a small but beautiful collection, primarily of Buprestidae, but likewise of Scarabaeidae (including rare Oregon Pleocoma material), Elateridae, and Cicindalidae. Beer took me on a delightful collecting trip the second afternoon to Mary's Peak, 4097 feet high, about 15 miles west of Corvallis.

June 18 and 19 I spent with Kenneth Fender in McMinnville, Oregon. Fender is a rural mail carrier, and both he and his wife, Dorothy, are enthusiastic naturalists and the authors of numerous papers. Their interesting home on the southern outskirts of town, by the side of an inviting creek, is overrunning with zoological material. Dorothy specializes on earthworms. Both she and Kenneth specialize on the Lycidae-Lampyridae - Cantharidae group of beetles, and I hope they will do the portion of these families in my book. Kenneth likewise has a general collection of Oregon beetles—probably the best in existence—arranged in trays in 20 or 30 large insect boxes. Sunday we had excellent collecting in the Yamhill River bottom near Dayton.

My second trip was east of the Cascade Mountains. On July 24 I drove to Walla Walla where I stayed with M. C. Lane, who has been in charge of wireworm investigations in eastern Washington for the United States Bureau of Entomology and Plant Quarantine for 30 years. Lane became interested in beetles through Dr. E. C. Van Dyke, and is one of the most energetic, persistent, and expert beetle collectors known to me. His general beetle collection (mostly of Northwestern material) numbers over 100 insect boxes, about three-fourths Adephaga, and his Elateridae, in which he has specialized, are arranged in trays in about 30 drawers and about 25 insect boxes, including many undescribed species. Lane is today one of the foremost authorities on both the taxonomy and biology of the Elateridae, and I hope that he will do the Elateridae in my book. Two of Mr. Lane's associates, Horace P. Lanchester and Edward W. Jones, have beetle collections, Lanchester likewise specializing on the Elateridae.

In College Place I visited Walla Walla College. This is a Seventh Day Adventist school. Their zoologist, Dr. Ernest Booth, is beginning an insect collection, having 17 drawers and 25 or 30 boxes of beetles. I did not meet Dr. Chalmer Chastian of Dr. Booth's staff, but last November I studied a collection of Blue Mountain Scolytidae made by him; but I did meet Gayle H. Nelson, one of Dr. Booth's graduate students, who had about 50 boxes of beetles, and is greatly interested in them. Nelson is located this year at Washington Missionary College, Takoma Park, Maryland; but he hopes to return to the Northwest. All in all, the Seventh day Adventists are doing right well by the study of beetles!

July 26 Lane drove Lanchester and me to Wallowa Lake in northeastern Oregon. There we met James H. Baker, a grocer of Baker, Ore. Mr. Baker has a very fine collection of Northwestern Geometridae, but under Lane's influence, he has been collecting Elateridae and Carabidae. I am urging him to begin accumulating beetles in general against the day when I shall want to borrow them for my **Coleoptera of the Pacific Northwest.** Baker is another very energetic fellow, and at Wallowa Lake he and Lane soon disappeared *up* the trail, leaving Lanchester and me far far behind! The day was only middling, but we got our share of beetles.

At Pullman, Wash., July 27-28, I stayed with Dr. Maurice T. James, the dipterist, who is in charge of the insect collection at the State College of Washington. The beetles are in trays in about 170 drawers plus 60 or 75 boxes of unnamed specimens. They represent the accumulation of many years and successive curators: C. V. Piper, A. L. Melander, J. F. G. Clark, R. D. Shenefelt, R. L. Webster,—but none of these men have been coleopterists. Since my coming to the state in 1927, I have always found the State College most cooperative and have felt free to use the collection just as though it were my own.

In the afternoon James and I drove to the University of Idaho at Moscow, eight miles away. The beetle collection there is arranged in trays in about 60 not too densely filled drawers and some 25 boxes of unnamed specimens and is in charge of Prof. H. C. Manis. Likewise in the Department of Entomology I met A. S. Waltz and Wm. F. Barr, both of whom lent me material (about an insect box each) from their private collections. Barr is especially interested in Buprestidae, and is this year on leave working on his doctorate at the University of California.

In the evening, James took me to call on N. M. Downie. Downie is doing personnel work in the Department of Education at the State College of Washington, but he is coleopterist on the side! His collection numbers about 16 very crowded drawers and a dozen boxes. It includes an extensive series of species that he collected in Turkey, but he is giving most of this material to me and to the State College, and is concentrating on Nearctic specimens.

June 28 I drove north, arriving after dark at the home of Gordon Stace Smith, a mile or so north of Creston, B. C. I had visited Stace Smith first the previous September, and was looking forward to working with him again in his spacious living room with its windows looking westward over the broad expanse of the Kootenay Valley with the Nelson Range of mountains beyond. It made one itch to go collecting, but I reflected that the coleopterological exploration of this corner of the Northwest is in most competent hands.

Mr. Stace Smith is a retired mining foreman and had formed two beetle collections; nearly a hundred boxes of beetles from British Columbia, where he has lived most of his life, and about 45 boxes of beetles from Quebec, collected during a five years sojourn in that province. The latter collection, however, he was selling to the California Academy of Sciences to give him increased facilities for the British Columbia series. Stace Smith's collection of British Columbia beetles is probably the best extant collection from the province.

We got to work on the beetles almost as soon as I arrived, and by the next afternoon had finished checking the portion of his collection on Adephaga. The next morning I was once more under way. The afternoon I spent with Loyal Weitz in his home on the south side of Spokane. Mr. Weitz is in charge of the Underwood Typewriter Agency in Spokane. His avocational interest in biology has crystallized on the beetles, of which he is forming a collection, especially encouraged by Mr. M. C. Lane. Mr. Weitz is the sort of person who would be particularly helped by a general handbook of the beetles of the region.

That same evening I had dinner with Prof. and Mrs. Robert W. Rogers of the Eastern Washington College of Education in Cheney. Rogers had taken a Master's degree under my supervision in 1947, and, while not himself forming a beetle collection, has been most helpful in supplying me with specimens from the vicinity of Cheney and north Idaho. The next morning I drove to Seattle after a most enjoyable and profitable week.

No survey of Northwestern beetle collections could be complete without a visit to the California Academy of Sciences in San Francisco. Consequently, on Aug. 14, Estelle (Mrs. Hatch) and I left for the south. The second night out, at Medford, Oregon, we called on Mr. Fred Lawrence, for whom I had named some beetles back in the thirties. Lawrence is a sign painter by trade, an artist and a collector of butterflies and beetles by avocation. He has 20 or 25 drawers of beetles, mostly from Medford, in nicely constructed little wooden trays. Due to lack of contact with others of similar interest and the absence of usable literature from which he might have made his own identifications, he has lost most of his former interest in his collection. A proper reference book on our beetle fauna might well have turned him into a contributor to our science.

After an hour or so with Mr. Lawrence, we called on Mr. L. G. Gentner. Gentner is entomologist at the Southern Oregon Experiment Station at nearby Talent. At home he is a specialist on flea beetles, having 50 or 75 boxes of specimens, including nearly all known North American species, many of them undescribed. I have hopes that Mr. Gentner will be willing to write the portion on Alticinae in my **Coleoptera of the Pacific Northwest.**

At the University of California at Davis we called the next afternoon on Mr. A. T. McClay. McClay is a preparator in the Department of Entomology and an inveterate beetle collector, having a couple of hundred boxes of mounted and much unmounted material. While an insecticide salesman some years back, he collected extensively around Medford, Ore., and I have this winter had the privilege of studying a box or so of his Oregon Carabidae.

The next morning (Aug. 17) we arrived at the California Academy of Sciences, and were given a most cordial welcome by Dr. Edward S. Ross, curator of insects, Mr. Hugh B. Leech, who has charge of Coleoptera, and Dr. Edwin C. Van Dyke. At the Academy of Sciences is one of the world's great beetle collections. It contains about a million and a half specimens in about 1500 drawers and 500 to 1000 boxes. Its basis is the collection of Dr. Van Dyke, who gave his collection to the Academy in 1924, with the understanding that he would have full use of it during his life. And still, at the age of 81, Dr. Van Dyke was coming to the Academy every day to work on his collection. Van Dyke's example induced Dr. F. E. Blaisdell (1862-1946) and others to take similar action.

The Northwestern material in the Academy derives largely from the collections of Dr. Van Dyke and Ralph Hopping, and from Hugh Leech's hydrocoleoptera. Van Dyke came first to the Northwest with the Sierra Club in 1905, when they camped at Paradise

Park on Mt. Rainier before there was anything but a trail into the area; and every few years since, he has made additional excursions into the region, his collecting being confined for the most part to south of the international border.

Ralph Hopping (1868-1941), a former member of this Society, from 1919 to 1939 was entomologist in charge of the Dominion Forest Insect Laboratory at Vernon, B. C. He assembled an extensive collection of Coleoptera, much of it from British Columbia, that came to number about 10,000 species and 97,000 specimens. With the exception of a portion belonging to the Vernon laboratory, it was purchased by the California Academy in 1948, and is gradually being absorbed in the general collection of the Academy.

Hugh Leech will be remembered by many here as the energetic and efficient secretary and editor of our Society. Since 1947 he has been happily employed as associate curator of insects at the Academy. He lives at rural Mill Valley, about 12 miles north of the Academy across the Golden Gate Bridge. His collection of about 130 boxes of water beetles, rich in British Columbia material, has been transferred to the Academy.

After returning from California, there remained only a trip into southwestern British Columbia to complete my survey of Northwestern beetle collections. Taking advantage of our Thanksgiving holiday, Estelle, our daughter, and I took the night ferry for Victoria. Nov. 24 I spent with Mr. G. A. Hardy at the Provincial Museum. Mr. Hardy has a collection of 50 or more double boxes of beetles, and has specialized, as we all know, on Cerambycidae, Buprestidae, and Elateridae. The museum has several collections that have been given to it, but so far these remain in their original boxes and have not been organized into a single whole.

The next day we drove north along Vancouver Island nearly to Wellington where we had lunch with Mr. Richard Guppy, Mrs. Guppy, and her sister. Mr. Guppy is another member of this Society. He has a chicken ranch, and has a collection of Vancouver Island Coleoptera and Lepidoptera. His beetles fill about a dozen boxes and drawers and is quite complete, considering the restricted area of his specialization. Mr. Guppy sells Vancouver Island insects to interested parties.

That evening we ferried over from Nanaimo to Vancouver, where we were entertained by Prof. and Mrs. G. J. Spencer. Prof. Spencer is in charge of the insect collections at the University of British Columbia. The beetles were arranged in 25 or 30 drawers some years ago by Mr. George R. Hopping, son of Ralph. Prof. Spencer introduced us to W. Lazorko, M.D., a refugee from Lemberg, Galicia, who had been in Canada about 18 months, in Vancouver about 11 months. He has a collection of some 300,000 beetles, 50,000 of them mounted, and 5000 or 6000 specimens from Vancouver. He is specially interested in the Carabidae and may well be heard from scientifically when he becomes settled in the New World.

This concludes my account. I do not assert to have mentioned all the Coleopterists in the Pacific Northwest, but only those I encountered in 1949.

UPON THE MATING HABITS OF THERMOBIA DOMESTICA PACK (Thysanura: Lepismidae)*

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In the course of a study of the bionomics of *Thermobia domestica* Pack, the firebrat, it was frequently noted that females follow males for long periods of time. Under the impression that this chase was some part of mating reactions, the performance was watched until it reached a climax. The process or "love-dance" may last one and one-half to two hours and is somewhat as follows:

* Contribution No. 294, Department of Entomology, University of Illinois, being a revised portion of a Master's Thesis presented to the Department.

The larger female follows the smaller male which seems very restless, moving from place to place after a few minutes in each position. As soon as the male comes to rest, it turns and faces the female and both touch their antennae at close quarters with many rapid movements and then stay quiet. The male then turns again and moves away, followed by the female and the process is repeated over and over again for long periods. In its wanderings around the cage amongst many other firebrats, the male may get separated from the female by a space of several inches and the angle or corner of the cage. The female then runs around in all directions and seems to pick up the trail of the male very much after the fashion of a bloodhound.

Now at the tips of the caudal sterna, the coxites of Walker or coxopodites of Snodgrass which flank the base of the male pseudocercus, are short unbranched setae in connection with relatively enormous, simple glands occurring in two series. There are six glands on each side dorsally and three on each side ventrally; the glands from the tip to the base of the seta above it, average 0.134 mm. long by 0.016 to 0.02 mm. broad. It is possible that either these glands or the eversible vesicles which occur on the coxopodites mesad of the styli, function at mating time as scent glands and provide the scent which the female follows when in pursuit of a male.

This love dance has been watched several times for an hour at a time but no climax took place. On five occasions, however, its completion was observed. The climax occurs when the movements of the male become more rapid and he does not run away from the female but turns around in a circle on a short axis, pausing every few seconds to touch antennae with those of the female while the latter now remains perfectly quiet, crouched low on the floor with antennae lying straight ahead of her. Each time the male turns around away from the female, he raises the tip of the abdomen in the air and waves it about. Finally on the under side of the tip of the abdomen there suddenly appears a semi-transparent pyriform spermatophore about one millimeter in length with the broader end discharged first and pointing caudad. In no more than three seconds from the moment of its appearance, the spermatophore is deposited on the floor just about three quarters of an inch directly in front of the female. The male then turns immediately, touches the female's head with his antennae which move at great speed in short, rapid jerks and turning abruptly aside, he moves away. Body raised up on the legs, the female then moves straight forward, passes over the spermatophore and presses the base of the ovipositor on it. Two very small drops of liquid are present at the base of the ovipositor and the spermatophore adheres to the abdomen of the female. She adjusts it by one or two slight touches of her mouth parts and as nearly as could be seen, makes a rent in it with the tips of the maxillae; a small quantity of liquid extrudes without, however, changing the shape of the object.

The contents of the spermatophore are absorbed by the female over a period of several hours. On three occasions when the absorption was noted it took one and one-half hours, four and one-half hours and overnight respectively. The walls of the spermatophore then drop off and are likely to be eaten by the female if not taken away from her. Microscopic examination of the empty receptacle showed no spermatozoa, only a thin chitinous case and some gelatinous material.

If there is any doubt as to this being an externally deposited spermatophore, the matter could readily be solved by removing it immediately after deposition and examining the contents microscopically for active spermatozoa. Since the whole procedure was observed only five times and it was necessary to determine the pre-oviposition period, this examination was not made.

The pre-oviposition period as observed in two instances, is from one and one-half to four and one-half days; the female that absorbed the contents of the spermatophore in the latter period laid eggs thirty-six hours afterwards.

Apart from the observations and findings reported above, it would be difficult for these firebrats to copulate in the normal manner of insects, in view of the extreme shortness of the male aedeagus which is relatively a minute, latent, oval tube; the entire absence of secondary copulator mechanisms or "grappling hooks," and the long, closely-knit bases of the dorsal and ventral valvulae of the female ovipositor, between which it would seem impossible for such a short aedeagus to penetrate.

A COMPARISON OF POTATO TUBER DAMAGE BY TWO FLEA BEETLES, EPITRIX TUBERIS GENT. AND EPITRIX SUBCRINITA (LEC.) (COLEOPTERA: CHRYSOMELIDAE)

H. R. MacCarthy

Dominion Entomological Laboratory, Kamloops, B. C.

In the course of a recent investigation into control of flea beetles on potato, at Kamloops, B. C., the question arose as to whether the western potato flea beetle, *Epitrix subcrinita* (Lec.), caused the same type of damage to potato tubers as its close and more numerous relative, the tuber flea beetle, *E. tuberis* Gent. A small experiment was set up at the Dominion Laboratory of Plant Pathology, University of British Columbia, to make a comparative study of the damage caused by the two species.

Collections of the two species by C. L. Neilson and D. G. Finlayson, Dominion Field Crop Insect Laboratory, Kamloops, B. C., from potato fields near Kamloops were sent to Vancouver. A group of 12 individuals of each species was placed on a potato plant in each of three cages. The external sexual characteristics being difficult to see in living specimens, the ratio of males to females was not known. Each group was a random sample.

The cages were developed from a type in use at the University of California. They were cylindrical, 30 inches high, the ends being 15 inches in diameter and made of 5-ply wood, with a 5½-inch hole in each. The ends were joined by four uprights and between two of these was a 9-inch pane of glass. The remaining three side panels were covered with organdy. The potted, caged plant grew up through the hole in the bottom. Cotton batting made an insect-tight filler at the rim where the cage rested on the pot. The host plants were White Rose potatoes from a single parent plant, growing in 10-inch pots. At the start of the experiment they were about 2 feet high. The soil moisture was maintained from water poured into saucers in which the pots were set. The cages were kept in a greenhouse and inspected daily. The beetles were introduced into the cages on July 29, and taken out on October 6. Emergence of second-generation adults started during the last week in September but was not complete by October 6.

When the soil was washed from the root systems, it was found that both species severely damaged the root, rhizome, and tuber. Tunnels up to four per inch were found in the rhizomes. In one cage containing a heavy population of *E. tuberis* some of the rhizomes were completely cut off. In all the cages many of the fibrous roots appeared to be cut and shortened. A thin peeling was taken off the tuber before damage marks were counted and for each species 50 tunnels in the tubers were chosen at random and measured at a depth of approximately 1 mm. The average length of tunnel in each instance was 2.5 mm. The range was from 1.0 mm. to 5.0 mm., with 40 per cent 2.0 mm. long and the frequency distributions were almost exactly the same for the two species. There were few surface tracks.

Under the conditions of the experiment, *Epitrix subcrinita* produced a substantial amount of tuber injury, practically identical in nature with that produced by *E. tuberis*. Both species also damaged roots and rhizomes severely. It does not follow, however, that the same results would be secured in experiments conducted in the field, or in field cages.

SCIENCE NOTES

Orthezia occidentalis, an Ensign coccid, in British Columbia (Homoptera: Ortheziidae). In the middle of October, 1945, Mr. Peterski, bus driver of Powell River, who lives a short distance out of that town, looked out one morning and saw what looked like a light fall of snow on two acres only of one of his fields which had been cleared but not cultivated. A light wind was blowing but the morning was not cold so Mr. Peterski went out to investigate. He found that the white covering consisted of moving particles, so he took some in to Dr. Boxall of Powell River Clinic. Being very interested in natural history, Dr. Boxall went out to the field and found that the alleged snow consisted of small, flat insects shaped like bedbugs which were covered all over with tiny, overlapping particles of white wax. By the time he got to the field, the insects had all disappeared under grass and moss and could be found only at ground level. He collected a number and sent them to me. I identified them tentatively as **Orthezia occidentalis** Douglas and forwarded them to the National Collection at Ottawa where a specialist confirmed my identification, adding that there is one record of it from Kaslo and one from Victoria, made by Mr. Downes. Professor "Essig in College Entomology" reports it from Alaska where it feeds on the roots of plants.

This snow-white species must have fed on the roots of grasses or plants at Powell River where it apparently developed unseen until it increased enormously and crowded to the tops of low vegetation in such numbers as to whiten the field.

The **Orthezia** scales are almost entirely tropical species of which one, **Orthezia insignis** Douglas, has become a greenhouse pest which is widely distributed by commerce. So far, I have taken only one other native species, as yet unidentified, of which I collected an isolated colony on sagebrush at MacGillivray's, half-way between Lytton and Lillooet, in July, 1931.—G. J. Spencer, Department of Zoology, University of British Columbia.

Further note on Orthezia occidentalis—By a curious coincidence the specimens recorded from Kaslo, B. C., were in the possession of the Editor when the above note by Professor Spencer was received. They were included in a small collection of Hemiptera made by the late A. W. Hanham, now the property of the Provincial Museum. There were also some specimens with a date, but no locality label, which were probably taken at Duncan. **Orthezia occidentalis** is a much commoner insect than is generally supposed but owing to its habit of living down among the crowns or clumps of grass it is seldom seen if not searched for. It is common in Victoria and probably occurs at many points on the east coast of Vancouver Island and the adjacent mainland.—W. Downes, Victoria, B. C.

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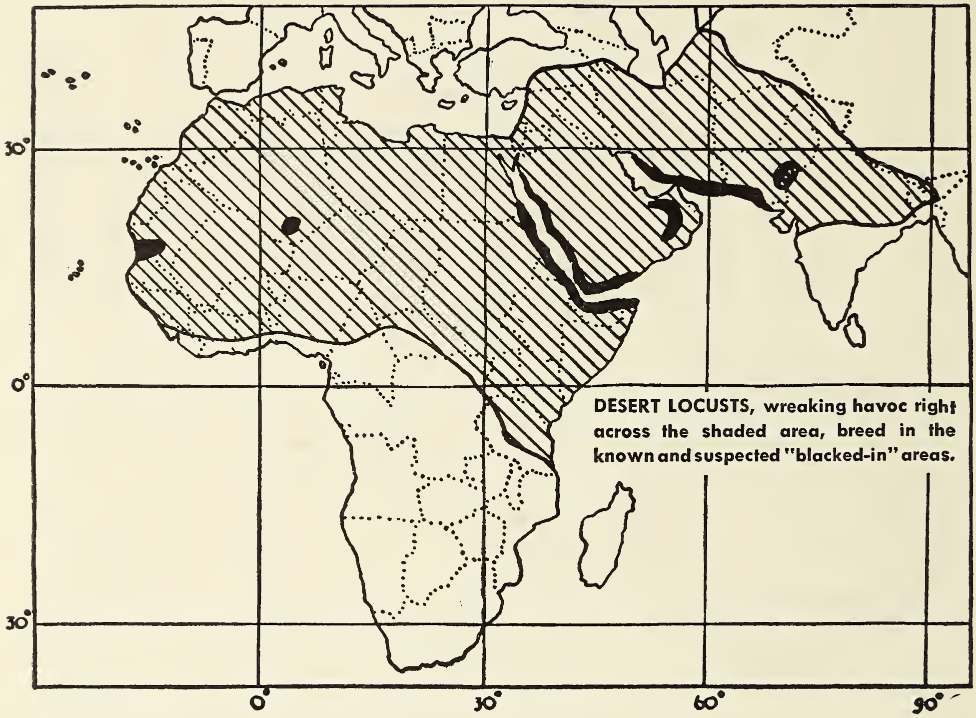

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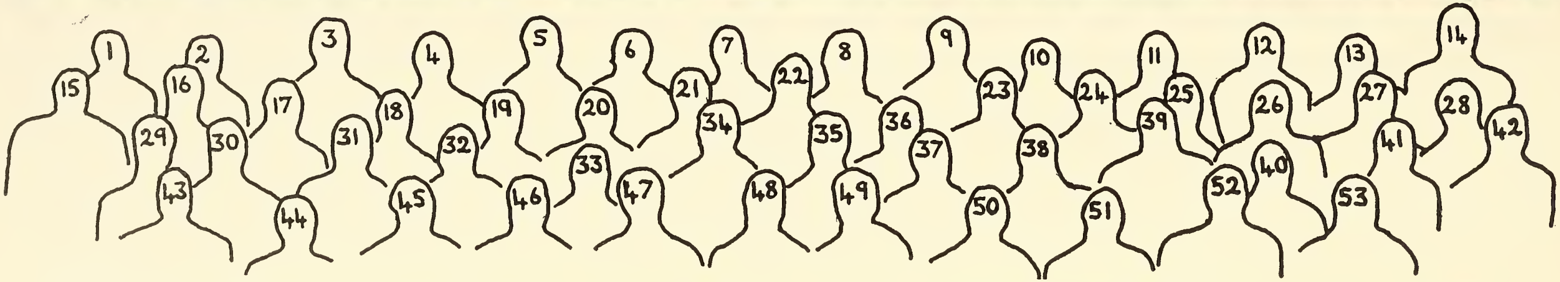

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SYSTEMATIC AND ECONOMIC

FIFTY YEARS OF ENTOMOLOGY ON VANCOUVER ISLAND

W. DOWNES
Victoria, B.C.

It is to be feared that this account will resolve itself mainly into a history of the work of the Victoria Laboratory. While the entomological events of the past thirty-five years can be related by me from personal observation, those of the previous fifteen can be gleaned only from the published reports of Government departments and those of the Entomological Society of British Columbia.

At the beginning of the century the economic importance of entomology had not attained the prominence in British Columbia that it has today, probably because pests were somewhat fewer and some of the more destructive ones, such as the codling moth, had scarcely arrived. There were no government entomologists in British Columbia and insect outbreaks were dealt with as best they could be by the fruit inspector and district horticulturists. It is evident, however, that growers were not without their troubles for in the report of the Minister of Agriculture for 1902 there were recommendations for control of cutworms, leafhoppers, aphids, red spider, cabbage butterfly, pear and cherry slug, June bug, oyster-shell scale, woolly aphis, tent caterpillars, peach tree borer, onion maggot and raspberry root-borer. In the same year there is reference to a heavy infestation of the oak looper, *Lambdina fiscellaria somniaria,* in the Uplands and Lake Hill districts of Vancouver Island and to an army of caterpillars of *Nymphalis californica* in the Grand Forks district of the mainland, the only insect outbreaks which are mentioned.

The Entomological Society of British Columbia had been founded in 1901 by a few amateur entomologists who were principally interested in collecting Lepidoptera and Coleoptera and the early publications of the Society contain no references to insect outbreaks. The members were principally concerned in collecting and cataloguing the orders in which they were interested. Short lists of Lepidoptera, Coleoptera and Diptera were published in 1906 to 1908 in the Society's "Quarterly Bulletins" and a list of Lepidoptera of British Columbia was compiled by E. M. Anderson of the Provincial Museum, and published by the Society in 1904. A corrected list citing 1061 species was published two year later.

In the early years of the Society the membership was small. Twenty-one members were listed in 1906 and seven years later the number was only twenty-four. Interest gradually waned and no meetings appear to have been held in 1909 and 1910. But in 1911, the late R. C. Treherne was appointed Entomologist-in-Charge by the Dominion Government with headquarters at Agassiz. He immediately set to work to instil new life into the somewhat moribund Society and the result of his efforts was immediately apparent. Treherne possessed a charming, magnetic personality and had the quality of transmitting his enthusiasm to others. The Society appointed him Secretary and he immediately commenced a drive for members, raising the membership from 24 to 101 in a single year. More than that, he succeeded in obtaining from the Provincial Government a grant of $250 a year, on the understanding that papers on economic entomology were to be published in the Society's Proceedings. It was about this time that the centre of the Society's activities settled in Victoria, and for several years the annual meetings were held there. Besides the resuscitation of the Entomological Society the arrival of Reginald Treherne was followed by a burst of activity in the economic field of entomology.

During these years insect pests appear to have been giving agriculturists and horticulturists more trouble

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than formerly. Outbreaks of codling moth appeared at Royal Oak, the first of which was said to have been dealt with by the rather drastic method of cutting down the affected trees. The cure does not seem to have been permanent because, in 1914, we find that the Department of Agriculture was engaged in a spraying campaign against codling moth on the Island. This was to have been continued in 1915, but in that year an event occurred which resulted in the permanent establishment of an entomological laboratory on the Island. This was the discovery of pear thrips at Royal Oak. The insect was recognized by Treherne who sent specimens to Ottawa. Gordon Hewitt, Dominion Entomologist, immediately ordered a control campaign to be undertaken against the pest. A. E. Cameron was sent from Ottawa to conduct the investigation and Treherne temporarily closed the Agassiz Laboratory and moved to Royal Oak. A field laboratory was set up in an old barn in the Brydon orchard at Royal Oak and life history studies and spraying experiments were carried out in 1915 and 1916. The result of these was highly satisfactory, the production of the orchard rising from a few hundred boxes at the beginning of the investigation to about 6,000 in 1916. Early in 1917 Cameron returned to Ottawa, Treherne returned to Agassiz, and I was engaged to complete the life history studies of the pear thrips and report upon any other insect troubles which developed.

I should mention here that, in addition to the thrips laboratory, natural control investigations were being carried out by John D. Tothill at Royal Oak. Mr. and Mrs. Tothill remained at Royal Oak for two seasons, during which Tothill was engaged in the study of parasites of tent caterpillars. One of the objects of his visit to British Columbia was to collect puparia of parasites, especially *Blepharipeza*, a tachinid fly, for shipment to eastern Canada. He conceived the idea of introducing the beetle *Calosoma sycophanta* to British Columbia for the purpose of keeping down tent caterpillars and oak loopers. One shipment of these was released in 1917 at Royal Oak by Tothill and another by myself at Victoria a year later. These releases constituted, I believe, the first attempts at natural control by introducing predators in British Columbia. The experiment, however, was not a success as the life history of the beetle did not synchronize with that of either the tent caterpillar or the oak looper and the beetles failed to become established. About this time also, R. Glendenning was engaged in conducting a survey of the currant bud mite situation on Vancouver Island. As the result of his investigations an attempt was made to eradicate the mite and a large number of infested bushes were rooted out.

It was during these years that the strawberry root-weevil came into prominence. During the previous decade the small fruit industry on Vancouver Island had been developing rapidly. The price of fruit was high and the growers, not understanding the habits of the weevil, conducted the culture of strawberries under conditions which gave the pest every opportunity to increase. Such heavy infestations occurred that it was not unusual for newly planted fields to be wiped out in a single season.

The growers apparently were able to obtain little help from the Provincial Government and with the success of the pear thrips investigation in their minds, they petitioned the Dominion Government to send an expert from Ottawa to study the problem of the weevil. Nothing was done until September 1918 when Gordon Hewitt visited Vancouver Island and, together with Treherne and myself, attended a growers meeting at Keating. Feeling appeared to run very high, the growers believing that the government had let them down, and among the more ignorant members of the community there was a feeling of antipathy to government "experts." Treherne, who for some years had studied the weevil on the Mainland, addressed the meeting, outlining the life history and giving the then known methods of control. He had not been speaking long when a man arose at the back of the hall and shouted—"Yes, you tell us that, but we don't believe a word of it." Hewitt jumped to his feet and said, "We are not here to listen to remarks of that description and we will withdraw immediately from this investigation unless you accept what we tell you as the truth." The meeting quieted down and concluded peaceably. It was arranged that I was to study the strawberry root weevil on the Island as the main project until a method of control that was satisfactory to the growers was worked out.

During the succeeding years experimental work against the strawberry root weevil continued to the exclusion of almost everything else and a great deal of co-operation was received from the growers. Only among a certain ignorant minority the old antipathy to government men persisted. This was evidenced during a meeting which I was addressing at Gordon Head. After I had described the life-history of the strawberry weevil, an old fellow arose and said—"Tell me, professor, can that weevil fly?" I said, "No, it cannot fly, it has no wings." "Now I *know* you're a liar" the old man shouted triumphantly, "because I've seen hundreds of 'em flying all over the place."

In 1919 it was decided to close the Royal Oak field laboratory and the Provincial Department of Agriculture provided us with an office in the Parliament Buildings. This was a cubby hole in one of the turrets, measuring about 6 ft. by 8 ft. and when the entomologist's table, bookcase and chair were installed there was just about room for the entomologist to turn round. However, this was the best they had to offer, and we occupied these palatial quarters for eight years, the only change being to another cubby hole of equal size in another turret. In 1920 I was joined by an assistant, R. Glendenning, and, in addition to strawberry root weevil control, studies of other small fruit insects, Hessian fly and the satin moth were commenced, the latter having just made its appearance on Vancouver Island. In 1921 Glendenning was transferred to Agassiz to take charge of the entomological laboratory and for two years no assistant was appointed for the Victoria laboratory.

During the succeeding five years the control of the strawberry root weevil continued to be the principal project upon which we were engaged at Victoria and strenuous attempts were made to solve the problem by means of weevil-proof barriers. Treherne had already tried this method without success but his tanglefoot barriers were poorly constructed and soon became ineffective. In fact Treherne was pessimistic about the whole project and writing to me in 1919 he says—"I have tried all those suggestions of yours, and if there is anything I have not tried, I would like to know what it is." However, it was decided to give the barrier method another trial and at Gordon Head, I enclosed ten acres of strawberries with a well-made wooden barrier with a tanglefoot band. This was a success in regard to keeping the weevils out, but the tanglefoot band required frequent attention or it soon became ineffective, and, in fact, the whole contraption was unwieldy and a nuisance. A more effective barrier was devised by using heavy lumber with a wide groove ploughed in the upper edge; the groove was filled with crude oil. This needed little attention and provided good protection, but like its predecessor it was clumsy and was soon discarded. The best barrier of all was found to be a wooden barrier with an overlap of tin. This required no attention and was applicable to any situation. Until the invention of the poisoned bait method, these barriers were widely used on Vancouver Island, but were quickly discarded as soon as the more practical method of control by poisoned bait was devised.

When at Royal Oak I had observed that strawberry root weevils seemed to be attracted by partly decayed windfall apples, but an attempt to attract them by means of fresh chopped apples was a failure. In Seattle, however, J. Forsell, a Washington County Agent, hit upon the idea of using evaporated apples as a bait and this was immediately successful. The poison used was magnesium arsenate, but while this was an effective killer, it became hygroscopic in the presence of the apple and the bait became sticky and unusable. At Victoria we substituted sodium fluosilicate and this proved greatly superior, the bait being not only more attractive but giving a better kill. The comparative trials made at Victoria were published in the Canadian Entomologist.

Forsell had patented his invention and evidently thought he had the strawberry growers over a barrel. He attempted to market his product at an exorbitant price, but was immediately met by substitute baits in Washington and elsewhere. At Victoria we devised a superior bait which did not infringe Forsell's patent. Spoiled raisins were used as the attractant and proved superior to apple. In those days quantities of raisins which had been on the grocers' shelves too long and had become wormy or candied, could be obtained for as little as six cents a pound. (The raisins were gathered up by the raisin company's agents and put through cleaning machines to remove the worms and then were sold in barrels to bakers who used them in raisin bread.) The raisin bait was used exclusively on Vancouver Island but eventually failed through the uncertainty of the supply of raisins, but it was used with great success in New York State against the alfalfa root weevil in 1926.

Other projects about this time included control of the narcissus fly and the two means of control which we experimented with at that time, crude napthalene as a repellent and oil emulsion spray are still the most effective today.

In 1923 Kenneth F. Auden was appointed assistant at the Victoria laboratory. At that time the rose leaf roller, *Cacoecia rosana* was giving much trouble in gardens and orchards and we were devoting some time to the study of its life history and control at a small orchard in the outskirts of Victoria. This minor project was given over to Auden for attention. It seemed to me that my assistant used to return every day with very slight information about the habits of the pest and I wondered why, until I discovered that next door there were two very pretty girls who took an unusual interest in the life history of leaf-rollers and entertained Auden with tea on the lawn every afternoon. When the experiment was transferred to a less attractive location progress was more satisfactory. However, Auden had the making of an excellent entomologist, being a keen observer and a good collector with a capacity for surmising accurately where a species was likely to be found and he seldom returned from a collecting trip without valuable material. He left to go to Northwestern University in 1926 and his death shortly after was very regrettable.

In 1927 John Stanley was appointed assistant at the laboratory. We were then very busy with the European earwig, experimenting with poisoned baits, and as the City of Victoria was conducting baiting campaigns every year in an endeavour to keep the earwig down, we had to survey the city for infested areas. Stanley and I were surveying a district adjacent to Ross Bay cemetery one evening, the method being to examine garden fences with a flashlight, and if a single earwig was found that block was considered infested. Rounding a corner I was suddenly seized by a policeman who wanted to know what I was doing. Explanations followed and the policeman said he had been called to the district by a woman who said she had seen two ghosts, all in white, coming out of the cemetery and one of them had a bright shining eye in the middle of his forehead! That, however, was not the last of it, for on the front page of the COLONIST next morning this appeared in large headlines—"Ghosts coming out of the cemetery resolve themselves into the persons of harmless entomologists."

It was quite a while before we heard the end of that.

John Stanley was an excellent assistant. He later went to Minnesota and afterwards, with Chapman, to Hawaii. He is now a professor at McGill. He was followed in 1928 by Geoffrey Beall. Geoffrey was fond of studying ants and, as at this time the Provincial Department of Agriculture had moved us from the aforesaid cubby hole to a large room in the annex behind the Museum, he was able to have ample room for his pets. He had been told that ants would not cross a barrier of lime so a barrier of slaked lime was built on the floor and a lively colony of ants thrown into the middle. The ants spent most of their time trying to get out and most of Geoffrey's time was spent trying to keep them in. Of course, the inevitable happened. In the night the ants broke down the barrier and wandered off into adjoining offices. In the morning there was serious trouble: the ants were busy climbing up the stenographers' legs and Geoffrey Beall and myself were far from popular. This episode, however, resulted in our being moved to more commodious premises. The authorities decided to segregate us and, as an old dwelling was available at the rear of the Parliament Buildings, we were given three rooms on the upper floor. The rooms were cleaned and renovated and are still occupied by my successor, Harry Andison. Geoffrey Beall later went to the laboratory at Chatham, Ont. He took his doctorate and was in charge of the laboratory for several years. Later he moved to the United States and is now engaged on commercial work.

It will be necessary to pass over the next few years rather quickly. From 1928 to 1933 we were engaged in studying the control of the cherry fruit worm, *Grapholitha packardi,* which was becoming very destructive among sour cherries. Also an endeavour was made to determine if berry blight, *Haplosphaeria deformans,* on logans and raspberries was conveyed by insects. Both these projects entailed extensive field work. A good control for cherry fruit worm was found by spraying for the eggs with summer oil—nicotine spray. No conclusive results were obtained in the berry blight experiments. Other projects included holly leaf miner, earwigs and *Merodon equestris.*

From 1934 to 1939 the chief project at the Laboratory was rearing the earwig parasite, *Digonichaeta setipennis.* Chester Smith came from the Belleville parasite laboratory to get the rearing started on a sound basis and remained with us for three months. Harry Andison was appointed assistant at the Laboratory and J. Aldous a year later.

The rearing and distribution of earwig parasites occupied our attention over the next few years until the end of 1939. The first year the output was 30,020; in 1936, 77,157, and in 1938, 120,056. In the same years we received and distributed hymenopterous parasites of the holly leaf miner, of which two species have become established. In 1936 and 1937 Andison conducted successful experiments against *Scirtothrips longipennis,* a thrips destructive to begonias in greenhouses; experiments were conducted against *Merodon equestris* and some work done in connection with codling moth which again was troubling the growers on the Saanich Peninsula. In 1938, and again in 1939, the cherry fruit fly, *Rhagoletis cingulata,* which had appeared a year or two before, caused serious loss to cherry growers and spraying experiments were conducted against it. This was the first recorded occurrence of this species on Vancouver Island. An attack of cherry fruit fly is said to have occurred many years ago just outside Victoria, in an orchard at Lake Hill which was owned by the late R. M. Palmer, but the species in that case was *Rhagoletis fausta.*

In 1938 a pest new to North America appeared at Victoria. This was *Sitona lineatus,* a small grey weevil destructive to peas and beans. Very good control was obtained by dusting seedling peas with 10 per cent. DDT dust.

About this time, too, we discovered another pest new to North America.

This was the apple sawfly, *Hoplocampa testudinea.* It attacks the young fruit when about an inch or so in diameter, causing it to fall to the ground. Experiments against this pest were conducted in 1940, 1941 and 1942. Excellent control was obtained by spraying with summer oil emulsion and nicotine sulphate just after the petals had fallen. We obtained far better results with this spray than have been obtained in England with nicotine alcaloid.

The year 1940 marks the commencement of far greater expansion of entomological activity on the Island than in former years. In this year the Dominion Division of Entomology decided to establish a Forest Insect Laboratory at Victoria and appointed M. L. Prebble to the position. Prebble remained in Victoria for five years, establishing the laboratory and organizing the work. He then left for Sault St. Marie and was succeeded by H. Richmond who is in charge at the present time. The work of this laboratory extends over the entire Pacific Coast of British Columbia and the Queen Charlotte Islands. Much of the work consists of surveying timber areas, reporting and scouting insect outbreaks, advising operators as to control measures and the study of life histories of forest insects and potential pests. Millions of seedlings also are raised for reforestation. A staff of about 20 is maintained with many more engaged on seasonal work. A sixty-foot motor vessel is used for transporting the men and their equipment to and from areas on the coast where their work is situated. Richmond's offices are in the Post Office Building.

In 1946 Kenneth King arrived in Victoria from Saskatoon to establsh a laboratory for the study of vegetable insects. The establishment of such a laboratory relieves the original Victoria laboratory of a portion of its load, for although nominally a fruit insect laboratory, it has had to handle every kind of insect problem except forest insects. King and his staff are currently engaged in the study of root maggots and wireworms with especial attention to the differentiation of larval forms. A staff of four is maintained, with offices on the second floor of the Belmont Building. Much progress has been made in the study of root maggots and their control. In addition to identifying the larval forms of indigenous species of wireworms, certain introduced species have been identified.

Returning now to the Victoria Laboratory and its work in 1941 and 1942, sufficient earwig parasites had been reared and distributed by that time to establish the species wherever earwings were found in British Columbia. We were then able to turn our attention to a pest which had been troublesome for many years, the June beetle, *Polyphylla perversa.* While formerly it had occurred occasionally and sporadically, sometimes injuring strawberry plantings to a slight extent and sometimes wiping out a quarter of an acre at a time, it now appeared to have established itself as a pest whose annual depredations could be considered inevitable. In fact it had become pest No. 1 to the small fruit grower. In 1943 it was decided to lease a plot of two acres, plant it with strawberries and use it as an experimental ground for June beetle. With the consent of the Department of Agriculture this was done and an agreement entered into with the Saanich Fruitgrowers Association whereby they agreed to supply a certain amount of labour for ploughing and cultivation.

Unfortunately this was a most unfavourable time for starting an enterprise of this sort. These were war years and help of any description was almost impossible to obtain. Andison had been temporarily transferred to Vernon and, with a major project on my hands, I had to manage as best I could. Much of the planting, weeding and cultivation was done by myself with occasional assistance from very unreliable local help and even the stenographer was pressed into service now and then for weeding and hoeing.

But, notwithstanding these difficulties, the plot was kept going somehow and tests were made with certain soil insecticides. An extensive trial was made of a method of using lead arsenate at planting time which was stated to have been very effective against white grubs in the east. But the tough Western June Beetle proved immune to arsenic and was equally scornful of DDT. Other insecticides also gave negative results.

The control of the holly leaf miner which had baffled us for so many years, was solved in 1946 by spraying with DDT just prior to the emergence of the flies in the spring.

Later in 1946 Andison became officer-in-charge of the Victoria laboratory and continued the experiments with soil insecticides against the June Beetle. Experiments were commenced with ethylene dibromide—DD mixture, benzene hexachloride and chlordane. An apparatus was devised at the laboratory whereby liquid insecticides could be dropped in the furrow behind the plough. The experiments were continued through 1947 to 1949. The result of these tests is considered highly satisfactory. Benzine hexachloride at the rate of one pound of gamma isomer per acre gave excellent control of white grubs and there is evidence that it also prevents the females from depositing eggs. Chlordane gave good control of the larvae of the strawberry root weevil. Efforts are now being made to find a soil fumigant that will be effective against the white grub and the strawberry root weevil at the same time and there is some prospect that this will be found.

Other successful investigations carried out during these years were in connection with field control of narcissus fly, western raspberry fruit worm and the leaf hopper *Typhlocyba tenerrima* on logans and raspberries.

Up to the present I have made only slight mention of the systematic side of entomology. In the early days of the Entomological Society many of the members collected extensively on Vancouver Island. The Rev. G. W. Taylor, the founder of the Society, collected Lepidoptera extensively. His collection of Geometridae was purchased by Wm. Barnes of Decatur, Ill., but the balance of his collection was neglected after his death and in time was destroyed by pests. The late G. O. Day and A. W. Hanham were also collectors of Lepidoptera, the collection of the former being particularly fine, every specimen being perfect. He had also a collection of British butterflies and moths representing every known British species. At his death these collections were bequeathed to the Shawnigan Lake Boys' School, where I am told they are neglected and gradually becoming a prey to museum pests. Besides Lepidoptera, Hanham collected Coleoptera and after his death his collection became the property of the Victoria Museum. E. M. Anderson of the Museum staff was a keen lepidopterist and published a list of British Columbia Lepidoptera in 1904. The late E. H. Blackmore accumulated a large and valuable collection of Lepidoptera. At his death most of this was purchased by the University of British Columbia, but some of it was acquired by the United States National Museum. G. A. Hardy of the Victoria Museum is an enthusiastic student of Coleoptera, especially Cerambycidae and he has collected extensively on Vancouver Island.

In 1916 when the pear thrips campaign was under way, the late R. C. Treherne commenced a collection of Thysanoptera, mostly of Vancouver Island species. Treherne published several papers on Thysanoptera in the Society's Proceedings. After his death his collection was transferred to the Canadian National Collection. E. R. Buckell studied the Orthoptera of British Columbia and in 1930 published a list of the Dermaptera and Orthoptera of Vancouver Island in the Society's Proceedings.

The Order Hemiptera seems to have been neglected by our entomologists, though a few collectors like Hanham and J. H. Keen preserved specimens of Hemiptera when they came across them. It was at the suggestion of R. C. Treherne in 1917 that I commenced a collection of Hemiptera since no one else at that time seemed willing to take up the study of that order. This collection now numbers about 14,000 specimens mostly from Vancouver Island. Nearly all species recorded from British Columbia are represented. Long series, however, cannot be kept for lack of space. About the year 1935 serious collecting had to be abandoned through lack of time to attend to systematic work, but lately has been resumed. A very imperfect list was published by me in 1927 and it is planned to produce a new list in the not too distant future.

Finally, in recent years, Mr. Llewellyn Jones of Cobble Hill created his fine collection of British Columbia Lepidoptera. In respect to the beautiful condition of the specimens Mr. Jones' collection rivals that made years ago by Mr. Day and is much larger. It forms the basis of a new list of British Columbia Macrolepidoptera which is just off the press. We understand that this fine collection will be presented to the University of British Columbia and together with the Blackmore collection the University should possess one of the finest collections of Lepidoptera in the West.

I would like to close this review of 50 years of entomology with a word of appreciation for the co-operation and help that has been received from the Provincial Department of Agriculture. About the time of Treherne's appointment an agreement was made between the Dominion and Provincial Governments that all entomological research in the Province would be conducted by the Dominion Government and the Province would provide laboratory space where no Federal building was available, as at Victoria and Vernon. Over the years, the entomologists at Victoria have had reason to be grateful for this arrangement, for the Provincial Department of Agriculture not only gave office space, but for 27 years provided a stenographer as well. In addition, the services of the Department's mechanics were always available when required and, in short, the Department did all in its power to supplement the meagre facilities of the laboratory. Towards the Entomological Society the Department has always extended a helping hand and it is principally due to this support that the Society has been enabled to print its Proceedings since the Government grant was withdrawn. With such a spirit of co-operation prevailing, the entomologists of British Columbia may look forward with confidence to the future.

REMINISCENCES OF FIFTY YEARS OF ENTOMOLOGY IN THE LOWER FRASER VALLEY OF BRITISH COLUMBIA

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These notes make no attempt to be a review of applied entomology; fifty years of such a subject compressed into one paper would be much too long. In addition, excellent accounts of early entomology in this province are available in our Proceedings. The chief of these are G. O. Day's presidential address, and an article by R. C. Treherne, both in No. 4 published in 1914, and a further review by Treherne in No. 13 published in 1921. These give a clear picture of the start of entomology, both systematic and applied up to 1920; they make interesting and profitable reading. So, instead of a tabulation of workers and their problems, I will recount some reminiscences of persons and incidents that may help you to envisage the past. In re-reading the various reviews already published, many memories are revived and personalities re-born, and one realizes the remarkable developments of entomology in the past 50 years—from the limited but enthusiastic observations and collections of the few early systematists (the Aurelians of British Columbia) to the present highly staffed organization of specialists, watched over by co-ordinators, helped by statisticians, chemists and biometricians, and assisted by researches seconded from other sciences. All this has happened in fifty years.

One thing that strikes with special emphasis in these early records is the dominance of R. C. Treherne in all planned entomology in British Columbia. As you know he resuscitated this Society in 1911, and led all entomological research here until he went to Ottawa in 1924. I knew little of those stalwarts, Harvey, Bush, Dashwood-Jones, Tom Wilson, Sherman and others who lived in Vancouver. They were all, primarily, systematists—with the exception of Tom Wilson, who doubtless, collected on the lower mainland for the most part, as automobile travel was not yet. In Quarterly Bulletin No. 3 is an account of a trip by Harvey and Sherman over the Hope trail to Princeton; it took eight days, and must have been quite a strenuous adventure. Now it can be made in eight hours, there and back.

My first meeting with any of the old brigade was in 1907 when I timidly approached Mr. Thomas Cunningham, then Inspector of Fruit Pests in Vancouver, for employment. I had recently arrived from England complete with letters of reference, but I did not impress him apparently. However, I was soon engaged in applied entomology, as in the following year I was employed in a Vancouver nursery painting "maidens" with coal-oil; a very effective but laborious method of checking woolly aphis. But labour was cheap then—I received 20 cents per hour. My next entomological employment was in 1915 when I first met Mr. Treherne as the result of a chance observation of the presence of the currant bud-mite at Duncan on Vancouver Island. Treherne had greater discernment of talent than Mr. Cunningham, as I was promptly employed by the Provincial Department of Horticulture to survey and eradicate the infestation. I drove around the Cowichan valley in a hired and tired horse and buggy.

Referring again to Mr. Cunningham, I would like to quote part of a paragraph from Treherne's Review of Applied Entomology in No. 4 of our Proceedings, wherein he refers to the general freedom of the province from insect pests. He says:—"If it had not been for the Horticultural Regulations against the introductions of dangerous insect pests, British Columbia entomology up to the present would have been very different. Instead of applying quarantine measures, we would have been studying and controlling insect pests of the farmer far more serious than any we have at present, and the published record of entomology in British Columbia would have been very different." That was in 1914. As you know these Elysian conditions do not now obtain, and on the face of it you might be tempted to think that Mr. Cunningham's successors had been lax in their duties. Such, I assure you is not the case, and the foregoing was quoted only to lead up to the point that I wish to make next—that the large increase in insect pests in this region is due to the greatly changed and changing conditions, not only in agriculture but in every phase of activity. Especially is this change pronounced in the increase in volume and methods of travel, and in the vastly increased acreage and variety of crops grown. I feel sure that many of the injurious species were here for years before they were first recorded as pests, but they had been kept to insignificant and un-noticed numbers through scarcity of food when subsisting on wild hosts ,and by greater vulnerability to parasites and predators under such conditions.

Turning now briefly to two other old timers that I knew well, Anderson and Hanham; Walter Anderson was an Inspector of Indian Orchards; he travelled the whole province on that excuse. The Indians were not orchardists, but he made many new records, both plant and insect. He was full of Indian lore, and was a good companion as long as you agreed with him. I soon learned to do this; others did not. Mr. Hanham was a bank manager at Duncan on Vancouver Island — a more enthusiastic collector I never knew—unless it is the income tax man or our present president, G. J. Spencer. Not satisfied with a vast collection of beetles and "micros," he also gathered stamps and molluscs, both fresh-water and marine. Even when well on in years he still had the energy and enthusiasm to collect, and I went up both Mount Cheam and Mount McLean with him. I can see him now leaping about on the high rock slides like a young antelope, chasing a small brown butterfly called *vidleri*. On the trip up Cheam Walter Anderson was also along, and Hanham committed the unpardonable sin of disturbing a wasps' nest and of running away so that the wasps were left with Anderson. The tongue lashing he received was equal to the wasps' invective.

Eric Hearle was one of the few specialists in the earlier days; he studied the mosquito problem in the lower Fraser valley for three years under the direction of the National Research Council, and in response to a request for a mosquito control programme by the municipalities on the lower mainland. He covered the valley from New Westminster to Hope by car, boat and airplane. His invaluable report stands like a bridge without approaches, because, when it came to providing funds to implement his recommendations, the municipalities decided that they had no mosquitoes. I went out with Eric Hearle once or twice; his keenness was most marked, and his arms a mass of bumps as he tested the virulence of the bites of the different species. He has gone, along with so many of the noble band of early days—Hewitt, Treherne, Dennys, Seymour Hadwen, Day, Hanham, Sherman, Anderson, Cunningham, Blackmore and Marmont, to mention only those personally known to me.

You will pardon me, I hope, if I become personal again in order to help you visualize the earlier days. I first went to Agassiz in 1919, assisting A. B. Baird who was then studying the natural control of the spruce budworm and tent caterpillars, and in 1921 I took over the Agassiz laboratory when Baird returned to the East. There were few entomologists in the province in those days; Treherne, Buckell, Ruhmann, Venables and Ralph Hopping in the Interior and Downes on Vancouver Island, so that I had the whole of the lower mainland including Vancouver for a field of work. The trend then was for a regional division of work rather than a crop-plant division as is now followed. Speaking medically, most of us were general practitioners rather than surgeons, obstetricians or psychiatrists; and from 1921 until quite recently I delved into every form of insect trouble—from shade tree pests on Vancouver streets to parasite collection and liberation around Lillooet; from grain pests in elevators, and earwigs and slugs in gardens to the wide open spaces where moles and clover seed midges roamed unchecked. I climbed to the tops of tall Douglas fir trees to find what was spoiling the seed-cone harvest, and flew over and waded through mosquito swamps to locate breeding pools. I tried out this and that for flea-beetles, hop aphis, root maggots and fruit flies. Undoubtedly I knew a little about a lot.

The expression—trying out this and that—brings me to my last theme—the ammunition that we had to work with for control measures. All the foregoing was in the pre-DDT era. It was so delightfully simple then. We had so few chemicals to worry about, and unless you drank them neat, they did not poison you. In the provincial bulletin "Diseases and Pests of Cultivated Plants" published in 1924, nine insecticides are listed—lead arsenate, mercury bi-chloride, paris green, hellebore, nicotine sulphate, kerosene emulsion, quassia, whale-oil soap and that great stand-by lime-sulphur. If none of these proved effective, one had to concentrate on cultural operations, a procedure too often neglected these days. With the evolution of spraying and dusting machinery, and the introduction of dozens of new organic and other chemicals, each more devastating than the last, and with names even more fearful, the humble practitioner finds that he is required to be an engineer and a chemist as well as an entomologist; and in the past few years with the increase in personnel he has to be an accountant, mathematician and administrator in addition. It is all so new and untried with so many different angles to watch.

I have mentioned many workers who have gone to the happy collecting grounds, and should mention one or two of the acquisitions that entomology has made during this period. In 1924 a whirlwind appeared in the province in the person of our president, G. L. Spencer.

His energy and enthusiasm have done much to advance our Society and entomology in general here. From various sources and by devious means he has amassed a vast collection of insects of the province at the University of British Columbia, and his effective tutelage has provided fieldmen with well trained assistants, where before there were none. Finally, mention must be made of the invasion of prairie and eastern entomologists which occurred a few years ago. The outbreak caused no little concern at the time as no control was known, but I am glad to say none has been found necessary. They all turned out to be, not commensals or inquilines, but excellent examples of mutualism, and a perfect symbiosis with the older workers has developed that I am sure will be of benefit to entomology in the province in the coming fifty years.

FIFTY YEARS OF ENTOMOLOGY IN THE INTERIOR OF BRITISH COLUMBIA

E. P. Venables
Vernon, B.C.

When I was selected to present a paper dealing with the above subject I felt somewhat at a loss; but, when told that I should be working with Mr. E. R. Buckell, the problem was simplified to a great extent because Buckell and I had already worked together on many occasions. One might approach this subject from variour angles, but as I was told that dry statistics were not required I have done my best to avoid them, and to give what may be a somewhat personal narrative dealing with certain characters whom I met and who were, at that time, the sole representatives of our science in the Okanagan Valley. I might deal with my own early struggles in the field of entomology and recount the difficulties which I had to overcome in order to gain a foothold on the ladder, which eventually landed me among the "elite" or, so I should have thought, in 1897.

It was my good fortune to meet the late Dr. James Fletcher quite early in my entomological career, and it was due to his personal interest that I was able to have my material named. Dr Fletcher was an inspiring personality, a naturalist of the old school, who when addressing the public, always stressed the interesting points of insect behaviour, rather than their control, for, as he said, "if one is interested in the subject the artificial control measures are much more easily understood." Fletcher filled the dual roll of Dominion Entomologist and Botanist. I wonder how one of us would feel if landed in that position today. He had one assistant, Mr. Arthur Gibson, who later became Dominion Entomologist and had much to do with the organization of the Division of Entomology as it exists today.

I remember so well that after sending a number of beetles to Dr. Fletcher for naming, I got a long letter in which he stated that several of the species were of particular interest, and that he would be glad if I could secure more of them because he wished to send them to Professor Wickham in the United States. The receipt of this letter filled me with new enthusiasm and I could understand Darwin's feelings when he got a letter from Lyall, the geologist, dealing with some material Darwin had sent from the Galapagos Islands. Lyall told him that not only were his specimens of great interest, but that his notes were of particular value to science. Darwin, in his reminiscences, says that, on receipt of this letter he sprang over the rocks and made them ring again with the blows of his geological hammer. I wonder if any of the professional workers here today, have, on the receipt of a letter from Ottawa, been inspired to leap on the spray tank and brandish the spray gun with renewed vigour?

It was about 1900 that I was asked by Fletcher to inspect several hundred peach seedlings which had been sent from Ontario to a nurseryman in Vernon. These were suspected of harbouring San Jose scale and I was directed to spray the whole block with kerosene emulsion in case the trees were infested. I believe that this may have been the first time an oil spray had been used commercially in the Okanagan Valley. Of course, in those days, fruit growing was in its infancy and people were very interested in the subject of pests and were rather pleased if they could find something new. They would proudly take their friends to view the work of, perhaps, the red humped caterpillar, or bud worm on their young trees. This would usually be on Sunday afternoon.

The Farmers' Institutes were organized, I think, about 1900 and it was at one of the meetings that I met Dr. Fletcher. The subjects dealt with on some of the programmes were very general, such as, *The Bacon Hog, The Dairy Cow* or *The Blue Jay.* Some of the speakers, however, were never at a loss, and would deal with almost any agricultural subject which the meeting might decide upon on the spur of the moment. For instance, on one occasion a gentleman was on the programme to talk on *The Blue Jay,* but when called upon for his address he said "There are no blue jays in the Vernon district, so I will talk to you on Cheese Factories, which he proceeded to do at some length. In another case, the subject was, Birds in Relation to Agriculture. When he rose to his feet, the speaker, however, changed this to The Construction of Silos.

With regard to the respect due to those who deal with agricultural subjects at farmers' meetings, it may teach some of us proper humility to hear the remarks of a Vernon farmer, who, when my father, who was Institute secretary, asked him to come to one of the meetings, delivered himself as follows: "No, sir. I ain't no use for them lads what talks all night and sleeps all day. Clever know-nothins, what don't know beans when the bag is opened."

One might continue at some length with reminiscences of the very early days, but I must refrain, and deal with the early development of economic entomology. With the arrival of Mr. R. C. Treherne our science took on a more serious, but perhaps, less human tone. Spraying was becoming a somewhat general practice although, even in 1919 and for several years following, hand pumps were the order of the day. Many of us made our own lime-sulphur sprays and this material was applied assiduously in the dormant period, usually before the snow had left the ground, and there was satisfaction in the brilliant yellow colouring of the snow coupled with the penetrating and healthful odour which, one felt, must be toxic to all pests. Of course, around 1900, there were no professional workers, so that our Society's efforts were quite unaided from that quarter. We circulated manuscript notes with lists of captures and remarks on the season, with occasional mention of injurious insects.

The late Mr. R. V. Harvey was the first secretary of the Entomological Society of British Columbia, a man of tremendous zeal and enthusiasm; he made the trip from Vancouver to Vernon via the Hope-Princeton trail on foot and camped on Long Lake for a fortnight.

Another member, Mr. W. Bush, was an ardent lepidopterist who usually carried a net with a handle about ten feet long with which he would sweep the shade trees in the city park. This, and the white suit which he used to wear, topped off by a large straw hat, attracted much attention, and served to advertise the science of entomology.

Then there was the Rev. G. W. Taylor who specialized in the Geometridae, of which group he had built up a large collection. He was in charge of the Anglican Church in Nanaimo, and it was in that church that I witnessed to what heights an entomologist might rise, or perhaps descend. During his sermon a desirable specimen was hovering round the pulpit light, and Taylor, with a few deft passes of a cyanide bottle captured the insect with no interruption of his discourse.

After Treherne's arrival a new era commenced. "Tre" as he was always called, was a splendid man, full of new ideas, and it was not long before he became secretary of our Society. He added a considerable number of members by insisting that any one he met who was connected with fruit growing, should join the society "for the good of the industry." Mr. Buckell was already engaged in entomological work when I was taken on in 1919. I remember that Tre and I were in Keremeos, and hearing that Buckell was camped up the river, went to look him up only to find that he was away up in the Lillooet country, I believe. His tent was pitched close to the river and a note attached to the flap warned visitors to "look out for the rattlesnake." Buckell's work, dealing as it did with locusts, necessitated quite long trips, which he made on horseback, and in this way covered an area from the Okanagan up into the Cariboo. Later he was provided with a Model T Ford complete with Ruxstel axle, but it would take a volume to recount his adventures with this contraption.

I think that the control of injurious insects has, today, lost the human interest which it had in the early days. Remedies were far more heroic in those days, and could be applied, in most cases, without referring to the chemist, who, today hovers in the foreground and almost excludes the entomologist. Take for instance the recommendations for tarnished plant bug. "Shake them from the trees before sunrise, and destroy them." In the case of the New York weevil remedy — "There seems to be none other than to catch and kill this mischief maker." The red-humped apple caterpillar "should be shaken from the tree and trampled under-foot." The apple-leaf sewer—"The most obvious remedy is, to carefully gather all the fallen leaves with the enclosed larvae and burn them." What has become of those hosts of injurious forms which were present in the late 'eighties? Who among us would recognize the *silky pyrophila,* the *American procris,* the *light-loving anomala,* or the *currant angeroa,* to mention a few. Are they all extinct? We don't see them mentioned on the spray calendar.

The period between 1900 and 1925 was an era in which mechanical barriers and traps were much to the fore. It was not uncommon to see lines of Chinamen, each with a blanket, chasing off swarms of grasshoppers. The strawberry weevil was turned aside with barriers. Crickets were prevented from entering the fields by the erection of wood, tin, or, in some cases, glass fences.

The control of insects now seems to be in the hands of the chemical engineer, and universal destruction is the order of the day. What the upshot will be remains to be seen and it might be of interest to maintain blocks of orchard trees under the spray programme used in, we will say, 1940 or thereabouts. Some valuable information might be forthcoming affording as it would, a direct comparison on insect populations.

A remark made by the president of the British Horticultural Society a few months ago gives one food for thought. He drew attention to the fact that, most of our leading types of livestock, cattle, horses, sheep, poultry, etc., were produced by the efforts of ordinary farmers, with little, or no assistance from Science as we know it today. He also put forward the idea that Science may, at times, actually delay discoveries by splitting too many hairs.

There is a good deal of truth in these statements, but it will be for the younger men to ponder them.

THE HISTORY OF THE STUDY OF EXTERNAL ARTHROPODS AFFECTING ANIMALS AND MAN IN BRITISH COLUMBIA

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The earliest observations of insects affecting man and animals date back to records made by early explorers on the voracity of some of these pests. In Dr. Cheadle's diary of his trip across British Columbia in 1863 are such comments as "Fearful amount of gadflies. Horses half mad . . . tormented to death by flies. Sandflies and musquitos terribly annoying . . . musquitoes murderous." Remarking on the terrible "musquitoes" at the plains of Sumas, he states that "Indeed men from all countries agree that the musquitoes of B.C. are unmatched for numbers and ferocity."

In the early nineties the mosquito still occurred in millions in the Fraser Valley, rendering work a "purgatory" from early July until September. Relief was obtained when the area was dyked. The first economic studies of animal insect pests were undertaken by Dr. Seymour Hadwen, Animal Pathologist at Agassiz in 1912. From his pen arose publications covering ticks, warble flies and other livestock pests, and under joint authorship with Dr. E. A. Bruce, he published his observations of the migration of warble lavae through the tissues of cattle. In a later bulletin he treated comprehensively the control of insects affecting livestock. In 1919, under the direction of the Dominion Entomologist, Dr. Hewitt, Mr. Eric Hearle commenced his studies of mosquitoes in the Fraser Valley. This was followed by his 1927 publication of the "Mosquitoes of British Columbia."

The study of insect and ticks affecting animals and man was placed on a firm footing with the official establishment of a Dominion Insect Unit at Kamloops in 1928. Eric Hearle was transferred from Indian Head, Saskatchewan, to act as Officer in Charge —and staff. His wire to the Dominion Entomologist, Mr. Arthur Gibson, that he had "located a place that is admirably suited to our needs" referred to an old shack that was located in the centre of town and which had served in its time various purposes from a funeral parlour to a bootlegging joint.

Once established, he set himself, singlehandedly, to the terrific task which lay before him. Not only was he treading on virgin territory as far as his work was concerned, but he was working in a province that contains a richer supply of biological material than all the rest of Canada. This is readily evidenced in later taxonomic studies of various insects.

During the first summer he studied and collected all data and specimens he could lay his hands on. This included mosquitoes, blackflies, sandflies, horseflies, ticks, mites and lice. His surveys covered the whole of lower British Columbia. Thirteen districts were examined for warbles, which were causing 75 per cent. warble damage in hides. Half a dozen addresses were given during the first month alone. Questionnaires on tick paralysis were sent to all doctors in the Interior and a display was set up at the Vancouver Exhibition. During most of this period he lacked a stenographer.

Within the next two years, mosquito controls had been inaugurated at Kamloops and Kelowna. Tick studies had advanced to include life-history studies of the more important species, including observations of their effect on both domestic and game animals. This brought to light many tick paralysis cases, including an outbreak at Douglas Lake involving 100 head of cattle, out of which 30 were lost. Tularaemia was first recorded for British Columbia in rabbits at Vavenby.

In 1931, the first of a series of large-scale warble control measures were undertaken at Tranquille. From this work it was demonstrated that the grub incidence in cattle could be brought successively from 19 per cent. to 0.3 per cent. within four years. During 1932 and 1933 Hearle spent several months in the vicinity of Jasper Park Lodge making a detailed survey of biting fly conditions. Over 1400 blackflies alone were pinned and determined. Following this work, at the age of 41, his health broke and he was confined to bed. There he continued with the classification of ticks, mosquitoes, blackflies and horse-flies, practically completing manuscripts on the ticks and blackflies of British Columbia, before his untimely death in the spring of 1934. His paper "The Ticks of Western Canada" and his bulletin "Insects and Allied Parasites Injurious to Livestock and Poultry in Canada" were published posthumously.

Immediately following Hearle's death, Professor G. J. Spencer took charge of the laboratory during the summer months. On the staff at that time were two assistants, T. K. Moilliet and the writer, and a stenographer. It was during the same year that the original working quarters burned down. While much of the laboratory equipment had been transferred to the Post Office Building, this fire resulted in a loss of field facilities. Steps were taken to secure 32 acres of land three miles west of Kamloops, and a plea issued for the construction on it of a laboratory, wherein the expanding problems of ticks and their diseases could be undertaken with greater safety to the public. It was shortly after Mr. Allen Mail's arrival, in 1937, from Montana, to take over his duties as Officer-in-Charge, that these plans went into effect, and a $21,000 two-storey building was erected. The occupation of the building was followed by the co-operative inclusion of members of the Dominion Rangeland Department and of the Department of Pensions and National Health. The presence of the latter marked the commencement of Western Canadian studies of plague and spotted fever, and surveys of ticks and fleas for their testing were first made by members of the entomological staff. Quarantine quarters and animal housing were added for this disease work, which is still in progress under the supervision of Dr. Humphreys, in what is now the Department of National Health and Welfare.

The next phase of study in livestock insect control appeared with the advent of power spraying, and extensive tests were made to determine the optimum pressures and derris mixtures for warble control under British Columbia conditions. The presence of wartime shortages in addition necessitated comparisons being made with derris and pyrethrum substitutes. Along with these studies came those pertaining to the protection of armed forces from the attacks of biting flies, and in this connection, many tests were made to determine the effectiveness and practical value of mosquito repellents.

In 1943, Mr. Mail resigned his post at this laboratory to accept work in the United States, leaving as his successor, J. D. Gregson. At this time chemical advances in the production of synthetic insecticides were creating a new aspect in insect control. Before long DDT and thiocyanates replaced pyrethrum fly sprays; citronella and other aromatic oils were cast aside for such superior compounds as 612, dimethyl phthalate and indalone. Gammexane was discovered to be a long-awaited acaricide and mosquito and blackfly oil larvicides were discarded for those embodying DDT. These and other discoveries shed a new light on insect control and, of course, provided much room for new research to meet our conditions. In tick control it has been necessary to discover dosages of BHC that will give maximum protection to cattle and sheep from ticks and keds, yet not prove injurious or objectionable in any way to the host or to its consumer. This has involved numerous field tests each year using artificially infested animals. These experiments have progressed from the deliberate application of overdoses on laboratory animals to cautious recommendation, and finally widely accepted use on range stock. During recent years attention has been devoted to the intriguing study of systemic insecticides, where it has been found possible to rid an animal of its external parasites by a single oral dose of material.

Mosquito control, the administration of which has long passed to the hands of some two dozen communities in British Columbia, has likewise undergone a great transformation, and since the establishment in 1949 at Kamloops of a Household and Medical Unit laboratory, its Officer-in-Charge, Mr. L. C. Curtis, has been engaged in perfecting modern control methods. These include air-spraying and fogging. The latter method is coming into popular use as an adulticide and can be generated by means of a gas engine exhaust adaptation. Since DDT is an effective biting-fly larvicide in such small amounts (one part in 20 million for blackflies), appropriate methods for its release in water are also being studied.

Linked with the economic progress of livestock insect control has been the advance of academic knowledge. Here may be included taxonomic studies, such as have stepped up the known number of British Columbia ticks from 12 to 20 within the past 20 years. The number of flea species known to exist in the province in 1907 was six. During the next 30 years Jordan and Rothchild of the Zoological Museum, Tring, England, described many additional species and by 1936, G. J. Spencer of the University of British Columbia had built this number up to 61. G. P. Holland, now Chief of the Systematic Unit, Ottawa, in his monograph of the fleas of Canada, lists over 90 as now occurring in British Columbia. Spencer's check lists in our proceedings have similarly demonstrated our increased knowledge of pediculous and dipterous parasites.

Ecological observations made at Kamloops have shed much light on tick behaviour, have shown tick life-cycles as long as 21 years, and indicated the gradual increase and decrease of such economic tick species as *Dermacentor andersoni* and *Ixodes pacificus* as apparently affected by civilization. Such outstanding species as the southern spinose ear tick *Otobius megnini* and the relapsing fever carrier, *Ornithodoros hermsi,* have in recent years been taken a number of times during field collections. Particular attention has been paid to the life-history of the warble fly, and by the use of specially constructed girdles on infested cattle, some 400 grubs have been collected for fly studies each spring.

In retrospect, the study of insects and allied parasites affecting man and animals in British Columbia has advanced rapidly and fully. With a staff of twelve now at the Kamloops laboratory, and with the increasing co-operation of Provincial, Dominion and University departments, the future should hold even greater progress.

APPLIED ENTOMOLOGY IN THE ORCHARDS OF BRITISH COLUMBIA, 1900-1951[1]

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Writing in the *Proceedings of the Entomological Society of British Columbia,* Winslow (1913) estimated that in 1912 the total return of the fruit crops of the interior of British Columbia had been $500,000, the actual returns to growers $250,000, and the cost of pest control $53,670. Pest control, therefore. took 20 per cent. of the net returns and that, said Mr. Winslow, was too much.

By 1946 the gross value of the fruit crops had reached about $25,000,000 and the net return may have been about $12,000,000. Cost of pest control had been in the neighbourhood of $1,500,000, or over 12 per cent. of the net returns. Hence the ratio of crop value to cost of pest control remained high, and 34 years later growers throughout the interior fruit-growing areas echoed Mr. Winslow's remark—it was too much. This was particularly so because, despite the drudgery and high cost of pest control, upwards of 10 per cent. of the apple crop was being lost to the codling moth.

Then came DDT and the synthetic organic acaricides. The number of codling moth sprays dropped from 6 or 7 to 4, then to 2 or 3. Cullage from insect infestation became negligible. And because of these new compounds, it became possible to develop the automatic concentrate sprayer, a device, largely British Columbian, that has further reduced the cost of pest control by at least a third and brought to the growers emancipation from one of the most unpleasant jobs in agriculture. Today, pest control is undoubtedly less costly, inconvenient and unpleasant to the fruit growers of British Columbia than at any other time since fruit growing became a sizable industry.

The history of the Entomological Society of British Columbia goes back nearly as far as that of the British Columbia Fruit Growers' Association. Because the affairs of the two organizations have often been closely associated, it is interesting to recall some conditions that were of concern to both and to compare them with conditions in 1951. In the early days of British Columbia fruit culture, Cunningham (1907) wrote as follows: "The standard sprays for the fruit growers may be reduced in number to lime, sulphur and salt for winter, Bordeaux mixture for both winter and summer, and arsenate of lead for summer. With these three sprays the whole line of successful orchard work and destruction of pests and disease may be accomplished." When, in the mid-'40's, the control of orchard pests had become a much more complex problem, the fruit industry no longer relied on Bordeaux mixture and lead arsenate; salt, believed to be an adhesive by Cunningham, had long since been omitted from the lime-sulphur mixture. Dormant-spray materials were high-viscosity dormant oil, distillate oil, dinitrocresol, and lime-sulphur. Summer sprays included the monoethanolamine salt of dinitrocyclohexylphenol, summer oil of medium viscosity and low unsulphonated residue, cryolite, nicotine sulphate, fixed nicotine, micronized phenothiazine, kerosene, rotenone, lime-sulphur, zinc sulphate, elemental sulphur, xanthone, DDT and BHC. Nowadays the trend is to the simple spray schedule, and most growers use heavy dormant oil-lime-sulphur mixture, or heavy dormant oil-dinitrocresol mixture for the early spray and DDT and parathion, or monoethanolamine dinitrocyclohexylphenolate (mono DNP) in summer applications.

There has been a great change in orchard spray machinery since the appearance of Cunningham's spray

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bulletin in 1907. At that time the power sprayer was unknown and the height of mechanization was the hand-operated barrel pump with vertical cylinders. It was superseded by the double-acting horizontal pump. But that did little to relieve the back and arms of the man who supplied the energy. Treherne (1914:67-71) records that the first barrel-type spray pump in British Columbia was purchased by Thomas Cunningham in 1885 for use in the coastal areas. The first of such pumps in the interior of the Province appears to have been in use in Vernon at the Coldstream Ranch in 1895. In 1910 the first gasoline-powered sprayer was imported into the Province; and by 1914 the Provincial government, in the course of its suppressive measures against the codling moth and the San Jose scale, had nine such machines in use. At that time there were, in addition, about 25 privately owned power machines in the Okanagan Valley.

The stationary power sprayers, which reached its greatest development and use in the Wenatchee area of Washington, did not, to any great extent, displace the portable power sprayer in the British Columbia fruit industry. A considerable number of stationary units, however, were installed in the late '30's and early '40's. Portable power sprayers, most of which were eventually operated by tractor power take-offs, did not undergo any basic changes in design until the appearance of the huge "speed sprayer" in the mid-'forties; consequently, they had been made to a fairly fixed pattern for nearly 25 years.

In 1946 a new type of portable sprayer employing an air blast to boost spray fog generated by a hydraulic pump was purchased by the Fruit Insect Laboratory at Summerland. Although this machine proved unsatisfactory, it was, nevertheless, the forerunner of the Okanagan experimental sprayer, a hybrid device built by the joint efforts of the British Columbia and Canada departments of Agriculture and the Defence Research Workshops. It has been described by Marshall (1948). The Okanagan experimental sprayer proved highly successful. It was the forerunner of four commercial models, which, in three years, have virtually revolutionized spraying in the orchards of this province. These automatic concentrate sprayers, as they are locally known, have put the British Columbia fruit industry in an outstanding position in the chemical control of pests. Already the spraying operations of the tree-fruits industry are about 90 per cent. mechanized.

It is a far cry from the laborious and messy business of hand spraying by barrel pump or even by conventional power sprayer to the simple but not unpleasant job of operating an automatic concentrate sprayer. And, fortunately, in addition to having practically eliminated the unpleasantness from spraying operations, the new machine has reduced the cost of labour by about 75 per cent. and the cost of spray materials by perhaps 20 per cent. Capital investment, too, has been greatly reduced. Although the new machines cost about one-third more than their predecessors, they are capable of spraying three times the acreage. Finally, they are operated by one man, the tractor driver, so that they release labour for other important cultural operations at the busiest time of the growing season.

Early in the century, there were few orchard pests in the Province and control of these was based largely on investigations that had been carried out in the United States. Treherne (1914:19-33) recorded the most important insects of the lower mainland: woolly apple aphid, *Eriosoma lanigerum* (Hausm.); green apple aphid, *Aphis pomi* Deg.; rosy apple aphid, *Anuraphis roseus* Baker; black cherry aphid, *Myzus cerasi* (F.); oystershell scale, *Lepidosaphes ulmi* (L.), pear-slug. *Caliroa cerasi* (L); apple leafhopper, *Empoasca maligna* (Walsh); pear leaf blister mite, *Eriophyes pyri* (Pgst.).

The most serious orchard pests of today are orchard mites, which, in the last five years, have replaced the codling moth in that category. Dash (1914) stated that the mites known to occur in the Okanagan Valley were two species of eriophyds; and the "red spider," *Tetranychus bimaculatus* Harvey; the brown mite, *Bryobia praetiosa* Koch; and the pear leaf blister mite, *Eriophyes pyri* (Pgst.). It is not known when the European red mite, *Metatetranychus ulmi* (Koch), first appeared in the orchards of British Columbia; but in the Okanagan Valley it was common in the 'thirties although not generally troublesome. By 1946 it had displaced the codling moth as the chief orchard pest and it maintains that distinction today. In 1939 the Pacific mite, *Eotetranychus pacificus* (McG.), was discovered at Oliver; it now occurs throughout the Okanagan Valley. Another troublesome orchard mite, the Willamette mite, *Eotetranychus flavus* (Ewing) was recorded at Summerland in 1949 and by the end of the 1950 season it was general throughout the south Okanagan. The brown mite, mentioned by Dash, has persisted, and in 1950 became injurious in a few orchards. The pear leaf blister mite, perhaps the first of the mites to be noticed in the Province, continues to cause trouble sporadically, but only where dormant spraying has not been done for several years. Two other species, the rust mite, *Callyntrotus schlechtendali* Nal., and the silver leaf mite, *Phyllocoptes cornutus* Banks, are also known to occur in the orchards of the interior but, so far, they have not caused measurable loss. In 1950 the two-spotted spider mite, *Tetranychus bimaculatus* Harvey, caused more injury in the orchards than at any other time since it was reported by Dash 36 years before. Still other species of orchard mites are being discovered as an intensive study of the biology of orchard mites gets under way at the Fruit Insect Laboratory at Summerland. Whether there is any connection between the use of DDT and parathion and the rise of the orchard mite problem remains to be seen, but C. V. G. Morgan of the Summerland laboratory has demonstrated a relationship between the use of parathion and the abundance of the most effective predator of orchard mites, the coccinellid beetle, *Stethorus picipes* Csy.

An event of some concern to pear growers of the Province was the discovery of the pear psylla, *Psylla pyricola* Foerst., at Oliver in 1942. Since that time the insect has spread throughout the Okanagan Valley, although it does not yet occur in the Kootenay fruit districts. Parathion has proved to be exceedingly effective against this species.

An unexpected pest, the apple mealybug, *Phenacoccus aceris* Sign., was reported from Nelson in 1927. Previously this insect was known to occur in Canada only in Nova Scotia. Until the introduction of the parasite *Allotropa utilis* Mues., through the Insect Parasite Laboratory, Belleville, Ontario, the mealybug caused some loss of fruit in the Kootenay Valley. The growth of the sooty fungus on fruit coated with the excretion that is copiously shed by these insects rendered the fruit unsaleable.

This year it appears that Okanagan fruit growers may have two additional insects to contend with. A leafhopper, *Erythroneura* sp., has occurred in outbreak numbers on grape at Osoyoos; and the black cherry fruit fly, *Rhagoletis fausta* (O.S.), has been taken in an orchard near Westbank Ferry. These insects may have been present in the Valley for some time.

Treherne (1916) reported the rise of the San Jose scale, *Aspidiotus perniciosus* Comst., as a serious orchard pest, but it was not until some 20 years later that it obtained such a strong foothold in the Oliver, Osoyoos, and Keremeos districts as to be a menace. The pear thrips, *Taeniothrips inconsequens* (Uzel), had been found on Vancouver Island; and the woolly apple aphid, *Eriosoma lanigerum* (Hausm.), which had first been noticed on the lower mainland in 1892, followed the expansion of fruit growing until by 1912 it was general in the interior fruit districts. Later, the relationship between the woolly apple aphid and perennial canker established the aphid as a major pest in the Okanagan Valley. The eye-spotted bud moth, *Spilonota ocellana* (D. & S.), occurred at Vernon in 1894 but was not common until 1915. Venables (1924) described four leaf rollers attacking fruit trees in the Okanagan Valley; referring to the fruit tree leaf roller, *Archips argyrospila* (Wlkr.), he wrote, "The control of this insect may at present be considered the most serious problem facing orchardists in the interior fruit growing section of the Province"; he recommended for its control the application of 8 per cent. miscible dormant oil. This insect became a minor pest after codling moth spraying with lead arsenate became general. Perhaps its decline may be ascribed to that arsenical.

As mentioned by Hoy (1942), the codling moth has been associated with the British Columbia fruit industry from the early days. Infestations were reported at Victoria in 1900 and at Kaslo in 1905. Referring to the codling moth regulations in force early in the century, the first Provincial fruit pests inspector, T. Cunningham (1907), wrote: "The duty of enforcing these regulations is exceedingly unpleasant, but after all, it is only kindness to the fruit grower to compell him to protect his own interests and those of the country in which it is his good fortune to have his home." Cunningham's words bear out the opinion, still heard, that he was a staunch patriot with a strong sense of duty. Eventually it was found that spraying regulations could not be adequately enforced.

The codling moth did not menace the Okanagan fruit industry until 1916; and, because of vigorous eradication measures undertaken by the Provincial government, the insect was kept in check until 1925. After that, however, control measures were left with the grower, and the codling moth steadily increased in destructiveness until, 20 years later, it almost appeared that it had doomed the apple industry. As mentioned earlier, the situation was immensely improved by the introduction of DDT, an insecticide that appears to be at its best under the climatic conditions of the Okanagan Valley.

Treherne (1921) reviewed the status of applied entomology, noting that in 1915 he was the only professional economic entomologist at work in the Province. Until that time he was stationed at Agassiz and no investigational work had been done in the interior fruit-growing areas. In 1916, however, it appeared that the greatest need for investigations in applied entomology were pending in the Okanagan Valley and, that year, Treherne and M. H. Ruhmann commenced a study of the life-history and habits of the codling moth at Vernon.

In 1917 the Dominion Entomological Branch began to expand its work in the fruit industry of British Columbia by the appointment of W. Downes to work on insects of small fruits at Victoria. After the First World War Treherne was transferred to Ottawa; then, in 1919 and the next few years, E. R. Buckell, E. P. Venables, A. A. Dennys and, still later, A. D. Heriot were successively appointed. All worked from Vernon. Buckell did most of his work on range insects but Venables, Dennys and Heriot worked exclusively on fruit insects. This group of investigators was associated with entomological investigations in the interior of the Province until about 1945. They were a colourful company, and all who were familiar with these Englishmen regret their departure from active work and have a feeling of nostalgia for the old days of the *S.S. Okanagan,* the Model-T Ford, and the collecting trip.

In December, 1938, the Division of Entomology appointed the writer to the Vernon office to work on the control of pests of tree fruits in the Province. During the Second World War the staff at the Vernon office included Venables, Dennys, Heriot, and the writer and, in 1942, Harry Andison, transferred from the Victoria laboratory after the untimely death of Alec Dennys. In 1946, after the south Okanagan had replaced the north Okanagan as the chief tree fruits area in British Columbia, the equipment of the old Vernon office on the third floor of the Provincial Court House was moved to Summerland. Harry Andison returned to Victoria to follow W. Downes as head of the investigations on insects of small fruits and greenhouses on the coast. Heriot and Venables had retired and were succeeded by C. V. G. Morgan (biology of orchard mites), M. D. Proverbs (insects of stone fruits), D. B. Waddell (spray equipment and chemical formulations), and R. S. Downing (chemical control of orchard mites). In the Fruit Insect Laboratory the naturalist with the modulated English voice had been replaced by the "spray bloke," with the flat Canadian monotone.

In checking back over the years the reader is impressed with the work in the control of fruit insects that has been done by the Provincial Fruit Branch. R. M. Winslow did good service in that field from 1909 to 1917. During the '30's and '40's, W. H. Robertson, then Provincial Horticulturist, now Deputy Minister of Agriculture for British Columbia, saw to it that, when help was needed for pest control, funds were provided as far as possible. The present Provincial Horticulturist, Ben Hoy, conducted eradication work in the early days of the codling moth in the Province and followed that by extensive investigations in the chemical control of a variety of fruit insects, particularly the codling moth, during the '30's and '40's. R. P. Murray, now District supervisor of Horticulture at Kelowna, has been keenly interested in the control of fruit insects and active in that field for 30 years. H. H. Evans, who served as Provincial District Horticulturist at Vernon, also helped a great deal in orchard pest control measures. E. C. Hunt, the Provincial District Horticulturist at Nelson, investigated the control of Kootenay orchard pests and diseases from about 1916 to 1951. From 1937 onward he received help from the investigators of the federal laboratory at Vernon and, later, Summerland. Hunt's work has been of great assistance to the Kootenay fruit grower. At present the Provincial Fruit Branch operates two truck-mounted power sprayers for experimental work in the Okanagan Valley and an automatic concentrate sprayer in the Kootenay Valley.

An interesting feature of pest control investigations in the interests of the tree fruits industry of British Columbia is the close collaboration that has developed between the British Columbia Fruit Growers' Association, the Provincial Fruit Branch, and the Federal Fruit Insect Laboratory at Summerland. The growers' organization keeps in close touch with investigations in pest control and takes an active part in the necessary extension work. The B.C.F.G.A., as it is commonly known, supplied a considerable sum of money for the equipment of the Fruit Insect laboratory at Summerland, which was opened in 1948. On occasion the B.C.F.G.A. has guaranteed growers against loss from field experiments undertaken in their orchards by investigators. The federal entomological and Provincial horticultural services operate practically as one in carrying on field work in pest control for the tree fruits industry. Men and equipment are interchanged so freely that nearly all orchard experiments in applied entomology in this province are joint ones. Seldom in the field of agricultural investigations has this close association between government services been matched; that is a matter of pride for all concerned.

Much of the credit for the present favourable status of applied entomology in the orchards of British Columbia goes to the chemists, whether in the federal service or in industry. The Fruit Insect Laboratory at Summerland is jointly operated by the divisions of Entomology and Chemistry of Science Service, Canada Department of Agriculture, the two organizations being, for practical purposes, so closely integrated at Summerland as to be one. Their work is greatly aided by pesticide research in the chemical industry of the United States, Great Britain, and Canada. In fact, without that research it is doubtful whether the apple business of this province could have survived. One must recall the ruinous and losing battle that was being waged against the codling moth only a few years ago to realize what the fruit growers owe to DDT, parathion, and the other synthetic organic pesticides in use today.

Although the tree fruits industry has come to place chief reliance on chemical control of orchard pests, it should not be concluded that biological control procedures have been, or are being, overlooked. In 1917, J. D. Tothill and R. C. Treherne of the Dominion Entomological Branch introduced into the Vernon district the mite *Hemisarcoptes malus* (Shimer) to aid in control of the oyster-shell scale, *Lepidosaphes ulmi* (L). That predator, although slow in dissemination, has been doing good work ever since. In 1929, through the Insect Parasite Laboratory, Belleville, Ontario, the parasite *Aphelinus mali* (Hald.) was released in the Okanagan Valley because the woolly apple aphid, *Eriosoma lanigerum* (Hausm.), by reason of its connection with perennial canker of apple, had become a serious orchard pest of the interior fruit belt. Almost from the start *A. mali* was a complete success, and the woolly aphid-perennial canker problem soon subsided. Still later, when the apple mealybug, *Phenacoccus aceris* Sign., became troublesome, through the Parasite Laboratory the parasite *Allotropa utilis* Mues. was released in the infested areas; within five years the apple mealybug caused little concern. From time to time the codling moth parasites *Ascogaster quadridentata* Wesm., *Ephialtes caudatus* (Ratz.) and *Cryptus sexannulatus* Grav. have been released in the interior fruit districts. So far, they do not appear to have exerted any appreciable effect in controlling the codling moth, but *A. quadridentata,* at least, seems to be well established.

It is recognized that compounds such as DDT and parathion may be injurious to parasitic and predacious insects and mites. Consequently, growers are advised to use these insecticides only when their application is clearly necessary. In the meantime, the Fruit Insect Laboratory at Summerland is devoting an increasing amount of time to a study of the effects of spray chemicals on biological control factors. In this work it is assisted by the Biological Control Investigations Unit of the Federal Division of Entomology, which, in 1951, stationed an investigator, D. A. Chant, at the Summerland laboratory.

The increasing complexity of pest control is further illustrated by the attention that is being paid to the effects of spray chemicals upon orchard soils and upon wild life. Experience in various orchard areas in the western United States has shown that serious poisoning of the soil can occur from an excessive concentration of lead arsenate. As the effects of most of today's synthetic organic insecticides in orchard soils are not well known, as investigation on the effects of spray chemicals on soils has been underway at Summerland for the last three years. These studies involve the Science Service divisions of Bacteriology, Chemistry, and Entomology. Effects of spray chemicals on birds and small mammals are being investigated by men representing the Department of Zoology of the University of British Columbia and the Wildlife Service of the Canada Department of Resources and Development. Their summer headquarters are at the Fruit Insect Laboratory, Summerland.

SUMMARY

The first 50 years of the Entomological Society of British Columbia have covered a great expansion in the fruit industry of the Province. Although the membership of the Society has not greatly increased since the early days, the status of its members has changed from predominantly amateur to predominantly professional. So far as control of tree-fruit pests is concerned, there is still a desirable diversification of methods. Chief reliance nowadays is being placed on mechanically efficient control of orchard pests with chemicals, but that

course is not being advocated blindly. Increasing thought is being given to the effects of spray chemicals on the biological balance and on orchard soils in recent years pest control problems have become more involved; and because of their complexity they are, as a rule, being studied not by individuals but by investigator groups that may include entomologists, chemists, horticulturists, zoologists and bacteriologists.

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THE DOMINION FIELD CROP INSECT LABORATORY AND ITS WORK, VERNON, 1918-1938, AND KAMLOOPS, 1939-1950

R. H. HANDFORD

Field Crop Insect Laboratory, Kamloops, B.C.

ESTABLISHMENT AND STAFF

Comparatively little research work concerning field crop and garden insects had been done in the interior of British Columbia prior to 1918. On April 1 of that year, R. C. Treherne moved his headquarters from Agassiz to Vernon. E. R. Buckell, who had spent four years in the provincial service, was employed by the Dominion Entomological Branch April 22, 1922, and took charge of the Vernon laboratory following Treherne's transfer to Ottawa in that year.*

*The first Government Entomologist appointed in British Columbia was Dr. W. H. Brittain, who held the dual position of Provincial Entomologist and Plant Pathologist from 1912 to 1913 at Vernon. On the appointment of R. C. Treherne, under the Dominion Government in 1912, the entomological work of the Province was divided between them, Brittain taking the interior and Treherne the coast. M. H. Ruhmann was appointed assistant to Brittain in 1912, and after Brittain's departure for Nova Scotia in 1913, he continued in the position of Assistant Provincial Entomologist at Vernon until his death in 1943.—Editor.

The Kamloops laboratory was established on May 1, 1939, with E. R. Buckell in charge, I. J. Ward as Insect Pest Investigator, and G. J. Spencer, University of British Columbia, employed as Entomologist during the summer months. The fruit insect investigations were continued by the staff remaining at Vernon. Buckell retired April 30, 1949, and R. H. Handford was placed in charge. C. L. Neilson was transferred to this staff from Lethbridge in 1947; D. Finlayson and H. R. MacCarthy joined the staff in 1948, and F. L. Banham in 1950.

CONTRIBUTIONS FROM RESEARCH

Grasshoppers. Grasshopper investigations were begun by E. R. Buckell before he joined the Dominion service in 1922 and have been carried on by one or more members of the staff since that date. The main contributions have been as follows:

Grasshopper outbreaks have been charted and described back to 1888; since 1922 these were based on the personal observations of E. R. Buckell and staff. Records of distribution and notes on ecology, and life history, are available for all known species of Orthoptera in British Columbia. The behaviour patterns of the more important species have also been recorded. While the distribution records were being obtained, series of all the species found in British Columbia were collected and deposited in the laboratory collection. The collection also includes representatives of nearly all other Canadian species. Intensive studies have been made of natural enemies and their effect on grasshopper abundance. The dipterous parasites have received special consideration and annotated lists of the many species have been published. Especially valuable have been the studies involving the relationship between range management and grasshopper abundance. These studies have resulted in much more general attention being paid to the rotation of cattle over grazing areas.

Bait investigations have resulted in a progressive reduction of baiting costs without loss of efficiency. The use of dried apple waste as a carrier with bran, was developed by the Kamloops laboratory. Diesel fuel oil for grasshopper control has been in use many years in British Columbia. More recently the value of chlordane and aldrin sprays has been demonstrated, as well as the more modern methods of application. A motor-driven bait spreader, especially adapted to the rough terrain of British Columbia range lands, was designed and tested by the Kamloops staff, and subsequently came into general use.

A world-famous type of grasshopper control organization, Grasshopper Control Zones, arose from the studies conducted soon after the establishment of the Vernon laboratory. In these zones, control is directed by a committee of ranchers, and the cost of bait materials and of hiring control crews, is collected as part of the land tax on all land within the boundaries of the organized "zone." This is of particular value in that it ensures control operations whenever and wherever needed. The Nicola Grasshopper Control Zone is a widely known, almost classic, example. In that zone, poisoning has been carried on annually for nearly 30 years with the result that no serious outbreak of grasshoppers has occurred there during that time.

Besides the many research contributions made to an understanding of grasshoppers and grasshopper control, assistance has been given the Provincial Department of Agriculture since 1918 with the organizing of control zones and extension work in connection with control.

Crickets. During the severe outbreak of *Anabrus longipes* Caudell in the Okanagan Valley in 1926, officers of the Vernon laboratory introduced, and demonstrated the value of, various types of barriers.

Cutworms. The Kamloops laboratory made observations in 1946 on the value of DDT dusts for cutworm control. At that time a survey of injurious species was begun as a minor project and is still in progress.

Bertha Armyworm. During 1928 the most efficient dilutions of calcium arsenate for controlling young and mature larvae of *Mamestra* (*Barathra*) *configurata* (Walker) were determined experimentally.

Wireworms. Detailed surveys conducted in a few fields in 1930 suggested that grass permitted a greater increase in wireworms than did alfalfa. On December 5 of that year, at Summerland, B.C., wireworms were still relatively close to the surface of the soil indicating that vertical migrations were probably dependent on weather conditions rather than being an inherent part of wireworm behaviour.

Onion Maggot. From studies of life history and behaviour in 1919 and 1920 it was learned that volunteer onions were selected for oviposition in preference to seedling onions. From these observations and experiments based on them it was concluded that "the value of a trap crop in the control of the onion maggot is very great." At the same time it was learned that off-type, short-necked onions were used very little for oviposition, suggesting possibilities for breeding resistant strains. During that period it was concluded that molasses-sodium arsenite baits were most effective in controlling adults of the species. Experiments during 1950 indicated that lindane surface treatments, aldrin surface treatments, chlordane trench treatments, and DDT seed treatments could be used to replace the more expensive calomel seed or surface treatment.

Cabbage Root Maggot. Extensive experiments in 1919 and 1920 proved that mercury bichloride surface treatments were superior to tarred felt discs.

Colorado Potato Beetle. As a result of the observations and advice of the Field Crop Insect Laboratory, Vernon, an intensive control programme was initiated by the Provincial Department of Agriculture in 1923 in an effort to prevent the spread of the species to other, non-infested districts. Although some spread has occurred since that time, the pest does not occur west of the Similkameen Valley, and in the Okanagan Valley it does not occur north of Penticton.

In addition to experimental work on control, and advice regarding control operations that might restrict the spread of the beetle, the staff of the Vernon laboratory co-operated with the Provincial Government to a considerable extent from 1922 to 1930 in the allocation of insecticides, extension work, and in making a survey of its distribution.

Potato Tuber Flea Beetle. Modifications of R. Glendenning's recommendations for control of the tuber flea beetle have been worked out experimentally, beginning in 1947, for the interior of the province. Differences in life history have also been determined. The 1950 experiments indicated that much time, and possibly considerable expense, could be saved without loss of efficiency by a single application of one of the newer synthetic insecticides to the soil.

Pollinators of Vegetable Seed Crops. During 1918 a study was made of insects observed visiting the flower heads of onion, carrot, beet, mangel, parsnip, and radish, and numerous species were listed.

Pests of Vegetable Seed Crops. A list of insects injurious to vegetable seed crops was prepared from field observations in 1918. Thirty years later the study was resumed. The amount of damage caused by a new pest, *Lygus campestris* (L), was determined experimentally and control methods demonstrated. A study of this pest is being continued and observations have begun on mites and plant lice.

During the years 1943 to 1948 an excellent collection of wild bees, especially leaf-cutter bees and bumblebees, was built up in the laboratory. This now serves as an index to possible pollinators of a wide variety of seed crops.

Collection of insects. An extensive collection of wasps was made during the years 1943 to 1948 and is now available in the laboratory for reference purposes.

During the period 1932 to 1944 dragon-flies were collected intensively and excellent series of all known B.C. species were placed in the laboratory museum.

In the course of work to determine the vector of witches' broom of potatoes an excellent collection of Cicadellidae of the northern Cariboo has been brought together.

Records of Insect Damage. Records of damage by insect pests have been kept since the inception of the field crop insect investigations in the interior of British Columbia 1918.

FIFTY YEARS OF PLANT QUARANTINE LEGISLATION AND ACTIVITIES IN B.C.

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Agriculture means so much to Canada today that any regulatory measures that will provide added protection against foreign pests and diseases are readily complied with by the importing public. But I can remember the time when these import restrictions were not accepted with the same good grace, and a quarantine officer was apt to become as popular as a skunk in a parlor if his middle name was not "Diplomacy." The people of British Columbia should be very grateful to those early quarantine workers who, even at the risk of this unpopularity, had vision enough to establish rules and regulations for this purpose and, as this is a Jubilee meeting commemorating history and progress of our Society in all its various phases, it would seem appropriate that we remember them in these records.

In 1893 the Government of the Province of British Columbia passed what was known as the "Horticultural Board Act." Members of this Board were the Hon. J. H. Turner, Minister of Agriculture; Jas. R. Anderson, Deputy Minister of Agriculture; R. M. Palmer, Thomas Cunningham, and Thomas G. Earle. Many of you will remember some of these men and their sterling qualities.

At a meeting of this Board held December 7 of that year R. M. Palmer was recommended for the position of inspector of fruit pests and, in the following year, he assumed the office and held this position until 1902, when Thomas Cunningham succeeded him. Cunningham was the inspector of fruit pests until March, 1916, when W. H. Lyne assumed charge and was responsible for this work from then until July 31, 1933, at which time all plant quarantine activities then supervised by the Provincial Department of Agriculture were transferred to the Division of Plant Protection, Dominion Department of Agriculture. This, then, is the record of those early appointments. In 1894 rules and regulations made and published under the authority of Section 7 of the Horticultural Board Act constituted the first provision for the inspection and treatment of imported nursery stock and horticultural plant products.

Plant quarantine rules and regulations have undergone many revisions since that time. This was to be ex pected. The international picture of pest and disease problems is more readily available today. International conferences held over the years have brought about a better understanding of the quarantine regulations and requirements of the various countries with general co-operation resulting.

ACTIVITIES

There has not been much change over the years in the principle of plant quarantines in Canada, but the scope of such activities has naturally been broadened to meet the new problems as they arise. In the early years of plant quarantine work in British Columbia most of the activities were tuned to cover the inspection and certification of imported plants and plant products, but Canada today is an exporting country as well and, naturally, the protection of our foreign trade in horticultural and other agricultural products is just as important as the protection of Canadian agriculture from foreign pests and diseases.

Many of our members are conversant with the work of this Division but, for the benefit of our visitors, the following might be recorded as some of the activities carried out in British Columbia:—

1. *Imports of plants.* I have not the figures of some of the early years covering the amount of imports in this

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connection, but the growth in this trade has expanded with the growth of Canada's population and improved standard of living. This year (1950-51) over 9,000,000 plants were imported into British Columbia. During the examination of this nursery stock some 33,000 plants were intercepted and treated or destroyed on account of pests or diseases.

2. *Inspection of passengers' baggage.* This activity applies mainly to the examination of the baggage of passengers arriving via ship and airliner. It will not be surprising to learn that the greater number of passengers are now travelling via air and that we have lost some of our palatial ships which used to ply between the Orient and Vancouver, as well as "down under."

3. *Introduction of live insects, plant disease organisms, etc.* This is a phase of our work which needs watching very closely, for live insects as a whole are not permitted entry unless for special scientific reasons. Most of this is for investigational and experimental purposes, and it covers not only all stages of insect life, but bacterial and fungus cultures as well. Import permits from this Division are required, and all importations are screened by collaborators.

4. *Imports of plant products.* This type of work is made much easier now due to the fact that by the use of fumigants, we are able to safeguard the country from inroads of certain pests that are found on such imports. We know more of insecticidal gases today, and their effects on various plant products. Stored product inspections and related investigations are carried on by this Division.

5. *Export of plants and plant products.* You will not be interested in figures on export of plants and plant products, but it will be sufficient to say that this work is gradually growing. Canada, as an exporting country, is finding a market in foreign lands and all exports of this type must be certified to comply with regulations of the importing countries. Previous to the war, 209 countries and their protectorates required certification, and it will be interesting for you to know that there were 84 different types of certificates to be made out to meet stipulated requirements of these countries.

6. Bulb certification in British Columbia is a new feature to our general work. The British Columbia Bulb Growers' Federation asked for an inspection service to cover the production of tulips, narcissi, iris, and hyacinths, which service has been provided since 1949.

7. *Ship inspection.* In line with the promotion of Canada's exports, all ships' holds which may be carrying grain or cereal products from Canada are examined prior to loading in accordance with regulations under the Destructive Insect and Pest Act and, if necessary, the ship is treated, either by fumigation or spraying. During the past fiscal year 505 ships were examined in Vancouver and New Westminster, of which 71 were fumigated and 54 sprayed. Canada is the only country in the world which provides a special service of this nature.

8. *Field projects.* Oriental fruit moth survey work has been carried on in the Okanagan Valley during the past several years. There is still no record of an outbreak of Oriental fruit moth in this province.

Inspection of fruit has also been a feature of our work. In the Okanagan the San Jose scale has created a condition whereby certification for export to certain countries might be prohibited. The British Columbia Fruit Growers' Association and the Provincial Department of Agriculture contributed financially to an annual survey supervised by this Division.

Finally, there is our general nursery inspection. This is done as an additional check to locate outbreaks of insects or diseases on our home grown stock. Such inspection, however, does not constitute the only basis of our certification work for the export of such products. Each consignment is examined when exported, but those early examinations of our nurseries do give us a lead on some of the problems that we might expect.

9. *Seed potato certification.* The only officially recognized seed potatoes in Canada are those duly certified from crops examined by inspectors of the Division of Plant Protection. In British Columbia, which ranks third in production by provinces, the work is carried out under the direction of H. S. MacLeod.

THE 1951 STATUS OF OUR KNOWLEDGE OF THE INSECTS OF BRITISH COLUMBIA

G. J. SPENCER
University of British Columbia

When putting in a plea several years ago for further collecting to be done in all Orders in this Province, I outlined before this Society, an approximate estimate of the numbers of species recorded up to that time. It seems in order now to take stock again and to record as far as one can, what half a century's collecting has produced in this Province which contains a larger and more varied insect fauna than any other part of Canada.

There are three ways in which fairly correct estimates can be made of the known British Columbian insects:—(1) by searching all published records, (2) by working over the material in the Canadian National collection, where material collected by officers in British Columbia of the Division of Entomology has been sent for many years and (3) by arranging, identifying and listing, collections now existing in this Province.

In the list of references, I have assembled all records of collections, but until an Entomologist is sent from this Province to spend many months going over the National collection and noting all British Columbia records, it will be many years before the lists can be compiled from that source. In the case of even one genus or even one family, one of the systematists at Ottawa might have time to write out the records, but to get these records in all Orders, would be a great task.

The best that I can do at this time, is to go down the list of Orders and to indicate what effort has been put on each one.

THYSANURA. Bristle-tails. Our indigenous fauna has distinctly separated, coastal and dry belt species which do not overlap. In all, I had some seven species which were sent to Dr. Silvestri at Portici, Italy, before the second world war. Correspondence before, during and after the war, failed to get identifications and now that that great man is dead, collections of Thysanura will have to be made all over again and submitted to some other authority.

APTERA. The order is represented by at least one species of native Campodeidae, not uncommon in forest duff and leaf mould in the vicinity of Vancouver and by possibly two species of Japygidae, a dry land form recorded by Saunders from Victoria in 1946 (*Evalljapyx sonoranus* Silv. 1911, previously recorded from Tucson, Ariz.), and another which occurs in rich garden soils around Queen Charlotte City. Mr. R. Guppy recently sent me one specimen from Wellington, Vancouver Island.

The **COLLEMBOLA** are practically untouched and sadly need attention. The only records are of those collected by J. D. Gregson from the Kamloops region and some of my own collecting at the Coast, whose list and identifications of 16 species were published in our Proceedings *44*, 1948.

The **ORTHOPTERA** sens. lat. has been well studied and recorded by Ronald Buckell. There are probably between 110 and 120 species in the Province of which extensive series are placed in the National collection, the Provincial Museum at Victoria and in the Dominion Laboratory in Kamloops. About 80 species are in the University collections. An insect that needs further attention is the readily accessible *Grylloblatta* at Kamloops. discovered by Gregson in 1938 and kept in captivity and partly written up by M. G. Campbell. I feel certain that diligent search in the Interior, of talus slopes similar to those at Kamloops where this insect occurs, will reveal a wide distribution of *C. campodeiformis* in the Province

The **DERMAPTERA** or earwings have been recorded by R. Buckell in his paper "The Dermaptera of Canada," 1929. Of the five species that he has recorded in this Province, only one, *Labia minor* may be indigenous: the rest are immigrants.

The **PLECOPTERA** or Stoneflies of the Cultus Lake region and southwestern British Columbia have been well written up by Ricker, but collections of these insects from further north, especially from cold mountain streams and higher latitudes, are badly needed. With Ricker and Ferris Neave, specialists in this Order, being both stationed at the Biological Station at Departure Bay, identifications can be readily obtained. All material should be preserved in 70% ethyl alcohol, not pinned.

Of the **ISOPTERA** or Termites, only three species have been found in British Columbia, two at the Coast and one in the Interior: on Vancouver Island, all three species occur. They have been written up by Beall and by Spencer in our Proceedings, but the best work on them was done by the late Kenneth Jacob as a huge Master's thesis at the University. Steps are being taken to have at least a portion of this work published.

Of the **CORRODENTIA** less than 20 species have been taken and are now in the University collections. They were named by Miss (Dr.) K. M. Sommerman of the United States National Museum.

The **MALLOPHAGA** or bird lice are represented by a very large collection, part at the Ontario Agricultural College and part at the University. I have published two short lists of species. Steps are being taken to get all the collections named: it will make a pretentious list.

The **ANOPLURA** or sucking lice are represented by about 25 named and several unidentified species at the University. I search almost all the mammals and birds that are taken for the University, but the collections grow slowly; not many species occur that have not already been taken, in both of these Orders of lice.

Of the **ODONATA** of British Columbia, the first list was published by R. C. Osburn in 1905; since then the Order has been well covered by E. M. Walker, F. C. Whitehouse and R. Buckell. Some 78 species have been recorded for the Province. Dr. Walker's material is at the Royal Ontario Museum in Toronto; Mr. Whitehouse divided his collection between the Provincial, Vancouver City and University Museums and the Buckell collection in vials of 95% alcohol, is at the University.

The **THYSANOPTERA** or thrips, were collected only by the late R. C. Treherne, who published two papers on the Aeolothripidae, but did not put out a list of British Columbia species. His collections are in the National collection, Ottawa. As far as I am aware, there are no collections of this Order in the Province beyond about a dozen species at the University.

HEMIPTERA-HOMOPTERA. Of the Hemiptera, H. M. Parshley published a short list in our Proceedings in 1921, but most of the collecting of both sub-orders has been done by W. Downes, whose collection of over 13,000 specimens covering about 800 species, is at his home in Victoria. He has published extensive lists in our Proceedings. Venables has published a list of British Columbia Coccidae. That much more work needs to be done, at least on the Homoptera, is shown by a list of over 100 species taken in the last four years from Quesnel and Soda Creek during a search for vectors of Witches' Broom on potatoes. Dr. B. P. Beirne who named the collection, tells me that four-fifths of the species are not represented in the National collection: this material is all at Ottawa and in the Dominion Laboratory at Kamloops. The Aphids of the Province have been written up by Mr. R. Glendenning and by Alice Macdougall, whose doctorate thesis on the Aphids of British Columbia is at the University of Toronto. In this work she states that about 170 species are recorded from British Columbia. Efforts are being made to have her thesis brought up to date and published. Her collections on over 1100 slides and a large amount of material in alcohol, was donated to the University by her husband, Mr. Patterson, when Alice died.

Of the **NEUROPTERA** sens. lat. I reported 54 species and 10 varieties in our Proceedings of 1942. Our two biggest families are the Chrysopidae and Hemerobiidae. A number of additional species have been collected, but not yet named. The material is all at the University.

Of the **MECOPTERA**, only two species have been named both from the Kootenays, by the late J. W. Cockle. Our Provincial forms are entirely wingless. The minute "Snow Flea" *Boreus*, occurs sparsely on the north shore mountains near Vancouver.

TRICHOPTERA or Caddis flies. Dr. H. H. Ross of Illinois has recorded 142 species from all sources, for this Province. Much of the material upon which his list is named, is at the University and he tells me that at least another 100 species should occur in our borders. Material should be collected in 70% alcohol, not pinned.

Of the **LEPIDOPTERA**, about 1,338 species represented by 9,953 specimens of Macros and Micros, are at the University, purchased from the estate of the late E. H. Blackmore, but many species recorded in Blackmore's check list of 1927, are missing from the collection. A few additional species have been added as they came to hand. The National collection at Ottawa has a large representation from British Columbia collected by Dr. J. McDunnough and the United States National Museum has 2,000 specimens from the Blackmore collection which Mrs. Blackmore gave or sold to Gates Clarke and he later gave them to the Museum when he joined that institution. The Provincial Museum at Victoria has a good display of

Lepidoptera, named to species. Another large collection is that made by Dr. W. R. Buckell, in the Salmon Arm district. This perfectly mounted collection of 773 species (541 Macros and 232 Micros) is in Ronald Buckell's home in Salmon Arm. Mr. J. R. J. Llewellyn Jones of Cobble Hill has recently placed his fine collection of Macro-lepidoptera of 471 species from Vancouver Island, at the University on permanent loan. The most up-to-date check list of the Macrolepidoptera of British Columbia is that published by Mr. Jones in 1951 in which he records about 1,200 species, with the check list numbers and synonyms brought up to date. A collection of several hundred species of Macros was made some years ago by Mr. W. Downes. Of these, the Geometridee were turned over by him to Mr. Llewellyn Jones. The remainder, consisting of about 400 species from both the Interior and Vancouver Island, is at his home in Victoria.

The **COLEOPTERA.** Until recently the best collection extant of British Columbia species was that of Gordon Stace-Smith of Creston, who has between 2,100 and 2,200 species from this Province. The huge Ralph Hopping collection at Vernon was willed to the California Academy of Sciences and since that institution received also the Hugh Leech collection of water beetles, it now has probably the best representation of British Columbia species. This University has about 2,000 species arranged in 36 Cornell drawers by George Hopping, about three-quarters of them being from this Province. Professor M. Hatch of the University of Washington in Seattle has over 400,000 specimens in his collection, mainly from the Pacific Northwest including material from British Columbia. Since Dr. Hatch has exchanged records with Stace-Smith and has examined all our University material (which includes specimens from Mrs. Hippesley Clarke), his forthcoming book on "The Beetles of the Pacific Northwest" should list fairly well, most of those that have been taken in this Province. Published lists of Coleoptera from British Columbia include those of Reverend J. H. Keen, G. A. Hardy R. H. Harvey, Mrs. Hippesley and Mrs. Clarke (formerly Hippesley). Kenneth Auden's B.A. thesis (unpublished) in the Department of Zoology, consists of a list of about 400 species from the Midday Valley near Merritt, B.C.

The **STREPSIPTERA** remain untouched. Hugh Leech found stylopized bees freely in the arboretum on our campus, but no one has worked on the Order.

The two large Orders, Hymenoptera and Diptera, both strongly represented in the Province, are virtually untouched except for lists of a few families.

HYMENOPTERA. The earliest numbers of our Proceedings contained short lists, but the names are out of date. The University collections have probably the largest number of specimens in the Province, partly separated into Families, most of it unnamed to Species. Outstanding are Buckell's distributional lists of the Ants, Megachilidae, Andrenidae and Bombidae. Buckell and Spencer have listed all the Vespidae that probably occur in British Columbia and Spencer and Wellington the Sphecidae. Many Sawflies and Horntails have been collected and named, but no lists have been published. Foxlee and Guppy have listed some of the Ichneumonidae. Buckell's collections are at Kamloops.

The **DIPTERA** are in much the same condition. After the work and early listings by the founders of our Society, followed by Osburn on Syrphidae, Sherman on Chironomidae, Garrett on several families, Hearle on mosquitoes and Spencer on Tipulidae and Dolichopodidae, little has been published. I have fairly extensive collections of Tabanidae, Syrphidae, Asilidae, Bombyliidae and Tachindae at the University, but only some 40 species of the Tabanidae have been named; many other families have been collected, but are less well represented.

The **SIPHONAPTERA** have been splendidly dealt with in Holland's "Siphonaptera of Canada" in which he lists 89 species for British Columbia. His several papers and two by J. Wagner deal fully with the Order. Brief earlier listings were made by Harvey and Spencer. Holland's book makes the fleas the best worked-up Order in British Columbia, if not in Canada. His huge series is at the National collection and he presented our University with an almost complete set of duplicates in balsam on slides. My collection of about 65 species named by the late Dr. J. Wagner of Belgrade, is also at the University.

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AN ANNOTATED LIST OF TRICHOPTERA COLLECTED ON SOUTHERN VANCOUVER ISLAND

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Although Trichoptera have been the object of considerable study, those of North America are not very well known. Faunistic data, in particular, are often lacking and many described species are unknown except for the type series.

In the hope of contributing a little to the knowledge of these insects we offer the following list of species collected on Southern Vancouver Island, B.C. These specimens were taken, over a period of three years, by the junior author. Where no other indication is given, the specimens were usually taken around the house and grounds, at lights, or by beating foliage. Many, however, were captured near streams or other bodies of water, which were evidently their natural habitat. As some of these places have no names we have adopted the following system of numbering.

(3) Small moderately rapid stream, permanent water, very shaded by bushes, at sea level.

(4) Nearly the same as (3), but often dry in late summer.

(6) Small rapid stream, with still pool, very clear, gravelly bottom, permanent water.

(7) More rapid than (6). Most collecting on this stream was carried out along a stretch running over a shelf of solid rock, with many small "pot holes" created by erosion.

(10) Small shallow muddy pools at about 900 feet elevation, thickly grown with sedges, always dry in summer.

(11) Very small stream falling over steep rock cliff. Water seems to be permanent, though very low in summer.

For other streams along which some collecting was done, we have used the names found on maps of the district.

RHYACOPHILIDAE

Rhyacophila angelita Bks. Fairly common in July. Wellington (4), Nanaimo, Chase R., Englishman R. Falls, Aug. 26, 1950.

R. grandis Bks. Very common, June to Oct. Wellington (3, 4, 7), Nanaimo, Chase R. and Millstone R.

R. norcuta Ross. Common. Forbidden Plateau, Aug., Englishman R. Falls, Aug. 26, 1950. Wellington (7), June and Oct.

R. oreta Ross. Common. Wellington (7), Mt. Benson, Sept. 19, 1950, Englishman R. Falls, Aug. 26, 1950.

R. vaccua Milne. Very common, July to Oct. Wellington (6, 7), Englishman R. Falls, Nanaimo, Chase R, Nanoose Creek, Nanoose Bay, Mt. Benson.

R. vaefes Milne. Wellington (7), June 15, 1950, 2♂♂.

R. verrula Milne. Common. Wellington (6, 7, 11), June and Oct., Englishman R. Falls, Aug. 26, 1950.

R. vuzana Milne. Fairly common, July and Aug. Wellington (4, 11), Nanaimo, Chase R., Englishman R. Falls.

Glossosoma penitum Bks. Wellington (3, 11), June 13, 1950, 2♂♂ and 2♀♀.

Palaeagapetus guppyi Schm. Mt. Benson, Aug. 19, 1949, 1♂.

PHILOPOTAMIDAE

Dolophilodes pallidipes (Bks.). Mt. Cokely (Arrowsmith) Aug. 10, 1948, 1♂. Forbidden Plateau, Aug. 1950, 1♂ and 1♀.

D. dorcus (Ross). Wellington (10), July 27, 1950, 1♂ and 1♀.

Wormaldia gabriella Bks. Very common. Nanaimo, Chase R. and Millstone R., Sept.-Oct. 1950.

PSYCHOMYIIDAE

Polycentropus variegatus Bks. Wellington (4), June 30, 1949 and July 4, 1950, also occasional specimens late July through Sept.

P. flavus Bks. Forbidden Plateau, Aug., 1950, 4♂♂.

P. interruptus Bks. Very common. Wellington, July-Aug.

P. remotus Bks. Forbidden Plateau, Aug. 1950, 2♂♂ and 2♀♀.

LEPTOCERIDAE

Triaenodes baris Ross. Wellington, July 21, 1949, July 27, 1950.

Mystacides alafimbriata H-Gr. Forbidden Plateau, very common, Aug. 1950.

LIMNEPHILIDAE

Colpotaulius secludens Bks. Wellington, Aug. 1, 1948, 1♀.

Grammataulius betteni Griff. Wellington, occasional in Sept. and early Oct.

Limnephilus externus Hag. Fairly common, Wellington (11), Sept. 28, 1950, and at light mid July through Sept.

L. fuscoradiatus Schm. Forbidden Plateau, Aug., 1950, 1♂ and 1♀.

L. harrimani Bks. Very common, Wellington, Aug.-Sept.

L. insularis Schm. Wellington, Sept. 28, 1948, 1♂; Sept. 23, 1949, 1♂.

L. indivisus Walk. Wellington, June 25, 1948, 1♂; Sept. 10, 1948, 1♂.

L. lopho Ross. Forbidden Plateau, Aug., 1950, 1♂ and 1♀.

L. nogus Ross. Wellington, extremely abundant during Sept. and Oct. Coloration of this species is rather variable.

L. sericeus (Say). Wellington, fairly common in late Sept.

L. sitchensis Kol. Wellington, very common July to Sept. This species also is very variable in coloration.

L. occidentalis Bks. Wellington, rather scarce, Sept.-Nov., one specimen, June 21.

Lenarchus vastus Hag. Wellington, very common Aug. to Oct. Nearly all specimens were taken at light, hence are mostly females. Their breeding haunts were not discovered.

L. rho Milne. Wellington, rather rare, July to Sept. Ten specimens emerged from larvae taken from pool (10).

L. cinnamoneus (Schm.). Wellington, Aug. 12, 1948, 1♂.

Halesochila taylori Bks. Said to be rare, this species was common at Wellington in 1950, coming frequently to light during September and October. A short visit to a muddy lake in October netted about a dozen specimens. Some were bred from larvae taken from this lake, and from the partly caved-in well of the abandoned whaling station at Hammond Bay. The species evidently requires deep, still, permanent water, with abundant aquatic vegetation.

Clistoronia magnifica Bks. Wellington, Sept. 12, 1950, 1♂; Mt. Benson, June 11, 1950, 1♀. The natural habitat appeasr to be mountain lakes. On the Forbidden Plateau the species is very conspicuous during August, large numbers being on the wing each evening at dusk.

Clostoeca disjuncta Bks. Not common, Wellington May 11, 1949 and June 17, 1950; Mt. Benson July 5, 1949, 1♂.

Chyranda centralis Bks. Fairly common, Forbidden Plateau, Aug.

Hesperophylax designatus Walk. Wellington, Sept. 17-20, 1950, 2♀♀. Forbidden Plateau Aug., fairly common.

H. occidentalis Bks. Not common. Wellington, June 15, 1950, 1♂, also from (4) Sept.-Oct., 1948; Mt. Benson, June 11, 1950, 1♀.

Glyphopsyche irrorata Fabr. Fairly common, Wellington, March, April and early May. Goldstream, April 2, 1950, 1♀.

Psychoglypha ulla (Milne). Very common, Wellington Sept.-Oct. and March-April. Reared from (3).

P. bella (Bks.). This species is difficult to collect; it is reluctant to take wing, stays close to its breeding haunts, and never comes to light. Specimens were reared from larvae taken from (6) (emergence date Nov. 9, 1948), and from French Creek (emerged Oct. 17, 1949). Adults were collected at (7) Aug 21, 1949, and Nanoose Creek, Oct. 19, 1949. Larvae were found in still, clear, gravelly pools, when the streams were low in summer.

P. alascensis Bks. Wellington, fairly common in Oct. Two specimens emerged from French Creek, larvae along with the *P. bella* specimen above.

Neophylax rickeri Milne. Common, Wellington, Nanaimo, Chase R., Nanoose Creek, Sept.-Nov.

Ecclisomyia conspersa Bks. Wellington (7), common in May; Forbidden Plateau Aug. 1950, 2♀♀.

Cryptochia pilosa Bks. Wellington (3), June

Apatania sorex Ross. Wellington, June 8, 1950, 1♀.

Dicosmoecus gilvipes (Hag.). Wellington (7) and Millstone R. Oct. 12, 1949, 6♂♂; Nanaimo, Oct. 8-15, 1949, and Sept. 26, 1950.

D. nigrescens Bks. Wellington, Sept. 14, 1950, 1♂ at light, (11) Oct. 13, 1950, 1♀.

D. tristis Bks. Wellington, Millstone R., Englishman R., French Creek, Nanaimo, Chase R., Common, late Aug.-Oct., close to large permanent streams, never taken elsewhere.

LEPIDOSTOMATIDAE

Lepidostoma cascadensis (Milne). Wellington, June 15, 1950, 1♂.

L. hoodi Ross. Wellington, Aug. 24, 1949, 2♂♂.

L. jewetti Ross. Wellington, Aug. and Sept., not rare; Nanaimo, Millstone R., Sept. 26, 1950. Englishman R., Aug. 1, 1950.

L. quercina Ross. Wellington, June 4, 1949, 1♂.

L. roafi (Milne). Very common in Sept., Wellington, Nanaimo, Millstone R.

L. rhino Ross. Wellington, July 10, 1950, 1♂.

L. strophis Ross. Wellington, Sept. 17, 1949, 1♂.

L. unicolor (Bks.). Wellington, fairly common in Aug. and Sept.

A PRELIMINARY LIST OF THE TRICHOPTERA OF BRITISH COLUMBIA

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This list records 142 species of Trichoptera from the Province of British Columbia, but the caddisfly fauna of British Columbia probably contains a good 100 species more. Records to date are chiefly from the southwestern and south-central parts of the Province, and in the main, from lower elevations. Large numbers of species known from neighboring mountains in Washington, Montana, and Alberta, as well as many other species, will undoubtedly be taken in British Columbia with future collecting.

A faunal analysis of the British Columbia caddisflies brings out several interesting points. In southern British Columbia there occurs a curious mixture of two large and distinctive elements, the transcontinental northern fauna and the western montane fauna. In the West the former extends little south of the Canadian boundary. Also emphasized by many species is the distinctive nature of the Cascade fauna in comparison with that of the eastern ranges.

Quite a number of species belong to closely-knit complexes composed of geographically isolated units. Included in this list are *Limnephilus sylviae,* and *Glossosoma wenatchee.* More information on the distribution of these and other species will be of tremendous help in unraveling the story of species genesis on the North American continent.

The largest single set of records comprises the collections made by Dr. W. E. Ricker at Cultus Lake. To Dr. Ricker and many others who have made material available we wish to express our sincere gratitude.

FAMILY RHYACOPHILIDAE

Includes only rapid stream or cascade inhabiting species.

Genus *Rhyacophila* Pictet

R. angelita Banks. July 3 to Nov. 24; Courtenay, Cowichan L. (Cowichan R.), Cultus L., W. of Hope (Silver Cr.). Western, widespread through the montane region.

R. bifila Banks. July 9 to Aug. 10; Cultus L., W. of Hope (Silver Cr.), W. Vancouver (Capilano R.), Vernon, Walhachin. Widespread through the western montane region.

R. coloradensis Banks. Aug. 10 to Oct. 11; Cultus L., W. of Hope (Jones Cr.), W. of Hope (Silver Cr.). Widespread through the western montane region.

R. grandis Banks. June 14 to July 15; Bon Accord, Cultus L., Vancouver (stream on Marine Drive), Vernon. Common in the Cascade and coastal regions from Ore. to B.C.

R. inculta new species.

Male.—Length 12 mm. Head and body various shades of dark brown, antennae and legs paler; wings dark brown with a purplish tinge.

Male genitalia as in fig. 1. Ninth segment nearly cylindrical, with the dorsal area wider than the ventral and bearing a pointed mesal projection extending above and over the base of the tenth tergite. Tenth tergite divided into a pair of thick, blade-like lobes held vertically, without other structures. Claspers with basal segment fairly long, wide at base and narrowed at apex, the ventral margin sinuate; apical segment of moderate size and definitely foot-shaped, the heel rounded and the toe robust. Aedeagus consisting of a mesal tube on each side of which is situated a membranous tubular arm ending in a pad bearing minute setae; these arms are extensile and when stretched out are longer than the claspers.

Female.—Slightly larger than male but similar to it in color and general structure. Eighth segment moderately long and wide, tapering from base to apex, this apical margin somewhat irregular and without conspicuous features. Spermatheca fairly long and wide, almost entirely membranous but with a few semi-sclerotized areas in its wall.

Holotype.—Male; Cultus Lake, July 23, 1936, H. H. Ross. INHS. *Allotype*.—Female; Cultus Lake, May 18, 1933, W. E. Ricker. INHS. *Paratypes*.—B.C.: Cultus Lake, same data as holotype, 2♂♂; various dates, W. E. Ricker, 25♂♂; 20♀♀; Vancouver, tributary of Lynn Creek, July 20, 1936. H. H. Ross, 1♂, 1♀. OREGON: Big Creek, Clatsop Co., Aug. 31, 1946, S. G. Jewett, Jr., 1♂; Clatskanie, May 9, 1936, K. Gray and J. Schuh, 9♂♂, 7♀♀. Deposited with the holotype and in the collections of the University of British Columbia, Canadian National Collection, and Oregon State College.

This is the species referred to by Ross (1938[1]) and others as *brunnea* Banks. The holotype of *brunnea* is a female from New Mexico and according to our present knowledge of the distribution of this group it is highly likely that it applies to *acropedes* Banks, which might, therefore, ultimately prove to be a synonym of *brunnea*. Rather than make this change, it seems better to await material from the type locality before making a decision as to the exact placement of *brunnea*. The Cascade species which has been recorded under the name *brunnea* is the species here described as *inculta*. It is a sister species of *vao* Milne and *acropedes*, differing from the former in the long projection of the ninth tergite, and from the latter by the more robust, deeper claspers. There is still some uncertainty as to the ultimate distinction between the Cascade species *inculta* and the more eastern *acropedes*. It is noteworthy, however, that *inculta* and *vao* occupy the same range, and are readily separated. Whatever the problem it seems certain that its analysis will be furthered by the retention of the species concept of *inculta*.

1 Ross, H. H. Psyche, 45:1-61, 1938.

R. norcuta Ross. March 13 to 27; Cultus L. Reported from western Calif., Ore., Wash., and B.C.

R. oreta Ross. March 27 to Oct. 12; Cultus L. Previously reported from Utah, Calif. and Ore.

R. perda Ross. July 26; Cultus L. Previously known from western Ore. and Wash.

R. perplana new species

Male.—Length 9.5 mm. Head and body light brown, antennae and legs lighter, the legs nearly straw-color; wings light brown with purplish tinge.

Male genitalia as in fig. 2, in general shape and proportions similar to *angelita* Banks. Tenth tergite forming a curious, angled structure which, when cleared and extended, appears as in fig. 2*a*. The dorsal portion is short and blunt, with a v-shaped apical incision of moderate depth; ventral arm flat. Beneath it articulate the two trianguloid sclerites which are connected with the dorsal tendon of the aedeagus. Claspers with basal segment fairly long and of uniform width, apical segment with a very rounded heel and blunt toe, the toe not extended as a finger-like process. Aedeagus almost exactly as in *angelita*, with the apex of the lateral flap almost lanceolate (it is obovate in *vuzana* Milne).

Holotype.—Male; Cultus L. South Cr., B.C., Nov. 1, 1936, W. E. Ricker, INHS.

This species belongs to the *angelita-vuzana* complex. From the former it differs in the short dorsal lobe of the tenth tergite which is very similar to that of *vuzana*; from *vuzana* it differs in the short apical segment of the clasper, the elongate apical lobe of the aedeagal arms, and the flat ventral arm of the tenth tergite, all of which resemble *angelita*. Since all three species occur at Cultus Lake, it was suspected at first that the specimen of *perplana* might be a hybrid, but examination of the material showed a consistency of characters which suggested that this was a very unlikely possibility. It seems more reasonable, with the information at hand, to consider that the progenitor of the complex was divided to form first the two species, *angelita* and a species very similar to *perplana,* and that, subsequently, the latter species was again divided to form *perplana,* which remained relatively unchanged, and *vuzana,* which developed additional differences in claspers and aedeagus.

R. tucula Ross. Aug. 25 to Sept 14; Chilliwack L., Cultus L. (along Chilliwack R.), Silver Creek. Recorded from B.C., Ore., Wash., and Wyo.

R. unimaculata Denning. April 16; Robson. Known only from this locality.

R. vaccua Milne. July 19 to Sept 14; Cultus L., Fitzgerald, Keremeos (Shingle Cr. Rd.), N. Vancouver. Widespread through the northern part of the western montane region.

R. vaefes Milne. Aug. 25; Cultus L. Known from B.C. and Ore.

R. vagrita Milne. Aug. 24; Cultus L. Known only from southern B.C.

R. valuma Milne. July 23 to Aug. 25; Cultus L. Known from the Cascade and coastal region.

R. vao Milne. May 20 to Aug. 9; Cultus L., Manning Park (Upper Skagit R.). Known from the Cascade region from Wash. to Alaska.

R. vepulsa Milne. May 22 to Aug. 9; Cultus L., Manning Park (Similkameen R., Allison Pass, 4500 ft.), Stave Falls (Steelhead Cr.). Known from the western ranges from Calif. to B.C.

R. verrula Milne. Aug 12 to 28; Cultus L. Widespread through the western montane region.

R. visor Milne. Aug. 12; Cultus L. Known only from a few localities in the Cascades from Ore. to B.C.

R. vobara Milne. Aug. 12; Cultus L., Revelstoke Mt. Known only from B.C.

R. vocala Milne. July 14 to Aug 16; Cultus L., Fernie, E. of Hope (17 mi. Cr.). Known from the Cascades from Ore. to B.C.

R. vujuna Milne. Aug. 9; E. of Hope (17 mi. Cr.). Known from B.C. and Ore.

R. vuzana Milne. Sept. 9; Cultus L. Known from B.C., Ore. and Calif.

Genus *Anagapetus* Ross

A. bernea Ross. Aug. 9; E. of Hope (17 mi. Cr.). Known from the Cascades in B.C. and Wash.

Genus *Glossosoma* Curtis

G. penitum Banks. June 10 to Aug. 10; Burnaby, E. of Chilliwack (Cheam View), Cowichan L., Cultus L., Peachland, Stave Falls (Steelhead Cr.), N. Vancouver. Occurs chiefly in the Cascades from Ore. to B.C.

G. pyroxum Ross. July 6; Port Coquitlam (Coquitlam R.). Known from B.C. and Ore.

G. velona Ross. April 4 to Nov. 14; Cultus L., N. of Ft. St. James (Middle R., 14 mi. from mouth). Widespread through the western montane region.

G. wenatchee new species.

Male.—Length 9 mm. Color of head and body various shades of light brown, the legs yellow. Mesal process of sixth sternite blunt and round. Genitalia as in fig. 3. Hood large. Lateral plates of tenth tergite sinuate. Cercus elongate, constricted at base and forming a long curve ending in a long. slender, whiplike apical portion surmounted by a thin style; before this style the cercus bears only a few minute setae. Clasper with base greatly constricted, its dorsal margin slightly concave, its ventral margin moderately convex, the apex with a very short, blunt point; the entire clasper is flat and its ventral edge is not angled mesad. Aedeagus tapering to a narrowed apical portion, occasionally with a slight shoulder before the apical constriction but usually more like fig. 4.

Holotype.—Male; Cashmere, Wash., Wenatchee River, June 23, 1940, H. H. and J. A. Ross, INHS. *Paratypes*: WASHINGTON: same data as holotype, 3♂♂; Chiwaukum, Wenatchee River, June 24, 1940, H. H. and J. A. Ross, 1♂. OREGON: Maupin, Deschutes River, June 5, 1947, S. G. Jewett, Jr., 2♂♂. B.C.: Keremeos, Shingle Creek Road, Sept. 14, 1934, A. N. Gartrell, 3♂♂. Paratypes in the collection of the Illinois Natural History Survey, University of British Columbia, and the Canadian National Collection.

This species belongs in the *alascense* complex and is most closely related to *califica* Denning, from which it differs in the fairly broad apex of the clasper, the narrower aedeagus, and the rather low apex of the lateral lobes of the tenth tergite.

FAMILY PHILOPOTAMIDAE

As with the Rhyacophilidae, members of this family occur only in rapid streams or cold brooks.

Genus *Dolophilodes* Ulmer

D. aequalis (Banks). June 26 to Aug. 4; Hope, Keremeos, Princeton. Widespread through the western montane region.

D. dorcus (Ross). Aug. 9-10; Bowser (Cook Cr.), E. of Chilliwack (Cheam View), Cultus L., E. of Hope (11 mi. Cr.). Known only from the western ranges of B.C. to Ore.

D. pallidipes (Banks). July 26; Hedley (Mt. Apex, 6000 ft. el.). Known from B.C., Wash. and Ore.

Genus *Wormaldia* McLachlan

W. anillus (Ross). Jan. 15 to Aug. 10; Agassiz, E. of Chilliwack (Cheam View), Cowichan L., Cultus L., Stave Falls (Steelhead Cr.), N. Vancouver. Known from B.C.

W. gabriella (Banks). June 30 to July 23; Cultus L., Oliver, Sardis, Vancouver. Widespread through the western montane region.

FAMILY PSYCHOMYIIDAE

Most of the British Columbia species in this family are taken along rivers or lakes.

Genus *Neureclipsis* McLachlan

N. bimaculatus (Linnaeus). July 30; N. of Ft. St. James (Middle R. of Takla L.). Holarctic; widespread in the north, eastward to Illinois.

Genus *Polycentropus* Curtis

P. aureolus Banks. Aug. 6; Quesnel. Known previously from the north-central and northeastern parts of the continent.

P. cinereus (Hagen). July 20 to Aug. 2; Cultus L., Keremeos, Quesnel, Seymour, Vancouver, Vernon. Widespread over most of North America.

P. flavus Banks. June 23; Canim Lake. Transcontinental and northern.

P. interruptus (Banks). Aug. 23; Soda Creek. Transcontinental and northern; previously reported from Colo. to the Atlantic.

P. remotus Banks. July 23 to Aug. 23. Peachland. Transcontinental and northern.

P. variegatus Banks. June 14 to Aug.; Burnaby (Stoney Cr.), Cowichan L., Seton L., Vancouver, W. Vancouver (trib. of Capilano R.). Confined to the western montane region.

Genus *Nyctiophylax* Brauer

N. vestitus (Hagen). June 27 to Aug. 19; Bowen Island, Cowichan L., Cultus L., Keremeos, Peachland, Vernon, Victoria. Widespread over most of North America.

FAMILY HYDROPSYCHIDAE

The first two genera inhabit cascades, but the others are primarily river-loving species.

Genus *Arctopsyche* McLachlan

A. grandis (Banks). May 26 to Aug. 16; Cranbrook, Kaslo, Keremeos, Lillooet, Merritt, Seton L., Vancouver. Widespread through the western montane region.

Genus *Parapsyche* Betten

P. almota Ross. May 12; Cultus L. Known from B.C. and Ore.

P. elsis Milne. July 8 to Aug. 9; Cultus L., Jesmond, Lytton (Blue Lake), Manning Park (Similkameen R., Allison Pass, 4500 ft.), Revelstoke. Known from B.C. to Ore.

Genus *Hydropsyche* Pictet

H. amblis Ross. June 11; Mons (Alta L.). Known from B.C. and Ore.

H. californica Banks. Aug.; Cowichan L. Widespread through the western montane region and recorded from Minn.

H. centra Ross. May 27 to June 20; Lillooet (Seton Lake). Known from B.C. and Ore.

H. guttata Pictet.
H. separata Banks, 1936, Psyche, 46:126. *New synonymy.* July 11 to 30; Chilliwack, Kamloops, Rosedale. Holarctic; in North America extending from B.C. to N.Y., northern. Material from North America has been compared with specimens from Switzerland and Russia and found virtually identical with them.

H. occidentalis Banks. June 9 to Aug. 13; Canim L., Cultus L., Lillooet (Seton L.), Nelson, Oliver, Sardis. Widespread through the western montane region.

H. oslari Banks. June 9 to Aug. 27; Chilliwack, Jesmond, Lower Post, Nicola, Oliver, Quesnel, Soda Creek. Widespread through the western montane region.

H. riola Denning. June 23; Canim L. Transcontinental, northern.

Genus *Cheumatopsyche* Wallengren

C. analis (Banks). July 4 to Sept. 11; Agassiz, Nicola, Vancouver (Beaver Cr.). Widespread over most of North America.

C. campyla Ross. June 19 to July 9; Cowichan L., Seton L., Walhachin. Widespread over most of North America.

C. gracilis (Banks). June 28 to Aug. 16. Lower Post, 100 Mile House. Transcontinental, northern.

FAMILY HYDROPTILIDAE

This family comprises the microcaddisflies, most of which are less than 3mm. long, although some reach a length of 6 mm. They occur in a variety of habitats.

Genus *Agraylea* Curtis

A. multipunctata Curtis. July 24 to Aug.; Chilliwack, Cowichan L. Holarctic; widespread across northern North America.

Genus *Ithytrichia* Eaton

I. clavata Morton. July 23; Cultus L., Sardis. Transcontinental, widespread.

Genus *Oxyethira* Eaton

O. serrata Ross. July 31 to Aug.; Cowichan L., N. of Ft. St. James (Middle R. of Takla L.). Transcontinental; previous records from east of the Rockies.

O. sodalis new species.

Male.—Length 2 mm. Color speckled gray, general structure typical for genus. Male genitalia as in Fig. 5. Lateral portion of posterior margin of eighth segment deeply incised just below mid-line; anterior margin of segment with a wide, fairly deep invagination. From beneath the dorsal margin of the incision on the apical margin there arises a curious process which is very large at the base and narrows rapidly to a curved, long apical portion; this enlarges slightly at apex and gives rise to a single long seta which curves back over the top of the ninth segment. Ninth segment with dorsal portion distinct, its posterior margin crenulate; ventral portion ending in a fairly wide apical plate tapering to a sharp point at apex; segment only moderately invaginated within the eighth. The lateral portion of the ninth bears, on each side, a pair of finger-like processes which diverge at their tips. These two processes are fused at the base and may represent the clasper, which is, otherwise, unaccounted for. Subgenital plate heavy and hook shaped. Aedeagus short, with a spiral process arising near its base and with its apex bulbous; the apex of the spiral process can not be distinguished with certainty in the specimen at hand.

Holotype.—Male; Soda Creek, B.C., Aug. 23, 1950, at light, G. J. Spencer, INHS.

This species is readily distinguished from all others in the genus by the curious lateral appendage of the eighth segment. It does not appear to be closely related to any known species although in shape of aedeagus and general shape of the capsule, it approaches most closely *forcipata* Mosely and *grisea* Betten.

Genus *Orthotrichia* Eaton

O. cristata Morton. July 24; Chilliwack. Transcontinental.

Genus *Hydroptila* Dalman

H. arctia Ross. Aug.; Cowichan L. Widespread through the western montane region.

H. consimilis Morton. Aug. 23 to 27; Soda Creek. Transcontinental, northern.

H. rono Ross. July 6; Port Coquitlam (Coquitlam R.). Widespread through the western montane region.

H. xera Ross. July 6; Port Coquitlam, Coquitlam R. Widespread through the western montane region.

FAMILY PHRYGANEIDAE

With this family begin the typical case-making groups, which contain all the species from here to the end of this list. The Phryganeidae are predominantly marsh inhabitants.

Genus *Agrypnia* Curtis

A. colorata (Hagen). June 13 to 17; Kamloops. Northern, widespread.

A. improba (Hagen). June 11 to July 15; Nicola, Quesnel. Western and northeastern.

Genus *Banksiola* Martynov

B. selina Betten. June 28 to Aug. 18; Kamloops, 100 Mile House. Transcontinental, northern.

Genus *Phryganea* Linnaeus

P. cinerea Walker. June 15 to Aug. 5; Canim L., N. of Ft. St. James (Middle R. at Takla L.), Nicola (Dry Farm), Salmon Arm. Transcontinental, northern.

FAMILY LIMNEPHILIDAE

Genus *Dicosmoecus* Martynov

All three members of this genus are widespread through the western montane region.

D. atripes (Hagen). July 30 to Aug. 31; Brem River, Hat Creek, Indian River, Merritt, Vancouver.

D. gilvipes (Hagen). July to October 15; Arrowhead L., Cultus L., Merritt, Penticton, Quesnel Lake, Vancouver, Wellington.

D. occidentis Banks. Aug. 11 to Oct. 28; Cultus L., Fernie, Quesnel, Wellington.

Genus *Imania* Martynov

I. bifosa Ross. July 20; Glacier. Known from B.C. and Alta.

I. tripunctata (Banks). Wellington. Widespread through the western montane region.

Genus *Cryptochia* Ross

C. pilosa (Banks). Aug. 10; E. of Chilliwack (Cheam View). Known only from the Cascade region in B.C., Wash. and Ore.

Genus *Glyphotaelius* Stephens

G. hostilis Hagen. July 12; Cariboo. Transcontinental, northern.

Genus *Hesperophylax* Banks

Both B. C. species are widespread western forms.

H. incisus Banks. June 6 to Aug. 27; Canim L., Fernie, Hat Creek, Lillooet, Merritt (Midday Val.), Nicola, Penticton, Pavilion L., Upper Peace R. Dist. (between Nelson and Finlay Div., Akie Pass), Wellington.

H. occidentalis (Banks). Aug. 19-20; Gold R.

Genus *Grammataulius* Kolenati

G. betteni Griffin. Sept. 12-29; Agassiz; Eburne; Saanich Dist. Known chiefly from the Cascades, from B.C. to Ore.

G. interrogationis (Zeff.). July 2 to Aug. 16; Lower Post, Rolla, Trinity Valley. Transcontinental, northern.

Genus *Philarctus* Martynov

P. quaeris (Milne). July 9 to Aug. 19; Kamloops, Quesnel L. Transcontinental, northern.

Genus *Lenarchus* Martynov

L. fautini Denning. July 17; Barkerville. Known from B.C., N.W.T., and Wyo.

L. rho Milne. June 6 to Sept 28; Agassiz, Bon Accord, Gulf of Georgia, Quesnel, Victoria, Wellington. Known from B.C. and Wash.

L. vastus Hagen. June 10 to Sept. 1; Cowichan L., Departure Bay, Vancouver. Known from Wash. to Alaska.

Genus *Limnephilus* Leach

L. batchewana Denning. July 2-17; Barkerville. Transcontinental, from Western Ont. to B.C.

L. bimaculatus Walker. July 7 to Aug. 14; Kamloops, Kamloops (Lac du Bois), Nicola. Transcontinental, northern.

L. cerus new species

Male.—Length 13 mm. Color of body and appendages various shades of reddish brown, the eyes and leg spines black, the wings finely irrorate with darker brown. General structure typical for genus. Head with one long macrochaeta mesad of the posterior margin of each eye. Front legs with basitarsus subequal in length to succeeding segment. Eighth segment simple, without dorso-apical projection or patch of setae. Genitalia as in fig. 6. Ninth segment moderately thick, reduced to a narrow bridge dorsally. Clasper with proecting portion longer than wide, its apex distinctly truncate, the corners rounded. Cercus of only moderate size, ovate, its mesal face very concave and without sclerotized points. Lobes of tenth tergite with scleortized portion slender, elongate, and curved latero-dorsad at apex. Aedeagus unusually long and slender, the lateral arms with a long slender stalk and a simple, enlarged concave apex bearing a cluster of spines and setae.

Holotype.—Male; Cultus L., B.C. (Sumas Slough), May 11, 1933, W. E. Ricker, INHS. *Paratype.* — Duncan, B.C., September 13, 1919, W. Downes, 1♂. (Canadian National Collection).

This species is most closely related to *lunonus* Ross, differing from it in the shorter cercus which has a convex posterior margin.

L. cinnamoneus (Schmid). Aug. 17; Quesnel, Wellington. Known only from B.C. and Alaska.

L. externus Hagen. June to Sept. 6; Cowichan L. (Cowichan R.), Kamloops, Kamloops (Lac du Bois), Lower Post, Nicola, Summerland. Holarctic, northern.

L. fagus Ross. Sept. 21; Cultus L. Cascades, from Ore. to B.C.

L. flavastellus Banks. Sept. 23; Wellington. Cascades, B.C. to Alaska.

L. harrimani Banks. July 15-20. Bon Accord, Vancouver (Stanley Park, Stream No. 1), N. Vancouver (Grouse Mt., 4000 ft.), W. Vancouver (Capilano R.). Western, from Ore. to Alaska.

L. hyalinus Hagen. June 28 to Sept. 28; Nicola, 100 Mile House, Quesnel, Shuswap, N. of Ft. St. James (Tachla R. at Stuart L.), Vernon. Transcontinental, northern.

L. indivisus Walker. July to Sept. 25; Chilcotin, Mission, Midday Val., Nicola, Soda Creek. Transcontinental, northern.

L. insularis Schmid. July 17 to Sept 28; Barkerville, Wellington. Known only from B.C.

L lopho Ross. Aug.; Barkerville, Hedley, Hope Mts. (6000 ft.), Revelstoke (6000 ft.). Known from B.C. and Ore.

L. nogus Ross. Feb. to Oct. 15; Arvas, Chilliwack, Cultus L., Departure Bay, Eburne, Haney, Point Grey, Vancouver, New West'r. Cascades, from Ore. to B.C.

L. occidentalis Banks. May 4 to Sept. 13; Duncan, Kamloops, Vancouver Island. Widespread in the western montane region.

L. pacificus Banks. Feb. 19 to Oct. 31; Cowichan L., Departure Bay, Hatzic Prairie, Wellington. Chiefly in the Cascades, from Ore. to B.C.

L. secludens Banks. June 28 to Aug. 27; Aspen Grove, Chilcotin, Fernie, Jesmond, Kamloops, Lower Post, Merritt (Midday Val.), Nicola, 100 Mile House, Penticton, Rolla, Soda Creek. Transcontinental, northern.

L. sericeus (Say). July 17 to Oct. 14; Australian, Barkerville, Chilcotin, Hat Creek, Kamloops, Quesnel, Shuswap Narrows, Soda Creek. Transcontinental, northern.

L. sylviae Denning. May 31; Vancouver (Seymour Mt.., 4700 ft.). Known from B.C. and Ore.

L. tarsalis (Banks). July 18 to Aug. 2; Kamloops, Quesnel. Transcontinental, northern.

Genus *Chyranda* Ross

C. centralis (Banks). Aug. 9-26; Fernie, Tahumming. Widespread through the western montane region.

Genus *Clostoeca* Banks

C. disjuncta (Banks). May 3 to June; Bon Accord, Vancouver. Widespread through the western montane region.

Genus *Halesochila* Banks

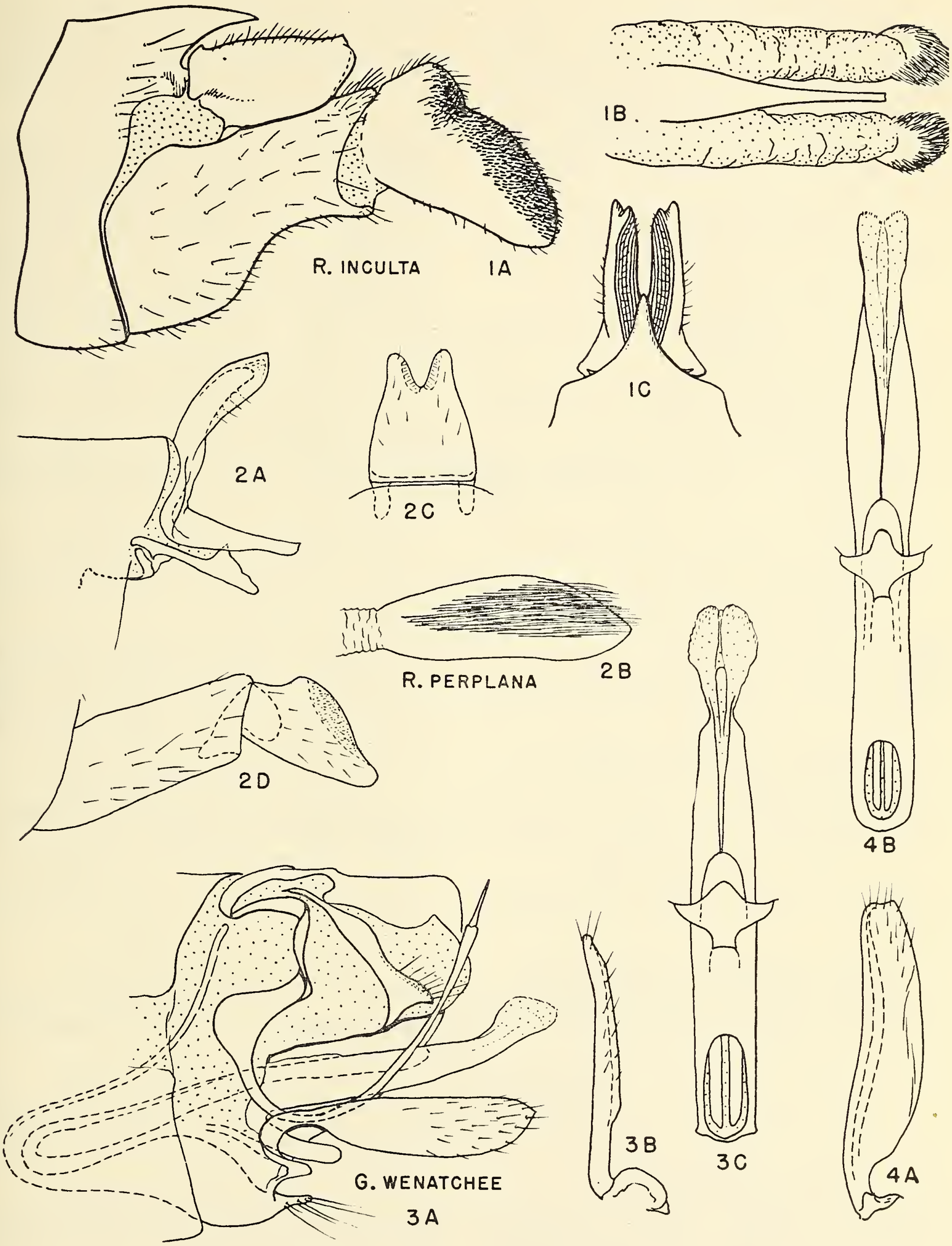
H. taylori Banks. Oct. 12; Point Grey, U.B.C., Wellington. Known only from B.C.

Genus *Hydatophylax* Wallengren

H. hespera Banks. July 3 to Aug. 1; Nanaimo (Departure Bay), N. Vancouver (Mosquito Cr.). Known from B.C., Wash., and Calif.

Genus *Glyphopsyche* Banks

G. irrorata (Fabricius). Wellington. Transcontinental, northern.



Figs. 1-4. Genitalia of caddisflies. 1, *Rhyacophila inculta*: *A,* lateral aspect; *B,* aedeagus, dorsal aspect; *C,* tenth tergite, dorsal aspect. 2, *Rhyacophila perplana*: *A,* tenth tergite, lateral aspect; *B,* apex of lateral arm of aedeagus, lateral aspect; *C,* tenth tergite, dorsal aspect; *D,* clasper. 3, *Glossosoma wenatchee*: *A,* genitalia, lateral aspect; *B,* clasper, ventral aspect; *C,* Aedeagus, ventral aspect. 4, *Glossosoma alascense*: *A,* clasper, ventral aspect; *B,* aedeagus, ventral aspect.

Genus *Psychoglypha* Ross

P. bella (Banks). Sept. 3; Nanaimo. Known only from B.C.

P. subborealis (Banks). July to Nov. 23; Langley Park, Merritt, Vancouver. Transcontinental and western montane.

P. ulla (Milne). July to Nov. 23; Cultus L., Jesmond, Wellington. Known only from B.C.

Genus *Drusinus* Betten

D. frontalis Banks. Terrace (Thornhill Mt.). Known from the Cascades, from B.C. to Ore.

Genus *Ecclisomyia* Banks

All three B. C. species are western mountain forms.

E. conspersa Banks. June 4 to Aug. 9; Cultus L., Glacier, E. of Hope (17 Mile Cr.), Keremeos, Nanaimo.

E. maculosa Banks. June 11; Fernie.

E. scylla Milne. June 8 to Aug. 12; Blue Lake, Cultus L., Hope Mts., Mt. Apex, Summerland.

Genus *Neophylax* McLachlan

N. rickeri Milne. Oct. 12 to Nov. 7; Cultus L. Known only from B.C.

Genus *Oligophlebodes* Ulmer

Both species listed here are entirely western in distribution.

O. ruthae Ross. Aug. 2; Barkerville.

O. sierra Ross. Aug. 9; E. of Hope (17 Mile Cr.).

Genus *Homophylax* Banks

H. andax Ross. June; Pitt Meadows. Known from B.C. and Ore.

H. crotchi Banks. July; Victoria. Known only from B.C.

FAMILY CALAMOCERATIDAE

This is primarily a subtropical group, with few representatives in northern areas.

Genus *Heteroplectron* McLachlan

H. californicum McLachlan. May and June; Cultus L., Duncan. Western, from Calif. to B.C.

FAMILY MOLANNIDAE

This small family of case-makers is entirely northern in distribution. The larvae live almost entirely on sandy patches of lake bottom.

Genus *Molanna* Curtis

M. flavicornis Banks. June 10 to Aug. 20; Canim L., Jesmond, Kamloops, 100 Mile House, Quesnel, N. of Ft. St. James (Tachla R. at Stuart L.). Transcontinental, northern.

FAMILY LEPTOCERIDAE

This widespread family includes both stream species and lake species.

Genus *Athripsodes* Billberg

A. cancellatus (Betten). June 23 to Aug. 17; Canim L., Cultus L., Lower Post, 100 Mile House, Seton L., Summerland. Widely distributed over central and northern North America.

A. cophus Ross. June 25; Kaslo. Widely distributed in the western montane region.

A. resurgens (Walker). July 23; Cultus L., N. of Ft. St. James (Middle R. at Takla L.). Transcontinental, northern.

Genus *Leptocella* Banks

L. albida (Walker). June 14-16; Quesnel, Summerland. Widely distributed over central and northern North America.

Genus *Mystacides* Berthold

M. alafimbriata Hill-Griffin. May 30 to Oct. 16; Agassiz, Cameron L., Canim L., Chilliwack, Cowichan L., Cultus L., Emerald L., Emerald L. (Yoho Pk.), Harrison L., Keremeos, Mons (Alta L.), Nelson, Nicola, Oliver, Penticton (Okanagan L.), Pitt L., N of Ft. St. James (Stuart L., Tachla R.), Saanich Dist., Sardis, Summerland, Vernon. A common lake species throughout the western montane region.

M. sepulchralis (Walker). June 14 to Aug. 20; Hat Creek, Quesnel. Transcontinental, widespread.

Genus *Oecetis* McLachlan

O. avara (Banks). June 27 to July 25; Cultus L., Lac La Hache, Okanagan L., Sardis. Widespread over all North America.

O. immobilis (Hagen). July 2; Okanagan L., Vernon. Transcontinental, northern.

O. inconspicua (Walker). June 23 to Aug. 1; Canim L., Cultus L., Jesmond, 100 Mile House, Salmon Arm, Sardis, Seton L., Squilax, Summerland, Vernon. Extremely widespread over North America.

Genus *Triaenodes* McLachlan

T. baris Ross. June 28; 100 Mile House. Known from B.C. and Ill.

T. grisea Banks. June 13 to Aug. 30; Kamloops. Transcontinental and northern.

T. tarda Milne. June 23 to Aug. 27; Cultus L., Minnie L., Nicola L., 100 Mile House. Transcontinental and northern.

FAMILY BRACHYCENTRIDAE

Larvae of this family frequently build a square case of very regular proportions.

Genus *Brachycentrus* Curtis

B. occidentalis Banks. April 26 to May 14; Bon Accord, Nicola. Oliver, Quesnel. Widespread through the western montane region.

Genus *Micrasema* McLachlan

M. bactro Ross. July 6; Stave Falls (Steelhead Cr.). Widespread through the western montane region.

FAMILY LEPIDOSTOMATIDAE

Members of this family build either log-cabin cases or slender, cylindrical ones.

Genus *Lepidostoma* Rambur

L. cascadensis (Milne). May 28 to July 15; Cultus L., N. Vancouver (Mosquito Cr.), W. Vancouver (Capilano R.), N. of Whonnock (Whonnock Cr.). Widespread through the western montane region.

L. hoodi Ross. June 10; Nanaimo (Departure Bay). Known from B.C. and Ore.

L. jewetti Ross. Sept. 25; Wellington. Known from B.C., Ore. and Calif.

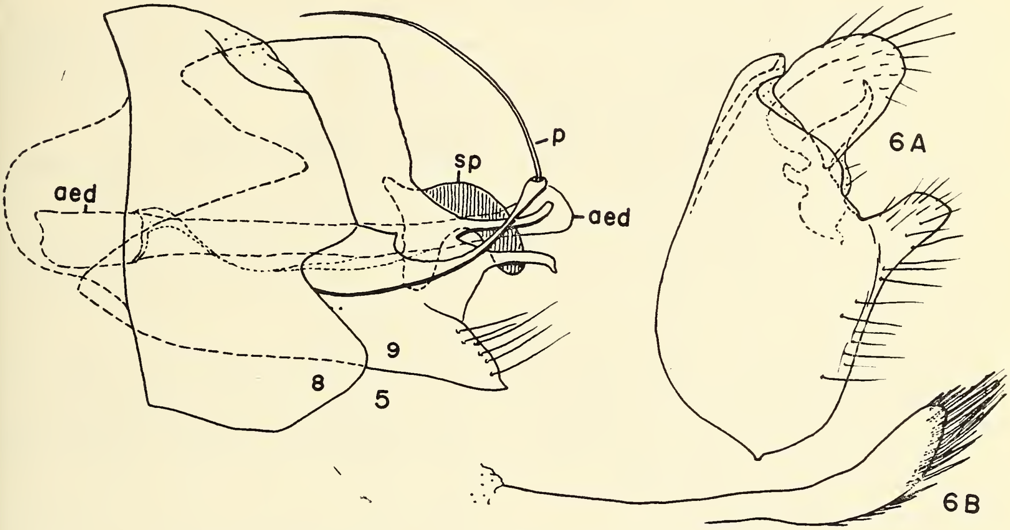
L. pluvialis (Milne). June 28; 100 Mile House. Widespread through eastern ranges of the western montane region.

L. rayneri Ross. July 16-18; Cultus L., Lillooet, Rosedale (Fraser R.), N. Vancouver. Apparently restricted to the Sierra Nevada and Cascade range from Calif. to B.C.

L. roafi (Milne). Vancouver, Vernon, Transcontinental, northern.

L. strophis Ross. June 5 to Oct. 16; Cultus Lake, N. of Ft. St. James (Middle R. at Takla L.), Vernon. Transcontinental, northern.

L. unicolor (Banks). July 15 to Sept. 13; Duncan, Vancouver (along Stream I). Transcontinental, northern.



Figs. 5-6. Genitalia of caddisflies. 5, *Oxyethira sodalis*: genital capsule, lateral aspect. 6, *Limnephilus cerus*: *A,* lateral aspect of capsule; *B,* lateral arm of aedeagus, lateral aspect.

A PRELIMINARY REPORT ON ACARICIDES TESTED FOR PROTECTION AGAINST THE TICK DERMACENTOR ANDERSONI STILES ON CATTLE[1]

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Economic considerations, which necessarily play an important role in the acceptance and use of any recommended insecticide, are particularly critical factors in the schedule of ranchers, whose products do not give them as high a return on their investments of property, care, and, notably, labour as do those of other agriculturists. In view of the nature of range practices in the British Columbia interior, a spray, if it is to be accepted by the ranchers, should be such that it might be applied only once: when the cattle are concentrated near spray chutes before being dispersed over the spring and summer grazing grounds. To advocate a compound of low residual properties for use against ticks will necessitate the rounding up of

1 Contribution No. 2921, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada; presented at the 50th Anniversary Meetings of the Entomological Society of British Columbia in Vancouver, June 13-18, 1951.

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scattered cattle for a second treatment and result in the ultimate breakdown of the control program.

The dangerous portion of the tick season generally lasts but two or three weeks. However, two factors contribute to the need for a chemical that can remain toxic for longer periods:

(a) in an occasional year, such as the 1951 season, the dangerous period extends to four or five weeks;

(b) for the convenience of the rancher, the acaricide should be compatible for mixing with warble spray, which is usually applied two or more weeks prior to the tick season.

Benzene hexachloride was investigated by Gregson (1946) and found very effective for the purpose, but the multiplicity of new synthetic insecticides that have appeared on the market in recent years required that a measure be taken of their effectiveness in controlling *Dermacentor andersoni* Stiles. This report deals with investigations preliminary to thorough future comparison of the compounds.

Materials and Procedures

The following materials were used:

Wettable powders: C-854 (p-chlorophenyl p-chlorobenzenesulphonate), Neotran (bis(p-chlorophenoxy) methane), chlordane, and gamma isomer of BHC.

Emulsions: aldrin, dieldrin, chlordane, and gamma isomer of BHC. The emulsifier employed in the formulations was Atlox 1045.

A concentration of 0.5 per cent. of active ingredient was chosen primarily on the basis that it was well within the effective limits for control of the tick by BHC (Gregson, 1946). This chemical, therefore, was used as a basis of comparison for the others before devoting time for a more complete examination of their properties.

The number of cattle which could be maintained on the laboratory premises was limited; hence one litre of a formulation was applied to the head, neck, and shoulders of each of four yearling steers and four heifers. One other steer was untreated and served as a control.

Ticks were collected at approximately weekly intervals and placed on the hosts' backs. The attached ticks were counted and removed at the end of each feeding period, before a new batch was placed on each animal. Occasional checks showed that the feeding ticks were not completing their development and leaving the host before they could be counted.

The mortality recorded in Table I was based only on female ticks, since the male tended to wander and drop from the host.

Results and Discussion

Three classes of ticks were noted, on the basis of their response to the effects of the acaricides:

The ticks unaffected by acaricidal contact, and those placed on the control, attached and proceeded to feed until repletion.

Most of the ticks affected by the acaricides died before they could become attached. This observation was substantiated by recovery of dead, flat ticks tangled in the hairs of treated hosts.

The third class consisted of ticks which attached on treated cattle but which died before becoming replete. Their bodies were collected, still attached by their mouth parts, where they had been feeding.

The variable reactions of the ticks to acaricides suggested a variable resistance of the individuals to the chemicals, even among those ticks which succumbed. Unfortunately, at the levels of acaricide concentrations used, the proportions of ticks of the third class were so low that a quantitive comparison of the types was not justified. However, in this preliminary study the totals of dead ticks were of primary concern; consequently, the last two classes were added and the sum was used to provide the data for the mortalities recorded in Table I.

Table I indicates that Neotran and dieldrin can be ruled out for future tests. Neotran had been tested on *D. albipictus* (Pack.) (unpublished data) as a dust at one, three, and five per cent. concentrations, and found ineffective in controlling that species.

TABLE I.

MORTALITIES OF *DERMACENTOR ANDERSONI* FEMALES EXPOSED TO VARIOUS ACARICIDES SPRAYED ON CATTLE

Chemical	Numbers of Female Ticks Placed on each Host Animal and Percentage Mortalities‡ (in parentheses) after Six to Nine Days							
	Number of Days After Treatment							
	5	12	21	27	33	41	50	57
Emulsions								
gamma BHC, 0.5%	50	25 (86)	25 (80)	25 (86)	25 (67)	25 (67)	0 (67)	-
chlordane, 0.8%†	50	25(100)	25(100)	25(100)	25(100)	0 (96)	-	-
aldrin, 0.5%	50	25(100)	25(100)	25 (71)	25 (33)	0 (70)	-	-
dieldrin, 0.5%	50	25 (0)	25 (0)	0 (0)	Discontinued			-
Wettable Powders								
gamma BHC, 0.5%	25	25(100)	25(100)	25(100)	9 (67)	0 (0)	10 (-)	0 (0)
chlordane, 0.5%	25	25(100)	25(100)	25(100)	22 (67)	0 (40)	10 (-)	0 (0)
Neotran, 0.5%	25	25 (2)	25 (5)	25 (-)	16 (3)	0 (0)	10 (-)	0 (0)
C-854, 0.5%	25	25 (82)	25 (85)	25 (90)	19 (40)	0 (23)	10 (-)	0 (0)

‡ Corrected by Abbot's formula (Shepard, 1946 p. 33) so that the controls show zero percentage mortality.

† Chlordane emulsion contained 0.8% of active ingredient because of an error in formulation.

Aldrin and C-854 showed some promise. The former compound produced greater mortalities than the comparable strength of BHC for 21 days, but its effects diminished considerably during the subsequent period. C-854 produced consistently lower mortalities than the corresponding BHC formulation. However, the mortalities of 82, 85, and 90 per cent. obtained during the first three weeks may be sufficient for practical control of infestations in the field.

The wettable form of BHC appeared to be more effective than the emulsion. A similar comparison could not be made for chlordane because the emulsion form contained 0.8 per cent. as opposed to 0.5 per cent. of the wettable powder. BHC and chlordane wettable powders produced identical results for three days, after which chlordane emulsion killed all of the ticks for 33 days and 96 per cent. until 44 days. A performance of this type might very well answer the needs of ranchers even in the occasional years of extraordinarily prolonged tick activity.

Although there were no records of toxic effects among the cattle treated, the problem of danger to livestock is an apt one and deserves mention. At the present time published data are not available for effects of dermal doses of aldrin, dieldrin, Neotran, and C-854 when applied to cattle.

Bushland *et al* (1948) and Radeleff and Bushland (1950) have investigated chlordane and benzene hexachloride in this respect. Bushland and his co-workers reported that a wettable powder at 0.25 per cent of gamma benzene hexachloride caused no injury when applied once as a drenching spray to three cows. However, when similarly applied at 0.75 and 1.5 per cent. of gamma isomer, benzene hexachloride did affect and kill the cows. Two Hereford heifers, thoroughly sprayed in eight treatments at four-day intervals with 1.5 per cent. chlordane emulsion, were not affected.

In the same paper the authors reported that of ten cattle sprayed with a two per cent. suspension of chlordane at two-week intervals, three cows died after 10-12 days following the fourth spraying. Other cattle sprayed similarly with two per cent. of benzene hexachloride (12 per cent. gamma isomer) showed no apparent injury.

Radeleff and Bushland (1950) found that suckling calves were particularly susceptible to benzene hexachloride, toxaphene, and chlordane at various levels from 8.0 per cent. to 0.025 per cent. of the toxic ingredients. In this experiment the calves were sprayed until thoroughly wet.

The meagre published results of work on this phase of the toxicity of the newer insecticides emphasizes a need for further investigation. To aggravate the situation, no standardized method of applying the insecticides has been attempted, for each group of workers has a different set of problems. For example, in the present experiment only one litre of insecticide was sprayed on each of the cattle, whereas Radeleff and Bushland and Bushland *et al* wet their cattle thoroughly. Each group was guided by the limits of its purpose in performing one experiment.

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FURTHER STUDIES ON TICK PARALYSIS[1]

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Tick paralysis in British Columbia and adjacent territories, as in South Africa and Australia, has long remained a disease of baffling origin. Though it is generally conceded that the symptoms produced in the host are brought on by the injection of a toxin by the tick, the reason why ticks of the same species vary in potency is still a puzzle. The solution to this mystery has been complicated by a series of factors which have included such nebulous conditions as are involved in different host and tick species, host susceptibility, and host immunity. Zumpt (1950) even questions whether these factors are the only ones, and as he suggests, the physiological condition of the individual tick seems to be of considerable significance, a factor which has resulted in studies too frequently containing so many unknowns that no logical pattern is apparent. This, together with the shortness of the annual period of natural tick activity, has rendered progress in the etiology of the disease slow. Nevertheless, each year some advance has been made and considerable data gained toward the understanding of this interesting phenomenon.

In British Columbia tick paralysis is caused by the female of the Rocky

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Mountain wood tick, *Dermacentor andersoni* Stiles, and is mainly a disease of cattle. If these animals are pastured on tick-inhabited ranges during the active adult tick season of March and April, they become infested with large numbers of the parasites. These congregate in dense masses on the heads and shoulders of the victims and attach for their seven-to-ten-day blood meal. It is toward the end of this period, when they have become replete with blood, that they may paralyse their host. Sheep, dogs, and humans are also affected, but usually on these hosts there are few ticks or only one.

This species of tick mates while feeding, which, as shown by Gregson (1944), enables the female to engorge to repletion much more rapidly than when deprived of a male. The feeding period of a mated female is approximately seven days, after which it drops from its hosts, whereas an unmated tick remains attached, half-engorged, for several weeks. For some time it was thought that fast-feeding, mated females were more virulent than the slow-feeding, unmated ones. This view is, however, weakened by the facts that in human paralysis the male tick is rarely present and that in most instances the causative tick is only half-replete at the onset of paralysis.

TEST ON SUITABILITY OF HOSTS

During the past few springs further attempts have been made at the Kamloops laboratory to demonstrate the conditions responsible for the production of paralysis. Since so many factors appear to be involved in the occurrence of paralysis in tick-infested animals, one of the first steps was to find a host that is subject always to paralysis. To permit large-scale infestations involving animals on which ticks had not previously fed, small laboratory animals were sought. It was with some degree of surprise that white mice were discovered to be ideal hosts of the adult ticks, for never in nature has this stage of tick been taken from the numerous wild mice present in tick-infested areas known at the Kamloops laboratory. Though the ticks in the laboratory had to be protected from the actions of their hosts by large rubber discs placed around the animals' necks, the cleanly nature of mice does not prevent other species of ticks in nature from attaching and engorging. The successful application of this discovery was short-lived, for it was found that though rapidly engorging, mated ticks did kill the mice, death was apparently due to a severe anaemia, as shown by blood counts, and slow-feeding ticks produced no typical symptoms of paralysis. These results covered 37 infestations. Of 18 mice infested with mating ticks, ten died and eight grew only sluggish by the time the ticks became replete. Nineteen, infested with single female ticks, were unharmed, and at the end of the seven days (the normal period for paralysis to appear) bore half-engorged specimens. One mouse harboured five and another two females for the same period without apparent ill effects, though a third with four females died — presumably because of the large blood meals of the ticks.

Mice, then, apparently do not fill the need for a host susceptible to paralysis —unless, of course, the ticks used in this experiment were for some reason not capable of producing paralysis.

Rabbits and guinea pigs appear to be immune to tick paralysis, as is suggested by the lack of symptoms of this disease during the course of infesting these hosts with thousands of ticks in spotted fever studies at the Rocky Mountain Laboratory, Hamilton, Montana (W. L. Jellison, personal communication), and during smaller-scale infestations at Kamloops. Dogs are relatively susceptible to tick paralysis and would undoubtably form convenient test animals were it not for the difficulties of procuring and maintaining them in sufficient numbers. Infestations on each of six puppies caused a paralysis in three of the hosts, on which one, four, and two ticks had attached.

TESTS ON LAMBS

In 1951, 30 lambs were available for further adult tick feeding observations at Kamloops. Though previous experiments had shown that all tick-infested lambs do not necessarily become paralysed, at least some are paralysed under favourable conditions.

METHODS AND DATA OF INFESTATIONS

The ticks in these experiments on lambs were confined on the hosts by dome-shaped screen capsules, which were anchored to the surrounding wool by linen threads. To provide optimum conditions for the ticks, each capsule was placed over a clipped area that had been washed free from natural grease. A dampened pad of absorbent cotton served to maintain the humidity until the ticks had attached. Unless these precautions were taken a large number of the ticks died before attaching. Such mortalities were excluded from the studies, the results of which are tabulated below.

Summary of infestations of individual lambs, various feeding rates, and paralysing powers of engorging females (Complete data of this experiment are available from the author):

1. Infested April 4, 13, 27 with 5, 4, 2♀ and 5, 0, 2♂ respectively. Three* females fed rapidly. No paralysis.
2. Infested April 26 with one pair. Female fed rapidly without producing paralysis.
3. Infested March 28, 31, April 7 with 5, 1, 0♀ and 0, 0, 20♂ resp. None fed rapidly. No paralysis.
4. Infested April 16, 26, May 8 with 6. 1, 8 ♀ and 0, 1, 8♂ resp. Seven females fed rapidly. No paralysis.
5. Infested April 13, 13, May 3 with 4, 0, 6♀ and 0, 4, 10♂ resp. Two females fed rapidly. No paralysis.
6. Infested April 13, 13, 13, 25 with 6, 0, 1, 1♀ and 0, 12, 1, 1♂ resp. Two females fed rapidly. No paralysis.
7. Infested April 11, May 3 with 1, 1,♀ and 2, 3♂ resp. Both females fed rapidly. No paralysis.
8. Infested April 14 with 10♀ and 0♂. None fed rapidly. No paralysis.
9. Infested April 16, 28, May 8 with 3, 2, 8♀ and 0, 1. 8 ♂ resp. The two females of the second group paralysed the lamb moderately when only half-replete. Recovery followed their removal. Five females of the last group fed rapidly, causing no further paralysis.
10. Infested April 14, 30 with 6, 1♀ and 3, 1♀ resp. Of the first group, one female fed rapidly, causing a slight paralysis which disappeared upon its release. Two subsequent females fed rapidly, causing no paralysis.
11. Infested April 14 with 3♀ and 0♂. None fed rapidly. No paralysis.
13. Infested March 28, 31, April 13, 30, May 10 with 5, 1, 5, 2, 10♀ and 5, 1, 0, 1. 0♂ resp. One female of the first group fed rapidly causing a slight paralysis. Four slow, and a subsequent fast feeder produced no symptoms. The lamb finally was paralysed severely by five slow-feeding ticks of the third group. Paralysis remained as the ticks were taken off at hourly intervals until the last was off. Two fast-feeding females of the fourth group and ten slow feeders of the last produced no further paralysis.
14. Infested April 11, 27 with 1, 1♀ and 2, 1♂ resp. Both females fed rapidly, the first producing a slight paralysis, the second none.
17. Infested May 3 with 3♀ and 2♂. Two females fed rapidly. No paralysis.
18. Infested April 12, 28, May 8 with 1, 1, 7♀ and 2, 2, 8♂ resp. First two females fed rapidly, causing no paralysis. Seven females of the last group fed rapidly, producing severe paralysis.
19. Infested April 30, May 8 with 2, 8♀ and 2, 8♂ resp. All females fed rapidly, each group producing a slight paralysis.
20. Infested April 25 with 2 pairs. Both females fed rapidly. No paralysis.

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* Failure of all females paired with males to feed rapidly is probably due to a delay in mating.

21. Infested April 13 with 1 pair. Female fed rapidly. No paralysis.

SUSCEPTIBILITY OF THE LAMBS

The lambs used in these experiments were as uniform a group as practical inasmuch as they were much of an age and none had been exposed to ticks before. Some of the lambs that were unaffected by ticks during the first infestations were susceptible to paralysis later (lambs 9 and 18). It is, however, unlikely that this later response was due to sensitization since six others (lambs 1, 3, 4, 5, 6, and 7) did not become paralysed after repeated infestations during similar periods. Indifference to tick paralysis because of development of host immunity can probably be ignored also, since paralysis was produced twice within eight days in two lambs (13 and 19). These facts suggest that some factor in the tick, rather than in the lambs, was responsible for the paralysis in the above instances. Though this assumption is later moderated by indications of a host resistance, it does offer a theory that is valuable for further progress, in view of the scantiness of substantial evidence.

VIRULENCE OF THE TICK

If, then, the presence of paralysis is considered to be due to a condition within the tick, attention can be directed toward a comparison of the virulence of the sexes. Though males are frequently associated with females in paralysis cases, at the Kamloops laboratory there is no record of paralysis caused by males themselves. In the experiments under discussion 32 male ticks were fed on lambs without apparent symptoms of paralysis. Presumably the sparsely feeding male tick can be omitted as a direct causative agent in this disease. Indirectly, it was felt it might constitute a factor by increasing the feeding rate of the female.

Assuming, now, that paralysis is caused only by the female tick, an analysis can be made of the effects of mated and unmated ticks on the host to determine whether or not the feeding rate is related to the virulence of the tick. In 28 separate infestations involving 80 pairs of ticks (fed in single pairs or in series up to ten pairs on 16 lambs) 50 ticks mated and engorged rapidly enough to drop replete in seven days. Of these 50, only 11 were possibly involved in the production of the six cases of paralysis that resulted. It is possible that actually only one tick was involved in each case, so that the ratio of virulent mated ticks to benign ones might then be approximately one to eight.

In ten other infestations involving 52 females without males (fed in numbers from one to ten on eight lambs), paralysis occurred in one lamb (13) on which five ticks were feeding. The possibility that all these ticks were involved in the production of the paralysis cannot be dismissed, since the symptoms did not subside until the last tick was removed. If. however, only this last tick was implicated, the ratio of virulent unmated ticks to benign ones was one to fifty-two. The above data suggests that mated, rapidly feeding female ticks are more likely to cause paralysis in lambs than slower-feeding ones.

As judged from this laboratory's records, the fact that slow-feeding, solitary females are so virulent in human infestations, where a tick seldom engorges without causing paralysis, suggests that man is more susceptible to the action of the tick than lambs—a theory that agrees with the mentioned variation in susceptibility among different species of animals. Lambs, then, are moderately resistant, since, out of the eight cases of paralysis mentioned, only two were severe enough to produce a loss in the use of the limbs; the remaining lambs exhibited only an unsteady gait. In contradiction to the aforementioned apparent uniformity of hosts, this latter symptom suggests that certain lambs had a greater resistance to the toxin. This resistance may even have masked the potentialities of seemingly innocuous ticks. According to records at the Kamloops laboratory, paralysis in cattle is invariably caused only by clusters of ten to 50 ticks and it is doubtful whether these animals could be paralysed by solitary specimens. However, not all animals with heavy infestations will become paralysed — suggesting again an individual resistance.

The data for lambs 10, 13, 14, 18, and 19 substantiate a variation in virulence among ticks. At the same time, there is an indication that a paralysed animal is so weakened that it may then be affected by ticks, which on a healthy animal, would not be considered virulent. This is evident in animals on the range which often remain prostrate for several hours until the last ticks are removed, and then make a rapid recovery. This could be the case in lamb 13.

Lamb 9 presented an interesting opportunity for a further experiment in that paralysis commenced when the two engorging ticks were only half-replete. The ticks were transferred to lamb 1, which, though having been subjected to ticks, had not yet been paralysed. The virulent ticks attached, and dropped within a day—but did not cause paralysis. Similar results occurred in a previous year when a partially fed tick from a paralysed child was induced to attach to a mouse, whereupon it mated and fed rapidly without harm to its second host. Again there are too many unknowns to establish a reason for this behaviour. It appears that a virulent tick can paralyse only the host upon which it commences to engorge.

In summary, it is assumed that tick paralysis is brought about in the host by a toxin secreted by the engorging tick. It appears that the production of tick paralysis in an animal depends on a combination of host susceptibility and tick virulence; and that where the host is relatively resistant, as in sheep and cattle, only a certain portion of rapidly feeding ticks produce the symptoms, whereas in humans, considered to be more susceptible, solitary, slow-feeding ticks are sufficient to cause paralysis. The conflicting evidence concerning the varying resistance of the host and the unknown virulence of the ticks makes it difficult to arrive at any conclusion.

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A REVIEW OF STUDIES ON THE SYSTEMIC CONTROL OF LIVESTOCK INSECT PARASITES[1]

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If, without causing harm to the animals, it were possible for a stockman to introduce into the diet of his livestock some substance that was toxic to bloodsucking arthropods feeding upon these animals, he would find a solution to one of the important problems of animal husbandry. Economic entomologists have recently devoted a great deal of effort toward the attainment of this ideal, and the investigations seem to indicate that it may be possible to achieve it.

However, the problem is not simple. Many difficult biochemical and toxicological factors must be studied and their roles elucidated before the problem can be solved. Because of these factors, the entire matter must be approached with caution. A full discussion of these aspects is beyond the scope of this paper because it is my intention only to review some of the more important studies that have been made in the past.

The first important contribution is that of Knipling (1938), who reported

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that, when cattle ingested phenothiazine, horn fly larvae did not develop in the manure subsequently eliminated by such animals. Bruce (1939) confirmed these findings and established the dosage levels required for maximum control. Creighton (1943) made an unsuccessful attempt to control chicken lice by adding sulphur to the concentrate portion of the poultry diet.

The recognition of the insecticidal properties of DDT and BHC instituted widespread investigations of the insecticidal properties of many organic chemicals, and the systemic aspect was not neglected. Linquest (1944) reported that oral ingestion by rabbits of either DDT or pyrethrum in massive dosages was toxic to bed bugs subsequently fed on the rabbits. de Meillon (1946) made a similar observation concerning the bed bug feeding on rabbits that had ingested the gamma isomer of BHC. This observation was confirmed by Wilson (1948), who administered it orally as a control for tsetse flies on cattle.

J. D. Gregson (personal communication) noted that ingested gamma isomer of BHC was toxic to ticks and lice feeding on horses, cattle, and chickens. This observation, together with the published data of deMeillon and Wilson, provided the basis for an extensive series of tests conducted at the Kamloops laboratory in the summer of 1949.

During that summer I carried out a test of the gamma isomer of BHC, using domestic hogs and their natural parasite, *Haematopinus suis* (Linn.), as experimental animals. Single dosages at the level of 40 milligrams per kilogram of animal body weight provided 100 per cent. control of the parasite for about eight to ten days. Daily dosages at the level of 20 milligrams per kilogram for four days were required to produce similar results. However, a series of toxicity tests, with guinea pigs as the test animals, showed that daily treatment at dosage levels of 20 milligrams per kilogram was a dangerous practice. It is perhaps invalid to extend experimental results determined with one animal species to other, dissimilar species; but since it is economically impossible to conduct satisfactory toxicity tests with animals such as cattle, horses, and hogs, it was decided that in this instance the extension was justifiable. Therefore these tests were considered to have indicated that this treatment was not a valid control method.

In the meantime other workers had conducted preliminary tests with many other chemicals. Knipling (1948) published the results of an extensive series of tests involving many different chemical compounds in an attempt to control the body louse, *Pediculus humanus corporis* Deg., feeding on rabbits. The most promising of the compounds tested was 2-pivalyl-1, 3-indandione. Babers (1949) published a favourable report of tests conducted with this chemical, using the same experimental animals.

This review of the systemic aspect of livestock parasite control is brief; however, it indicates that the problem is not being neglected and suggests a concrete basis for its solution.

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NOTES ON SOME PTINIDAE OF BRITISH COLUMBIA (COLEOPTERA)[1]

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The writer has made observations during the past year and a half on insects infesting stored products in flour warehouses, feed mills, grain elevators, and other food storage or food processing plants in British Columbia. One of the most important groups of insects found in such places are the Ptinidae, or spider beetles. This paper deals with the insects belonging to this group.

Spider beetles are important pests of cereal products and seeds in storage in Canada. They attack practically all types of cereal and animal feeds. Most of the species found in Canada are able to survive the winter in protected habitats. The adults of some species are very prolific and the females frequently oviposit through the mesh of cotton sacks (Gray, 1933). The larvae complete their development within the food material in approximately two to three months at summer temperatures. When mature, the larvae frequently leave the food product and burrow into the timbers of the warehouse before pupation. The scarring produced by the larvae is positive evidence of previous spider beetle infestation (Gray, 1942).

Hinton (1941) recorded 21 species of Ptinidae as pests, most of these causing damage to stored products of various kinds. Manton (1945) reported that 15 species had been recorded in the British Isles as infesting stored products or as present in buildings where such products are normally kept. The writer has found 11 species in British Columbia, ten determined, and one uncertain.

Ptinus ocellus Brown [=*P. tectus* auct.], the Australian spider beetle, is the most widespread and abundant of the ptinids in British Columbia. In British Columbia this species was first reported from Victoria in 1927 by W. Downes (Brown, 1940). Spencer (1942) reported that it was sent to him in 1926 from Prince Rupert, where it was infesting fish meal on a wharf "in the thousands." In Canada this species appears to be restricted very largely to the coastal regions. It is widely distributed throughout British Columbia, including Vancouver Island, and was found in 43 per cent. of the places visited. Due to the mild climate this species is active throughout the year in this area.

P. ocellus is a pest of considerable economic importance in many parts of the world. Hinton (1941) stated that it is the most generally distributed of the warehouse pests in Great Britain, having become established there in 1901. It is also a pest of major importance in Germany and several other European countries. It has been reported from a variety of products, including cayenne pepper, chocolate powder, desiccated soup, cacao, nutmegs, almonds, ginger, figs. sultanas, dried pears, dried apricots, beans, rye, fish food, maize (Hatch, 1933), and fish meal (Brown, 1940). The writer has found it infesting pastry flour, fish meal, turkey starter, calf meal, and mixtures of oats, bran, flax, rye, and wheat. The writer has successfully reared this species on nearly all of the above mentioned products in the Vancouver laboratory and on a mixture of whole wheat flour and brewers' yeast.

The writer, in test work, has found that the larvae can complete their development on relatively small amounts of food. When food is lacking the larvae eat their excreta and the glandular material used in the formation of the pupal cells (Gunn and Knight, 1945). Both larvae and the adults can survive for a long time without access to water if the moist·ure content of the food is reasonably high. However, under laboratory conditions, eggs are not produced by

1 Contribution No. 2909, Division of Entomology, Science Service, Department of Agriculture, Canada.
2 Officer-in-Charge.

the adults if free water is not available (Ewer and Ewer, 1942). The writer has also found this to be true.

Ptinus fur (L.), the white-marked spider beetle, ranks second in importance in British Columbia. It is widely distributed throughout Canada, but seems to be more abundant in British Columbia than in the other provinces (Brown, 1940). In the United States this species was first reported in 1869 and losses were recorded in flour in Canada as early as 1893 (Gray, 1942). This species feeds on a variety of dried and decaying animal and vegetable matter. In this Province, *P. fur* has been found in 11.7 per cent. of the establishments inspected, usually in association with *P. ocellus.* This species has also been reared in the Vancouver laboratory on whole wheat flour and brewers' yeast.

The species that follow have been found on only a few occasions and are not widely distributed in British Columbia. *Ptinus raptor* Sturm is thought to be of European origin and is now almost world-wide in distribution (Hinton, 1941). In Canada it was first taken at St. Peters, Nova Scotia, in 1930 by M. L. Prebble (Brown, 1940). Later Gray (1942) found that this species was the most abundant spider beetle in the warehouses of Nova Scotia, New Brunswick, and much of Quebec. This species was found by the writer infesting flour in warehouses at Nelson, Vancouver, and Victoria.

In Canada *Ptinus villiger* (Reit.), the hairy spider beetle, was taken first in Manitoba in 1915, is well established in the Prairie Provinces, and also occurs in Ontario and Quebec and to a lesser extent in the Maritime Provinces (Gray, 1933). The losses to cereal products caused by this spider beetle far exceed those by any other member of the group (Gray, 1942). In British Columbia this species was first reported in 1933. The writer found it at three scattered points in 1950: Rossland, Creston, and Vancouver.

The writer found *Trigonogenius globulus* Solier, the globular spider beetle, infesting three warehouses in Vancouver and one in Victoria. Great numbers were found in Victoria, and in one of the warehouses in Vancouver a heavy infestation was encountered on sacks containing cracked corn. Brown (1940) reported that the species is confined largely to the Pacific region of North America. It has been reared in the Vancouver laboratory on the same medium as *P. ocellus.*

In British Columbia *Eurostus hilleri* (Reit.) [=*E. alienus* Brown] was found first by H. E. Gray at Kamloops in 1939 (Brown, 1940). During the past year the writer found it in small numbers in two warehouses: one in Victoria and one in Vancouver. Hinton (1941) recorded it only in Japan, Great Britain, and Canada. According to Manton (1945) it has become established in England in recent years and appears to feed mainly, if not entirely, on rat and mouse droppings. Where the writer found this insect, no appreciable amounts of droppings were visible. It has been reared in the Vancouver laboratory in small numbers on whole wheat flour and brewers' yeast. On this medium the time required for development for *E. hilleri* is similar to that for *P. ocellus.*

Howe (1949) reported that the fertility of this species is very low, less than 50 eggs per female being laid in the laboratory. Results in the Vancouver laboratory confirm Howe's findings. This insect is not likely to become a serious pest in this province.

Ptinus bicinctus Sturm was recorded by Hinton (1941) from Europe, North Africa, and North America. It was taken by the writer in association with *P. fur* at Rossland, B.C., in June, 1950, infesting flour in a warehouse. According to Brown (1940), it is rarely taken on this continent and the capture reported here appears to be the first record of *P. bicinctus* in British Columbia. It has been found previously in Alberta, Ontario, Quebec, and Nova Scotia (Brown, 1940).

Specimens of *Niptus hololeucus* (Fald.), the golden spider beetle, were found by the writer in four Vancouver warehouses. Spencer (1942) reported that this species was found by H. B. Leech in 1936 at Fernie, B.C. Brown (1940) reported that it had been taken in Nova Scotia, New Brunswick, Quebec, Ontario, and Alberta, and at Fernie and Victoria in British Columbia. Hinton (1941) recorded it as nearly cosmopolitan but absent in the tropics. It has been a pest of importance in Europe for some time.

Ptinus latro Fab. has been taken by the writer on three occasions. The exact locality of specimens taken in 1950 is uncertain, but others were found in 1951 in warehouses in Vancouver and in Mission, B.C. These appear to be the first records of this insect in British Columbia. In Canada this species was first taken in Montreal in 1937. It was found again in Montreal in 1939 and in Toronto in 1940 (Brown, 1940). It is similar in appearance to *P. hirtellus*, the brown spider beetle. Hinton recorded it as cosmopolitan in distribution.

One specimen of *Mezium affine* Boiel. was found in a warehouse in Vancouver by the writer. In the same area in the warehouse were several of three other species, namely, *Trigonogenius globulus, Niptus hololeucus,* and *Ptinus ocellus. M. affine* was reported previously by Prof. G. J. Spencer, University of British Columbia (verbal communication, 1951), as having been taken in dwelling places and being reared in his laboratory on fox chow. Hinton (1941) reported the distribution of *M. affine* as being restricted to Europe and North Africa. Brown (1944) recorded that it occurred in the United States as early as 1904 and is convinced that all specimens from Canada that have been recorded as of *M. americanum* (Lap.) should be referred to as *M. affine* Boiel. The latter species is found in northeastern United States as well, whereas *M. americanum* has a more southern distribution, being recorded from Texas and Florida.

Spencer (1942) also reported having taken *Sphaericus gibboides* (Boiel.) in British Columbia and rearing it successfully in the laboratory. Hinton (1941) reported this species from California, southern Europe, and North Africa.

There is some doubt as to the identity of the other species of spider beetle found in British Columbia. Two specimens were taken in Vancouver by the writer, which have been tentatively identified by W. J. Brown as of *Ptinus* sp., probably *hirtellus* Sturm, possibly *latro* Fab. If it is the brown spider beetle, *P. hirtellus,* it is a cosmopolitan species (Hinton, 1941), reported from many localities in the United States but previously recorded in Canada only from Toronto and Kingsville, Ontario, and at Lunenburg, Nova Scotia (Brown, 1940).

The writer is indebted to Mr. W. J. Brown, Systematic Entomology, Division of Entomology, Ottawa, for identification of species.

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THE ENTOMOLOGICAL SOCIETY OF CANADA[1]

W. A. ROSS
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I believe members of the Entomological Society of British Columbia are aware that at the 87th Annual Meeting of the Entomological Society of Ontario, held at Guelph on November 1-3, 1950, it was decided to form a national society to be called The Entomological Society of Canada. This very important event in the history of Canadian Entomology was the outcome of several years of study by a committee set up to implement the oft-expressed desire of Canadian entomologists to have a truly national association in this country. I shall not take the time to discuss the problems the committee encountered; suffice is it to say that all of them were happily solved.

Although the constitution of The Entomological Society of Canada has not yet been written and approved, I can give you, on the basis of the resolution adopted at the Guelph meeting, an outline of the important functions of the association.

The new society will serve not as the parent of but simply as the link between the Acadian Entomological Society, the Entomological Society of Quebec, the Entomological Society of Ontario, the Entomological Society of Manitoba, the Entomological Society of British Columbia and any others that may be established. It seemed evident to those of us who had given careful thought to the advancement of the science of entomology by learned societies, that such advancement could be brought about most successfully in this country of ours, with its great distances and with its many local variations and needs, by placing the greatest emphasis on the fostering of regional societies. Therefore, each regional society will be autonomous, with authority to set up its own constitution and by-laws and its membership and annual dues, and to publish, if it so desires, its own annual report, *e.g.*, the annual reports of the Entomological Society of Ontario, the Entomological Society of Manitoba, and the Entomological Society of British Columbia. (There is a little matter in connection with annual reports which I should deal with here. All members of the Entomological Society of Canada as well as subscribers to the Canadian Entomologist will continue to receive the Annual Report of the Entomological Society of Ontario. We have to thank the Ontario Society and the Ontario Department of Agriculture for this generous arrangement. But it does not follow that other regional societies will want or be able to do the same sort of thing. What they do with their annual reports in the matter of distribution, etc., will be entirely their own business.) The national organization will promote the welfare of the regional entomological societies and will encourage the formation of others. It will do nothing that might conceivably weaken them and in no sense will it dominate them. In brief, it will serve as the link in a Canadian commonwealth of regional autonomous societies.

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[1]Presented at the 50th Anniversary Meetings of the Entomological Society of British Columbia in Vancouver, June 14-16, 1952.

The Entomological Society of Canada publishes The Canadian Entomologist and it shares this responsibility with the Entomological Society of Ontario for two good reasons, one historical and sentimental, and the other financial: (1) It should never be forgotten that the Entomological Society of Ontario founded The Canadian Entomologist and was responsible for its publication for 82 years; (2) By maintaining a direct and financial interest in The Canadian Entomologist, the Entomological Society of Ontario is still eligible for the Ontario Government grant which will be used as a contribution to the cost of printing The Canadian Entomologist.

When the constitution is drafted and adopted, I hope it will be possible to say that membership in the Entomological Society of Canada is open to all persons, no matter where they live, whose pursuits or studies are connected with entomology or who are interested in natural history. Be that as it may, in the meantime I can say that all entomologists in Canada are eligible for membership in the Canadian Society. But, again with the idea of fostering and featuring the regional society, there are two classes of fees:—

1. For entomologists in an area not served by a regional society, for example Saskatchewan, the membership fee for 1951 is $4.00 and this is payable to our Treasurer, Mr. A. B. Baird.
2. For entomologists who are members of regional societies, the membership fee in the Entomological Society of Canada is $3.00, payable to the Secretary-Treasurer of one of the local societies.

It follows, therefore, that most of the dues will be collected by the regional societies. I suppose it is scarcely necessary to point out that the $3.00 fee is additional to the local society fee and that the size of the local fee is entirely the affair of the regional organization.

The annual meeting of the National Society will always be held jointly with the annual meeting of one of the regional societies, *e.g.*, with the Entomological Society of Ontario in 1951, possibly with the Entomological Society of Quebec in 1952, with the Entomological Society of Manitoba in 1953 and so on. This will avoid the holding of too many major entomological meetings in Canada, will be less apt than any other arrangement to weaken the attendance at regional society meetings and will make it possible for most Canadian entomologists to attend at least one national meeting every several years. Incidentally the first annual meeting of the Canadian society will be held jointly with the 88th Annual Meeting of the Entomological Society of Ontario, November 1, 2, and 3, in Ottawa —fittingly—in Ottawa, the capital of Canada, and also the headquarters of the national society. I sincerely hope it will be possible for a number of your members to attend this historic meeting.

I should like to say a special word about our journal, The Canadian Entomologist. As I have already mentioned, it is the responsibility of the Entomological Society of Canada to publish this journal regularly, to maintain high standards in it, and to keep it solvent, but the editor of the journal and the other society officers, cannot carry this responsibility without the whole-hearted support and co-operation of the regional societies. Each regional society, therefore, must exert every effort to enlist practically 100 per cent. of its members in the Entomological Society of Canada and to provide the editor of the journal with papers of high quality. The future status of The Canadian Entomologist and of the Entomological Society of Canada will be determined very largely by the amount of support afforded them by the regional societies and by all entomologists in this country.

LIST OF THE ELATERIDAE OF BRITISH COLUMBIA

M. C. LANE[1]
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Some of the species of the coleopterous family Elateridae, commonly known as wireworms or click beetles, have long been known as important insect pests of agricultural crops. In connection with the research on the life history and control of these economic forms, it is also desirable to learn as much as possible about their distribution, as well as that of related non-economic species. Distribution records are obtained by collecting and publishing the results. There are all too few publications of this sort. The present list has been compiled from a rather extensive list of articles and references to the Coleoptera of British Columbia, brought together by M. H. Hatch, from original descriptions, from revisional publications, and from recent collections made or seen by the author. The earliest list of Elateridae for British Columbia is one of 28 species recorded from Vancouver Island by LeConte in 1869. This was followed by other lists by LeConte and many others until 1927-1928, when G. H. Hardy published two lists, one of species from Garibaldi Park and another of species on Vancouver Island.

The author has been collecting this family in the Pacific Northwest since 1917, as well as receiving considerable material from other entomologists for determination. Many private and semi-official collections have been checked, including the very fine and extensive collection of Gordon Stace-Smith of Creston, B.C. In a short visit to Vancouver Island in June, 1950, the writer collected 17 species of Elateridae adults in two days on the home grounds of his host, Kenneth M. King, at Victoria, as an example of the concentration of species that sometimes occurs under favorable circumstances.

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Altogether, there appear to be at least 74 authentically determined species on Vancouver Island alone, of which 19 species have been recorded from the Island only, although they may also occur on the mainland. There are 129 species listed as present on the mainland of British Columbia, 55 of which are also found on the Island. The list here appended includes a total of 150 species of Elateridae for the Province of British Columbia. From the literature and from collections made in adjoining areas, there are probably about 25 more described species that should eventually be recorded as occurring in British Columbia. It is a very large Province and, undoubtedly, many new species are yet to be discovered. This paper is written in the hope that it will provide an incentive for further collecting and the discovery of new species.

Acknowledgment is due to the following workers for studies or for material collected in the group on which this list is based: E. C. Van Dyke, W. J. Brown, H. B. Leech, Ralph and George Hopping, K. M. King, M. H. Hatch, Gordon Stace-Smith, Richard Guppy, C. L. Nielson, D. J. Finlayson, H. R. MacCarthy, W. H. A. Preece, R. H. Handford, and others whom I may have overlooked.

LIST OF ELATERIDAE OF BRITISH COLUMBIA

* Species occurring on Vancouver Island only.
** Species occurring on the mainland only.
Unmarked species occur on both the island and mainland.
"auct." as used here refers to a name used erroneously by the determiner, in most cases eastern names of species later described as western.

Lepidotus Stephens, 1830
(*Lacon* Cast. *Adelocera* auct.)
**brevicornis (LeC.)
**obtectus (Say)
profusus (Cand.) (*cavicollis* (LeC.))
rorulentus (LeC.) (*prysolepis* auct.)
**sparsus (Cand.)

Alaus Esch., 1829
melanops Lec. (*oculatus* auct.)

Drasterius Esch., 1829 (*Aeolus* auct.)
debilis Lec.
**dorsalis (Say) (*mellillus* (Say), *comis* (LeC.)

Limonius Esch., 1829 (*Pheletes* Kies.)
**aeger LeC.
*bicolor Van D.
canus Lec. (*discoideus* LeC.)
*californicus (Mann.) (*occidentalis* LeC.)
consimilis Walk. (*nitidicollis* LeC.)
**crotchi Horn
*humidus Lane
infuscatus Mots.
nitidulus Horn
**pectoralis LeC.
**rufihumeralis Lane
**seminudus Van D.
subauratus LeC.
**venablesi Wick.

Elathous Reitt., 1890
nebulosus (Van D.)

Athous Esch., 1829
*imitans Fall
nigropilis Mots.
pallidipennis Mann.
rufiventris (Esch.) (*ferruginosus* (Esch.))
scissus LeC.
vittiger LeC.

Ctenicera Latr., 1829 (*Corymbites* Latr., *Ludius* Esch.)
aereipennis (Kby.)
angularis (LeC.)
angusticollis (Mann.) (*fraterna* (LeC.), *spectabilis* (Mann.))
**bipunctata (Brown)
bombycina (Germ.) (*fallax* auct.)
callida (Brown) (*inflatus* auct.)
**carbo (LeC.)
columbiana (Brown) (*propola* auct., *furcifer* auct., *nubilis* auct.)
comes (Brown)
**conjungens (LeC.)
**crestonensis (Brown)
**festiva (LeC.) (*cruciatus* auct., *pulcher* auct.)
*diversicolor (Esch.) (*rotundicollis* auct.)
**funerea (Brown) (*semivittatus* auct., *fusculus* auct.)
*furtivua (LeC.) (*monticola* auct.)
**glauca (Germ.) (*inflatus* auct.)
hoppingi (Van D.)
**kendalli (Kby.) (*aeneicollis* auct.)
**laricis (Brown)
*lateralis (LeC.)
lobata (Esch.) (*caricina* (Germ.), *telum* (LeC.), *tarsalis* auct.)
**lutescens (Fall)
**maura (LeC.)
**mendax (LeC.)
**moerens (LeC.)
**montana (Brown)
**morula (LeC.)
nebraskensis (Bland.)
*nigricans (Fall)
**nigricollis (Bland.) (*vernalis* auct.)
**ochreipennis (LeC.)
*opacula (LeC.)
**protracta (LeC.)
**pruinina (Horn) (*noxia* (Hysl.))
pudica (Brown) (*hieroglyphicus* auct.)
**pygmaea (Van D.)
resplendens (Esch.)
**rupestris (Germ.)
sagitticollis (Esch.) (*insidiosa* auct.)
**semimetallica (Walk.)
**silvatica (Van D.)
**stricklandi (Brown)
suckleyi (LeC.)
**triundulata (Rand.)
*uliginosa (Van D.)
**umbricola (Esch.) (*rudis* (mots.))
umbripennis (LeC.) (*gracilor* (LeC.))
**vidua (Brown)
**volitans (Esch.)
weidti (Angell)

Eanus LeC., 1861 (*Paranomus* Kies.)
**albertanus Brown
**decoratus (Mann.)
granicollis Van D.
striatipennis Brown

Hemicrepidius Germ., 1839 (*Asaphes* Kby.)
morio (LeC.) (*dilaticollis* auct.)
oregonus (LeC.)
*tumescens (LeC.)

Hypolithus Esch. 1829 (*Cryptohypnus* Esch., *Hypnoidus* Dillw. pars.)
**bicolor Esch. (*lucidulus* (Mann.))
funebris (Cand.) (*planatus* auct.)
**glacialis (Van D.) (*grandicollis* auct.)
**hyperboreus (Gyll.)
**impressicollis (Mann.) (*abbreviatus* auct.)
**nocturnus Esch.
**squalidus (LeC.)

Negastrius Thom., 1859 (*Cryptohypnus* Esch., *Hypnoidus* Dillw. pars.)
caurinus (Horn)
**gentilis (LeC.)
**manki (Fall)
*musculus (Esch.)
**ornatus (LeC.)
**pectoralis (Say)
**striatulus (LeC.)
**tumescens (LeC.)

Dalopius Esch., 1829 (*Dolopius* auct.)
**assellus Brown
*corvinus Brown
**fucatus Brown
**gartrelli Brown
**insolens Brown
insulanus Brown (*lateralis* auct.)
**maritimus Brown
spretus Brown
**suspectus Brown
tristis Brown

Sericus Esch., 1829 (*Sericosomus* auct.)
incongruus (LeC.) (*brunneus* auct.)

Agriotes Esch., 1829
**apicalis LeC.
**criddlei Van D.
ferrugineipennis LeC. (*fucosus* auct.)
*lineatus (L.)
*obscurus (L.)
*opaculus LeC.
sparsus LeC.
**tardus Brown
theveneti Horn

Agriotella Brown, 1933 (*Betarmon* auct.)
*columbiana Brown
occidentalis Brown
Ampedus Dej., 1833 (*Elater* Esch., nec Linn.)
**apicatus (Say)
**behrensi (Horn) (*cordifer* auct.)
bimaculatus (Van D.)
**brevis (Van D.)
carbonicolor (Esch.)
columbiana Brown (*varipilis* auct., *cordifer* auct.)
**hoppingi (Van D.)
**moerens (LeC.)
nigrinus (Hbst.) (*anthracinus* auct.)
oregonus (Schffr.)
phoenicopterus (Germ.)
**pullus (Germ.)
rhodopus (LeC.)
**ursinus (Van D.)
Megapenthes Kies., 1858
caprella (LeC.)
**nigriventris LeC.
**stigmosus (LeC.)
tartareus LeC.
Melanotus Esch., 1829
oregonensis (LeC.)
Cardiophorus Esch., 1829
**fenestratus LeC.
*latiusculus Esch.
*longior LeC. (*longulus* err.)
**mimeticus Horn (*edwardsi* auct.)
**pubescens Bl.
tenebrosus LeC. (*amplicollis* auct.)
**tumidicollis LeC.
Horistonotus Cand., 1860
**sufflatus (LeC.)

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THE EFFECT OF CERTAIN INSECTICIDES ON THE GERMINATION AND GROWTH OF ONIONS
I. INSECTICIDES APPLIED TO THE SOIL[1]

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Introduction: The onion maggot, *Hylemya antiqua* (Meig.), has for many years caused serious damage to onion crops throughout the interior of British Columbia. In 1950, insecticide trials were undertaken at the Kamloops laboratory to provide a more satisfactory and less expensive control for this pest than the commonly used calomel seed-treatment. As an extensive review of the literature revealed that practically no work had been done on the phytotoxicity of the

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insecticides to this crop, study was also directed toward whether certain insecticides when applied to the soil at commonly used rates would affect the onions.

The results of the latter study are dealt with in this paper. In a following paper, D. G. Finlayson discusses the effects of some of the newer insecticides when applied as seed treatments.

Methods and Materials: The experiment was conducted in clay pots in an insectary, so that attack by the onion maggot or other insects was prevented. There were six insecticidal treatments, the amounts being calculated on an area basis as follows:—

1) Dowfume W-85 emulsion (containing 83 per cent. by weight of ethylene dibromide) applied at the rate of nine U.S. gallons per acre.
2) Dowfume W-85 emulsion applied at the rate of 4.5 U.S. gallons per acre.
3) Aldrin, 2½ per cent. dust, applied at the rate of 100 pounds per acre.
4) Technical chlordane, 5 per cent. dust, applied at the rate of 200 pounds per acre.
5) Lindane, 1 per cent. dust, applied at the rate of 100 pounds per acre.
6) DDT, 5 per cent dust. applied at the rate of 200 pounds per acre.

These six treatments and a check were replicated four times, giving a total of 28 pots. Each treatment was applied once, the dust or the emulsion being sprinkled on and thoroughly mixed with sufficient uncontaminated, uniform, sandy loam soil for one seven-inch clay pot. Fifteen onion seeds of the Yellow Globe Danvers variety were planted at uniform depths, and at uniform spacing, in each pot. The pots were then set out in a randomized block design in an insectary that was covered with 14-mesh galvanized wire screen. Equal amounts of water were applied daily to all pots.

In determining the effects of the treatments on the onion seeds and seedlings, emergence of the plants from the soil, weight, height, colour, uniformity of the top growth, and plant survival were the criteria used. The number of emerged plants was recorded from thrice-weekly counts for each pot. Growth was determined by noting the total weight of all the plants in each pot at harvest and calculating the average. Notes were also made during the growing season and at harvest on height, uniformity of top growth, and variations in colour of the top growth.

Results and discussion: Table I shows the effects of the various treatments on total plant weight, average plant weight, and total number of plants. None of the insecticides used with the possible exception of chlordane, adversely affected the emergence or growth of onion seedlings. All treatments, except that of chlordane, exceeded the check treatment in the number of plants emerging and in the total weight of plant material produced. DDT and lindane produced slightly smaller plants than the checks, whereas the other treatments produced plants that were as large as or larger than those in the check. The total plant weights suggest that aldrin and the 4.5-gallon rate of ethylene dibromide stimulated emergence and plant growth. DDT, the nine-gallon rate of ethylene dibromide and lindane, in that order, also showed indications of favourable effects, but to a lesser degree. However, in each instance the favourable effect was due to stimulation of emergence rather than of growth.

Each of the treatments except chlordane stimulated emergence somewhat. During the first three weeks, emergence and plant survival were slightly greater for ethylene dibromide at nine gallons and 4.5 gallons. The chlordane caused a high mortality after emergence. The aldrin had a delaying effect on emergence for the first twelve days, later, emergence and growth appeared to be stimulated.

The DDT and lindane treatments appeared to hinder rather than promote growth.

Although none of the results of this experiment was statistically significant the results of some of the treatments appeared fairly definite. In some instances they support and in other instances contradict, statements made by other workers who have written on the phytotoxicity of insecticides. Much of this published material is so contradictory that it appears to be meaningless. Thorough investigation of such factors as plant species and variety, soil fertility, soil texture, soil moisture, fertilizers, climatic conditions, and their relationship to insecticides is urgently required as a prerequisite to further work on phytotoxicity. A compilation of all the material on the phytotoxicity of insecticides and a set of standard procedures to permit consistent results are necessary before sound experimentation of this type can be undertaken.

Summary: Five insecticides were incorporated into the soil in pots to find the effect on the germination of onion seeds of the Yellow Globe Danvers variety and on the growth of the resulting plants. All of the treatments except one produced more total plant material than the checks, but none was statistically better or worse than the untreated check.

Acknowledgments: The author acknowledges with thanks the assistance given by Dr. R. H. Handford, Officer-in-Charge, Field Crop Insect Laboratory, Kamloops, B.C., in the planning of the experimental work and in the writing of this paper. The author also wishes to express his appreciation to Dr. G. H. Harris, Professor of Plant Nutrition, Department of Horticulture, University of British Columbia, for advice on the statistical analysis of the data.

TABLE I.

Effect of one soil application of each of various insecticides on onion plants in four replications.

Treatment	Application Rate per Acre	Total Number of plants		Weight of Plants at Harvest	
		Emerged	At Harvest[1]	Average[2] (grams)	Total[3] (grams)
Chlordane 5% dust	200 lb.	27	21	0.573	12.0
Check	nil	30	27	0.477	12.9
Lindane 1% dust	200 lb.	34	31	0.465	14.4
Dowfume W-85	9 U.S. gal.	35	32	0.478	15.3
DDT, 5% dust	200 lb.	37	34	0.467	15.9
Aldrin, 2½% dust	100 lb.	36	33	0.507	16.7
Dowfume W-85	4.5 U.S. gal.	38	32	0.559	17.9

[1]Difference necessary for significance at 5% level—14.
[2]Difference necessary for significance at 5% level—0.156.
[3]Difference necessary for significance at 5% level—6.4.

THE EFFECT OF CERTAIN INSECTICIDES ON THE GERMINATION AND GROWTH OF ONIONS
II. INSECTICIDES APPLIED TO THE SEED[1]

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INTRODUCTION

In 1949, it appeared that the recommended calomel seed-treatment did not satisfactorily control the onion maggot, *Hylemya antiqua* (Meig.), in seedling onions in the interior of British Columbia. Because of this, and its excessive cost, an investigation of the control of this pest with some of the newer insecticides was initiated in 1950. Analyses of yield data showed significant differences between various treatments. These differences were not all directly attributable to the attack of the maggots, since some treatments produced yields almost twice as great as others with almost similar percentage damage. The lower yields appeared to occur where insecticides had been applied either directly to the seed or to the seed trench.

To investigate this point, germination tests, the results of which are presented below, were conducted in the greenhouse during the winter of 1950-51. Further tests were conducted in the laboratory throughout the summer of 1951.

METHODS AND MATERIALS

The chemicals investigated were wettable powders of DDT, toxaphene, BHC, chlordane, Aldrin, and dieldrin; emulsible concentrates of aldrin and dieldrin; and powdered calomel (mercurous chloride). These were applied in three ways:—

Stirring in slurries of wettable powder. Onion seeds were treated with a 25 per cent. concentration of actual insecticide in water for each of the following: DDT, Toxaphene, BHC, chlordane, aldrin, and dieldrin. The seeds were stirred into the slurry for 5 minutes and the mixture was then poured through a 20-mesh copper screen to drain off the excess liquid. The seeds were placed on paper towelling to dry and were agitated periodically by means of a glass rod to prevent them from adhering to one another, so that none of the chemical coating might be removed in separating the seeds.

Dipping in emulsions. The seeds were stirred into a 5 per cent. emulsion of each of aldrin and dieldrin for 1 minute, the mixture was then poured through a 20-mesh copper screen and the seeds were placed on paper towelling to dry.

Coating seed with dry powder. The seeds were first soaked in water for 5 minutes, and then mixed with an equal weight of calomel. When as much of the calomel as possible had adhered to the seeds, they were separated from the powder by screening. This procedure is commonly recommended for controlling the onion maggot.

In the greenhouse the seeds were grown in 8-inch flower pots and each of the 10 treatments was replicated 5 times. Each replicate (*i.e.,* 10 pots) was set up as a randomized block.

Seeding was done by hand, 100 seeds per pot. These were sown in concentric circles with about half an inch between seeds and about the same distance between circles.

The first germination count was made 8 days after the first seedlings began to appear. Two additional counts were made at intervals of 10 days. Although daily recording might have given higher counts the germinations obtained by the above method indicated those seedlings that had grown beyond the period when food was supplied by the seed. The count at which the maximum number of plants was recorded was considered the total germination for the treatment.

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Throughout the growing period the plants were checked periodically for toxicological symptoms. Conclusions were based on comparisons involving three aspects of growth: the root and leaf systems, the average green weight per plant, and the average dry weight per plant. The average green weight per plant was determined by carefully removing all plants from the pots after allowing the soil to become slightly dry, and then washing the clinging soil from the plants by immersing them in warm water. After the excess moisture had been removed they were weighed as a group for each pot and the average weight per plant was calculated. The average dry weight per plant was obtained by placing the plants in a warming oven at 80°C. until a constant weight was obtained.

In the laboratory tests wettable powders and emulsions were applied to seed of a different lot from that used in the soil tests. In this series, samples of ½ oz. of onion seed were treated with either a 25 per cent. concentration of actual insecticide in water from a wettable powder or a 5 per cent. emulsion from an emulsifiable concentrate. The following numbers of ounces of actual insecticide adhered to one pound of onion seed:

DDT (w.p.)	3.5
BHC (w.p.)	4.0
aldrin (w.p.)	2.5
dieldrin (w.p.)	2.1
chlordane (w.p.)	4.1
toxaphene (w.p.)	4.1
aldrin (emul.)	0.16
dieldrin (emul.)	0.07
calomel (approx.)	16.0

Germination tests were conducted periodically to determine whether storage of the chemically treated seeds in an open glass container affected germination. Four tests were completed in all. In the first three, single lots of 25 seeds were placed in 10-cm. petri dishes on two thicknesses of No. 1 filter paper and covered. The filter paper was moistened daily so that the quantity of water could be better controlled. Germination counts were begun on the fourth day after the seeds were set out and continued daily for the following 12 days. The fourth test was similar to the previous three except that it was initiated 110 days after treatment and consisted of 5 replications. In addition to the germination counts observations were made periodically on development of the seedlings, colour, and general vigour of the plants.

RESULTS

Germination in Soil

A 5 per cent. emulsion of aldrin or dieldrin appeared to retard by 10-15 days the germination of the seeds planted in soil, aldrin seeming to be more harmful than dieldrin. In addition to the delay, the percentage germination was significantly low for both of these treatments (Table I). Although there was a significant decrease in the percentage germination of seed treated with BHC, no delay was evident. Toxaphene and dieldrin wettable powder treatments produced results similar to those for BHC. The percentage germination for the treatments is shown in Table I.

No significant differences were present between the remaining treated and the untreated series.

Effect of Storage on Germination

The effects of storing the chemically treated seeds in an open-topped glass container are shown in Tables II and III. In seeds tested immediately after treatment, germination was delayed by all chemicals except BHC. Tests begun 30 and 80 days after treatment did not exhibit this condition; however, in tests begun 110 days after treatment a marked delay in germination occurred for each treatment.

In the seeds stored 0 to 80 days, the percentage germination was highly significantly low for aldrin emulsion and significantly low for dieldrin emulsion; all the other treatments had similar germination to that of the untreated seeds. For seeds stored 110 days all treatments caused delay in germination; significant differences appeared as early as the second day

TABLE I.

Percentage germinations, in pots, of onion seed treated with various insecticides

Treatment	Ounces of actual insecticide adhering to one pound of seed	Germination	
		Total[1]	Percentage
Chlordane, 40 per cent. wettable powder	4.1	120	24.0
Untreated		117	23.4
Aldrin, 50 per cent. wettable powder	2.5	103	20.6
DDT, 50 per cent. wettable powder	3.5	91	18.2
Calomel, 100 per cent. dry powder	16 (approx.)	90	18.0
Dieldrin, 50 per cent. wettable powder	2.1	87	17.6
Toxaphene, 40 per cent. wettable powder	4.1	73	14.6
BHC, 50 per cent wettable powder	4.0 (BHC)	52	10.4
Dieldrin, 5 per cent. emulsion	0.07	41	8.2
Aldrin, 5 per cent. emulsion	0.16	19	3.8

[1]Difference necessary for significance: 5 per cent. level, 27.2.

after germination commenced (Table III). By the second day DDT wettable powder. BHC wettable powder, and aldrin emulsion each caused significantly lower germination than aldrin, dieldrin, and toxaphene wettable powders. Chlordane wettable powder and dieldrin emulsion were not significantly different from either of these groups. However, by the twelfth day of germination, DDT, BHC, toxaphene, aldrin emulsion, and dieldrin emulsion treatments each gave significantly low counts.

Characteristics of Growth in Soil

Periodical observations indicated that plants grown from treated seed did not differ from those from untreated seed, except those from seed treated with BHC or chlordane. Plants grown from BHC-treated seed were stunted and stocky, the leaf portion being two to four times thicker than in the untreated plants. Within a week after germination these plants exhibited chlorosis, and necrosis was developing. Several such plants were removed from the soil, all showing the following characteristics: short, stubby, primary roots; no secondary root system; no root hairs; and little or no bulb. Later examination proved that the roots from all plants grown from BHC-treated seed had similar symptoms. Plants grown from seed treated with chlordane appeared to have larger root and leaf systems than those of the checks.

The treatments did not cause significant differences in either the average green weight or the average dry weight of the onion plants. As a result of reduced germination, however, the grand total of green and dry weights was significantly reduced by treatment with BHC, toxaphene, aldrin emulsion, or dieldrin emulsion.

TABLE II.

Germination counts, in petri dishes, of treated onion seed after storage for 0, 30, and 80 days in open-topped glass containers.

Treatment	Ounces of actual insecticide adhering to one pound of seed	Germination counts at 1, 6, and 12 days for 25 seeds								
		0 Days' Storage			30 Days' Storage			80 Days' Storage		
		1	6	12	1	6	12	1	6	12
Chlordane, 40 per cent. wettable powder	4.1	6	23	24	10	22	22	4	19	24
Untreated		10	22	22	17	22	22	15	25	25
Aldrin, 50 per cent. wettable powder	2.5	0	23	24	9	19	21	3	15	20
DDT, 50 per cent. wettable powder	3.5	2	21	21	9	22	23	5	15	22
Dieldrin, 50 per cent. wettable powder	2.1	0	22	23	14	23	23	9	18	21
Toxaphene, 40 per cent. wettable powder	4.1	0	21	22	11	21	21	8	16	20
BHC, 50 per cent. wettable powder	4.0 (BHC)	17	24	24	10	16	20	6	14	22
Dieldrin, 5 per cent. emulsion	0.07	0	16	18	8	10	12	6	15	21
Aldrin, 5 per cent. emulsion	0.16	0	7	10	0	2	4	0	1	2

Growth Characteristics in Petri Dishes

The toxicological symptoms observed in the seedlings grown in petri dishes from treated seeds were more pronounced. As the petri dishes were covered to maintain moisture content, fumigation may have been a factor. The relative sizes of the seedling plants for these tests are shown in Fig. 1.

The symptoms produced by BHC were the most pronounced. Chlorosis was present from the time of germination of the seeds until the death of the plants. The length of the sprout in BHC-treated seed did not exceed ½ inch, even 10-12 days after germination. On the other hand, in the untreated series, the young plants had dark-green leaves, secondary roots and root hairs, and small bulbs; and the leaf had begun to straighten from the "loop stage."

Other treatments that caused some difference in the development of the seedlings were chlordane wettable powder, toxaphene wettable powder, and aldrin emulsion. The seedlings of chlordane-treated seed exhibited a lack of root hairs, slight chlorosis, and a thickening at the neck of the bulbs. The two other treatments caused exactly opposite conditions: seedlings from toxaphene-treated seed had poorly developed root hairs, whereas those from aldrin emulsion-treated seed had root hairs that were longer and more abundant than those of the untreated seedlings.

TABLE III.

Germination counts, in petri dishes, of treated onion seed after storage for 110 days in open-topped glass containers.

Treatment	Ounces of actual insecticide adhering to one pound of seed	Germination counts at 2, 4, 6, 8, 10, and 12 days for 125 seeds					
		2[1]	4	6	8	10	12[1]
Chlordane, 40 per cent wettable powder	4.1	19	50	80	97	102	104
Untreated		118	121	123	124	124	124
Aldrin, 50 per cent. wettable powder	2.5	29	52	81	91	108	109
DDT, 50 per cent. wettable powder	3.5	6	33	67	86	95	100
Dieldrin, 50 per cent. wettable powder	2.1	30	68	91	97	102	105
Toxaphene, 40 per cent. wettable powder	4.1	27	50	73	86	89	93
BHC, 50 per cent. wettable powder	4.0 (BHC)	11	27	36	75	88	98
Dieldrin, 5 per cent. emulsion	0.07	18	39	65	79	85	87
Aldrin, 5 per cent. emulsion	0.16	2	5	12	22	29	35

[1]Difference necessary for significance, 5 per cent. level:
second day, 16.9,
twelfth day, 23.6.

DISCUSSION

Although the percentage germination of the onion seed used in soil was far from satisfactory, the potential rates of germination of treated and untreated seeds were similar. The germination for untreated seeds averaged only 24 per cent., which is far below that required for commercial seed. Nevertheless, the germination of seed treated with BHC wettable powder, dieldrin wettable powder, toxaphene wettable powder, a 5 per cent. emulsion of aldrin, or a 5 per cent. emulsion of dieldrin was significantly lower than that of the checks. In the last two treatments it is thought that germination was not retarded by the insecticides themselves, but by the liquid solvent used in the emulsion concentrate. If this be so it could either act as a mechanical barrier to the moisture necessary to produce germination or have a lethal effect on the embryo within the seed.

Germination tests conducted in petri dishes substantiated the results obtained for treated seeds used in soil, this seed giving almost 100 per cent. germination in the checks. Here again the germination of seeds treated with BHC, toxaphene, a 5 per cent. emulsion of aldrin, or a 5 per cent emulsion of dieldrin was significantly lower than for the checks. However, for one additional treated series, that of DDT, germination was significantly lower than for the checks.

Throughout the series of tests to determine the effect of storage on chemically treated seeds there was a delay in germination of all treated

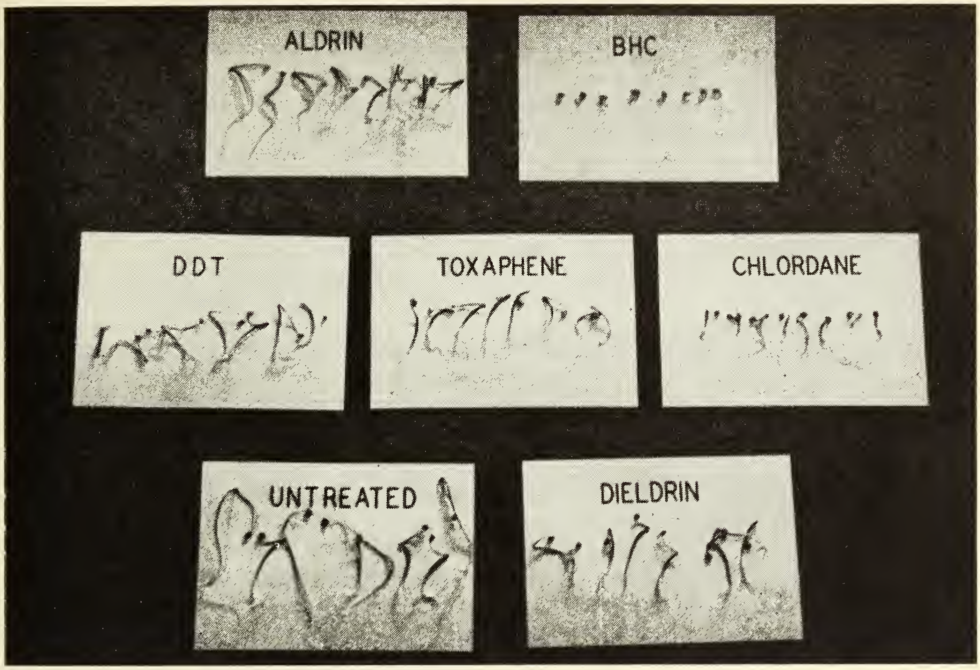

Fig. 1.—Growth produced by onion seeds treated with various insecticides and kept for 12 days in covered petri dishes after initial sprouting.

seeds except those treated with BHC. In this instance, the germination of seeds stored 0 days was similar to that for the checks. As the period of storage increased, the initial germination of the BHC-treated seeds decreased so that by 110 days after treatment all treated seeds had the same delay in germination.

Growth was apparently unaffected by the treatment of seed except in the case of BHC. In this treatment, although germination was significantly reduced, there were sufficient plants to observe its effect. Necrosis developed early, a factor found also by McLeod (1946) in his investigation on onion maggot control. J. R. Douglass and F. H. Shirck, U.S. Department of Agriculture, Twin Falls, Idaho (personal communication), found that wettable powder of lindane or chlordane applied to the seed trench at 0.46 or 1.4 pounds of active ingredient per acre, respectively, caused severe reduction in the onion stand; lindane caused 96.7 per cent. reduction, and chlordane 47.0 per cent. Although no serious effect on germination was observed for chlordane-treated seeds in the Kamloops tests, the necks of the bulbs were enlarged and chlorosis and necrosis appeared about the tenth day in the petri-dish tests.

SUMMARY

1. Germination of onion seed was adversely affected when the seed was treated with a wettable powder of DDT, BHC, dieldrin or toxaphene, or a 5 per cent. emulsion of aldrin, or a 5 per cent. emulsion of dieldrin. The solvent is suspected of being the toxic factor in the case of aldrin and dieldrin emulsions.

2. Growth of the onion plants, once the seed germinated, was not seriously affected by any of the treatments except that with BHC.

3. Storing of chemically treated onion seed in open glass dishes did not further seriously affect the eventual percentage germination, but it did delay germination.

ACKNOWLEDGMENTS

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Reference

McLeod, W. S. 1946. Hexachlorocyclohexane in the control of the onion maggot. J. Econ. Ent. 39: 631-637.

OBSERVATIONS ON THE STUDY OF BEETLES IN BRITISH COLUMBIA

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The study of the beetles or any other group of organisms in an area like British Columbia that was originally peripheral to the world centres of scientific study falls somewhat naturally into several periods. First there is a period of exploration, during which specimens are collected by itinerant scientific collectors and brought back to the centres of scientific activity where they are studied and reported upon. Eventually, however, itinerant collectors give way to resident collectors and the endemic study of the fauna gets under way. For long, however, the endemic collectors remain dependent on outside aid, and it is only gradually that fully endemic studies backed up by fully equipped museum and library facilities become established.

In British Columbia the first of the three periods in the study of the beetles was unusually transitory. The first beetles were not collected until about twenty-five years after the first specimens had been collected in the Oregon Country to the immediate south. In British Columbia, the first specimens to be taken seem to have been collected about the year 1859 to 1861 by the naturalists attached to the Anglo-American Northwest Boundary Commission. Dr. John L. LeConte of Philadelphia, the leading American student of the Coleoptera in the third quarter of the last century, records *Cicindela longilabris* Say and *Cupes serrata* LeC. in 1861 from "Camp Kootenay."[1] With lack of precision that is characteristic of the coleopterological work of the period, he failed to notice whether the "Camp Kootenay" referred to was the east crossing of the international border by the Kootenay River in Montana or its west crossing in Idaho. In either event, the specimens were as likely to have been taken on one side of the boundary line as on the other.

John Keast Lord, the British naturalist with the Commission in his *Naturalist in Vancouver Island and British Columbia,* 1866, refers to collecting beetles at least twice: once (Vol. II, p. 109) near Palouse-Falls in Washington, once (Vol. II, p. 123) along Slesse (Selece) Creek, a tributary of the Chilliwack River near Chilliwack. His list of 94 species of beetles published in an appendix[2] to his book, contains no intimation of localities. While some of the species listed probably were collected in British Columbia, others were not, and Lord is known to have travelled overland all the way from San Francisco to the Canadian border. His book shows him, moreover, to have been preoccupied with the vertebrates.

The real beginning of the scientific study of British Columbian beetles began with a collection made probably

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1 New species of Coleoptera inhabiting the Pacific district of the United States. Proc. Acad. Nat. Sci. of Philadelphia 1861, pp. 338-359.

in the late sixties in "Vancouver Island and British Columbia" by Henry and Joseph B. Matthews, brothers of the Rev. Andrew Matthews, the British microclepidopterist. The collection which Henry Matthews, who was likewise a clergyman, brought back to England with him in 1869, was submitted by Andrew Matthews to LeConte. LeConte published a list of 186 species in the Annals and Magazine of Natural History in the same year. He considered British Columbia and Vancouver Island to be at that time the least explored portions of North America.[3] Notable among the new species described here was our famous ground beetle, *Zacotus matthewsii.* Three years later Andrew Matthews described two species of Amphizoa from the same source.[4]

Though George Robert Crotch collected beetles about Victoria and along the Fraser River in 1873, these remained the only significant publications on British Columbian beetles for fifteen years.

What I would call the period of resident collectors extends in British Columbia from about 1882, when George W. Taylor settled on Vancouver Island, to about 1919, when Ralph Hopping was called to Vernon. The principal Coleoptera literature, pertaining to the Province, that appeared during this forty year period consisted of about a dozen or fifteen separate short lists plus an annual listing, beginning in 1902, of 25 or 30 or more species in the Annual Report of the Entomological Society of Ontario.

The first endemic beetle work in the Province was Taylor's 1886 list in the Canadian Entomologist of 76 species of Cicindelidae and Carabidae from the vicinity of Victoria, named for him by Henry Ulke of New York. Lists by Brodie (1888) and Wickham (1893) represent the work of itinerant collectors. The most ambitious paper was the list of 241 species from Massett collected by the Rev. J. H. Keen, published in the Canadian Entomologist in 1895. The identification of Keen's specimens was arranged for by James Fletcher of Ottawa, Dominion Entomologist, who solicited the aid of numerous coleopterists in the eastern United States and Europe. A beginning at a Provincial list was made in 1906-1907 in the abortive Bulletin of the British Columbia Entomological Society, 154 species in Cicindelidae, Buprestidae, Coccinellidae, and Cerambycidae being listed. The status of the knowledge of the beetle fauna as a whole is suggested by the 800 species which in 1906, were stated by the Secretary of the Society, R. V. Harvey of Queen's School, Vancouver, to be in the provisional unpublished list of the Society.[5]

The local collectors were completely dependent on coleopterists residing for the most part in eastern Canada and northeastern United States for their determinations, and the westerners' contribution consisted almost exclusively in collecting material and transcribing the names assigned to it by others. There was no attempt at independent study because, as W. Downes explained to me some years ago, of the almost complete lack of basic literature. This was a lack which neither the public nor the private financial resources of the region was able to make good. In this connection, one notes the acknowledgment of A. H. Bush, in a 1914 list of 106 species from Mount Cheam, of the help in identification of Dr. E. C. Van Dyke of San Francisco. The endemic centres of beetle-study were beginning to close in on the Pacific Northwest.

Turning to the economic bases of the beetle studies of this period, one notes

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2 List of Coleoptera, Vol. II, pp. 309-334. The list was prepared by Francis Walker (1809-1874), entomologist at the British Museum, whose authorship is attested to on p. 290. For comments on this publication see LeConte, Ann. Mag. Nat. Hist. 4 (6), 1870, pp. 395, 399-402.

Another similar publication is LeConte, **List of Coleoptera**, Geol. Surv. Can. Rept. of Prog. 1875-76, 1877, pp. 107-109. 145 species are listed; but there is nothing to indicate which of the species were taken in British Columbia and where, and which, if any, were secured in Alberta or even further east!

3 See selected bibliography at end of paper for citation of this and other papers mentioned.

4 Descriptions of two new species of Amphizoa from Vancouver's Island: **A. josephi, A. Lecontei,** Cistula Entom. I, 1872, pp. 119-122. See likewise A. Matthews' obituary notice of the Rev. H. Matthews (d. 1874) in Ent. Mo. Mag. XIV, 1877, pp. 38-39.

with interest that the two first resident workers, Taylor and Keen, were clergymen. This is evidence of the British influence, for during the 19th century several of the most important British coleopterists were clergymen. One searches in vain for a clergyman advancing the study of beetles at this time in the United States. A. W. Hanham, who was contributing heavily to "The Entomological Record" during this period, was manager of the Bank of British North America in Duncan. R. V. Harvey, who was working on a Provincial list, was a school teacher. E. P. Venables was a farmer in the vicinity of Vernon. E. M. Anderson was connected with the Provincial Museum in Victoria. J. B. Wallis, public school teacher of Winnipeg, collected extensively at Peachland in 1909. A. H. Bush was an engineer on the Canadian Pacific Railroad. W. H. Brittain, who published a list of 73 species of Coleoptera from the Okanagan district in 1904 was employed in economic entomology.

In these tentative "Observations on the Study of Beetles in British Columbia," I should like to suggest that a new period in the study of the beetles of the Province dates from about 1920. The University of British Columbia was established in 1915. Entomology was first taught there in 1919, and Professor G. J. Spencer joined the staff of the institution as entomologist in 1924. Professor Spencer is not a coleopterist, and his beetle-studies have been confined to some of the household species. He has, however, laid the foundations for a Provincial collection, and the institution which he serves seems to furnish the condition under which we can expect that fully endemic beetle-studies can be carried on.

More important than the University of British Columbia as a centre of beetle-study, especially during the late twenties, is the Provincial Museum at Victoria, where G. A. Hardy has published a number of reports on the Elateridae, Buprestidae, and Cerambycidae of Vancouver Island. Mr. Hardy, however, serves the Museum as Botanist as well as Entomologist. While the Museum's beetle collection is extensive, as late as 1949, at any rate, it is badly in need of consolidation in modern insect boxes or drawers.

The most important beetle-studies to have been conducted in British Columbia in the past thirty years were those under the leadership of Ralph Hopping, 1868-1941, from 1919 entomologist in charge of the Dominion Forest Insect Laboratory at Vernon. Beginning in 1925, Mr. Hopping was assisted at the Vernon laboratory by his son, George R. Hopping, and beginning in 1930, by Hugh B. Leech, both of whom became interested in the taxonomy of the Coleoptera and both of whom remained connected with the Vernon laboratory for eight or nine years following Ralph Hopping's retirement in 1939. The Hoppings concentrated on the Cerambycidae, in which family they produced an important series of monographs,[6] but Ralph Hopping's studies in particular extended over the beetles as a whole. On September 1, 1938, his unpublished card index of British Columbia beetles numbered 2070 species, a figure to be compared with the 1906 figure cited above of 800 species, and indicating the growth of knowledge in the intervening period. The collection at Vernon came to number about 10,000 species in about 97,000 specimens, including large amounts of British Columbia material. In accordance with Ralph Hopping's own desire, his collection was sold for a nominal sum by his widow to the California Academy of Sciences in 1948, making that institution one of the most important repositories of British Columbia beetles.

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5 Bull. Ent. Soc. B.C., No. 1, March 1906, p. 2. From 1901-1933 about 800 species of beetles were listed in the Coleoptera section of "The Entomological Record" which was published annually in the Annual Reports of the Entomological Society of Ontario from the 32nd Report for 1901, published in 1903, through the 61st Report of the Quebec Society for the Protection of Plants, published in 1934.

Hugh Leech specialized at first in both the Staphylinidae and the aquatic Coleoptera, later exclusively in the aquatic families. He has published a very extensive series of excellent short papers. In 1947, in order to secure the opportunity to concentrate on his taxonomic studies, he accepted the position of Associate Curator of Insects at the California Academy of Sciences, taking with him his collection of about 130 boxes of water beetles. With George Hopping's removal to Calgary the following year, the Vernon Group of coleopterists was dissolved.

A collector of beetles of some note in the vicinity of Terrace and Massett, in part some of the country formerly worked by the Rev. J. H. Keen, is Mrs. M. E. Clark of Terrace. As Mrs. W. W. Hippisley, she published some *Notes on Northern British Columbia Coleoptera* in the Canadian Entomologist (XLIV, pp. 63-66) in 1922. In 1948 and 1949 she published a list of 420 species of Cicindelidae through Coccinellidae in the Proceedings of our Society—the most extensive single list of species so far to have been published in British Columbia. Her specimens were named for her by C. A. Frost of Framingtham, Mass., who retained samples of most of her species, and she has recently deposited the residue of her collection at the University of British Columbia.

The leading presently active student of British Columbia beetles is Gordon Stace Smith, a mining foreman, now retired, of Creston. In 1929 and 1930, Stace Smith published a list of 323 species from Copper Mountain near Princeton, and he has one of the finest collections of the beetles of the Province ever assembled. Stace Smith represents the earlier collector-type of investigator, and he represents this type at its very best. An expert and indefatigable collector, he insists on the most precise preparation and labeling of every specimen. Each specimen, moreover, carries the names of the various coleopterists who have seen it and the names—not always congruent—that they have assigned to it. Stace Smith confines himself to the beetles of the Province, which he has represented in his collection in series up to 20 or 25 specimens of a species. At the end of 1950 he figured that he had representatives of a few over 2000 species of British Columbia beetles in his collection. He is, moreover, being of the utmost possible assistance to me in my work on *The Beetles of the Pacific Northwest.*

Finally, I have to mention Richard Guppy, of Wellington, near Nanaimo. Mr. Guppy confines his collection to Vancouver Island, and is proving very helpful in supplying material from that locality.

I now give some comparative figures on five collections of British Columbia beetles. In part I of my book, I recognize about 675 species of Northwestern beetles in the suborder Adephaga, which includes Carabidae, Dytiscidae, and related families. Of these 675 species, 511 are listed from British Columbia. Of these 511 species, I have found examples of 373 species in the collection of the California Academy of Sciences, 359 species in the collection of G. Stace Smith, 294 species in my collection at the University of Washington, 256 species in the collection of the University of British Columbia, and 157 species in the collections of the Provincial Museum at Victoria.*

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*Ed. Note.—Over 250 named species of this group are in the collection of the Vernon Forest Insect Laboratory.

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NOTES ON THE POPULATION AND PARASITISM OF THE LARCH SAWFLY, PRISTIPHORA ERICHSONII (HTG.) (HYMENOPTERA: TENTHREDINIDAE), IN BRITISH COLUMBIA[1]

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In British Columbia the larch sawfly, *Pristiphora erichsonii* (Htg.), was first reported in 1930 in an area about 30 miles north of Fernie. In 1933 a survey showed that the infestation covered a large area in and around Fernie. Cocoon samples were obtained at that time and were examined at the Forest Insect Laboratory, Vernon, B.C., and at the Dominion Parasite Laboratory, Belleville, Ont. No evidence of parasitism was found, and parasites were released in the infested area. The first colony of parasites, comprising 393 males and 280 females of *Mesoleius aulicus* (Grav.), was released in July, 1934, at Lizard Creek, 2 miles from Fernie.

P. erichsonii spread rapidly north and east following the distribution of western larch, *Larix occidentalis* Nutt., which, in the main, is confined to the southern interior of British Columbia. As parasites became available they were released in the newer areas of infestation to hasten establishment and distribution. Details concerning parasite releases and host distribution were given by Hopping, Leech, and Morgan (1943). At no time has *P. erichsonii* reached outbreak proportions in British Columbia except in isolated areas. The population in each of the heavily infested areas for which there are records became heavily parasitized by *M. aulicus* and subsided without serious injury to the trees.

In 1948 a project was initiated to provide colonies of *M. aulicus* from British Columbia for release in Western Ontario, Manitoba, and Saskatchewan. In that year 105,000 *P. erichsonii* cocoons, heavily parasitized by *M. aulicus,* were obtained. In 1949 one hundred and thirty thousand cocoons were collected. In 1950, after a thorough search of the infested area, only 2,500 cocoons were obtained. The numbers of cocoons collected in the 3 years do not accurately represent the change in population, but there was a reduction in 1950. All available data have been examined to determine the factor or factors responsible for the reduction in host population and its effect on *M. aulicus.*

In 1949 many of the larch trees in the infested area were affected with needle cast, the symptoms of which are a premature yellowing and early dropping of the needles. This caused some larval mortality during the feeding period, but no significant reduction in the number of cocoons collected in the most heavily infested area. It is possible that the viability of the larvae in the cocoons was reduced, but no evidence was obtained to support this theory. Emergence was normal from the 130,000 cocoons collected in October and November, 1949. and stored in an unheated laboratory room over winter, Random samples of cocoons taken from the 1948, 1949, and 1950 collections were dissected; the percentages of dead larvae were 16.5, 7.5, and 12.0, respectively (Table I). There was a decrease of 9.0 per cent. in larval mortality of *P. erichsonii* in 1949 rather than an increase, which would have occurred if needle cast had affected the viability of the larch sawfly larvae.

The winter of 1949-50 was unusually cold and a heavier-than-normal snowfall occurred. Weather records taken at the Grand Forks office of the Canada Department of Transport (14 miles from the infested area) show that the average temperature was below normal during the winter of 1949-50. On May 19, 1950, although much of the infested area was still covered with snow, a collection of cocoons was obtained. It was immediately

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placed in rearing at unheated room temperature (average, 62°F.) in Vancouver. The emergence from this collection was normal; therefore, it must be assumed that the reduction in population of *P. erichsonii* was not caused by winter mortality.

The next factor that was considered was parasitism. An increase in the percentage parasitism could have accounted for the decrease in the *P. erichsonii* population in 1950. However, there was a decrease in parasitism amounting to 6.7 per cent. (Table I).

TABLE I

Larval mortality, and parasitism, of *Pristiphora erichsonii* (Htg.) in British Columbia, 1948, 1949, and 1950.

	1948		1949		1950	
	Number	Per cent.	Number	Per cent	Number	Per cent.
Cocoons dissected	1464	100	536	100	441	100
P. erichsonii larvae						
dead (causes unknown)	248	16.5	40	7.5	53	12.0
living	1216	68.2	496	92.5	388	88.0
M. aulicus larvae						
living	829	83.5	305	61.5	213	54.9

Evidently, the mortalities caused by needle cast, winter weather, and parasitism were not responsible, individually or collectively, for the reduction in the population of *P. erichsonii* in 1950.

Finally, the diapause factor was considered. In British Columbia *P. erichsonii* normally completes its life-cycle in 1 year, but in 1950 there was evidence that a portion of the population remained in diapause. In September, 1950, the cocoons were most numerous in the area most heavily infested in 1949; previously, the centre of infestation had changed from year to year and had usually moved in a westerly direction. The cocoons were darker in colour than freshly formed cocoons normally are, and many of them were collected under trees from which cocoons had been taken in 1949. These trees showed fewer signs of larval feeding than would have been expected if the larvae that formed cocoons under them had fed on the 1950 foliage.

The first concrete evidence that some *P. erichsonii* remained in diapause throughout the summer of 1950 was found when the intact cocoons from a laboratory-reared collection were opened in August, 1950. There were 1,181 cocoons in the collection and of these 88, or 7.45 per cent., contained living *P. erichsonii* larvae. This percentage was not large enough to account for the important decrease in *P. erichsonii* population in 1950. During May and June; when normally diapause is broken and pupation occurs, the temperature in the laboratory was considerably higher than in the field. The average temperature in the laboratory was about 62°F.; at Grand Forks, which is about 1500 feet lower in elevation than the area of *P. erichsonii* infestation, the average temperatures during May and June were 51°F. and 61°F. respectively. The higher temperature in the laboratory could have been responsible for a smaller portion of the *P. erichsonii* larvae remaining in diapause in the laboratory than in the field.

TABLE II

Average weights of *P. erichsonii* cocoons in 3 size groups, 1949 and 1950.

Size of cocoons	1949		1950		Weight decrease, mg.
	Number	Average weight, mg.	Number	Average weight, mg.	
Large ($10\frac{3}{4}$ to less than $11\frac{3}{4}$mm.)	145	86.2	113	83.5	2.7
Medium ($9\frac{3}{4}$ to less than $10\frac{3}{4}$mm.)	170	73.6	229	69.2	3.4
Small (8 to less than $9\frac{3}{4}$mm.)	221	55.5	99	50.9	4.6

If a large portion of the *P. erichsonii* larvae did in fact remain in diapause in the cocoons during the summer of 1950, it would be expected that the cocoons collected in the autumn of 1950 would be similar in weight and size to those that were collected in the autumn of 1949. There was no important difference in the weights of cocoons in the two years (Table II). The slight decrease that occurred in 1950 could have been caused by desiccation during the summer of 1950.

However, there was an important difference in the percentages of medium and small cocoons (Table III). There was a large increase in the percentage of medium and a large decrease in the percentage of small cocoons in 1950. This seemed to be irrefutable evidence that the cocoons collected in 1950 could not have been part of the 1949 population as they must have been if the larvae in them had remained in diapause.

TABLE III

Percentages of large, medium, and small cocoons of *P. erichsonii*, 1949 and 1950.

Size of cocoons	1949		1950	
	Number	Per cent.	Number	Per cent
Large	145	27.1	113	25.6
Medium	170	31.7	229	51.9
Small	221	41.2	99	22.4

An explanation for this anomaly was found when the rearing data were examined. The random collection from which the 88 larvae remaining in diapause were dissected was comprised of 1,181 cocoons, and from these 634 adults of *M. aulicus* and 309 adults of *P. erichsonii* were incubated. The numbers of each and the number of *M. aulicus* that remained in diapause are shown in Fig. 1, each plotted point representing the number of specimens for a 5-mg. group; *e.g.*, from cocoons weighing 46 to 50 mg.

4 adults of *P. erichsonii* emerged. It was seen that there was complete emergence from all cocoons that weighed less than 60 mg. and that the insects remained in diapause only in the larger and heavier cocoons. The largest numbers that remained in diapause were in the 75-mg. group. This corresponds closely with 73.6 mg., the average weight of the medium-sized cocoons in 1949 (Table II). If this occurred in the field, it would explain the reduction in the number of small cocoons and the increase in the number of medium-sized cocoons in 1950 (Table III).

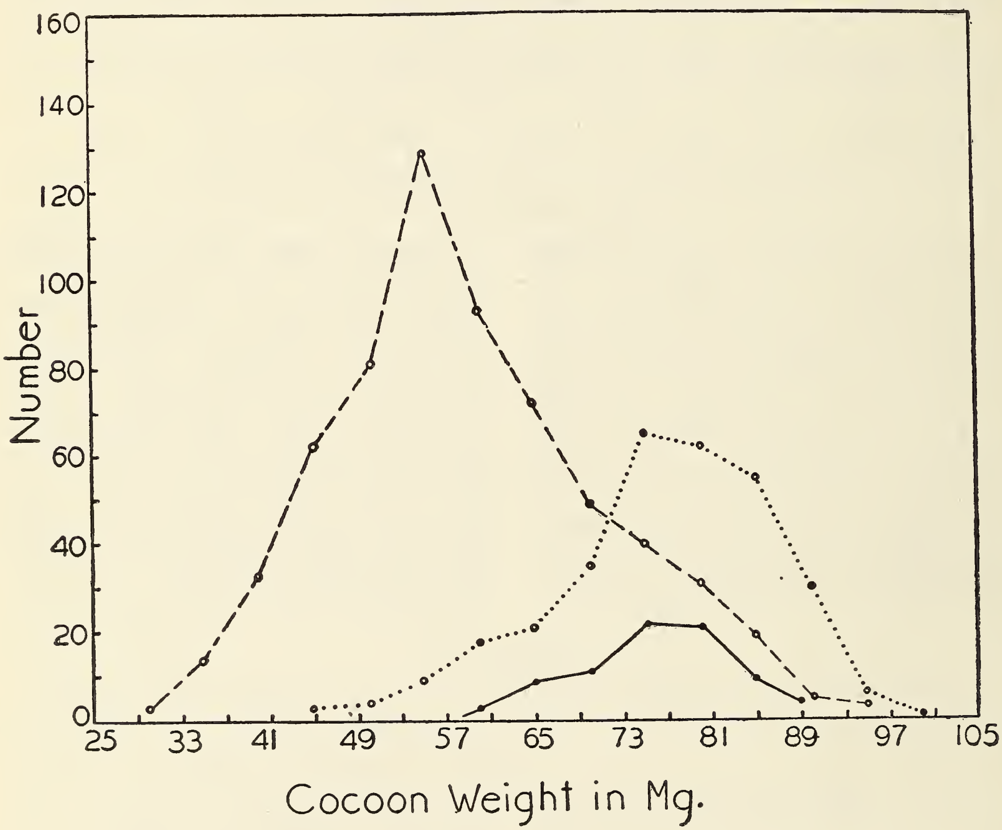

Fig. 1.—Numbers of adults of *Pristiphora erichsonii* (Htg.) (. . . .) and of *Mesoleius aulicus* (Grav.) (- - - -) that emerged, and numbers of larvae of *M. aulicus* remaining in diapause (————), from various weights of cocoons of *P. erichsonii* collected in British Columbia in 1949 and reared in 1950; each plotted point represents the number of specimens for a 5-mg. group, e.g., from cocoons weighing 46 to 50 mg. 4 adults of *P. erichsonii* emerged.

All the information obtained from field observation and laboratory rearing data supports the opinion that the reduction in abundance of *P. erichsonii* in 1950 was caused by a large portion of the population remaining in diapause. There was no evidence that needle cast, winter weather conditions, or parasites were responsible for the unusual population reduction.

Although parasites are not considered to have been responsible for the reduction in the population of *P. erichsonii* in 1950, they are an important control factor. This opinion is supported by the record of percentage parasitism obtained by dissection (Table I) and by the proportion of *M. aulicus* adults that emerged from the random collection of 1,181 cocoons of *P. erichsonii* collected in 1949 and reared in 1950 (Fig. 1). Further evidence of the effectiveness of *M. aulicus* was obtained when the diapause *P. erichsonii* larvae were dissected in August, 1950; 89.8 per cent. of them contained living *M. aulicus* larvae. This showed that the parasite had synchronized its development with that of the host, thus ensuring the continued effectiveness of the parasite.

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BIOLOGY AND CONTROL OF THE CHERRY CASEBEARER, COLEOPHORA PRUNIELLA CLEMENS, IN BRITISH COLUMBIA[1]

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An outbreak of the cherry casebearer, *Coleophora pruniella* Clem., occurred in two adjacent apple orchards at Creston in the Kootenay Valley in 1947. This is the first record of this species for the Province of British Columbia. The insect was reported causing serious damage to apple at Salem, Oregon, in 1937, by Hsiao and Mote (1939), marking the most westerly record for this species. Known since 1861, when it was described, the cherry casebearer has been a serious pest of both cherry and apple in the United States and Canada during the past 25 years. Petch and Armstrong (1926) recorded that apple orchards in the Lake St. Louis area of Quebec had been heavily infested for several years. These authors were the first to give adequate descriptions of all stages of the insect and an adequate account of the life-history. Petch and Maheux (1930) reported little damage to apple in Quebec from this species, whereas 5 per cent. injury was caused by the cigar casebearer, *Coleophora occidentis* Zell. The latter species, the only casebearer hitherto recorded as having caused damage to orchards in British Columbia, was reported by Treherne (1914, p. 25) to be present in every orchard of the Lower Fraser Valley in 1912-13. Later Glendenning (1923) noted its presence in that valley but not as a serious pest. Hutson (1931, '32) reported the cherry casebearer to be a spectacular pest of cherry in Michigan. Its depredations in orchards were first noted in 1929, although known on wild black cherry from the time of its description.

LOCALITY, VARIETIES OF FRUIT ATTACKED, AND SEVERITY OF INFESTATION

The coleophorid infestation was confined to two adjacent orchards one mile southeast of Creston, at the southern end of the Kootenay Valley. One orchard contained only mature McIntosh apple trees, the other a mixed planting with McIntosh predominating but including Delicious, Jonathan, Winter Banana, and scattered pears and cherries. All fruit varieties were attacked, McIntosh most severely; the heaviest infestation and damage occurred in the orchard with the mixed planting. The difference in severity of damage between the two orchards was due to an application of dormant oil-dinitro orthocresol to the McIntosh planting but not to the mixed planting.

The infestation was first noted in the fall of 1947, when the twigs and fruit spurs were literally covered with overwintering cases. Evidently some damage had occurred in 1947 but had not been reported by the growers. In

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1948 the injury to the developing foliage was severe, approximately 60 per cent. of the leaves on some trees being almost completely skeletonized. Set, size, and colour of fruit were markedly affected. Late summer damage by young larvae was noticeable but not severe. Injury in 1949 was light, because of the application of a dormant spray in each orchard.

LIFE-HISTORY

The life-history of *C. pruniella* in the the Kootenays follows in general that related for Quebec (Petch and Armstrong, 1926), Michigan (Hutson, 1931), and Oregon (Hsiao and Mote, 1939). Dates noted in the developmental period refer to 1948 records.

Egg.—The eggs are light yellow, convoluted, and conoid; they are laid singly, usually on lower leaf surfaces in mid-July (July 12-23). As many as 60 eggs were observed on one leaf. Thirty leaves taken at random from lower portions of trees averaged 20 eggs per leaf. The incubation period was approximately 10 days. Petch and Armstrong (1926) reported 18 days as the average period of incubation for Quebec, whereas Hsiao and Mote (1939) reported 14 days for Oregon. All eggs hatched by August 10.

Larva. — Eclosion occurs through the base of the egg, so that the larva never exposes itself as it commences to mine the area between the upper and lower epidermal layers. The egg shell serves as a protection for the larva and for the storage of frass, while the larva gradually bores its way through the leaf tissues, forming a blotch mine around the egg shell. It continues to feed in the original mine for 3 to 3.5 weeks before forming a case and becoming mobile. The earliest cases were observed on August 16; forming of cases was complete by September 2. The larva moves frequently once the case is formed, tunnelling out a small, almost circular mine at each feeding site, so that the leaves become "peppered" with mines. After continuing to feed for 4 to 6 weeks the larva moves to a twig or spur, there to overwinter. Although feeding is prolonged over a 7-week period, mining is slow and larvae do not increase greatly in size. The original case is enlarged at least once. The overwintering cases are about 3.5 mm. long and 1.0 mm. in diameter. The majority of the larvae had moved to overwintering quarters by October 15. The larvae move from winter quarters at the end of April, when they attack the opening leaves. They feed for approximately 7 weeks, during which two additions are made to the cases. Mining is extensive during this period, and leaf injury may be severe, appearing as skeletonized dead and brown areas varying in shape and size. There was no yellowing or leaf drop as reported by Hutson (1931) in Michigan.

Pupation:—When mature, the larvae usually move to the twigs to pupate; some, however, remain attached to leaves and others lower themselves to the ground by silken threads and move to the tree trunks. The pupation period is about 10 days. Hsiao and Mote (1939) reported a pupation period of 3 weeks, but this record may refer to the period between cessation of feeding and moth emergence. About 2 weeks after the larvae cease feeding (about June 7) the moths emerge.

Adult.—In 1948, moths commenced to emerge on June 25 and continued until July 12, with the peak of flight about July 11. At this time hundreds of moths were noted in the cover crop and on the lower limbs of each tree. The moth population then gradually declined toward the end of the month. The first eggs were noted on July 12, the majority being laid by July 23.

CHEMICAL CONTROL

The normal spray schedule for apple scab and the codling moth, consisting of 4 to 5 sprays of lime-sulphur and calcium arsenate commencing in the pink stage of apple development, was of no value in controlling this pest. Additional sprays of lead arsenate and cryolite also failed to have any effect. Petch and Armstrong (1926) and Hutson (1932) reported similar results with these materials. Treherne (1914), however, noted that lead arsenate applied before or after blossoming would control the cigar casebearer. Also, Gould (1936) reported control of the pistol casebearer, *C. malivorella* Riley, with lead arsenate. Hutson (1932) in Michigan, and Lilly and Fluke (1933, '34) in Wisconsin, reported effective control of the cherry casebearer with dormant oil 6 to 10 per cent. concentration. The latter authors found that a dormant lime-sulphur spray (1:8) in a fall application gave satisfactory control. The cigar casebearer, *Coleophora occidentis* Zell., in Norfolk County, Ontario, was not controlled with arsenicals, but dormant sprays of 1 per cent. "Elgetol" (20% dinitrocresol) or 0.5 per cent. "Elgetol" in 3 per cent. dormant oil emulsion gave excellent control (Hall, J. A., in litt., 1948). Of the chemical treatments applied at Creston, by far the most satisfactory was dormant oil, 2 gallons, and 40 per cent. dinitrocresol, 1.5 pounds, per 100 gallons of spray mixture.

NATURAL CONTROL

The egg, larval, and pupal stages of *C. pruniella* are known to be heavily parasitized. Petch and Armstrong (1926) reported 17 species of hymenopterous parasites in Quebec. Doner (1934) reared 32 species of parasites in Wisconsin; *Bracon pygmaeus* Prov., obtained from 70 per cent. of all parasitized larvae, was the most abundant. The same author (1936) recorded a long list of parasites, of which *B. pygmaeus* was again the most important. Total parasitism of mature larvae in Wisconsin ranged from 5 to 59 per cent. *Eurydinota lividicorpus* Gir. was the most common chalcidoid. Hsiao and Mote (1939) noted that these two parasites were important factors in the control of the pest in Oregon. Gould (1936) reared 36 species of parasitic Hymenoptera from the pistol casebearer, *C. malivorella* Riley; and later, Gould and Geissler (1940) reported a total of 40 species reared from the same host in West Virginia. Beacher (1947) recorded 15 species of parasites of *C. malivorella* in Pennsylvania and Delaware.

The species of hymenopterous parasites reared from the pistol casebearer are the same as those attacking the cherry casebearer. Indeed, some of these parasites, e.g., *E. lividicorpus*, attack only members of the genus *Coleophora*. The occurrence of this particular parasite in Creston indicates that the insect may have been present in that area for some time.

In 1948, some 500 encased larvae were collected from the infested Creston orchards in May and June. Five species of parasites were reared, including three chalcidoids and two ichneumonoids. The most abundant was the chalcid *Spilochalcis albifrons* (Walsh), which constituted 49 per cent. of the total. In 1949, 2,770 encased larvae were collected in May and July. Parasitism of larvae and pupae totalled approximately 15 per cent. and included 22 species, of which 16 were chalcidoids and the remainder ichneumonoids.

It was not possible to demonstrate the presence of egg parasites, although one such species, *Closterocerus* sp. near *tricinctus* (Ashm.). was reared from a mature coleophorid larva. The parasites reared may not all be primary parasites. Possible hyperparasitic species include *Gelis tenellus* (Say) and *Hypopteromalus percussor* Gir., although the former has been noted elsewhere as a primary parasite of *C. pruniella*. The limited number of individuals of some parasitic species suggests that their role as coleophorid parasites may have been accidental. The encyrtid *Copidosoma truncatellum* (Dalm.) is one of these. Three species, *G. tenellus*, *Closterocerus* sp. near *tricinctus*, and *Tetrastichus* sp., were found to have as alternate hosts two unidentified willow leaf miners. Examination of the figures for the relative abundance of the parasite species (Table I) indicates that the braconid wasp *Bracon pygmaeus* Prov. is the most important parasite of the cherry casebearer in Creston. *Tetrastichus* spp. and the chalcid *Spilochalcis albifrons* (Walsh) are next in importance.

TABLE I

Relative abundance of parasites of COLEOPHORA PRUNIELLA Clem. at Creston, B.C.

Species	Per cent. of total reared 1948	Per cent. of total reared 1949
Bracon pygmaeus Prov.	24.0	39.6
Tetrastichus sp.		12.6
Sympiesis sp. near *ancylae* Gir.		9.8
Spilochalcis albifrons (Walsh)	49.0	8.8
Hypopteromalus percussor Gir.		7.6
Gelis tenellus (Say)		7.1
Itoplectis obesus Cush.	14.0	5.5
Habrocytus thyridopterigis How.		3.5
Elachertus proteoteratis How.		1.3
Eurydinota lividicorpus Gir.		1.0
Closterocerus sp. near *tricinctus* (Ashm.)		0.5
Tetrastichus xanthops (Ratz.)	12.0	
Habrocytus phycidis Ashm.	1.0	
Other species (11)		2.7

A large number of the parasitic Hymenoptera reared from coleophorids at Creston are new records as casebearer parasites. However, the most important parasites, including *B. pygmaeus, S. albifrons, Tetrastichus* spp., *G. tenellus* and *E. lividicorpus,* are continentally widespread as parasites not only of *C. pruniella* but also of other coleophorids (Table 2).

LONGEVITY OF PARASITES

Studies were carried out on the longevities of some species of parasites reared from coleophorid larvae and pupae. Upon emergence from host cocoons, the parasites were transferred to shell vials, 5.5 inches in length and 1 inch in diameter, stoppered with corks. Dried raisins, pinned to the corks and wetted periodically, were supplied as food. Table 3 records the results.

TABLE II

Parasites of the Cherry Casebearer, COLEOPHORA PRUNIELLA Clemens, in British Columbia, and Records of Some of these Species from Quebec, Oregon, and the Pistol Casebearer, C. MALIVORELLA Riley

Species	Locality: British Columbia 1948	Locality: British Columbia 1949	Locality: Quebec*	Locality: Oregon**	Host: *C. malivorella****
HYMENOPTERA					
CHALCIDOIDEA					
CHALCIDIDAE					
Spilochalcis albifrons (Walsh)	X	X			X
ENCYRTIDAE					
Copidosoma truncatellum (Dalm.)		X			
EULOPHIDAE					
Horismenus sp. near *fraternus* (Fitch)		X			
Elachertus proteoteratis How.		X			
Chrysocharis sp.		X			
Closterocerus sp. near *tricinctus* (Ashm.)		X			
Sympiesis sp. near *ancylae* Gir.		X			
Pnigalio sp. near *tischeriae* Ashm.		X			
Sympiesis sp.		X			X
Tetrastichus sp.		X			X
Tetrastichus xanthops (Ratz.)	X				
PTEROMALIDAE					
Catolaccus aeneoviridis (Gir.)		X			X
Eurydinota lividicorpus Gir.		X	X	X	X
Habrocytus phycidis Ashm.	X				X
Habrocytus thyridopterigis How.		X			X
Habrocytus sp.		X			
?*Habrocytus* sp.		X			
Hypopteromalus percussor Gir.		X			
ICHNEUMONOIDEA					
BRACONIDAE					
Bracon pygmaeus Prov.	X	X	X	X	X
ICHNEUMONIDAE					
Gelis tenellus (Say)		X			X
Itoplectis obesus Cush.	X	X			
Itoplectis quadricingulatus (Prov.)		X			
Scambus hispae (Harr.)		X			

* Petch and Armstrong (1926)
** Hsiao and Mote (1939)
*** Beacher (1947), Pennsylvania and Delaware; Gould and Geissler (1940), West Virginia.

TABLE III

Longevities of parasites of the cherry casebearer

Species	No. of individuals	Length of life in days Maximum	Minimum	Mean
Bracon pygmaeus Prov.	20	77	5	36.9
Sympiesis sp. near *ancylae* Gir.	23	61	5	23.0
Spilochalcis albifrons (Walsh)	18	177	8	78.0
Gelis tenellus (Say)	8	81	8	50.4
Itoplectis obesus Cush.	10	33	1	16.8

The longest-lived of the parasites was *S. albifrons,* one specimen surviving for 177 days. The mean of 78.0 days is considerably higher than that of the next longest-lived species, *G. tenellus* (50.4 days). The maximum and mean longevities of *B. pygmaeus* (77 and 36.9 days) and *S. albifrons* (177 and 78.0 days) show a marked difference from the results found by Beacher (1947), who recorded 58.0 and 22.1 days for the former, and 10.0 and 8.0 days for the latter. Beacher used raisins for the food supply, but did not record supplying water, which may account for the differences.

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EFFECTS OF LOW WINTER TEMPERATURES ON SOME ORCHARD MITES[1]

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INTRODUCTION

Many observations have been made on the effects of abnormally severe winters on the mortality of insects, but very few records have been noted of the influence of such climatic conditions on the development of orchard mites. Yothers (1917), in discussing the effects of the freeze of February 2-4, 1917, upon citrus pests in Florida, stated that the rust mite, *Eriophyes oleivorus* Ashm., was nearly exterminated in those areas in which the minimum winter temperature varied from 15 to 20°F. Adults of the citrus red mite, *Paratetranychus citri* (McG.) [*Tetranychus citri* McG.,], were not affected, but the eggs were thought to have been killed, as the pest was not abundant the following summer. The mite *Tenuipalpus bioculatus* McG. was slightly reduced in number, but *Tetranychus yothersi* McG. appeared to have been seriously affected. Several other authors have published accounts of the influence of climatic factors on mite development, but these have been mainly concerned with the effects of summer temperatures on abundance.

The observations reported here were made in the Okanagan and Kootenay valleys of British Columbia during 1950, immediately after the coldest winter on record in Western Canada. Temperatures during November and December, 1949, did not fall below zero, but mean temperatures for December were one to four degrees below normal in the southern interior of the Province. Below-zero temperatures were common throughout January and the first few days of February, 1950. Records kept at the Summerland laboratory showed that these temperatures occurred in three cycles; the first from January 2 to 4 (minimum −9.0°F.), the second from January 13 to 18 (minimum −8.8°F.), and the third from January 24 to February 3 (minimum −15.9°F.). Minimum winter temperatures recorded at official weather stations were: −23°F. at Oliver, −16°F. at Penticton, −24°F. at Kelowna, −32°F. at Vernon, −37°F. at Kamloops, −16°F. at Nelson, and −20°F. at Creston. These temperatures were 15 to 20 degrees below normal in the interior valleys immediately north of the International Boundary (Boughner, 1950). As a result orchard trees of all types were severely damaged throughout the Okanagan Valley. In addition it might be expected that such abnormally low temperatures would have a detrimental effect on the invertebrate fauna of the orchards. It was the purpose of the investigation to determine the effects of the sub-zero temperatures on the mortalities of the overwintering forms of the following orchard mites: the European red mite, *Metatetranychus ulmi* (Koch); the two-spotted spider mite, *Tetranychus bimaculatus* Harvey; the Pacific mite, *Eotetranychus pacificus* (McG.); and *Eotetranychus flavus* (Ewing), known to growers as the yellow Willamette mite.

METHODS

Samples of overwintering mites were collected from the latter part of February to the end of April, 1950. Where possible these collections were made from a number of areas to obtain material subjected to various minimum winter temperatures. The minimum temperature given for each collection site was based largely on a compromise of records from a number of household thermometers and the nearest weather station, since the collection locale was often many miles from an official station.

European red mite mortality was determined by placing the spurs or twigs containing the winter eggs in

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TABLE I

Percentage Survival of European Red Mite Winter Eggs Subjected to Various Minimum Winter Temperatures and Incubated at 65, 75, or 85°F.

Area	Minimum winter temperature, °F.	Incubation temperature °F.	Eggs in sample	Survival per cent.
Nelson	—18	65	242	68.6
		75	453	62.3
		85	248	52.8
Oliver	—23	65	305	54.1
		75	102	46.1
		85	223	39.9
Vernon	—32	65	3079	15.8
		75	2674	12.6
		85	2542	10.4
Salmon Arm	—30 to —35	65	294	0.0
		75	500*	0.0
Salmon Arm	—35 to —38	65	489	0.0
		75	500*	0.0
Salmon Arm	—40	65	2500*	0.0

* Estimated

a constant temperature cabinet and incubating the eggs until they hatched. The eggs were incubated at 65, 75, or 85°F. and at a relative humidity of approximately 80 per cent.

The two-spotted spider mite, the Pacific mite, and the Willamette mite winter as mature females, generally in colonies under the bark scales of scaffold limbs and the trunk, and under fallen leaves and debris on the ground around the tree base. Mites that hibernate in the latter site obtain extra protection from cold by snow coverage. Accordingly, two samples of infested bark scales were taken at each collection point, one above snow line and the other below. These samples were gradually warmed to room temperature, and mortality was determined by comparing the numbers of living and dead mites. Only one collection of the Willamette mite was obtained, as at that time this mite was not known to occur in large numbers except in one orchard.

RESULTS

Differences in the survival of the European red mite winter eggs subjected to various low winter temperatures are shown in Table I. Between 52.8 and 68.6 per cent. of the eggs survived a temperature of −18°F. Where −32°F. was experienced, only 10.4 to 15.8 per cent. of the eggs remained alive. No larvae could be reared from eggs collected in the Salmon Arm area, where temperatures of −30 to −40°F. were common. The results indicated that all winter eggs of the European red mite would be killed by a minimum temperature between −32 and −35°F. and that this might be the minimum isotherm that could determine the possible northern limit of existence of this mite. Subsequent field observations, however, proved that this was not the case. Although the European red mite could not be found in the Salmon Arm orchards in June or July, 1950, several specimens were observed in August, and by the spring of 1951 it was common enough that control measures would probably be required sometime during the year. In the Okanagan Valley, the European red mite was not particularly troublesome in 1950, but this may have been due to the application of the parathion "pink" spray, which gave excellent control in the majority of orchards for the remainder of the season.

The results also indicate that a relatively cool spring may be more conducive to the occurrence of large populations of the European red mite than very warm weather when winter eggs are incubating. Fewer larvae were obtained when the eggs were incubated at 85°F. than at 75 or 65°F.

Mites that overwinter in the adult stage appear to be less resistant to extremely low temperatures than those, such as the European red mite, that overwinter as eggs. Of the three mites investigated that winter in the adult stage, the two-spotted spider mite may be the hardiest: 37.2 per cent. survived a temperature of −23°F., whereas only 5.6 to 6.2 per cent. of the wintering adults of the Pacific mite remained alive after being exposed to −22°F. and less than one per cent. of the adults of the Willamette mite survived a temperature of −20°F. Table II demonstrates the value of the protection offered by the snow cover, the survival being much higher below than above the snow line.

TABLE II

Percentage Survival of the Two-spotted Spider Mite, the Pacific Mite, and the Willamette Mite Subjected to Various Minimum Winter Temperatures.

Mite	Area	Minimum winter temperature °F.	Collection above or below snow line	Winter adults in sample	Survival per cent.
Two-spotted spider mite	Oliver	—23	above	3839	37.2
			below	1676	46.0
	Salmon Arm	—30	above	3000*	0.0
			below	457	31.3
	Kamloops	—37	above	3000*	0.0
Pacific mite	Summerland	—22	above	839	6.2
			above	1816	5.6
	Kelowna	—25	above	282	0.0
			below	220	41.8
	West Summerland	—30	above	2000*	0.1
			below	2593	35.1
Willamette mite	Summerland	—20	above	5000*	0.1
			below	5973	14.6

* Estimated

Although these three pests were greatly reduced in numbers in many areas, the reduction was not sufficient to be of economic importance to the fruit grower. In 1950, the two-spotted spider mite did more damage in the Okanagan Valley than at any time previously; severe infestations were very common from Penticton north to Salmon Arm. Pacific mite populations were slightly larger than in 1949, and medium to severe infestations occurred in several orchards. The Willamette mite, which was found in the fall of 1949 at Summerland for the first time in the Province, occurred throughout the Valley from the International Boundary north to Kamloops. Severe infestations developed in a number of orchards.

SUMMARY

In the British Columbia fruit- growing area the coldest winter on record occurred in 1950. Temperatures of −15 to −15°F. were common. This was 15 to 20 degrees below normal.

Field collections of the overwintering forms of the European red mite, the two-spotted spider mite, the Pacific mite, and the Willamette mite were made from the latter part of February to the end of April, 1950, to determine the effects of the low winter temperatures. Practically 100 per cent. of the European red mite winter eggs were killed in the Salmon Arm area, where temperatures of −30 to −40°F. were common. The European red mite was not found in this area until August, 1950, but by the spring of 1951 it was common enough that control measures were necessary. The two-spotted spider mite appeared to be the hardiest of the three forms that winter as adults. Although these three mites were greatly reduced in numbers by the cold winter, summer populations were larger during the growing season of 1950 than in 1949.

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A PRELIMINARY LIST OF THE HEMIPTERA OF THE KOOTENAY VALLEY[1]

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INTRODUCTION

Studies to determine the insect vector or vectors of the little cherry virus disease in the Kootenay Valley were carried out during the seasons of 1946-49. As part of the investigation a survey was made of the insects occurring on sweet cherry and other host plants common in the Valley. Although all orders of insects were collected, little interest was taken in other than the Hemiptera, since nearly all the virus vectors known belong to that order. The accompanying list forms only part of the total.

METHODS, HOSTS, AND COLLECTION AREA

Collecting was done by various means: (1) a sweeping net, (2) knockdown sprays and a large canvas ground sheet, (3) a hand suction apparatus, and (4) 6-inch-by-12-inch plywood boards coated with "Deadline" tanglefoot on one surface and hung by wire loops in tree or shrubs. The last-named method proved highly satisfactory and yielded species that were not taken from the same hosts by any other means. There was some difficulty in removing the tanglefoot from the specimens. The most successful procedure involved placing a drop of kerosene on each specimen, which was then loosened and removed from the board with dissecting

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needles and placed in a small beaker of kerosene. The beaker was warmed; the contents were gently swirled, and filtered through a number 4 Whatman filter paper. The insects were removed from the filter paper and placed in petroleum ether, gently swirled, and poured on to a dry filter paper. The petroleum ether quickly evaporated, and then the specimens were mounted or stored. Sometimes while the insects were in the kerosene and/or petroleum ether it was necessary to use fine dissecting needles to tease out large masses of the tanglefood trapped in the legs. The tanglefood collecting method was useful for most Hemiptera and Coleoptera, and some Diptera and Hymenoptera.

Regular collections were made from the following hosts throughout the growing season: sweet cherry, *Prunus avium* L.; wild cherry, *Prunus emarginata* (Dougl.) Walper var. *mollis* (Dougl.) Brewer; apple *Pyrus malus* L.; wild rose, *Rosa nutkana* Presl.; thimbleberry, *Rubus parviflorus* Nutt.; willow, *Salix* sp.; poplar, *Populus trichocarpa* T. & G.; red clover, *Trifolium pratense* L.; alfalfa, *Medicago sativa* L.; and cover crops: mixed grasses, clovers, and alfalfa.

Collections were made in the area limited by Creston, at the south end of Kootenay Lake; Kootenay Bay, 50 miles north, on the east side of the lake; Nelson, 50 miles north and 30 miles west, on the west arm of the lake; and Kaslo, 80 miles north, on the west side of the lake. Collections in 1946 were made by Mr. Harry Andison of the Fruit Insect Laboratory, Victoria, British Columbia.

DESIGNATION OF PLANT "HOSTS"

The indiscriminate usage of the term *host* has been the bane of taxonomists for some time, particularly in the Heteroptera and Homoptera. In the accompanying list the plant-insect relationship is designated as follows: where no symbol is given, the plant listed is one on which the insect species was collected, and does not imply a food or host-plant relationship. H (host) indicates a plant in which eggs were deposited and on which nymphal development occurred. F (food plant) indicates a plant known to be utilized as a source of food by adults. The additional symbol *Test* indicates that the insect species survived on sweet cherry, at least during the experimental period in vector feeding tests.

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TABLE I

HOMOPTERA

Insect Species	Collection Source
CICADELLIDAE	
Agallia quadripunctata (Prov.)	cover crop
Aceratagallia californica (Baker)	sweet cherry
Oncopsis pruni (Prov.)	cover crop, flying near willow
Oncopsis spp. (two)	flying near willow
Idiocerus spp. (two)	on cages surrounding test trees
Idiocerus spp. (five)	willow
Gyponana angulata (Spbg.)	cover crop
Gyponana serrata DeL.	thimbleberry, willow
Aphrodes albifrons (L.)	thimbleberry, poplar, cover crop, sweet cherry. Test
Aphrodes costata (Panz.)	cover crop, sweet cherry, thimbleberry
Draeculacephala sp.	cover crop
Neokolla hieroglyphica (Say)	cover crop
Dikraneura absenta DeL. & C.	sweet cherry, F; cover crop, F; poplar. Test
Dikraneura carneola (Stal)	sweet cherrv. Test

Dikraneura sp., prob. *carneola* (Stal)	cover crop
Dikrella cruentata Gill.	sweet cherry, F; thimbleberry, F. Test
Empoasca atrolabes Gill.	thimbleberry
Empoasca incida DeL.	willow, poplar
Empoasca maligna Walsh	sweet cherry, H; cover crop. Test
Empoasca deluda DeL.	cover crop
Empoasca sp. near *vincula* DeL.	wild cherry, sweet cherry . Test
Empoasca sp.	thimbleberry
Empoasca sp.	sweet cherry
Typhlocyba ariadne McA.	sweet cherry, F; cover crop; willow; thimbleberry. Test
Typhlocyba commissuralis Stal	willow. Test
Typhlocyba pomaria McA.	sweet cherry, H; wild cherry; cover crop. Test
Typhlocyba prunicola Edw.	sweet cherry
Typhlocyba rosae (L.)	wild rose, H; sweet cherry, H. Test
Typhlocyba sp.	sweet cherry, willow. Test
Typhlocyba sp.	sweet cherry, thimbleberry
Typhlocyba sp.	sweet cherry
Erythroneura sp. near *acicularis* Beam.	wild cherry. Test
Erythroneura aspera B. & G.	sweet cherry, F. Test
Erythroneura insigna B. & G.	sweet cherry. Test
Erythroneura plena Beam.	wild cherry, H; sweet cherry, F. Test
Erythroneura sp. *obliqua* group?	sweet cherry
Erythroneura sp.	sweet cherry, F; wild cherry. Test
Erythroneura sp.	wild cherry. Test
Erythroneura sp.	willow. Test
Scaphytopius acutus (Say)	thimbleberry, poplar, cover crop, sweet cherry. Test
Scaphytopius oregonensis (Baker)	sweet cherry
Balclutha punctata (Thumb.)	sweet cherry, cover crop. Test
Macrosteles divisus (Uhl.)	sweet cherry, cover crop. Test
Osbornellus borealis DeL. & M.	willow, sweet cherry
Colladonus flavocapitatus (Van D.)	poplar, wild cherry
Colladonus geminatus (Van D.)	cover crop; alfalfa, F; sweet cherry. Test
Colladonus montanus (Van D.)	cover crop; F; sweet cherry. Test.
Idiodonus cockerelli (Ball)	sweet cherry
Twiningia pellucida (Ball)	willow
Fitchana twiningi (Uhl.)	willow
Paraphlepsius bifidus (S. & DeL.)	sweet cherry
Euscelidius schenkii (Kbm.)	cover crop; red clover, F
Scleroracus sp.	cover crop. Test
Exitianus exitiosus (Uhl.)	sweet cherry, cover crop. Test
Psammotettix affinis (G. & B.)	sweet cherry
Psammotettix sp.	cover crop
Sorhoanus flavo-virens (G. & B.)	cover crop
Latalus sp.	cover crop
DELPHACIDAE	
Delphacodes consimilis (Van D.)	cover crop
Delphacodes pellucida (F.)	cover crop
Delphacodes sp.	cover crop
CERCOPIDAE	
Philaenus leucophthalmus (L.)	sweet cherry; cover crop, H; thimbleberry; wild cherry. Test
Aphrophora permutata Uhl.	cover crop, on cages enclosing cherry trees
Clastoptera obtusa var. *tristis* Van D.	willow
PSYLLIDAE	
Psylla trimaculata var *astigmata* Crawf.	sweet cherry, F; willow; wild cherry, F. Test
Aphalara persicaria Cald.	cover crop
CICADIDAE	
Platypedia areolata (Uhl.)	sweet cherry, on cages enclosing cherry trees
Okanagana vanduzeei Dist.	sweet cherry
MEMBRACIDAE	
Telamona pyramidata Uhl.	willow

APHIDIDAE	
Myzus cerasi (F.)	sweet cherry, H. Test
COCCIDAE	
Phenacoccus aceris (Sign.)	sweet cherry, H; apple, H. Test

HETEROPTERA

TINGIDIDAE	
Corythucha mollicula O. & D.	willow, F. Test
PENTATOMIDAE	
Euschistus variolarius (P.B.)	cover crop, on cages enclosing cherry trees. Test
Cosmopepla bimaculata (Thom.)	cover crop. Test
Eurygaster alternatus (Say)	cover crop
Meadorus lateralis (Say)	thimbleberry, willow
ARADIDAE	
Aradus funestus Bergr.	on cages enclosing cherry trees
Aradus inornatus Uhl.	on cages enclosing cherry trees
Mezira pacifica Usinger	on cages enclosing cherry trees
NABIDAE	
Nabis alternatus Parsh.	cover crop
Nabis rufusculus Reuter	cover crop
LYGAEIDAE	
Stignocoris rusticus (Fall.)	sweet cherry, cover crop. Test
Kleidocerys franciscanus Stal	cover crop
Kleidocerys resedae (Panz.)	on cages enclosing cherry trees
MIRIDAE	
Stenotus binotatus (F.)	cover crop
Miris dolobratus (L.)	cover crop
Stenodema virens (L.)	cover crop
Capsus ater (L.)	cover crop
Lygus hesperus Knight	cover crop
Lygus elisus Van D.	cover crop
Lygus shulli Knight	cover crop, H; wild cherry. Test
Lygus ceanothi deleticus Knight	thimbleberry
Lygus sp.	sweet cherry
Deraeocoris fasciolus Knight	sweet cherry. Test
Deraeocoris sp.	sweet cherry
Phytocoris interspersus Uhl.	willow
Phytocoris hesperius Knight	poplar
Plagiognathus obscurus Uhl.	cover crop
Plagiognathus chrysanthemi (Wolff)	cover crop
Hyaliodes harti Knight	willow, sweet cherry, cover crop. Test
Diaphnidia pellucida Uhl.	willow
Dicyphus sp.	thimbleberry. Test
Pilophorus sp.	willow

Summary

A preliminary list of 108 species of Hemiptera collected in the Kootenay Valley of British Columbia from 1946 to 1949 is recorded. These include 63 species of Cicadellidae, 3 of Delphacidae, 3 of Cercopidae, 2 of Psyllidae, 2 of Cicadidae, 1 of Membracidae, 1 of Aphididae, 1 of Coccidae, 1 of Tingididae, 4 of Pentatomidae, 3 of Aradidae, 2 of Nabidae, 3 of Lygaeidae, and 19 of Miridae.

A MODEL PROBLEM IN INSECT ECOLOGY

Kenneth Graham
University of British Columbia

During the course of its life cycle, every insect encounters a number of crucial trials which it must pass if the species is to survive. These trials concern three important life activities, namely, reproduction, development and survival. A species must maintain a sufficient reproductive output, develop at a sufficient rate, and have enough survivors if it is to remain in existence. Ordinarily a species occurs in somewhat greater abundance than the mere minimum for its survival. It exists in dynamic balance, decreasing under adversity, and increasing when conditions are especially favorable. Different environments provide conditions ranging from those which prohibit the existence of a given insect species, to those permitting great outbreaks.

Among the problems of insect ecology are those concerned with explaining why certain insects produce outbreaks, yet others in the same locality and even feeding on the same host do not. Another problem concerns the reason why certain areas experience the increase in insect population while others do not. The lodgepole pine needle miner (*Recurvaria milleri* Busck) provides an excellent opportunity for enquiry into these outbreak problems.

The lodgepole pine needle miner had not been known in the Canadian Rockies until 1942. In that year, its injury to the needles resulted in discoloration of a small area of forest near Banff. This heralded the beginning of an outbreak which increased in extent and severity until it covered an area of about 400 square miles, involving Banff, Kootenay, Yoho and Jasper National Parks. Great concern arose over the possible extension of the infestation into the pine stands of the East Slope watershed. The loss of those stands could be calamitous to communities far along the rivers that have their origin in the mountains.

Certain basic questions arise over this problem. Why did the outbreak develop where and when it did? Can the infestations spread from epidemic centres, or do they develop autochthonously from endemic populations? Are the East Slope forests really in danger from spread of outbreaks or build-up from endemic populations? These problems are all open to investigation by considering the particular crucial trials that the needle miner must encounter. And now, what are these trials?

The crucial part in the life of a needle miner begins in the food reserves carried into the pupal stage from the larva. The ultimate egg output depends firstly upon the quantity and quality of the food on which the larvae feed. The quality of food must vary according to numerous factors affecting the growth of the tree. Age of trees, soil, soil moisture, aspect, altitude, injuries, all varying locally and regionally, may have an influence on the food quality of foliage, and thereby affect the storage of materials for eventual egg production in the insect.

The next trial in the life of the insect-to-be is the successful pupation of the larva containing the future egg-forming substances. Conditions of environment determine the proportion of individuals that can complete the transformation. Of these conditions, temperature and humidity are probably the most important. Some seasons and some areas may be more favorable or less so than others. The needle miner in the Canadian Rockies passes through a long pupal period during the hottest and driest part of the year. In the dry hollowed-out needle the pupa, though partially protected, is nevertheless exposed to desiccation and high temperature, for a period of up to six weeks. This stage is important in many Lepidoptera as the period when the ovaries are developed and oogenesis takes place. Desiccation during this period can greatly reduce the egg potential. It is conceivable that only certain areas, in certain years, provide conditions favorable to this process. This suggests the problem of determining the effect of environments in the non-infested areas to find whether or not they provide conditions favorable to egg formation.

The pupal stage is beset with other hazards to survival at that time, the principal ones in the needle miner being parasites and birds. As another obstacle at the time of emergence, the adult may be unable to free itself from the pupa or needle containing it. Here again atmospheric moisture conditions may be influential.

The eggs developed in the female must be fertilized if they are to hatch. The process of mating in Lepidoptera meets with maximum success only within rather narrow limits of temperature, humidity, light and air movement. Under adverse environmental conditions, low fertility may result. Here is another problem for study.

Next, the fully formed, fertilized eggs, contained in the female, must be successfully laid. For this, the female must live a sufficient length of time and she must experience suitable environmental conditions in order to lay them. Adverse temperature, and humidities during this period may cause a failure of the population in most areas and in most years. The eggs of the needle miner in the Canadian Rockies are almost exclusively laid within the cavity of the dry needles mined out during previous larval feeding. Here the delicate eggs are moderately well protected from mechanical damage, but not entirely from desiccation and heat. The success in hatching may thus vary locally, regionally and seasonally.

When the larva has issued from the egg, it must crawl from the old mined-out needle to seek the foliage of the current season's growth. Then, having found suitable needles, it must bore through the epidermis to find food and relative security. In this process of locating its food, the larva must overcome the trials of establishment during late summer and early fall. In the needles, the larva feeds during autumn as long as temperature permits. Under continually falling temperatures it apparently enters an induced diapause, in which state it does not respond readily to warming. During the winter months it is subjected to intense cold, sometimes of considerable duration, depending on the locality, altitude, and inflow of Chinook winds. Towards spring it may be subjected to early warming and partial activation, followed by sub-zero temperatures. Severe conditions between autumn and spring result in drastic reductions in needle miner populations. The degree of mortality varies according to locality and altitude. There appears to be less mortality in valleys where premature spring warming does not occur. There is also less killing at a certain elevation above the valley floor, the reason probably being the presence of a warmer thermal layer during winter cold. It is probable that certain areas never provide winter conditions permitting population build-up of this insect.

Finally, during a first summer of larval development, the needle miner is attacked by parasites, diseases and birds. Then it is exposed to a second winter of cold and a second summer of attack by natural enemies before it finally pupates. It is evident that the needle miner must pass the test of numerous critical conditions if it is to increase or even merely survive. Some areas, we know, provide conditions which, on occasion, permit population increase. Other areas probably are always unfavorable in at least one respect. In those areas, epidemics may never occur, regardless of the presence of an endemic population, and despite contagious tendencies of populations in adjacent areas. It may well be asked if perhaps the East Slope of the Rockies is too dry and hot during the reproductive period of the insect, and too cold or changeable during the overwintering stage of the larvae.

The needle miner therefore offers many interesting and productive ecological problems. It is especially convenient for study because, in the needle, the larva possesses relative fixity of abode, and thereby is amenable to refined sampling methods. With pine as a host, it is possible to estimate the number of miners per branch tip, the number of branch tips per tree of various heights, and the number of trees of various sizes per acre. From these data a population census of the insect has been possible. Applying percentage figures for parasitism, it has been possible to determine the number of parasites per acre.

This insect is therefore an eminently suitable one for developing population sampling statistics. The acquisition of reliable procedures for taking stock of populations will be of material assistance in measuring the influence of various factors. Nevertheless, after many decades of entomological progress, in this case we cannot do better than turn to the insect itself for the real answers to some of the most far-reaching problems.

The Proceedings of the Entomological Society of British Columbia is published annually. Individual volumes may be had for $1.00. Special rates on sets. Address C. L. Neilson, Secretary-Treasurer, Entomological Society of British Columbia, Court House, Vernon, B.C.

ERRATA VOL. 47, 1951

Page 4, line 27—for IXODIAE read IXODIDAE

Page 30, lines 8, 11 and 16—the names *Ascogaster quadridentata, Bessa harveyi* and *Bigonichaeta setipennis* are misplaced and the upper half of the table should read as follows:—

SPECIES	HOST	LOCALITY	YEAR	ORIGIN	NUMBER RELEASED
Ascogaster Carpocapsae (Vier.)		South Okanagan	1937	"	291
		Vernon	1937	"	725
		Victoria	1937	"	560
		Winfleld	1937	"	2,845
		Victoria	1939	"	570
		Vernon	1939	"	33,250
	Pea moth. *Laspeyresia nigricana* (Steph.)	Chilliwack	1936	Ontario	300
		Sumas Prairie	1936	"	966
		East Chilliwack	1937	"	50
Ascogaster quadridentata Wesm.	Pea moth. *Laspeyresia nigricana* (Steph.)	Sumas Prairie	1937	England	34
		Chilliwack	1938	"	127
		Musselwhite	1938	"	753
		Chilliwack	1939	"	4,377
		Cloverdale	1947		3,592
Bessa harveyi (TT) *selecta* Mgn. of American auth.)	European larch sawfly *Pristiphora erichsonii* (Htg.)	Edgewood	1942	New Brunswick & Ontario	3,750
		Vernon	1942	"	2,245
Bigonichaeta setipennis (Fall.)	European earwig *Forficula auricularia* (L.)	New Westminster	1928	England & U.S.A.	165
		New Westminster	1929	"	212
		New Westminster	1930	"	326
		New Westminster	1931	"	373

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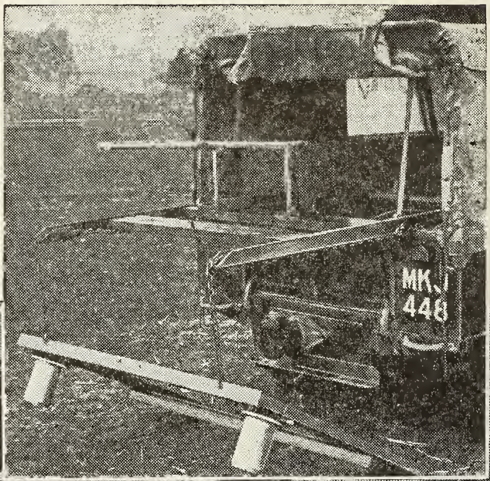

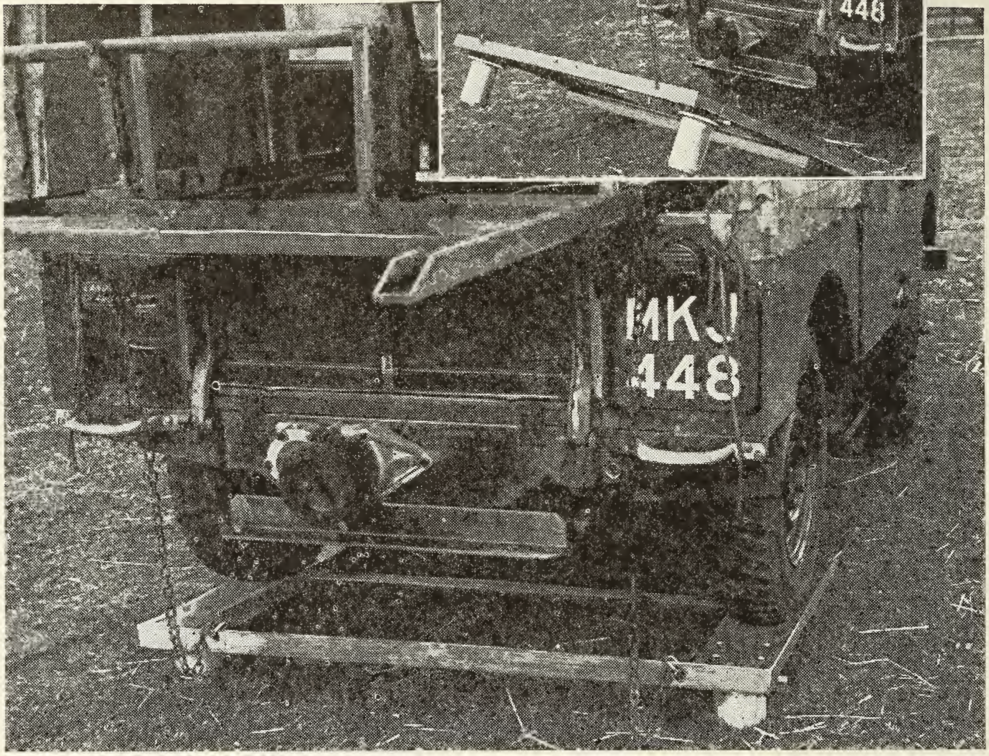

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A DECADE OF PEST CONTROL IN BRITISH COLUMBIA ORCHARDS[1]

J. Marshall[2]
Fruit Insect Laboratory, Summerland, British Columbia

The last ten years have brought more significant advances in tree-fruit production in British Columbia than any previous period in the history of the fruit industry. Several of the new procedures apply to pest control, and are developments original to this province. Some of them are briefly discussed herein. They were jointly introduced since 1940 by officers of the Fruit Insect Laboratory, Summerland, and the Horticultural Branch, British Columbia Department of Agriculture.

Spray Residue, Soil Poisoning, and the Dual Fruit-wiper

In the late 'thirties, excessive arsenical spray residue had cut off British Columbia apples from the valuable United States market. Unfortunately, heavy lead arsenate spraying was necessary to check the steadily increasing inroads of the codling moth, *Carpocapsa pomonella* (L.). Field experiments in 1939 and 1940 showed that better control of the codling moth could be attained by lessening the periods between the first brood spray applications in May and early June, and by substituting cryolite (sodium aluminium fluoride) or fixed nicotine-petroleum oil for lead arsenate in later treatments (Marshall, 1943). This procedure was recommended and the industry quickly adopted and profited from it. Within a year excessive arsenical spray residue was a thing of the past and the United States market had been regained for over a million boxes of apples a year.

Four years later, Okanagan Valley orchardists led the way in eliminating arsenicals from the spray schedule. In so doing, not only did they remove the possibility of arsenical contamination of fruit but, perhaps more important, they ended the danger of such serious soil poisoning as had occurred in thousands of acres of fine orchard land in the State of Washington.

A survey of packing-houses in 1939 had shown that much of the apple-wiping equipment in the tree-fruit area was inefficient and, doubtless, had been a factor in the loss of the United States market. Shortly before this survey, a new type of fruit and vegetable cleaner had been developed in the United States. It was fitted with revolving brushes and an exhaust fan in addition to the buffer cloths characteristic of the existing wipers. Although nothing was known of its capacity to clean apples, a dual wiper was imported and many chemical analyses were made at the Summerland laboratory to determine its efficiency. The new machine proved superior to the buffer wipers in three respects. It removed more spray residue; it produced a more attractive finish on the fruit; it removed poisonous dusts from the atmosphere. All new wiper installations were recommended to be of this type and packing houses have followed the recommendation with success.

High Viscosity Dormant Spray Oil

The use of dormant petroleum oil was becoming standard practice in western deciduous fruit orchards by 1930. It was generally accepted, and is still accepted in the western United States, that the best type of oil, phytotoxicity and insecticidal effectiveness considered, has a Saybolt viscosity of 100-110 seconds at 100°F. But many orchards in British Columbia suffered bud injury from that type of oil and, in districts heavily infested with the San Jose scale, *Aspidiotus perniciosus* Comst., it lacked effectiveness. Experiments were begun in 1939 to overcome these difficulties. Five years later a new type of dormant oil of 200-220 S.S.U. viscosity was introduced and it is now used throughout this province. There has been less bud injury since the industry abandoned the lighter oil and control of

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1 Contribution No. 2989, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.
2 Senior Entomologist.

AUG 10 1953

the San Jose scale and the European red mite, *Metatetranychus ulmi* (Koch), has been measurably improved (Marshall, 1948).

Dormant Oil-Lime-Sulphur

While the experiments on petroleum fractions were underway, field trials were proceeding with a number of ideas for improving control of the San Jose scale. From that work eventually came a dormant spray mixture that is still the most effective preparation available for killing crusted San Jose scale. It is a mixture of heavy dormant oil and lime-sulphur. In the days of conventional hand application of spray mixtures the oil concentration was two per cent. and the lime-sulphur four. Nowadays the mixture is applied by automatic concentrate applicators at six gallons of oil and twelve of lime-sulphur per acre. There are three advantages in the use of this mixture as compared with oil alone or lime-sulphur alone. First, the presence of the oil renders the lime-sulphur less irritating to the operator. Second, the quantity of oil being only half that required where oil alone is used, the danger of oil injury to buds and twigs is minimized. Third, although synergism has not been established, the mixture seems more toxic than would be expected from the individual effects of the two constituents.

"Low Sulphonation" Summer Spray Oil

Another innovation in orchard pest control in this province is the so-called low sulphonation petroleum oil of about 75 per cent. unsulphonated residue that is used for foliage application. Before the introduction of this oil, only summer oils of about 94 per cent. unsulphonated residue were employed in fruit production. The latter oils cost the growers about twice as much as the "low sulphonation" type but gave no better pest control. The suitability of the cheaper oils was demonstrated in a series of field experiments carried out from 1939 to 1944. No "high sulphonation" summer oil has been used in British Columbia for about five years although it is still the only type of summer oil used in the western United States (Marshall, 1948).

Perhaps one reason that the cheaper oil has been satisfactory in this province is that summer oil has not been used at greater than 0.5 per cent. concentration in hand machines or at more than two gallons per acre in cocentrate machines. At higher concentrations, such as used in many other fruit-growing areas, it is somewhat more prone to cause foliage injury than the expensive oil.

Trunk Spray for Codling Moth Control

For a time in the early 'forties it appeared that the codling moth would soon bankrupt the British Columbia apple grower. In spite of a continually heavier and more expensive spray program the attacks of the insect increased and cullage mounted. In those days DDT was unknown and codling moth control was dependent upon spray applications of lead arsenate, cryolite, and fixed nicotine directed against the first-instar larva, the egg, or both. To supplement this treatment experiments were undertaken to determine whether the codling moth is vulnerable to insecticides when it is a cocooned larva and, later, when it is adult.

Foliage spraying with a dilute solution of dinitro cresol proved moderately effective against the adults but it was not brought to the point of commercial application (Dennys, 1942). Tree-trunk spraying with an emulsion of a petroleum solution (38-40 S.S.U. Vis. 100°F.) of dinitro cresol was developed sufficiently for some growers to use it with fair success against the overwintered cocoons (Heriot, 1942). At that time, however, DDT was under trial and very shortly it proved so effective against the codling moth that supplementary control measures became unnecessary. There have been signs recently that the effectiveness of DDT against the codling moth may may not be quite so outstanding as it was when that remarkable insecticide was introduced. If that should prove to be so, the day may not be far off when supplementary control measures will once more be necessary. The foliage and the trunk sprays will be available if required, and there is little doubt they can be made more effective.

Monoethanolamine Dinitrocyclohexylphenolate

With the general use of DDT in Okanagan Valley orchards came increased trouble from phytophagous mites (Marshall, 1946). Neither of the acaricides available at that time proved satisfactory for holding the mites in check. One of them, the dicyclohexylamine salt of dinitrocyclohexylphenol, gave erratic results, particularly in cool weather. The other, xanthone, caused alarming dermatitis to susceptible orchard workers.

At the Summerland laboratory work had been conducted for several years on dinitrophenol derivatives as acaricides, and, among other compounds, the monoethanolamine salt of dinitrocyclohexylphenol had been made and its acaricidal value studied. This material proved superior to those recommended at the time (Morgan and Marshall, 1944). Even today it has a particular advantage over several of the acaricides of more recent introduction: apart from being relatively harmless to humans, it appears to have selective action, *i.e.,* it is not harmful to insect predators. A shortcoming of mono DNP, to give it its popular name, is that it may cause foliage injury if used in concentrated form in hot weather. When concentrate sprayers became standard equipment in the British Columbia fruit industry, therefore, the use of mono DNP declined.

The Automatic Concentrate Sprayer

After World War II, labour costs increased rapidly and the fruit grower was faced with a new problem. The value of his product did not advance with his production costs, chief of which was labour. Consequently, labour overhead had to be reduced.

One of the orchard operations that required a great deal of labour was spraying. In 1946, officers of the Summerland laboratory, in co-operation with the Provincial Department of Agriculture and the Defence Research Experimental Station, Suffield, Alberta, undertook to mechanize spraying operations. By 1948 the three services had built and successfully demonstrated an experimental machine. The first commercial units, based on this experimental sprayer, were available in 1949 (Marshall and Miles, 1948, 1949; Marshall, 1949). By 1952, spraying operations had been approximately 90 per cent. mechanized, and British Columbia orchardists were possibly farther advanced in methods of applying chemical control than those of any other fruit-growing area. The automatic concentrate sprayer has saved upwards of 75 percent. of the cost of labour for orchard spraying operations, and perhaps 20 per cent. of the cost of spray chemicals. It has almost eliminated hand spraying, the unpleasantness of which can only be appreciated by those who have spent long hours operating a spray gun.

Introduction of a Parasite of the Apple Mealybug

Seventeen years ago. the fruit growers of the Kootenay Valley noticed an unusual insect in their plantings. It soon became a serious problem because its copious excretion covered the fruit and resulted in the growth of a sooty fungus that rendered the fruit unsaleable until washed. This insect was the apple mealybug, *Phenacoccus aceris* (Sign.), a pest then known to occur only in one other area in Canada, namely, western Nova Scotia. In that area the insect had never been epidemic as it was in the Kootenay Valley; investigation indicated effective control by the parasite *Allotropa utilis* Mues. Subsequently *A. utilis* was reared at the Dominion Parasite Laboratory, Belleville, Ontario, and shipments of it were sent from time to time to the Fruit Insect Laboratory at Vernon. Five years after the first liberation the parasite was well established in the Kootenay West Arm district and today it gives effective control of the apple mealybug. This must be one of the outstanding exemples, in Canada, of biological control by an introduced parasite (Marshall, 1942, 1944).

Trends in Pest Control Research

Most orchardists in this province are well aware of the importance of biological control of fruit pests. But isolated and abandoned orchards and orchards that have been cultivated but not sprayed show, organic farming enthusiasts to the contrary, that Nature alone will not ensure sufficient marketable fruit for a profitable commercial operation. Consequently, the first line of defence against pests is chemical control—but chemical control applied as sparingly as possible and based on the knowledge that the preferred chemicals are those that have low toxicity to beneficial insects and mites and to birds. In 1948 the investigators in the joint operations of the Canada divisions of Entomology and Chemistry at Summerland were provided with an excellent laboratory and staffs were substantially increased. It then became possible to study insect behaviour in addition to the immediate but practical problems involved in helping to keep the fruit industry on a profitable basis. Biological studies were given welcome support when Biological Control Investigations of the Division of Entomology stationed an investigator at the Summerland laboratory to work directly with Fruit Insect and Insecticide Investigations on the biology of orchard mites. From now on there should be good balance at Summerland between fundamental, long-term biological studies and the entomological-chemical investigations that are a season-to-season necessity.

Summary

During the decade 1940-1950 advances in production methods of the British Columbia fruit industry were greater than in any previous period; some of the most significant were original developments in pest control. These included:

1. Introduction of the dual fruit wiper.
2. Elimination of arsenicals from the spray schedule prior to the introduction of DDT. (This removed the dangers of arsenical poisoning of the soil and arsenical residues on fruits.)
3. Introduction of heavy dormant petroleum oil (200-220 S.S.U. Vis.), which is now the only type of dormant oil used in the province.
4. Development of heavy dormant oil—lime—sulphur mixture as the standard dormant spray mixture for apples and pears.
5. Introduction and general use of summer petroleum spray oil of low unsulphonated residue (under 75%).
6. Development of the tree trunk spray for codling moth control.
7. Introduction of the monoethanolamine salt of dinitrocyclohexylphenol as a selective acaricide.
8. The successful introduction and dissemination of the parasite *Allotropa utilis* for control of the apple mealybug.
9. The designing and construction of the Okanagan experimental sprayer. This machine led to the mechanization of orchard spraying and the general use of spray concentrates in British Columbia.

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NOTES ON THE CABBAGE SEEDPOD WEEVIL, CEUTORHYNCHUS ASSIMILIS (PAYK.) (COLEOPTERA: CURCULIONIDAE), AND ITS PARASITES[1]

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The cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.), is an indigenous pest of cruciferous seed crops in Europe. It was first reported in North America by the Division of Entomology (1935, p. 463) from a specimen taken at Vancouver, British Columbia, by Hugh B. Leech in May, 1931. The insect did not become economically important in British Columbia until the importation of turnip, cabbage, and cauliflower seed from Europe was prevented in 1940 by the naval blockade of western Europe. There was then an increase in the acreage planted to cruciferous seed crops on Vancouver Island and the lower mainland of British Columia, and the weevil became the most important insect pest of these crops. The use of parasites to reduce damage by this pest was undertaken in 1943 as a co-operative project between the Field Crop Insect Laboratory at Agassiz, B.C., and the Dominion Parasite Laboratory, Belleville, Ont.

The weevil became economically important in the western United States about the same time as in British Columbia. It was reported in 1935 in the northwestern part of Washington, where most of the cabbage seed produced in the United States is grown (Baker, 1936). From this area it spread southward through Oregon to California, where it was reported in 1946 (Hagen, 1946).

In Washington it became of increasing importance and a laboratory, now known as the Northwestern Washington Experiment Station, was established at Mount Vernon, to investigate the weevil and other pests of cruciferous seed crops. Its biology, distribution, food plants, and parasites were studied (Hanson *et al.*, 1948).

Mr. R. Glendenning, Officer-in-charge, Field Crop Insect Laboratory, Agassiz, studied the course of the infestation in British Columbia from 1939 to 1945. The infestation on the mainland was severe during the early years of his investigation, but gradually became less severe until 1945, when it had virtually disappeared. During this period the infestation on Vancouver Island remained at a high level.

In 1949 a survey was initiated at the Vancouver laboratory to obtain information concerning parasitism of the weevil in British Columbia with special reference to the value of introduced species. Further information concerning its distribution and the degree to which it infests cruciferous seed crops was necessary. The project was continued in 1950 and 1951 and collections of infested material were obtained from the important seed-growing areas from June to October.

The insect was obtained from seed fields of cabbage, cauliflower, Brussels sprouts, and swede turnip and also from wild turnip, *Brassica campestris* L.; garden radish, *Raphanus sativus* L., growing as an escape; and a wild

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mustard, *Brassica juncea* (L.) Coss. The wild host plants are more widely distributed and it is from weevils infesting these that the cultivated cruciferous seed crops become infested. These wild plants remain green and succulent much later in the season than do the cultivated species. The latter species ripen and become unsuitable for larval feeding during July, whereas the former remain green until October and provide food for its extended seasonal activity.

The percentage of cruciferous seedpods infested by the weevil varies considerably from year to year (Table I).

TABLE I

Infestation of the cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.), in British Columbia, 1949, 1950, and 1951.

Area	Seedpods Examined		Per Cent. Infested
Vancouver Island			
Cabbage	1949	3,830	94.7
"	1950	731	75.6
"	1951	656	55.9
Fraser Valley			
Turnip	1949	1,688	30.7
"	1950	1,210	54.6
"	1951	600	62.3

The percentage of cabbage seed destroyed by the larvae increases disportionately with the percentage of the seedpods infested. For example, an infestation of 80 per cent reduced the seed yield by about 40 per cent, whereas an infestation of 30 per cent reduced the seed yield by about 10 per cent. The reason for the increased percentage loss of seed in heavily infested fields is the larger proportion of pods in which there are 2 or more larvae.

Eleven species of parasites have been reared from the weevil on the Pacific coast. Of these, 7 species have been found in British Columbia, 8 in Washington (Breakey, *et al.*, 1944, and Hanson *et al.*, 1948), and 5 in California (Carlson, *et al.*, 1951). The parasite species and the state or province from which they have been reported are shown in Table II.

Table II shows that *Trichomalus fasciatus* (Thoms.) is the only parasite species that has been reported from each of the 3 areas; 6 of the species found in British Columbia have been reported from Washington, and 2 species reported from Washington have also been reported from California.

TABLE II

Parasites reared from the cabbage seedpod weevil on the Pacific coast.

	British Columbia	Washington[1]	California[1]
Amblymerus sp.		x	
Amblymerus mayetiolae Gahan			x
Bracon sp.	x		
Eupelmella vesicularis (Retz.)	x	x	
Eurytoma sp.	x	x	
Habrocytus sp.	x	x	
Necremnus duplicatus Gahan	x	x	
Spilochalcis side (Walk.)			x
Trichomalus fasciatus (Thoms.)	x	x	x
Trimeromicrus maculatus Gahan			x
Xenocrepis pura Mayr		x	x
Zatropis sp.	x	x	

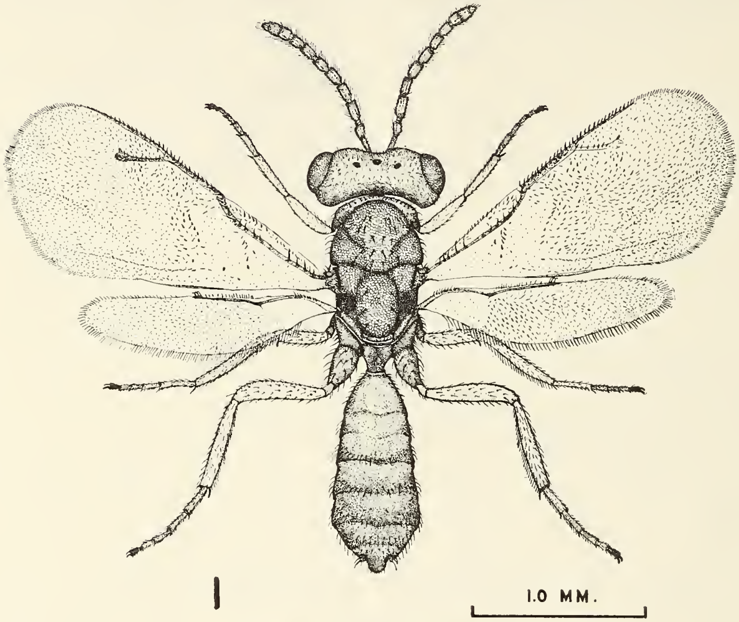
1 Records from Breakey **et al.**, 1944; Hanson **et al.**, 1948; and Carlson **et al.**, 1951.

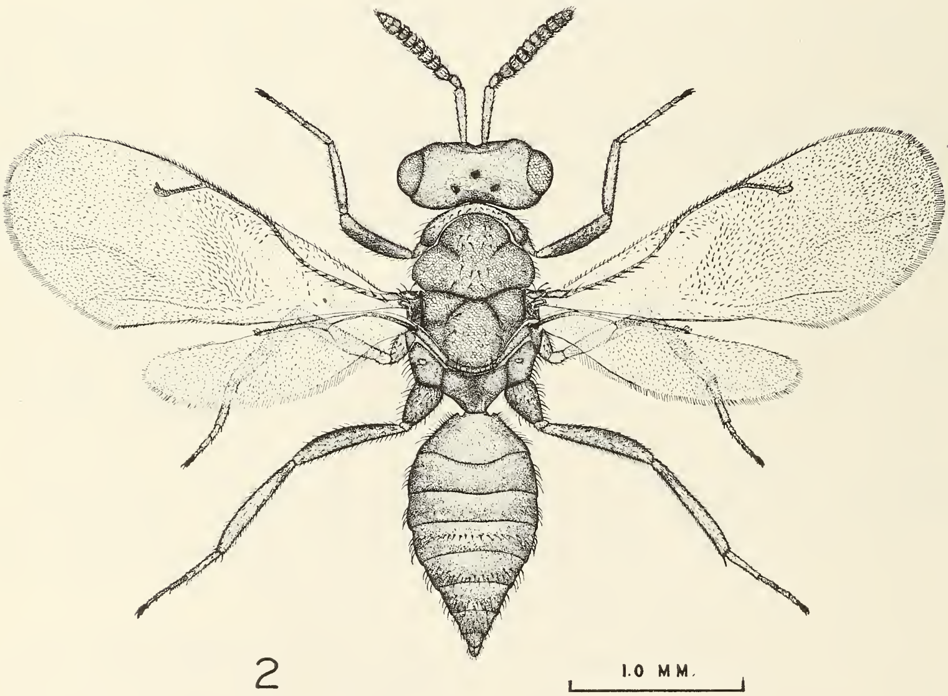
This is a comparatively large parasite complex to be associated with a host insect that has only recently become established in North America. There is evidence that 2 species, *T. fasciatus* and *Xenocrepis pura* Mayr, are native to Europe, where they also attack the cabbage seedpod weevil. *Habrocytus* sp. has been reported from Washington and a species of *Habrocytus*, probably the same species, has been colonized in British Columbia from material obtained in Europe. The remainder of the parasites are probably native species that attack the cabbage seedpod weevil as an alternate host.

Amblymerus mayetiolae Gahan is indigenous to North America. Peck (1951) listed its hosts as the hessian fly, *Phytophaga destructor* (Say), and a jointworm, *Harmolita* sp. Many species of this genus are hyperparasites and further investigation may show that *A. mayetiolae* is associated with the cabbage seedpod weevil in this way.

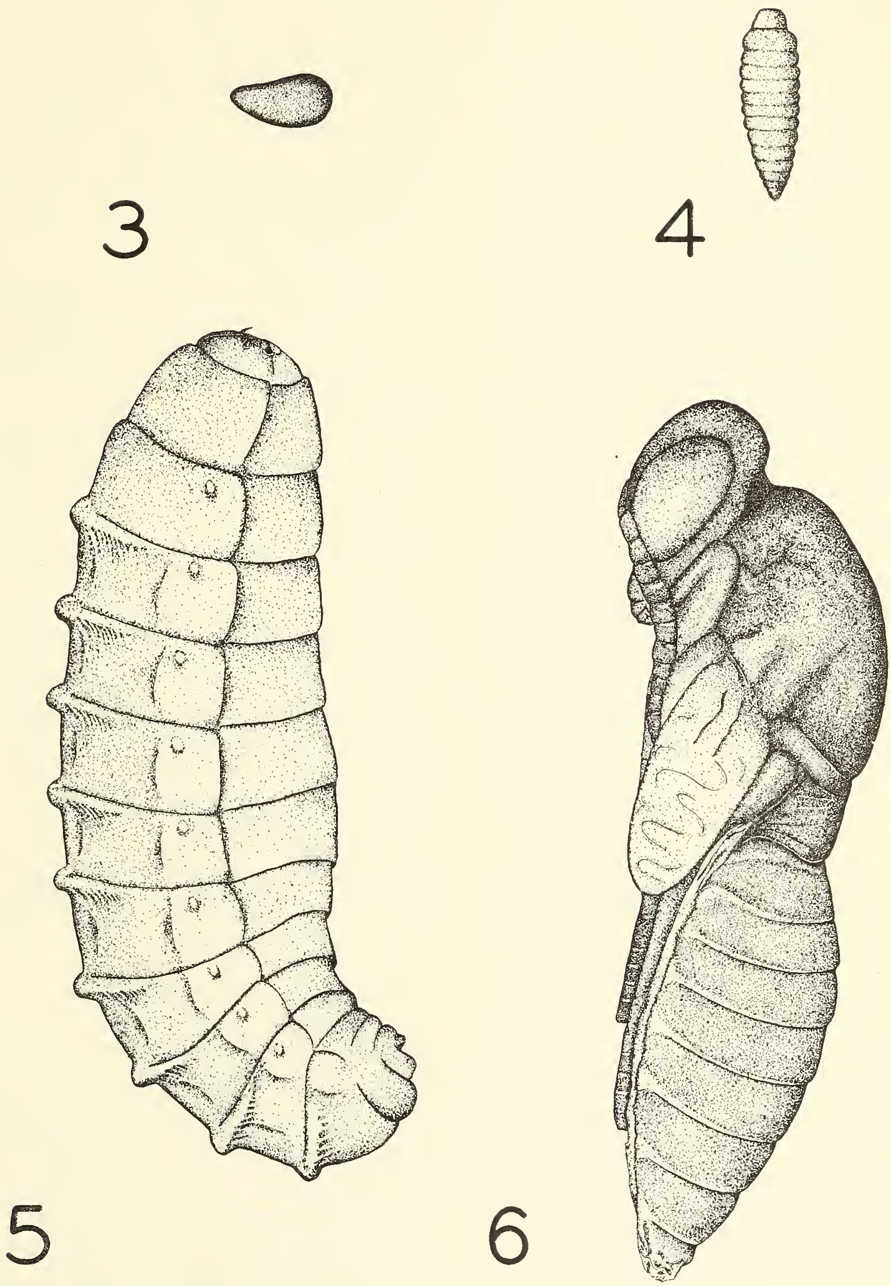
Bracon sp. has been reported from British Columbia only. In 1943 on Vancouver Island the cabbage seedpod weevil was more abundant and less heavily parasitized than on the mainland. At that time *Bracon* sp. was relatively abundant on the mainland but had not been observed on Vancouver Island. Mr. R. Glendenning obtained a quantity of tailings from threshed seed turnips from the mainland and shipped it to the Dominion Parasite Laboratory, where it was kept in cold storage over winter. In the spring of 1944 the material was placed in incubation and a large number of *Bracon* sp. that had passed the winter in the pupal stage emerged. They were shipped to Victoria and released in infested cabbage seed fields on Vancouver Island by officers of the Division of Entomology. The same procedure was followed in 1945 and 1946. In the 3 years during which this project was carried on, 1,241 individuals of *Bracon* sp. were colonized on Vancouver Island. Since 1949 this species has been recovered in small numbers in collections of the weevil from that area.

As no species of *Bracon* has been reported to be parasitic on the cabbage seedpod weevil in Europe, it is assumed that this species is a native of North America that attacks the cabbage seedpod weevil as an alternate host. Until the species is identified it will not be possible to determine whether it has any other hosts.





Figs. 1-2. *Trichomalus fasciatus* (Thoms.). 1, male. 2, female.



Figs. 3-6. *Trichomalus fasciatus* (Thoms.). 3, egg. 4, early larva. 5, late larva 6, pupa.

Eupelmella vesicularis (Retz.) is widely distributed and has an extensive host list in Europe and North America. It was reported in North America many years before the establishment of the cabbage seedpod weevil, and undoubtedly attacks it or one of its parasites as an alternate host. Clausen (1940) reported it as a primary parasite of the hessian fly in North America. Morris (1938) reported it in Europe as a predator of *Dahlbominus fuscipennis* (Zett.), a primary parasite of the European spruce sawfly, *Diprion hercyniae* (Htg.). He also reported that it is parthenogenetic and that it passes the winter as a prepupa. *E. vesicularis* has been reared from the cabbage seedpod weevil in British Columbia but not in California. It has also been reared in British Columbia from *Hylemya* sp. on lupine.

Eurytoma sp. is one of the less important parasites attacking the cabbage seedpod weevil in British Columbia and Washington. It has not been reported from this host in Europe. It is assumed that it is one of the 73 species of that genus recorded in North America and that it attacks the cabbage seedpod weevil as an alternate host.

Habrocytus sp. has been reported from the cabbage seedpod weevil in British Columbia and Washington only. In July, 1949, a colony of 183 individuals of *Habrocytus* sp. was released in British Columbia from material obtained in Europe and incubated at the Dominion Parasite Laboratory; this species was not collected in 1950 or 1951. Until species determination can be obtained it will not be known whether the species present in British Columbia and Washington is the same as that introduced into British Columbia from Europe.

Necremnus duplicatus Gahan, described from specimens taken in Washington, is one of the most important parasites of the cabbage seedpod weevil in Washington and British Columbia. It is not known in Europe and no other host record is listed by Peck (1951) for North America.

Trichomalus fasciatus (Thoms.) is a European species that was described in 1878. It is the only species of the genus that has been reported in North America and its only known host in North America is the cabbage seedpod weevil. It is a widely distributed parasite of this host in Europe and probably accompanied its host when the latter was accidentally introduced into North America.

T. fasciatus is the most important parasite of the cabbage seedpod weevil in British Columbia: it comprised 94.1 and 85.9 per cent of all the parasites that were obtained in 1950 and 1951 respectively. It is also one of the most important parasites of the insect in Washington and in 1951 was reported from California (Carlson *et al.*, 1951). The adults sting and paralyse the host larvae before ovipositing on them. After the parasite larvae complete their development they pupate without forming cocoons and the adults emerge in 8 to 12 days. There are probably two generations each year. Adults emerged in the laboratory from July 11 to October 10. Those that emerged during July and early August died within 3 weeks. Those that emerged after August 15 remained active until October, when lower temperatures caused them to seek the protection of small cracks in their cage; there they remained inactive during the winter.

Trimeromicrus maculatus Gahan is the only species of the genus listed by Peck (1951) for North America. Its known distribution is from Illinois to California. Peck listed the following hosts: the sunflower seed weevil, *Desmoris fulvus* (Lec.); the alfalfa gall midge, *Asphondylia websteri* Felt; and the clover seed chalcid, *Bruchophagus gibbus* (Boh.). It has been taken recently in California (Carlson *et al.*, 1951) from the cabbage seedpod weevil, but it has not been reported in Washington or British Columbia. Whether it is a primary parasite or a hyperparasite is not known.

Xenocrepis pura Mayr has been reared from this host in California and Washington, but not in British Columbia.

Three colonies comprised of 1,269 individuals of this species were released in British Columbia in 1949 from material obtained in Europe and incubated at the Dominion Parasite Laboratory.

X. pura is reported to be the most important parasite of the cabbage seedpod weevil in California (Carlson *et al.*, 1951). It is less effective in Washington; and in British Columbia, the northern limit of the host insect's distribution, it has not yet been recovered even where colonized. The range of *X. pura* is the reverse of that of *T. fasciatus*: the latter is the most important parasite at the northern limit of its host's range.

Zatropis sp. is of minor importance in British Columbia and Washington and has not been reported from California. It is a North American species, but its other hosts are not known.

Although the present parasite complex does not prevent injury to cruciferous seed crops by the cabbage seedpod weevil, it reduces the amount of seed loss in two ways. The parasite adults sting and paralyse the host larvae; these larvae are often in the later instars before they are parasitized, but the feeding period of even the more mature larvae is shortened considerably. This reduces the number of seeds destroyed by each larva with the result that there is an immediate reduction in the amount of seed loss. There is a further reduction the following year caused by the reduction in weevil population due to the parasitism and resulting mortality of the weevil larvae.

Evidence of the effect of parasitism in reducing the number of seeds destroyed per larvae was obtained in 1950. A random collection of infested pods was taken from a swede turnip seed field in which the infestation was 39.7 per cent and the aggregate parasitism 79.8 per cent. There were 749 seedpods in the collection and 8,662 seeds, of which 872 were destroyed by larvae. The weevil larval population was 332. Therefore the number of seeds destroyed by each larva was 2.6. A random collection was taken from another field in which the infestation was 87.9 per cent and the aggregate parasitism 9.4 per cent. There was 348 seedpods in the collection and 4,389 seeds, of which 1,859 were destroyed by larvae. The weevil larval population was 394. Therefore the number of seeds destroyed per larva was 4.7. The difference in the numbers of seeds destroyed per weevil larva was highly significant. Insecticides had not been used on either of the plots from which the collections were taken.

Summary

The cabbage seedpod weevil is a European species that has become a major pest of cruciferous seed crops in western North America. Its spread has been facilitated by widely distributed wild host plants. The degree of infestation varies considerably from district to district and from year to year.

Eleven species of parasites are known to be associated with the cabbage seedpod weevil. The 2 most important species in North America, *Trichomalus fasciatus* and *Xenocrepis pura*, are of European origin. The remainder are probably native species that have accepted the cabbage seedpod weevil as an alternate host.

Parasitism of the cabbage seedpod weevil reduces the amount of seed loss in 2 ways:—

1. When the adult parasites sting and paralyse the weevil larvae, thus preventing further feeding, there is an immediate and significant reduction in the number of seeds destroyed by each cabbage seedpod weevil larva.

2. Parasitized larvae are killed, so that the infestation and seed loss the following year are reduced.

The adult male and female and the egg, early larva, late larva, and pupa are illustrated in Figs. 1-6. The original drawings were prepared by George Yamanaka, formerly of the Vancouver laboratory.

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NOTE ON THE OCCURRENCE OF RHAGOLETIS FAUSTA (O.S.) (DIPTERA: TRYPETIDAE) IN THE OKANAGAN VALLEY

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In the winter of 1950, a sample of frozen sour cherries infested with dipterous larvae was received from the Canada Experimental Station at Summerland. The larvae were partially decomposed when they reached the Fruit Insect Laboratory, Summerland, so that positive identification was impossible. However, it was believed that the larvae were of one of the cherry fruit flies common to many fruit-growing areas of North America.

Neither *Rhagoletis fausta* (O.S.) nor *R. cingulata* (Loew) has previously been recorded from the Okanagan Valley. In British Columbia *R. fausta* has been a pest in the Kootenay district for many years. It was also reported from the north shore of the Shuswap Lake, opposite Canoe, in 1936, and at Salmon Arm in 1937. *R. fausta* is the only species recorded from the Flathead Valley of Montana, whereas *R. cingulata* is the only species found in the lower mainland of British Columbia. Both *R. fausta* and *R. cingulata* are pests on Vancouver Island and as far north as Wenatchee in the State of Washington.

The source of the infested cherries was traced to an orchard in the Bear Creek district, about three miles from the Westbank ferry landing. In the spring of 1951, traps were set out in this orchard to determine what species of fruit fly was present. On May 31, soil sifted from under the sour-cherry trees yielded five puparia and two empty pupal cases. The latter were in good condition, suggesting that flies had recently emerged from them, although no adults were seen in the orchard at this time. Seven days later one fly was caught in a soil emergence cage and two on a sticky board. These flies were subsequently identified as of *Rhagoletis fausta* (O.S.) by Mr. J. F. McAlpine, Division of Entomology, Ottawa.

Fly emergence reached its peak in the third week of June. By the end of the month almost every sour cherry (largely Montmorency) contained one or more maggots, and an occasional sweet cherry (Bing and Lambert) was also infested. A few flies were still found alive on the sticky boards when trapping was discontinued on July 10.

Orchard and packing-house surveys conducted in the Westbank and Kelowna districts by officers of the Provincial government did not reveal any further orchards infested with the cherry fruit fly.

KEY TO PUPARIA OF THE DIPTEROUS PARASITES OF MALACOSOMA SPP., IN BRITISH COLUMBIA[1]

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The following is an illustrated key to the purparia of dipterous parasites reared by the Forest Insect Survey at Vernon from *Malacosoma disstria* Hbn., *M. pluviale* (Dyar), and *M.* sp. nr. *pluviale* (Dyar), collected in British Columbia.

Grateful acknowledgment is given to J. H. McLeod of the Biological Control Unit, Division of Entomology, Vancouver, for the loan of puparia unrepresented or poorly represented in the Vernon reference collection, and to G. E. Shewell, Division of Entomology, Ottawa, for the identification of adults and criticism of the key.

The illustrations accompanying the key were drawn by B. A. Sugden.

Terminology in this and a published key (1952) is adapted from C. T. Greene's (1921) pioneering treatise on the puparia of North American Muscoids.

1. Posterior spiracles in a deep cavity, partially hidden from view......2
— Posterior spiracles not in a cavity 4
2. Opening of cavity circular or oval; rim, relatively smooth with a few "warts", may be lightly sculptured 3
— Opening elliptical, the ellipse generally acute at both ends; rim strongly sculptured......**(Fig. 1) Sarcophaga aldrichi** Park.
3. Rim about opening of cavity, rounded, the edge incurved; a few obscure "warts" on outer edge of rim **(Fig. 3) Pseudosarcophaga affinis** (Fall.)
— Rim somewhat flattened, edge not incurved, usually a portion extruded; "warts" on rim prominent **(Fig. 2) Sarcophaga houghi** Ald.
4. All stigmal slits strongly serpentine 5
— Stigmal slits straight or only slightly curved (usually some of stigmal slits somewhat serpentine in **Patelloa pachypyga)** 6
5. Stigmal plates strongly protruded; stigmal slits in three discrete groups; stigmal ridges broadly rounded; button shallow, may be obscure; no swelling ventrad to plates; pupal horns not extruded **(Fig. 4)† Carcelia malacosomae** Sell.
— Stigmal plates slightly raised; stigmal slits neither on ridges, nor in three discrete groups; button large, circular; small swelling ventrad to plates; pupal horns extruded ...... **(Fig. 5.) Achaetoneura frenchii** (Will.)*
6. A swelling (protuberance) ventrad to stigmal plates 7
— No swelling ventrad to plates......10
7. Posterior end of puparium slightly depressed above horizontal axis; stigmal plates at acute angle to longtitudinal axis of puparium 8
— Posterior end of puparium not depressed above horizontal axis; stigmal plates at right angle to longtitudinal axis 9
8. Sides of puparium smooth, may be sparse transverse wrinkles; pattern of spinules readily discernable ...... **(Fig. 6) Exorista mella** (Wlk.)*
— Puparium rugose over whole surface; pattern of spinules somewhat obscured by rugosity—**(Fig. 7) Tachinomyia similis** (Will.)

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† Stigmal slits normally much more serpentine than in figure. (G. E. S.)

* Adults of species marked with an asterisk emerge during the summer; the remaining species overwinter as puparia and the adults emerge during the spring.

9. Protuberance small and shallow; plate fan-shaped, button at edge; ridges bearing stigmal slits almost straight; puparium smooth...... **(Fig. 8) Compsilura concinnata Mg.***

— Protuberance very prominent; plate circular, button not at edge; stigmal slits curved; puparium rugose **(Fig. 9) (Rileymyia americana** (B. & B.)

10. Centre of button above horizontal axis of stigmal plate; stigmal ridges, narrow. strongly raised, gradually curved downward toward ends; anal slit vertical; usually adult emerges from host pupa .... **(Fig. 10) Nemochaeta lateralis** (Macq.)*

— Centre of button below horizontal axis of plate; stigmal ridges only slightly raised; anal slit horizontal 11

11. Stigmal slits, at most, only slightly curved; stigmal button well-defined, off centre of area enclosed by stigmal slits .... **(Fig. 11) Euexorista futilis** (O.S.)*

— One or more stigmal slits usually with double curve, or a right-angled curve; button ill-defined, centrally located among stigmal slits .... **(Fig. 12) Patelloa pachypyga** A. & W.

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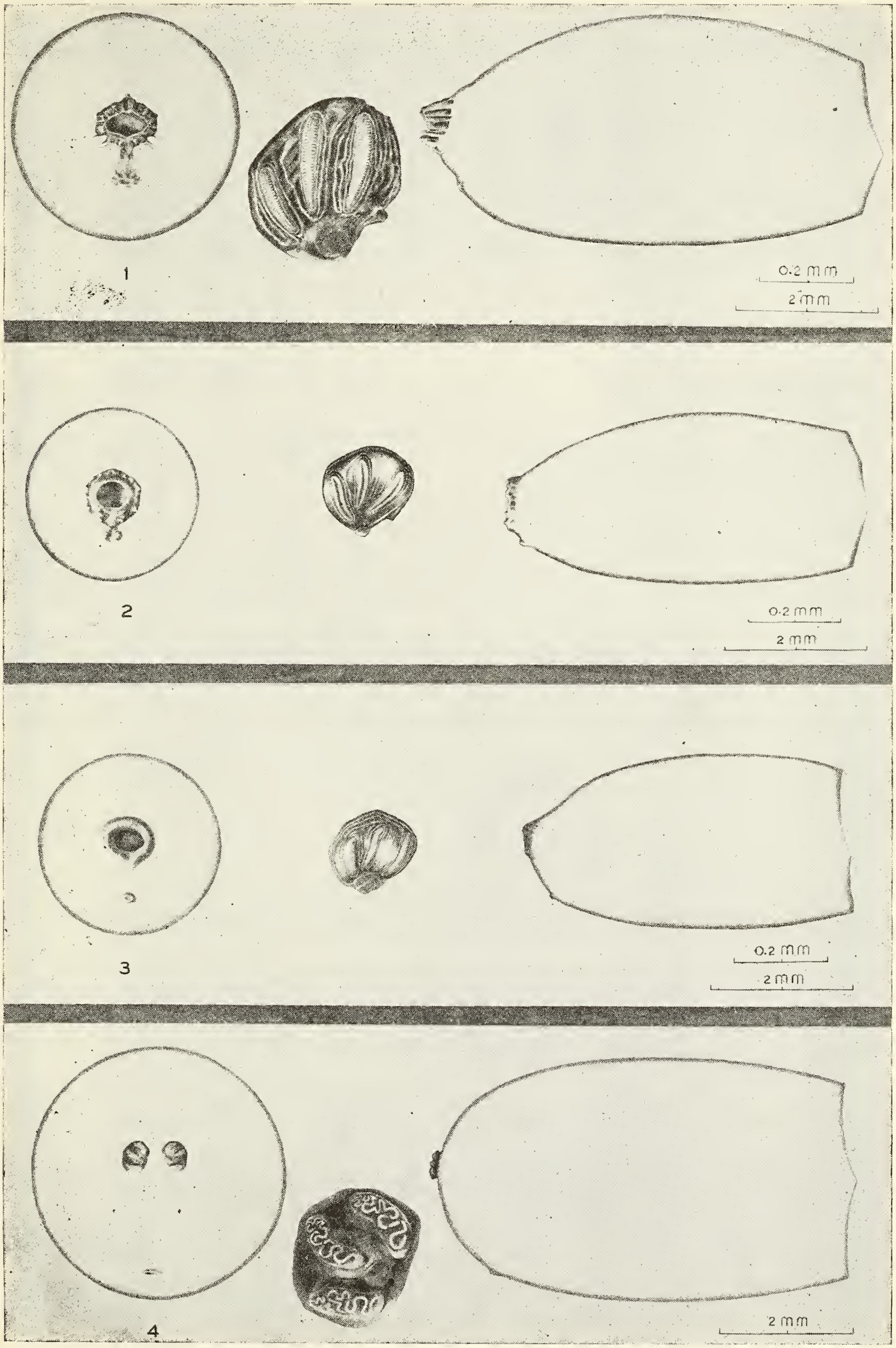
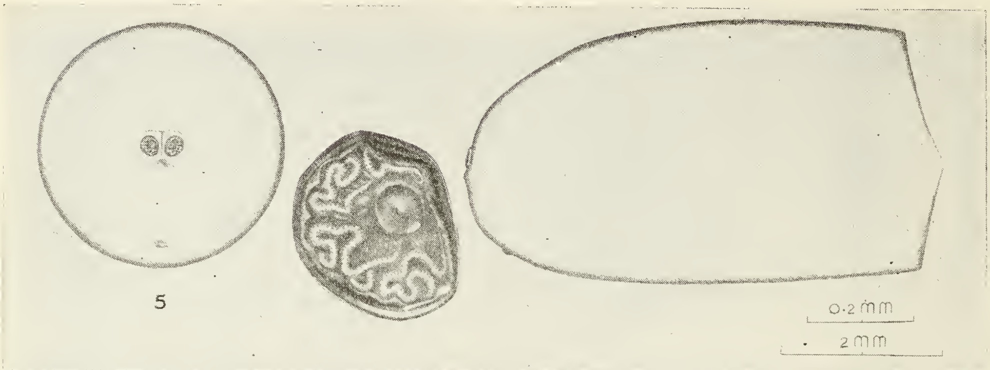


ROSS— DIPTEROUS PARASITES OF MALACOSOMA



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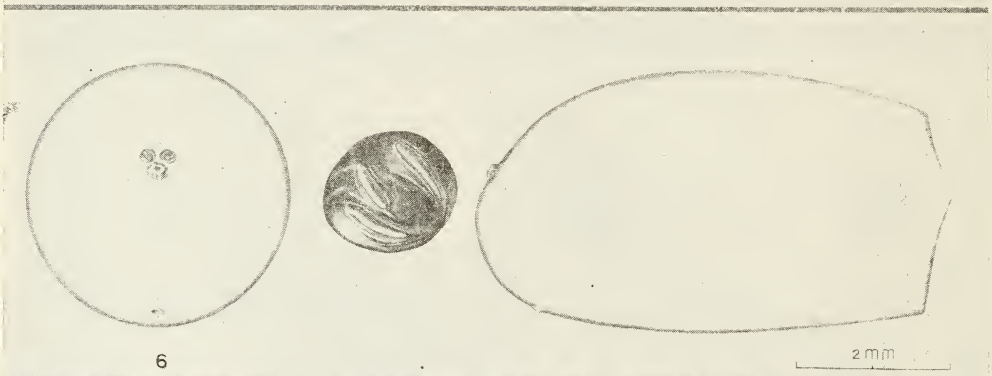

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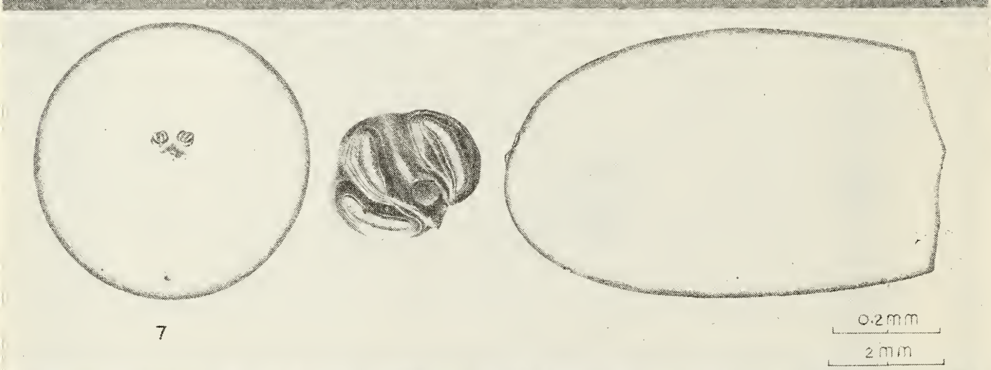

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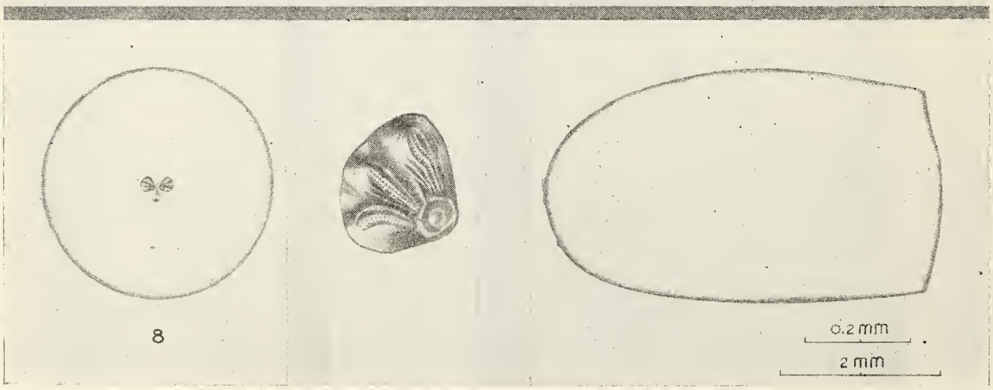

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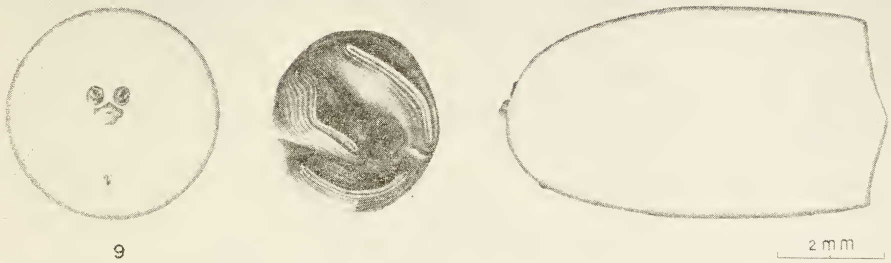

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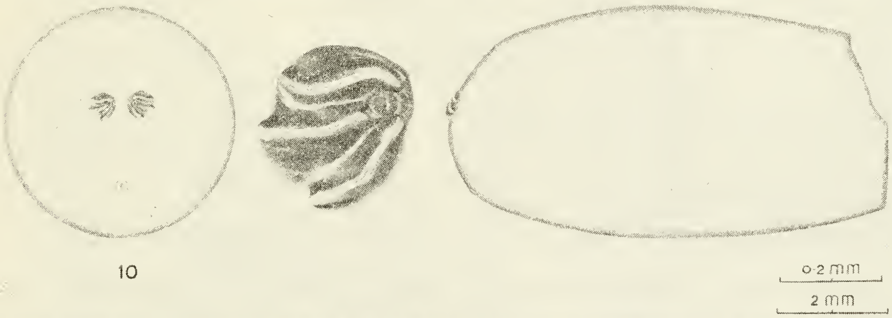

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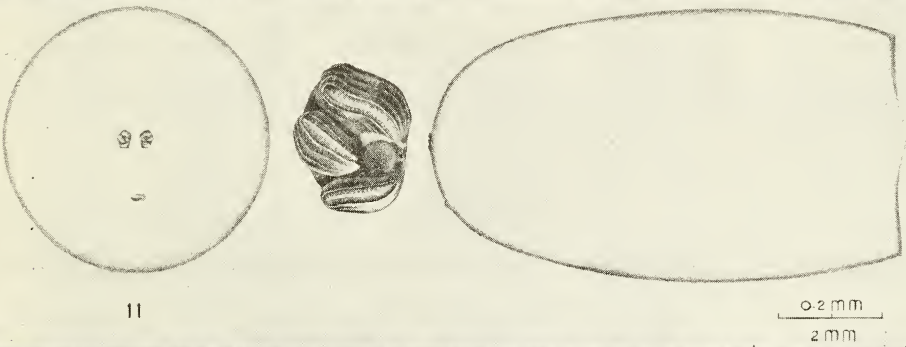

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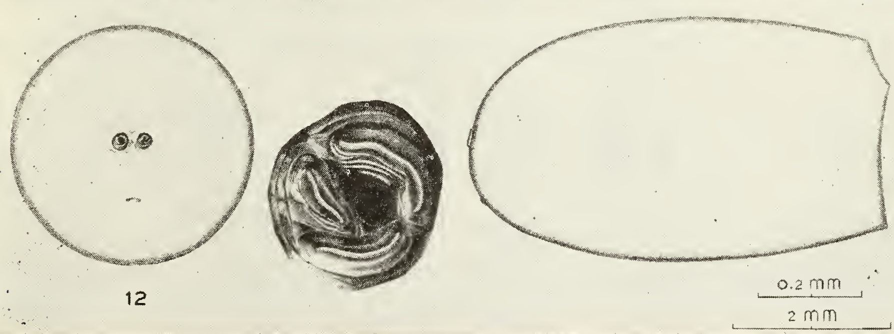

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ROSS— DIPTEROUS PARASITES OF MALACOSOMA

UPON NEUTRALIZING THE ODOUR OF NOMIUS PYGMAEUS (DEJ.), THE STINK BEETLE (COLEOPTERA: CARABIDAE).

G. J. SPENCER
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During certain summers, and especially when the smoke of forest fires on Vancouver Island is driven by a west wind, any section of the City of Vancouver may be plagued with *Nomius pygmaeus* (Dej.), the stink beetle, which, for its size, is probably one of the most powerfully obnoxious creatures in the world. One individual, crushed or injured in a room, will render that room uninhabitable for two weeks, and the smell persists for months. In late August, 1951, a number of reports was received by the Department of Zoology, of these beetles occurring in homes; one such enquiry came from a physician who was attending a woman for a slight head wound and from her hair he removed a stink beetle; he felt that the stench could not possibly arise from such a slight wound and wondered if the beetle had been attracted by the wound. Another report, from North Vancouver, was of three beetles found on steps just outside a basement door over a period of two days; the beetles had not been injured in any way but were rendering the basement most foul by their mere presence.

From various sources, three beetles were obtained uninjured and a number of chemicals, including activated charcoal, tested as possible deodorants. None was effective except those containing active chlorine such as sodium hypochlorite, ordinary household bleach and chloride of lime. A few drops of sodium hypochlorite on the cork of a test-tube will deodorize the smell of a beetle in the tube in ten minutes, leaving only a faint musty odour: further exposure renders the beetle as inoffensive as any ordinary pinned carabid.

For the treatment of rooms where beetles had been crushed, it was recommended that household bleach be used in an ordinary fly sprayer. For outside premises, dusting with fresh chloride of lime was recommended. The citizens reported that the treatment was successful and the stink of the beetle was neutralized almost completely in a short time.

PRELIMINARY ORCHARD TRIALS WITH SYSTEMIC INSECTICIDES[1]

R. S. DOWNING[2]
Fruit Insect Laboratory, Summerland, B.C.

At the Summerland laboratory work on systemic insecticides was commenced in 1950. Prestox 3 (30 per cent schradan[3]) was applied to Delicious apple trees as a "pink" spray at one quart per 100 imperial gallons against the European red mite, *Metatetranychus ulmi* (Koch). It compared favourably with the standard recommendation of one pound of 15 per cent. parathion. Seasonal averages in terms of mites per leaf were Pestox 3, 0.6, and parathion, 0.2. The untreated trees carried 14.8 mites per leaf in late May and had to be sprayed. In August, Systox (32.1 per cent. diethyl S-ethylmercapto-ethyl thiophosphate)[4] at one quarter-pint was applied to Delicious apple trees to control the two-spotted spider mite, *Tetranychus bimaculatus* Harvey. A comparison with 15 per cent. parathion, one pound is given in Table I.

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2 Assistant Entomologist.

3 Pest Control Limited, Cambridge, England.

4 Geary Chemical Co., New York, N.Y.

5 C1014, Dow Chemical Co., Midland, Michigan.

6 Naugatuck Chemicals, Elmira, Ontario.

TABLE I

Effect of summer applications of acaricides against the two-spotted spider mite on apple; materials applied by a conventional hand-gun sprayer on August 27, 1950.

Acaricide	Amount per 100 gal.	Average number mites per leaf		
		Before spraying	After spraying	
		Aug. 27	Sept. 1	Sept. 9
Systox, 32.1%	0.25 pt.	24.3	0.3	0.9
parathion, 15%	1 lb.	23.6	0.2	0.9
check	no treatment	13.0	10.6	4.8

In 1951, formulations were changed; schradan and Systox were supplied as 45[5] and 50 per cent. liquid concentrates respectively. Both materials were applied as "pink" sprays to control the clover mite, *Bryobia praetiosa* Koch, on Newtown apple trees. Schradan, at one quart, caused slight marginal leaf injury, but Systox, at one-quarter pint, caused no sign of phytotoxicity. Results from two orchards are summarized in Table II.

TABLE II

Effects of "pink" application of acaricides against the clover mite on apple; materials applied by conventional hand-gun sprayer in May, 1951.

Orchard No. 1

Acaricide	Amount per 100 gal.	Average number mites per leaf				
		May 25	June 8	June 21	July 4	Aug. 9
Systox, 50%	0.25 pt.	0.0	0.0	0.0	0.0	0.6
schradan, 45%	1 qt.	0.0	0.0	0.0	0.1	0.6
parathion, 15%	1 lb.	0.0	0.0	0.1	0.4	12.8
check	no treatment	0.6	0.6	3.4	8.4	(sprayed July 4)

Orchard No. 2

		May 23	June 6	July 16	Aug. 7	
Systox, 50%	0.25 pt.	0.0	0.1	0.3	0.3	
parathion, 15%	1 lb.	0.0	0.1	0.5	4.0	
Aramite, 15%	2 lb.	0.1	0.1	3.6	19.1	

Another experiment was carried out to determine the effects of systemic insecticides applied as "pink" sprays against mites that overwinter as adult females. In the southern Okanagan in 1951, most of the mites had moved from their winter quarters and had started to deposit eggs by the time apple flower buds were in the pink or balloon stage. For most effective results at this period, an acaricide should have either a long residual action against active stages or an ovicidal action and, in addition, a high initial toxicity to the adult mites. Systox appeared to have the necessary requirements because it has long residual action. It was applied as a pink spray to Delicious apple trees infested with the yellow mite, *Eotetranychus flavus* (Ewing) (formerly called the Willamette mite, *Tetranychus willamettei* McG.). Aramite (15 per cent. beta-chloroethyl-beta-(p-tertiary butylphenoxy)-alpha-methyl ethyl sulphite),[6] the acaricide that is presently being recommended for control of the yellow mite in British Columbia orchards, was used at two pounds as a comparative material. The numbers of mite-injured leaves, recorded early in September, are summarized in Table III.

TABLE III

Effects of "pink" application of acaricides against the yellow mite on apple; materials applied by a conventional hand-gun sprayer in May, 1950.

Acaricide	Amount per 100 gal.	Percentage leaves injured in Sept.
Systox, 50%	0.25 pt.	0
Aramite, 15%	2 lb.	14
check	no treatment	92

Although aphid colonies were not counted, there was an obvious difference in the numbers of colonies on the two plots. On August 1, all plots except the one sprayed with Systox were heavily infested with both the woolly apple aphid, *Eriosoma lanigerum* (Hausm.), and the green apple aphid, *Aphis pomi* Deg. On the Systox plot there were no woolly apple aphids and only a few green apple aphids.

Systox Residues

Systox was applied to McIntosh and Newtown apple trees as a "pink" spray by an automatic concentrate sprayer at one quart per acre. At harvest, samples from both varieties were sent to Geary Chemical Co., New York, for chemical analysis. The McIntosh apples contained 1.8 parts of pure Systox per million and the Newtown apples less than 0.2 parts per million.

Conclusions

1. A 30 per cent schradan emulsible concentrate applied at the pink stage of apple bud development, at one quart per 100 gallons, was approximately equal in effectiveness to one pound of 15 per cent. parathion wettable powder against the European red mite.

2. As a "pink" spray, 45 per cent. schradan at one quart was superior to one pound of 15 per cent. parathion against the clover mite, but caused slight marginal injury to Newtown apple foliage.

3. Against the two-spotted spider mite, Systox (32.1 per cent.) at 0.25 pints per 100 gallons was equal in effectiveness to 15 per cent. parathion at one pound.

4. As a "pink" spray, Systox (50 per cent.) at 0.25 pints was more effective against the clover mite than 15 per cent. parathion at one pound.

5. As a "pink" spray against the yellow mite, Systox (50 per cent.) at 0.25 pints gave excellent control throughout the season and, in addition, controlled the woolly apple aphid and the green apple aphid.

ANNOTATED LIST OF INSECTS AND MITES COLLECTED ON BRAMBLES IN THE LOWER FRASER VALLEY, BRITISH COLUMBIA, 1951[1]

N. V. TONKS[2]

Fruit Insect Section, Laboratory of Entomology, Victoria, B.C.

A survey of insect and mites on brambles was made in 1951 as part of a long-term study of bramble fruit insects in the lower Fraser Valley. Host plants included both wild and cultivated species of *Rubus*. The common wild bramble in this area is the thimbleberry, *R. parviflorus* Nutt.; cultivated forms are limited mainly to raspberry, loganberry, and blackberry. Collections were made throughout the growing season.

Determinations were made by officers of the Division of Entomology, Ottawa, as follows: Coleoptera, Messrs. W. J. Brown and R. de Ruette; Diptera, Mr. J. F. McAlpine; Hemiptera, Dr. B. P. Beirne and Mr. L. A. Kelton. Acarina were determined by Dr H. H. J. Nesbitt, Carleton College, Ottawa, and Thysanoptera by Miss Kellie O'Neill, Bureau of Entomology and Plant Quarantine, Washington, D.C.

COLEOPTERA

Byturidae

1. **Byturus bakeri** Barber, western raspberry fruitworm.

   Adults taken on raspberry, loganberry, and thimbleberry, Abbotsford, Hatzic, late April to end of June, 1950, 1951.

   This is one of the more serious pests of bramble fruits in the Fraser Valley. Adults emerge in late April. Egg laying apparently begins about the middle of May, at which time the adult population is at its peak. Larvae reach maturity and leave the fruit in July and early August.

Coccinellidae

2. **Coccinella trifasciata subversa** Lec.

   Adults taken on raspberry, Huntingdon, 1951.

3. **Psyllobora** sp.

   Adults collected from loganberry and thimbleberry, Abbotsford, 1950, 1951.

4. **Stethorus punctillum** Ws.

   Adults collected from raspberry leaves heavily infested with mites, Lulu Island, 1950. This species was first reported in America by Brown (1950), who recorded it from Massachusetts and Ontario.

Curculionidae

5. **Brachyrhinus ovatus** (L), strawberry root weevil.

   Adults were found on raspberry, Huntingdon and Hatzic, June to August, 1950, 1951. This species is a serious pest of strawberries in the lower Fraser Valley, but observations have shown no large populations on raspberry, and no damage to the latter has been apparent.

   swarmed extensively in April and May,

6. **Brachyrhinus sulcatus** (F), black vine weevil.

   Adults collected from brambles, Huntingdon and Hatzic, June to August, 1950, 1951. This root weevil is also a serious pest of strawberries, but specimens have not been numerous on brambles, and no economic damage has been observed in the lower Fraser Valley.

7. **Rhynchites bicolor** (F), rose curculio.

   Adults taken on thimbleberry, Abbotsford and Mission, May, June, 1951. Buds of thimbleberry frequently show considerable damage from the feeding of this weevil, but no damage has occurred in cultivated bramble plantings.

8. **Sciopithes obscurus** Horn.

   Adults present on raspberry, Huntingdon and Hatzic, April to September, 1950, 1951. Very few specimens were found, and damage was not apparent.

Elateridae

9. **Agriotes ferrugineipennis** (Lec.).

   Adults taken on raspberry, Huntingdon, May, 1951.

10. **Ctenicera lobata caricina** (Germ.).

    Adult found on raspberry, Huntingdon, May, 1951.

11. **Ctenicera suckleyi suckleyi** (Lec.)

    Adults taken on raspberry, Clearbrook and Huntingdon, May, 1950, 1951.

12. **Limonius discoideus** (Lec.)

    Adults collected from raspberry, Clearbrook, May, 1950. This species was reported by Essig (1926) to be injurious to the buds and blossoms of fruit trees; no damage has been observed on brambles. Wireworm adults were fairly common on bramble foliage during April and May, but were not found later in the season.

Lampyridae

13. **Lucidota californica** (Mots.)

    Adults collected in small numbers from raspberry and thimbleberry, Huntingdon and Hatzic, April to October, 1950, 1951.

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2 Technical Officer.

Lathridiidae

14. **Melanophthalma** sp.
Adults common on raspberry, boysenberry, and thimbleberry, Yarrow, April, May, June, 1951.

Scarabaeidae

15. **Hoplia** sp.
One specimen collected from raspberry, Yarrow, May, 1951.

DIPTERA

Agromyzidae

16. **Agromyza (Liriomyza)** sp. **(A. pusilla** Mg. complex)
One specimen collected from raspberry, Huntingdon, 1951.

Anthomyidae

17. **Pegomyie rubivora** (Coq.), raspberry cane maggot.
Larvae collected from blackberry, Huntingdon, June, 1950.
This species has caused only slight damage to commercial plantations in the lower Fraser Valley.

Bibionidae

18. **Bibio** sp., ? **nervosus** Loew
Adults collected from brambles throughout the lower Fraser Valley, April, May, 1950, 1951. These flies and were found resting on a wide range of plants.

Chloropidae

19. **Thaumatomyia glabra** (Meig.)
Adults common on raspberry, loganberry, and thimbleberry, Abbotsford and Mission, April to September, 1950, 1951.
The larva was reported by Smith *et al.* (1943) to be predacious on aphids, especially those feeding below ground.
20. **Thaumatomyia grata** (Loew)
One adult collected from raspberry, Huntingdon, August, 1951.

Lauxaniidae

21. **Minnettia lupulina** (Fab.)
Adults collected from raspberry and thimbleberry, Huntingdon, June to September, 1951.

Opomyzidae

22. **Opomyza combinata** L.
One adult found on raspberry, Abbotsford, September, 1950.

Trupaneidae

23. **Terellia florescentiae** (L.)
Adults collected from raspberry, Huntingdon, August, 1951. The larva of this fly lives in the heads of Canada thistle.

HEMIPTERA

Anthocoridae

24. **Orius insidiosus** (Say)
One specimen found on raspberry, Huntingdon, August, 1951.
25. **Orius minutus** (L.)
Adults collected from raspberry and loganberry, Lulu Island, Huntingdon, 1951. Both these species of **Orius** are predacious on mites, thrips, leafhoppers, and other small insects. Collections on brambles during 1951 showed **O. minutus** to be the more common species. Adults were present in small numbers throughout the growing season.

Miridae

26. **Campylomma verbasci** (Meyer)
One specimen collected from loganberry, Lulu Island, September, 1951.
27. **Lygus** sp., ? **shulli** Knight
Adults common on brambles, Abbotsford, Hatzic, Lulu Island, April to September, 1950, 1951.
28. **Plagiognathus chrysanthemi** (Wolff)
Adults collected from raspberry, Huntingdon, August, 1951.

Nabidae

29. **Nabis ferus** (L.)
Adults collected from raspberry, loganberry, and thimbleberry, Hatzic, Lulu Island, September and October, 1951. Populations of this predator were not large. Specimens were collected on hosts having a considerable population of leafhoppers.

Pentatomidae

30. **Cosmopepla bimaculata** (Thos.)
Adults collected from raspberry, loganberry, and thimbleberry, Abbotsford, Hatzic, 1951. Specimens were common from May to September. Nymphs were occasionally observed clustered on loganberries in July, apparently feeding on the developing fruit.

HOMOPTERA

Aphididae

31. **Amphorophora rubi** (Kltb.)
Specimens collected from raspberry, Burnaby, July, 1949. Populations of this aphid were low on brambles, and no damage was apparent.

Cicadellidae

32. **Colladonus montanus** (Van D.)
Adults collected from raspberry and loganberry, Lulu Island and Huntingdon, August, September, 1951. Specimens were not numerous, and were found mainly on the lower parts of the bushes and weeds in the row.
33. **Dikraneura absenta** DeL. & C.
Adults collected from loganberry, Abbotsford, September, 1950.
34. **Macrosteles fascifrons** (Stal) complex (**divisa** auctt.)
Adults collected from raspberry, Huntingdon, August, 1951.

Typhlocybidae

35. **Typhlocyba rosae** (L.) rose leafhopper.
Adults collected from raspberry, loganberry, and blackberry throughout the lower Fraser Valley, 1950, 1951. These were the most common leafhoppers on brambles. There are two generations a year; adults of the first generation mature in June, those of the second generation in August. Adults were collected as late as November on loganberries where the trailing canes and dense foliage provided shelter.

HYMENOPTERA

Tenthredinidae

36. **Monophadnoides geniculatus** (Htg.), raspberry sawfly.
Second-generation larvae collected from raspberry, loganberry, thimbleberry, September, October, 1951. Slight damage by this species occurred on brambles in the spring.

LEPIDOPTERA

Aegeriidae

37. **Bembecia marginata** (Harr.), raspberry root borer.
Eggs found on raspberry and thimbleberry, August, September, October, 1950, 1951. This species is one of the more injurious pests of brambles in the lower Fraser Valley. Egg hatching began in mid-September in 1951 and was about 50 per cent. complete by the end of the month, but in 1952 hatching did not begin till the end of September. Approximately 15 per cent. of the eggs were parasitized in 1952.

Tortricidae

38. **Archips rosaceana** (Harr.), oblique-banded leaf roller.
Larvae collected from raspberry, June 20, 1951, and reared to adults in insectary, July 3, 1951. Infestations of this leaf roller were common on raspberries during 1951.

THYSANOPTERA

Phlaeothripidae

39. **Haplothrips** sp., near **niger** (Osb.)
Specimens collected from blackberry and loganberry flowers, Huntingdon, June, 1951.

Thripidae

40. **Frankliniella** spp.,**occidentalis** complex
Specimens collected from blackberry and loganberry flowers, Huntingdon, June, 1951. Most of the specimens were **F. moultoni** Hood; a few were of **F. trehernei** Morg. Some of the heavily infested flowers showed dark discoloration around the bases of the stamens, but otherwise little injury was apparent on the blossoms. Occurrence of thrips on harvested fruit seemed to be the major economic problem with infestations on brambles.

41. **Taeniothrips atratus** (Hal.)
Three specimens obtained from blackberry and loganberry bloom, Huntingdon, June, 1951.

42. **Taeniothrips vulgatissimus** (Hal)
Adults common in flowers of blackberry and loganberry, Huntingdon, June, 1951.

43. **Thrips tabaci** Lind., onion thrips.
Five adults collected from blackberry and loganberry bloom, Huntingdon, June, 1951.

44. **Thrips madronii** Mlt.
Specimens collected from blackberry and loganberry flowers, Huntingdon, June, 1951.

45. **Thrips** sp., near **fuscipennis** Hal.
Adults collected from blackberry and loganberry blooms, Huntingdon, June, 1951. Miss Kellie O'Neill, in commenting on the identification of these specimens, stated that the only published record for **T. fuscipennis** in North America is Hood's (1927) record of it in New York.

ACARINA

Tetranychidae

46. **Tetranychus bimaculatus** Harvey, two-spotted spider mite.
Specimens collected from raspberry, Lulu Island, June, July, 1950. There has been no excessive build-up in mite populations on brambles in the lower Fraser Valley area despite the widespread use of DDT since 1948 for control of the raspberry fruitworm. Mite populations during 1951 on brambles were almost nil.

47. **Eotetranychus pacificus** (McG.), Pacific mite.
Specimens collected from raspberry, Lulu Island, July, 1949. One raspberry plantation on Lulu Island had a heavy infestation of **E. pacificus** in 1949, but there has been no further outbreak of it here.

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RECORDS OF THE TICK OTOBIUS MEGNINI (DUGES) FROM BRITISH COLUMBIA (ACARINA: ARGASIDAE)

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Division of Entomology, Canada Department of Agriculture
Kamloops, British Columbia

Otobius megnini (Dugès) is a common parasite of cattle in the southern United States, where it is known as the spinose ear tick. Farther north, it is less plentiful and Cooley and Kohls (1944) list only nine instances of its presence in Oregon, Washington, Idaho, and Montana. In these records its hosts were deer, mountain sheep, man, rabbit, cattle, and horses. This tick was first collected in Canada in 1941, when a nymph was taken from a cat at Ewings Landing on Okanagan Lake, British Columbia. This area lies below Terrace Mountain, upon which dwells a small band of mountain sheep. It is of interest that the late Allan Brooks, in a personal interview, spoke of having seen ticks in the ears of these animals about 50 years ago. Possibly these were of the above species.

In 1943, a number of the ticks were taken from a mountain goat at Bryant Creek, near Windermere, British Columbia, by Dr. Ian McTaggart Cowan Two more collections were made by Dr. Cowan in 1950 from mountain sheep and a mule deer at Vaseaux Lake and Barriere. Because of the last record, attention was paid to deer brought out by hunters from the North Thompson Valley in the fall of 1951. Of the 28 deer examined, 15 had infested ears. The heaviest concentration was 172 ticks on one animal. The average infestation was approximately 30 ticks per infested animal. Domestic sheep graze in the same locality, but so far, no infestations have been found on them, although the ears of 350 were examined carefully. Why this tick restricts itself to feral hosts in its northern range is not yet known.

During the above survey 12 deer carcasses from the Okanagan Valley were examined and ticks were found on three of them; however, none were found on 41 carcasses from the Cariboo District (Clinton to Quesnel).

Reference

Cooley, R. A., and G. M. Kohls. 1944. The Argasidae of North America, Central America, and Cuba. American Midland Nat. Monograph No. 1: 21-31.

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BOOK REVIEW

"Insect Physiology", by 15 authors, Kenneth D. Roeder (Edit.) pp. xiv + 1100; with 256 figures, 108 pp. of references. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Limited.

The objectives of this volume are best expressed in the preface by the editor: " . . . the book is a critical discussion rather than a complete review of insect physiology . . . " and: "It has not been our intention to present insect physiology as an insulated compartment of knowledge."

The literature on insect physiology is now so vast that a complete review within the space of a thousand pages is impossible. Accordingly, certain omissions are understandable, especially since some of the omitted material is already reviewed in other books on insect physiology. Instead, subjects not covered elsewhere take its place. Deficiencies pointed out in this review are therefore intended as statements of fact rather than as derogatory criticisms of the book as a whole.

Notable among the new items is the "inclusion of information on the mode of action of enzyme inhibitors, drugs, and other chemical agents." The biochemical aspects of insect physiology are well reviewed throughout the book. Various phenomena associated with nerve function are also well covered. On the contrary, the more fundamental aspects of the structure and biophysics of living protoplasm are not mentioned, despite the fact that the most significant feature which distinguishes a living cell from a dead one is the internal control which it maintains over its colloidal state. Without reference to this phenomenon, all toxicological findings beg the question, because many effects are reversible until physical degeneration has occurred.

Considering the dominating influence of temperature on insect growth, it is surprising that the authors evidently did not consider it necessary to include brief coverage of growth-temperature relationships. Their scant reference to "temperature characteristics" of Crozier gives no hint of the tenuous and empirical philosophy of its interpretation. Excellent coverage is given of the role of hormones and enzymes in diapause of certain post-embryonic stages, but consideration is not given to diapause in eggs and embryos, nor is mention made of the possible ultimate involvement of water-binding in the colloids. The question of bound water in insects is passed off lightly in the face of much evidence of colloidal physics.

"Insect Physiology" is well written and indexed, and is a welcome addition to the literature on insects, and indeed no entomological library can be complete without it. It does not, however, entirely take the place of other works on the subject.

—Kenneth Graham.

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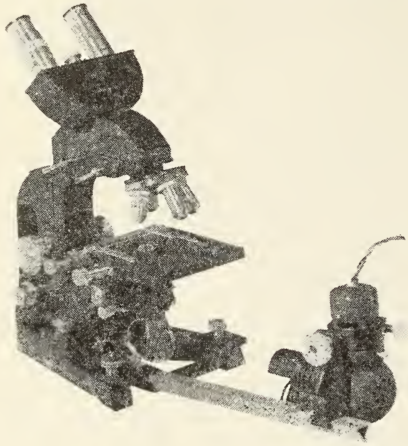

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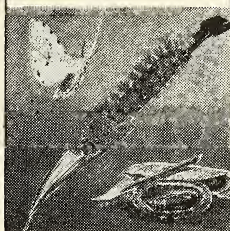

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cotton fleahopper
cotton leafworm
cowpea aphid
cowpea curculio
cucumber beetles
cutworms
darkling beetles
fall armyworm

southern corn rootworm
spittlebugs
stink bugs
strawberry crown bore
strawberry leaf roller
strawberry weevil
suckfly
sugar beet webworm
sweetclover weevil

bollworm
cabbage caterpillars
cattle lice
chiggers (on vegetation)
chinch bugs
clover seed chalcid
corn earworm
corn lantern fly
cotton aphid

pecan weevil
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plum curculio
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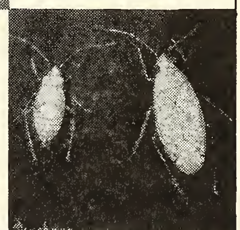
southern armyworm



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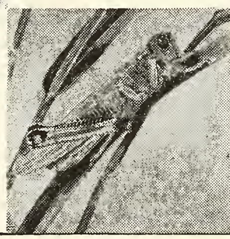
flea beetles
fleece worm
grasshoppers
goat lice
hog lice
horn fly
leafhoppers
little fire ant



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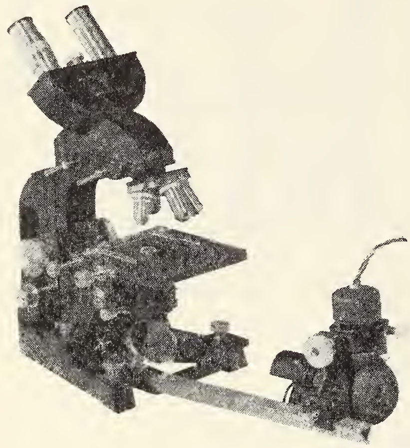

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THE BROADER IMPLICATIONS OF THE DEVELOPMENT OF ENTOMOLOGY IN THE PACIFIC NORTHWEST

Melville H. Hatch

University of Washington, Seattle, Wn.

For some years the writer has been interested in the history of entomology in the Pacific Northwest. In 1949 the University of Washington Press issued the result of his studies under the title, "A Century of Entomology in the Pacific Northwest", and since then he has published a number of shorter historical studies. Moreover, the 1952 issue of the Proceedings of the Entomological Society of British Columbia contained a number of papers on the development of entomology in that portion of the Northwest. At the present time, accordingly, there seems no point in merely summarizing again what has been said before. Rather it seems more challenging at this juncture to carry the enquiry to the stage where the attempt is made to extract from the history something of its general significance. I propose to proceed by asking a series of questions about the development of entomology in this region in the hope that light will be shed on the subject by thus considering it from diverse points of view.

My basic assumption is that a science like entomology does not develop in a vacuum but is a part of a complex social process related to a complex array of factors in the environment in which it develops. As entomologists, we are well aware that the insects that we study are complexly related to the environment in which they occur. It is similarly true that the very fact that we are studying insects rather than, for instance, debating how many angels can dance on the head of a pin, is the result of complex factors in the sociological environment.

(An address given at the Annual Meeting of the Entomological Society of Canada, Victoria, B.C., October 19, 1953; in part based on an address given in a Symposium on the Development of Entomology in the West at the Pacific Coast Branch Meeting of the Entomological Society of America at Lake Tahoe, Calif., June 24, 1953.)

First, then, I ask: What is the over all position of the Pacific Northwest in regard to the development of entomology?

Entomology arose as part of that awakening interest in nature that occurred in Western Europe in the sixteenth century. The first insects were not taken in the Pacific Northwest until the beginning of the second third of the nineteenth century, and it was another forty or fifty years before an indigenous study of insects began to appear in our region. As regards both time and geography, then, entomology in the Pacific Northwest occupied a peripheral position, far removed from the central mainsprings of our western European culture.

The Pacific Northwest was one of the last portions of the North American continent to be claimed by men of European descent. California and Alaska had been occupied by Spain and Russia in the eighteenth century, but the first trading posts were not established in the intervening region until about 1808.

Modern natural history, as has been said, arose in Western Europe in the sixteenth century. The first studies were concerned with the more conspicuous plants and vertebrates, but by the end of the century a manuscript on the less conspicuous insects was being put together by a series of English naturalists, and Ulysses Aldrovandus, Professor of Natural History at the University of Bologna in northern Italy, was at work on his vast compendium, *de Animalibus Insectis,* which saw publication in 1603. A small but increasing number of books on insects appeared in the seventeenth and early eighteenth centuries, laying one of the bases for the *Systema Naturae,* in the middle of the eighteenth century, of the great Swedish Naturalist, Carolus Linnaeus, in the 1758 edition of which its author gave relatively precise descriptions of some 4400 species of animals, including about 2100 insects. Thus, seventy-five years before the first insects were collected in the Pacific Northwest, Linnaeus had created a mature science of insects and had devised the method whereby, eventually, the million or so different species of insects may be classified.

Meanwhile, Linnaeus' pupil, the Dane, Johan Christian Fabricius, had specialized on the insects and had thus become the first strict entomologist. In eastern North America, Thomas Say had described some 1575 new species of insects between 1818 and 1834, and Dr. T. W. Harris, the librarian of Harvard, had published a catalogue of 2350 species of insects from Massachusetts in 1833 and would in 1841 publish the first American book on harmful insects, "A Report on the Insects of Massachusetts Injurious to Vegetation."

It was, accordingly, against the background of a mature but rapidly growing entomology that the first insects were collected in the lower Columbia River Valley about 1835. And it is not surprising to realize that the history of entomology in the Northwest has consisted in the main of a series of reactions to cultural influences of western European and eastern North America origin.

My second question is: What are the general features of Northwestern entomology as it actually developed?

As already noted, insects are relatively inconspicuous and their study tends to follow on that of the plants and vertebrates. Thus, the first scientific observations on Northwestern natural history were those made by Archibald Menzies, surgeon accompanying the Vancouver Expedition, in the 1790's, followed by additional observations by Lewis and Clark and others. Similarly at the present time, Northwestern plants and vertebrates are described in numerous detailed manuals, whereas the insects have so far been only rather sketchily listed, with only the barest beginning of descriptive works.

The beginning of the study of insects in the region dates from the first scientific collection of specimens in the lower Columbia River Valley about 1835. For thirty years all the insects taken in the region were by itinerant collectors who were not themselves entomologists, but transmitted their materials to specialists in Northwest Europe and Northeastern United States. Only with the seventies did two or three entomologists pass through the region, and the same decade saw O. B. Johnson living in the Willamette River Valley and G. W. Taylor on southern Vancouver Island. These were the pioneer resident entomologists of the region. The eighties saw O. B. Johnson commencing the teaching of entomology at the University of Washington in Seattle. The nineties saw the establishment of agricultural experiment stations at Pullman, Washington; Moscow, Idaho, and Corvallis, Oregon, with the beginning of investigational work in applied entomology.

The turn of the century witnessed the beginning of original work in insect taxonomy by J. M. Aldrich at Moscow and Trevor Kincaid at Seattle, joined later by G. W. Taylor at Nanaimo and A. L. Melander at Pullman. The nineteen tens witnessed the establishment by the federal governments of both the United States and Canada of permanent laboratories for investigations in applied entomology. In the United States these laboratories supplement the work of the states, but in British Columbia they have preempted nearly the entire field. Finally, by the 1920's the economic work in the region was so well established that occasional discoveries of national significance began to appear. After ninety years, Northwestern entomology had begun to come of age!

What have been the economic and cultural bases of Northwestern entomology? For no sort of science flourishes in a vacuum, but is related to other aspects of the culture.

The first Northwestern insects were collected as a by-product of the unsuccessful attempt of a business man of Boston to break into the Northwestern fur trade. The next insects to be gathered—those taken in 1841 by Dr. Charles Pickering and Titian R. Peale—were an outcome of the New England whaling industry. At least, I suggest that whaling was an important factor in inducing Congress to send the Wilkes Exploring Expedition to the Antarctic and the Pacific, and Pickering and Peale were among the naturalists on this expedition. From 1853 to 1856, insects were taken by the Railway Surveys, which the American Government organized in order to keep the communities of an expanding western frontier integrated with the life of the rest of the country. And specimens secured between 1857 and 1864 were taken by the parties surveying the international boundary between the United States and Canada.

Of course, the very fact that the fur trade, the whaling industry, and the railroad and boundary surveys produced insects for scientific study was itself the result of cultural tendencies then long at work in the Atlantic community. The awakening interest in nature to which the 16th century had given birth came to permeate the highest circles of European society. To this the Royal Society of England and the Academies supported by the French, Prussian, and Russian governments bore witness. Moreover, in the persons of Benjamin Franklin and Thomas Jefferson, the new American republic had come into contact with the best continental traditions. The result was that, as the United States felt its way westward and as the Anglo-Canadian governments joined with it, scientific exploration became an integral part of geographical and commercial exploration.

With the early seventies, amateurism entered the picture—the industrial wealth of Great Britain made it possible for a Lord Walsingham to spend a year in northern California and Oregon collecting microlepidoptera and the Anglo-American coleopterist, George Robert Crotch, to collect beetles. By the seventies, moreover, life in the pioneer communities had become sufficiently established so that an occasional immigrant in very ordinary economic circumstances, like O. B. Johnson and G. W. Taylor, took up the study of insects. A decade later academic entomology became established at the as yet very tiny University of Washington.

The intrusion of applied entomology on the Northwestern scene had diverse roots. The sort of insect study that up to this time had operated in our area was the working out of the spirit and genius of Linnaeus in seeking to subject the works of the Creator to a rational ordering. But not the Swede, Linnaeus, but the Frenchman, Antoine Lavoisier, was the greatest scientist of the eighteenth century, and not Linnaeus, again, but the great Englishman, Charles Darwin, who was the biologist who was destined to leave the most indelible stamp on the modern world. It was the experimental techniques employed by Lavoisier in virtually founding the science of chemistry that in the course of two or three generations began to make an effective science of agriculture possible. And it was the evolutionist Darwin who showed that insects were something more than jewels fresh from the hand of the Creator, that they were veritable parts of the processes of nature, to be understood and controlled. Moreover, an advancing agriculture was intensifying its entomological problems, gradually bringing in additional pests from distant parts of the world and, by growing crops in ever more extensive continuous stands, producing ideal conditions for the multiplication of insects.

Harris' 1841 "Report on the Insects of Massachusetts Injurious to Vegetation" was a recognition of the problem. The 1854 appointment of Townsend Glover as federal entomologist by the United States government followed by the appointment by New York, Illinois, and Missouri, of state entomologist in 1856, 1867, and 1868, was acknowledgment by government that insects were of public concern. Finally, the spectacular control of the Colorado potato beetle by Paris Green in the sixties and the control of the grape Phylloxera by the use of resistant hosts in the seventies showed what entomological research could accomplish. The result was an accumulation of pressures making for government participation in combating insects as part of the general promotion of applied agriculture.

In the late eighties, the American Congress was induced to pass the Hatch Act matching state with federal funds in maintaining an Agricultural Experimental Station in each of the states and territories. This led to the establishment of research and teaching in applied entomology in each of the Northwestern states. The pressure on the federal government to aid agriculture was not satisfied with this direct help to the states, however, so that from the early nineties special agents were sent into the states who worked in close conjunction with the several state entomologists on special entomological problems. By 1910 the federal agents were spending two or three years at a time in the region. The work of these agents continued to expand, until, with the second decade of the present century, semi-permanent federal laboratories were established on both sides of the border: at Agassiz, Victoria, and Vernon, in British Columbia, at Wenatchee and Ritzville in Washington, and at Ashland and Forest Grove in Oregon. In British Columbia the federal agency virtually supplanted the provincial entomological service, except for instructional work carried on at the University of British Columbia after 1919. South of the border, the federal and state services have coexisted and collaborated with each other closely. In these ways the economic resources of an entire continent have been brought to bear on the agricultural problems of one of the less densely populated portions.

Accordingly, since the nineties, the continuing importance of a knowledge of insects in the maintenance and development of agriculture and forestry has been the main factor in promoting the study of Northwestern entomology. Academic entomology remains at the University of Washington, where we have virtually the strongest entomological library in the Northwest and where there are no economic involvements except for some recently introduced very elementary instruction in the College of Forestry. Seven or eight amateur entomologists of importance reside at various localities in our territory, but in general, applied entomology has dominated the field.

Northwestern entomology acquires additional interest for the student of cultural history from the fact that the region in which it operates is traversed by an international boundary. Because of the different political affiliation of the two regions, the area south of the border was settled by persons from the eastern United States, a generation or several removed from their European ancestors. Moreover, the diversity of cultural traditions represented by the people of the eastern United States was reflected in the settlers in general and the entomologists in particular. North of the border, on the other hand, a preponderance of the settlers was of British birth and brought their British traditions with them to their new home. Paramount among these traditions, from an entomological point of view, was a more general interest in nature and a wide-spread amateurism characteristic of the older more settled society from which they came. It was, perhaps, the continuation of the eighteenth century tradition that had produced Gilbert White's "Natural History of Selborne," 1788, at a time when Americans were making homes for themselves in a primeval wilderness.

In line with this tradition, there were, among the early entomologists of British Columbia, three clergymen: on Vancouver Island, Henry Matthews in the sixties and G. W. Taylor in the eighties and later; on the Queen Charlotte Islands, J. H. Keen in the nineties. One looks almost in vain for clergymen pursuing entomology on the American scene!

A vigorous amateurism, again, was involved in the organization and early years of the Entomological Society of British Columbia in Vancouver in 1902, and the consistency with which the

British Columbians have gotten their findings into print. The published proceedings of their Society gave them the vehicle and their amateur attitude gave them the drive for publishing their results. Many of these amateurs, it is true, later secured professional positions in the Dominion Entomological Service, but at a period in their lives too late to alter their basic attitudes. The outcome has been that, in the period since 1880, and virtually up to the present, a preponderance of the non-economic literature references to Northwestern insects refer to the British Columbia fauna. But the years effect changes. The amateur attitude does not apparently persist in the face of the increased efficiency of greater professionalism, and the time may soon be at hand when such differences as are referred to here may no longer distinguish the entomological work on the two sides of the border. Another influence of the border is seen in the personnel of the professional entomologists to the north and south of it. Because of the border and because of the control of the two federal services from Ottawa and Washington respectively, the movement of personnel tends to be east and west and not north and south. Moreover, the contacts with British entomology is far closer in British Columbia than in the states. The results are probably beneficial, tending to maintain a diversity of entomological outlook that otherwise might be absent.

Another way in which the international border has affected entomology is economic. The fact that Washington, Idaho, and Oregon are an integral part of the mid-twentieth century's greatest political, economic and military power, as well as the further circumstance that they are favorably situated with regard to agricultural, commercial and increasingly, to industrial wealth, means that, in the long run, tremendous economic resources are available for the study of entomological problems. The favorable present position of the University of Washington as regards library resources in entomology is one of the results of this economic power. The time will come, I suspect, when it will be regarded as strange that this Northwest country—one, as it is, in geography, in language, in flora, in fauna, and in basic economic relationships—should be divided, even to the extent that it is, by an invisible political boundary, and that its essentially similar entomological problems north and south of the 49th parallel should, in part, be administered separately from Ottawa and from Washington.

Another question that can be asked is: To what extent is the Pacific Northwest a natural unit for the consideration either of historical processes relative to the study of insects or to the study of insects themselves.

In my 1949 study of Northwestern entomology and in my forthcoming book on beetles, I have adopted British Columbia, Washington, Idaho, and Oregon as my unit for study. Faunistically, the area is only approximately natural, and southeastern Alaska and Montana west of the continental divide are integral parts of it, excluded for practical considerations. To the south, the area shades off gradually, especially in the mountains. In general, however, I suggest that the Arctic area to the north, the Great Plains east of the Rocky Mountains, and the Great American Desert to the south delimit the Pacific Northwest as a natural entomological region. In addition to these theoretical considerations, there is the following practical one for taking the Pacific Northwest as an area for study. Entomological problems, including those having to do with entomological history, are so complex that they must be broken down in various ways for analysis and study. Our primary political units, the United States and Canada, are too large and unwieldy for many types of studies. In Europe, regions like the British Isles, France, Italy, or Germany have repeatedly proven useful for detailed analysis. The Pacific Northwest represents a similar unit, one of the same order of size as the European area mentioned. The cultural effect of the international border has already been noted. I suggest, however, that similar north and south extending climatic and faunal zones involving similar crops and similar entomological problems, unite far more effectively than the border separates.

What have been the principal organizations that Northwestern entomologists have set up in order to expedite the prosecution of their entomological activities? Oldest and most important is the Entomological Society of British Columbia. Founded in Vancouver, in 1902, revived in 1911 by R. C. Treherne, this society has by its annual meetings and long series of publications promoted the entire field of entomology in the more northern portions of the Pacific Northwest. Similar in scope, but much more recent in origin, is the Oregon Entomological Society. Founded in 1939, under the sponsorship of the Oregon State College, it meets four or five times a year at various places in the Willamette Valley, issues a mimeographed *Bulletin* of proceedings, and co-ordinates effectively the activities of both amateur and professional entomologists.

Since the 1900's economic entomologists have participated in the annual meetings and publications of the state horticultural societies of Washigton and Oregon, and since 1918 the Northwest Association of Horticulturists, Entomologists, and Plant Pathologists has met annually for the reading of papers and informal discussions. Since 1926 the Western Co-operative Oil Spray Project, for many years under the chairmanship of E. J. Newcomer, has held informal annual meetings in various Northwestern cities. No formal recommendations have emerged from these meetings, but their informal findings have constituted the basis of all official spray recommendations made in the Pacific Northwest, and it is the considered opinion of some that this conference has done more for applied entomology in the Northwest than any other single organization. Its success led to the formation along similar lines of a Pea Weevil Control Conference in 1936, reorganized six years later as the Pacific Northwest Truck Crop Insect Control Conference. An annual Pacific Northwest Pest Control Operators Conference, organized at Corvallis in 1950, may come to play a similar role in that field of applied entomology.

The crucial question to be asked concerning Northwestern entomology pertains to the nature of its contributions to man's understanding of the insects. This is a question that the present author is able to answer only in part and imperfectly.

First, there is the matter of the Northwest insect fauna, the aspect of Northwestern entomology with which the speaker has been most concerned. During the first thirty or forty years of Northwestern entomology the insects collected and reported on were mostly Coleoptera, of which LeConte issued a list of 233 species in 1857 and of which perhaps as many, 500 or 600, were known from the region by 1880. By the nineties, however, the British Columbians were becoming especially interested in the Lepidoptera, resulting in 1904 in a catalogue of 1128 species that was issued by the Provincial Museum in Victoria. The same period saw less complete listings of groups of Hymenoptera, Diptera, Coleoptera, Trichoptera, Odonata, Neuroptera, and Orthoptera from British Columbia, so that by 1910 the Canadians were well on the way to a preliminary knowledge of their fauna.

This early work took the form largely of simple lists, in part, because the economic resources of these pioneer Northwestern entomologists did not permit them to assemble either the libraries or the collections necessary for descriptive work. They sent their specimens to specialists in the northeastern United States and eastern Canada, and frequently the extent of what they knew about them was represented by the names attached to the returned insects.

Not all the work, however, remained on this preliminary level. At the turn of the century the two most outstanding entomologists in the Northwest were probably Trevor Kincaid of the University of Washington and John Merton Aldrich of the University of Idaho. These men, to be joined shortly by A. L. Melander of the Washington State College and the Rev. G. W. Taylor of the Nanaimo Biological Station, were the first to show that entomological work other than the mere listing of names assigned by others or the issuance of routine economic information was possible in this new country. Taylor in Geometridae and Aldrich and Melander and Kincaid in Diptera demonstrated beyond peradventure of doubt that entomological work of the most exacting sort was possible even in these far reaches of North America; and Aldrich's brusque dismissal from the University of Idaho in 1913 is a dark page in the history of Northwestern entomology. This northwest interest in Diptera spread to Oregon, where it resulted in Cole and Lovett's *List of the Diptera of Oregon* in 1921.

Somewhat analogous to the Aldrich-Melander Diptera studies was the Vernon "school' 'of Coleoptera studies at the Dominion Forest Insect Laboratory at Vernon, B.C., between 1919 and 1948. Here Ralph Hopping (1868-1941) and his son, George R. Hopping, produced a number of continent-wide studies of Cerambycidae, and Hugh B. Leech laid the foundations for his work on water beetles. I am informed that during this period Hopping's staff was encouraged to collect beetles in general and not just those of economic importance to the forest, with the result that, for better or for worse, a very fine collection was assembled, one that I am finding invaluable in my present studies. Now the pendulum swings in the other direction: not only does no general beetle collecting go on at the laboratory, but the forest beetles are being themselves neglected for other insect types such as the defoliators. In our own decade, the private studies of Kenneth and Dorothy Fender of McMinnville on the Lampyroid families of Coleoptera are likewise on a continent-wide scale. But such work has been scattered. The bulk of Northwestern taxonomic entomological activity has concerned the local fauna.

Whatever the administrators back in Ottawa and Washington, or in the presidents' or deans' chairs of the agricultural colleges may have intended to the contrary, the basic taxonomic problem as it relates to insects has come out; and there has been scarcely an entomological laboratory in the region that in one way or at one time or another has not made contributions —sometimes of an extensive nature— to the knowledge of the fauna. Large collections of Northwestern insects exist at the State College of Washington, the Oregon State College, the University of British Columbia, the University of Idaho, and, outside the Northwest, at the California Academy of Sciences, with an important collection of Coleoptera at the University of Washington—not to mention a number of collections in the hands of individuals and at certain of the experiment stations and federal laboratories.

One is tempted to make a generalization. In the early decades on economic work there is a tendency to recruit personnel in important measure from men who were attracted into entomology by the aesthetic appeal of insects and who have insisted on continuing this interest along with their strictly practical studies. Aldrich, Melander, Hopping, and others are examples of such men. As economic entomology has matured, however, numerous factors have combined to end this tendency. The methods open for the investigation of economic problems become more extensive and more preoccupying. Students are attracted into the field primarily by the opportunity it offers for earning a living rather than because it is a chance to work with insects in which they are already interested. Finally there comes a time when the administrators themselves have become thoroughly conditioned to such a view point and regulations are effected to see that all the foolishness with insect collections and insect nets—the badge of the dreamy impractical enthusiast —is relegated to the limbo of forgotten things!

Applied entomology in the Northwest began with a short series of letters by O. B. Johnson on a number of insect pests, in the Willamette Farmer between 1874 and 1877. It got underway in earnest with the establishment of the state experiment stations in the early nineties, but for three decades was largely occupied with applying in the Northwest discoveries that had been made elsewhere. C. L. Metcalf, for instance, in his 1940 survey of entomological progress between 1909 and 1919, cited 73 names on his "roll of honor" for the decade. The only Northwesterner on the list was Aldrich, listed for his taxonomic work on Diptera, and he had been discharged from the University of Idaho in 1913! With the 1920's, however, the picture began to change, and some ten Northwesterners are among the more than 300 names cited in the bibliography in a special study by E. O. Essig of entomological progress in this decade. Essig's list may be of interest: Leroy Childs, F. R. Cole, B. B. Fulton, Eric Hearle, A. L. Lovett, A. L. Melander, O. M. Morris, R. A. Muttkowski, E. J. Newcomer, and R. C. Treherne. I leave to someone more competent the task of a comprehensive chronicle of Northwestern achievement in applied entomology.

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NOTES ON THE LIFE HISTORY OF THE SHADED UMBER NEPHELODES EMMEDONIA CRAM. (F. PECTINATA SM.) LEPIDOPTERA: PHYLAENIDAE

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This moth often turns up at my porch light in Saanich, B.C. during the month of August and September. In 1951 a female was captured and placed in a box within which she laid a batch of eggs. The following life-history notes were taken.

Ova. On August 29, 1951, 200 eggs were deposited loosely in the box. No cementing material was used; they were free to roll about whenever the box was tilted. The egg is spherical, 1 mm. in diameter, slightly flattened on opposite sides, like an orange, finely ribbed and cross-ribbed, white to cream in colour, changing to a dull pink or leaden hue by September 15, 1951 As no signs of hatching were observable on October 17, to ascertain their condition one or two eggs were dissected. This disclosed the young larvae fully developed and lying curled up in a dormant condition. Head pale brown, body more or less translucent.

1st Instar. Some hatched about February 16, 1952. Length 1.5 mm. Head pale brown, body light grey in colour. The egg shell is not eaten. I had difficulty in getting the larvae to feed despite a variety of plants in leaf at this time of the year. Finally they reluctantly took to *Bromus* sp.

2nd Instar. February 29, 1952. Length 4 mm. Head pale brown, body green, darker above than beneath, slightly translucent; a white broad spiracular line, followed by two narrow ones and a medium dorsal line of the same colour.

3rd Instar. March 12, 1952. Length 7 mm. Head and body similar to the last instar, but the white lines edged with black. Spiracular line creamy, spiracles black.

4th Instar. March 25, 1952. Length 12 mm. Colour as before but body darker and stripes more creamy and more pronounced; in some larvae the creamy white of the spiraclar line is centred by a pinkish colour.

5th Instar. April 10, 1952. Length 18 mm. Head pale brown or greenish with dark freckles; body colour has changed from green to black, with a slight bronze reflection, in sharp contrast to the white black-bordered, longitudinal stripes, each of which has a delicate pink flush superimposed upon it.

6th Instar. April 26, 1952. Length 35 mm. Colour and marking as before, but the bronzy reflections more noticeable, and with the surface of the skin with many minute transverse wrinkles. Full fed about May 15. Length 45 mm. tapering a little towards each end. Width 6 mm. in middle of body. One larva burrowed beneath the soil on May 31, but failed to pupate.

Remarks. Of the 20 ova, the majority hatched, but the larvae rapidly died off. Only two finally reached maturity, but without the vitality to complete the metamorphosis. Possibly the food plant was not the correct one. The eastern form of *N. emmedonia* — the Bronzed Cutworm — is reported as feeding on various cultivated crops. Judging from this and the loosely laid ova, I would have expected the western form to be more catholic in its tastes than has proved to be the case in the present instance.

Moulting was very difficult and prolonged, often lasting for several days; many died before completing the moult and some were not even able to commence it. At no time did the larvae spin a silk thread when moving about or when dislodged from the food plant.

They fed only at night, hiding under the herbage by day, though at no time did I observe them burrowing into the soil except once, evidently for the purpose of pupation. When touched they snap their bodies vigorously from side to side. If alarmed the body is formed into a semicircle with head raised, and held motionless for some time. When at rest along a grass blade, the stripes render them very inconspicuous; they seemed to blend into the grass. One cause for the rapid decline in number, since many disappeared without leaving any sign, may have been due to cannabalism, but no proof of this was discovered. Moulting difficulty appeared to be the cause of most of the casualties.

SCIENCE NOTE

Note on a cat flea population, *Ctenocephalides felis* (Bouché):—On November 6, 1953, I treated a friend's basement for fleas and dusted the pillow on which the cat slept, over a paper, to collect flea eggs. The host cat was quite short-haired and apparently harboured a considerable number of fleas on its body, judging by its energetic scratching. Since the animal was accustomed to sleep by day on several pieces of upholstered furniture in the house which most probably had eggs on them, these were dusted and vacuum cleaned by the owner. The pillow yielded a fair amount of trash, a small amount of dried flea blood, frass and a considerable number of eggs with a very few recently hatched, wriggling larvae. It was all promptly placed in a tightly lidded tin and supplied with powdered fox chow biscuit and a small piece of wetted blotting paper attached to the lid, for moisture. By next day the eggs were hatching freely and the larvae burrowed into the food. The box was kept in a table drawer closed so as to reduce light, at laboratory temperatures, and was examined at intervals.

In four to five weeks the larvae matured and pupated; much of the food powder was used up by sticking to the outside of the silken cocoons which now resembled a bed of rough seeds. Fleas started to emerge and by January 4 all had emerged and died. Their growth was apparently affected by an inadequate supply of flea blood of which not one particle remained in the rearing cage and all the fleas were stunted, males averaging 1.25 to 1.5 mm. and females only slightly larger. There were 902 adults and one dead larva in the box, giving a possible total of 903 fleas by the end of January. If this record is a normal infestation on a short-haired cat, the flea population raised by a long-haired cat or dog must be truly immense.

To separate out the dead fleas, the trash in the box was sifted through three grades of wire mesh. The sifting yielded, besides the fleas, one small hymenopteron, three completely apterous minute mycetophilids and one specimen of the dipterous family phyllomyzidae, genus *Desmomyza*, about two thirds the size of the normal flies in this genus.

The presence of these three other insect species is puzzling unless their pupae had been carried up to the pillow on the cat's feet from the earth around an assortment of plants and bulbs recently dug up and stored for the winter in the basement, over which the cat may have walked. I am not aware of either hymenopterous or dipterous parasites on flea larvae. They were certainly not in the fox-chow biscuit powder supplied to the larvae since this food had been pulverized, sterilized for a week at $-40°$ F. and stored in a tin with a tight lid for a year before being used.— *G. J. Spencer.*

NOTES ON THE LIFE HISTORIES OF EPIRRHOE PLEBECULATA GN. AND EUPHYIA LACTEATA PACK (LEPIDOPTERA: GEOMETRIDAE)

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So far as I can gather there appear to be no records of the food plants or life histories of these two British Columbia moths. The following notes are the results of my investigations concerning them.

Epirrhoe plebeculata Gn. The Orange-winged Carpet. This species is quite common in the Victoria district. Jones (1911) gives its distribution for the province as "Southern B.C." It is on the wing early in the year, being one of the first moths to appear in March and continuing in lessening numbers into May. It may be found flying by day in bright sunshine along woodland borders and forest trails.

An attempt to rear it was made in 1952. Several batches of eggs were obtained from captured females. As the moths were always found in the vicinity of coniferous trees, Douglas fir was tried as a likely food plant, but was refused. A number of other trees, shrubs and herbs was tried, but without avail. All the caterpillars died.

In 1953 another attempt was made. After many trials the larvae took readily to *Galium aparine,* thriving and growing to maturity on it. Several batches of eggs were obtained during the season and reared separately. The number of eggs from individual females varied from one to 50. They were laid indiscriminately on the sides of the box, each separate and independent of the others and affixed by a natural adhesive. The following is a brief chronological account.

Ovum. Laid April 15. Length 0.75mm. x 0.5mm. Elongate oval, slightly flattened, smooth with microscopic reticulations that scarcely appear on the surface, pearly white in colour, becoming yellowish to cream at the time of hatching.

1st Instar. April 25. Length 1 mm. Head light brown speckled with dark brown. Body translucent, later becoming dull bluish-green as food is ingested. A few scattered hairs on each segment. The egg shell is not eaten.

2nd Instar. May 6. Length 5 mm. Head as before. Body pale greenish-grey with whitish dorsal line and lemon intersegmental rings.

3rd Instar. May 10. Length 10 mm. Head as before. Body pale greenish to brown with six fine white longitudinal lines, interrupted at the juncture of each segment by a pale lemon-coloured ring encircling the body. A black dot at the point of insertion of hairs.

4th Instar. May 17. Length 15-16 mm. Head pale beige, spotted with black, sparsely covered with short setae. Body light reddish to greyish brown. Dorsum of thoracic segments with a pronounced longitudinal black line; first five abdominals with a dark brown to black mark on the dorsum, each consisting of an inverted triangular dark brown spot tipped with white; the last four abdominal segments with a strongly marked black line edged with beige colour—a more emphatic repetition of a similar line on the thoracic segments. Underside grey with four white longitudinal lines; a broad dark brown dash in the centre at the juncture of the segments. Spiracular line whitish, marked on the fourth and fifth segments with a thick oblique brown dash. Spiracles black.

The general effect of the above markings is of a small chain terminating at each end with a straightened link and giving to the caterpillar a two-headed appearance, especially as it holds the head extended forward.

At maturity the caterpillar measures 23-25 mm. in length with all markings very pronounced. It feeds at night, hiding at the base of the food plant by day where it lies straight and motionless looking like a twig or dead stalk. At no time was it observed to use silken threads for support or in an emergency such as on a sudden alarm. However, just prior to pupation a few threads were spun to tie together bits of debris or a few grains of sand, as a protection for the pupa.

Pupa. May 30. Pupated about this time, going just beneath the surface soil or getting between leaves or formed into a frail cocoon of bits of loose debris lightly bound together. Length 7 mm. x 3 mm., smooth, shiny; bright mahogany in colour. Cremaster consisting of a two-pronged fork with a very short stem.

Euphyia lacteata Pack.
The March Gem

This is another early day-flying moth, being on the wing from late February to early May. It is to be found in similar habitats to *E. plebeculata.* The moth is quite common around Victoria. Its range in British Columbia, according to Jones' list, is "Southern Vancouver Island, Lower Fraser Valley, Kaslo."

I made the same error as in the study of *E. plebeculata* in supposing the food plant to be a coniferous tree and with the same result. In 1953 renewed efforts were rewarded by finding that the larvae would feed on *Montia perfoliata* and *M. sibirica,* though the succulent nature of these plants gave digestive troubles as the larvae grew older, so that only a few reached the pupal stage.

A pair of adults were taken in coitu on the trunk of *Alnus oregona* on April 8 about 4.30 p.m. From the female 65 fertile ova were obtained. Most of them were laid in a crack in the chip box in which the female was confined; others were scattered indiscriminately over the interior of the box.

From the presence of the moths among alder trees and the deposition of eggs in crevices it was thought that the food plant might be alder; subsequent trials proved this surmise to be incorrect. Only after experimenting with a large variety of trees, shrubs and herbs was it found that *Montia* was the preferred plant genus.

Ovum. Laid April 10. Length 0.75 mm. x 0.5 mm. Oval, slightly larger at one end, smooth with fine microscopic reticulations showing beneath the surface. Colour nearly white becoming lead colour towards hatching time.

1st Instar. April 22. Length 1 mm. Head pale brown, body a translucent watery grey with a few short hairs on each segment. When alarmed the larva rears up on its hind claspers and curls head down, assuming the form of a question mark, and remains motionless in this position until all is quiet again.

2nd Instar. April 29. Length 5-6 mm. Head pale brown, body translucent green; some larvae are reddish in colour.

3rd Instar. May 5. Length 8-10 mm. Head pale brown, body pale green with dark green dorsal stripe due to ingested food; some show faint whitish dorsal and subdorsal lines. Towards the end of this instar the body becomes less translucent and has a grey-green colour with dark dorsal and two thin white subdorsal lines. Spiracles black, intersegmental rings pale.

4th Instar. May 12. Length 15 mm. Head pale brown dotted with light brown flecks. Body jet black with four whitish interrupted lines that take the form of dash-like marks at juncture of the segments.

5th Instar. May 20. Length 23 mm. Head pale brown with small brown dots and an irregular v-shaped brown mark on upper part of head. Body variable in colour as the larvae continue to grow, losing the intense black and pattern of the initial stage of the fourth instar. Dark fuscous to light grey-brown or buff with a broad, black dorsal stripe edged with pale yellow colour, sometimes interrupted on each segment; two thin black lines between the dorsal and the spiracular line. Spiracles black. Underside light grey with four fuscous longitudinal lines interrupted on each segment by the ground colour, thus giving the appearance of a chain of dashes.

Pupa. Pupation about June 1st. Length 7 mm. x 2.5 mm., dark brown in colour, cremaster consisting of two diverging slightly curved spines. Some of the larvae became sluggish and listless during the close of the last instar, and failed to pupate; only a small percentage of those hatched reached the pupal stage. No cocoon was formed, the larvae merely creeping under debris or between old leaves and pupating after lying quiescent for a day or two.

Remarks. From the ease with which *Epirrhoe plebeculata* fed and thrived, *Galium aparine* is evidently a perfectly satisfactory food plant. At all times the larvae were vigorous and there were no deaths. *Euphyia lacteata,* on the other hand, while readily taking to *Montia* and in fact refusing other plants offered, did not thrive in the final stages, a hint that something was wrong. Possibly the food plant was too succulent, or in nature they changed to some other species of plant. Future investigations may clear the matter up.

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STATUSES OF SOME INTRODUCED PARASITES AND THEIR HOSTS IN BRITISH COLUMBIA[1]

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From 1949 to 1953 the statuses of the parasites and predators introduced into British Columbia to aid in the control of 11 insect pests were investigated. The methods used were mainly empirical because more accurate methods are not known. The value of a parasite was determined by its ability to provide commercial control over a long period, including intervals of host abundance and scarcity. All biological control projects in British Columbia have been started during periods of host abundance. Species that have reduced the host populations to and maintained them at economic levels for 14 years or more are classed as effective control agents.

This arbitrary method of evaluating parasites has many weaknesses. Commercial control can be achieved at widely different host population levels, *e.g.*, a population up to 10,000 of a lecanium scale or 1,000 of larch sawfly larvae per tree would not be economically important, but 100 codling moth larvae per tree would be.

In this paper, percentage parasitism does *not* indicate the effectiveness of a parasite species, but is used to indicate the relative numbers of the various species that attack the same host or to indicate the numbers of a parasite in relation to those of its host. The numerical relationship between the parasite and host populations necessary for commercial control varies greatly and is dependent upon the effectiveness of other mortality factors.

Apple Mealybug, Phenacoccus aceris (Sign.)

The apple mealybug, *Phenacoccus aceris* (Sign.), was discovered in British Columbia in 1913 and by 1935 was causing serious inconvenience to the fruit growers in the Kootenay Valley. The excretion from the insects promoted the growth of a sooty fungus that rendered the fruit unsalable unless washed.

From 1938 to 1943 colonies of *Allotropa utilis* Mues. totalling 6,602 adults

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were released at 11 selected points throughout the infested area. By 1943 this parasite had become well established. In 1944 and 1945, four colonies comprising 4,549 individuals obtained at the original release points were released in the Kootenay Valley. In 1948 a colony of 133 adults was released in a small area of infestation near Royal Oak on Vancouver Island.

The apple mealybug has been controlled by *A. utilis* in the Kootenay Valley since 1943 and on Vancouver Island since 1949. An important factor in the effectiveness of *A. utilis* is its ability to survive sprays of dormant oil lime-sulphur whereas many of the apple mealybugs are killed by this treatment. When the spray is applied, *A. utilis* is in the pupal stage and is protected by the mummified remains of the host, in which it pupates.

Marshall (1953) stated that *A. utilis* must be one of the outstanding examples in Canada of biological control by an introduced parasite.

Codling Moth, Carpocapsa pomonella (L.)

The codling moth, *Carpocapsa pomonella* (L.), was first reported on Vancouver Island in 1900 and in the interior of British Columbia in 1905. The menace of this pest to the fruit industry was recognized at an early date and rigorous eradication regulations are credited by Marshall (1952) with preventing serious losses until the regulations were relaxed in 1925. During the next 20 years the codling moth increased in destructiveness. Since 1945 the use of DDT and the development of more efficient spray equipment have controlled the codling moth in commercial orchards (Masshall, 1953). The general use of DDT is believed to be responsible for the rapid increase in orchard mite populations and for this reason substitute insecticides are being sought.

Biological control of the codling moth was attempted through the introduction of three species of parasites: *Ascogaster quadridentata* Wesm., *Ephialtes caudatus* (Ratz.), and *Cryptus sexanulatus* Grav. Stock of *A. quadridentata* was obtained in Ontario and propagated at the Entomology Laboratory, Belleville, Ontario. A total of 50,800, in colonies of 291 to 33,250 individuals, were released at various points throughout the Okanagan Valley in 1934, 1935, 1936, 1937, and 1939. *A. quadridentata* became established but its numbers have not yet increased sufficiently to affect the codling moth population.

Small numbers of *E. caudatus* and *C. sexannulatus* were imported from France and both species were propagated at the Belleville laboratory. Colonies of 54 and 4,199 adults of *E. caudatus* were released in the Okanagan Valley in 1942 and 1946, respectively. Colonies totalling 3,030 of *C. sexannulatus* were released at six points in the interior of British Columbia in 1941, 1946, and 1947. Neither species has been recovered. The search for effective parasites of the codling moth is continuing.

European Earwig, Forficula auricularia L.

The European earwig, *Forficula auricularia* L., was first reported from British Columbia in 1916. In 1929 Buckell reported that on the Pacific coast the European earwig had become firmly established and was a serious garden and household pest.

Small colonies of *Bigonicheta setipennis* (Fall.) obtained from England and released at New Westminster between 1928 and 1931 did not give evidence of becoming established. In 1933 breeding stock of this parasite was obtained from the City of Portland, Oregon. More than a quarter of a million parasites were propagated at the Divisional laboratory at Victoria and were released at selected points from 1934 to 1939.

B. setipennis became established and in 1945 seventy per cent. parasitism was recorded in Vancouver by Spencer (1947). In 1951, the range of parasitism at seven widely separated points on Vancouver Island was from 10.9 to 50.0 per cent.; at 10 on the mainland, from 1.6 to 30.4 per cent. Further data on the parasitism in the Vancouver area were obtained when mass collections of the earwigs were reared to obtain *B. setipennis* for transfer to other infested areas in Canada. The numbers of *B. setipennis* and of *F. auricularia* and the percentage parasitism for collections made in 1950, 1951, and 1952 were respectively: 6,211, 52,500, and 11.8; 8,097, 42,800, and 18.9; 7,669, 71,300, and 10.8.

B. setipennis is the only parasite that has been reared from the European earwig in British Columbia and is a more important control factor than predators or disease. One of the most important predators is a carabid, *Feronia melanaria* Ill. Spiders have been observed feeding on the earwig. The common house spider, *Parasteatoda tepidariorum* (C. L. Koch), is an efficient predator of arboreal earwigs.

B. setipennis puparia are parasitized by a pteromalid, *Dibrachys* sp. *Dibrachys cavus* Wlkr. was reported by Thompson (1943) as a parasite of *B. setipennis* in England; but Dr. O. Peck, Entomology Division, Ottawa, who examined specimens reared from *B. setipennis* in British Columbia, reported (in litt.) that these secondaries through *B. setipennis* are distant from *D. cavus* and presumably of a new species.

B. setipennis is not numerous enough to control the earwig, but with other control agents it has prevented the earwig from becoming a major insect pest in British Columbia.

Lecanium Scales

The identities of lecanium scales in British Columbia are obscure. It is believed that there is a mixed population of two or more species, including the European fruit lecanium, *Lecanium corni* Bouché, and the hazel nut scale, *L. coryli* (L.), both of which were introduced accidentally from Europe. Glendenning (1933) stated that since 1925 the lecanium scale had been one of the most destructive insects in the coast region of British Columbia. A colony of 263 adults of *Blastothrix sericea* (Dalm.), obtained from England, was released in 1928; and two colonies totalling 779 adults were released in 1929. Glendenning (loc. cit.) reported that the colonies of *B. sericea* released in 1928 and 1929 became established and by 1932 had spread over the entire area of infestation, which at that time was 200 square miles. The number of scales per foot of twig was reduced from an average of 35 in 1930 to a maximum of two in 1932. The parasitism of the few adult scales present in 1932 ranged from 90 to 100 per cent. Lecanium scales have not since been of economic importance in British Columbia.

Clausen (1951) proposed the theory that a "fully" effective parasite would achieve control at the colonization points within three host generations or within three years after the parasites are released. He assumed that certain requirements had been met, and included in the list "that releases were synchronized with the time of abundance of the preferred host stages." The colonies of *B. sericea* that were introduced into British Columbia were released from June 24 to July 27, when the host is in the egg or early "crawler" stage and is not suitable for parasitism. Graham and Prebble (1953) stated that in southwestern British Columbia the first-generation eggs of *B. sericea* were never found in the nymphal scales earlier than September 18, although adults of *B. sericea* emerged from the fully formed female scales in the latter half of June, and the young scale crawlers were on the foliage from early June onwards; there was thus an interval of more than two months when the parasite was apparently not associated with the scale. Investigations by the author in 1952 and 1953 confirmed these findings. It was also found that *B. sericea* females of the summer generation do not become sexually mature until shortly before oviposition occurs, in late September. This is an example, therefore, of an introduced parasite having controlled a host within three years although its release was not synchronized with the time of abundance of the preferred host stage.

The simultaneous increase in the population of *B. sericea* and decrease in that of *L. coryli* reached its climax in 1931 and was followed by a long period of low host population. During their investigation, from 1941 to 1945, Graham and Prebble (loc. cit.) found that although the *L. coryli* infestation had remained at a low level it had spread about 70 miles eastward on both sides of the Fraser River. It had also spread westward to Vancouver Island, where it was well established in the Victoria district. By 1951 it had spread northward on Vancouver Island to the Saanish Peninsula. *B. sericea* has followed its host to all the new areas of infestation.

Spiders in the field and European earwigs in the laboratory have been observed feeding on *L. corni,* but predators are not believed to be an important control factor. A few specimens of a native parasite, *Aphycus* sp. near *kincaidi* Timb., have been obtained from several thousand scales reared in the laboratory. No secondary parasites of *B. sericea* have been reared. Although recent investigations have shown that there is seldom more than 40 per cent parasitism of the overwintering scale population, this additional mortality factor is probably responsible for the continued low level of the lecanium scale population in British Columbia.

Greenhouse Whitefly, Trialeurodes vaporariorum (Westw.)

The greenhouse whitefly, *Trialeurodes vaporariorum* (Westw.), has been a pest of many greenhouse crops since it was first reported in British Columbia in 1907. With the development of more efficient and economical fumigation material and equipment, many growers have been able to control the whitefly without serious difficulty. Other growers, whose greenhouses are unsuitable for effective fumigation or who produce crops that are easily injured by fumigants, have used the parasite *Encarsia formosa* Gahan extensively.

In British Columbia *E. formosa* was first used successfully in greenhouses in 1934; and for 20 years from 100,000 to 475,000 of these parasites, propagated at the Belleville, Ontario, laboratory, have been shipped annually on request to greenhouses and conservatories in British Columbia. It is necessary to recolonize *E. formosa* each year because of the methods of handling greenhouse-grown crops.

Improved methods of propagating and shipping *E. formosa* have been developed and the optimum number of the parasites required for satisfactory control may be calculated from the size of greenhouse, the crops grown, the degree of infestation, and the temperature at which the greenhouse is maintained (McLeod, 1936).

Holly Leaf Miner, Phytomyza ilicis (Curt.)

The holly leaf miner, *Phytomyza ilicis* (Curt.), was accidentally introduced into British Columbia with imported nursery stock, and by 1931 it was causing considerable injury and was widely distributed over the holly-growing area (Downes, 1931).

Five species of parasites were imported from England and colonies were released on Vancouver Island from 1936 to 1938 and on the mainland in 1939 as follows:—

	Vancouver Island	Mainland
Chrysocharis gemma (Wlkr.)	34,564	11,393
Chrysocharis syma Wlkr.	1,978	179
Cyrtogaster vulgaris Wlkr.	2,227	471
Opius ilicis Nixon	33	10
Sphegigaster flavicornis Wlkr.	6,359	852

On Vancouver Island the first recoveries were obtained in 1940 (Downes and Andison, 1941). *C. gemma* was obtained in large numbers at one of the release points and "a survey of the plantation revealed the fact that approximately 80 per cent of all *Phytomyza* mines were parasitized." *O. ilicis* was also established in 1940, although no recoveries had been obtained in 1938 from the caged tree on which 33 individuals were released in 1937.

From 1949 to 1953, collections from Vancouver Island and the mainland yielded specimens of all species that had been released except *C. syma,* but *C. gemma* was recovered only on Vancouver Island and *C. vulgaris* only on the mainland. The percentage parasitism from these collections was not so high as that reported by Downes and Andison (loc. cit.), the highest being 60 and the average about 30 on both Vancouver Island and the mainland. On Vancouver Island *C. gemma* was responsible for more than 90 per cent of the parasitism and on the mainland *O. ilicis* was responsible for 80 to 90 per cent. *S. flavicornis*, although present in both areas, was of minor importance.

It is remarkable that *O. ilicis* attained its present status on the mainland as the original colony consisted of only four males and six females. This species is a relatively unimportant parasite of the holly leaf miner in England; Cameron (1939) stated that it was a rare species and that only 0.3 per cent of the mines were attacked by it.

No native parasites were reared from the holly leaf miner during this investigation; but several specimens of *C. vulgaris* were reared from a native species of grass leaf miner, *Phytompza nigra* Mg., which has apparently been adopted as an alternate host.

The usefulness of these parasite species is difficult to evaluate. The holly bud moth, the strawberry root weevil, and the black vine weevil often require chemical treatment for their control in commercial holly plantations, and these treatments also control the holly leaf miner. However, there are thousands of holly trees in ornamental plantings in the area and few of these receive chemical treatment. The introduced parasites undoubtedly contribute materially to the control of the holly leaf miner in such plantings.

Larch Sawfly, Pristiphora erichsonii (Htg.)

In British Columbia the larch sawfly, *Pristiphora erichsonii* (Htg.), was first reported in 1930 (Hopping, Leech, and Morgan, 1943). In 1933 cocoon samples were obtained and no evidence of parasitism was found. Colonies of parasites were introduced in 1934, 1935, 1936, 1941, and 1942. The larch sawfly infestation started near Fernie, in the southeastern part of the province, and spread westward. The parasite releases in 1941 and 1942 were made on the western fringe of the infestation to hasten establishment of the parasites over the entire area of infestation.

Three species of parasites were released as follows:—*Bessa harveyi* Tns. (=*selecta* Mg. of American authors): 1942, 5,995; *Mesoleius tenthredinis* Morley: 1934, 673; 1935, 2,196; 1936, 781; 1941, 624; 1942, 702; *Zenillia* nox Hall.: 1935, 1,265.

M. tenthredinis became established and increased rapidly. *B. harveyi* became established, but has not increased enough to be of economic importance. *Z. nox* has not been recovered.

Tritneptis klugii (Ratz.), a European species that was not released, has also become established. This species may have spread into British Columbia from contiguous areas of larch sawfly infestation in Montana. The usefulness of *T. klugii* is doubtful because it oviposits in larch sawfly cocoons indiscriminately and destroys many of the host larvae that have already been parasitized by *M. tenthredinis*.

Specimens of *Endasys* (*Endasys*) sp. and *Euceros* sp. have been reared from mass collections of larch sawfly cocoons. Both are hyperparasites of *M. tenthredinis*, but neither species is abundant enough to be of economic importance.

At no time since it became established in British Columbia has the larch sawfly reached outbreak proportions except in small, isolated areas. The population in each of the heavily infested areas for which there are records became heavily parasitized by *M. tenthredinis* and subsided without serious injury to the trees.

From 1948 to 1951 samples of larch sawfly cocoons were obtained from a localized infestation and were dissected to determine the degree of parasitism and mortality. The results (Table I) showed that a large part of the mortality during this period was due to parasitism by *M. tenthredinis*. In 1952 and 1953 the larch sawfly population had dropped to such a low level that it was impractical to collect cocoons to determine the degree of parasitism.

TABLE I

Mortalities and parasitism of larch sawfly larvae in cocoons in British Columbia, 1948 to 1951

Condition of Larvae	1948		1949		1950		1951	
	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.
Cocoons dissected	1,500	100	536	100	441	100	1,200	100
Dead	248	16.5	40	7.5	53	12.0	102	8.4
Parasitized by *M. tenthredinis*	829	66.2*	305	61.5*	213	54.9*	747	68.0*
Parasitized by *T. klugii*	10	.8*	23	4.6*	5	1.3*	7	.7*
Living	413	27.5	168	31.3	170	38.5	344	28.7

* Based on number of living larch sawfly larvae.

Oystershell Scale, *Lepidosaphes ulmi* (L.)

The oystershell scale, *Lepidosaphes ulmi* (L.), has been a pest of fruit and other deciduous trees in British Columbia for at least 50 years. In 1914 Treherne included it among the more important pests of the lower Fraser Valley. The oystershell scale is not now an important pest in commercial orchards, as it is kept under control by the regular spray schedule for other pests. However, commercial orchards are continually subject to reinfestation from infested wild host plants.

The introduction of the predacious mite *Hemisarcoptes malus* (Shimer) in 1917 marked the first attempt in Britissh Columbia to control insect pests through their natural enemies. Colonies totalling approximately 1,000 of *H. malus* were released at one point on Vancouver Island, two points in the Fraser Valley, and one point in the Okanagan Valley. Glendenning (1931) reported that at Agassiz and Vernon the mite survived, and under certain conditions effected excellent control.

Recent investigations by the author have shown that *H. malus* is now widely distributed in British Columbia. The population of this species was greatly reduced during the winter of 1949-50, when the temperature dropped below $-30°$ F. at many points in the interior of the province. It is known, however, that *H. malus* has at times been an important control factor.

Pea Moth, *Laspeyresia nigricana* Steph.

The pea moth, *Laspeyresia nigricana* Steph., was first reported from British Columbia in 1933. It soon became a serious pest in the Fraser Valley, where most of the canning peas in British Columbia are grown. Wishart (1947) stated that from 1934 until 1945 it increased steadily on Sumas Prairie and in 1945 eighty per cent of the pods were infested.

Four species of parasites were imported from England and colonies were released from 1937 to 1939 as follows: *Ascogaster quadridentata* Wesm., 5,291; *Glypta haesitator* Grav., 1,543; *Horogenes* spp., 35; *Pristomerus vulnerator* (Panz.), 5. *A. quadridentata* and *G. haesitator* became established and the numbers increased rapidly. The percentage parasitism was reported for the release area by Wishart (loc. cit.) for 1941, 1942, 1943, 1944, and 1945 as follows: *A. quadridentata,* 0.34, 1.24, 7.59, 10.80, and 76.39; *G. haesitator,* 0.14, 1.87, 0.70, 3.00, and 3.74; total parasitism, 0.48, 3.11, 8.29, 13.80, and 80.13. *Horogenes* spp. and *P. vulnerator* have not been recovered.

In 1946 the pea moth infestation dropped from 80 to 35 per cent in the parasite release area. In that year an important change occurred in pea-growing practices in the area. The growing of dried peas was discontinued and only canning peas were grown commercially. When dried peas are produced, the crop is not harvested until after the pea moth larvae have left the infested pods and entered the soil to pupate. When canning peas are produced, the crop is harvested before the pea moth larvae have completed their development and many of them are destroyed. The 45 per cent reduction in infestation that occurred in 1946, however, could not have been caused exclusively by this change in cultural practice, for an infestation of 76 per cent was recorded in areas where the parasites had not yet become established.

Between 1947 and 1953 the population of the pea moth remained at an extremely low level in cultivated peas. In 1949, of 8,921 pods examined, 196 were infested; in 1950, 1951, 1952, and 1953 the infestation was less than one per cent.

Yet there was a relatively large population infesting wild host plants, the most favoured of which is a species of vetch, *Vicia angustifolia* L. Larvae in these plants were heavily parasitized by the introduced parasites. In 1951, 61.6 per cent .of the larvae were parasitized, 45.1 per cent by *A. quadridentata,* 13.8 per cent by *G. haesitator,* and 2.7 per cent by undetermined Hymenoptera.

The low population of recent years is probably due in part to the abandonment of the production of dried peas. The introduced parasites *A. quadridentata* and *G. haesitator* are, however, an important contributing factor. There are many thousands of home gardens in the infestation area. In most gardens peas are grown and some are left to ripen. Although home gardens and wild host plants are potential sources of infestation, infestations in cultivated peas have been extremely light and chemical control has been unnecessary. The high percentage parasitism in the wild host plants is probably the most important factor in the continued low population of the pest.

Satin Moth, Stilpnotia salicis (L.)

The satin moth, *Stilpnotia salicis* (L.), was first reported from British Columbia in 1920. The infestation developed to serious proportions in the willow and cottonwood stands of the lower Fraser Valley (Glendenning, 1931). Four species of parasites were introduced from New Brunswick and Massachusetts between 1929 and 1934 as follows: *Apanteles solitarius* (Ratz.), 1933, 737; *Compsilura concinnata* (Mg.), 1929 to 1934, 3,592; *Eupteromalus nidulans* (Thoms.), 1933, 4,313; *Meteorus versicolor* (Wesm.), 1934, 520.

All species except *E. nidulans* became established and *A. solitarius* increased and spread rapidly. The infestation of the satin moth abated and no widespread outbreak has occurred since 1934. In 1951 there was a light infestation on two willow trees on the University of British Columbia campus. From 259 satin moth larvae collected from these trees, 50 adults of *C. concinnata,* 102 of *M. versicolor,* and 14 of *A. solitarius* were obtained, the combined parasitism was 64.1 per cent.

The three species of introduced parasites were parasitized by native secondary parasites. *Dibrachys cavus* Wlkr. parasitized all three species and *Gelis tenellus* (Say) parasitized *M. versicolor.* However, these secondary parasites were not abundant enough to seriously affect the primary parasites. Although no species of native primary parasites have been reared from the satin moth during the present investigations, Glendenning (1932) reported having reared five species of Diptera and three of Hymenoptera from larvae and pupae. He stated that none of these native parasites had been noticed in recent years and they could not be relied upon to check this pest to any appreciable extent. The introduced parasites have survived through an extended period of low host population and continue to be effective control agents.

Woolly Apple Aphid, Eriosoma lanigerum (Hausm.)

The date when the woolly apple aphid, *Eriosoma lanigerum* (Hausm.), became established in British Columbia is not known, but in 1914 Treherne included it in a list of economically important insects in the lower Fraser Valley. *Aphelinus mali* (Hald.) is the most important parasite of the aphid and has been introduced into most of the countries where the latter occurs.

A. mali was introduced from Ontario to the lower Fraser Valley in 1921 and to the Okanagan Valley in 1929. Reports on the introduction, establishment, and distribution of *A. mali* in the Okanagan Valley were given by Venables (1931, 1937).

The past and present statuses of both the woolly apple aphid and its parasite *A. mali* have been succinctly stated (in litt.) by Dr. J. Marshall, Officer-in-charge, Entomology Laboratory, Summerland, B.C., as follows: "Twenty-five years ago the woolly apple aphid was the most troublesome pest of the British Columbia apple industry. It malformed the trees, smutted the fruits, and made picking highly unpleasant, and, most important, its feeding was associated with the development of the serious fungus disease, perennial canker. The fungal organism develops only in tissue that has been fed upon by woolly aphids. With the equipment of the time, chemical control of the aphid was unsatisfactory. Consequently, work was begun to establish biological control, and it was accomplished within a few years by introduction of the parasite *Aphelinus mali,* which was introduced into the province through the Entomology Laboratory, Belleville, Ontario. The aphid became a minor pest and remained so until DDT was generally used for codling moth control, in 1945. As DDT proved innocuous to the aphid but toxic to the parasite, once again the aphid is a major pest. Investigations are to be undertaken to re-establish the effectiveness of the parasite either by substituting for DDT in the apple spray schedule a chemical non-toxic to the parasite, or by developing a DDT-resistant strain of the parasite."

Discussion

Introduced parasites achieved commercial control for 14 years or more of five pest species, *i.e.*, the apple mealybug, the larch sawfly, lecanium scales, the pea moth, and the satin moth. A sixth insect pest, the woolly apple aphid, was controlled for at least 10 years, until DDT was used for the control of the codling moth.

The times required for the parasites of these six insect pests to give evidence of commercial control conformed, with one exception, with Clausen's (loc. cit.) conclusion that a "fully" effective parasite or predator will achieve control near the colonization points within three host generations or three years after release. The one pest that was not brought under control within three years was the pea moth; *A. quadridentata* has continued to be the most abundant parasite species since it became established, but it did not become an effective control agent until six years after the last colony was released.

Three of the insect pests investigated were controlled only in some areas and in some years, *i.e.*, the oystershell scale, the European earwig, and the holly leaf miner. The degree of control that has resulted from the establishment of the parasites and predators of these pests is difficult to assess. There has not been an important outbreak of any of the pests mentioned since the establishment of their natural enemies in British Columbia.

The parasites of the codling moth have been ineffective. Two species did not become established; the third became established, but though widely distributed, is ineffective. The requirements for commercial control of the codling moth are so rigid as to entail practical elimination of the pest. It is doubtful whether a biological control agent can be found that will by itself achieve such a degree of control. However, a new combination of chemical and biological control for the codling moth may solve the present extremely complex problem of orchard mite control, presumably brought about through the use of DDT and the absence of effective biological agents to control the codling moth.

E. formosa, the parasite of the greenhouse whitefly, is effective under suitable temperature conditions, but because of the methods employed in handling greenhouse-grown crops it is necessary to recolonize the parasites at frequent intervals.

The insect pests that have been discussed are all introduced species. There is no evidence that any native parasite attacks any of these pests in appreciable numbers. There are two species of exotic parasites and one exotic predator that are relatively important. *T. klugii* has become established as a parasite of the larch sawfly, but it also destroys large numbers of the effective introduced parasite *M. tenthredinis*. *A. mytilaspidis* is a widely distributed parasite of the oystershell scale, but the population is not large enough to provide control. The carabid beetle *F. melanaria* is a predator of the European earwig but is not abundant enough to be effective.

A few indigenous species of secondary parasites are known to parasitize some of the introduced parasites, but none are economically important except possibly *Dibrachys* sp. This species may at times be an important secondary parasite of the European earwig through *B. setipennis*.

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FOREST INSECT SURVEYS

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Probably no single phase of entomological activities offers a wider field for variety in object and methods than surveys, for each survey must vary according to its size, purpose, and the circumstances governing it. This paper deals in general with the Forest Insect Survey in which we are presently engaged in Canada and specifically with its operation in British Columbia.

The Forest Insect Survey in Canada had its inception in 1935 when an organized attempt was made to keep an annual check on the spread and distribution of the European spruce sawfly in Eastern Canada. Since that time the survey has expanded in size and purpose and today it operates from Newfoundland to British Columbia. No longer restricted to the recording of species distribution and insect outbreaks, it now includes within its function general ecological consideration of our forest insect populations. In brief, its objects may be outlined as follows: to report annually on the fluctuations of insect populations encountered in the forest on a scale sufficiently broad to be representative of the entire forest area; to amass records as complete as possible on parasites and their hosts; to follow the course of disease of insects, particularly of those species known to be our more important forest destroyers; to locate incipient outbreaks as early as possible; to locate and, if possible, control any newly arrived foreign pest before serious damage or dispersal has occurred; to provide information on life histories, habits and identification of immature forms and to gather such specialized data as may be vital to some specific research undertaking. Within the last year the survey has expanded to include the procuring of data relative to certain specific tree diseases.

In its immediate application the survey provides information on the current status of forest insects over specific areas, permitting those concerned to take such action as may be expedient to prevent or reduce possible losses. On a long-term basis the survey provides much important data for specialized projects and points up many problems requiring intensive study. It is therefore as much a tool to the service as it is an end in itself.

In the operation of a continent-wide survey, methods and procedures must fit local conditions and hence no one standard method can be applied. In the beginning the survey was primarily qualitative in nature. The general method of sampling the insect population on a tree was to spread a sheet of standard size on the ground below the tree and to strike the limbs above with a pole of standard length. Dislodged larvae fell to the sheet, were collected, placed in a mailing container with food and a completed enclosure slip, and mailed to a regional laboratory for identification and rearing. Data from such collections were quantitative only in a very gross way. Although referred to as the earliest method of sampling, it is still used quite widely in random sampling for defoliators over extensive and remote regions. As the value and application of survey data became evident, new and specialized sampling methods were developed to meet peculiar requirements and situations. In many areas, sampling is now being done on permanent sample plots selected as representative of the forest stand of the region. Sampling from the same plot may be done three or four times a season. The use of plots has been developed on a rather restricted basis pending a thorough appraisal of the relative merits of random observations in contrast with similar data derived from representative plots. Work of this nature is possible only in areas readily accessible, free from cutting and with assurance of a degree of permanency. Another sampling method has been the cutting of measured branches or twig samples and recording the number of larvae present. Collecting moss for egg counts

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and sampling of the forest floor for hibernating insects are other special methods employed.

Probably the greatest difficulty in sampling for defoliators on the west coast is the size and height of trees and the impossibility of reaching up the bole even a short distance. In an effort to cope with this problem, research of recent years suggests the practical application of the collection and measurement of frass fall from the feeding population. In this procedure, portable canvas trays are established below representative trees in the area concerned and through the accumulation of frass over a definite period correlated with the increase in body weight of the larvae in the same period, an index of the feeding population is obtained.

Although the survey is still in its early development we have learned much from it, but no doubt its greatest value will be evident in the future as more data are amassed. Illustrative of this is the relationship of one species of insect to another in the chronological sequence in their cyclic recurrence. There is reason to believe that during the general population increase of defoliators in the west, the build-up of the various species may follow a fairly definite pattern. In other words the increase of a certain species may presage the later rise in population of another and perhaps more important species. If and when increased knowledge permits an accurate prediction of events before they happen we will have passed an important milestone on the way toward coping with our forest insect problems.

With the extension of random surveys, however, a point of diminishing return is eventually reached when successively less new information is obtained for equal expenditure of effort. More and more attention is now being directed to selected problems to provide more critical information on population trends, control factors, and damage caused by infestations. In the West, such work has centred about the western hemlock looper and bark beetles.

Since major outbreaks such as the hemlock looper occur at intervals of 12 or 15 years, opportunities are infrequent for the study of events in the insect complex that lead up to such outbreaks. We are, in fact, only beginning to accumulate data relative to such phenomena. The early records of insect outbreaks were for the most part very general in nature, concerned only with the species responsible for the damage and restricted to the one or two years when the insect was most prevalent. While probably quite adequate at that time, these early records give little historical or scientific background information with respect to the rise and fall of the outbreak. The inclusion of data on the associated species of no apparent importance was obviously impossible with the limited personnel employed in the early days of entomology in this country.

The survey in which we are engaged places equal emphasis on insects whether they be of minor or major importance economically. Knowledge of these so-called minor associates may eventually supply the key to long term predictions of population trends of other pests: to an understanding of the survival of parasites during periods of low population of its preferred host, or the zoning of the forest for possible distribution of certain major pests. One might speculate at great length on future possibilities of such work. Since important outbreaks recur but a few times in the life of any worker, few workers today will live to realize the full significance or value of such surveys. Our successors will benefit from the fuller, deeper understanding that must accrue from long-term, intense surveys.

With this general review of the survey, mention should now be made of something of the mechanics of its operation. The sampling of insects, the establishment of plots, mapping, reporting and the many phases of work in the field are handled by a specially trained non-technical staff of insect rangers. An important requirement in field work is familiarity of the particular region concerned, the forests of that area, personnel engaged by either the Forest Service or industry, methods of travel, etc. Permanence of staff is therefore essential to give continuity from year to year and to produce maximum efficiency. For these and other reasons a ranger staff as mentioned is considered best. Rangers are chosen with great care since it is exacting work requiring a man of very special temperament. There are nineteen rangers employed in British Columbia.

The British Columbia coast does not lend itself to easy survey methods due to the almost total lack of roads. With approximately 7,000 miles of shore line, many parts cannot be reached more frequently than once in two years. It has become evident to many of the larger operators that regular sampling can be achieved only if their personnel in that area assist. Arrangements have been made in several regions whereby the companies concerned conduct periodic sampling throughout the year on plots originally established in co-operation with the Forest Insect Laboratory.

Associated with the field staff of rangers is the professional staff at the laboratory who receive, identify, and rear the living larvae through to the completion of their life cycle from which final records are compiled. Specialized rearings and studies of certain specific groups of insects are undertaken by the laboratory personnel for life-history studies, parasite and disease work, taxonomic data or other related problems.

Directing all survey activities both in the field and in the laboratory is the survey head for the province. He must be a combined forester, entomologist, and ecologist. Through him the work of the ranger staff is organized on a sound scientific basis. Current reports are analyzed for their significance and the work of the survey is co-ordinated with the research staff. Thus the survey not only supplies information on abundance, distribution, etc., but it also yields valuable data for those undertaking special research investigations.

In order to achieve continuity throughout the service, to promote a maximum of efficiency, and to unify procedures and methods, the Canada-wide survey is headed by a divisional survey co-ordinator. The over-all efficient operation of the survey and the development of specialists needed in its operation at the various centres are his responsibilities.

During a typical year the survey in British Columbia handles some 25,000 individual rearings which, in turn, entail a similar number of separate rearing sheets, each record containing the pertinent insectary and field data. A periodic analysis of so large a volume of records, if done manually, would be impossible without a greatly expanded staff. To cope with this a standard punch-card system of recording was established across Canada in 1952.

Henceforth all information, including the identity of the insect, will be coded and punched on the cards. The mechanical sorter can handle 400 cards per minute, sorting for as many as 12 columns simultaneously. Hence it will be possible to draw out information as required with a minimum of effort and time for as many years as one may wish. The installation of this equipment in all main survey centres across Canada and the development of a standard punch card and field record sheet constitute an important step in rounding out an adequate forest insect survey, for unless the information is readily usable its recording would seem futile at the outset.

Almost synonymous with surveys is the problem of population sampling. The development of surveys in Canada and the United States and the application of these data to specific problems and research projects call first for a study of the basic problem of population sampling. Obviously it will be many years before techniques of known value capable of being used by non-specialists can be developed for each important insect. In the meantime methods purely empirical in nature must be employed which in many cases are of doubtful significance. As qualified investigators develop the field of sampling techniques so may we expect advancement in the field of insect surveys.

NOTES ON THE LIFE HISTORY OF CORYPHISTA MEADI PACK. AND FORM BADIARIA HY. EDW. (LEPIDOPTERA: GEOMETRIDAE)

George A. Hardy

Victoria, B.C.

The following notes on the life history of the moth *Coryphista meadi* Pack. may be of interest as bearing on the relationship of the colour forms. A female of the form *badiaria* was taken on Mount Prevost on May 20, 1952. From this specimen a batch of ova was obtained and the resulting larvae were reared to maturity.

Ova. Laid in small box on May 20-23 inclusive, singly or in short strings in which the ova were laid side by side, until a total of 75 was obtained. Shape oblong, smooth with minute reticulations. Size 0.75 mm. x 0.50 mm. Colour creamy, becoming darker towards hatching time.

1st Instar. Hatched May 27. Length 2 mm. Head light brown; body colourless, translucent, soon becoming green after feeding. No markings. The larva does not eat the egg shell. The food plant is *Berberis nervosa;* other plants, placed before it were refused. When jolted the larva hangs by a silk thread to the twig or leaf from which it has fallen. When mildly disturbed it draws the body into a tight vertical loop, claspers and true legs touching. In this position it remains motionless for some time, or until all is quiet again.

2nd Instar. June 1st. Length 10 mm. Head pale brown; body dark green to black with white interrupted spiracular line Feeds at first on underside of leaf, chewing through the epidermis on one side only. Later it feeds at edge of leaf in the usual manner.

3rd Instar. June 6th. Length 14 mm. Head as before; body black with a broad irregular spiracular line and four thin longitudinal lines on the back, all white. Underside dark olive green.

4th Instar. June 10th. Length 18 mm. Head orange; body as before but with intensification of the black and white; spiracular line very conspicuous and with a chain-like formation due to a series of interrupted black hyphen-like marks along the centre of the line, placed at the junction of two segments. The wider part of the line is suffused with pale lemon yellow, and contains two black tubercles. The spiracles are black and are centred on the spiracular line, giving to the segments containing them the appearance of three black dots. Underside fuscous with a medium white line. When full fed the larva measures 25 mm; it is then a strikingly handsome caterpillar.

Pupa. Pupated June 15. All went below the surface of the soil within an hour or so. Colour dull mahogany brown, cremaster shining, black, with two short, stout outwardly curved hooks. Length 14 mm. by 4 mm. The pupa is enclosed in a cocoon made of loosely cemented soil particles just below the surface of the ground.

Imagines. Nearly all emerged on July 8th almost at the same time. With about 60 arriving at once the rearing box presented a lively appearance.

Remarks. The ova hatched in seven days from time of laying. The larval period was 19 days, while the pupal life was completed in 23 days, making a total of 49 days from egg to adult. From the 75 ova obtained, 57 adults were reared. Of these, 29 were typical *meadi* and 28 were of the form *badiaria* with no intermediate grades. Sexes were indiscriminately distributed among the two forms, with males predominating.

With such a marked distinction the name *badiaria* is a convenient term to distinguish this colour phase from typical *meadi,* the colour form from which the original description was drawn. The uniformity with which the larvae developed, pupated and the adults emerged, each stage at about the same time almost to the minute, is rather remarkable under confinement.

An attempt to mate the moths was unsuccessful. As this species is apparently single brooded, it is possible that mating would be delayed until the following spring, as the female *meadi f. badiaria* from which the ova were obtained was very worn and minus a hind wing, evidently a hibernated specimen.

TWO DECADES OF HOUSEHOLD PESTS IN VANCOUVER: A SUMMARY OF ENQUIRIES

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There are certain unavoidable imperfections in these records.

1. Citizens of this Province and of Vancouver have been slow to realize that they can get a measure of help from the University in connection with their insect problems.
2. Many enquiries have come in and have been answered over the telephone: only in later years have some of these messages been recorded.
3. Those recorded have been mostly letters sent to enquirers, of which carbon copies are on file.
4. While 95 per cent. of these records are from Vancouver, I have purposely included some from other points in the Province to show the spread of an insect or its distribution.
5. Most of the enquiries come in during the summer months when I am away on field work.

With the University becoming better known, the volume of enquiries is steadily increasing until now they average 30 to 40 per month throughout the academic year. Some of these enquiries sent to The Entomologist, credit me with encyclopedic knowledge; some I can hand to other members of our Department, but the rest I have to answer. Samples of these are:—

Types of questions sent in to an Entomologist

How to remove moss from roofs.

What rotifers occur in moss on roofs?

How to prevent woodpeckers drilling in roofs and pigeons from fouling cornices.

Will carpenter bees in nail holes in walls and between shingles on roofs destroy the house?

Concerning insects brought into houses on cut flowers or leaves, aphids, thrips, blotches on holly leaves, borers in rose stems, *Leptoglossus* on holly, aphids and scale on ferns.

Odd insects flying in, esp. *Polyphylla crinita* Lec.

Horn-tails being attracted to gas works.

During war years, "how to raise silk?"

How to remove toads, snakes and moles from gardens.

How to tell sexes of guinea fowl and muskrat.

How to remove flies and mites from mushroom beds.

Mites in honey-bee colonies and on earthworm cultures.

How to remove swarms of honey-bees from gardens.

How to rear frogs and toads and to start earthworm farms.

Why has a moose a bell?

Why are there no skunks in central B.C.? and so on.

Therefore the following records are cut down heavily to include only those affecting homes, in one way or another.

In view of the above-mentioned imperfections in these records, I can give you only an *idea* of what household pests occur in Vancouver; it is at best, only an *indication* and therefore curves or histograms of records are of little use and are consequently omitted and the enquiries are grouped into topics or categories.

Categories of Enquiries

	Species Concerned
Pests of the *Fabric* of homes	7
Pests attacking man's food	16
Pests of clothing and furniture	9
Pests attacking man's person	8
Pests on household animals or pets	3
Stragglers into homes	33
A total of	76 categories or species

and in addition there are 214 identifications of various sorts.

Insects attacking the **Fabric of Homes** are carpenter ants, termites, Anobiid beetles of two species, the beetle *Buprestis aurulenta* L. the longicorn *Criocephalus productus* Lec. and beetles of the genus *Lyctus*.

During 12 years out of 20, there were 55 enquiries about carpenter ants, 10 each year in 1951 and 1953 and the number is steadily increasing, reported chiefly from old houses. Of termites, there are 89 enquiries: all but one concern *Zootermopsis angusticollis* (Hagen), the one received two weeks ago is *Z nevadensis* (Hagen). Faulty construction in houses whereby the woodwork touches the earth, are responsible for most of the damage although I have four records where the colonies became established completely away from contact with the ground. Here again, the damage is increasing very heavily; in 1950 there were 12 enquiries, in 1951, 17; in 1952, 10 and so far this year 1953 there have been eleven. In many cases the damage both from black carpenter ants and from termites, has been very serious, necessitating extensive and very expensive repairs to buildings. I have a 4-ft. piece of an 8 x 10 foundation pillar from an apartment house where the inside has been completely hollowed out by termites leaving a shell, in places less than 1/8 in. thick. Anobiid or death watch beetles are also becoming of prime importance in homes. The European death watch, *Anobium punctatum* Deg., generally starts from antique furniture imported from Europe and spreads to the fabric of the house itself. I have ten records of this beetle, four in furniture alone and six in walls, but in two instances the infestation did *not* arise from heirloom furniture; the beetles apparently flew in from outside. There are 15 species of Anobiidae in the University collections, ten connected with timber of which four are on the coast and six spp. in the interior. The species that is spreading badly in Vancouver is *Coelostethus quadrulus* (Lec.) which is attracted to homes where the wood-destroying fungi *Merulius lacrymans* (Wulf.) and *Poria* spp. have produced dry rot. So far I have 23 records of infestations of *C. quadrulus* (Lec.) in Vancouver, one involving the entire house. In places where dry rot is not concerned, sapwood only is affected; heart wood is not attacked. *Buprestis aurulenta* L. originates usually in logs and the grubs that have been missed by the saws develop in the timbers, sometimes emerging as beetles from 14 to 18 years after the house was built. I have 14 records of these beetles emerging from buildings, the latest one, received this year from Port Alberni church, where many beetles emerged from floor joists, flooring and especially the pews. The church was completed fifty years ago and the pews were installed at that time. This is surely a world's record for slowness of development of any insect.

The longicorn, *Criocephalus productus* Lec., originated in fire-scorched trees, and four buildings constructed from timber from these trees, were riddled by larvae and emerging adults.

Lyctus beetles emerged from three homes where oak flooring, imported from the southern States during the war, had not been dry kilned.

Insects on **man's food** include about 20 common species; four spp. of spider beetles, the drugstore beetle, *Tribolium,* the saw-toothed grain beetle, granary and rice weevils, Mediterranean flour moth, *Plodia,* the bean weevil, cockroaches, ants, red-legged ham and larder beetles, book lice and mites on cereals and mites on cheese and dried fish. Almost all of the total of 104 records of spider beetles involve *Ptinus tectus* (Boield) (=*Ptinus ocellus* Brown) which, with 49 records of drugstore beetles, almost always start from cans of paprika and other spices and spread to other foodstuffs. Just this year I have four definite records of *P. ocellus* occurring in carpets in considerable numbers where the grubs must have been feeding on trash deep inside the pile because they normally do not eat keratin. The drugstore beetle also is brought into houses in spice tins and packages of cereals and once did great damage to the herbarium of our university, completely destroying flowers and leaves of many pressed plants. The German cockroach is reported almost every year, as are ants in pantries. I have definitely identified Pharoah's ant only once with two more records of probably this species: the other records are of ants native to this Province. The 12 other insects in this category are of minor importance though some of them, such as the bean weevil, are sometimes very abundant when they do occur.

Insects attacking **clothing and furniture** consists of the varied carpet beetle, the black carpet beetle and the eastern buffalo carpet beetle: clothes moths, spider beetles (as recorded above), silver fish, *Perimegatoma vespulae* Mill., and *Anobium punctatum* Deg. in the wood of furniture. The varied carpet beetle, *Anthrenus verbasci* (L.), with 268 records, is easily the worst household pest in the Province. The first record in 1934 was of five larvae brought into Vancouver from an auto camp on Vancouver Island and from these five I have maintained colonies in tins every year since, but from 1938 onwards it has been sent in from this city, from most of the lower mainland, Victoria, the Okanagan and as far east as Creston and Trail. Reared in the laboratory with abundant food, there are two generations a year but usually only one in homes; in some years *two* broods per year develop in homes. In 1951 there were 74 enquiries about this pest and so far this year there have been 61; ten enquiries came in on one morning the second week in November.

The black carpet beetle was first reported from Vancouver in 1944, with 22 records up to now, nine in 1951 and four so far in 1953. It is slowly spreading in the city although it is quite common in the dry belt, as at Kamloops. The eastern buffalo carpet beetle is established at Haney and at Mission some 50 miles from Vancouver with one record from Vancouver, and it will not be long before it spreads in this city.

Twenty years ago clothes moths were the chief household pest locally but they almost completely faded out when D.D.T. came on the market, being reported only one to three times a year, but they jumped back in 1951 when seven complaints about them came in. It would appear that these two moths have developed a measure of resistance to D.D.T.

Silver fish are spreading slowly but surely, with 25 records, the highest being five in 1951. Both *Lepisma saccharina* L. and *Thermobia domestica* (Pack.) are represented. Psocids or book lice have been reported 13 times and cause annoyance and hysteria out of all proportion to their size when they flood all over a house and are very difficult to eradicate. The newest household pest is the dermestid *Perimegatoma* (or *Megatoma*) *vespulae* Milliron which is common in the dry belt at Kamloops, but has been sent in from Vancouver twice, in 1949 and 1953. For some years it was a menace to the university insect collections, having been introduced in dried insects brought down from Kamloops but it was eradicated in 1951. Last year, however, it came down from the dry belt in great bundles of pressed plants collected in the interior and developed into a serious threat, eating the flowers of dried plants, especially those of *Ranunculaceae*. This summer the herbarium collections had to be fumigated against it.

On **human beings,** 10 species occur—the human flea, cat and dog fleas, ticks, itch mites, bedbugs, body and crab lice and rat and poultry mites. The *human flea* has been reported in nine out of 20 years with not more than two reports of it in any one year. But in several parts of eastern Vancouver

Island, chiefly Qualicum and Sydney, It sometimes develops in tremendous numbers on sea beaches. There are 119 reports of cat and dog fleas, of which 44 occurred in the year 1940, when people became conscious of it after a broadcast on fleas. One or other of the two species (or both) has been reported for 17 years out of 20. This climate is well suited to these insects which sometimes develop to plague proportions in a house. There have been 19 records of bedbugs with no reports at all from 1947 to 1950; only five since then: it is possible that these insects also are becoming resistant to D.D.T. Body lice are unusual with only two records; but one, in 1946 was outstanding because the almost unbelievable hordes of these insects were a contributing factor to the death of an old man living alone in a cabin. Both rat mites and poultry mites on pigeons, developing in the nests of these animals, sometimes swarm out and spread over buildings; such invasions have been reported six times.

There are 34 records of ticks, almost all of the coast tick with one only (1953) of the Rocky Mountain spotted fever tick, *Dermacentor andersoni* Stiles (*venustus* Marx), attaching to a woman on Fraser Avenue in Vancouver when she was out of the house for ten minutes. Nobody in the house and no neighbours had recently been up-country and the origin of this dry belt tick in Vancouver, cannot be explained.

On house pests, ear mites of dogs and cats are common; mange mites and puppy lice and mites on birds are occasionally reported. Fleas on cats and dogs are, of course, of perennial occurrence.

The list of **stragglers into homes** is large, with complaints of spiders and ants heading the list. Spiders have been reported for 17 years and ants for eleven years, the invasions of ants generally occurring in new houses, when their homes having been disrupted the insects wander in all directions for some days and straggle into buildings. House flies are so taken for granted that there were only 11 complaints about them, five in 1939, one in 1950, two in 1952, and three in 1953. There are two definite reports of resistance to D.D.T. in houseflies in 1953, one from a packing house in this city where the management spent $1,000 in vain last year, and the other from the sanitarium at Tranquille near Kamloops. This autumn I received details of myiasis by the lesser house fly, *Fannia canicularis* Linn., when a large number of larvae was discharged from the urinary passages of a five-year old girl. In 1952 one record from North Vancouver concerned two successive broods of the house fly, *Musca domestica* L., developing in the mattress of a baby's crib: the resulting adults were only half normal size.

Other *invaders* of homes are constantly reported but are of very minor importance, several species of Diptera, including *Drosophila*, mosquitoes and black flies; sowbugs, earwigs, wasps and wasps' nests, mud wasp nests, pseudoscorpions, *Bryobia* mites, caterpillars and moths, European house crickets and native black crickets, *Tropidischia xanthostoma* Scudder, the giant cave cricket and smaller camel crickets; bedbugs from bats and swallows, great flghts of ladybird beetles in the autumn (*Hippodamia ambigua* Lec.), the black vine and strawberry weevils, Collembola, and carabid beetles seeking shelter for the winter in basements.

Some stragglers or invaders merit attention. I have 25 records of Case bearer larvae appearing for eight years since 1944, in large numbers, migrating from trees near houses. I have fed these larvae on scale insects on willow and find them actively carnivorous, cleaning out sheets of scale and even eating the wax of scales, but have never succeeded in rearing the moths. Millipedes have 24 times invaded houses in huge numbers, migrating from woods alongside of newly erected houses. In the four years 1938, 1944, 1945 and in 1952, parts of the city were invaded by *Nomius pygmaeus* (Dej.), the stink beetle,

ANNUAL TOTALS OF ENQUIRIES 1933–1953

which rendered homes untenable for days until I found out that chlorine will neutralize their appalling odour.

A distinct phase of invaders are those that come into homes with firewood—some breeding in the wood, like Nitidulidae; bark beetles, like *Pseudohylesinus;* wood eaters as *Ergates spiculatus* Lec., buprestid larvae and Bostrichidae; carabid beetles, and sow bugs. The borings or tunnels of the shipworm teredo, *Bankia* sometimes cause alarm when they are apparent in firewood.

Not insects, but *rats*, have been reported 27 times; citizens apparently class them with insects, as household vermin.

Finally, I must comment on the attitude of people since 1945, towards insects in general. The whole attitude of citizens has changed; they have become *too* insect conscious and demand relief by the use of chemicals, from innocuous, inconsequential and even useful insects. Hysteria caused by the presence of insects, is increasing: I have now 16 case histories of "insectophobia" varying from unwarranted loathing, to hysteria, to mental unbalance necessitating long periods in mental hospitals. If taken early, these cases can be cured by commonsense appeal and reasoning, but the more severe ones are tragic and pitiable, necessitating phychiatric treatment and hospitalization. Much of this hysteria can be laid to awareness of modern insecticides which is inducing people to want to get rid of ALL insects, everywhere.

SCIENCE NOTE

Notes on the Occurrence of the Painted Lady, *Vanessa cardui L.* on Vancouver and the Queen Charlotte Islands in 1952.

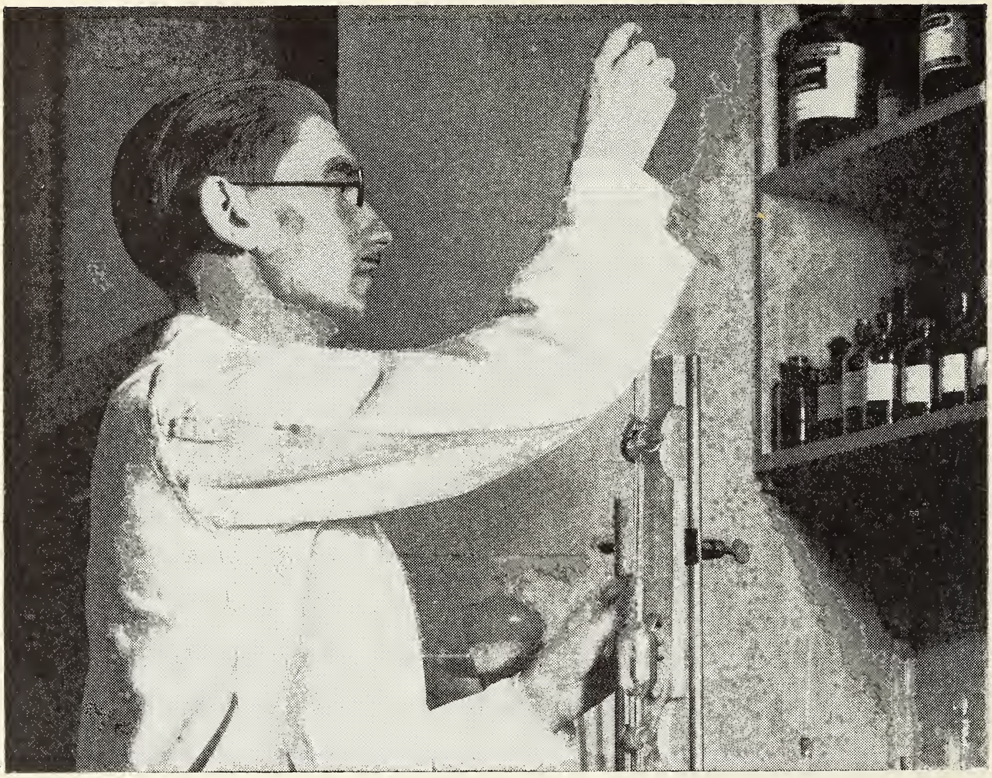
This cosmopolitan species, well known for its unpredictable abundance or scarcity from one year to another, has been common on Vancouver Island during the season of 1952. Worn specimens were noted early in the spring, evidently having hibernated elsewhere than on the island for the species was not noticed by me during the fall of 1951. These battered and faded individuals were observed continually until near the end of August, when freshly emerged specimens began to appear and remained abundant until well into October. They were very partial to the flowers of thistles, and in gardens, buddlia, scabiosa, asters, dahlias, etc. Individuals of this species were seen everywhere from Island View Beach on the coast to the summit of Mount Arrowsmith and all places in between. Philip Dover of Sandspit, Queen Charlotte Islands, wrote to me stating that to his knowledge he has seen them this year for the first time. They were never seen in as large numbers as reported from time to time in other countries, but occurred here in ones and twos, up to a dozen or two at any one time, throughout the season, and at almost every hour of daylight in suitable weather. From late August to October larvae were frequently found in their little tents on thistles; almost every patch had its quota. All these pupated and emerged in the period August to October of this year. The parasite *Ichneumon rufiventris* Brulle was reared from one pupa. This was named by W. R. Mason at Ottawa.

Up to July 1953 no painted ladies have been seen, although numerous examples of other hibernating species have been noted during February and March.

Have the large number of *cardui* seen late in the fall all died during hibernation or did they migrate elsewhere before finally seeking winter quarters; or did they just die, without hibernating or migrating? So far there is no evidence to show what happened.—*G. A. Hardy.*

The Proceedings of the Entomological Society of British Columbia is published annually. Individual volumes may be had for $1.00. Special rates on sets.

Address: C. L. Neilson, Secretary-Treasurer, Entomological Society of British Columbia, Court House, Vernon, B.C.



A non-aqueous indicator solution at work

The problem of heating and decomposition during formulation of chlorinated hydrocarbon insecticides into wettable powders and dusts is known to occur occasionally. For a long time the reason for these occurrences were not understood. The problem was studied by Shell at Denver, Colorado in relation to DIELDRIN and it was found that decomposition of DIELDRIN at time of manufacture of the powders was closely associated with the acidic surfaces of certain common carriers.

This true acid strength could not be shown by testing a paste or suspension of the carrier in water in the regular way and the use of non-aqueous indicator solutions applied directly to the dry carrier was necessary. Carriers found to have these hitherto unsuspected acid spots were termed catalytically active.

Having found the key to the solution of the problem, it was then a simple matter to determine additives that would counteract or inhibit the catalytic action.

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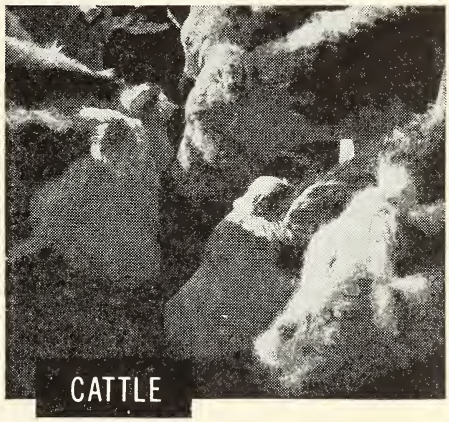

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