Ontario Department of Agriculture

Fifty-First Annual Report

OF THE

Entomological Society

OF ONTARIO

1920

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by CLARKSON W. JAMES, Printer to the King's Most Excellent Majesty
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THE RYERSON PRESS.

To His Honour, LIONEL H. CLARKE,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

I have the honour to present herewith for your consideration, the Report of the Entomological Society for 1920.

Respectfully submitted,

MANNING W. DOHERTY,

Minister of Agriculture.

CONTENTS

Entomological Society of Ontario

OFFICERS FOR 1920-21

President—Mr. Arthur Gibson, Entomological Branch, Dept. of Agriculture, Ottawa.

Vice-President—Mr. F. J. A. Morris, M.A., Peterborough.

Secretary-Treasurer—Prof. A. W. Baker, B.S.A., O. A. College, Guelph.

Curator—Mr. G. J. Spencer, B.S.A., Lecturer in Entomology, O. A. College, Guelph.

Librarian—Mr. G. J. Spencer, B.S.A., O. A. College, Guelph.

Directors—Division No. 1, Dr. J. M. Swaine, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, Mr. C. E. Grant, Orillia; Division No. 3, Dr. A. Cosens, Toronto; Division No. 4, Dr. Watson, Port Hope; Division No. 5, Mr. J. W. Noble, Essex; Division No. 6, Mr. H. F. Hudson, Strathroy; Division No. 7, Mr. W. A Ross, Vineland Station.

Directors (ex-Presidents of the Society)—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Guelph; Prof. John Dearness, Vice-Principal, Normal School, London; Rev. Thomas W. Fyles, D.C.L., F.Y.S, Ottawa; Prof. Wm. Lochhead, B.A. M. Sc., Macdonald College, Que.; John D. Evans, C.E., Trenton; Prof. E. M. Walker, B.A., M.B., F.R.S.C., University of Toronto; C. Gordon Hewitt, D.Sc., F.R.S.C., Dominion Entomologist, Ottawa; Mr. Albert F. Winn, Westmount, Que.; Prof. Lawson Caesar, M.A., B.S.A., O. A. College, Guelph.

Editor of "The Canadian Entomologist"—Dr. J. McDunnough, Entomological Branch, Dept. of Agriculture, Ottawa.

Delegate to the Royal Society of Canada—The President.

FINANCIAL STATEMENT

For the Year Ending October 31st, 1920

Expenditures.		*Receipts.*	
Printing	$1,692 09	Cash on hand, 1919	$ 82 81
Annual Meeting	28 05	Subscriptions	475 86
Expense	19 00	Members' Dues	102 00
Cash in Bank	94 15	Advertisements	93 29
		Back Numbers	70 75
		Bank Interest	8 58
		Government Grant	1,000 00
	$1,833 29		$1,833 29

To balance due on printing	$467 51
To Editor's salary	100 00
To Annual Report	25 00
	$592 51
By cash in Bank	94 15
Net deficit	$498 86

Respectfully submitted, A. W. Baker. *Secretary-Treasurer.*

Auditors: L. Caesar.
J. E. Howitt.

Entomological Society of Ontario

ANNUAL MEETING

The Fifty-seventh Annual Meeting of the Entomological Society of Ontario was held at the Ontario Agricultural College, Guelph, on Wednesday and Thursday, November 17th and 18th, 1920. The daily meetings were held in the Entomological Lecture room of the College and the evening meeting in the men's sitting room. The following members were present: Dr. E. P. Felt, State Entomologist, Albany, N.Y.; Rev. Prof. C. J. S. Bethune, Prof. L. Caesar and Messrs. A. W. Baker and G. J. Spencer, O. A. College, Guelph; Messrs. Arthur Gibson, L. S. McLaine, H. G. Crawford and E. Hearle, Dominion Entomological Branch, Ottawa; Prof. W. Lochhead, Macdonald College, Que.; Father Leopold, La Trappe, Que.; Mr. F. J. A. Morris, Peterborough, Ont.; Prof. E. M. Walker, Toronto, Ont.; Mr. W. E. Biggar, Hamilton, Ont.; Mr. Jas. Dunlop, Woodstock, Ont.; Mr. E. R. Buckell, Dept. of Agriculture, Victoria, B.C.; and the following officers of the Dominion Entomological Branch: Messrs. C. E. Petch, Hemmingford, Que.; W. A. Ross, Vineland Station, Ont.; H. F. Hudson, Strathroy, Ont.; Norman Criddle, Treesbank, Man.; and E. H. Strickland, Lethbridge, Alta.

Among the visitors present were Prof. C. R. Crosby, Cornell University, Ithaca, N.Y.; Messrs, W. R. Walton and L. H. Worthley, Bureau of Entomology, Washington, D.C.; Mr. A. V. Mitchener, Manitoba Agricultural College, Winnipeg, Man.; Mr. A. H. McLennan, Dept. of Agriculture, Toronto; Mr. R. H. Gurst, Dominion Pathological Laboratory, St. Catherines, Ont.; and Professors R. Harcourt, J. E. Howitt, D. H. Jones and J. W. Crow, Dr. R. E. Stone, and Messrs. C. R. Klinck and W. G. Garlick, O. A. College, Guelph.

Letters of regret on their inability to attend the meeting were received from the following: Rev. Dr. T. W. Fyles, Mr. George Maheux, Prof. P. J. Parrott, Prof. O'Kane, Prof. Headlee, Prof. J. J. Davis, and Messrs. Moore, Winn and Corcoran of the Montreal Branch.

On Wednesday morning a meeting of the Council was held, at which the report of the proceedings of the Society for the year was read by the Secretary and approved and several important matters concerning the welfare of the Society discussed. A committee, consisting of the President and secretary of the Society and Dr. E. M. Walker was appointed to deal with the matter of adjusting the finances of the Society. It was also decided that the following policy with respect to the journal of the Society be followed in future as closely as possible, viz:—that no papers be published unless the author be a subscriber or member of the Society and that the author bear the full cost of all cuts. It was suggested that in view of the fact that the Annual Meeting of the American Association for the Advancement of Science is to be held in Toronto in 1921, that the Annual Meeting of the Entomological Society of Ontario be held in the same city at such a time that visiting entomologists could attend our sessions.

WEDNESDAY AFTERNOON

The regular meeting was called to order by the President, Mr. Arthur Gibson.

The various reports of the Society, except that of the treasurer, were taken as read. The financial statement was then read by the Secretary-Treasurer.

Professor Caesar spoke a few words of appreciation of Dr. Hewitt's work, and moved that a letter be sent to Mrs. Hewitt expressing great regret that Dr. Hewitt was not with us. This was seconded by Prof. Lochhead and carried.

The remainder of the afternoon was occupied by the reading of papers and discussion.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1919-20.

The fifty-sixth annual meeting of the Society was held at Ottawa on November the sixth and seventh, 1919. The attendance was good and very representative of the National character of the Society, members being present from Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba and British Columbia. In addition to the Canadian members there were two welcome visitors from the United States: Mr. C. L. Marlatt, Assistant Chief of the Bureau of Entomology, Washington, D.C., and Dr. Summers of Massachusetts.

The following papers were read:—"Insects of the season in Ontario," W. A. Ross and L. Caesar. "Insect Conditions in the Province of British Columbia," R. C. Treherne. "Results of some Preliminary Experiments with Chloropicrin," G. J. Spencer. "Ephydra hians and its Occurrence in Western Canada," Dr. C. Gordon Hewitt. "Our Common Cercopidae," George A. Moore. "Further Notes on the control of the Pear Psylla," W. A. Ross and W. Robinson. "My Experience this year in Dusting and Spraying," Rev. Father Leopold. "The Chief Factors in the Natural Control of Insects," J. D. Tothill. "The Present Condition of the Balsam and Spruce Injury in Quebec," J. M. Swaine. "Recent Observations on Eastern Ticks," S. Hawden. "How the United States is preventing the Introduction of Foreign Insect Pests and Plant Diseases," C. L. Marlatt. "Hopkins Bioclimatic Law," W. Lochhead. "On the Wings of the Wind," A. F. Winn. "Locusts in Manitoba with Special Reference to the Outbreak in 1919," Norman Criddle. "Ecological Notes on certain Species of Locusts prevalent in British Columbia," E. R. Buckell. "Symposium on the Cabbage Root Maggot and its Control in 1919," W. H. Brittain, R. C. Treherne, Arthur Gibson and L. Caesar. "Present Status of Pests of Canadian Flour Mills," E. H. Strickland. "Life-History of a hobby Horse—Part II—Boy and Man," F. J. A. Morris. "Some Notes on the Life History of our Common June Beetles," H. F. Hudson. "Further Notes on the Life History and Control of the Strawberry Root Weevil," W. Downes. "The Strawberry Weevil," W. A. Ross. "Borers in Corn and other Field and Garden Plants which have been or may be mistaken for the European Corn Borer," Arthur Gibson.

The Canadian Entomologist, the official organ of the Society completed its fifty-first volume in December last. The size of the magazine was enlarged in order to be uniform with the standard size of bulletins, and the number of pages in each issue was reduced but without making any diminution in the amount of reading matter published. The volume contained 287 pages, illustrated by 20 full page plates and 36 figures from original drawings. The contributors to its pages number 65, and include writers in Ontario, Quebec, Manitoba, Alberta and British Columbia, and also in twenty-one of the United States. Ten papers were published on "Popular and Practical Entomology," which continued to form an attractive and instructive feature for the benefit of the general reader.

Ten numbers of the 52nd volume have so far been issued and the volume will be completed by the publication of the November and December numbers.

It is again the sad duty of the Council to record the loss of one of our most eminent members, and it is difficult to express in suitable terms the profound regret that all Entomologists feel at the death of Dr. C. Gordon Hewitt, Dominion Entomologist and a former President of the Society. He died at Ottawa on February the 29th, 1920, of pneumonia, following a brief but very severe attack of influenza. By his death Canada has lost one of her ablest men of science and the Department of Agriculture a most valuable and efficient servant, through whose wide knowledge of economic zoology, great administrative ability and far-seeing judgment, the Dominion Entomological service has developed to a remarkable extent since his appointment as Dominion Entomologist in 1909. A full acount of his life and work, together with an excellent portrait, was published in the *Canadian Entomologist* for May.

REPORT OF THE LIBRARIAN.

No books have been purchased for the Library during the year ending October 31st, 1920, owing to the lack of funds for the purpose. Thirty-six bound volumes, nearly all of them the gift of the Librarian, have been added to the Society's collection making the total number 2,328. There is a large accumulation of periodicals, bulletins and other publications, many of which should be bound in order to be available for reference, but at present there is no prospect of any means being available, nor has it been possible to have them classified and catalogued.

Respectfully submitted,

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE MONTREAL BRANCH.

The 392nd regular and 47th Annual Meeting of the Montreal Branch was held on Saturday, May 8th, 1920, in the Lyman Entomological Room, Redpath Museum, McGill University.

The following reports were given:—

The Council reported that during the season 1919-20, eight meetings had been held with a total attendance of eighty-one or an average of ten per meeting. This was larger than for the previous season. The Annual Field Day was held at St. Hilaire on Victoria Day. During the year twenty-one papers were read on the following subjects:—

1. President's address .... A. F. WINN.
2. Notonectidæ (Hemiptera) .... GEO. A. MOORE.
3. Collecting at Peaks Is. Me., 1919 .... A. F. WINN.
4. A trip to Tadousac, Que. .... A. F. WINN.
5. The annual meeting at Ottawa .... GEO. A. MOORE.
6. Common characteristics of the Ephemeridæ .... DR. CORCORAN.
7. The North America species of Coelambus .... J. I. BEAUNE.
8. The House Centipede, Cermatia forceps Raf. in Montreal .... DR. A. WILEY.
9. Superstitions about insects .... A. F. WINN.
10. Our common Cercopidæ .... GEO. A. MOORE.
11. Studies in Donacia .... G. CHAGON.
12. North American species of Parnassius .... A. F. WINN.
13. Dangerous Insects found in Montreal .... J. I. BEAUNE.
14. New Year's Message .... A. F. WINN.

15. Woodboring beetles found at Ft. Coulonge .... J. I. Beaune.
16. Ocelli .... Geo. A. Moore.
17. The preparation of Entomological material for the microscope ... Dr. F. S. Jackson.
18. Studies in the genus Podisus (Hemiptera) .... Geo. A. Moore.
19. Notes on a collection of Lepidoptera from Murray Bay, collected by Jas. G. Holmes .... A. F. Winn.
20. Specific, subspecific and varietal categories .... Geo. A. Moore.
21. Note on a species of Bot Fly, Bogeria grisea Coq. taken at Tadousac, Que. .... A. F. Winn.

The Treasurer reported a balance on hand of $157.38.

The following were elected officers:—

President .... A. F. Winn.
Vice-President .... G. Chagnon.
Secretary-Treasurer .... Geo. A. Moore.
Librarian .... J. W. Buckle.
Council .... Dr. Corcoran, G. H. Hall, A. C. Shepherd.

Geo. A. Moore, *Secretary.*

REPORT OF THE TORONTO BRANCH.

The 239th regular and 24th Annual Meeting of the Toronto Branch was held in the Biological Building of the University of Toronto on Thursday evening, October 21, 1920.

The report of the Council showed that during the season eight regular meetings and a field meeting were held, with an average attendance of twelve persons.

During the season the following papers and addresses were given before the Society:—

1. "Wohlfahrtia vigil as a Human Parasite" .... Dr. E. M. Walker.
2. "Collecting at Port Sydney, in 1919" .... N. K. Bigelow.
3. "Collecting at Go Home Bay, Ont." .... H. V. Andrews.
4. "Habits of Our Commoner Dipterous Larvæ" .... N. K. Bigelow.
5. Exhibit of the Entomological Collection of the Royal Ontario Museum of Zoölogy .... S. Logier and N. K. Bigelow.
6. "Insects as Carriers of Disease" .... H. V. Andrews.
7. "Mayflies" .... Dr. W. A. Clemens.
8. "Grasshoppers and Locusts" .... Dr. E. M. Walker.
9. "Ox-Bot Flies" .... A. W. Baker.
10. "The Nesting Habits of Ants" .... S. Logier.

Seven new members were elected during the year, i.e. Miss C. A. Brown, Miss Jean Scott, Miss M. Maitland, Mr. R. W. Hall, Mr. A. H. Leim, Mr H. Haworth and Mr. A. C. Auchinachie.

The Treasurer's Report showed a balance of $26.25.

The following officers were elected for the coming year:—

President .... H. V. Andrews.
Vice-President .... S. Logier.
Secretary-Treasurer .... Norma Ford.
Librarian .... N. K. Bigelow.
Council .... Dr. E. M. Walker, Dr. A. Cosens, Dr. W. A. Clemens, and A. H. Leim.

Respectfully submitted,

Norma Ford, *Sec.-Treas.*

REPORT OF THE BRITISH COLUMBIA BRANCH.

The 19th Annual Meeting of the British Columbia Entomological Society was held in the I.O.D.E. rooms, No. 401 Jones Building, Victoria, on Saturday, Feb. 21st, 1920. Seventeen members were present and several visitors. The meeting was a most successful one and several important resolutions were passed. Chief among these was one moved by Mr. Treherne and seconded by Mr. Lyne in favour of co-ordinating entomological work throughout the Dominion and in favour of establishing national journals of entomology, one for systematic and one for economic entomology. The secretary was instructed to forward a copy of this resolution to the Ontario Entomological Society.

Other resolutions were passed as follows:—

"That the Dominion Government be asked to publish a handbook on the birds of Canada west of the Rocky Mountains."

"That the Secretary write to the Natural History Societies requesting co-operation in bringing the necessity for control of the Tent Caterpillar to the Civic and Municipal Authorities;"

"That prizes be given at the fall fairs for the best collection of insects by school children, at the discretion of the Advisory Board."

"That the subscriptions of members joining later than August be good for the following year."

"That arrangements be made with a dealer in the city of Victoria to act as agent for entomological supplies."

The following papers were read during the meeting :—

Common Dragonflies of B. C. .... W. Downes.
A collecting trip to Lillooet .... G. O. Day.
Further notes on Aeolothripidæ .... R. C. Treherne.
Native flowers for bees .... J. Davidson.
Some new species of Mycetophilidæ .... R. S. Sherman.
Life history of Apateticus crocatus .... W. Downes.
The Argynnids and Brenthids of B. C. .... E. H. Blackmore.
Entomology in the Schools .... J. W. Gibson.
Further notes on the control of the Onion Maggot .... R. C. Treherne and M. H. Ruhmann.
Further notes on the Tent Caterpillar and its natural control .... A. B. Baird.
A new honey-eating larva .... J. W. Cockle.
The Locusts of B. C. .... E. R. Buckle.

The following officers were elected:—

Hon. President .... Francis Kermode.
President .... E. H. Blackmore.
Vice-President (Coast) .... R. S. Sherman.
Vice-President (Interior) .... R. C. Treherne.
Advisory Board .... Messrs. J. Davidson, J. W. Gibson, L. E. Breun, E. W. White, L. E. Marmont.

Alan G. Dustan, *Secretary.*

REPORT OF THE NOVA SCOTIA BRANCH.

The sixth meeting of the Entomological Society of Nova Scotia was held in the biology lecture room at Acadia University, Wolfville, N.S., on August 24th. In the absence of the President, Prof. W. H. Brittain, due to illness, the chair was taken by the Vice-president, Mr. J. D. Tothill. At the business meeting, which was held in the morning, it was decided to hold in future two meetings of the Society each year; a summer meeting, to take the form of a field day; and a winter meeting, at which papers and addresses would be presented. The following officers were elected for the ensuing year:

Honorary President ....DR. A. H. MACKAY, Halifax.
President..............................PROF. W. H. BRITTAIN, Truro.
Vice-President ....J. D. TOTHILL, Fredericton.
Secretary-Treasurer ....A. G. DUSTAN, Fredericton.
Committee ....DR. EDNA MOSHER, L. G. SAUNDERS, V .B. DURLING.
Publications Committee ....W. H. BRITTAIN, A. KELSALL, A. G. DUSTAN.

At the afternoon session addresses were given by MR. ARTHUR GIBSON, Dominion Entomologist, and Dr. A. H. MACKAY, Superintendent of Education for Nova Scotia, and a number of papers were read by different members.

During the past year the fifth "Proceedings of the Entomological Society" was issued. This publication, which comprises ninety-four pages and includes four plates, contains some very valuable data on the various insects studied throughout the year. It also includes an account of the latest insecticide-fungicide combinations which have been tested in Nova Scotia during the past season.

ALAN G. DUSTAN, *Secretary.*

REPORTS ON INSECTS OF THE YEAR.

Division No. 3. Toronto District—A. Cosens.

With reports from different parts of the province of serious damage done by the Hessian Fly, and from another part of the appearance of the Corn Borer, the Entomological happenings in the Toronto District seem very unimportant.

The Tussock moth, so much in evidence for several years, has apparently passed the peak of its development and will now decrease in numbers for a term of years. In the western part of the city few caterpillars were seen in districts where the trees have been badly infested for several years. The parasites are clearly establishing a control of the pest, but this natural check has been assisted by the system of spraying and intelligent collection of egg masses carried out by the City Parks' Department.

Two moths, noted as being unusually plentiful, were the day-flying, black and white Shearmark. *Rheumaptera hastata* and the Linden Moth, *Erannis tiliaria.* The latter was common, flitting about the electric street lamps, until the cold spell that commenced October 25th brought its activities to a close.

The Monarch butterfly was only rarely seen this season and specimens of the Common Sulphur were less numerous than usual.

Reports from the eastern part of the city indicate that the Soldier Bugs have been more than usually aggressive in their attacks on the Colorado Potato Beetle. These carnivorous insects kill the "Potato Bug" by thrusting their beaks into it, a mode of attack quite different to that of the beetles for which they are often mistaken.

There is a beetle, *Lebia grandis,* however, that kills large numbers of the Potato Beetles. It attacks both larvae and adults as well as feeding on the egg clusters of the pest. This insect friend of the gardener is easily recognized by its dark blue outer wings and red-coloured legs and body.

Other beneficial insects, frequently seen in this district, are the Ground Beetles. There are two common species of them, both of which are distinctly marked. The Searcher or Caterpillar Hunter, *Calosoma scrutator,* has its outer wings colored a vivid violet green, margined with reddish, while those of the Fiery Hunter, *Calosoma calidum,* are black, marked with regular rows of yellowish, punctated dots.

These species destroy a large number of destructive, leaf-eating insects, tent-caterpillars, cutworms, canker-worms and other equally injurious forms. Their segmented, flattened larvae burrow just beneath the surface of the ground and attack the insects entering the ground to complete their development. These larvae are very active and so well-armed with a sharp pair of jaws, that they are able to overcome larvæ much larger than themselves. The adult insects hunt at night, and like the larvae feed upon other insects. Because of this nocturnal habit and their hiding under stones and logs during the day, they are seen less frequently than some other insects that are not so plentiful. They are, however, found often in the mornings on the pavements under the electric lights that have attracted them during their night-marauding expeditions.

There have been very few acorns on the mossy-cup oaks, *Quercus macrocarpa,* in this locality for several years, but this season, on the contrary, nearly all the trees are well-fruited. A large number of the acorns bear on their cups galls produced by *Andricus glandulus.* These galls resemble closely minature acorns, as the inner gall containing the larvæ is formed in a small cup with a mossy-fringed border like that of the acorn. When mature the inner gall falls out of the cup to the ground, where the larva remains in it and does not mature until the following spring.

Division No. 4.—F. J. A. Morris, Peterborough.

One of the first events of the season was the appearance of borers about Virginia Creeper on a neighbour's garden wall. Warned by the previous year's date of emergency I was on the look out before the close of May. Sure enough, on the 29th of May I began to find specimens of *Psenocerus supernotatus* about the broken stems and dead twigs at the base of the shrubbery and in the course of four or five days captured over a score of these. On May 31st I observed the first specimen of *Saperda puncticollis,* and between June 1st and June 10ah I captured over forty. They were nearly always taken on the foliage near the top of the hedge. In bright, hot sunshine they became very active crawling out on to leaves and flying about with great readiness. On June 19th while exploring a wood west of Bethany Junction I found feeding on the blossoms of maple-leaved Vibernum or Dockmackie a species of Leptura that was new to me; it proved to be *L. octonotata.* On June 30th while exploring the northwest corner of the famous Murray Swamp between Meyersburg and Codrington, on the alders at its edge I captured my first specimen of the handsome little buprestid *Eupristocerus cogitans.*

On Saturday, July 17, while wheeling across the Oak Hills between Stirling and Frankford, noticing large patches of New Jersey Tea in bloom about the edges of the groves of oak and pine, I dismounted in the hope that the oak might breed certain new species of anthophilous beetles; my hopes were realized by finding among several familiar forms of Leptura and Typocerus, the less common *Typocerus lugubris* and *Leptura zebra;* the latter I regard as quite a prize; it bores in oak and I made three captures in my short stay.

On Tuesday, July 20th, while on a botany trip north of Norwood, I spied a specimen of the brilliant little *Chrysobothris Harrisii* settling on some pine brush; I had only once before seen this creature (many years ago, at Lanark) and had never captured it. It was therefore a great triumph to take three specimens during the day, all on branches of white pine lying beside the road. I saw several others, but they were too active for capture. On the same day, in a rocky hardwood heavily culled, I noticed by the path some shrubs of New Jersey Tea in bloom and acting hosts to a varied gathering of guests; among many common species I was overjoyed to capture two specimens of *Leptura plebeja.*

In August while camping in the Algonquin Park I took both sexes of *Leptura hamata* and a single speciment of *Leptura biforis.*

NOTES ON LEAF BUGS (*MIRIDAE*) ATTACKING FRUIT TREES IN ONTARIO.

L. Caesar, Guelph.

The cause of deformed or disfigured fruit is always a matter of much interest to entomologists. All deformities of course are not due to insects for there is no doubt that some are brought about by other factors such as imperfect fertilization, some of the so-called physiological diseases, and by fungi. By far the majority, however, are due to insects. Of the insect agents Leaf Bugs (Miridae) play an important part—a part that has only begun to be realized the last few years. Slingerland and Crosby by their work on the Red Bugs (*Heterocordylus malinus* and *Lygidea mendax*), were among the first to call our attention to Leaf Bug injuries. Since then Parrott and Hodgkiss, Brittain and several others both in North America and Europe have added greatly to our knowledge; so that now there is a fairly long list of Miridae known to attack fruit. In Ontario I have observed the following:—*Heterocordylus malinus, Lygidea mendax, Neurocolpus nubilus, Paracalocoris colon, Campylomma verbasci, Lygus communis* and *Lygus quercalbae.*

The last two were discovered as offenders only this year and fortunately each seems limited to a small area. They are not, however, new insects nor are their fruit-feeding habits in Ontario new; for the owners of the orchards in each case have observed their work for several years without, however, knowing the name of the insect.

Lygus communis is the so-called Green Apple Bug of Nova Scotia, and also the False Tarnished Plant Bug of New York which Parrott and Hodgkiss found attacking pears in that State. This insect was found by me this year in two orchards at Newcastle, both orchards containing apples as well as pears.

An interesting feature about its work was that both pears and apples were attacked. Now Knight states in his "Revision of the Genus Lygus" that he spent four summers inspecting orchards in New York state and was unable to take any form of *L. communis* on apples, though he says Herrick received the typical *communis* last year from apples in Eastern New York. Brittain, however, tells me that it is preeminently an apple pest in Nova Scotia and that any injury to pears there is largely brought about by the adults flying in from neighboring apple trees and feeding upon the fruit. At Newcastle both nymphs and adults were observed both on apples and pears. For instance, at my second visit I estimated that from 20 to 60 per cent. of Ben Davis apples were attacked and from 30 to 90 per cent. of the pears.

Another interesting peculiarity of the attack was that the blighting of young fruit and twigs, so common in Nova Scotia and at first mistaken there for Pear Blight, was very little, if at all, in evidence on any tree. My first visit to the orchards was on June 25th at which time most of the nymphs were in their last instar and a considerable number had transformed into adults. The second visit was on July 14th when no nymphs were seen but adults were very abundant and though concealed on the twigs could easily be knocked into any receptacle; in fact I caught nearly all mine by tapping the branches and knocking them into my hat. The third visit was on September 10th. No adults were then present.

An examination of the orchard at this date showed that a remarkably large percentage of the apples had outgrown the injury, though some had doubtless dropped off. Only about two per cent. showed any noticeable injuries. These injuries took the form either of deep depressions or of small elevations with a brown, rusty surface.

Pears had not outgrown the injury but had become worse as they increased in size. In orchards of about an acre in extent the fruit of every variety was badly deformed, apparently over 90 per cent. being knotty or scarred and unmarketable. In the other orchard 50 per cent. were affected. In this latter orchard the injury consisted chiefly of unsightly large and small brown scars on the surface without many deep depressions. The former pear orchard had more of the knotty type of injury with the deep depressions and stone cells; though many surface scars were also in evidence. Hence, it is just possible another Mirid, or some other insect than *L. communis* was also at work in it.

In both orchards many specimens of *Camptobrochis borealis,* a brown Mirid slightly larger than *L. communis* were taken by beating, both species being present, as a rule, in about equal numbers on the same branches. Knight says this species feeds upon Rosy Aphis of Apple and also upon *Phyllaphis fagi* on beech trees, but that, while he has never seen it puncturing apples he thinks it might do so when abundant, for when aphids are not present it will subsist on sap from the apple tree. In the case in question there were very few aphids on the apple trees; therefore it will be interesting to see next year whether we have here, as in the case of *Campylomma verbasci, Neurocolpus nubilus* and some other Mirids, an example of the changing food habits of an insect.

All the Mirids referred to so far have attacked either apple or pear or in some cases both, but I wish now to call attention to a species that did much damage to peaches in at least one orchard and to some extent for several years. At St. David's in the Niagara district there is a peach orchard of about six acres, bordered on two adjoining sides by woods, in which are a good many oak trees. About 90 per cent. of the fruit on fully half of this orchard, namely all the portion near the oak trees, was so badly scarred by the feeding of adult Mirids that it was unmarketable and not profitable for canning factory purposes because it would all have to be pared by hand instead of by alkali and machinery as is the usual custom. Only a small part of the affected fruit was knobby for the injury seldom affected the shape of the peach. At my first visit, June 26th, almost every fruit in this portion of the orchard had from one to five or six adults feeding or resting upon it. The species as determined by Knight was *Lygus quercalbae,* a species that Knight says breeds so far as he knows on white oak only. There is almost no doubt that the adults flew to the peaches from the surrounding oak trees, though I could find very few on oak leaves at the above date. A neighbor stated at the time, and of course before I heard from Knight, that he felt sure they had come from the oak trees because a few days before they were very plentiful on these trees. An inspection of the orchard also revealed that the farther the peach trees were situated from the oaks the fewer the number of adults and of injuries. This was true even of peaches alongside a pond surrounded by such trees as poplar, sassafras, willow and sumac but not oaks.

As fully three-quarters of the oak trees in the woods were not white oaks but red oaks with sharp pointed lobes on the leaves, I cannot help but think that *Lygus quercalbae* must breed on red oak also. Another thing that tends to confirm this belief is that numerous eggs of a Mirid were found on red oak twigs, either in the tissues beneath or alongside the newly formed buds or beneath the leaf stem. Eggs on white oak were also easily found in the same place though more in this case were situated beneath the leaf stem. This slight variation, however, could be accounted for easily by the difference in size of the buds of the two varieties. Knight tells me that Parrott reported to him from New York State a similar case of injury to peaches this year from *Lygus caryae*, the adults having flown into the orchard from hickory trees on which they breed.

Whether the above action of *Lygus quercalbae* and *L. caryae* portends a greater amount of trouble in orchards from Miridae or not, only time can tell, but I sincerely hope it does not because they are among the most difficult of insects to control.

THE MANITOBA GRASSHOPPER CAMPAIGN OF 1920.

A. V. Mitchener, Winnipeg, Man.

As early as the year 1865 we have records of damage done by grasshoppers in Manitoba. The Rocky Mountain Locust (*Melanoplus spretus*) migrated from the south-west to the Red River Valley and entirely devoured the crops of those early settlers. Since that time there have been outbreaks of locusts at various times, but none so severe and extended as the outbreak which began in 1919. During that year, damage was largely confined to a restricted portion of the south-western part of Manitoba. In the spring of 1920, grasshoppers appeared over a much larger area; and it is with this particular phase of the outbreak that we are here concerned.

The area most severely infested in 1920 included six municipalities in the extreme south-western corner of the province with an area of 1,728 square miles. Here practically every farm was polluted with eggs, and later on with locusts. Outside of this area and immediately surrounding it on the north and on the west was an area of over 4,000 square miles where the infestation was less severe on an average but where grasshoppers were very numerous in places. In other parts of the province there were scattered areas, usually not large, where grasshoppers did some damage to the crops.

On May 17th when the area was first visited, young grasshoppers were hatching in great numbers from the lighter soils. Examinations were made in the sod along roadsides, fences, lanes, etc., and in stubble fields to find out what the prospects were for grasshoppers later in the season. As many as seventy-five egg clusters were found to the square foot. Each egg cluster averaged about twenty eggs. This meant that millions of eggs were in the sod along fences bordering the grain fields. Later in the season when most of the eggs had hatched, the edges of grain fields were literally swarming with tiny hoppers, and it was no unusual sight to see hundreds of thousands huddled together along the edges of the fields. When young they went into a field slowly: as they progressed, they entirely stripped the ground of every blade of grain. Nothing was left. The ground was as bare as a summer-fallow. During this period of their life poisoning was much more easily accomplished than later when they had spread all through the standing grain.

In Manitoba we have a large number of species of locusts which are native to the province. All those species that have been injurious during the present outbreak are native. They are present every year; but due to dry weather and other causes have increased enormously in numbers during the past few years. The four most injurious forms are:

Camnula pellucida, **The Pellucid Locust.**
Melanoplus atlanis, **The Lesser Migratory Locust.**
Melanoplus femur-rubrum. **The Red-legged Locust.**
Melanoplus bivittatus, **The Two-striped Locust.**

These are not the only ones, but are the principal ones with which we had to contend.

During the latter part of May organization meetings were held in the towns in the infested area where it was decided to fight the locusts with poisoned baits. The plan suggested by the provincial Department of Agriculture was adopted. The plan of campaign, briefly, was to have each municipality a unit with the reeve in charge of the whole. Each of the four councillors was to have charge of his ward under the general control of the reeve. Mixing stations were to be established at convenient points where the farmers could obtain the poisoned bait ready mixed. Each farmer was responsible for his own land and the roadsides next to his land. In case of waste lands, men were to be hired by the council to put the bait out. The cost of the campaign was to be borne both by the provincial government and by the municipalities where the campaign was carried on. The provincial government agreed to furnish all the ingredients for the poisoned baits free, while the municipalities were to bear all the local expenses such as the cost of labor for mixing, rentals for buildings, gasoline, etc.

At the beginning of the campaign the mixing was done mostly by hand, but soon the demand for bait was so great that the farmers could not be supplied. This situation produced the Manitoba Mixer, a machine designed to turn out several tons of mixture per day. This machine is run with a gasoline engine of 1½ to 2 horse-power. Other types of machines were tried out; but the one based upon he principle of a stationary drum with revolving stirring rods on the inside proved pre-eminently satisfactory. Two or three men are required to keep the mixer running to full capacity. A maximum output was obtained when the routine work was divided among the workers, each man having certain duties to perform. Some idea may be gained of the amount of work accomplished at one of these stations in a day when it is stated that on June 15th, 185 farmers called at one station alone for some 39,800 lbs. of poisoned bait. Records were kept of all the poisoned bait sent out from these stations. A blank form was provided, which was filled in by the farmer when the baits were taken from the station.

At the beginning of the campaign the poisoned bait known as the Kansas Mixture was used with success. This bait is made up of the following materials:

Bran	100 lbs.
White Arsenic, or Paris Green...........	5 lbs.
Lemons	12-15 fruits.
Black Strap molasses	2 gals.
Water	14 gals.

The bran and the dry poison were first put in the Mixer and thoroughly intermingled. The Mixer was then opened and the liquid consisting of ground lemons, molasses, and water was added. The whole was then stirred until thoroughly mixed, when it was dumped out on the floor, ready to be scooped up in sacks by the waiting farmers. The whole operation was immediately repeated. During the worst part of the campaign, the mixing stations were kept going from early in the morning until well on toward midnight.

At some of the stations, a mixture consisting of the following materials was used; viz.,

Bran	100 lbs.
White Arsenic, or Paris Green	4 lbs.
Salt	2 lbs.
Water	14 gals.

This mixture was first substituted for the Kansas Mixture when supplies of molasses and lemons ran out, and later was used at one of the stations even when fruit and molasses were obtainable. At this station, they claimed that it gave as good results as the Kansas Mixture. However, the consensus of opinion was that the Kansas Mixture gave somewhat more reliable results over the whole area.

Later in the season, a modified Kansas Mixture was used with most excellent results. In this mixture, instead of using 100 lbs. of bran as a base for the other ingredients, 50 lbs of bran and an equal bulk of sawdust were used as the base. The addition of the sawdust improved the physical properties of the mixture. It broke up more readily when being scattered on the land, and of course, had the other advantage of making a much cheaper mixture. The other ingredients used in this bait were the same as those used in the Kansas Mixture.

The Criddle Mixture was used with good results by some of the farmers; but owing to the relative scarcity of horse droppings, and also due to the fact that the other mixture was free, this remedy was not used on a large scale. The mixture consists of the following ingredients.

Fresh horse droppings	15 gals.
White Arsenic or Paris Green	1 lb.
Salt	1 lb.
Water sufficient to moisten.	

Sawdust to replace one-half of the horse droppings was found to improve the physical condition of the mixture.

White Arsenic is superior to Paris Green as a poison in the mixtures. Paris Green is a very fine powder and rises readily as a dust in the air. This is breathed by the workers, and sometimes produces bad cases of poisoning. The White Arsenic does not float around in the air nearly so readily; hence, is greatly to be preferred on that account. Some of the workers used masks so that they might not breathe the poisons. White Arsenic seemed to give as good results as Paris Green, and costs about a quarter as much per pound. Its one disadvantage is its color. Paris Green can be seen in the mixture more easily.

The mixtures were spread during the first part of the season in the early morning. Later, they were spread almost at any time except in the heat of the day. Bright, sunny, calm days were best. Very poor results were obtained when the mixture was scattered during cold, wet weather.

The campaign of poisoning continued from the last week in May until about July 23rd. The demand for bait fluctuated very much during that time, but reached it maximum during the week of June 14th to 19th. There were upon record 7,703 applications from farmers for a total of 1,659,100 lbs. of prepared bait during that time.

Practically every farmer in the grasshopper area reports satisfaction from the use of poisoned baits. Actual counts of dead 'hoppers showed almost incredible numbers in some places. On June 12th on a piece of sod road allowance, an area of one square foot showed 440 dead grasshoppers. An average of eight counts taken in widely separated places showed 1,035 dead 'hoppers per sq. yd. The largest count made was 34 dead to 4 square inches of surface. This figures out to over 53 million dead 'hoppers to the acre. There is absolutely no question about the effectiveness of poisoned baits.

The following table shows the estimated value of the various crops saved by the use of the poisoned baits:

Value of Crops Saved By Poisoned Baits, 1920.

Wheat	$10,293,920.00
Oats	3,900,067.00
Barley	1,065,370.00
Rye	574,576.00
Flax	250,755.00
Total	$16,084,688.00

This estimate only includes that part of the province lying west of range 15, and south of township 12. The value of the total crop saved outside of this area is roughly valued at one million dollars, making a total saving of over seventeen million dollars' worth of grain besides a great deal of native grass, etc.

The ingredients for the poisoned baits used in Manitoba in 1920 cost in the neighborhood of $155,000.00 while the estimated value of the crops saved is $17,084,688.00. This means that for every dollar spent in baits one hundred and ten dollars' worth of crop was saved. From the standpoint of this year's crop alone, it can be seen that the campaign was a success. What it will mean to subsequent crops, we can only venture an opinion.

SOME PHASES OF THE PRESENT LOCUST OUTBREAK IN MANITOBA.

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The present locust outbreak in Manitoba is the first that has occurred in those parts with a professional entomologist residing close at hand. It is, therefore. the first occasion we have had for studying the insects in all their conditions of life. Unfortunately the severity of the outbreak obliged us to devote most of our time to control measures rather than to life studies, but no one could cover the infested areas, as we have done, without observing the insects' habits. Nor could they fail to take note of the various factors which must eventually bring the pest under control. It is true that such observations were often casual at first and frequently quite fragmentary, but, by degrees, they have been marshalled into definite order so that the accumulation provides many of the facts we were in search of.

One of the most important features of the present locust outbreak has been the complications due to the presence of two genera which have, in some respects, very dissimilar habits. There have also been a number of species involved which differ somewhat in their general habits, though with the one exception these all belong to the genus *Melanoplus*.

The chief offenders during the present outbreak have been the Lesser Migratory Locust, *Melanoplus atlanis,* and the Road-side locust, *Camnula pellucida.* The habits of the first are too well known to make it necessary for me to go into details. I will merely state, therefore, that it prefers the stubble fields or old deserted farms for egg laying and that it deposits its eggs around vegetation rather than in the midst of it. The Road-side locust, on the other hand, avoids the stubble fields and similar areas, selecting instead land that is under grass, with a special preference for the unbroken lands along road-sides. Hence the name Road-side locust instead of the inappropriate one of Pellucid locust. Incidently I might point out that the wings of *Camnula* are not truly pellucid, but are yellowish, secondly all species of *Melanoplus* are clear-winged, consequently the name "pellucid" is not at all a happy one. In addition to its habit of selecting sod land for egg laying purposes the Road-side locust differs from the Lesser Migratory locust in that it deposits its eggs amid the clumps of grass instead of around or between them.

The marked difference in egg laying habits was detected at the commencement of the outbreak even before we were sure of the species involved. Later we found that the Road-side locust was even more particular in its selection of egg-laying sites than we supposed. Not only grass lands were required but a particular species of grass. True there are exceptions to this habit but, so far as we could learn, the only marked exceptions occurred when the favorite breeding grounds were absent while somewhat similar ones were present in their stead.

The areas chosen by the Road-side locust for egg laying are generally on uplands having a dryish aspect. Their chief attraction, however lies in the presence of Western Couch grass, *Agropyron smithii.* This grass has many of the habits of its eastern ally, but is distinguished by a very marked bluish tinge to the leaves. It is a common grass in the west and grows in large dense patches. It is amid this grass that the Road-side locusts congregate towards the middle of July, flying from the fields that they have previously infested. They soon attain very large numbers so that an area of a few square yards may contain thousands. Breeding is now the chief object in life, and egg-laying is continuous whenever the weather is suitable. The appearance of the breeding areas at this time is a remarkable one. Individuals of both sexes are constantly in motion while the least alarm sends them off into the air. Scattered over the practically bare ground, for they have eaten it clean, are numerous small heaps of the insects which close inspection shows to be made up of ovipositing females with eight or ten males clinging around each.

It is no wonder that these breeding grounds become literally packed with eggs, yet it seems remarkable that the lands so close around should be practically without them. I have observed places where it was impossible to stick the point of a knife into the ground without revealing a sac of eggs. In others I counted fully 3,000 eggs to a square foot of sod.

As noted above, these breeding places become very much denuded of vegetation, and they are, consequently, easily noted even at a distance. This fact has been of great value to us in scouting for eggs, as it has enabled us to drive quickly over the country and pick out the infested places from a motor car. We have also been able to make practical recommendations to the farmers for dealing with these egg areas.

Apart from the two main locusts mentioned before, we have had several others of less importance. In some districts the Two-striped locust occurred in large numbers and its egg masses of sixty or more eggs were not uncommon last fall. The Red-legged locust was also present in all parts and was especially noticeable late in the season due to the fact that it appears later in the spring and is consequently later in maturing. This last insect inhabits rather wetter ground than does *atlanis*.

The natural control of locusts involves many factors, some at least of which are imperfectly understood. That dryness favours the insects' increase, is generally acknowledged, just as wet seems to produce a contrary effect, but we have yet to learn when these factors come most into play. My own experiments go to show that cold in itself does not affect the eggs but that heat does. Thus eggs exposed to all the vicissitudes of winter on top of the ground came through without important mishap while similar ones exposed to the sun in April and May were nearly all destroyed. Eggs exposed in September in the same way also lost their vitality.

The most interesting part of the work, in my estimation, has been that of watching for the causes which must eventually reduce the pest to insignificance. They are undoubtedly at work around us now, but so many circumstances arise in connection with them that it is very difficult even at this time, to accurately forecast what agencies will ultimately bring the insects under control.

In 1919 we had reason to expect that flesh flies, among which *Sarcophaga kellyi* was prominent, would prove an important factor in the locusts control, but unfortunately the large increase of the previous year was not maintained in 1920.

The common fungus disease, *Empusa grilli,* did much in restricted areas, and took locusts sparingly nearly everywhere in both 1919 and 1920. It is one of those diseases that appears with great suddenness over large sections of the country but is checked with equal rapidity.

Locust mites (*Trombidium sp.*) have increased enormously and during the present year fully seventy per cent. of the species of *Melanoplus* were heavily infested. Their presence on the locusts, however, appeared to produce little effect and when they dropped off in the course of a few weeks, the locusts went about their work apparently none the worse for the experience.

It is interesting to note here, that the Road-side locust escaped these mites almost entirely even when the two genera intermingled.

While mites appear to play but a minor part in reducing the adult locusts it is possible that they are of more importance as destroyers of locust eggs. I found them not uncommonly in egg sacs of *Melanoplus* where they appeared to be doing excellent work, but here again *Camnula* escaped their attack.

Two locust enemies came prominently into play during 1920, both egg destroyers. They were species of blister beetle and the Locust bee-fly (*Systœchus vulgaris*). There is no doubt that these insects have been of marked benefit, and at present they are by far the most promising of all the locust enemies. The locust bee-fly has been especially notable for its destruction of locust eggs, in some restricted areas ninety per cent. of the eggs being destroyed by its larvæ, while there are very few districts that do not show its presence in numbers. In the earlier locust infested parts of the province, the Bee-flies occurred in enormous numbers and during July they might be seen resting on nearly every blossom.

We found blister beetles nearly everywhere though the abundance of the various species is naturally governed by the presence or absence of their food plants. The two most important species during 1920 were *Macrobasis unicolor* var. *murina* and *Cantharis sphœricollis.* The first is somewhat of a pest to all members of the pea family as well as to potatoes, and is often known as the Black Potato beetle. The Cantharis, on the other hand, has for its native food plant the prairie snowberry, *Symphorocarpus occidentalis,* but from this it has spread to species of cultivated honeysuckle which it sometimes defoliates.

Apart from these more important species there are two others of lesser value, namely *Epicauta sericans* and *Cantharis nuttalli.* The first of these feeds chiefly upon species of *Anemone,* but has been found eating lambsquarters also. The latter is usually found upon members of the pea family, and is locally known as the Caragana beetle owing to its habit of feeding upon that shrub.

There seems to be little doubt that the larvæ of each of these species destroy locust eggs as the increase of the beetles coincide with a similar increase of locusts. We have also reared some kinds from the egg, while others have been found among them.

In comparing the destruction wrought by the principal enemies of locusts' eggs, I was interested to find that the larvæ of bee-flies were much more numerous in the egg-sacs of *Camnula* than in those of *Melanoplus,* while blister beetle larvæ, on the other hand, showed a marked preference for the eggs of the latter genus.

One other ally was reared from locust eggs during the year. It is, I think, that small hymenopterous insect described by Riley as *Scelio luggeri.* As a rule every egg in a sac will be infested, each producing a single adult. It is interesting to know that this insect takes a full year to reach maturity and that it emerges at the time when the locusts are busily laying eggs. The parasite, therefore, finds abundance of food available for the perpetuation of the species. I am unable to state, at present, what part this little insect played in the locust egg destruction of 1920.

On reviewing the results to date, I think we have every reason for being satisfied with the progress attained. The artificial methods of control were all that we could possibly expect. I do not think the country has ever been threatened with such serious losses by insects and yet escaped so lightly, and this, of course applies equally to Saskatchewan and Alberta. We have also reason for believing that the locust outbreak in Manitoba has reached its greatest magnitude and that next year will begin to show a reduction in the hordes of 'hoppers which have given us so much trouble to date. Such reductions, when they do come, usually terminate the outbreaks quickly. But while the prospects are encouraging for the near future, we must not forget the present. We have almost surely to face a continuation of the pest next spring and it behooves us to be prepared for the worst, even though we may expect relief in the course of a year or so.

THE INFLUENCE OF LOCUSTS ON THE RANGES OF BRITISH COLUMBIA.

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During the past few years there have been a number of reports of locust injury in British Columbia. The most important outbreaks have been in the range areas throughout the Dry Belt of the Province from the United States Boundary to the Chilcotin district as far north as Latitude 52.

As the damage done by locusts has been in some cases of considerable importance, and in view of the fact that the Provincial Government has been asked, by settlers, for aid in controlling the locusts which have been destroying their crops, it was thought advisable to make a study of the species of locusts to be found on the range areas of British Columbia and to devise, if possible, remedial measures.

Reports had been received that the Riske Creek range and adjoining ranges in the Chilcotin district were being seriously damaged by locusts. Consequently this area, being a typical range area, was selected for special study, although contact was maintained with the conditions presented on other range areas.

The work undertaken in the Chilcotin district was a study of the life-histories and habits of the Orthoptera of the region. Special attention was paid to the species damaging the grass on the cattle ranges. Some experiments have also been conducted with poisoned bran bait on the open range to ascertain its value.

In studying the distribution, life histories and habits of a group of insects, such as the Orthoptera, it is of great importance to make a collection of all the species present, in as many localities as possible, with notes on their relative abundance and typical habitats. It is desirable also at the same time to make a study of the Ecological factors, Meteorological conditions, and the Floral and Faunal characteristics of the locality, and the types of soils. If the line of study indicated above is carried out it may be found that certain species of Orthoptera are definitely associated with certain distinct types of soils, vegetation or Faunal zones. If our information be exact enough we may be able to decide with little difficulty what species may be expected to occur in any given locality, and whether any of the species present are liable to cause serious or marked injury. Furthermore from poison bait experiments we would be able to tell whether an outbreak is one which can or cannot be successfully controlled.

The Riske Creek range is a triangular piece of country lying in the angle made by the junction of the Chilcotin and Fraser rivers. This area contains about 300 square miles of which by far the greater part is open grass land used as a cattle range. It lies 150 miles north-west of Ashcroft on the 52nd Parallel.

The Riske Creek range is part of an undulating plateau ranging in elevation from 3,000 ft. to 3,500 ft. and the rivers bounding this area on two sides lie in deep terraced U-shaped valleys from 1,500 to 2,000 ft. below the level of the main plateau. According to the Canadian Commission of Conservation Report on the Forests of British Columbia by H. N. Whitford and R. D. Craig, the

Chilcotin district at Big Creek has a mean annual temperature of 37°, a winter mean of 17°, and a summer mean of 57° Fahr. The annual rainfall is about 15 inches. This area is volcanic in origin, but many glacial deposits occur; some portions of the range showing long lines of ice-worn boulders undoubtedly the remains of glacial moraines.

The Riske Creek range and the country adjoining it lies in the Interior Douglas Fir type of forest. The Sage- brush (*Artemesia tridentata*) reaches up the lower part of the Fraser valley to the mouth of the Chilcotin river, and the Western Yellow Pine (*Pinus ponderosa*) also disappears at about this point. On the higher portions of the Chilcotin plateau above 3,500 ft. line, the Douglas Fir type merges into the Englemann Spruce type of forest. At the present time a large portion of the original Douglas Fir stand has been replaced by the Lodgepole Pine (*Pinus contoria*), the Douglas Fir (*Pseudotsuga mucronata*) having been destroyed by fires.

The open range was originally and approximately 15 years ago covered with a fine stand of Bunch-grass (*Agropyron spp.*), often from two or three feet in height and the settlers were in the habit of mowing and stacking it for hay. To-day this grass has been practically destroyed, largely by overgrazing. Three species of *Agropyron* are believed to occur.

Several plants which are typical of the Dry Belt are found, among which may be mentioned the Rabbit-brush (*Chrysothamnus sp.*) and the Prickly Pear or Cactus (*Opuntia polyacantha*).

The main plateau of the Riske Creek range lying south of a line drawn from Hanceville on the Chilcotin river to Meldrum Creek on the Fraser, is almost entirely open grass land on which innumerable clumps and patches of timber grow

The timber is either Aspen (*Populus tremuloid s*) or Douglas Fir and Lodgepole Pine. In many cases the centre of the clump is composed of Fir and Pine while a narrow belt of Aspen fringes the outside. These patches of timber may be less than an acre in extent or may cover an area of from 200 to 300 acres. In moist locations, such as the margins of lakes and in creek bottoms, the Western Birch (*Betula occidentalis*) is often associated with the Aspen and several species of Willow (*Salix*) are commonly found. The Mountain Birch (*Betula fontinalis*) grows commonly in the bogs. On many of the warm slopes the Rocky Mountain Juniper (*Juniperus scopulorum*) is common.

The range is well watered by several creeks and innumerable lakes and "pot-holes." Many of these are permanent, while others gradually dry up during the summer and are filled again by the melting snow in the spring.

The area just described with the vast timbered country to the north forms the summer range for the cattle.

There is also a very large area of land on the steep slopes of the river valleys.

The upper range often ends very abruptly and the land descends precipitously in a series of terraces to the rivers, which are from 1,500 ft. to 2,000 ft. below. These steep river valley slopes are of two distinct types. Slopes facing towards the north and east are heavily timbered and of little value to the cattle industry. Those slopes facing towards the south and west are free from timber and covered with Bunch-grass.

Those Bunch-grass slopes form the winter ranges, which having been fenced many years ago, and all cattle and horses kept off them except during the winter, still produce a fair stand of Bunch-grass. On any unfenced portions of these slopes on which the cattle have been allowed to range all summer and spring, the Bunch-grass has been practically exterminated by overgrazing just in the same way as it has on the main ranges.

As the cattle and horses increased the Bunch-grass died out, being replaced by a number of other grasses, until to-day the Bunch-grass has been almost entirely destroyed. It can only be found growing in enclosed pastures, such as the winter ranges just mentioned on the river valley slopes, and around homesteaders' shacks where a small area is sometimes fenced to keep out the cattle, or in clumps of rose bushes, cacti, etc., where the cattle cannot eat it down to the ground.

On an adjoining range, known as Alkali Lake range, there are some large areas which have been fenced for a number of years and some interesting observations can be made in these pastures. The winter range, sloping down to the Fraser river has been most carefully guarded and has a fine stand of Bunch-grass growing on it. Many of the plants were more than three feet in height and very large in circumference.

Other fenced areas on the upper range had a fair percentage of Bunch-grass among the other grasses. In these fenced pastures the cattle had been allowed to run only for a few months each year, but even this small amount of grazing has caused about 60 per cent. of the Bunch-grass to disappear.
pastures mentioned above, the Bunch-grass has been almost exterminated and the range presented the same appearance as at Riske Creek. A piece of this bare, depleted range, was fenced in about 1914 and no cattle have been allowed on it since. To-day we find a good stand of grass on this piece of land, but very little Bunch-grass.

From these observations it would appear that Bunch-grass is very easily killed out by cattle, and once gone will not return again unless the roots are still present and alive. The other grasses, however, which replace the Bunch-grass, if kept free from cattle for five or six years, will form a good pasture again. It is worth emphasizing at this point, in drawing attention to the influence of locusts on the range, that the only difference between these good pastures and the bare range outside is the presence of a barbed-wire fence, a complete barrier to the cattle but no hindrance to the grasshoppers should they wish to leave this range and enter the taller grasses of the pastures. As a matter of fact, as will be shown later, the grasshoppers do not prefer the longer grass of these pastures but will remain outside so long as a vestige of green vegetation remains. If they enter they only feed on the edges, the tall grass being an unnatural habitat of these insects, particularly of the main injurious species.

At the time when the Riske Creek range was covered with Bunch-grass, and in fact, up until the last few years when the increase in cattle and horses has kept the range continually eaten down, the grasshoppers were never in sufficient numbers to be noticed by the settlers. Several of the older ranchers claim that grasshoppers were not present on the ranges in the early days, but have come suddenly during the last few years. There is little doubt that this statement in its substance is incorrect. It is probable that all the injurious species, now found, were present in the years gone by, but in far smaller numbers and have only increased but slightly from time to time.

There is little doubt that the main injurious species of grasshoppers found on the British Columbia ranges are insects whose natural habitat is a dry, bare.

closely-grazed range, their food consisting of the small tender grass shoots which continue to come up although the grass is persistently eaten down by stock. This young grass comes up throughout the spring and summer and early fall, except during the hottest weather in July and August, in the same manner that lawn grass continues to grow on a lawn which is kept mown. As soon as the intense heat comes about July 1st, the young shoots of grass cease to appear and in a few days all the young green blades are eaten up by the grasshoppers and the range changes suddenly from a green colour to a dead brown and not a particle of green feed is left. The cattle which have been on this open range since they were turned out of the feed-yards and winter ranges in the spring, disappear into the timber for the first time and search out the wild hay in the small natural meadows in the timber.

The majority of the grasshoppers whose natural habitat is the open range, spread into the timber, or into any growing crop or fenced pasture where there is standing grass or vegetation of any kind. The reason for this is that, after they have cut off all standing grass on the open ranges and the grass particles being left lying loose upon the ground, they were unable to feed upon it as it slips away from them when they try to bite it. The range often presents an appearance as though a miniature mowing machine had been over it when examined two or three days after a hot spell has set in and checked further growth. Until this time of drought the tall tough flowering stalks are seldom touched by the grasshoppers, but the tiny tender new shoots coming up around the base of the plant form the chief food. They are attacked from the tip when less than 1½ inches high and are eaten down to the ground, there being no waste. Any grass blades from two to six inches in height which have escaped the grasshoppers and the coarse flowering stalks, are only attacked when drought causes the supply of tender shoots to fail. This grass is gnawed off about one inch from the ground and forms the material seen on the ground a few days after drought sets in, as described above.

Where cattle are allowed, as on the Riske Creek range, to remain out on the open grass land from the time the snow goes in the spring until it becomes deep again in the fall, the grass has very little chance to seed as the flowering heads are eagerly sought after by cattle, particularly by horses and sheep. It is believed that the part played by grasshoppers in causing the disappearance of the Bunch-grass from range so grazed may be considered slight indeed. That they help very materially to keep it in a depleted condition cannot be doubted.

The feeding of the cattle and horses, by killing out the Bunch-grass and causing the range to be thinly clothed by low growing grasses, opened the range to the full glare of the sun and creates an ideal habitat for the species which are the most injurious in British Columbia. With the disappearance of the Bunch-grass, these injurious species, probably rare hitherto, doubtless increased rapidly in numbers while the species adapted to the Bunch-grass type of land are to-day practically extinct on the upper ranges, and are only met with among the Bunch-grass of the winter ranges. The species whose natural habitat is among the Bunch-grass, have seldom been known to increase sufficiently to cause injury, so that the Bunch-grass does not suffer much damage from its natural inhabitants, the damage being done during periods of drought, by the migration of the injurious species, which are present in great numbers on the depleted range immediately outside the winter range fences.

A good example of this point was seen this summer. A section of winter range situated on the banks of the Fraser river was observed. For five miles outside this winter range fence the range was swarming with the injurious species of locusts and no Bunch-grass was visible. In many places the grasshoppers were present at the rate of from fifteen to thirty to the square yard. Immediately inside the barbed-wire fence was a fine stand of Bunch-grass, in places higher than one's waist and showing no signs of grasshopper injury. Ten yards inside the fence there were about five grasshoppers to the square yard; at twenty only an occasional specimen of the injurious species could be found, but a few of the species typical to Bunch-grass land were seen. At the time that these first observations were made the injurious species were confining their attention to the young green grass shoots which were plentiful on the open range. The barbed-wire fence seemed literally to be a barrier, the choice of food keeping them outside.

A few weeks later, on July 30th, after the drought had set in, this area was again visited. In riding across the main range it was noticed that there were now no green shoots coming up and the grasshoppers had cut down all the standing grass, which was lying about on the ground as before described. As the winter range was approached the grasshoppers became markedly scarcer, especially was this the case with *Camnula pellucida,* a habitually migratory species. On reaching the winter range a distinct change could be seen, particularly just inside the fence. On entering the winter range it was found to be swarming with the injurious species of grasshoppers which were working in from the open range outside. The Bunch-grass plants presented a broken, ragged appearance, and the ground beneath the plants was strewn with pieces of stalk and leaves which had been bitten off.

As one advanced further into the winter range the damage became gradually less and less apparent, until at about 300 yards from the fence hardly any of the injurious species could be found. The spell of dry weather was unusually severe this year and the grasshoppers being more numerous than hitherto recorded in this locality, the damage to winter ranges was of considerable importance. As well as spreading into the winter ranges the grasshoppers entered the timber and ate the timber grass and the Aspen leaves, and could be found in some places to have penetrated to a depth of two miles. Towards the end of August some very heavy rains occurred, and in the course of a week the range was a sheet of green again instead of a dead brown. Every grass plant had sent up a number of new tender shoots.

As soon as this occurred the majority of the grasshoppers deserted the dry Bunch-grass of the winter ranges and the timber, and went out on to the main ranges again. They were on the decrease by this time, and were quite incapable of keeping down the new grass. The cattle, it was also noticed, left the timber at this time and worked out on to the open ranges again, where they had an abundance of good green fall feed.

It may be understood from what has been said that overgrazing of a range bears a very important relation to the increase of the locusts. Overgrazing causes the disappearance of some species of grasshoppers, while it favours the increase of others. The species which benefit by the overgrazing are unfortunately the most destructive species found in British Columbia. Not only does the overgrazing of a large area favour the increase of some species but it may even change the habits of oviposition and feeding of some of those species.

To illustrate this point it may be mentioned that *Camnula pellucida,* one of the main injurious species, is stated to have the habit of remaining together in swarms and of migrating over the country during the summer, often entering long grass and grain fields which are quite unsuitable for oviposition. Under ordinary circumstances, as soon as the females are ready to lay their eggs they leave the main swarm and fly to special egg-laying grounds. These egg-laying grounds or egg-beds, it is claimed, are usually situated on flat, dry, alkaline pieces of ground covered with close cropped grass, or on low, raised, dry, gravelly knolls. It has been recorded that this species, although distributed over hundreds of square miles of ground while feeding, will resort to a comparatively few acres of ground for oviposition, where only a small amount of land is of the right nature for their egg-beds. These egg-beds are said to be covered by these grasshoppers during oviposition time, and can be detected from a distance by the smell of the dead bodies of the males, which die soon after pairing.

Camnula pellucida was common on the Riske Creek range and seemed to find the whole range so much to its liking that it did not keep at all rigidly to the so-called typical habits mentioned above. It did not migrate in dense swarms, but spread out from innumerable small egg-beds scattered all over the range. It was often, also, observed to be much more common in some places than in others, but was never observed exhibiting the typical migratory habits in swarms. Oviposition grounds were scattered all over the ranges and eggs were laid in comparatively small numbers in innumerable locations throughout the whole of the high ground on the main upper range.

The range areas in British Columbia, which from time to time become seriously damaged by grasshoppers, are so large and the population so small that at the present time it is not thought to be possible to conduct any control measures by means of poison bran bait. It would also appear in addition that some of our most injurious species will not eat the poison bran bait. The use of hopper-catchers is also considered impractical on account of the enormous areas involved on the British Columbia ranges. The only use that could be made of these machines would be on the small dry farms, where they could probably be used to advantage on the young grain.

Sufficient data have not been gathered at present to give any definite statement as to the effect of the natural control agencies, such as parasites and weather conditions, upon a locust outbreak under range conditions. Probably weather conditions at the time of emergence of the young nymphs from their eggs is the chief controlling agent. To what extent the parasitic and predaceous insects help in controlling the locusts needs further study. Birds undoubtedly destroy large numbers. The fungus disease, undoubtedly *Empusa grylli,* in the Chilcotin district only attacked *Camnula pellucida.* Other species equally common and closely associated with *Camnula pellucida* appeared to be immune to the disease. It is hoped that further information on these points will be available at a later date.

Our chief hope of improving our ranges, and thereby increasing the number of our cattle, would seem to be in an organized system of range rotation where sufficient fences are present to keep the cattle off portions of the range during the growing and seeding seasons of the grasses. It is also believed that the main injurious species of grasshoppers, whose most favourable habitat is a dry, depleted range, would probably decrease considerably in numbers if the range was again covered with a taller and thicker growth of grass. The erection of fences on some of our main ranges, and the close observation of a small, fenced, experimental plot, may help us to find out our best method of improving our cattle ranges throughout British Columbia, and this is the work planned for 1921.

In conclusion, I would like to express my appreciation to Mr. R. C. Treherne, who materially assisted me in the preparation of this paper, and who was largely responsible for the conduct of the experiments, and for his personal supervision of the general details of the locust studies.

THE INVASION OF SOUTHERN ALBERTA BY BEET WEBWORMS.

E. H. Strickland,
Entomologist in Charge of Lethbridge Laboratory.

In the fall of 1919, the second generation of Beet Webworm larvæ (*Loxostege sticticalis L.*) were extremely abundant in several districts in the southern part of Alberta, but since this generation did not appear until September they attracted little attention other than by somewhat impeding trains and by proving an annoying household pest. These larvæ migrate in immense armies, prior to spinning their subterranean cocoons, and refuse to turn aside for any obstruction. Hence they may enter houses in vast swarms, while if any irrigation ditch, or even a horse-trough lies in their line of march they will enter it and drown by the million.

The majority of these hatched from eggs laid on the abundant growth of weeds that sprang up after heavy rains in August, and though they cleared out miles of lambs-quarters and Russian thistle they fed very little on other vegetation.

In the early spring of 1920 immense numbers of cocoons were turned up on weedy stubble, and from a large number of these that were sent to the laboratory for determination, a few specimens of the parasite *Meterous loxostegii* were bred.

By June 6th adults were flying freely, and this flight reached its maximum intensity between the 9th and 20th, when a single light trap on the Entomological Laboratory at Lethbridge captured an average of 2,000 moths a night. Since this was much in excess of anything seen in previous years, and these moths were almost invariably considered as being "cutworm millers," illustrated press articles were sent out from the laboratory describing the habits of the species and the likelihood of there being large migrations of larvæ later in the season. Eggs were not located at Lethbridge on lambs-quarters, which possibly is the exclusive breeding plant in Alberta, till July 12th, but by the 19th a flood of reports were received by phone and letter from points throughout an area of some 3,600 square miles between Lethbridge and Calgary to the effect that migrating larvæ were appearing in enormous numbers and that hundreds of promising gardens were disappearing before their onslaughts. On the 19th of July the district agent of the C.P.R. reported that two trains had been stalled by them on the lines running south from Calgary, and that section foremen were anxious to know what steps should be taken. As a result the whole C.P.R. system in Alberta was circularised that afternoon. Press articles were prepared, and given widespread circulation, but control measures proved somewhat inadequate, inasmuch as the larvæ travelled mainly at night-time and gardens were so heavily infested when the ravages were first seen that spraying was of little avail. Paris green certainly killed them, but they were so numerous that they usually destroyed the crops before they succumbed. Furrows treated with poisoned bait proved to be effective in staying the approach of armies, but since the larvæ bred for the most part upon weeds in "stubbed in" grain fields, and the gardens were often adjoining such fields, little was seen of the moving swarms till they had actually entered the gardens and had almost destroyed them.

On the 23rd-25th of July a trip was made from the laboratory through the worst infested area. For mile after mile the roadsides were stripped bare of weeds, while from many grain fields which had been shockingly weedy there now projected above the wheat, only a forest of bare lambs-quarters' stems. The wheat being practically immune from attack now had the fields to itself. To what extent this most effective weeder improved our crops, which were unavoidably weedy owing to the exceptional seasonal conditions, it is difficult to estimate. One farmer, who was receiving much commiseration from his neighbours since his wreck of a garden had always been considered the best for miles around, was with difficulty lured from the Paris green and coal oil that had taken the entire attention of his family and himself since the larvæ appeared. He did not want to take us to his fields, for he said that he was ashamed of them; he knew they contained more weeds than wheat. When, however, we had made a thorough inspection of them and had found them entirely free from weeds, he asserted that after all the "worms" were the best thing that had ever come his way. The depredation to gardens, however, attracted far more attention than did the improvement of grain fields. At every point visited the same conditions were encountered. Onions were invariably wiped out of existence, and the "worms" often followed these plants down below the surface of the soil in order to feed on the bulb. Sunflowers which are now somewhat extensively grown, had their leaves veined overnight, cabbages, turnips, swedes, and rhubarb came next in preference, beans were less favoured than peas, while potatoes enjoyed immunity when other dainties were present, but fields of this crop which were free from weeds suffered as badly as any, for the larvæ had a tendency to bite through the stem, thus cutting off, though not eating the leaves. The most surprising observation regarding the food choice of these Beet Webworms was that they never fed on beets till they had exhausted other possibilities. Cottonwoods and other poplars to a height of three to four feet from the ground, had their leaves stripped of epidermis. This was a new record, for in former years these trees had proved immune.

In so far as field crops were concerned grain was almost untouched. Wheat, in some cases, had a little epidermis removed from a few blades after all weeds had been entirely destroyed, but the damage was insignificant. No feeding was observed on oats or barley, though we received an unconfirmed report that rye had suffered rather severely. In a few cases corn leaves were attacked and had the upper epidermis extensively eaten. Flax, though fed on freely, was left untouched until all lambs-quarters, pigweed, Russian thistle and buck brush had been consumed. Alfalfa, however, was eaten readily. Fortunately the first generations of webworms were not present in large numbers in the alfalfa-growing districts of Alberta.

On July 26th migrating swarms of larvæ appeared in the city of Calgary, and their numbers increased with such startling rapidity that the effect upon the citizens might almost be described as one of panic. Newspaper headlines referring to the "devastating bugs" appeared in type that is usually reserved for announcing war news or murders. Not only were gardens destroyed wholesale, but the larvæ were entering houses, much to the annoyance of their inmates. All available

Paris green was rapidly used up, some lead arsenate, and Black-leaf-40 were unearthed from forgotten stocks, but by July 30th a newspaper headline announced that there was "No Poison in City to Destroy Bad Bugs." As a result many methods, some of them rather unfortunate, were advocated and put into practice by the city authorities. Among these was the use of a flame thrower for the treatment of vacant lots, on which lambs-quarters grew to profusion.

Migrations of larvæ, however, precede by a few days only their entrance into the soil for pupation and the trouble subsided almost as quickly as it arose.

At the laboratory it was anticipated that the second generation would greatly outnumber the first. Such had been the case in former years. This belief was strengthened when the second flight of moths appeared. As was stated earlier, we captured some 2,000 moths a night in June, during the first flight. Early in August, however, our trap repeatedly overflowed, and since it had a capacity for only some 15,000 moths we do not know how many more visited that single electric bulb in a night, and escaped, by being unable to fall into the cyanide jar below. For this reason we considered it advisable once more to enlist the services of the press in order that we might warn the public of what they might anticipate.

The second generation, however, failed to materialize, owing to the following interesting conditions.

During July the whole infested territory was blessed with two days of heavy rain. This was followed by hot "forcing" weather. As a result there was an excessive growth of tender lambs-quarters, on which the moths laid their eggs in abundance, Subsequently there was an entire absence of rain until late in the fall. This dry period was accompanied by hot winds which soon dried up the egg-infested weeds. In many cases the eggs had not hatched, while very few of the larvæ were sufficiently mature to migrate when the food supply was thus cut off. Hence the majority of them died from starvation among the dead weeds on which they had bred. The shortage of food resulted in an acceleration of maturation in the case of a few individuals, with the result that, during the middle of September, our trap captured a few dwarfed adults, which had little more than half the wing expanse of the normal moth. This is our only record of a partial third generation in Alberta.

Some idea of the possibilities of the second generation, given favourable conditions, was gained in the irrigated district around Brooks. Here the weeds remained succulent, thus allowing the larvæ to develop and to migrate normally. In this district the first generation was insufficiently numerous to attract attention.

Towards the end of August several fields of first year alfalfa, standing about one foot in height, were attacked by migrating swarms. Almost overnight, they had every leaf veined, so that the whole field turned white. The growers feared that their crops had been killed outright. Alfalfa, however, stands more rough treatment than does any other crop grown in Alberta, and when the infested fields were inspected on September 10th they were found to be covered with new growth and apparently they suffered very little from the close pasturing to which they had been subjected.

Probably the Beet Webworm will attract little attention in 1921, even though cocoons containing hibernating larvæ are abundant in weedy stubble field. When it is present in comparatively small numbers it is always a beneficial insect. and despite the alarm and inconvenience that it caused this year we are convinced that its activities have been of financial benefit to Southern Alberta.

THE PRESENT STATUS OF THE HESSIAN FLY IN WESTERN ONTARIO.

H. F. Hudson, Dominion Entomological Laboratory, Strathroy.

The Hessian fly during the past season has inflicted a considerable loss on farmers in Western Ontario, particularly in the counties of Essex, Elgin, Kent, Middlesex and Lambton. While it is difficult to estimate the financial loss entailed, it may be stated that in some cases the crop has been entirely ruined, necessitating the planting of other grains, while very few fly-infested fields averaged more than ten bushels of grain per acre, and on the lighter soils the yield was reduced to five bushels per acre. This loss is due entirely to the "fly," for in localities where the fly was not present the yield of wheat ran from thirty-five to forty-five bushels per acre. For the past three years repeated warnings have been sent out, telling the farmers of the presence of the insect, and that once a crop was infested nothing could be done to prevent the injury, but in spite of all warnings the custom that prevailed was to sow as early as possible, with the result that conditions so favoured the increase of the pest, that more loss has been entailed this year than for a number of years past. Investigation work has not yet reached that stage where it is possible to give a "fly-free" date to all these localities, but in connection with our experimental work, the progress made toward this end is decidedly satisfactory.

In the fall of 1919 it was noticed that the insect was on the increase, and 1/10 of an acre wheat plots were planted at different dates to ascertain the fly-free date for that year. Careful daily observations were made on these plots until October 5th, when no more flies were observed on the wing. This work was again checked up in the early spring before the middle of April as an infested plant could be more easily determined in the spring. It was found that wheat planted September 18th, was only slightly infested, and a later sowing made September 25th was free. This seems rather remarkable, as the flies were on the wing in small numbers until October 5th. It may be that the female flies live for a short time after their ovaries are "spent," as no oviposition was observed in October. One thing is quite certain, and that is, that no wheat should be sown in August, as an examination in early spring showed that between 70% and 90% of August sown wheat was killed by the fly where no fertilizer was applied. Where fertilizer was applied the injury ran from 30%-50%. A gradual decrease in injury followed the later sowings and an extra sowing put in in October and treated with fertilizer was the most promising of all. The fertilizers used were:—lime only at the rate of 1,000 lbs. per acre, acid phosphate, 200 lbs. per acre, lime and acid phosphate mixed, and no treatment. Infested August sown wheat ran from two to ten flax-seeds to the plant. On May 5th, 1920, the first female fly was observed on the wing in the field. The weather from that date until May 16th was decidedly cool and wet, but emergence was very active May 17th. Under field conditions emergence was practically complete May 21st. No flies were observed on the wing in the field after May 25th. These plots were subsequently harvested, but the infestation was so heavy in all the plots, that the wheat was mowed with a scythe and thrown to chickens; it is doubtful if there was a bushel of grain on the whole experimental field. A similar experiment was duplicated this fall on the same ground. The soil was thoroughly worked, the stubble carefully buried, and the field manured with barn yard manure, reinforced with acid phosphate. The first sowing was made September 15th; second sowing, September 22nd; third sowing, September 29th; fourth sowing, October 5th; last sowing, October 9th. The infestation will be checked up in the spring as other work prevented this from being done this fall. We do know, however, that the first planting is fairly heavily infested.

It is gratifying to mention that the campaign launched the past summer to delay the sowing of wheat as late as possible has met with a fairly generous response. Talking to Mr. Noble, the agricultural representative of Essex Co., I am informed that little if any wheat was planted before the middle of October. In Middlesex Co. some wheat was sown early and all such wheat examined is infested. In Elgin Co. very little wheat was planted before October. Most of my information regarding the sowing of wheat has been obtained from the weekly report of the Ontario Department of Agriculture, Toronto, Ontario. The area sown to wheat this year is less than that last year, and generally speaking planting has been delayed from two to three weeks later than last year. The fine open fall has been perfect for the late planting of wheat, and this may mean a material check on fly increase. How long the flies were on the wing this fall is not known.

Notes on the Stages and Life History of the Insect.

The eggs which are small, long, slender, and of a shining reddish colour, are usually placed in the grooves on the upper surface of the wheat leaf. Sometimes they are placed at the base of the leaf and stem. Eggs hatch in from four to six or seven days, depending on temperature and the moisture content. The maggot on hatching is a bright red colour, and apparently makes its way down between the leaf sheath and stalk through the agency of moisture. In the outside insectary where the moisture content can be controlled, the young maggots died on the surface of the leaf where moisture or dew was withheld, while under normal conditions outside, the larvæ were able to get between the leaf and stem and develop. A maggot may be scratched with a dissecting needle, but no movement is observable, but in the presence of water, it squirms vigorously. For the first few days the young maggot is almost translucent, as feeding progresses the colour changes to a greenish white. The larval stage lasts in the spring about three weeks. Flies were abundant May 17th, and the first flaxseed was discovered June 7th. In the fall conditions vary, some larvæ may winter over in small numbers as maggots, but the majority as flax-seeds. In the fall practically all the maggots and flax-seeds are located at the base of the plants and around the roots, but in the spring the larvæ usually change to the "flax-seed" stage at the first or second joint above ground. At the time wheat is starting to head ninety-five per cent. of the maggots will have changed to the flax-seed state. The injury is too well known to need description. The killing of the tissue of the stem interferes with the passage of food material, and the plant is consequently starved, and the degree of infestation governs whether the plant will be killed outright, or produce a dwarfed head of shrivelled grain.

Means of Control. From the few parasites that were obtained this year, it would indicate that other means of control are necessary. The destruction of all volunteer wheat, the careful ploughing under of all infested stubble as soon after the harvest as possible, rolling the ground as firm as possible, thorough preparation of the seed-bed, generous application of fertilizers, the avoidance of planting wheat after wheat, and delaying the planting of wheat as late as possible to insure sufficient growth before winter, will materially check the ravages of this pest. As there are two broods, one in the spring, and another in the fall, to insure effective control farmers should realize that indiscriminate dates of planting will not keep this pest in check, and a community should agree among themselves to plant during a certain stipulated week, because an infested field in the fall is a menace to late planted fields in the spring.

INSECTS OF THE SEASON 1920.

H. F. Hudson,

Dominion Entomological Laboratory, Strathroy

The season of 1920 has been remarkable for the exceptionally heavy yields of all crops, truck, orchard, and farm alike. The season has been somewhat cool, but there has been ample moisture for all crops. In spite of the fact that it has been frequently stated that the average yield of farm crops has been heavier than the average for the last twenty-five years, insect pests have in some cases materially reduced the yield. This is particularly noticeable in the wheat yield due to the ravages of the HESSIAN FLY (*Mayetiola destructor*). Fields in Essex Co. were in some cases completely destroyed, necessitating the planting of other crops; in Kent Co. the injury was not so noticeable although frequently the yield has only been from nine to ten bushels per acre; in Middlesex Co. in the vicinity of Ekfrid Twp. cattle were turned in to pasture the wheat crop, while the average yield in Caradoc Twp. in infested fields varied from five to ten bushels per acre. In Elgin and Lambton Counties similar conditions prevailed. The appearance of the European CORN BORER (*Pyrausta nubilalis*) in Western Ontario has added another important insect to our already long list of field crop insects. While considerable data have been gathered on the ravages of this pest, the extent of injury and possible means of prevention, a sufficient study has not been made to recommend suitable control measures. It would appear that cutting the corn low, just at or a little below the surface, feeding the stalks up early, or better ensiling them, combined with the destruction of such plants as ragweed (*Artemesia trifida*), barn yard grass (*Panicum crusgalli*), and other thick-stemmed plants and weeds would materially reduce the ravages of this pest.

THE WHEAT WIREWORM (*Agriotes mancus*) has been responsible for con-considerable injury to the oat crop in the vicinity of St. Mary's, Ontario. Information as to the prevalence of this pest was not received in time for us to make an investigation as to the extent of the outbreak, but from reports received from my colleague Mr. J. A. Flock, who was requested to look over the situation, there can be little doubt that the crop yield was considerably reduced. The potato beetle is still with us, and with an extremely heavy first brood indications pointed to serious injury. However the weather kept cool, and with plenty of rain, a larger yield of tubers was gathered this year than for several years past. Strange as it may seem, in our experimental breeding work on this insect, we were unable to obtain a second brood. The beetles fed for a few days and hibernated. A number of late planted fields were not even sprayed, a rather unusual occurrence.

CUCUMBER BEETLES (*Diabrotica vittata*) were more than usually abundant. They seemed to be fairly easily controlled by dusting when the vines have started to run. I dusted one and one-half acres this year for the beetle, using a mixture of hydrated lime twenty pounds, Paris green one pound. The plants were thoroughly coated and one application seemed to be sufficient.

CABBAGE ROOT MAGGOT. I do not know when I can recall a season when so much damage was done to cabbage, cauliflower, radish and turnip, by the various root maggots. Practically all local early crops of the above vegetables were ruined. Although corrosive sublimate was recommended, I do not know of anyone who tried it.

CUTWORMS were not frequently mentioned as injurious this year, except in old sod. The poisoned bran mixture for the surface-feeding species is so well known that reports of injury are less numerous than formerly.

SEED CORN MAGGOT. This is the first time that I have seen any injury by this pest in Western Ontario. The injury was slight, generally speaking, although it was necessary to replant several corn fields in Harwich Twp., Kent Co. Part of this injury was also due to an unidentified species of elaterid.

CABBAGE WORM. Unusually destructive this year, but easily controlled by using pyrethrum powder.

PARSNIP WEBWORM (*Depressaria heracliana*). A pest of considerable economic importance when seed is required. Very abundant this year.

WARBLE FLY (*Hypoderma bovis*). Undoubtedly this noxious cattle pest is increasing in numbers, and is causing cattle graziers some alarm. Some thirty-eight warbles were extracted from the backs of cattle this summer, but we were unable to secure the adult fly. In contradistinction to general belief that the warbles emerge in early summer, they were still present in small numbers in the cattle in early August.

INSECTS OF THE SEASON IN ONTARIO.

I. Caesar, O. A. C., Guelph, and W. A. Ross, Dominion Entomological Laboratory, Vineland Station, Ont.

Orchard Insects.

THE CODLING MOTH (*Cydia pomonella*). This insect was not nearly so abundant as last year. Low temperatures in June and July caused the adults to appear late, and this, together with the general lower summer temperature, resulted in there being practically only one brood even in the warmer parts of the province. The large percentage of dead young larvæ found in apples in early July would indicate that disease also may have played a considerable part in lessening the amount of injury. In most sections the percentage of "side-worm" injury in sprayed orchards was small.

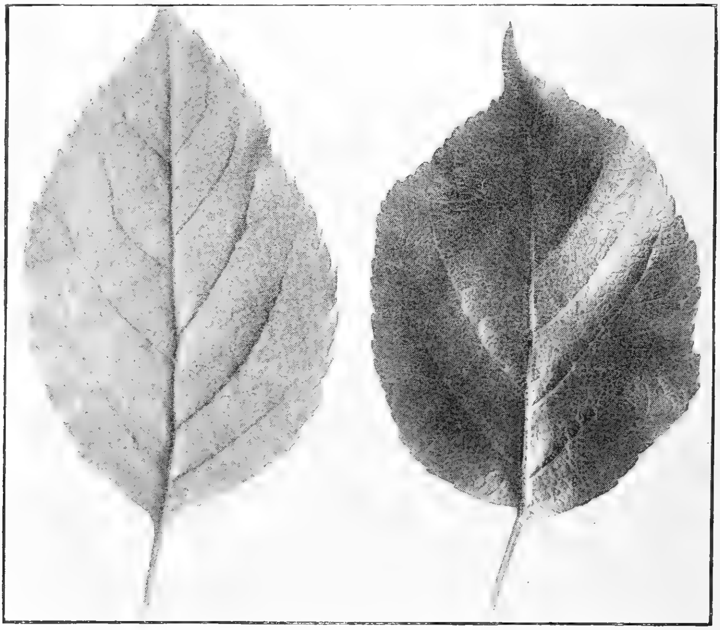
THE SAN JOSÉ SCALE (*Aspidiotus perniciosus*). This well-known pest continues to increase in unsprayed and poorly sprayed orchards. It is worth while noting that in some localities it is being parasitized to an appreciable extent by chalcids.

THE OYSTER-SHELL SCALE (*Lepidosaphes ulmi*). There has been a marked increase of this scale insect in many orchards during the past two or three years.

THE FRUIT TREE LEAF-ROLLER (*Tortrix argyrospila*). This insect is coming into prominence in the vicinity of Newcastle, where from ten to twenty per cent. of the apples in several orchards were injured by it this year. On the other hand, in the Simcoe district, where it used to be so troublesome, it has almost disappeared.

THE GREEN APPLE BUG (*Lygus communis*). This species has been found in the Newcastle district in two orchards attacking apples and pears, and doing considerable damage, especially to pears.

The Fall Canker Worm (*Alsophila pometaria*). The fall canker worm is rapidly increasing in Halton and Wentworth counties. One orchard at Flamborough Centre was almost completely defoliated by it this year. The probability is that many orchards will suffer considerably next year from its depredations.



Apple leaves. On left showing whitening of leaf by sucking nymphs of Rose Leaf-hopper; on right normal leaf.
Life size.

The Rose Leaf Hopper (*Empoa rosae*). This species, which was so prevalent last year, was even more abundant this past season on apple trees throughout the province. In many infested orchards practically all the foliage became mottled and pallid, as a result of the feeding activities of the hopper and much of the fruit, especially in the lower parts of the trees, became specked and dirty with hopper excreta. Fortunately most of this excreta was washed off by rains before picking time.

The Rosy Apple Aphis (*Aphis malifoliae*). This plant louse was very injurious in different parts of the province, and in many orchards a large percentage of the fruit, in the lower and inner parts of the trees, was dwarfed and deformed by its depredations.

Apple Maggot (*Rhagoletis pomonella*). By way of record it should be mentioned that the apple maggot was found this year in Elgin and Huron—two counties from which it had not been reported heretofore.

(Hoplia trifasciata?). Stout scarabæid beetles of the genus *Hoplia*, probably *H. trifasciata*, occurred in destructive numbers both in 1919 and 1920 in an orchard near Nottawa, Simcoe county. They attacked the blossoms of young Duchess apple trees, and destroyed them almost as quickly as they opened. Wealthy blossoms were also attacked, but to a lesser extent. It seems probable that the beetle came from the woods near by. This is the first time either writer has seen injury from this insect in Ontario.

Pistol Case-bearer (*Coleophora malivorella*). This insect is usually unimportant in Ontario, especially in the colder parts, being much less abundant than the Cigar Case-Bearer. This year, however, it was very prevalent on apple foliage at Newcastle.

The Oak Leaf-bug (*Lygus quercalbae*). This mirid, which normally breeds and feeds on oak, attacked the fruit of peaches in late June at St. Davids, and rendered a large percentage unfit for sale. Only orchards close to oak trees were affected.

The Mullein Plant Bug (*Campylomma verbasci*). This small plant bug was again found attacking apples in two large orchards at Simcoe. It was present however, in comparatively small numbers, and caused no serious injury.

The Pear Psylla (*Psylla pyricola*). The cool summer and the comparative scarcity of insect enemies were apparently very favorable for the development of this insect and it became unusually abundant in the Niagara, Burlington, Bowmanville and Newcastle districts. At Burlington practically all the Bartlett pears were stained by the honey-dew fungus to such an extent that they had to be washed before the buyers would accept them. The psylla was very scarce at Guelph.

The Pear and Cherry Slug (*Eriocampoides limacina*). We are glad to report that this insect, which was so destructive in 1918-19, was comparatively scarce this year. In a few neglected cherry orchards some trees were partially defoliated, but in most fruit sections the slug caused no appreciable damage.

Green Fruit Worms (*Graptolitha sp.*). A species of *Graptolitha* was quite abundant on peaches in the Vineland district. However, on account of the abundance of fruit the loss caused by this insect was not felt after the injured peaches had been thinned out.

Peach Tree Borer (*Sanninoidea exitiosa*). According to complaints received from growers, and reports from the Provincial Inspector and his staff, this borer was responsible for more injury than usual in the Niagara district.

Fruit-tree Bark-beetle (*Eccoptogaster rugulosus*). Several complaints of bark-beetle injury to peach trees were received from the Niagara district and Kent county.

Rose Chafer (*Macrodactylus subspinosus*). Local outbreaks of this pest occurred at Simcoe, St. Catharines and Fenwick. Grapes, peaches, apples and other plants were attacked and in some cases seriously injured.

Black Cherry Aphis (*Mysus cerasi*). This plant louse was very abundant on, and injurious to sweet cherry trees in the Niagara fruit belt.

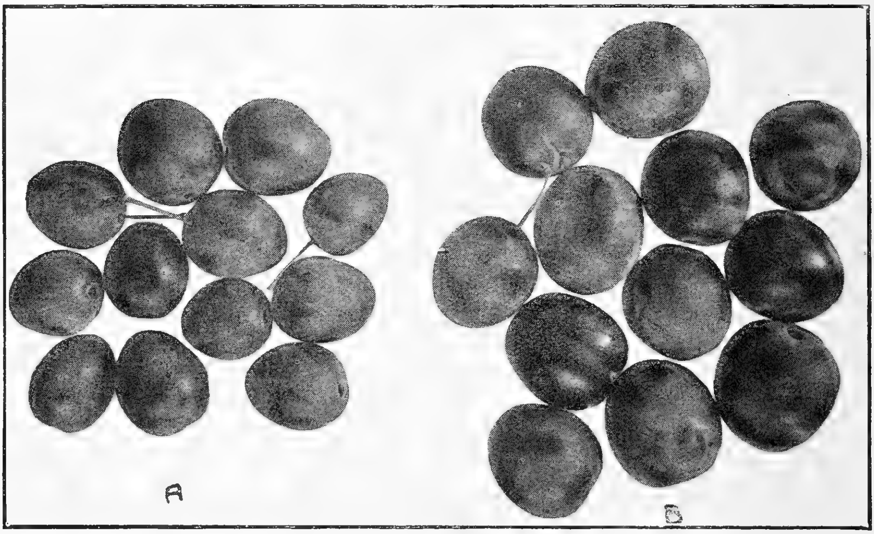
Plum Spider-mite (*Tetranychus pilosus*). In the Niagara district plum trees, unsprayed or sprayed with Bordeaux mixture, were heavily infested by this species. On badly attacked trees the mite not only made the foliage pallid and sickly in appearance. and checked the growth of the trees, but it also dwarfed the fruit and retarded its ripening.

By weighing and measuring lots of plums from infested and uninfested trees we secured the following data:

Loss of weight due to mite infestation—Gueii 41.5%, Pond Seedling 20.6%, Lombard 27.3%, Reine Claude 28.7%.

Loss in size—Gueii 40.3%, Pond Seedling 24.3%, Lombard 19.1%, Reine Claude 24.8%.

Our experiments this year proved again that this pest can readily be controlled by spraying with Lime Sulphur.



(A) Dwarfed plums from trees infested with plum spider mites.
(B) Normal fruit from uninfested trees.
Life size.

The Mealy Plum Louse (*Hyalopterus arundinis*). In early summer many plum trees in the Niagara district became heavily infested with this species and in several orchards spraying had to be resorted to.

Grape and Small Fruit Insects.

Blackberry Leaf-miner (*Metallus bethunei*). This miner was again injurious to blackberries in the Collingwood, Oakville, Burlington and Niagara districts. In a number of fields almost every leaf was badly mined.

The great abundance of an Ichneumon parasite this fall will probably result in lessened injury next year. Egg parasites were also present.

The life history of the miner has been worked out and a promising method of control discovered. Further experiments, however, are necessary to discover whether there are any unforeseen difficulties in applying the remedy.

Strawberry Weevil (*Anthonomus signatus*). This weevil was again injurious in some strawberry patches in the Niagara district.

The Red-headed Flea-beetle (*Systena frontalis*). This large, black flea-beetle was found attacking the foliage of black currants, raspberries, apples and several kinds of weeds at Mountain in September.

The Strawberry Root-worm (*Typophorus canellus*). Here and there in strawberry patches in the Niagara and Burlington districts, leaves riddled by this flea-beetle were very conspicuous. The flea-beetle was most abundant in old patches, but even in them caused no serious damage.

Currant Stem-girdler (*Janus integer*). The work of this saw-fly was conspicuous in a number of currant patches in the Niagara district.

Raspberry Saw-fly (*Monophadnus rubi*). The spiny, green larvæ of this saw-fly were present in greater or less numbers in practically all raspberry patches throughout the Niagara district.

Grape Leaf-hopper (*Typhlocyba comes*). This hopper was present in injurious numbers in several Niagara vineyards.

THE ROSE SCALE (*Aulacaspis rosae*). This scale insect was unusually common on raspberries in some parts of the Niagara district.

THE TREE CRICKET (*Oecanthus nigricornis*). Quite a few complaints were received last spring regarding injury to raspberry canes by this species.

Vegetable Insects.

CUTWORMS. According to reports received from different parts of the province, cutworms were unusually destructive in May and June to tomatoes, corn and cabbage.

THE IMPORTED CABBAGE WORM (*Pieris rapae*). This well-known pest was not nearly so abundant as last year, although as usual it was present in fairly large numbers toward the end of the season.

THE CABBAGE MAGGOT (*Phorbia brassicae*). This destructive insect was very common and very injurious in many localities to early cabbage, cauliflower, early turnips and radishes. In New Ontario it seems to be even a greater pest than in old Ontario, and sometimes does serious damage there to field turnips.

We are pleased to report that the corrosive sublimate remedy is coming into quite general use. In all cases where the treatment was made according to the usual directions, excellent results were secured this year.

THE ONION MAGGOT (*Hylemyia antiqua*). Here and there throughout the province this maggot caused considerable loss.

THE ONION THRIP (*Thrips tabaci*). Weather conditions were unfavorable for the development of this insect, and as a result no injury was done by it to the onion crop.

THE COLORADO POTATO BEETLE (*Leptinotarsa decemlineata*). Was remarkably scarce in the Niagara and some other districts.

POTATO APHIDS. In July some potato patches in the vicinity of Grimsby became very heavily infested with the spinach aphis—*Myzus persicae.* This pest was readily brought under control by spraying with Black-leaf-40 in combination with Bordeaux mixture.

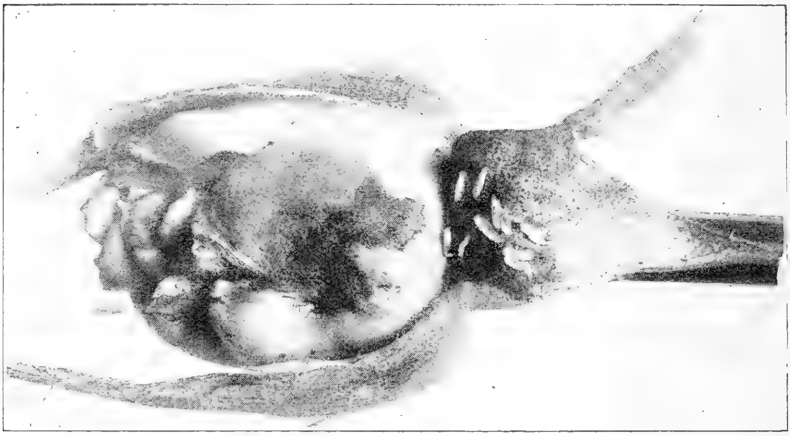
THE DESTRUCTIVE PEA APHIS (*Macrosiphum pisi*). This plant louse was again very injurious to canning factory peas. In Norfolk county it was estimated that it cut down the yield of peas to about one-third of a crop. For the first time in the experience of the Dominion Canners at Simcoe, early peas were severely attacked by the aphis.

BORING CATERPILLARS. Many specimens of the common stalk-borer (*Papaipema nitela*) and of the burdock borer (*P. cataphracta*) were submitted for identification by growers who mistook these caterpillars for the European Corn Borer. The common stalk-borer was found in corn and potatoes, and the other species in corn and cultivated asters.

STEM-BORING WIREWORMS. In a tomato field near Vineland, about 65% of the plants were infested by two species of stem-boring wireworms, (*Agriotes mancus* and *Melanotus sp.*). In some instances the larvæ bored five to five and one-half inches up the stem. About 20% of the tomatoes were so seriously injured that they were pulled out. The infested plants left in the field managed to survive, but made very little growth.

PARSNIP WEB WORM (*Depressaria heracliana*). The greenish-yellow caterpillars of this species were abundant as usual on parsnips grown for seed.

EUROPEAN CORN BORER (*Pyrausta nubilalis*). The outbreak in Southern Ontario of this undesirable alien is discussed elsewhere.



Injured rose bud opened to show Rose Midge maggots feeding within. (Enlarged three times.)

Rose Bud stems distorted by larvae Life size.

Stem of chrysanthemum showing galls formed by larvae of chrysanthemum Midge.
Life size.

THE STRIPED CUCUMBER BEETLE (*Diabrotica vittata*), THE SQUASH BUG (*Anasa tristis*), ASPARAGUS BEETLES (*Crioceris asparagi and C. duodecimpunctata*). Except in a few localities these insects were rather scarce.

POTATO LEAF HOPPER (*Empoasca mali*). This species, although not nearly so abundant as it was last year, was present in quite large numbers, and in some localities a considerable amount of "hopper-burn" developed on the potatoes.

Experiments conducted at Vineland indicated that this year, unlike last year, weather conditions played little or no part in producing potato "leaf-burn" and that all or practically all the "burning" was caused by hoppers.

FLEA BEETLES. The Pale-Striped Flea-Beetle (*Systena taeniata*) was very prevalent on potatoes, tomatoes, beans, egg plants, peppers, and asters.

Early in the season tomato plants in parts of the Niagara district were badly damaged by the potato flea-beetle (*Epitrix cucumeris*).

Insects Injurious to Field Crops.

WIREWORMS AND WHITE GRUBS. These well-known pests were as usual the cause of considerable damage to various crops.

GRASSHOPPERS. Outbreaks of grasshoppers occurred in Huntsville and Waterdown districts and in several other parts of the province. At Thedford, celery grown near waste land was badly injured. Greater loss from grasshoppers was prevented by copious showers in July and August.

THE HESSIAN FLY (*Mayetiola destructor*). The outbreak of Hessian fly is discussed elsewhere.

THE GRASS THRIPS (*Anaphothrips striatus*). Specimens of oat heads with characteristic thrip injury were received from central Ontario with the report that a considerable percentage of the oat plants were similarly affected.

GREATER WHEAT-STEM MAGGOT (*Meromyza americana*). In Manitoulin Island, according to the Agricultural Representative, ten per cent. of the heads of spring wheat in some fields was destroyed by this maggot.

CHINCH BUG (*Blissus leucopterus*). In referring to the outbreak of chinch bug in Lincoln county last year, we expressed the hope that fall rains and the winter would reduce the hibernating adults to insignificant proportions. Our hope was more than realized, because this season it was practically impossible to find a bug in the infested district.

COTTONY GRASS SCALE (*Eriopeltis festucae*). This scale, which we believe has not been reported from Ontario before, was very abundant on grass at Coniston in Northern Ontario.

Greenhouse Insects.

THE CHRYSANTHEMUM MIDGE (*Diarthronomyia hypogaea*). We regret to report that the chrysanthemum midge appears to be pretty well established throughout the province. It is present in greenhouses in St. Catharines, Toronto, Kitchener, London, Chatham, Midland and Ottawa, and there is no doubt that a survey of Ontario greenhouses would show it to be established in other places. It would appear from the manner in which the midge has spread, that in a comparatively short time practically all our growers of chrysanthemums will have to contend with it.

It is worth while noting that Mr. W. W. Gammage, London, claims that he has practically eliminated the midge by spraying with the following mixture :

Hammond's Thrift Juice	1 pt.
Nicotine or Nicofume	1½ ozs.
Water	5 gals.

This spray was applied two or three times a week for a period of five weeks.

THE ROSE MIDGE (*Dasyneura rhodophaga*). Discussed elsewhere.

THE CYCLAMEN MITE (*Tarsonemus pallidus*). In a St. Catharines greenhouse, somewhere in the neighbourhood of three thousand cyclamens were so badly damaged by this species that they had to be discarded. The florist estimated that the mite had caused a loss of approximately $2,000.00.

THE CURLED ROSE SLUG (*Emphytus cinctipes*). This fall there was a minor outbreak of this slug in greenhouses at Grimsby.

THE TARNISHED PLANT BUG (*Lygus pratensis*). This notorious pest was apparently not so abundant as usual; however in some districts it caused a considerable amount of damage, especially to asters. Miss Olfield of Grimsby, reports that hydrated lime, which we advised her to try, when dusted on asters was quite effective as a repellant.

THE GREENHOUSE LEAF TYER (*Phlyctaenia ferrugalis*). Judging by the number of complaints received from florists, this pest was more injurious than usual to chrysanthemums, cinerarias and other plants.

Insects Injurious to Domestic Animals.

THE WARBLE FLY (*Hypoderma bovis*). Complaints of "gadding" of cattle caused by this fly were received from Lambton, Oxford, Lincoln, Norfolk, Perth, Huron and Peel counties. "Gadding" was reported as early as June 12th and 15th.

Insects Injurious to Forest and Shade Trees and Shrubs.

BIRCH LEAF SKELETONIZER (*Bucculatrix canadensisella*). In September birch trees along the C.P.R. from Ottawa to Napanee looked as if their foliage had been blighted, so severely had the leaves been attacked by the tiny larvæ of this species.

WHITE OAK CATERPILLARS. Almost every oak with the white oak type of leaf along the C.P.R. from a few miles east of Napanee to a few miles west of Belleville had its foliage destroyed by some caterpillar. The injury was first noticed in August, and the leaves were off early in September. Oaks, like red oak, with sharp pointed leaves were apparently not attacked. The writer did not see the caterpillars, but received about a score of pupæ collected from underneath one of the trees, and hopes to rear the adults from them next year.

TETRANYCHUS BICOLOR. Ornamental oak trees in different parts of the Niagara district were heavily infested by this mite.

SNOW-BALL APHIDS (*Aphis viburnicola and Aphis rumicis*). These insects as usual were abundant and caused typical curling of the foliage and the defective development of the bloom. Tests made in 1919 and 1920 demonstrated that they can be controlled easily by spraying with Black-leaf-40 and soap just as the buds are commencing to burst. Heavy and thorough spraying is necessary. The difference between the bloom and foliage on sprayed and unsprayed bushes is very striking.

WEDNESDAY EVENING.

In the evening a meeting, in the form of a smoker, was held in the men's sitting-room of the College Residence, at which Prof. Lochhead acted as chairman.

Dr. E. P. Felt, State Entomologist of New York, read a paper entitled "Some of the Broader Aspects of Insect Control," in which much interest was shown by the audience in the discussion that followed. The second event of the evening was the reading of the continuation of Mr. Morris' delightful "Life History of a Hobby Horse." Mr. Morris captivated his audience by the charm of his language and delivery, and the fine scholarship and whimsical humour which characterised his address.

Dr. Felt's paper appears below, while Mr. Morris's "Hobby Horse" which was commenced in our Report for 1918, is being continued in the "Canadian Entomologist," in the series of papers on "Popular and Practical Entomology."

The meeting was enlivened by several musical selections played by the College Orchestra.

SOME OF THE BROADER ASPECTS OF INSECT CONTROL.

E. R. Felt, State Entomologist of New York.

This is not so much a contribution as a general consideration of the primary function of the economic entomologist, namely, the more effective control of injurious insects.

Insect abundance depends upon a certain prolificacy, sufficient suitable food, favorable climatic conditions and relative freedom from the operation of checks of one kind or another.

Very limited reproduction prevents an insect from becoming economically important and such species therefore usually escape notice.

A sufficiency of suitable food is necessary, and we desire in this connection to call attention to the adjective, suitable, because food habit limitations are often more real than apparent. There is need of distinguishing between plants upon which a species thrives and those upon which it can just maintain itself, or where this is true only of some of the older larval stages. In the case of borers there is a marked economic difference between real food plants and "shelter" plants.

Although some insects can withstand great extremes, it is a fact that most economic species are greatly affected by climatic conditions, and some respond so readily that it is difficult to recognize the cause for the difference in behaviour.

Controlling factors, aside from climate noted above, are susceptible of modifications in some cases and deserve most careful consideration.

The past twenty-five years have witnessed notable improvements in both spraying outfits and insecticides. Compare for example, the hand sprayers and blowers of the earlier days with the large power spraying outfits and dusters of the present time; and recall the development and extensive use of arsenate of lead, lime sulphur wash and nicotine sulphate, all important and extremely valuable additions to the pharmacopœia of the oconomic entomologist.

It is quite within possibilities that the airplane may be used for distributing poisons over forest areas, and perhaps extensive orchards, and investigations of insectides indicate continued progress in the search for and development of materials which can be used for the better control of insect pests.

The profound influence of climate must be taken into account. It is well known that cool, backward weather conditions in the spring greatly reduce the numbers of certain insects, for example, the first generation of the San José scale and the elm leaf beetle; and in the case of the former, adverse winter conditions may destroy a very large proportion of the hibernating females. Cold, wet rains are fatal to many insects, and, on the other hand, unusually high temperatures and low humidity have their effect, and various combinations of this character exert marked changes upon insect abundance from season to season. It sometimes happens that exceptionally good growing weather appears to be the main reason why plants outgrow insect attack and as a consequence there is very little serious injury.

The concentration of crops following local specialization is likely to result in unusual outbreaks. This is very marked in orchard regions, vineyard areas and wheat growing sections, and is the main justification for modifying agricultural practices by the rotation of crops, variations in the time of planting and other changes.

The United States is spending many thousand dollars annually in the support of a quarantine system which logically should be extended to every port if it is to accomplish its purpose namely, the exclusion of dangerously injurious insects and plant diseases. Everyone acquainted with this line of work must realize that occasionally some pest may escape the watchful eye of the inspector, and perhaps establish itself in a limited section. Furthermore, there is always the possibility that an insect, harmless in its native surroundings may develop destructive habits in a new environment.

Quarantine should logically be supplemented by provisions for the early detection and elimination of restricted infestations. It may be remembered that the gypsy moth maintained itself in America practically unnoticed for twenty-two years, and the European corn borer for some ten years. These cases and others of a like nature suggest the need of more efficient methods for the early detection of unusual and potentially injurious species. There should be wider appreciation of the important part played by insects, and the general public should be systematically encouraged to report anything unusual, because this is an economical and apparently a very effective method of bringing such developments to light.

It is admittedly difficult to forecast the probable economic status of a recently introduced insect and partly for this reason there has usually been an investigation of the species before a comprehensive effort for extermination was begun and, as a consequence, such insects as the gypsy moth, the San Jose scale and the cotton boll weevil, to mention only a few, spread rapidly and golden opportunities were lost, not necessarily through the fault of any individual or group of individuals but because methods had not been developed and possibilities demonstrated to such an extent as to make any other course practicable under the conditions then obtaining. The experience of the last twenty-five years has laid an excellent foundation for the adoption of a more comprehensive and effective policy which might reasonably be expected to eventuate in the better handling of problems in connection with recently introduced insects. The conditions are sufficiently similar in these projects that it would seem advisable to create an organization specially qualified by training and experience to handle such propositions, and to make provision in the annual appropriations for a reasonable sum to be available in the case of emergencies, which latter are never anticipated and should not be compelled to await the relatively slow process of legislative investigation and approval. It should at least be possible to adopt at once a vigorous policy of suppression and control designed to keep the pest within certain bounds until investigations and field experience—both are important—develop a fund of information sufficient to ensure a satisfactory disposal of the case. The bean ladybird situation in Alabama with no Federal or State funds available is a striking instance of unpreparedness. An incipient infestation compells immediate, though somewhat wasteful, action if an insect is to be eradicated. Time, tide and insects wait for no man. The drastic and prompt extermination of the Colorado beetle infestations in both England and Germany are cases of this character.

The utilization of natural enemies of one kind or another for the control of insects should be advocated wherever practicable. There is no question as to the great value of many birds in checking leaf-eating caterpillars and the better protection of bird life is one of the most promising methods of safeguarding forest areas from insect depredations.

The importation of the Australian lady beetle and its speedy control of the cottony cushion scale gave a great impetus to the utilization of natural enemies. The collection and redistribution of native hibernating lady beetles on the Pacific slope is a similar method of making use of beneficial insects.

Most of our recently introduced pests are comparatively insignificant forms in their native countries, and are there controlled presumably very largely by beneficial insects. The extended and systematic introduction of natural enemies of both the gypsy and brown tail moths has resulted in a very thorough study of these insects and eventuated in a reasonable expectation of control through these agencies. The present search for the natural enemies of the green Japanese beetle and of the European corn borer are later attempts along the same line.

There is also the possibility of utilizing native beneficial insects. Doctor Pierce made an extensive study of the parasites of native weevils and has demonstrated the possibility of concentrating them upon the introduced cotton boll weevil. Similar work has been undertaken in connection with the European corn borer. The probabilities are that native species will largely retain their characteristics when attacking introduced forms as was the case with the extraordinary abundance of Trichogramma in the eggs of the European corn borer in 1919, and its relative great scarcity the past season. The possibilities along this line are well worthy of most careful attention.

The marked reduction in the numbers of a certain insect may have a much greater effect than is commonly supposed. The studies of bark beetles by Doctor Hopkins have shown the possibility of securing very efficient control by simply reducing their numbers, in some instances by seventy-five per cent, to such an extent that those remaining would be unable to overcome the resistance of the tree. This of course applies to enemies of living trees and presupposes that a minimum amount of injury must be inflicted or the attack can be successfully resisted, a condition which accords very closely with the facts.

The work of W. F. Fisk upon the Tsetse fly has shown that it is only necessary to reduce the infestation by this pest to moderate limits in order to secure very satisfactory freedom from attack. The studies of Roubaud upon malaria in France indicate intimate connection between this disease and the numbers of mosquitoes per host. The author suggests what he calls animal prophylaxis, that is the introduction of enough cattle to attract the insects and thus to protect man to a large extent. Both of these cases are simply forms of percentage reduction.

Somewhat similar conditions prevail when the farmer relies upon good culture to prevent insect injury, since vigorous growth frequently enables the plant to successfully resist or outgrow insect attack. The late Professor F. M. Webster was a strong believer in good cultivation, and on more than one occasion has expressed his faith in such treatment as a means of preventing insect injury.

There is much data along this line and yet present day entomologists content themselves largely with alluding in general terms to the value of good agriculture and sometimes unduly emphasize direct remedial measures, whereas in certain cases there should be emphasis upon the former rather than the latter.

Let us turn for a moment to the early history of the wheat midge and the Hessian fly in this country. Both insects caused huge losses over large areas, and owing to practical limitations direct repressive measures were impossible. These insects are now largely controlled by a modified agriculture, though it has taken years to demonstrate the feasibility of such measures. We have in the European corn-borer an insect which apparently must be controlled by modifications in agricultural methods, and we believe that in this particular case there is a splendid opportunity for economic entomologists to demonstrate in a most convincing manner possibilities in this direction and on a sufficiently large scale, so that there can be no question as to the validity of the findings.

It is very probable that the efficiency of quarantine measures is materially increased by the fact that ordinarily the chances are against a small infestation surviving, since a few insects are very liable to succumb to attacks by birds, predaceous and parasitic insects, or to the effects of untoward climatic conditions, or unfavorable food. This very probably occurs in many sections and escapes record because the entire incident is on such a small scale. It may be recalled in this connection that five living nun moths were taken in Brooklyn, N.Y., in 1901, and yet the insect does not appear to have become established.

The potency of a more or less systematic reduction in numbers is well illustrated in certain of the larger animals. We refer to these forms because the process is more easily seen and understood. It should also be noted that in not a few instances the supposedly impossible has been brought about by the irresponsible urge of self-interest, and not through carefully directed co-operative efforts for the attainment of a definite aim. One of the most striking instances of this kind is the extermination of the passenger pigeon, a bird at one time so extremely abundant that three carloads a day were shipped from one small Michigan town for a period of forty days. The large herds of buffalo were saved from extinction at the last moment through the intervention of naturalists interested in preserving the wild life of the country. The depleted salmon, shad and herring fisheries, the necessity of protecting both the oyster and the lobster and the great scarcity of certain whales have been brought about by similar agencies, though it would seem as if inhabitants of the water would have a better chance of escape from a persistent human enemy than would be the case with terrestrial forms. It is true that these unfortunate conditions have resulted through specific peculiarities or limitations which have made attack at certain points particularly detrimental, such as killing birds when migrating or in their nesting retreats, the wholesale catching of spawning shad or salmon and the depletion of oyster beds. Those dependent in large measure for their living upon these various forms could not believe that the natural prolificacy of the various species would not offset almost any attack by human or other agencies. Have we reason for believing that similar conditions may not exist among invertebrates, especially insects, and particularly those species considered injurious or destructive ?

It follows from the above that the mere occurrence of immense numbers by no means indicates impossibility of control or extermination.

Secondly, it would appear that relatively minor changes in environment or attacks limited to comparatively restricted areas might accomplish the apparently impossible.

Thirdly, although there were probably in the case of the larger animals enumerated above, exceptional individuals which under certain conditions varied widely from the normal habit, these departures were not sufficiently marked or numerous to save the species from extinction.

The possibilities of extermination demand more than a passing notice. The layman is inclined to approach the subject with an easy confidence, unembarassed by experience, while the expert, oppressed with the numerous possibilities of exceptional behavior may conclude that nothing short of absolutely destroying all life in the infested area will accomplish the desired results. There is a possibility that the truth lies midway between these extremes.

Those familiar with the early efforts of the State of Massachusetts to exterminate the gypsy moth, will recall that attempts were made to destroy much of the vegetation and great attention was given to killing the eggs and a little later, larvæ. It required more than ten years experience to show that a fairly speedy elimination of the insect was possible without wholesale destruction of the vegetation, providing advantage was taken of the feeding limitations of the species. The efficacy of these methods has been repeatedly demonstrated on relatively large though restricted infestations.

The State Plant Board of Florida has undertaken a very similar piece of work and is exterminating an isolated infestation of the sweet potato weevil by the application of modified agricultural methods and the elimination of conditions favorable to the existence of the insect, and although this work has been in progress for less than three years, the speaker has been informed by Plant Commissioner Newell that the inspectors hope and are confident that 85 per cent. of the previously infested farms will be found free from weevil this fall and the possibilities are that portions of the infested tract may be freed from restrictions another season. It is true that the wingless sweet potato weevil with its closely restricted food habits offers exceptionally favorable opportunity for the demonstration of such measures and yet the present partial success of the undertaking is striking evidence of the soundness of the policy and by no means proves its inapplicability to insects well provided with wings and possessing more general food habits.

The attack along all lines upon the green Japanese beetle infestation in New Jersey will soon disclose the possibilities of both control and eradication in the case of a very difficult insect, though it should be remembered that the really early work against the gypsy moth appeared relatively hopeless and that the really efficient methods were developed only after years of study and practical experience.

The attempted eradication of the pink boll weevil in the south affords another opportunity of demonstrating possibilities along this line.

The systematic destruction of the ermine moth in nursery centers is relatively easy and is a most practical method of preventing another potentially serious pest becoming established in this country.

The progressive extermination of the cattle tick from nearly 500,000 square miles of territory and the consequent elimination from this area of a very destructive infection is along the same line though outside the usually accepted bounds of entomology. Gratifying progress has been made in demonstrating methods of controlling the Rocky Mountain spotted fever tick, a carrier of deadly human infection.

The mere fact that a proposition is a large one does not make it impossible or impracticable in these days of excellent organization and unsurpassed publicity. Both are exceedingly important in the development of any large undertaking, be it scientific or commercial. There is no reason why advantages demonstrated in other branches of human activity, may not be appropriated for the better control of insect pests, and it is gratifying to know that there is a distinct trend along these lines.

Within a year an attempt to exterminate the cotton boll weevil has been proposed in all seriousness, and while the undertaking is a gigantic one and involves an organization extending over a group of large states with provision for financing one of the most important crops of the country, and a profound change in the agriculture of the infested section for at least one season, present day developments prohibit our classing this as impossible though the entire proposition should be studied most carefully from all angles before any attempt is made to put the plan into execution.

The repressive work in connection with the gypsy moth in New England is the outcome of sound policy. It has been admirably administered for a series of years. This destructive pest has been well controlled and in certain large areas exterminated under conditions as adverse as any obtaining in the earlier days when the Commonwealth of Massachusetts entered the lists alone against this insect. The failure to obtain appropriations proportionate to the increased costs of the last few years and the recent discovery of the insect in several areas remote from the main infested section will shortly compel a decision in regard to this pest, and incidentally the verdict is bound to affect our attitude toward similar problems. It is only necessary to turn to the recorded discussion of the 1919 session of the American Association of Economic Entomologists to find a confident statement to the effect that this insect even now could be exterminated from America if sufficient funds were available. This utterance is the matured conviction of a man qualified by years of practical experience to express an opinion regarding this insect.

The agricultural interests of this country are confronted by grave problems along many lines and they rightly look to the entomologists for the solution of those relating to insects. Among the most urgent are those in connection with the exclusion and control of introduced or recently established insect pests. Quarantines must be effective or we may expect in the near future a series of introductions which will be followed by extensive depredations, and control of the latter must be prompt and effective if golden opportunities are seized. The only practical solution is to recognize the seriousness of the situation and so far as possible adopt adequate measures. There is no peculiar merit in large scale operations unless they are absolutely justified by conditions and in some cases in the past it would seem as though the work had not been planned and executed on a sufficiently extended scale to warrant a reasonable hope of success. Such projects are not only possible but entirely feasible if a careful, though tentative, plan is presented and the preparation for the execution of the undertaking be advanced by means of a well directed educational campaign. This latter is necessary in any large project, otherwise it is impossible to secure the essential co-operation. It is the speaker's opinion that we have not yet reached the practical limits in large scale repressive work, a type of activity which appears to be in its infancy and one, in the speaker's judgment, as worthy of recognition and development as the commonly, more highly regarded, investigative activities.

THURSDAY MORNING.

The session was commenced with the election of the officers for the ensuing year, the results of which are given on page 6.

The remainder of the morning was occupied by papers and discussion on the European Corn-borer in Ontario.

At the close of the discussion it was moved by Professor CAESAR, seconded by MR. CRAWFORD. that the thanks of the Society be extended to DR. HOWARD for sending Messrs. Walton and Worthley to the meeting. Carried.

THURSDAY AFTERNOON.

Before proceeding with the reading of papers the following resolution was moved by Professor LOCHHEAD and seconded by Professor CAESAR, viz., "That the Society learns with regret that the Rev. Dr. Bethune is retiring from his Professorship in the Ontario Agricultural College on account of advancing years. It is pleased to know, however, that the Government has seen fit to allow him a superannuation allowance on account of long and prominent service as Entomologist and Professor.

"The Society cannot permit the occasion of Dr. Bethune's retirement from active work to pass without an expression of appreciation of his long and valued services on behalf of Entomology. It remembers that Dr. Bethune was one of the prime movers in the founding of the Entomological Society of Ontario, fifty-eight years ago. It remembers, also, that he acted for many years as Editor of the "Canadian Entomologist" and during this period the "Canadian Entomologist" became recognized as one of the best entomological magazines on this continent. It remembers also his long service as Professor of Entomology in the Ontario Agricultural College and his wide influence on the many young men who have been his students, many now occupying high positions.

"The Society desires, therefore, at this time, to place on record its high appreciation of Dr. Bethune's long and unselfish service to Entomology, especially in connection with the origin and development of this Society, to extend to him its best wishes for many happy years in his well-earned retirement, and to hope that he will continue to give the Society the benefit of his long experience."

The motion was spoken to by Messrs. CRIDDLE and BAKER. Carried.

It was then moved by Mr. CRIDDLE, seconded by Mr. MORRIS, "That a telegram be sent to Dr. Fyles offering the greetings of the Society." Carried.

It was also moved by Mr. MORRIS, seconded by Mr. CRIDDLE, "That this meeting express to President Reynolds its appreciation of the courtesy shown by himself and various officers of the Ontario Agricultural College to the Entomological Society of Ontario during its present session at the College." Carried.

FURTHER DATA ON PHORBIA BRASSICAE.

L. CAESAR, O. A. C., GUELPH.

1. Numerous tests made not only by the writer and his assistants, but also by Gibson, Brittain, and Treherne, have proven beyond question that corrosive sublimate in solution will control the cabbage maggot both on cabbage and cauliflower. Many growers, largely due to the influence of Mr. A. H. MacLennan, the vegetable specialist, and his predecessor Mr. S. Johnston, have used this substance on their plots for several years with excellent results: so that it is now long past the experimental stage.

2. Our own experiments in 1919 and 1920 have shown that this substance will also control the radish maggot. Two applications are all that a grower can afford to give to radishes because they are such a low-priced crop that more than two would make the growing of them unprofitable. To treat radishes successfully they must be grown in rows, not broadcast

3. Our experience with creosote clay has not been satisfactory. Some of the compound was made by ourselves, using air-slaked lime instead of clay, and some was obtained from Nova Scotia. On radishes it failed to control the maggot, and on half the cabbages treated once it so stunted the plants that we dare not repeat the treatment. The other half showed very little difference from those treated with corrosive sublimate. I have not been able to make sure whether the injured plants were treated with our own or Brittain's mixture. Therefore the substance should be retested.

4, Judging from results on radishes—all of which were pulled, washed and carefully examined—a strength of 1 to 1,000 (1 oz. to 6¼ imperial gallons) was considerably superior to 1 to 1,600 (1 oz. to 10 gallons) but not much superior to 1 to 1,280 (1 oz. to 8 gallons). As radishes would appear to be well suited for testing the most satisfactory strength of corrosive sublimate to use against *Phorbia brassicae,* I feel like recommending our own growers to use 1 to 1,280 (1 oz. to 8 gallons).

5. Some work was done with cabbage seed beds, this indicated that the corrosive sublimate was satisfactory for them also; but further tests are necessary to determine the point definitely under different weather conditions.

6. Our experiments this year on both cabbage and radishes cause us to think that two well-timed applications at a strength of 1 oz. to 8 gallons of water are probably all that should be required any year. Often one application would suffice, but variations in weather from year to year are so great that it would not be safe to rely on fewer than two.

7. The proper time to make the first application to early sown radishes, cabbage and cauliflower requires long and close observation to determine, but its determination is a matter of great importance; for it would often mean the saving of one application. The rule:—to apply the solution first four days after setting out the plants and again twice at intervals of a week—is not a scientific rule and is unsatisfactory. Judging by last year's experience, the first treatment should be just about the time that European plums begin to bloom. Flies began to emerge in our cages last year on May 12th, and were first observed in the field on May 13th. Egg laying in cages began May 17th, and eggs in the field were fairly common by May 22nd. European plums began to bloom in the same district between May 17th and 19th.

8. When plants are not set out until the flies are known to be present and to be laying eggs, the first application should apparently be made on the third day after the setting out or, in the case of radishes, the third day after the earliest plants have come through the soil. The reason for this is that we must try to destroy the eggs and prevent the entrance of the tiny maggots into the root. As eggs sometimes hatch in two days it would be unsafe to postpone treatment later than the third day, unless of course the weather was cool, when an extra day might be allowed.

9. The best length of time between applications may vary somewhat from year to year because of variations in weather but, judging from our results on radishes this year, a five days interval is better than a week.

10. The presence of a mixed fertilizer (4-8-4) did not make much difference in results on radishes (It was not tried on cabbage). There was a little higher percentage of infestation on the fertilized part, but not sufficient to justify one in concluding that the fertilizer was the cause.

11. Much time was devoted to determining how the corrosive sublimate controls the maggot. Strange to say our results this year are almost directly opposite to those in 1919. The difference in results may be partly due to the great difference in the seasons themselves, and partly to the different methods employed in the two years. In 1919 our results indicated that corrosive sublimate controlled only by repelling the larvæ, but this year they indicated that it controlled by killing most of the eggs and also many small larvæ and some larger larvæ and by repelling larvæ from the plants.

THE CONTROL OF THE CABBAGE ROOT MAGGOT IN BRITISH COLUMBIA.

R. C. Treherne, Entomologist in Charge for British Columbia, and M. H. Ruhman, Assistant Entomologist.

During 1919 the experiment conducted for the control of the Cabbage Root Maggot (*Chortophila brassicae*) on both cabbages and cauliflowers proved the superiority of the Mercury Bichloride treatment over other remedial measures, including the tar-paper protector. The 1920 experiments, therefore, were planned to test the value of Mercury Bichloride on a strictly commercial scale. A field of 25,000 Early Jersey Wakefield cabbages was chosen, and four applications were planned with Mercury Bichloride in solution at the rate of 1 oz. to 10 Imperial gallons of water. The first application was to be given three days after transplanting, and this was to be followed by three further applications at ten day intervals. Close watch was kept for the deposition of the first generation eggs and for the first appearance of adults. Transplanting took place in the field on April 25th this year and on the few days following. The materials for application were in readiness for the third-day treatment but, inasmuch as no eggs were yet laid and no flies had been seen, it was decided to withhold any action. The first adults seen in the field were observed on May 5th and the first eggs were laid on May 10th. Hence the first treatment took place on May 11th, or sixteen days after transplanting, or in other words, again, exactly in time for the scheduled second treatment.

The second treatment should have been made on May 21st, but owing to a recent irrigation which left the soil too wet to walk over, it was delayed until May 25th. The third treatment was made on June 4th. A fourth treatment was applied on June 18th, but only to half the acreage. So that, in summary, 25,000 cabbage plants, transplanted about April 25th., received three applications of Mercury Bichloride at 1 oz. to 10 gallons of water on May 11th, May 25th, and June 4th, and about 12,000 plants received a fourth application at the same strength on June 18th.

The results showed no maggot injury, and no larval infestation was observed on any plants examined either on those plants which had received three applications or those which had received four. The stand was perfect, and the experiment was a complete commercial success. About 1,000 plants died in the first week or two after transplanting, from a damping-off fungus, but these were not replaced. In fact no plants were replaced throughout the season. The crop harvested was 29 tons of marketable cabbages. It may be stated here, that in another block of 25,000 cabbages under similar crop handling and growing on similar soil and presumably with a similar degree of infestation but untreated, the crop harvest was 16 tons. Time did not allow us to check closely the comparative data of fly or larval infestation. Consequently, even allowing for all variations and experimental errors the difference in the marketable yields was so great as to leave no doubt at all as to the efficacy of the Mercury Bichloride treatment.

Various blocks of cabbages at various points in the North Okanagan were treated on our recommendations with Mercury Bichloride, under individual growers' own immediate directions. Records from these blocks have now been received, and without exception complete satisfaction has been obtained. Several growers reported no loss at all, others claimed a slight degree of infestation after the last treatment at the end of May, and all recorded yields per acre of from fifteen to twenty tons. In the Armstrong district, of those cabbage plantations which were not treated, not twenty-five per cent made even small cabbages, and in those blocks where the paper discs were used about seventy five per cent of marketable heads were cut. The results of the 1919 and 1920 experiments have left no doubt in our minds as to the efficacy of the mercury salt treatment, and those growers with whom we have worked are clearly of the opinion that the tar paper disc is not so good, and although the cost may be less, the tar paper method is not so commercially practicable as the mercury treatment.

Method of Application. The method of application we used in handling 25,000 plants was as follows:

A concentrated stock solution was prepared the day previous to treatment by dissolving the mercury salt in boiling water. This was done by suspending the salt in the sugar sack in a fifty American gallon oil barrel, and pouring the boiling water over the sack. This stock solution was drawn on a waggon to the centre of the field, a large watering cart with a capacity of two hundred Imperial gallons and a number of empty barrels being drawn also to the same point. This stock solution was reduced to make a solution of 1 oz. to 10 gallons of water, there being 2 oz. of mercury salts in each gallon of stock solution. Two ordinary four gallon coal oil tins were suspended on a yoke placed across the labourer's shoulders, and the diluted solution was applied to the roots of each plant, at the rate of two fluid ounces, by means of a cheap dipper.

The Cost of Application.

Per 24,000 plants.

1st Application:	$HgCl_2$, 2½ lbs. at $4.00 per lb.	$ 10 00
	Time: 20 hours, 1 man at 50c per hr.	10 00
2nd Application:	$HgCl_2$, 3 lbs. at $4.00 per lb.	12 00
	Time: as above	10 00
3rd Application:	$HgCl_2$, 3 lbs .at $4.00 per lb.	12 00
	Time: As above	10 00
Time for preparation, Hauling, etc.,		3 00
	Total Cost:	$ 67 00

The total cost of three applications approximates one cent for four plants, while for four applications the cost would be one cent for three plants.

INTER-RELATIONS IN NATURE.

W. Lochhead, Macdonald College, Que.

To the economic entomologist the investigation of the "Inter-relations in Nature" should be one of the most important fields of study, for abundant evidence has been collected to show that all nature is a vast system of linkages, one part dependent upon another in an intricate web of life, and that disturbances in one portion of the system are followed by disturbances in another. To Darwin, more than any other person, science is indebted for the elaboration of the idea and for the clear demonstration of its practical importance.

Since Darwin's time the number of examples of inter-relations has been greatly extended through the observations of thousands of investigators. In our boyhood days we were accustomed to rhyme the chain of events in "The House that Jack Built," which ends with "This is the cat that killed the rat that ate the malt that lay in the house that Jack built." In Nature many such chains have been unravelled, binding animal with animal, and animals with plants and these again with the inorganic world. Man eats the fishes that eat crustacea that eat infusoria that eat bacteria that feed on decaying organic matter in some pond.

The purpose of this paper is to discuss briefly, or rather to point out those inter-relations in nature that have to do more particularly with insect life. The subject is a big one, so that much more must necessarily be left unsaid than can possibly be said in a paper on this occasion.

The following relationships will be discussed.

1. Insects in relation to insects.
2. Insects in relation to other animals.
3. Insects in relation to plants, including bacteria and fungi.
4. Insects in relation to inorganic nature.

1. Insects in Relation to Insects.

The part played by predatory and parasitic insects in the regulation of insect life has been frequently discussed at these meetings. The topic is a very important one and studies are being carried on at many stations, and none better than those by Mr. Tothill, of the Dominion Entomological Laboratory at Fredericton, on the factors operating on the Forest Caterpillar and the Fall Web Worm.

The elaborate studies of the parasites of the Gypsy Moth in New England, and their part in the control of the pest have been summarized by H. S. Smith in the "Journal of Economic Entomology," August 1919, as follows:—

1. The reproductive capacity of available entomophagous insects must be much higher than that of the host. This proposition is self-evident, and needs no amplification.

2. A complete sequence of parasites affecting the egg, larva and pupa of the pest. The importance of this factor was fully shown in the campaign against the gypsy moth.

3. The entomophagous forms must be capable of being reared or obtained in sufficient quantities to overcome the pest in the field. This factor is one of the most difficult to bring into operation. Lady-birds are readily reared and collected.

4. The cost of producing natural enemies must remain well within the bounds of profitable crop production.

5. Secondary parasites in the local fauna should limit as little as possible, much less entirely prevent, the action of the primary parasites. This factor is also one that is most difficult to control.

6. Agricultural practices such as spraying and fumigation which affect adversely the breeding of natural enemies should be prevented. It is probable that the extermination of the imported Chinese lady-bird in southern orchards was due mainly to spraying operations with lime-sulphur carried on as a practice.

7. The relative ability of the pest and its enemies to spread is an important factor. If both be good fliers, the power of spreading is increased but the likelihood of extermination of the pest is lessened.

The citrus mealy-bug has been controlled in Southern California by the Australian lady-bird *Cryptolaenus montrouzieri* which was reared in large numbers at the State Insectary, and collected in orchards where they had become abundant late in the season. In this instance, as in that of the cottony-cushion scale, the lady-bird is an active insect while the scale insect is fixed to the plant. Moreover, the lady-bird has more generations than the scale insect, and is practically free from parasites.

Dr. P. Marchal calls the gipsy and brown-tail experiments in America "a gigantic biological analysis and synthesis bearing upon all the elements which constitute the harmonic groupings of plant-feeding insects, their predators, parasites and hyperparasites; the taking apart piece by piece of the whole system, and its partial reconstruction in a new environment, forcing it to give the greatest possible stress to the elements most favorable to man, and reducing to the minimum those which oppose their action."

2. Insects in Relation to Other Animals.

Nature has evolved not as independent but often as closely dependent organisms. The well-being of one set is frequently related in many ways to other sets, and no creature can be said to live unto itself. Insects and plants, for example, have been for long ages mutually adapting themselves one to the other, the plant to the insect and the insect to the plant. We all know how birds keep down insects and many rodents; in fact, an approximate equilibrium has been established between them. Any disturbance or sudden reduction in the numbers of the birds of a region is sure to disturb the balance in the insect world and cause much loss to the crops upon which the insects feed.

Moreover, the number of carnivorous animals bears a definite proportion to the herbivorous animals upon which they feed, the herbivorous animals to the plants, the plants to insect visitors, etc. In this web of nature we may note that the animals preyed upon are more prolific than the predaceous forms. "Small rodents tend to be much more prolific than carnivores. The primary reason for this is probably that less individuated types tend to be more prolific." —(Thomson).

Sometimes man interferes with the balance of nature and serious consequences follow. Rats became a great plague in Jamaica, and to offset them the mongoose, a weasel-like animal, was introduced. The mongoose made short work of the rats, but it turned its attention to useful animals such as poultry, ground-birds and insect-eating lizards and snakes. As a result injurious insects and ticks have increased greatly, and both plants and animals have suffered much injury.

Facts which convince even the most sceptical are accumulating regarding the valuable role played by birds in the control of noxious insects. Studies of bird diets prove conclusively that the majority of our common birds feed mainly upon insects. Forbes of Illinois states after a careful study of the contents of the stomachs of birds that about two-thirds of the food of birds consists of insects. Well-informed writers tell us that without birds the earth would be uninhabitable after six years, and yet man in his ignorance is constantly destroying these valuable friends, simply because he finds that they levy an insignificant toll on his fruits and grains. It is possible that we would be better off if certain birds were greatly reduced in numbers, but of this we are not absolutely certain, for the web of life is most complex, and no person knows how far-reaching the results would be.

Aside from the fact that birds aid very materially in reducing the numbers of insects when they come as scourges, it is very important to remember that birds nip many incipient scourges in the bud. Their mobility and varied character and habits enable them to move rapidly from place to place and thus maintain the balance of nature which man is always tending to upset. Even in wild nature the balance is never quite complete; at best the equilibrium is unstable.

"It is very interesting that the two great classes of successful fliers should be, in the wide economics of nature, pitted against one another, wings against wings, freeman against freeman, invertebrate against vertebrate, 'little brain' against 'big brain,' 'instinct' against 'intelligence.' Practically this is the most important conflict of classes that the world knows."—(Thomson).

It is worthy of note that the Italian entomologists do not share the opinion of American and British fellow-workers as to the great value of birds in the control of insect life.

From 1850 to 1873, Rondani, an Italian, made most valuable contributions to the study of parasitology. He was of the opinion, however, that parasites were far more important than birds as control factors. He said: "The policing of the fields cannot be entrusted to birds because they are unreliable and kill the guilty with the innocent; they are robbers as well as guardians of the field products, and therefore do not yield the most, and sometimes any, calculable advantage. In the latter case they often do even more harm than good in the very things which were sought to be saved by their means."

Perris and Decaux of France in the seventies and eighties advocated strongly the use of parasites, and Berlese and Del Guercio of Italy, later recognized and emphasized the value of entomophagous insects rather than insectivorous birds.

In this conection it is interesting to note Silvestri's own opinion. He says: "I, for my part, believe that the usefulness and the harm of insectivorous birds balance each other, and that more frequently the former may be superior to the latter, considering things only from the viewpoint of immediate agricultural interest."

Insects and Animal Diseases.

The relation of insects to animal diseases is now well known. The Anopheles mosquito carries the malarial organism, the Stegomyia mosquito the yellow-fever organism, the house-fly tubercular, typhoid fever and other germs, tsetse flies the trypanosomes of the terrible "sleeping sickness" of Central Africa, rat-fleas plague germs, lice typhus fever germs, etc. There is no longer any doubt as to the inter-relationships that exist in this part of the web of life.

Again, fishes furnish another link in the chain connecting mosquitoes and malaria. As is well known, certain fishes feed upon mosquito larvæ, and in many districts are undoubtedly instrumental in regulating the amount of malaria. It is believed that the presence of the small fish called "millions" in Barbados is the reason why that island is so free from malaria.

Rabbits are not only a direct cause of great losses to the Australian farmers, but also in directly developing the blow-fly pest which is very destructive.

3. Insects and Plants.

We are familiar with the enormous losses produced every year by the action of insects and fungous diseases on our cultivated crops. But we should not fail to look at the other side of the shield, and ascertain how many plants are dependent upon insects for their fertilization and the production of seed.

Elsewhere (*In the Third and Fourth Reports of the Quebec Society for the Protection of Plants*) I have discussed the relations between insects and plants, and their value as pollinators of useful plants. In this connection I may quote Dr. Phillips' remarks regarding the value of the honey-bee: "The production of millions of dollars worth of fruit depends largely on insect pollination, and no insect is so important in this work as the honey-bee. It is a most conservative estimate to claim that the honey-bee does more good to American agriculture in its office as a cross-pollinator than it does as a honey-gatherer."

In the relation of insects to plant diseases, two aspects present themselves, viz. 1, the rôle of insects as disease-carriers to plants, and 2, the role of fungous diseases in destroying insects.

It is clear that if these relations are to be thoroughly investigated, the economic entomologist must work in close co-operation with the plant-pathologist.

With regard to the part played by insects as disease-carriers to plants, I cannot do better than refer you to the excellent paper by Prof. Caesar read at the last meeting here (1918 Report Ont. Ent. Soc.), and to the article by Mr. E. M. DuPorte in the 11th Report of the Que. Soc. Protection of Plants (1918-19) where the subject is fully discussed.

An interesting relation is the double-host relation of many aphids. Nearly every year adds to the number of aphids that have this relation, and future studies will perhaps furnish an explanation of this interesting movement in early and late summer to the host plants. The relation is of interest to the economic worker as it suggests additional means of control.

Another inter-relation somewhat closely related to the foregoing is that of useless plants and insects. One instance will suffice. The hawthorns act as hosts for many insects that are injurious to the apple. It is clear that this relationship demands more careful study by economic entomologists.

With regard to the utilization of fungous and protozoan diseases[1] in insect control, it may be said that many experiments have been conducted within the last thirty years with the object of controlling injurious insects through the artificial production of epidemics of fungous diseases. As in the case of parasitism, unexpected difficulties have appeared under field conditions. It was soon discovered that "fungi are very dependent upon external conditions, and in many cases the apparent absence of a particular fungus in a locality is usually an index of conditions unfavorable for its development and an artificial introduction will be useless." (Glaser).

Out of the large number of experiments that have been carried out, I shall briefly refer to a few of the most outstanding ones. Franz Tangl in 1892 used spore emulsions of *Botrytis bassiana* against the caterpillars of the nun moth of Central Europe. While the experiments were eminently successful in the laboratory where all the infected caterpillars died of "muscardine," those carried on outdoors gave negative results. Tubeuf also obtained like results with *Cordyceps militaris.*

Many of us perhaps are familiar with the work of Snow and Forbes in connection with the artificial use of *Sporotrichum globuliferum* against chinch bugs. Later Billings and Glenn also carried on experiments with the same fungus. Their results are summarized as follows:—

"1. In fields where the natural presence of the fungus is plainly evident, its effect on the bugs cannot be accelerated to any appreciable degree by the artificial introduction of spores.

"2. In fields where the fungus is not in evidence, spores introduced artificially have no measurable effect.

"3. Apparent absence of the fungus among chinch bugs in a field is evidence of unfavorable conditions rather than lack of fungous spores.

"4. Laboratory experiments can be made to prove that artificial infection accomplishes results upon bugs confined in cramped quarters and without food, but in the field, where fresh and usually drier air prevails and food is abundant, an entirely different situation is presented."

In 1912, Morrill and Black experimented with the artificial use of the white fly fungi, *Aegerita webberi, Aschersonia aleyrodis and A. flavocinta.* They summarized their conclusions in these words:

(1) European botanists, such as DeBary and Tulasne, about the middle of the last century, called attention to the importance of white muscardine (*Isaria Densa* Link.) as a check on many insects. Metchnikoff, and Krassilstscik cultivated the green muscardine (*Metarhizium anisopliae* Sorokin) for the control of Anisoplia and the beet weevil (Cleonus punctiventris).

Efforts have also been made to check the white grub in Europe by means of *Cordyceps melolonthae* Tul., *Isaria densa,* and *Botrytis tenella* Sacc.

"1. The fungus parasites thrive only under suitable weather conditions during a period of about three months each year; generally speaking the summer months in the case of the two Aschersonias and the fall months in the case of the brown fungus.

"2. Under natural conditions, without artificial assistance in spreading, the fungi have ordinarily, in favored localities, controlled the white fly to the extent of about one-third of a complete remedy through a series of years.

"3. The infections secured by artificial means of introducing fungi, while successful in introducing fungi, have thus far proved of little or no avail in increasing their efficacy after they have once become generally established in a grove.

"4. Experiments by the authors, and by citrus growers in co-operation with the authors, involving the treatment of thousands of trees with suitable 'checks' or 'controls' have shown that when fungus (red or yellow Aschersonia) even in small quantities is present in a grove, there is no certainty that from three to six applications of fungus spores in water solution will result in an increased abundance of the infection on the treated blocks of trees by the end of the season. In some of the most important and carefully planned and executed experiments, the fungus has increased more rapidly in sections of the groves which were not sprayed with spore solutions than in the experimental blocks."

The brown-tail caterpillar is attacked by the fungus *Entomophthora aulicae,* and an attempt was made by Speare and Colley in 1912 to use it in the control of the pest. They state that considerable success has attended their efforts, not that the fungus is a "cure-all" but it is a powerful check. Under proper conditions of introduction from sixty-three to one hundred per cent. of the caterpillars can be destroyed.

Reference has already been made to the "wilt disease" of the gipsy-moth caterpillars as a factor in the control of these pests in New England. It made its appearance about 1900, and is now distributed over the territory infested with the gypsy moth, according to Glaser. It is an infectious disease but epidemics occur only in localities infested heavily with the gypsy moth. Infected caterpillars became flaccid, and later their tissues disintegrate completely, due to the fermentative and toxic nature of the virus. The brown liquid of a dead caterpillar shows under the high power of the microscope large numbers of polyhedral bodies of various sizes, but the exact nature of the casual organism has not been determined. The virus is filterable with difficulty.

The success of wilt infection experiments is absolutely dependent upon attention to seemingly insignificant details, but this much is known, that infection takes place through the mouth by means of the food.

It is possible that further studies of the disease will evolve some practical method of using the virus for the destruction of larger numbers of the caterpillars. Already, however, it has been ascertained that climatic conditions appear to bear an important relation to wilt in the field, and that temperature has an important relation to the period of incubation of wilt.

4. The Relation of Insects to Inorganic Nature.

This relation has also been investigated by many workers, for it has long been known that insects are influenced profoundly by climatic conditions. The effects of changing and unusual conditions of heat and cold, snows and rains, humidity and dryness, and other seasonal changes have long been known to be important factors in regulating the number of insects.

A variable winter is more fatal to most forms of insect life than a continuously severe or a continuously mild winter. When insects go into hibernation they become torpid and are able to resist quite low degrees of cold, but if thaws occur they may become partially active for a short time. With every change of this nature the insect loses vitality and this loss may prevent transformation in the spring. Moreover, the effects of thaws in breaking up larval and pupal cells in the ground are often quite marked.

Sudden changes of temperature of say thirty degree range within a few hours, which are quite common in our latitude, are very fatal to aphids and many caterpillars during their early stages.

Another feature of the environment of insects is the different degree of humidity demanded by each species or genus. Some insects like the thrips, chinch bug, wheat midge and red spiders are more abundant under dry conditions, while other insects like the plant lice and Hessian-fly develop best under moist conditions.

Observations seem to show that meteorological changes are often fatal to those insects that live on the fringe of their distributional range. Under favorable conditions some insects may migrate northward, and even do much damage, but such movements may be termed *incursions,* as they are temporary and spasmodic in their character.

The range of distribution of different insects has been mapped ,and this has shown that insects tend to conform to the same zonal distribution as plants, birds and mammals. Dr. Hopkins, of Washington, has extended our knowledge of the Bioclimatic Law and has shown how it may be utilized by the economic entomologist in solving some of his problems. (See Article in 1919 Report of this Society.)

The recent study of tropisms appears to show that the movements and conduct of insects are often the result of stimuli proceeding from the inorganic world, such as *light, gravitation, heat, electricity, moisture, pressure,* and *chemical substances.* Already many interesting observations have been made and a few of these have an economic bearing.

It seems to me that this field of study, viz., the reactions of insects to stimuli, is full of great possibilities for the economic entomologist. In the future, when our knowledge of tropistic responses has greatly increased, we may expect to see the introduction of many modifications of our present methods of control.

He who studies attentively any common plant or animal may form a conception, often an imperfect one, of the widely extending lines and cross lines of inter-relationships with other plants and animals. The work of science is to classify and describe these inter-relations, and in this line much progress has been made since Darwin's day. The economic entomologist and botanist, who are specially interested in the control of injurious insects and plants, must keep constantly in view this idea of relationships in Nature if they would deal successfully with the problems confronting them.

At the recent meeting of the American Association of Economic Entomologists at Philadelphia many prominent leaders emphasized the necessity for a more thorough biological study of all injurious forms. In other words, more attention should be given to ecologic or bionomic relations, that is, to the study of the Web of Life.

A knowledge of inter-relations, even in departments not usually considered in close alliance, is often essential in unravelling the intricate pattern of life's web.

"Over a ploughed field in the summer morning we see the spider-webs in thousands, glistening with dew-drops, and this is an emblem of the intricacy of the threads in the web of life—to be seen more and more as our eyes grow clear. Or, is not the face of Nature like the surface of a gentle stream, where hundreds of dimpling circles touch and influence one another in an intricate complexity of action and reaction beyond the ken of the wisest ?"—(Thomson).

CONFERENCE ON THE EUROPEAN CORN BORER.

Mr. Gibson, in introducing the subject, discussed in general the corn borer situation in Canada and stated that the pest had been found in southern Ontario on August 10th, 1920. He also gave a brief account of visits which he had made to Massachusetts and New York States where the borer has become established, and referred to important conferences held in Ontario to discuss our infestations. The methods of control which the Entomological Branch had recommended were mentioned. Investigational studies were being made by the Division of Field Crop and Garden Insects chiefly by Mr. H. G. Crawford. The quarantine and scouting work was being done by the Division of Foreign Pests Suppression, under the direction of Mr. L. S. McLaine, Chief of the Division.

Mr. McLaine outlined the work that had been carried on by the Entomological Branch since the corn borer was found in the vicinity of Boston in 1917. The first steps taken were in the spring of 1919 when scouting work was undertaken in the Maritime Provinces and all shipments of corn on the cob from the infested areas in Massachusetts were traced. With the finding of the European Corn Borer in Western New York in the fall of 1919, two Canadian scouts were sent to the New York territory to receive training. Later in the season they scouted Welland County, particularly along the Niagara River.

Early in August, 1920, scouting was again started in southern Ontario and on August 10th, the first infestation was found at Lorraine Station, Humberstone Township, Welland County. The scouting was finally completed on October 23rd. Thirteen counties in all were scouted of which seven were found to be infested. One hundred and five townships were visited of which thirty-five were infested. As a result of the scouting work two distinct infestations were uncovered.

Infestation No. 1 extends along the Lake Erie shore from Fort Erie on the east to Dunnville on the west and about ten miles inland. This infestation covers approximately 340 square miles.

Infestation No. 2 extends along the Lake Erie shore from Bayham township on the east, to Harwich on the west and from Farquhar, Usbourne township, Huron County, on the north to the Lake shore. This infestation covers approximately 2,440 square miles.

Prof. Caesar stated that as soon as he learned of the discovery of the insect, he visited the district, and then appealed to the Ontario Department of Agriculture for the use of a Ford car and the appointment of two scouts. This request was granted and the men joined the Dominion forces and remained on the work until the close of the scouting. One of the scouts, Mr. Garlick, was then assigned to make field observations and prepare for next season's investigations. He made estimates of the percentage of larvæ in the stubble, and also treated stubble in various ways to see the effect of the winter on the larvæ under different conditions.

All the District Representatives of the western portion of the province were called together, and a field meeting was held in some of the worst infested fields near St. Thomas. The life history of the insect was explained, and means of control outlined. Later in the season a similar meeting was held with the District Representatives in the eastern portion of the province.

He realized that the European Corn Borer was a serious pest, and that the handling of the situation was a serious problem, but he was optimist enough to believe that the combined efforts of the U. S. Bureau of Entomology, the Entomological Branch and the Ontario Department of Entomology, would result in the discovery of a practical method of control and that the corn industry would be saved.

Mr. Worthley (in charge of the corn borer field work) of the U.S. Bureau of Entomology stated that in 1919 the state of Massachusetts appropriated $100,000. for corn borer control. This was the first large appropriation for the control of this pest. On July 1st of the same year the U.S. Federal appropriation of $250,000 was made available.

At the present time a total of 5,651 square miles are infested by the pest in the United States.

The New England infestation covers			3,350 square miles.		
" eastern New York	"	"	1,365	"	"
" western New York	"	"	936	"	"

Mr. Worthley pointed out the difficulty of handling the corn borer situation in Massachusetts, particularly in the vicinity of the market gardens. It was found that the weed infestation was very heavy in certain market garden sections and it was stated that in a ten acre weed patch adjacent to some celery fields the number of corn borer larvae probably averaged two million to the acre. In order to overcome this difficulty extensive operations were carried on in burning over these districts. When the burning was first started fuel oil was used but this grade of material deteriorated so that it was necessary to replace it with kerosene oil which was purchased in 50,000 gallon lots.

In addition to burning, extensive experiments were carried on with weed killers and in some localities were found to be generally satisfactory.

As regards the control work in western New York extensive experiments were carried on in the mowing of corn stubble close to the ground. The stubble after being cut was collected and thrown into a machine for crushing.

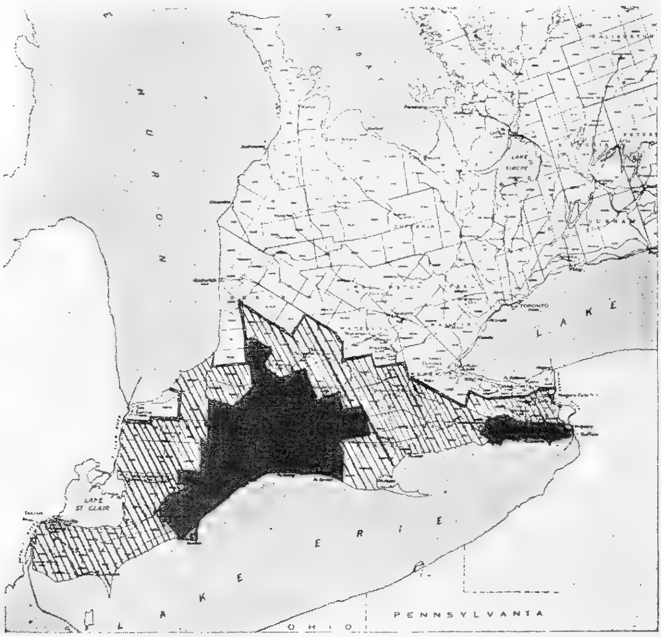
Potato diggers have also been experimented with for the purpose of taking out stubble but these were not found practicable in all cases on account of the fact that whereas they work satisfactorily in sandy soil a great deal of trouble is encountered if the soil is at all heavy or wet.

In addition to the control work the quarantine of the infested territory has to be maintained. This necessitates the inspection of all plants liable to harbour the corn borer consigned to points outside the area infested by the pest. Eighty inspectors are now engaged on this inspection work and up to the present time 500,000 inspections have been made.

European corn borer egg clusters have been found on celery, beans, rhubarb and spinach. Chrysanthemums have also been found to be infested with the borer in the greenhouses and markets.

Mr. Walton, Entomologist in charge of Cereal and Forage Insect Investigations, briefly stated his Division was continuing a series of investigations on the biology, habits, etc., of the corn borer and had established a laboratory at Arlington, Mass. Branch laboratories were also located in the vicinity of Schenectady and Silver Creek, N.Y.

In addition to the investigational work arrangements were being completed for the importation of parasites from Europe. A laboratory was also established at Auch, France, in charge of Mr. W. R. Thompson. It was expected that a large importation of parasites would be made this coming winter. It is also expected that additional laboratories would be established in Europe as necessity arose.



Map of Western Ontario, showing area scouted for European Corn Borer in 1920. Townships in solid black were found to be infested, those crossed by the diagonal lines only, were scouted but no borers were found.

Mr. Crawford spoke in general of his investigations in the Union Village area about six miles from St. Thomas, Ont., in the autumn of 1920. It was in this area, an essentially flint growing region where the greatest infestation was found. In some fields from 70 to 99% of the stalks were infested, while pure stands of dent corn in the same vicinity had a 45% stalk infestation.

One field of flint corn in which 93% of the stalks were infested had been studied closely. The attack in this field was distributed over the different parts of the plant as follows: Tassels, 50% injured; nodes, 17%; internodes, 25%; cobs, 55%; shanks, 51%; nubbins, 45%; stubble, 29%. This infestation resulted in the falling of 50% of the tassels, a devouring of 3% of the kernels and a breaking down of 42% of stalks at one or two points.

Mr. Crawford referring to the infestation in dent corn stated that this variety was very markedly less intensely attacked than flint corn and the effect upon the plant much less. Thus the field of dent corn 45% infested lost but 7.7% of tassels and only 8% of the stalks were broken over, almost no cobs infested and the stubble but very slightly infested. Even in a mixed field of flint and dent corn where the flint cobs were 38% infested, the dent corn showed but 9%.

NOTES ON THE CONTROL OF THE ROSE MIDGE.

William A. Ross,

Dominion Entomological Laboratory, Vineland Station.

At the annual meeting of this Society held at Guelph in 1916, Mr. Arthur Gibson, of the Dominion Entomological Branch, directed your attention to a serious greenhouse pest—the rose midge—which recently had been introduced from United States into Canada.* At that time, it was present only in one greenhouse, but since then it has been found in seven other greenhouses.

The experience of florists, both in United States and Canada, has shown that this insect when present is by far the most destructive pest of roses. In 1919 its depredations in one Ontario greenhouse caused a loss of twelve thousand dollars, and in another six to seven thousand dollars.

The following description of the injurious habits and life history of the rose midge is taken from a short article, which the writer published in the Agricultural Gazette of Canada, Vol. 6, No. 2, Feb. 1919.

NATURE OF INJURY. "When very abundant, the larvæ of the midge—whitish maggots—may be found feeding on any succulent part of the rose bush, as for instance, at the base of the flower buds, within the buds, on the upper side of tender leaves, and on leaf petioles. However, the usual point of attack is on the young shoot in the axil of a leaf petiole. Infested shoots grow crooked, and, as a general rule, wither and die. Affected flower buds, when not killed outright, may be so disfigured as to be unsaleable."

LIFE HISTORY. "The adult insect is a fragile two-winged fly, less than 1/16" in length. The female deposits her eggs between the folded leaves of the leaf buds, and to some extent in the axils of tender leaves and between the sepals and petals of the blossom buds. Under greenhouse conditions the eggs hatch in about two days. The maggots, as previously stated, feed on the tender tissues of shoots and buds, and become mature in from five to seven days. They then drop to the soil, change to the pupal stage and emerge as adult flies in about six days."

"The midge is most abundant and destructive during summer. With the coming of autumn it declines in numbers and by winter wholly disappears from the rose plants. It remains dormant in the soil through the winter months, and does not reappear again until the last of February or early March."

CONTROL. Various methods of combating this pest have been tested or at least recommended—and among others the following:

CROP ROTATION AND THOROUGH CLEANING OF HOUSE IN MID WINTER. At the time the attention of the Entomological Branch was first directed to this pest only two reliable methods of controlling it were known, namely: (1) the growing of another crop instead of roses for one year, and (2) the destruction of all the plants and the removal of the soil in mid winter. Both of these methods would entail a very serious derangement and loss in business, and for this reason the growers refused to consider them until all other possible remedies had been exhausted.

* The Superintendent of the Dale Estate, Brampton, informs me that a pest, which he believes was the rose midge, was present in one of the Dale rose beds fifteen years ago. It was very destructive that year, but wholly disappeared after the soil in the infested bed was thrown out in March.

CHANGING THE SOIL ANNUALLY. The value of changing the soil annually as a method of controlling rose midge, supplemented by the pinching off of all infected buds, has been proved by the experience of the Bedford Park Floral Co., Toronto. According to the foreman, the midge has been present in these greenhouses for the past four years, and although at times it has been fairly abundant on Ophelia roses, it has never increased to such an extent as to cause any serious loss. The soil in these houses is removed and replaced annually during the period early May to the first of July. Infested buds have always been destroyed as soon as they were noticed.

LIQUID BAITS. Several experiments were conducted at Grimsby in 1919, in order to determine if it were possible to trap the adult midges by means of liquid baits. Pans containing various mixtures with the following substances used as lures—molasses, oil of citronella, oil of lemon, oil of rhodium, oil of cloves, kerosene, cresol—were suspended among the rose bushes, and were left for two or three weeks. A considerable number of Diptera were caught in the pans, but not one of the "catch" proved to be a rose midge—most of the insects were fungus-gnats.

DRYING OFF. Although this method has not been tested, it seems certain that the rose midge could be exterminated in a greenhouse by drying off all the rose plants at the same time during the summer. As there would be no tender shoots on the plants for at least four weeks, the midge would die of starvation.

TOBACCO FUMIGATION AND DESTRUCTION OF INFESTED BUDS. Since 1916 Messrs. Miller & Sons, Toronto, have been combating the midge by means of tobacco fumigation and pinching off and destruction of all infested buds. At first they made a practice of fumigating for a period of three or four weeks in spring, and again whenever the midge became troublesome, but as this method did not wholly eliminate serious midge injury, they changed the system this past year, and fumigated every other night from early April to the last of October. This kept the insect down to insignificant proportions all season, and as a result no damage worth mentioning was effected.

The disadvantages of this remedial measure are (1) that in places where tobacco stems are not easily procured and where commercial nicotine preparations would have to be used, it is very costly: (2) that it does not wholly eradicate the pest: and (3) that according to some florists frequent fumigations stunt the growth of the plants.

NICOTINE FUMIGATION AND TOBACCO DUST TREATMENT. In 1916 Messrs. Sasscer and Borden * of the United States Bureau of Entomology, having determined by cage experiments that a covering of tobacco dust on the rose beds would prevent the full-grown larvæ from entering the soil, conducted the following experiment in a midge infested house in Maryland. All the rose beds were covered on October 12th, 1916, with tobacco dust averaging from one fourth to one half inch deep. To prevent the larvæ from entering the dirt walks of the houses, all walks were sprayed with kerosene emulsion. Simultaneously nightly fumigation with tobacco stems was inaugurated and continued until October 30th, inclusive, and from that date until November 8th the houses were fumigated every other night. The object of this fumigation was to kill all adults before eggs were deposited.

The results secured from this experiment were excellent—the midge was practically eradicated.

* The Rose Midge—Bulletin No. 778 of the United States Department of Agriculture.

TOBACCO DUST TREATMENT. The results secured by Sasscer and Borden with tobacco dust were, later on, confirmed by laboratory experiments at Vineland Station. These experiments furnished us not only with positive evidence that a coat of tobacco dust would kill the full-grown larvæ which dropped from the plants, but also that the nicotine absorbed by the soil from the dust would destroy the midge pupæ and larvæ in the soil. In short, our laboratory tests indicated that in combating the midge it was not necessary to supplement the soil treatment by nightly fumigation with nicotine. In view of the cost of nightly fumigation the importance of this discovery is apparent.

For various reasons we were unable to give the tobacco dust remedy a trial under commercial conditions until this year, when it was tried out in four greenhouses.

OLFIELD'S GREENHOUSES. Messrs. Olfield and Sons' establishment at Grimsby, with 250,000 sq. ft. of glass, and containing some 85,000 rose plants, was very heavily infested with midge in 1919, when the insect caused a loss of approximately $12,000. At the time operations were commenced against the midge practically one hundred per cent. of the young growth of all the susceptible varieties was infested.

During the second week of August the fallen leaves on the beds were removed and the soil was tamped in order to break up lumps and to make the surface as smooth as possible. The beds were then thoroughly drenched with water, and a coat of tobacco dust one-fourth to one-half inch thick was applied, great care being taken to cover all parts of the beds (35 tons of dust used). As an additional precaution all the walks were sprayed with kerosene emulsion, in order to kill any larvæ which might have fallen from the plants to the walks. For two weeks after the dust was applied the foliage was syringed occasionally, but the beds were not actually watered. Our object in withholding the water was to prevent the washing of nicotine out of the dust until all the larvæ present on the plants had dropped to the soil.

RESULTS. The establishment consists of three ridge and furrow houses, which, for the sake of convenience may be referred to as Nos. 1, 2, and 3. In houses 1 and 3 absolutely no larvæ, with the exception of some present on the plants for a short time after treatment, have been found since the application of the remedy. In No. 2 a few infested Ophelia buds * were discovered on September 11th. All these buds were immediately destroyed, and the section in which they were discovered was promptly treated again with tobacco dust. Since this second treatment no midge has been seen up to the present.

It is of interest to note that the application of kerosene emulsion to the walks caused a very small percentage of the foliage of White Killarney to drop. The plants, however, were not injured to any appreciable extent.

DALE ESTATE. The Midge, introduced into this large plant in 1919, had established itself in three houses, and was causing serious loss. Early in July of the present year, from 300 to 400 infested buds were pinched off and destroyed daily in the worst affected section.

Operations were commenced against the midge about mid July. The beds were cleaned up, tamped, and were then carefully covered with tobacco dust, (38 tons used). At the same time the sidewalks were sprayed with kerosene emulsion.

* We have good reason to believe that this infestation came from affected buds thrown under the benches by a careless grower.

RESULTS. Excellent results were secured from this treatment. With the exception of some larvæ present on the plants for a short time after treatment, no midge has been seen up to the present.

OTHER CORROBORATIVE RESULTS. The tobacco dust remedy proved equally effective in two other greenhouses—one in Toronto and the other in Grimsby.

It is of interest to note that at Ivey's Conservatories, Port Dover, good results in the control of midge were secured by covering all the rose beds early in the season with a heavy coat of finely cut tobacco stems. The beds were watered as usual, and it would appear that the nicotine washed in this way from the stems destroyed practically all the insects in the soil, because throughout the season no infested plants were found except in one section. This particular section was treated with tobacco dust in September, and Messrs. Ivey are now pretty confident that they have wholly eradicated the pest.

SOME MOSQUITO PROBLEMS OF BRITISH COLUMBIA.

Eric Hearle, Entomological Branch, Ottawa.

British Columbia has many serious mosquito problems with which to cope. She is not alone in this respect, for, on the Atlantic coast, in Northern Ontario and Quebec, and in certain of the Prairie provinces, mosquitoes occur in such numbers as to be of economic importance. The mountain province has, however, conditions and problems peculiar to herself, which are very different from those found elsewhere in Canada.

In British Columbia the huge ranges of mountains and the rivers fed by their melting snows constitute the main factors determining mosquito abundance. Other important factors are the climatic conditions, which determine whether the snow shall melt gradually or shall melt so suddenly that the rivers are unable to carry off the water sufficiently fast to prevent the flooding of the low-lying lands. The main mosquito problems of British Columbia are caused by those species of the mosquito fauna which breed in the flooded bottom lands bordering the rivers.

The Lower Fraser Valley Problem.

For the last two years a detailed study has been conducted of the serious mosquito problem presented in the Lower Fraser Valley. By means of automobile, motor boat and canoe, larval and adult surveys were made over an area of more than two thousand square miles. These, life history and laboratory experiments, and aerial surveys over some of the main breeding areas have resulted in the accumulation of sufficient data to indicate the important factors in the problem.

The Fraser river emerges below Hope from the precipitous, rocky, Fraser canyon into the Fraser delta—a broad low-lying valley of over two thousand square miles. The low elevation may be gauged from the fact that at the town of Mission, about forty miles from the coast, the altitude is only twenty-one feet above sea level. The dyking of huge tracts of land has appreciably reduced the mosquito breeding places; but there remain along the river many extensive low-lying areas capable of flooding at high freshets, and which are the cause of the mosquito trouble in the district. The height of freshet varies considerably. In 1919, the river rose 17′ 4″ (at Mission) and there was no mosquito pest. In 1920, the river rose 21′ 0″ (at Mission) and a very serious pest resulted.

It is very hard to estimate with accuracy the losses involved when a fairly thickly settled district such as the Fraser Valley is subject to the attacks of hordes of blood thirsty mosquitoes, but there are very few industries necessitating outside labour that are not seriously affected. The picking of small fruit is hampered, general farm labour is hard to obtain, work in the woods is almost impossible and, in 1920, most of the labour camps in the affected district were closed during the worst of the scourge. In places, the construction of roads and highways was held up. Cattle became emaciated and the drop in milk production was very marked. During 1920, in the worst affected places, even hens stopped laying eggs as they were unable to rest at night owing to the attacks of mosquitoes. In spite of screens, mosquito dope, and the general use of smudges, the inhabitants of the affected district suffer terribly from the winged pest that makes life a misery.

The Lower Fraser Valley has a fairly rich mosquito fauna, twenty species coming to hand during the two years, 1919 and 1920. Of these, two only constitute the really serious pest as conditions are not suitable for the development of the others in very large numbers.

Flood Water Mosquitoes.

Aedes aldrichi Dyar and Knab. This is a very small sage-grey mosquito with a central, divided brown line on the thorax. The abdomen has crisp, white bands, and the legs are dark and unbanded. The species is the dominant one in the Lower Fraser Valley, and breeds mainly in the flood pools in the alder-bottom areas bordering the river. The larva, previously unknown, was taken for the first time by the writer this summer. The only other records we have of this insect come from Idaho and Montana.

Aedes vexans Meigen. A medium-sized, dusty-brown mosquito. The abdominal bands are strongly constricted in the centre and the legs have small rings at the base of the tarsal segments. This species is second in importance in the Lower Fraser Valley and although not so abundant as *Aedes aldrichi,* it sometimes occurs in enormous numbers. Open flooded meadows and prairies are the main breeding places, although great numbers also breed in the alder-bottom flood pools. The species is a very common one both in Europe and America.

Aedes cinereus Meigen. A very small species with a rusty brown thorax and unbanded black legs. The abdominal segments are usually unbanded but there is a broad, white stripe along the side of the abdomen. The species is a fairly common one in the Lower Fraser Valley but is comparatively unimportant. The larvæ are found in shallow protected surface pools, as well as in flooded alder-bottoms.

General Breeders.

Culex tarsalis Coquillett. This fairly large brown mosquito has a very striped appearance. The legs have broad bands at the base and apex of the tarsal segments and the proboscis has a broad crisp stripe, the abdomen is fairly broadly banded. The thorax is dark chestnut brown and is ornamented with fairly distinct markings. The tip of the wing has an indistinct patch of yellow scales Although generally distributed throughout the valley, this species is not a very abundant one. It is a vicious and persistent biter, and enters houses. The larvæ are found in a great variety of habitats, roadside ditches and open flooded meadows being the chief among them.

Anopheles punctipennis Say. The yellow and black patches on the wings are the distinguishing feature of this mosquito, which is the commonest anopheline in the district. The poison is very irritating and the insect shows great persistence in entering houses. The larvæ are ubiquitous. Fortunately this species does not occur in abundance in the district.

Culex saxatilis Grossbeck. A very small dark culex in which the white abdominal bands are at the apex of the segments, instead of the base. The legs are dark and unbanded, and the brown thorax is ornamented with two paler spots. This mosquito is very generally distributed in the valley and is fairly common. It is of no importance, however, as it is non-predaceous on warm-blooded animals. The larvæ are found mainly in surface pools and ditches, especially those protected by willow and other growth.

Woodland Mosquitoes.

Aedes punctor Kirby. This is the commonest mosquito in deep woodlands and in wooded mountain areas. It is a fairly large, dark, robust species with a yellowish grey thorax having a broad, central, brown band. The abdominal segments have narrow white bands and the legs are dark and unbanded. Although not a very vicious biter, this species is troublesome in localized areas, as it sometimes occurs in great abundance. It is restricted to woods and the larvæ breed in temporary woodland pools.

Aedes varipalpus Coquillett. This is a very beautiful black and white mosquito. The tarsal segments have broad, white basal bands and the white abdominal bands are V shaped, being narrowed at the sides and broadened centrally. The thorax is beautifully ornamented with a variegated pattern of black and white. Although it is a bad biter, the species is of no importance as, although very generally distributed, it is never abundant. It is a woodland species and breeds in treeholes. The males will hover around and settle on the person, as well as the females.

Aedes canadensis Theobald. This species has a light brown thorax. The legs are banded at the base and apex of the tarsal segments, and the ultimate hind tarsal segment is entirely white, The black abdomen has indistinct white bands at the base of the segments. This is essentially a woodland species. It is very rare in the Lower Fraser Valley.

Aedes fletcheri aloponotum Dyar. This large red-brown mosquito has broad white bands on the legs at the base of the tarsal segments. The abdomen has broad white basal segmental bands, and the thorax is brown and unornamented. It is rare in the district and is found mainly in wooded areas.

Salt Marshes and Coastal Pools.

Aedes curriei Coquillett. A very beautiful fawn-coloured species. The legs have small bands at the base and apex of the tarsal segments, and the abdomen has a broad longitudinal stripe as well as basal segmental bands. The thorax is straw-coloured and is ornamented with a median and sublateral brown stripes This species was taken only along the coast-line and on outlying islands. Larvæ are found in brackish water in rock pool and salt marshes. It is seldom sufficiently abundant to be of importance.

Permanent Swamps.

Mansonia pertubans Walker. This stoutly-built, dusty-looking mosquito is easily recognised by the mixture of broad black and white scales clothing the wings, the striped proboscis and abdomen, and the striped legs in which the tarsal segments have broad basal stripes and the hind tibiæ have also broad stripes. The poison of this species is more virulent than that of any other Canadian mosquito, but fortunately the species is a rare one in the Lower Fraser Valley. It breeds in permanent swamps where there is much vegetation. The larvæ and pupæ do not come to the surface to breath, but remain attached to the submerged portions of certain aquatic plants.

Artificial Receptacles and Small Collections of Waters.

Culiseta incidens Thompson. This is the common rain-water barrel mosquito of British Columbia, and is one of the most abundant mosquitoes of the Lower Fraser Valley. Fortunately the blood-lust is so poorly developed that the species is practically non-predaceous on man. The very large size, dark appearance, and the black spots on the wings render the species an easy one to recognize. The abdomen is truncate at the tip and has broad white basal bands. The thorax is ornamented with indistinct markings and the legs have very indistinct bands at the apices of the tarsal segments. The larvæ, although preferring rain-water barrels to other breeding places, are to be found in a great variety of habitats, even having been taken in brackish coastal pools in company with *Aedes curriei.*

Culex pipiens Linnæus. This mosquito has probably only recently been introduced into British Columbia, as it was found only in Vancouver and was very scarce there. It was probably brought in by shipping, as it is known to have been very widely spread in this way. The species is one without very outstanding characters. The abdomen has crisp white basal bands, the legs are dark and unbanded and the thorax is a dusty reddish-brown. Although rain-water barrels are the favorite larval habitats, the larvæ are to be found in almost any collections of water round houses. *Culex pipiens* is essentially a domesticated species whereas *Culiseta incidens* is in the transition stage and is only semi-domesticated.

Miscellaneous.

Culiseta impatiens Walker. This very large brown mosquito is fairly common in the Lower Fraser Valley, but is of little economic importance. The legs and prosboscis are brown and unbanded and the thorax is clothed with brown scales. The abdomen has broad basal segmental bands.

Culiseta inornatus Williston. This mosquito is very hard to distinguish from the last. The color is somewhat paler and the cross-veins on the wings are scaled, unlike *C. impatiens,* in which they are bare. This species is comparatively rare.

Culiseta alaskœnsis Ludlow. This species is larger and darker than the above two, and is easily recognized by the indistinct spots on the wings and the distinct white basal bands on the tarsal segments. It is a very rare mosquito in the Lower Fraser Valley.

Besides the above, two other species were found which have not yet been identified; one of these, a rare species from the Fraser Canyon, appears to be new to science.

Eucorethra underwoodii and *Sayomyia trivittata,* two interesting insects very closely allied to the true mosquito, were also found to be fairly abundant in the district.

In dealing with the mosquito problem of the Lower Fraser Valley only two species need to be given serious consideration. The peculiarities of topography and flooding, at times, provide these two members of the mosquito fauna with satisfactory conditions for developing in enormous numbers. The reclamation of the low lands bordering the river, by dyking and pumping, has proved to be the most effective control measure, whenever it has been undertaken in an efficient manner. While much dyking has been done, huge breeding areas remain unreclaimed and produce little but mosquitoes. An aerial survey is to be undertaken next year to map out the unreclaimed areas capable of flooding, and it is believed that when these large breeding places have been dealt with, the mosquito pest will cease to be a source of misery and financial loss to the inhabitants of the affected parts of the valley.

Other Southern British Columbian Mosquito Problems.

During the past two years a number of brief surveys of mosquito conditions in other parts of British Columbia were undertaken. The Columbia valley, the Arrow-lake district, the Slocan valley, the Osoyoos valley and other places were visited. Although the details of the problem, the species involved, and the intensity of the pest at different places varied considerably, the basic factors in the problems appeared much the same, the flooding of breeding areas through the quick melting of the snow at the mountain sources of the rivers. *Aedes vexans* was found to be a very constant species, but the fauna of the different valleys varied considerably; *Aedes punctor* replaced *Aedes aldrichi* as the dominant species in the more deeply wooded, less developed valleys, while still other species, not found in the Lower Fraser Valley, were dominant in the drier, more arid regions. As the surveys were very brief and incomplete, these species will not be dealt with here, but enough has been said to indicate the enormous field for valuable research that British Columbia offers to those interested in the study of Mosquito Control. The problems are of vast importance and their satisfactory solution can only be arrived at as a result of careful faunal and topographical investigations.

REPORT ON INJURIOUS INSECTS IN QUEBEC DISTRICT FOR 1920.

Georges Maheux, Provincial Entomologist, Que.

From the viewpoint of injurious insects, we have not experienced, during this last summer, any higher damages than the previous year. It is to be noted that most of those insects which are usually prevalent were rather scarce this year; and this especially proved true of two species, *Hemerocampa leucostigma* (Sm. and Ab.) and *Vanessa antiopa* L. The few serious cases we have on record were generally restricted to a limited area. On the whole, no regular outbreak has been observed.

Ornamental and Shade Trees. The most remarkable thing in this group of plants was the large increase of poplar borers, *Cryptorhynchus lapathi* Linn., undoubtably due to the fact that shade tree plantations have made enormous progress these last two years. Plants imported from Ontario nurseries and elsewhere are too often infested by this borer. The writer inspected a place where out of eight Carolina poplars set up in May six were literally crowded with grubs and died before the end of August. This situation has rapidly grown into a serious problem requiring our attention without delay.

The bronze birch borer, *Agrilus anxius* Gory, has continued to kill our fine cut-leaved birches at the same rate as last year; in fact, we receive about the same number of complaints each season indicating that the reproduction of the borer is simply normal. From Levis and Portneuf counties injuries to the sugar maple were reported caused by the cottony leaf scale, *Phenacoccus acericola* King. In the city of Levis particularly some maples had their foliage badly infested; consequently, the leaves started to turn yellow and dried by the middle of August. Since 1918, as mentioned above, *Vanessa antiopa* L. and *Hemerocampa leucostigma* Sm. & Ab., have gradually decreased in number; these two species are evidently in a period of depression and, in all probability, will not be worth mentioning for a few years to come. Forest tent caterpillars were so scarce that they hardly deserve mention in a list of actually injurious pests.

VEGETABLES. In our vegetable gardens, the most conspicuous insect was again the cabbage butterfly (*Pieris rapœ,* Linn.). This year, as usual, it was largely distributed and worked havoc till the end of September. Next in importance would come the common cutworms (*Agrotis, Euxoa sp.*) which, in Portneuf county, severed a large number of cabbage and tobacco plants. During June we observed an outbreak of flea-beetles, *Epitrix cucumeris* Harris; for a fortnight they could be seen riddling the leaves of potatoes and tomatoes. Bordeaux mixture sprays drove them away in quick style, and, after all, the damage was smaller than last year. Cabbage and onion maggots (*Phorbia brassicœ* Bouche, *P. ceparum* Mg.) were reported at work in Quebec, Lotbinière and Portneuf counties; onions were the chief victims in most localities, but this could not be taken for a general outbreak, as the occurrence was only local and scattered over widely separated areas.

We may mention the return of an old offender, the old fashioned potato beetle, at Lac-au-Sable, county of Portneuf, which rapidly defoliated the potato plants during the last two weeks of June; this species, *Macrobasis unicolor* Kirby, was nowhere else observed. In July around Quebec city we have noticed an abundance of minute jumping insects belonging to the Thysanura group, which we identified as being *Smynthurus hortensis.* They occured in large numbers at night on beans, but the injury was only slight. Beans were chiefly attacked by garden slugs, which seem to have greatly increased in number since three years. They have a marked preference for moist and low soils. Due to their concentration in rather small sections ten days were sufficient for them to destroy entire bean plots covered with two week old plants. Two species, nearly equally represented, worked together, *Limax agrestis* and *L. campestris;* they also paid a visit later on to cabbages, turnips, cauliflowers and green peas, injuring the foliage or the pods. From Richmond we receive the information that wire-worms have seriously damaged the potato crop tunnelling the tubers, which later, were more suspectible to rot. White grubs were also observed to be numerous in many fields in Eastern Townships. For the first time, the writer collected a celery caterpillar in Quebec city; there was just one specimen.

FRUIT TREES. Early in spring, bud moths (*Tmetocera ocellana* D. & S.) killed a large percentage of buds in neglected family orchards and others not protected by sprays. The worst case was observed at Saint-Nicolas, six miles above Quebec city, along the Saint-Lawrence river. As a logical consequence of this outbreak, the crop has been greatly reduced. Codling moths (*Carpocapsa pomonella* Linn.) and apple maggots (*Rhagoletis pomonella* Walsh) were still numerous, though showing a slight decrease over last year. The same may be said for apple aphis (*Aphis pomi* De G.). We only had a few isolated cases of woolly aphis (*Schizoneura lanigera* Haus.) and none of a dangerous character. Among the late summer caterpillars the red-humped (*Schizura concinna* Sm. & Ab.) is the only one worth mention. Generally speaking, insects caused, this year, much less damage to fruits and fruit trees than fungous diseases.

FIELD CROPS. The writer has inspected a field in lake Saint-John district where locusts (*Melanoplus atlanis* Riley) nearly swarmed especially on sandy hills. Damages were reduced to nothing as means of protection were applied in due time.

FLOWERS. Before closing these remarks I may mention the information given me by a florist, which I was unable to confirm myself. This florist says that an insect has destroyed a very high percentage of flower buds on dahlias. The insect he sends as representative of the pest is nothing but the tarnished plant bug (*Lygus pratensis* L.). I wonder if this is the real offender, as I personally had no opportunity to look after his case. A large number of dahlia plants did not flower at all and the whole trouble is attributed to this species by the gardener. I would be pleased to have the opinion of the members of this society on this point, if they have already met with the same injury and if *L. pratensis* is really the cause of the damage experienced.

THE ENTOMOLOGICAL RECORD, 1920.

Norman Criddle, Entomological Branch, Dominion Department of Agriculture, Ottawa.

The collecting season of 1920 appears to have been more varied than usual. In British Columbia collectors report it as generally unfavorable, especially for Lepidoptera. On the prairies there was not much variation from normal, excepting for the abundance of grasshoppers, while in the east insect life seems to have been rather more prevalent than usual.

Canadian entomologists will be pleased to learn that much progress has been made in arranging the National Collection of insects, under the able curatorship of Dr. McDunnough; as a result species in many families can now be determined much more quickly and accurately than was formerly possible.

It is gratifying also to know that Canadian collectors are recognizing the importance of placing types in the National Collection where they can be seen at a central point and where they are moreover comparatively safe from the dangers to which private collections are subject. A particularly notable addition to the Collection during the year was the acquisition of the Wolley-Dod Collection of Lepidoptera, generously willed to us by the late owner.

Our entomologists are again greatly indebted to specialists in the United States and Great Britain for assistance in determining specimens as well as for many other favors for all of which we express our grateful thanks.

Among the publications which have appeared during 1920, the following should be of special interest to Canadian students.

McDUNNOUGH, J. H. Studies in North American Cleorini (Geometridae). Bul. No. 18, Dom. Entomological Branch, Ottawa. This work is primarily a generic revision of a group of moths that were previously nearly all lumped under the genus *Cleora*. In it are described 16 new genera, and a generic key is provided on page 11. The bulletin comprises 64 pages including eleven plates of illustrations showing genitalia and other structural characters, in addition to a number of species.

Barnes, William and Busck, August. Contributions to the Natural History of the Lepidoptera of North America, Vol. IV, No. 3, 1920, entitled, Notes and New Species. This number is a continuation of the series previously issued under the authorship of Barnes and McDunnough, and deals with micro-lepidoptera. A number of new species are described, several being from Canada. There are three plates showing photographs of moths and twelve depicting the genitalia.

Hampson, Sir George. Catalogue of the Lepidoptera Phalaenae, Supplement, Vol. II, 1920, entitled, Catalogue of the Lithosidæ (Arctianae) and Phalaenoididae in the Collection of the British Museum. This volume is supplementary to Vol. III, and includes descriptions of the species described since the original volume was published, besides bringing other matter up to date. It is accompanied by the usual separate of colored plates and in every way maintains the reputation of previous volumes.

Carr, F. S. An Annotated List of the Coleoptera of Northern Alberta. Published by the Alberta Natural History Society, Red Deer, Alberta, 1920. This list will be welcomed by all who are interested in the distribution of North American Coleoptera. It is largely compiled from the personal collection of Mr. Carr made in the vicinity of Edmonton, and includes 525 species. Valuable notes on food plants are added.

Casey, Col. T. L. Memoirs on the Coleoptera IX. The New Era Publishing Company, Lancaster, Pa. This latest publication of Col. Casey contains: I. A Revisional Study of the American Platyninae; II. Random studies among the American Caraboidea; III. Some descriptive Studies among the American Barinae. In this large work there are 527 pages of printed matter containing descriptions of approximately 650 new species or varieties of which several are recorded from Canada..

Blatchley, W. S. The Orthoptera of Northeastern America. The Nature Publishing Company, Indianapolis, Ind. This Book will be welcomed by all students of North American Orthoptera and especially by those residing within the territory covered by it. It contains keys and descriptions of all the species found in the "U. S. east of the Mississippi River and Canada east of the 90′ Meridian." It includes in all 353 species and 55 varieties. The work is clearly written and contains many text and other illustrations in black and white. The work is a necessary part of an Orthopterist's library.

Morse, Albert P. Manual of the Orthoptera of New England including the Locusts, Grasshoppers, Crickets, and their Allies. Proceedings of the Boston Society of Natural History, Vol. 35, No. 6, pp. 197-556, pl. 10-29. April, 1920.

This is a valuable contribution to a knowledge of the Orthoptera and as a work covering a limited area probably ranks alone in its thoroughness. The book is designed for the beginner as well as for the advanced student and is in consequence provided with careful anatomical descriptions accompanied by clear text figures. There are keys to the various genera and species followed by descriptions and often accompanied by figures. At the end of the book are 12 plates, six of them colored, showing adults and anatomical structures used in classifications. We believe that no orthopterist can afford to be without this Manual.

Banks, Nathan. A Revision of the Nearctic Termites with notes on Biology and Geographic Distribution by Thomas E. Snider. U. S. National Museum Bulletin 108, Washington, 1920. This work forms a complete treatise on the Termites found within the United States and Canada. The descriptions are accompanied by excellent drawings prepared chiefly by Miss Mary Carmody, under the guidance of Mr. Snider. Part 2, Biology, prepared by the junior writer, treats interestingly of the general habits of the insect, gives their distribution and provides a bibliography of the species.

Comstock, J. H. An Introduction to Entomology. The Comstock Publishing Company, Ithaca, New York. This is the first part of a text book on entomology and it deals chiefly with the structure and metamorphosis of insects. There are 4 chapters under the following headings: I. The Characteristics of insects and their near relations; II. The External Anatomy of Insects; III. The Internal Anatomy of Insects; IV. The Metamorphosis of Insects. The work is illustrated by many text figures and is provided with an important bibliography. It comprises 220 pages.

RECORD OF CAPTURES.

Species preceded by an asterisk (*) described during 1920.

Lepidoptera.

(Arranged according to Barnes and McDunnough's Check List of the Lepidoptera of North America.)

Nymphalidæ.

186. *Argynnis eurynome* Edw. Miniota, Man.; Hugh Gibbon. New to Manitoba.

205. *Euphydryas colon* Edw. Blairmore, Alta.; June, (K. Bowman).

* *Strymon acadica* ab. *muskoka* Wat. and Comst. Gravenhurst, Muskoka, Ont.; July, 1918, (H. S. Parrish). Bull. Am. Mus. Nat. Hist. Vol. XLII, Dec., 1920.

Sphingidæ.

742. *Pholus labruscae* Linn. Winnipeg, Man.; Oct., 1920, (E. Webster).

Arctiidæ.

955. *Diacrisia vagans* Bdv. Blairmore, Alta.; June 1920, (K. Bowman).

957. *Isia isabella* A and S. Calgary, Alta.; June, 1920, (G. Salt).

987. *Apantesis blakei* Grt. Calgary, Alta.; July, 1920, (G. Salt).

989. *Apantesis phyllira* Dru. Lake of Bays, Ont.; Aug. 14, 1920, (J. McDunnough).

Noctuidæ.

1218. *Copablepharon alba* Harv. Lethbridge, Alta.; (E. H. Strickland).

1259. *Euxoa catenula* Grt. Lethbridge, Alta.; (E. H. Strickland).

1310. *Euxoa atropulverea* Sm. Blairmore, Alta. ; Sept., 1920, (K. Bowman).

* *Euxoa scholastica* McD. Meach Lake, Que. ; July, (C. H. Young); Ottawa, Ont. ; Aug. 1904; Trenton, Ont. ; July, (J. D. Evans). Can. Ent. Vol. LII, Nos. 6-7, 1920.

1459. *Agrotis atrata* Morr. Larder Lake, Ont.; July, 1920, (H. C. Cook). New to Canada.

2022. *Oncocnemis albifasciata* Hamp. Lethbridge, Alta. ; (E. H. Strickland).

2043. *Oncocnemis augustus* Harv. Lethbridge, Alta.; (E. H. Strickland).

* *Ferälia deceptiva,* McD. Vancouver, B.C.; April, (Bush.). Can. Ent. Vol. LII, Nos. 6-7, 1920.

2215. *Conistra fringata* B. & McD. Salmon Arm, B.C. ; (W. R. Buckell). New to Canada.

2362. *Eremobia alticola* Sm. Cadomin, Alta.; Aug.; (K. Bowman).

2596. *Crambodes talidiformis* Gn. Lethbridge, Alta.; (E. H. Strickland).

3057. *Catocala verecunda* Hlst. Lethbridge, Alta. ; (E. H. Strickland).

* *Caenurgia erechtea* form *parva* Blackmore. Victoria, B.C.; April-May; (E. H. Blackmore). Can. Ent. Vol. LII, No. 11, 1920.

3555. *Capis curvata* Grt. Aweme. Man.; June, 1920; (Criddle).

3576. *Lomanaltes eductalis* Wlk. Edmonton, Alta.; July, 1920. (D. Mackie).

Lymantriidæ.

3712. *Olene vagans* B. & McD. Aweme, Man.; July, 1920. (Criddle).

Lasiocampidæ.

* *Tolype dayi* Blackm. Quamichan Lake, Sept. ; (G. O. Day) ; Slugget, Sept.; (W. Downes) ; Victoria, Sept.; (Blackmore) ; All on Vancouver Island, B.C. Can. Ent. Vol. LII, No. 12, 1920.

Geometridæ.

3945. *Carsia paludata* Thun. Edmonton, Alta., August, (D. Mackie).

* *Eustroma nubilata* form *macdunnoughi* Blackm. Rossdale, June, (Blackmore), Goldstream and Vancouver, (Blackmore), Vancouver, (R. V. Harvey), Chilliwack, (W. B. Anderson). Fraser Mills, (L. E. Marmont). All B.C. Can. Ent., Vol. LII, No. 12, 1920.

* *Lobophora simsata* Swett. Victoria, B.C., May, (Blackmore), Duncans, B.C., May, (Livingston), Wabasha River, Alta., June, Edmonton, Alta., (Swett). Lepidopterist, Vol. III, Nos. 4 and 5, 1920.

3977. *Lygris diversilineata* Hbn. Calgary, Alta., August, (K. Bowman).

Lygris propulsata Wlk. Edmonton, Alta., July-August, (K. Bowman).

* *Dysstroma sobria* form *Swetti* Blackm. Victoria, B.C., June, (Blackmore). Can. Ent., Vol. LII, No. 12, 1920.

Hydriomena macdunnoughi Swett. Nordegg and Cadomin, Alta.; May, (K. Bowman).

* *Xanthorhoe ramaria* Swett and Cassino. Rama, Lab., 1899, (Strecker and Sornburg Col).

* *Xanthorhoe reclivisata* Swett and Cassino. Lake Louise, Laggan, Alta., July, 1904, (Wolley-Dod).

* *Xanthorhoe dodata* Swett and Cassino. Emerald Lake, (Woolley-Dod.) Pocahontas, (K. Bowman).

* *Xanthorhoe incurvata lagganata* Swett and Cassino. Laggan and Field, Alta, (Wolley-Dod) ; Nordegg, July, (K. Bowman).

The above four species described in Lepidopterist, Vol. III, Nos. 3 and 4, 1920.

* *Orthonama evansi* McD. Trenton, Ont., (J. D. Evans), Hull, Que., Can. Ent. Vol. LII, No. 12, 1920.

* *Eulype albodecorata* Blackm. Gold Stream, B.C., May-June, (Blackmore). Can. Ent. Vol. LII, No. 2, 1919.

* *Eupithecia moirata* Swett and Cassino. Penticton, B.C., April, 1913, (Blackmore). Lepidopterist, Vol. III, No. 2, 1919.

4156. *Eupithecia palpata* Pack. Edmonton, Alta., June, (K. Bowman).
* *Eupithecia probata* Swett and Cassino. Duncans, B.C., (Livingston). Victoria, B.C., March-April, 1916, (Blackmore). Lepidopterist Vol. III, No. 2, 1919.
4401. *Itame occiduaria* Pack. Nordegg, Alta., July, (K. Bowman).
4424. *Itame decorata* Hlst. Calgary, Alta., July-August, (G. Salt).
4568. *Cleora manitoba* Grossb. Larder Lake, Ont., July, 16, 1920, (H. C. Cook). New to Ontario.
4644. *Sicya macularia agyllaria* Walk. Nordegg, Alta., (August); Banff, Cadomin, Alta., (K. Bowman).
4711. *Selenia alciphearia* Wlk. Aweme, Man., June, (E. Criddle).
4726. *Metanema quercivoraria* Gn. Nordegg, Alta., July, 1920, (K. Bowman).
4748. *Pero occidentalis* Hlst. Pocahontas, and Nordegg, Alta., June, (K. Bowman).

Pyralidæ.

5097. *Phlyctaenia indistinctalis* Warr. Nordegg, Alta., July, (K. Bowman).
5102. *Phlyctaenia tertialis* Gn. Edmonton, Alta., Nordegg, Alta., July, (K. Bowman).
Pyrausta nubilalis Hbn. South West Ontario, (Simpson and Keenan).
Cornifrons simalis Grt. Lethbridge, Alta., (Strickland).
* *Herculia florencealis* Blackm. Rossland, B.C., July, (W. H. Danby). Can. Ent. Vol. LII, No. 12, 1920.
5322. *Prionapteryx nebulifera* Steph. Aweme East, July 7, 1920, (E. and N. Criddle).
5403. *Thaumatopsis pexellus coloradellus* Kearf. Lethbridge, Alta., (Strickland).
5591. *Ambesa laetella* Grt. Lethbridge, Alta., (Strickland).
5689. *Lipographis leoninella* Pack. Aweme, Man., August, 1920, (Criddle).
5694. *Melitara dentata* Grt. Lethbridge, Alta., (Strickland).
5739. *Staudingeria albipenella* Hlst. Lethbridge, Alta., (Strickland).
5743. *Hulstia undulatella* Clem. Lethbridge, Alta., (Strickland).

Pterophoridæ.

5862. *Platyptilia edwardsi* Fish. Mt. Cheam, B.C., August, (Bush).
5932. *Pterophorus brucei* Fern. Aweme. Man., March, 1920, (Criddle).
5934. *Pterophorus grisescens* Wlshm. Lillooet, B.C., June, (A. Phair).
5946. *Stenoptilia exclamationis* Wlshm. Trenton, Ont., August, (J. D. Evans).

Gelechiidæ.

* *Gelecia psiloptera* B. and B. Meach Lake, Que., (J. McDunnough). Cont. Nat. Hist. Lep. Vol. IV, No. 3, 1920.

Eucosmidæ.

6866. *Argyroploce glaciana* Moesch. Laird River, Y.T., at mouth of Poplar River, July, 1919, (E. J. Whittaker).
* *Laspeyresia novimundi* Hein. Previously referred to as *L. nigricana* Steph. Wide spread in Canada as a pea pest and in wild vetches. Can. Ent. Vol. LII, No. 11, 1920.
6878. *Pseudogalleria inimicella* Zell. Aweme, Man., June, 1920, (Criddle).

Tortricidæ.

7308. *Sparganothis vocaridorsana* Kearf. Lethbridge, Alta., (Strickland).
* *Cacoecia hewittana* Busck. Sydney, N.S., (Mrs. S. J. Harrington). Bred from raspberry by A. Gibson. Can. Ent. Vol. LII, No. 6, 1920.

* *Tortrix invidana* B. and B. Duncans, B.C., (Hanham), also Victoria, B.C.

* *Tortrix dimorphana* B. and B. Duncans, B.C., (Hanham).

* *Peronea maximana* B. and B. Vancouver, B. C., (Hanham), Victoria, B.C., (J. Croker).

* *Peronea fuscana* B. and B. Aweme, Man., (Criddle).

* *Peronea stadiana* B. and B. Ottawa, Ont., (C. H. Young). The above five species described by Barnes and Busck. Cont. Nat. Hist. Lep. Vol. IV, No. 3, 1920.

Haploptilidæ.

* *Haploptilia atlantica* Hein. Trenton, Ont., (J. D. Evans). Proc. Ent. Soc. Wash. Vol. 22, No. 7, 1920.

Coleoptera.

Arranged according to Henshaw's List of Coleoptera of America, North of Mexico.

Cincindelidæ.

Cicendela lengi var. *versuta* Csy. Chilcotin, B.C., August, (E. R. Buckell). New to B.C.

* *Cicindela repanda edmontonensis* Carr. Edmonton, Alta., August 21, 1919, (F. S. Carr). Can. Ent. Vol. LII, No. 10, 1920.

Carabidæ.

86. *Cychrus elevatus* Fab. Onah, Man; July, 1919 (Criddle and Roberts). Apparently a small race.

96. *Cychrus marginatus* Fisch. Peachland, B.C., August 27, 1919, (W. Metcalfe).

147. *Calasoma wilkesii* Lec. Peachland, B.C., August 17, 1919, (Metcalfe and Wallis).

* *Callisthenes* (*Calosoma*) *reflexus* Coq. "Northern Rocky Mountains Region." Mem. Col. IX, 1920.

156. *Elaphrus lecontei* Cr. Beaver Lake, Alta., July, 1907, (A. Halkett).

373. *Bembidium obtusangulus* Lec. Baldur, Man., May 25, 1920, (Criddle and Vroom). New to Manitoba.

396. *Bembidium ephippiger* Lec. Baldur, Man; May 25, 1920, (Criddle and Vroom). New to Manitoba.

Bembidium henshawi Hayd. Baldur, Man., May 25, 1920, (Criddle and Vroom).

403. *Bembidium scudderi* Lec. Baldur, Man., May 25th, 1920, (Criddle and Vroom).

431. *Tachys vittiger* Lec. Baldur, Man., May 25th, 1920 (Criddle and (Vroom).

* *Brennus columbianus* Csy. Victoria, B.C. Mem. Col. IX, 1920.

* *Cryobius patulus* Csy. Stikine River, B.C., (Wickham). Mem. Col. IX., 1920.

Amara coelebs Howe. Cawston, B.C., October, 21, 1919, (W. Metcalfe)

* *Diplochila modesta* Csy. Montreal, Que. Mem. Col. IX. 1920.

* *Diplochila undulata* Carr. Edmonton, Alta., May 10, 1919, (F. S. Carr). Can. Ent. Vol. LII, No. 10, 1920.
* *Platynus puncticeps* Csy. Ontario, Can.
* *Platynus turbidus* Csy. Winnipeg, Man., (Wickham).
* *Platynus distinguendus* Csy. Ontario, Can.
* *Platynus frigidulus* Csy. Stikine River, B. C., (Wickham).
* *Platynus fragilissimus* Csy. Toronto, Ont., (Wickham).
* *Platynus insulina* Csy. Victoria, B.C., (Wickham).
* *Platynus suffusum* Csy. Agassiz, B.C.
* *Platynus symmetricus* Csy. Vernon, B. C.

The above 9 species described in Mem. Col. IX, 1920.

* *Chlaenius frostii* Carr. Edmonton, Alta., May 11, 1918, (F. S. Carr). Can. Ent. Vol. LII, No. 10, 1920.

1059. *Agonoderus lineola* Fab. Baldur, Man., May 25, 1920, (N. Criddle).

1103. *Harpalus carbonatus* Lec. Baldur, Man., May 25, 1920, (Paul N. Vroom).

1164. *Tachycellus nigrinus* Dej. Peachland, B.C., July 27, 1919, (W. Metcalf).

Dytiscidæ.

Coelambus dispar Lec. Le Pas, Man., June 30, 1917, (J. B. Wallis).

Hydroporus appalachius Sherm. Mile 332, H. B. Railway, Man., July 18, 1917, Winnipeg, June 26th, 1820, (Wallis)., Aweme, East, July 10, 1920; (Wallis and Roberts).

1331. *Hydroporus septentrionalis* Gyll. Mile 332, H. B. Railway, Man., July 13, 1917, (J. B. Wallis). New to Manitoba.

1338. *Hydroporus solitarius* Sharp. Mile 214, H. B. Railway, Man., (J. B. Wallis). New to Manitoba.

Hydroporus congruus Lec. Peachland, B. C., July 27, 1909, (J. B. Wallis). Previously identified as *rivalis* var. by C. H. Roberts.

Hydroporus obesus Lec. var. Peachland, B. C. July 27, 1919, (J. B. Wallis).

1342. *Hydroporus occidentalis* Sharp. Peachland, B. C. August 7, 1919 (J. B. Wallis).

1344. *Hydroporus obscurus* Sturm. Miles 214 and 332; H. B. Railway, Man.. July, 1917, (J. B. Wallis).

1345. *Hydroporus tenebrosus* Lec. Winnipeg, Mile 214, H. B. R., Man., (Wallis). Previously recorded as *rusticus*, (J. B. W.).

Hydroporus dispectus Sharp. Peachland, B. C., August, 1919; (Wallis), Foulder, B. C., (S. Criddle).

1346. *Hydroporus signatus* Mann. Mile 332, H. B. Railway, Man., July, 1917, (J. B. Wallis). New to Manitoba.

1348. *Hydroporus glabriusculus* Aub. Mile 256-332. H. B. Ry., Man., July, 1917, and Winnipeg, August 7, 1920, (J. B. Wallis). New to Manitoba.

1351. *Hydroporus notabilis* Lec. Stony Mountain, Man., June, Miami, Man., October, Mile 332, H.B.Ry., July 18, 1917, (J. B. Wallis). New to Manitoba.

Hydroporus striola Gyll. (*vittula* Er.) Mile 214-332, H.B. Ry., Man., August, Onah, Man., July; Stonewall, Man., April; Peachland, B.C., August 7, 1919, (J. B. Wallis). New to Manitoba.

1352. *Hydroporus tristis* Payk. Peachland, B.C., August 7, 1919, (J. B. (Wallis).

1356. *Hydroporus humeralis* Aube. Peachland, B.C., August 17, 1919, (J. B. Wallis).

1361. *Hydroporus niger* Say. St. Norbert, Man., September; Onah, Man., July; Stonewall, Man., September 20, 1919, (J. B. Wallis). New to Manitoba.

1367. *Hydroporus stagnalis* G. and H. Stonewall, Man., September 18, 1920, (J. B. Wallis). New to Manitoba.

Hydroporus conoideus Lec. Winnipeg, April, Aweme East, July 10, 1920, (J. B. Wallis); previously recorded, (teste C. H. Roberts) as *oblongus* Steph.

9297. *Hydroporus fuscipennis* Schaum. Peachland, B. C., August 7, 1919, (J. B. Wallis).

All the above species have been submitted to Dr. Fall who is revising the group.

Gyrinidæ.

1519. *Gyrinus affinis* Aube. Cawston, B.C., April 29, 1917, (W. R. S. Metcalf).

1529. *Gyrinus picipes* Aube. Cawston, B. C., April 17-29, 1917, (W. R. S. Metcalf).

Hydrophilidæ.

1683. *Cercyon granarius* Er. Stonewall, Man., August 18, 1918. In fungus,—(J. B. Wallis).

Silphidæ.

1698. *Cecrophorus marginatus* Fab. Lethbridge, Alta., September 22, 1920, (E. H. Strickland); Red Deer River, September 11, 1917, (C. H. Young).

1782. *Liodes globosa Lec.* Winnipeg, Man., June 15, 1918, (L. Roberts). New to Manitoba.

Staphylinidæ.

2101. *Quedius sublimbatus* Makl. St. Norbert, Man., August 24, 1917, (J. B. Wallis). Previously taken at Hudson Bay by Dr. Bell.

2150. *Philonthus furvus Nord.* Stoney Mountain, April 21, 1916, (Wallis).

Leptacinus, (Leptacinodes) flavipes Lec. Winnipeg; September 2, 1916, (J. B. Wallis). New to Manitoba.

2270. *Xantholinus obsidianus* Melsh. Miami, Man., July 27, 1916, (J. B. Wallis).

2325. *Stenus pettiti* Csy. Onah, Man., July 11, 1918, (Wallis). New to Manitoba.

2329. *Stenus rugifer* Csy. Winnipeg, July, 1917, (L. Roberts).
Treesbank, Man., July 18, 1918, (Wallis). New to Manitoba.

2376. *Stenus colonus* Er. Treesbank, Man., July, 1918, (Wallis). New to Manitoba.

2384. *Stenus egenus* Er. Victoria Beach, Man., August 7th, 1916, (Wallis). New to Manitoba.

2396. *Stenus rigidus* Csy. Winnipeg, June 10, 1916, (Wallis). New to Manitoba.

2435. *Stenus advena* Csy. Husavick, Man., July, (Roberts); Rosebank, Man., July; Onah, Man., July, 1913, (Wallis). New to Manitoba.

Stilicus hanhami Wick. Winnipeg, May 1, 1916, (Roberts).

2560. *Trachyseetus confluens* Say. Birds Hill, Man., May 3, 1917, (Wallis).

2679. *Habroceerus schwarzi* Horn. Stoney Mountain, Man., August, 18, 1918; (Wallis). In rotten fungus; new to Manitoba.

Erotylidæ.

3200. *Languria mozardi* Lec. Aweme, Man., September, 1920, (E. Criddle).

Histeridæ.

3625. *Saprinus petruelis* Lec. Aweme East, July, 1920, (Criddle and Wallis); New to Manitoba.

Heteroceridæ.

* *Heterocerus moleculus* Fall. Aweme, Man., July-September, 1917, (Wallis and Criddle). Can. Ent. Vol. LII. No. 9, 1920.

* *Heterocerus canadensis* Fall. Thornhill, Man., July 1, 1916, (Wallis). Can Ent. Vol. LII. No. 9, 1920.

Elateridæ.

4083. *Adelocera profusa* Cond. Peachland, B. C., July, 1919, (Wallis).

4161. *Cryptohypnus pectoralis* Say. Husavick, Man., July 4, 1918, (L. Roberts).

4218. *Elater nigrinus* Payk. Calgary, Alta., May 20, 1915, (Tams).

4220. *Elater pullus* Germ. Aweme, Man., May 2, 1920, (Criddle).

4496. *Corymbites inflatus* Say. Calgary, Alta., May 20, 1915, (Tams).

4504. *Asaphes dilatricollis* Mots. Peachland, B. C. August, 1919, (Wallis).

Buprestidæ.

4631. *Anthaxia viridicornis* Say. Aweme, East, July 6, 1920, (Criddle).

* *Agrilus criddlei* Frost. Aweme, Man., June, (Criddle). Can. Ent. Vol. LII, No 11, 1920.

Ptinidæ.

* *Hadrobregmus subconnatus* Fall. Aweme, Man., June, 1919-20, (N. and E. Criddle). In rotten spruce. Can. Ent. Vol. LII. No. 9, 1920.

Cisidæ.

Dolichocis manitoba Dury. Victoria, B.C., May, (W. B. Anderson). New to B. C.

Plisiocis cribrum Csy. Saanich, B. C., September 10, 1918, (W. Downes). New to B. C.

Scarabæidæ.

* *Aphodius canadensis* Garrett. Cranbrook, B.C., May-July, Crows Nest, B.C., April-May, (Garrett). Can. Ent. Vol. LII, Nos. 6-7, 1920.

5682. *Serica curvata* Lec. Onah, Man., July, (Wallis, Roberts and Criddle), Aweme, Man., (Criddle).

5705. *Diplotaxis obscura* Lec. Cawston, B. C., August, 1917, (W. Metcalf).

5739. *Lachnosterna lanceolata* Say. Aweme East, Man., July, 1920, (Wallis, Criddle, Roberts, Vroom, Robertson). New to Canada.

5796. *Lachnosterna tristis* Fab. Vernon, B.C., April, 1920, (R. Hoppy). New to Canada.

Cerambycidæ.

5992. *Hylotrupes ligneus* Fab. Peterborough, Ont., (F. J. A. Morris).
6351. *Leptura octonotata* Say. Peterborough, Ont., (F. J. A. Morris).
6487. *Saperda puncticollis* Say. Peterborough, Ont., (F. J. A. Morris). From Virginia creeper.

Chrysomelidæ.

* *Donacia serricauda* Schaeff. British Columbia. Jour. N.Y. Ent. Soc. Vol. XXVII, No. 4, 1920.

* *Donacia tuberculifrons* Schaeff. Toronto, Ont., Jour. N.Y. Ent. Soc. Vol. XXVII, No. 4, 1920.

10,337. *Syneta hamata* Horp. Okuty Falls, B. C., (Hanham).

6785. *Doryphora clivicollis* Kby. Teulon, Man., July, 1918, (F. Pandier).

* *Lina (Malosoma) immaculata* Schaeff. British Columbia, (Chas. Weldt). Jour. N. Y. Ent. Soc. Vol. XXVII, No. 4, 1920.

6964. *Haltica inaerata* Lec. Husavick, Man., July, 1917, (L. H. Roberts). New to Manitoba.

Haltica carni Woods. Husavick, Man., July, 1915, (L. H. Roberts). New to Manitoba.

6967. *Haltica torquata* Lec. British Columbia, (Taylor Col.).

* *Haltica heucherae* Fall. Aweme Man., May, September, (N. and E. Criddle). On *Heuchera hispida*. Psyche, Vol. XXVII, October, 1920.

6971. *Haltica foliacea Lec.* Onah, Aweme, Stockton, Lyleton, Man., (Wallis and Criddle). On *Oenothera* and *Epilobium*. Previously recorded as *punctipennis* Lec.

Cassida flaveola Thunb. Mile 17, H. B. Ry., Man., July 2, 1917, (Wallis).

9097. *Cassida nigripes* Oliv. Winnipeg, Man., (F. Dolman).

Tenebrionidæ.

7226a. *Phellopsis parcata* Lec. Peachland, B. C., August 12, 1919, (Wallis).

Cistelidæ.

7594. *Hymenorus niger* Melsh. Winnipeg, June, 24, 1919, (Wallis).
7631. *Androchirus erythropus* Kby. Aweme, Man., 1920, (Criddle).

Mordellidæ.

7761. *Penturia trifasciata* Melsh. Aweme, Man., July 15, 1918, (Wallis).
7811. *Mordellistena pallipes* Sm. Aweme, Man., July, 15, 1918, (Wallis).
7847. *Mordellistena marginalis* Melsh. Aweme, Man., 1919, (Criddle).
7852. *Mordellistena bihamata* Melsh. Aweme, Man., 1919, (Criddle).

Anthicidæ.

7943. *Anthicus californicus* Laf. Baldur, Man., May, 1920, (Criddle and Vroom).

Meloidæ.

8026. *Nemognatha lutea* Lec. Waskada, Lyleton, Lauder, and Melita, Man., July, (Criddle). New to Manitoba.

8037. *Nemognatha immaculata* Say. Melita and Pipestone, Man., July, 1920, (Criddle and Vroom). New to Manitoba.

8083. *Epicauta ferruginea* Say. Ninga, Man., July, 1920, (Criddle and Vroom).

8158. *Cantharis sphaericollis* Say. Hartney to Boissevain and Westward, July-August, (Criddle and Vroom).

Curculionidæ.

8525. *Cleonus carinicollis* Lec. Aweme East, July 9, 1920, (E. Criddle).

* *Elleschus borealis* Carr. Edmonton, Alta., May 24, 1919. (F. S. Carr). Can. Ent. Vol. LII, No. 10, 1920.

8827. *Auleutes epilobii* Payk. Aweme, Man., June 3, 1920, (Criddle).

* *Centrinogyna canadensis* Csy. Winnipeg, Man., (Hanham). Mem. Col. IX, 1920.

Anthribidæ.

* *Allandrus brevicornis* Frost. Edmonton, Alta., July 30, 1916, (F. S. Carr). Can. Ent. Vol. LII, No. 11, 1920.

Diptera.

(Arranged according to the Catalogue of North America Diptera by J. M. Aldrich. The numbers refer to the pages.)

Tipulidæ.

* *Dicranomyia terrae-novae* Alex. Spruce Brook, Newfoundland, (G. E. Englehardt). Jour. Ent. and Zool. Vol. 12, No. 4, 1920.

87. *Chionea vulga* Harr. Mara, B. C., March, 1920, 8000 feet, (R. C. Treherne).

* *Limnophila adjuncta* Dietz. Eastern Harbour, Cape Breton Isl., July, 1917, (G. A. Huntsman).

* *Limnophila magdalena* Dietz. Amherst Isl., Magdalen Isl., Que., July, 1917, (G. A. Huntsman).

* *Tipula huntsmaniana* Dietz. Eastern Harbour, Cape Breton Isl., N. S.

The above three species described in Can. Ent. Vol. LII, No. 1, 1920.

Culicidæ.

* *Aedes leuconotips* Dyar. Prince Rupert, B.C., May, 1919, (H. G. Dyar).

* *Aedes cyclocerculus* Dyar. Prince Rupert, B C., May, 1919, (H. G. Dyar).

* *Aedes callithotrys* Dyar. White Horse, Yukon Ter., June, 1919, (H. G. Dyar).

* *Aedes mercurator* Dyar. Dawson, Yukon Territory, (H. G. Dyar).

* *Aedes stimulans albertae* Dyar. Edmonton, Alta., May, 1919, (H. G. Dyar).

The above mosquitoes described in Ins. Ins. Mens., Vol. VIII, No. 1-3, 1920.

Stratiomyidæ.

* *Euparyphus pretiosa* Banks. Vancouver, B.C. Can. Ent. Vol. LII, No. 3, 1920.

Tabanidæ.

195. *Chrysops callidus* O. S. Aweme, Man., July, 1920, (Criddle).

196. *Chrysops discalis* Will. Baldur, Man., July, 1920, (Criddle and Vroom).

196. *Chrysops fallax* O.S. Simcoe, Ont., July, 1915.

Bombyliidæ.

221. *Spogostylum vandykei* Coq. Osoyoos, B. C., June, 1919, (W. B. Anderson).
222. *Spogostylum albofasciatum* Macq. Hull, Que., Ottawa, Ont., Trenton, Ont., (Evans); Lake of Bays, Ont., (McDunnough); Aweme, Man., (Criddle and H. A. Robertson).
223. *Spogostylum simson* Fab. Jordan, Ont., September, 1917, (W. A. Ross).
223. *Spogostylum varium* Fab. Lillooet, B. C., July, 1918, (A. W. Phair).
225. *Exoprosopa caliptera* Say. Aweme, Man., July-August, (Criddle); Lethbridge, Alta., July, (Wallis); Lillooet, B. C., June., (A. W. A. Phair).
225. *Exoprosopa capucina* Fab. Sudbury, Ont., August, 1889, (Evans Coll.).
Exoprosopa decora Loew. Aweme and Melita, Man., (Criddle and Vroom); Lethbridge, (J. B. Wallis); Princeton, B.C., (W. B. Anderson); Peachland, B.C., (J. B. Wallis).
225. *Exoprosopa doris* O. S. Osoyoos, B. C., June, 1919. (Buckell).
225. *Exoprosopa eremita* O. S. Victoria, B. C., July, 1912, (J. B. Wallis).
225. *Exoprosopa fascipennis* Say. Treesbank, Man., July, (Wallis).
Exoprosopa grata Coq. Osoyoos, B. C., June, 1919., (Anderson and Buckell).
227. *Anthrax alpha* O. S. Lethbridge, Alta., August, 1912, (J. B. Wallis).
229. *Anthrax bigradata* Loew. Aweme, Man., (Fletcher); Aweme East, June., (S. Criddle).
229. *Anthrax catulina* Coq. Kamloops, B. C., May, (W. B. Anderson); Ebert, B. C., June, (N. Chrystal).
Anthrax fenestratoides Coq. Aweme, Man., July, 1920, (P. Vroom); Princeton, B. C., July, 1919., (W. B. Anderson).
Anthrax lepidota O.S. Fairview, B.C., August, 1919, (E. R. Buckell).
233. *Anthrax nugator* Coq. Osoyoos, B. C., June, 1919, (W. B. Anderson).
233. *Anthrax pretiosa* Coq. Penticton, B. C., (E. R. Buckell); Peachland, B. C. (Wallis); Lillooet, B. C., (Anderson).
234. *Anthrax serpentina* O. S. Peachland, (Wallis); Fairview, (Buckland).
Anthrax webberi Johns. Chelsea, Que., (C. H. Young); Bellville, Ont., (Evans); Norway Pt., Lake of Bays, Ont., (J. McDunnough).
234. *Anthrax willistonii* Coq. Aweme, Man. 1904, (Fletcher); 1920, (Criddle and Vroom); Fairview, B. C., (Buckell); Williams Lake, B. C., (Anderson).
235. *Bombylius albicapillus* Loew. Victoria, B. C., (A. W. Hanham).
235. *Bombylius aurifer* O. S. Banff, Alta., (N. B. Sanson); Cranbrook, B. C., (C. B. Garrett).
238. *Ploas atratula* Loew. Vernon, B.C., May.
238. *Ploas nigripennis* Loew. Goldstream, B.C., July, 1998.
238. *Ploas serrata* Coq. Victoria, B. C., (A. W. Hanham).
240. *Lepidophora aegeriiformis* West. Sudbury, Ont., (J. D. Evans).
Geron senilis Fab. Fairview, B. C., August, 1919, (E. R. Buckell).

Therevidæ.

247. *Psilocephala pectipennis* Wied. Toronto, Ont. July, 1911, (M. C. Van Duzee).

Asilidæ.

256. *Stenopogon californiae* Walk. Penticton, B. C., June, 1919, and Lillooet, B. C., (Anderson).
258. *Myelaphus lobicornis* O.S. Invermear, B.C., June, (F. W. L. Sladen).
259. *Dioctria sackeni* Wills. Buccaneer Bay, B.C., July, (Treherne); Ebert. B. C., (Chrystal); Cowichan, B. C., July, (W. Downes).
259. *Cyrtopogon bimacula* Walk. Truro, N.S., Gaspé, Que., (C. H. Young); Sudbury, Ont., (Evans).
260. *Cyrtopogon maculosus* Coq. Penticton, B.C., April, (E. R. Buckell).
260. *Cyrtopogon montanus* Loew. Banff. Alta., (Hewitt and Sanson).
260. *Cyrtopogon nugator* O.S. Banff, Alta., June, (Hewitt); July, (Sanson).
260. *Cyrtopogon varipennis* Coq. Royal Oak, Duncan and Victoria, B. C., (R. C. Treherne).
260. *Lasiopogon cinereus* Cole. Banff, Alta., (N. B. Sanson).
262. *Stichopogon trifasciatus* Say. Ottawa, (W. Metcalf); Severn, Ont., (C. H. Curran); Aweme, Man., (Fletcher, Criddle and Vroom).
267. *Nicocles dives* Loew. Royal Oak, B.C., May, 1917, (Treherne).
271. *Dasyllis californica* Banks. Vancouver, B. C., (R. V. Harvey). Agassiz, B. C., (Treherne).
271. *Dasyllis fernaldi* Banks. Kelso, B. C., (Fletcher); Vancouver, B. C., (Anderson); Royal Oak. (W. Downes).
271. *Dasyllis partitor* Banks. Banff. Alta., (Sanson); Peachland, B. C., (Wallis); Penticton, B. C., (E. R. Buckell).
271. *Dasyllis insignis* Banks. Qu'Appelle, Sask., July, (A.Halkett).
272. *Laphria janus* McA. Ft. Coulonge, Que., (J. I. Beaulne); Kazabazua, Que., (F. W. L. Sladen); Chelsea, Que., (Fletcher); Sudbury, Ont., (Evans); Aweme, Man., (Fletcher and Criddle); Miami, Man., (Wallis); Banff, Alta., (Sanson); Kaslo, B. C., (Cockle).
272. *Laphria felis* O. S. Kaslo, B. C., June, 1906, (J. C. Cockle).
272. *Laphria ferox* Willst. Banff, Alta., October, (N. B. Sanson).
Laphria gilva Linn. Peachland, B. C., July, (J. B. Wallis).
275. *Erax bicaudatus* Hine. Lethbridge, Alta., August, (Wallis).

Dolichopodidæ.

284. *Psilopus caudatus* Wied. Toronto, Ont., 1912, (M. C. Van Duzee).
285. *Psilopus patibulatus* Say. Ridgeway, Ont., July, (Van Duzee).
286. *Psilopus scobinator* Loew. Montreal, Que., (Beaulieu).
287. *Psilopus unifasciatus* Say. Ridgeway, Ont., June, (Van Duzee).
287. *Psilopus scintillans* Loew. Ridgeway, Ont., September, (Van Duzee).
288. *Diaphorus opacus* Loew. Joliette, Que., July, St. Louis, Que, August, (J. Ouellet).
Diaphorus leucostoma Loew. Ridgeway, Ont., July, (Van Duzee).
Diaphorus gibbosus VanD. St. Remi, Que., July, (J. Ouellet).
288. *Diaphorus palpiger* Wheel. Toronto, Ont., 1911, (Van Duzee).
289. *Chrysotus affinis* Loew. St Remi and Montreal, June, (Jas. Ouellet).
Chrysotus ciliatus Mall. Ft. Erie, Ont., June, (Van Duzee).
290. *Chrysotus picticornis* Loew. Ft. Erie, Ont., June, (Van Duzee).
290. *Campsicnemus hirtipes* Loew. Ridgeway, Ont., June, (Van Duzee)
291. *Argyra calcitrans* Loew. Ridgeway, Ont., June, (Van Duzee).

291. *Porphyrops effilatus* Wheel. Toronto, Ont., July, (Van Duzee).
291. *Porphyrops melampus* Loew. Toronto, Ont., June, (Van Duzee).
294. *Xanthina helvinus* Loew. Ridgeway, Ont., July, (Van Duzee).
Neurigona maculata Van D. Joliette, Que., July, (Van Duzee).
296. *Medeterus veles* Loew. Chatham, Ont., June, (Van Duzee).
296. *Medeterus nigripes* Loew. Ridgeway, Ont., July, (Van Duzee).
297. *Scellus exustus* Walk. Ridgeway, Ont., June, 1919, (Van Duzee).
297. *Hydrophorus aestuum* Loew. Ft. Erie, Ont., July, (Van Duzee).
297. *Hydrophorus pirata* Loew. Mount Royal, Que., September.
298. *Liancalus genualis* Loew. Niagara Falls, Ont., (Van Duzee).
299. *Dolichopus acuminatus* Loew. Montreal and St. Louis, Que., July, (Jas. Ouellet).
299. *Dolichopus bifractus* Loew. Ridgeway, Ont., August, (Van Duzee).
299. *Dolichopus batillifer* Loew. Joliette, Que., July, (J. Ouellet).
300. *Dolichopus calcaratus* Ald. Kearney, Ont., (Van Duzee).
301. *Dolichopus cuprinus* Wied. Bond Lake, Ont., July, 1919, (Van Duzee).
301. *Dolichopus dakotensis* Ald. Ridgeway, Ont., June, 1919, (Van Duzee).
301. *Dolichopus discifer* Stan. Montreal, Que., May, (J. Ouellet).
301. *Dolichopus fulvipes* Loew. Ridgeway, Ont., July, (Van Duzee).
301. *Dolichopus gratus* Loew. Toronto, Ont., June, 1918, (Van Duzee).
302. *Dolichopus longimanus* Loew. Kearney, Ont., June, (Van Duzee).
303. *Dolichopus occidentalis* Ald. Nanaimo, B.C., June, 1920, (Van Duzee).
304. *Dolichopus ramifer* Loew. Ft. Erie, Ont., May, (Van Duzee).
304. *Dolichopus scapularis* Loew. Kearney, Ont., July, (Van Duzee).
304. *Dolichopus setifer* Loew. Niagara Falls, Ont., September, (Van Duzee).
304. *Dolichopus sincerus* Melan. Elmsdale, Ont., July, (Van Duzee).
304. *Dolichopus splendidus* Loew. Ridgeway, Ont., June, (Van Duzee).
305. *Dolichopus terminalis* Loew. Ridgeway, Ont., July, (Van Duzee).
305. *Dolichopus variabilis* Loew. Brule Lake, Ont., August, (Van Duzee).
305. *Dolichopus vigilans* Ald. Ft. Erie, Ont., July, (Van Duzee).
305. *Dolichopus vittatus* Loew. Ridgeway, Ont., June, (Van Duzee).
305. *Gymnopterus crassicauda* Loew. Ft. Erie, Ont., June, (Van Duzee).
305. *Gymnopterus flavus* Loew. Niagara Falls, Ont., July, (Van Duzee).
305. *Gymnopterus frequens* Loew. Montreal, Que., June, (J. Ouellet).
305. *Gymnopterus despicatus* Loew. Montreal, Que., June., (J. Ouellet).
305. *Gymuopterus humeralis* Loew. Montreal, Que., June, (J. Ouellet).
306. *Gymnopterus tristis* Loew. Joliette, Que., July, (J. Ouellet)).
308. *Tachytrechus vorax* Loew. Ft. Erie, Ont., July, (Van Duzee).

Representatives of the above species collected by Mr. M. C. Van Duzee, have been kindly presented to the National Collection by him.

Sarcophagidæ.

* *Sarcophaga apertella* Park. British Columbia, (R. S. Sherman).
* *Sarcophaga savoryi* Park. B.C.
* *Sarcophaga wrangeliensis* Park. Vancouver, B C., May, Canfield, B. C., May, 1918, (R. S. Sherman).

The above three species were described in the Bull. Brooklyn Ent. Soc. Vol. XV. No. 4, 1920.

Sciomyzidæ.

* *Dryomyza dayi* Cres. Columbia River, B.C., (J. C. Bradley). Trans. Am. Ent. Soc. Vol. XLVI, No. 1, 1920.

578. *Sciomyza pubera* Loew. Montreal, Que., September, (J. Ouellet).

* *Melina palustris* Melan. Nelson, B.C. Ann. Ent. Soc. Am. Vol. XIII, No. 3, 1920.

* *Melina maculata* Cres. Done Creek, Selkirk Mts., B. C., (J. C. Bradley). Trans. Am. Ent. Soc. Vol. XLVI, No. 1, 1920.

* *Renocera johnsoni* Cres. Bear Lake, B. C., (R. P. Currie). Trans. Am. Ent. Soc. Vol. XLVI, No. 1, 1920.

Sapromyzidæ.

* *Lonchaea aberrans* Mal. Spruce Brook, Newfoundland, August 8; Elphinstonee, Man., (W. A. Burman). Can. Ent. Vol. LII, Nos. 6 and 7, 1920.

Anthomyiidæ.

* *Mydaea persimilis* Mal. Lake Louise, Alta., (C. S. Minot).

* *Mydaea brevipilosa* Mal. Fogo Island, Newfoundland.

* *Helina hylemyoides* Mal. Field, B. C., (S. Brown).

* *Helina tuberculata* Mal. Lake Louise, July, (C. S. Minot).

* *Helina nasoni* Mal. Grand Lake, Newfoundland, July.

* *Limnophora gibsoni* Mal. Youghill, N. B., July, (A. Gibson).

* *Limnophora alticola* Mal. Nain, Labrador; Lewis Port, Newfoundland. July.

* *Trichopticus conformis* Mal. Mt. St. Piran, Alta., (H. Skinner); Cape Breton, N. S., Youghill N. B., (Gibson); Spruce Brook, Newfoundland; Lillooet, B. C.

* *Trichopticus brevitarsis* Mal. Bear Lake, B. C., (Currie); Kokanee Mt., B. C., (Currie).

* *Coenosia dichaeta* Mal. Fairwell Creek, Sask., July.

* *Coenosia denticornis* Mal. Fairwell Creek, Sask., July.

* *Coenosia johnsoni* Mal. Gold Rock, Ont., (H. H. Newcomb).

* *Pegomyia unguiculata* Mal. Lake Louise, Alta., July, (Minot).

* *Pegomyia labradorensis* Mal. Nain, Labrador, August.

* *Pegomyia triseta* Mal. Montreal, Que., June, (G. Beaulieu).

* *Prosalpia angustitarsis* Mal. Cape Breton, N. S., July.

* *Hylemyia innocua* Mal. Lewisport, Newfoundland, July-August, (L. P. Gratacap); Godbout, Que., (E. M. Walker).

* *Hylemyia bicruciata* Mal. Great Caribou Island, Labrador, July.

All the above Anthomyiidae described in Trans. Am. Ent. Soc. Philadelphia, Vol. XLVI, No. 2, 1920.

Hymenoptera.

Tenthredinidæ.

* *Platycampus victoria* MacG. Victoria, B. C., (W. Downes), on Lombardy Poplar. Can. Ent. Vol. LII, No. 3, 1920.

Braconidæ.

Meteorus dimidiatus Cres. Retlaw, Alta., (E. H. Strickland).

* *Apantelese victoriae* Mues. Victoria, B.C. Proc. U. S. Nat. Mus. Vol. LVIII, 1920.

* *Apanteles tmetocerae* Mues. Nova Scotia, (W. H. Brittain). Proc. U.S. Nat.. Mus. Vol. LVIII, 1920.

Ichneumoninæ.

* *Ephialtes leavitti* Cush. St. Johns, N. B., (A. G. Leavitt). Proc. U. S. Nat. Mus. Vol. LVIII, 1920.

* *Ephialtis pacificus* Cush. Vancouver, B. C., (C. F. Baker). Proc. U. S. Nat. Mus. Vol. LVIII, 1920.

* *Arutus maurus* Roh. Mission, B.C. Proc. U. S. Nat. Mus. Vol. LVIII, 1920.

Amblyteles subfuscus Cres. Lethbridge, Alta., (Strickland).

Miscogasteridæ.

* *Tridymus clavicornis* Girau. Oxbow, Sask., (F. Knab). Proc. U.S. Nat. Mus. Vol. LVIII, 1920.

Encyrtidæ.

* *Copidosoma gelechiae* var. *saga* Girau. Ottawa. Proc. U. S. Nat. Mus. Vol. LVIII, 1920.

Hemiptera

Arranged according to A Check List of the Hemiptera,—excepting the Aphididae, Aleurodidae and Coccidae,—of America north of Mexico by E. P. Van. Duzee, N. Y. Ent. Soc. 1916).

Scutelleridæ.

15. *Homaemus bijugis* Uhl. Regina, Sask., (J. Fletcher).

23. *Phimodera torpida* Walk. Aweme, Man., June, 1903, (Fletcher); Dauphin, Man., (Mrs Hippesley).

Cydnidæ.

29. *Thyreocoris anthracinus* Uhl. Dauphin, Man., (Mrs. Hippesley).

58. *Pangaeus bilineatus* Say. Kaslo, B.C., June, (J. W. Cockle).

71. *Sehirus cinctus* (P. B.) Winnipeg. (A. W. Hanham); Dauphin, Man., (Mrs. Hippesley); Sask., (Fletcher).

Pentatomidæ.

93. *Peribalus abbreviatus* (Uhl). Carp, Ont., June, 1905, (A. Gibson).

105. *Rhytidolomia faceta* (Say). Aweme, Man., April, 1906, (Criddle).

110. *Carpocoris remotus* Horv. Aweme, Man., June, 1916, (Criddle).

125. *Euschistus tristigmus* (Say). Winnipeg, Man., (Hanham).

139. *Coenus delius* (Say). Winnipeg, (Hanham); Westburn, Man., (J. B. Wallis); Aweme, Man., (Criddle).

144. *Aelia americana* Dall. Ottawa, (Fletcher); Winnipeg, (Hanham). Dauphin, Man., (Mrs. Hippesley); Aweme, Man., (Criddle); Lethbridge, Alta., (E. H. Strickland).

206. *Elasmostethus atricornis* (Van D.). Ottawa, Sept. 25, 1920, (J. McDunnough).

Coreidæ.

247. *Leptoglossus occidentalis* Heid. Jordan, Ont., June, 1917, (W. A. Ross).

322. *Alydus pluto* Uhl. Meach Lake, Que., October 17, 1906, (Fletcher); Olds, Alta., (T. N. Willing); Dunvegan, Alta., (E. H. Strickland).

Aradidæ.

361. *Aradus quadrilineatus* Say. Aweme, Man., May, 1915, (Criddle).
389. *Aradus falleni* Stal. Victoria, B.C.

Lygæidæ.

538. *Ligyrocoris diffusus* (Uhl.) Beaver Dam, Alta., August, (Strickland).
600. *Eremocoris ferus* Say. Aweme, Man., May, (Criddle); Jasper, Alta., August, (C. G. Hewitt).

Tingididæ.

654. *Gargaphia tiliae* (Walsh). Norway Pt., Lake of Bays, Ont., July 25, 1920, (J. McDunnough).

Reduviidæ.

724. *Pygolampis pectoralis* (Say). Winnipeg, Man., (Hanham).
Arilus audax Banks. Aweme and Carberry, Man., July, (Fletcher).

Anthocoridæ.

861. *Anthocoris musculus* Say. Montreal, Que., (G. Beaulieu); Lake of Bays, Ont. (J. McDunnough); Winnipeg, (Hanham).

Miridæ

Phytocoris erectus Van D. Norway Pt., Lake of Bays, Ont., July 30, 1920, (J. McDunnough).
* *Phytocoris conspurcatus* Knt. Trenton, Ont., August 6, (J. D. Evans). Bull. Brooklyn Ent. Soc. Vol. XV, Nos. 2-3, 1920.
* *Phytocoris corticevivens* Knt. Kingsmere, Que., July, (Chrystal); Hemmingford and Covey Hill, Que., (C. E. Petch). Bull. Brooklyn Ent. Soc. Vol. XV., Nos. 2-3, 1920.
967. *Adelphocoris superbus* (Uhl). Raddison, Sask., June, 1907, (Fletcher).
1004. *Poecilocapsus lineatus* (Fabr.) Aweme, Man., July, 1909, (Criddle).
1032. *Lygus elisus* Van D. Cowley, Alta., (R. N. Chrystal).
1035. *Lygus plagiatus* Uhl. Winnipeg, Man., September, 1909, (Wallis).
Lygus fagi Knt. Lake of Bays, Ont., July, (McDunnough).
Lygus atritylus Knt. Lake of Bays, Ont., July, (McDunnough).
Lygus ulmi Knt. Chicoutimi, Que., July, (Beaulieu).
Lygus tiliae Knt. Lake of Bays, Ont., July, (McDunnough).
Lygus omnivagus Knt. Aylmer, Que., June., Lake of Bays, Ont., July, (McDunnough).
Lygus ostryae Knt. Ottawa, Ont., June, (Crawford), Lake of Bays, Ont., (McDunnough).
Lygus canadensis Knt. Lake of Bays, Ont., July, (McDunnough).
1044. *Neoborus pettiti* (Reut.) Ottawa, Ont., June, 1920, (McDunnough).
* *Neoborus pubescens* Knt. Kirk's Ferry, Que., June, (Crawford). Bull. Brook. Ent. Soc. XII, 1917.
1063. *Camptobrochis histrio* (Reut.) Aweme, Man., June, (E. Criddle).
1106. *Hyaliodes vitripennis* (Say). Lake of Bays, Ont., June, (McDunnough); Aweme, Man., July, (Criddle).
1147. *Lopidea confluenta* (Say). Aweme, Man., June 21, (Criddle).
Lopidea minor Knt. Winnipeg, Man., (Hanham); Spirit River, Alta., August, (Strickland).
1153. *Hadronema militaris* Uhl. Raddison, Sask., July, 1907, (Fletcher); Olds, Alta., (T. N. Willing); Lethbridge, Alta., July, (Strickland).
Orthotylus ornatus Van Du. Ft. Coulonge, Que., July, (J. E. Beaulne).

1188. *Mecomma gilvipes* Stal. Cascades, Que., July, (H. G. Crawford).
1204. *Macrotylus tristis* Uhl. Ottawa, Ont., June, 1913, (W. Metcalf).
1256. *Europiella rubida* (Uhl.) Hull, Que., and Ottawa, Ont., (Beaulieu); Winnipeg, Man., (Hanham).

Cicadellidæ.

1767. *Agallia sanguinolenta* (Prov.). Lake of Bays, Ont., (McDunnough); Winnipeg, (Hanham); Dauphin, Man., (Mrs. Hippesley); Aweme, Man., (Criddle).
1779. *Idiocerus suturalis* Fh. Edmonton, Alta., August., (Strickland).
1795. *Idiocerus lachrymalis* Fh. Aweme, Man., June, (Criddle). Crows Nest, Alta., 1888, (J. Macoun).
1839. *Bythoscopus rufoscutellatus* (Bak). Raddison, Sask., (Fletcher).
1847a. *Oncometopia lateralis* Fab. Aweme, Man., September, 1904, (Criddle).
1855. *Cicadella gothica* (Sign.). Aweme, Man., (Hewitt and Griddle).
1864. *Graphocephala coccinea* (Forst.). Aweme, Man., August, (Criddle).
1955. *Parabolocratus viridus* (Uhl.). Lethbridge, Alta., June, (Strickland).
1987. *Scaphoideus consors* Uhl. Aweme, Man., July 10, 1914, (Criddle).
2179. *Eutettix seminudus* (Say). Aweme, Man., August 12, (Criddle).
2181. *Eutettix strobi* Fh. Aweme, Man., July, 1907, (Fletcher).
2265. *Thamnotettix clitellarius* (Say). Aweme, Man., August, 1909, (Criddle).
2356. *Cicadula punctifrons* Fall. Aweme, Man., July, 17, (Criddle).
2370. *Balclutha punctatus* (Thun.). Lake of Bays, Ont., August, (McDunnough).

Orthoptera.

Tryxalinæ.

Cheoealtis abdominalis Thom. Chilcotin, B.C., July-August, (E. R. Buckell).

Cheoealtis consperca Han. *Chilcotin,* B. C., July-August-September, 1920, (E. R. Buckell).

Platybothrus brunneus Thom. Chilcotin, B. C., July, 1920, (E. R. Buckell). New to B. C.

Oedipodinæ.

Circotettix carlinianus Thom. Chilcotin, B. C., July, 1920, (E. R. Buckell).

Locustinæ.

Melanoplus occidentalis Thom. Newgate, B.C., July, 1920, (W. B. Anderson). New to B. C.

Melanoplus brunneri Scudd. Chilcotin, B. C., July-September, 1920, (E. R. Buckell).

Melanoplus alpinus Scudd. Chilcotin, B. C., July, 1920, (E. R. Buckell).

Melanoplus borealis Fab. Chilcotin, B. C., July, 1920, (E. R. Buckell). New to B. C.

Melanoplus infantilis Scudd. Chilcotin, B.C., July, 1920, (E. R. Buckell).

Melanoplus altitudinum Scudd. Chilcotin, B.C., July, 1920, (E. R. Buckell).

Odonata.

(Arranged according to Muttkowski's Catalogue of the Odonata of North America. The numbers refer to pages in the Catalogues.)

Gomphinæ.

91. *Gomphus descriptus* Banks. Cascades, Que., June 13, 1920, (J. McDunnough).
97. *Gomphus spicatus* Hagen. Ottawa, Ont., June 3, 1920, (J. McDunnough).

Ephemeridae.

17. *Choroterpes basalis* Banks. Ottawa, Ont., August 25, 1920, (C. B. Hutchings).
20. *Baetisca obesa* Say. Ottawa, Ont., June 14, (J. McDunnough).

Collembola.

* *Pseudochorutes saxatilis* Macna. Marshalls Bay, Ont., August-October, (C. Macnamara). Can. Ent. Vol. LII, No. 8, 1920.

Myriapoda.

* *Scytonotus Columbianus* Cham. Columbia Valley, B.C., September 26, 1883, (J. B. Tyrrell).

* *Conotyla albertana* Cham. Bow River, Alta., September 28, 1883, (J. B. Tyrrell).

* *Parajulus perditus* Cham. Waterton Lake, August 24, 1883, Wigwam River, July 25, 1883, (J. B. Tyrrell).

The above three species described in Can. Ent. Vol. LII, No.6-7, 1920.

INDEX

Ontario Department of Agriculture

Fifty-Second Annual Report

OF THE

Entomological Society

OF ONTARIO

1921

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THE LEGISLATIVE ASSEMBLY OF ONTARIO

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THE RYERSON PRESS

To His Honour, HENRY COCKSHUTT, ESQ.,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

I have the honour to present herewith for your consideration, the Report of the Entomological Society for 1921.

Respectfully submitted,

MANNING W. DOHERTY,

Minister of Agriculture.

Toronto, 1922.

CONTENTS

Entomological Society of Ontario

OFFICERS FOR 1921-22

President—Mr. F. J. A. Morris, M.A., Peterborough.

Vice-President—Dr. J. M. Swaine, Entomological Branch, Ottawa.

Secretary-Treasurer—Prof. A. W. Baker, B.S.A., O. A. College, Guelph.

Curator and Librarian—Captain G. J. Spencer, B.S.A., O.A. College, Guelph.

Directors—Division No. 1, Dr. J. M. Swaine, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, Mr. C. E. Grant, Orillia; Division No. 3, Dr. A. Cosens, Toronto; Division No. 4, Mr. F. J. A. Morris, Peterborough; Division No. 5, Dr. J. D. Detwiler, Western University, London; Division No. 6, Mr. J. F. Hudson, Strathroy; Division No. 7, Mr. W. A. Ross, Vineland Station.

Directors (ex-President of the Society)—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Toronto; Prof. John Dearness, Vice-Principal, Normal School, London; Prof. Wm. Lochhead, B.A., M.S., Macdonald College, Que.; John D. Evans, C.E., Trenton; Prof. E. M. Walker, B.A., M.B., F.R.S.C., University of Toronto; Mr. Albert F. Winn, Westmount, Que.; Prof. Lawson Caesar, M.A., B.S.A., O. A. College, Guelph; Arthur Gibson, F.E.S., F.E.S.A., F.R.S.C., Dominion Entomologist, Ottawa.

Editor of "The Canadian Entomologist"—Dr. J. McDunnough, Entomological Branch, Ottawa.

Delegate to the Royal Society of Canada—The President.

FINANCIAL STATEMENT

For the year ending October 31st, 1921.

Receipts.

Cash on hand, 1920	$94 15
Subscriptions	494 31
Members' Dues	135 40
Advertisements	226 86
Back Numbers	21 51
Bank Interest	6 45
Exchange	27 22
Cuts, etc.	69 32
Government Grant	1000 00
	$2075 22

Expenditures.

Printing	$1861 46
Expense	40 46
Library	6 50
Cuts, etc.	109 68
Exchange	1 87
Balance Cash in Bank	55 25
	$2075 22

Accounts Receivable.

Advertising	$140 00	
Cuts, etc.	58 86	
		$198 86
Cash in Bank		55 25
		$254 11

Accounts Payable.

Printing	$320 00
Salary	100 00
Cuts	56 77
Annual Report	25 00
Salary and Annual Report (Arrears)	125 00
	$626 77

To Accounts Payable	$626 77
By Accounts Receivable and Cash in Bank	254 11
Net Deficit	$372 66

A. W. Baker,
Secretary-Treasurer.

Entomological Society of Ontario

ANNUAL MEETING.

The fifty-eighth Annual Meeting of the Entomological Society of Ontario was held at the University of Toronto during the week of December 28th. The meeting was held at this time in order to afford our members an opportunity of meeting with the members of the Entomological Society of America and of the American Association of Economic Entomologists.

Among the members present were Dr. C. J. S. Bethune, Toronto, Ontario; Mr. J. D. Evans, Trenton, Ontario; Prof. J. H. Comstock, Ithaca, N.Y.; Dr. L. O. Howard, Washington, D.C.; Dr. E. P. Felt, Albany, N.Y.; Prof. E. M. Walker. Dr. W. A. Clemens, Dr. Craigie, Mr. Bigelow and Miss Norma Ford, Toronto University; Messrs. A. Gibson, Dr. Swaine, L. S. McLaine, R. C. Treherne, H. G Crawford, F. C. Craighead, Dominion Entomological Branch, Ottawa; Profs. L. Caesar, A. W. Baker and Messrs. G. J. Spencer and W. G. Garlick, O. A. College Guelph, Ont.; Miss Edna Mosher, Albuquerque, N.M.; Father Leopold, La Trappe, Ont.; Prof. W. H. Brittain, Truro, N.S.; Mr. F. J. A. Morris, Peterborough, Ont.; Dr. J. D. Detwiler, Western University, London, Ont.; Mr. C. H. Curran, Orillia, Ont.; Mr. W. E. Biggar, Hamilton, Ont.; Prof. A. V. Mitchener, M.A. College, Winnipeg, Man.; Dr. Matheson and Mr. H. C. Huckett, Cornell University, Ithaca, N.Y.; Drs. S. Hadwin and A. C. Baker, Washington, D.C.; and the following officers of the Dominion Entomological Branch:—Messrs. G. E. Sanders, Annapolis Royal, N.S.; J. D. Tothill, Frederickton, N.B.; C. E. Petch, Hemmingford, Ont.; W. A. Ross, Vineland Station, Ont.; H. F. Hudson, Strathroy. Ont.; Norman Criddle, Treesbank, Man.; E. H. Strickland, Lethbridge, Alta., and W. Downes, Victoria, B.C.

The meetings were also well attended by members of the Entomological Society of America, The American Association of Economic Entomologists and others.

On Wednesday afternoon a meeting was held with the Entomological Society of America in Room 10, Medical Building, at which a number of papers were contributed by members of the two societies.

On Friday evening an Entomologists' dinner was held at the Prince George Hotel under the auspices of the American Association of Economic Entomologists. Many members of our society accepted the kind invitation of this society to be present.

The business meeting was held on Saturday morning. Considerable discussion in regard to the financial condition of the society took place.

REPORT OF THE COUNCIL.

The council of the Entomological Society of Ontario begs to present its report for the year 1920-1921.

The fifty-seventh annual meeting of the society was held at the Ontario Agricultural College, Guelph on Wednesday and Thursday, November 17th and 18th, 1920.

The meeting was well attended by members of the society from the various provinces of the Dominion, members of the staff of the Ontario Agricultural College and other visitors from Ontario, as well as several distinguished ones from the United States. Among the latter were Dr. E. P. Felt, State Entomologist, Albany, New York; Professor C. P. Crosby, Cornell University, Ithaca, New York; Messrs. W. R. Walton and L. H. Worthley, Bureau of Entomology, Washington, D.C.

The following papers were presented at the meeting: "Notes on Leaf Bugs (Miridae) Attacking Apples in Ontario," by Prof. L. Caesar; "The Manitoba Grasshopper Campaign, 1920," by A. V. Mitchener; "Some Phases of the Present Grasshopper Outbreak in Manitoba," by N. Criddle; "The Influence of Locusts on the Ranges of British Columbia," by E. R. Buckell; "The Beet Webworm Outbreak of 1920," by E. H. Strickland; "Paris Green should be Discontinued as an Insecticide," by Rev. Fr. Leopold; "Present Status of the Hessian Fly in Western Ontario," by H. F. Hudson; "Life-history of a Hobby Horse, 3rd and concluding part," by F. J. A. Morris; "Recent Investigations in Forest Insects," by Dr. J. M. Swaine; "Further Evidence of the Effectiveness of Mercury Bichloride in the Control of the Cabbage Root Maggot in British Columbia," by R. C. Treherne; "Some Further Data on the Cabbage Maggot (*Phorbia brassicæ*)," by Prof. L. Caesar; "Some of the Broader Aspects of Insect Control," by Dr. E. P. Felt; "Codling Moth Investigation in Michigan," by Prof. R. H. Pettit; "Insects of the Year in Ontario," by Prof. L. Caesar and W. A. Ross; "Inter-relations in Nature," by Prof. W. Lochhead; "Notes on *Psyllia mali* Schmid," by Prof. W. H. Brittain; "Collecting Lepidoptera in the West and Far West," by Dr. J. O. Corcoran; "The Control of the Rose Midge" by W. A. Ross; "Insects of the Season in Quebec District," by George Maheux; "Some Mosquito Problems of British Columbia," by E Hearle.

In addition to the papers presented at the meeting a very interesting discussion took place on the European Corn Borer in which many members and visitors took part.

The Canadian Entomologist, the official organ of the society completed its fifty-second volume in December last. The volume contained 290 pages, illustrated by eleven full page plates and twenty-five original figures. The contributors to these pages numbered fifty-eight, and included writers in Ontario, Quebec, Manitoba, Alberta and British Columbia, and also in sixteen of the United States, in south America, Hawaiian Islands and Japan. Ten papers were published during the year on popular and practical entomology.

It is the sad duty of the council to record the loss of two of our best-known members. The Rev. Dr. Fyles was one of the oldest members of the society. He has long been a contributor to the pages of the *Canadian Entomologist* and to the annual report of the society. His presence at our annual meetings was looked forward to by all members. For thirty-four years he did not fail to furnish a paper for these meetings. He died at Ottawa on Tuesday, August 9th, in his ninetieth year. A full account of his life and works was published in the November number of the *Canadian Entomologist.*

Mr. F. W. L. Sladen, Dominion Apiarist, met accidental death by drowning off Duck Island in Lake Ontario on September 10th. Mr. Sladen joined the society in 1912, and has been an active worker in the various groups of the aculeate hymenoptera since that time. An obituary appeared in the October number of the *Canadian Entomologist.*

It would not be fitting to close this report without a reference to the fact that Dr. C. J. S. Bethune has given up active work in Entomology at the Ontario Agricultural College and is now living in well earned retirement in Toronto.

The council also wishes to express its regret that the illness of Prof. Lochhead has prevented him from being present at this meeting. It is hoped that soon he again will be able to take up his duties in Entomology.

REPORT OF THE NOVA SCOTIA BRANCH.

Since the last report was presented to our parent Society our scope has been broadened out to include the Maritime Provinces and our name changed to the *Acadian Entomological Society*. A new number (1920) of our "Proceedings" was published in March 1921 comprising 89 pages and including considerable new data on the biology and control of insects.

Two meetings have been held—one in Halifax, N.S. and the other in St. John, N.B.—The papers presented at the Halifax Meeting were published in the last Proceedings. At the St. John Meeting the following papers were read and discussed:

The Alpine Flora of British Columbia, (Public Lecture)	DR. JOHN D. TOTHILL.
Some Properties of the Lead Arsenates	A. KELSALL.
Insecticide Investigations in New Brunswick	G. P. WALKER.
Some notes on the Female Reproductive Organs in the Hymenoptera	A. B. BAIRD.
The Work of the Museum of the New Brunswick Natural History Society, St. John, N. B.	WM. MCINTOSH.
Experiences in the Collection and Study of Hymenoptera	A. GORDON LEAVITT.
The Production of Altae in certain Aphididæ	PROF. W. H. BRITTAIN.
Life History and Natural Control of the Pine Leaf Scale	R. P. GORHAM.
Losses caused by the recent outbreak of the Spruce Budworm in New Brunswick	J. D. TOTHILL.

The following officers for the year 1922 were elected:

Hon. President	DR. A. H. MACKAY, Halifax, N. S.
President	MR. WM. MCINTOSH, St. John, N. B.
Vice President	PROF. W. H. BRITTAIN, Truro, N. S.
Sec. Treasurer	MR. A. B. BAIRD, FREDERICTON, N. B.
Asst. Treasurer	MR. W. E. WHITEHEAD, Truro, N. S.
Member of Committee	DR. EDNA MOSHER, Albuquerque, New Mexico.

A. B. BAIRD,
Secretary-Treasurer.

REPORT OF MONTREAL BRANCH.

The 400th regular and 48th Annual Meeting of the Montreal Branch was held in the Lyman Entomological Room, Redpath Museum, McGill University on Thursday, May 12th, 1921.

The President read his Annual Address which was entitled "The lighter side of Entomology" which was both amusing and entertaining.

The Council's report showed that eight meetings had been held during the season with a total attendance of 91.

Field Days were held at St. Hilaire on Victoria Day and Labour Day at which good catches were taken.

Papers were read and talks given by nine members during the year as follows:—

1. President's Address. "The Value of a long series of Specimens .. A. F. WINN.
2. Aradus luteolus Fyles .... GEO. A. MOORE.
3. Collecting in England, 1919 .... L. GIBB.
4. The breeding of Ants in a formicary .... G. H. HALL.
5. Hemiptera from Peaks Is. Me. 1918-19-20 .... GEO. A. MOORE.
6. Collecting at Great Chebeague, Me. .... A. F. WINN.
7. Trip through the Western Provinces .... DR. CORCORAN.
8. Sugaring for Catacolas .... J. W. BUCKLE.
9. Heredity .... GEO. A. MOORE.
10. The Association of Pentatomids with certain plants .... A. F. WINN.
11. Work of the Entomological Branch of the Dominion Department of Agriculture .... A. GIBSON.
12. Notes on Notonectidæ .... T. C. BAINES.
13. Annual meeting of the Quebec Society for the Protection of Plants .... A. F. WINN.
14. Entomology in France .... M. DU PORTE.
15. Notes on the genus Utetheisa Hubn. (Arctiidæ) .... A. F. WINN.
16. Fulgoridæ .... GEO. A. MOORE.
17. Large Copper Butterfly and Varieties .... L. GIBB.
18. A butterfly hunting trip in the Orient, 1919-20 .... H. M. SIMS.

The following were elected officers for the ensuing year:—

President .... A. F. WINN.
Vice-President .... G. CHAGNON.
Secretary-Treasurer .... GEO. A. MOORE.
Librarian .... J. W. BUCKLE.
Council .... DR. CORCORAN, G. H. HALL, A. C. SHEPHERD.

GEO. A. MOORE,
Secretary.

ANNUAL REPORT OF THE TORONTO BRANCH.

The twenty-fifth Annual Meeting of the Toronto Branch was held in the Biological Building on October 26th, 1921.

The report of the council showed that during the past season seven regular meetings and a field meeting were held at which there was an average attendance of sixteen persons. At a special meeting we were very fortunate in having as the speaker Mr. F. Morris of Peterborough, who read Part III of his delightful paper, "The Life-history of a Hobby Horse." This lecture had an attendance of about seventy. During the year the following papers and addresses were given:

"Respiration of Insects" .... PROF. E. M. WALKER.
"The Life-History of a Hobby Horse" .... MR. F. MORRIS.
"Protective Coloration" .... MR. C. W. NASH.
"Hymenoptera of Point Pelee" .... MR. N. K. BIGELOW.
"Notes on Insects of Point Pelee" .... MR. S. LOGIER.
"The Bees in the Collection of the Royal Ontario Museum" .... MR. N. K. BIGELOW.
"The Rearing of Lepidoptera" .... MR. R. W. HALL.
"Insect Food of Bears" .... MR. N. K. BIGELOW.
"The Ant Fauna of the Nipigon Region" .... MR. S. LOGIER.

One new member was elected, viz, Miss Mary Pettigrew. The Treasurer's report showed a balance of $22.52.

For the season of 1921-1922 the following officers were elected:—

President	MR. S. LOGIER.
Vice-President	MR. A. H. LEIM.
Secretary-Treasurer	MISS NORMA FORD.
Librarian	MR. N. K. BIGELOW.
Council	DR. WALKER, MR. ANDREWS, MR. BLAKELY, MR. HALL.

NORMA FORD,
Secretary-Treasurer.

REPORT OF THE BRITISH COLUMBIA BRANCH.

The twentieth annual meeting of the B.C. Entomological Society was held in the Chamber Court Room of the Provincial Court House, Vancouver, B.C. on Saturday, February 12th, 1921. There was an attendance of seventeen members at the morning session and twenty-two in the afternoon.

The meeting was called to order at 9.30 a.m. and the Secretary read the annual report and statement of accounts. Among the resolutions passed it was decided to take steps to have the Society incorporated under the Benevolent Societies' Act. The annual subscription was raised to $2.00.

During the morning and afternoon sessions the following papers were read:—

A review of Economic Entomology in British Columbia and its progress in recent years	R. C. TREHERNE.
Notes on the early stages of Nepytia Phantasmaria	G. O. DAY.
The Lepidoptera of the Kootenay	J. W. COCKLE.
A Talk on insects imported from the Orient	W. H. LYNE.
Notes on the Fauna and Flora of Mount McLean	R. GLENDENNING.
Man's influence on the native flora with special reference to insect pests	J. DAVIDSON.
The Sphingidae of British Columbia	E. H. BLACKMORE.
Notes on Amnesia decorata and the Holly Bud Moth	W. DOWNES.
Notes on the Satin Moth	R GLENDENNING.
Report on collections of Hemiptera from B.C.	DR. H. M. PARSHLEY.
Notes on the ecological distribution of some Orthoptera from the Chilcotin district of B. C.	E. R. BUCKELL.

In celebration of the twentieth anniversary of the Society the members met for supper at the Citizens Club and later returned to the meeting room and listened to a lecture by Mr. W. B. Anderson on "Collecting Places in B.C." illustrated with lantern slides. It was decided to hold the next meeting in Victoria.

During the season the Society will publish four numbers of its annual Proceedings, namely, Nos. 16 and 18 of the Systematic series and No. 13 and 15 of the Economic series, and a complete index to all numbers published, from 1 to 15, is being prepared by one of our members, Mr. E. P. Venables, and will be published shortly.

The Society is in a flourishing condition and the members now number forty-one.

W. DOWNES,
Hon. Secretary-Treasurer.

REPORT OF THE ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA.

The twenty-first annual meeting was held in Victoria on Saturday, January 21st, 1922.

The President L. E. Marmont was in the chair and 14 members were present.

The Secretary's Report and Financial Statement was read by Mr. R. Glendenning, Assistant Secretary, in the absence of Mr. Downes.

The business and discussion upon it occupied nearly the whole of the morning session, the subjects being:—The continuance of the Entomological Record; The Society's Cup offered for school competition; The by-laws revised for incorporation, and the proposed increase in subscriptions to the parent society.

The following motion was passed relative to the last subject "That this Society thinks a subscription of $1 to the Ontario Entomological Society is sufficient, in view of the decrease in prices."

The following papers were read:—

The use of Spreaders in Poison Sprays .... A. L. LOVETT.
Hemisarcoptes malus and its relation to Oyster shell scale E. P. VENABLES.
Economic Insects of the Year in the Lower Fraser Valley. R. GLENDENNING.
A talk on the Chilcoten country and its Orthoptera. .... E. R. BUCKELL.
(illustrated with lantern slides).
The Teaching of Entomology in the public schools ...... J. W. GIBSON.
Aerial Surveys as an aid to Entomological Investigation.. E. HEARLE.
The life of the poplar sawfly .... W. DOWNES.
The European earwig in B.C. .... R. C. TREHERNE.
Incidental observations regarding certain insects .... W. H. LYNE.

Election of officers resulted as follows: —

Honorary-President .... F. KERMODE,
President .... L. E. MARMONT.
Vice-Presidents .... R. S. SHERMAN (Coast).
M. H. RUHMANN (Interior).
Advisory Board.—The above and E. H. BLACKMORE, W. H. ROBERTSON, J. W. GIBSON, W. H. LYNE. E. HEARLE.
Hon. Secretary-Treasurer .... R. GLENDENNING, Agassiz, B.C.

A hearty vote of thanks was accorded to Mr. W. Downes, the retiring Secretary, for his valuable services.

It was decided that the next meeting would be held in Vancouver.

R. GLENDENNING,
Hon. Secretary-Treasurer.

REPORTS ON INSECTS OF THE YEAR.

DIVISION NO. 3. TORONTO DISTRICT—A. COSENS.

The promise of the warm weather of April was not fulfilled in an early spring. There were no insects of any kind plentiful until June. On May 28th, the Toronto Entomologists held a field day at Lawrence Park, north of the city. Although the day was warm and sunny only a few captures were made. Two butterflies were taken:—the Meadow Fritillary. *Brenthis bellona,* and the Common Blue, *Lycaena ladon.* A few Cabbage butterflies and Common Sulphurs were seen, also two or three Tiger Swallowtails, *Papilio turnus.*

Again this season as in 1920 and 1919, the Monarch butterflies were rare. They became more plentiful later in the season as the following dates on which specimens were seen show:—Sept. 21st, 22nd, 26th, 29th, Oct. 1st and 3rd.

Early in June, from about the 10th to the 14th, large beetles were reported to be emerging from a lawn in the northern part of the city. The question concerning whether they were harmful or not led to the examination of a couple of specimens. They were found to be Stag Beetles, *Lucanus dama.* The group owes its name to the peculiar mandibles of the male, which are very long, sharply pointed, sickle-shaped and bear in this species a small tooth on their inner edge near the centre. The head is correspondingly large in the male, being much smaller in the female. The eggs of the beetles are deposited, about the end of July, in the bark of a tree, commonly willow or oak. The long, thick, white larvæ require several years to reach full development. When mature they build a cocoon of the chips formed in their feeding. By boring into the trunks and the roots of the trees they sometimes do considerable damage.

An explanation of their emergence from the lawn is found in the nature of the soil in that part of the city. A great deal of filling in was done in that district when it was opened up for building operations. Trunks of trees were no doubt buried at that time and from these the bettles were emerging.

The Stag beetles are closely related to another family, the Scarabeidæ. This includes two main groups, the beneficial scavenger beetles and the injurious leaf-chafers. The former contains forms that have the curious habit of rolling up balls of manure to provide food for their larvæ. The historically interesting Sacred Scarabeus may be taken as a type of this group. These beetles were held in such high veneration by the Egyptians that paintings and carvings of them are often found among the relics of this ancient people. Some of the beetle models are small and made of gem stones or of gold, while others are large and fashioned from less expensive materials, a granite specimen in the British Museum being four feet in length.

The June-bugs or May-beetles, *Lachnosterna fusca,* are the most familiar examples of the leaf-chafers. Their white larvæ, often plentiful in sandy soil, are very injurious to pastures, strawberry patches etc. The large, brownish black adult beetles feed on the foliage of fruit trees and in some instances do appreciable damage.

POISONED MOLASSES FOR THE DESTRUCTION OF NOCTUID MOTHS.

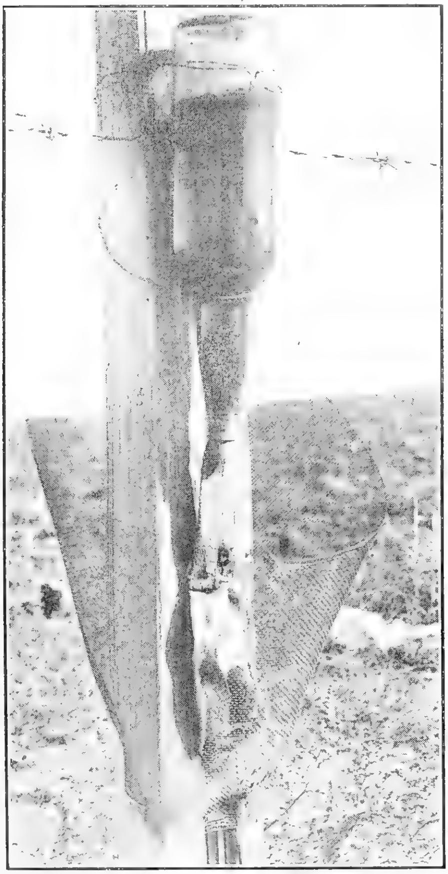
BY E. H. STRICKLAND, ENTOMOLOGICAL BRANCH, OTTAWA.

The annual loss on the western prairies from the destruction of grain crops by the Pale Western Cutworm (*Porosagrotis orthogonia* Morr.) has amounted in recent years to several millions of dollars. Numerous experiments, conducted in the infested provinces and states, have failed to produce an effective method of controlling this pest in its larval stage. For this reason the problem of destroying the adults before they have reproduced has received considerable attention.

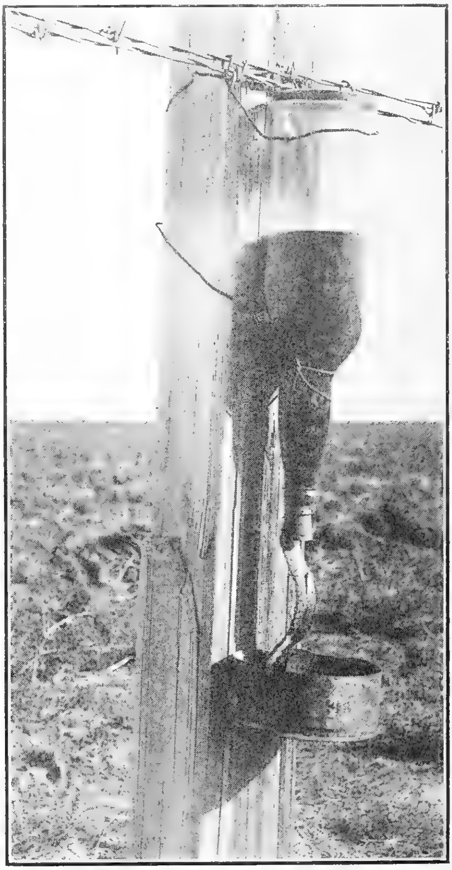
Three methods have presented themselves to us as a possible means of gaining this end, namely, light-traps, molasses troughs and poisoned molasses. In experimenting with these we have aimed at producing a method that will have the following qualifications; all materials used are readily procurable in any farming community, very frequent attention to traps is unnecessary, and it is inexpensive to operate. The employment of poisoned molasses approaches more closely to the fulfillment of the conditions than does either of the other methods.

LIGHT-TRAPS.

In 1913, we placed a few light-traps in fields around Lethbridge, where an outbreak of *P. orthogonia* had been somewhat severe. The nightly catch never exceeded 58 moths of this species, and of the total capture 97.5% were males. For this reason we considered the method to be economically ineffective. In 1920, Circular 94 of the Montana Experiment Station recorded a night's capture of as many as 1,500 moths of this species in individual light-traps which were of a superior type to that which we had used in 1913. This year Mr. H. L. Seamans, who has recently come from the Montana Station to take charge of the Dominion Entomological Laboratory at Lethbridge, constructed a number of traps similar to those in which these large captures were made. Two of these were set out in a badly infested field at Lethbridge, and about six were operated by our assistant Mr. W. Carter with the help of some farmers in the very heavily infested district around Retlaw, which is about sixty miles to the north-east of Lethbridge. These traps were set out from the middle of July till September 8th, when snow and frost put an end to the flight of *P. orthogonia*. During periods of moonlight, high wind and other unfavourable weather these traps were not operated.



Trap so arranged that the majority of moths will be retained.



The most suitable type of trap for moth destruction.

THE ALBERTA MOTH TRAP

The results were disappointing. The largest capture of *P. orthogonia* at Lethbridge was 517 males and 17 females, the average per "trap-night" being 84.3 males and 2.03 females. The Retlaw traps captured 41.3 males and 3.8 females per "trap-night." Of the total capture of 34,500 specimens of *P. orthogonia* which were taken in the field by light-traps 94.97% were males. This percentage was very little better than that obtained in 1913.

We do not know to what extent the males are monogamous in nature, but it would appear that on this factor alone depends any appreciable benefit to be derived from light-traps.

We consider light-traps to be unsatisfactory as a general method of control on the prairies for the following reasons: —

1. They require attention twice daily.
2. They are somewhat expensive to operate.
3. They are practically ineffective during periods of full moon.
4. They are not well adapted to a windy country.
5. For the species under consideration they catch too small a percentage of females.

Molasses Troughs.

This method was suggested by the experiments conducted by Dobrovljansky* for the control of *E. segetum* in Russia. Early in September 1920, three galvanized iron troughs, 2 feet long and 6 inches wide and deep, were set out in a badly infested area. Each was half filled with a 66% solution of molasses in water. On the first night they captured a total of 382 moths of which 135 were females of *P. orthogonia*. A slight crust had formed on the surface of the molasses by the following night when 16 moths only were retained. Of these 8 were females. It was obvious that we might be attracting to the field moths that we were unable to capture and that possibly our troughs were doing more harm than good to the owner.

Attempts to improve the consistency of the molasses solution failed to give satisfactory results. In a 50% solution many moths swam to the sides and escaped while any stronger solution crusted over in a very short time. Some twenty troughs were used in 1921, and attempts were made to retain the moths in weak solutions by the addition of vegetable and other oils, with tanglefoot and with poisons, but without success.

This method was early abandoned for the following reasons:

1. The troughs require very frequent attention.
2. A great many of the moths escape.

Poisoned Molasses.

P. orthogonia comes very readily to "sugar" applied to fence posts. A fence post can be kept permanently "sugared" every evening for from ten to fourteen days by means of a simple apparatus. The only material required is a quart bottle with a cork to fit, 6 inches of lamp wick and a small piece of absorbent cloth. The bottle is filled with the sugaring mixture and the end of the wick, which has first been well saturated in the mixture, is inserted. A well-fitting cork, that has been slightly flattened on one side by cutting away a small portion with a knife, is pressed fairly tightly into the bottle with the flattened side next to the wick. The bottle is then inverted and wired or tied to the west side of a fence post, and the free end of the wick is nailed to the post through a piece of absorbent cloth. When a rapidly killing poison is used, and it is desired that material obtained be preserved, a partial funnel of mosquito netting or paper can be attached to the post. A modification, suggested by Mr. Carter, is to replace the cloth with a shallow pan made from a tomato can. This forms a reservoir for any surplus flow of poison.

The bottle is fastened to the west side of the fence post in order that it will not be exposed to the direct rays of the sun till the afternoon. The heat then causes its contents to expand and to drive some of the liquid down the wick and on to the cloth. This action usually continues till nearly sunset and it liberates sufficient bait to attract moths throughout the night. After the sun has set a reverse pressure in the bottle draws in sufficient air to replace the expelled liquid.

*Extract in Rev. applied Ent. Series A. Vol. I, page 490, 1913.

Provided the variations in temperature are not too extreme, or fermentation too rapid, a quart bottle will run every evening for from ten to fourteen days. We have tried several modifications of reservoir and methods of controlling the flow of bait, such as the "drinking fountain," siphon, and gravity feed, but find the inverted bottle to be as satisfactory as any.

Having obtained a satisfactory apparatus, our next concern was to find a suitable poisoned bait. As a basis a 10% solution of cane molasses was used in all cases. This ferments within a few days of mixing. In the fall of 1920, experiments were made in which the decantation from a saturated solution of white arsenic was used as the diluent. This killed moths in the laboratory in from 8 to 40 hours, but was found to be somewhat deterrent to feeding.

When this solution was used in bottle traps moths fed on it and obtained sufficient poison to cause their death within 24 hours. This was proved by captured specimens. In the field, however, they all flew from the traps before dying. It was hoped that some immediate killer could be obtained in order that we might estimate the value of the traps, and be certain that gravid females were unable to deposit their eggs before dying. It was also highly desirable that those who might be using the traps as a practical means of control should be able to see some results from their efforts in the form of dead moths.

To this end we planned a series of experiments in 1921, but it was not until nearly the end of the season that Mr. Seamans found quassia to be the nearest approach to what we desired. Subsequent observations showed that this material must be used in conjunction with some other poison.

Among substances employed with the hope of obtaining an immediate killer were various arsenicals, soluble strychnine, copper sulphate, formalin, mercuric chloride, sodium cyanide in solution, and sodium fluoride. All of these failed to kill in less than about 12 hours except in strengths that proved to be deterrent. Arsenical poisons showed the least deterrent effect in the field when they were employed in weak solutions. Various objections to most of the forms of arsenic that are readily available to a farming community decided us to adopt commercial fly pads, at the rate of one pad per quart of solution, as the most satisfactory source of supply. At this strength the arsenic is very slightly deterrent and there is no precipitation. The pads can either be soaked in the solution over-night or cut into strips which are inserted into the bottles. Moths captured while feeding on bottles so poisoned died in from six to one hundred hours, depending upon the amount of feeding prior to capture. The majority of poisoned moths died within 36 hours. Checks taken from unpoisoned bottles lived for an average of 130 hours without subsequent feeding.

The season was unfavourable for bait traps. A very dry summer had resulted in the failure of many crops and had seriously hampered summer-fallowing, with the result that nearly all classes of fields were covered with Russian thistle. This was flowering at the time of flight. Noctuidæ feed freely on these flowers, but the favourite food plant in Alberta appears to be golden-rod, which flourishes in restricted areas of waste land. Experiments with traps placed in these golden-rod areas showed that fermenting molasses, when used alone, was not sufficiently attractive to overcome the predilection of the moths for these flowers. With the addition of eight drops of amyl acetate per quart of the solution, both sexes of *P. orthogonia* could be attracted to feed on the bait despite the close proximity of a strong counter-attractant.

The abundance of feeding is very variable, and we did not obtain very definite data upon the probable catches made by our experimental traps. At night there were frequently as many as 20 to 30 moths, of which over 50% were female, feeding on a single trap at a time when very few were attracted to troughs of molasses. By day males were found feeding at all hours, though they were most abundant between the hours of two and five p.m. Females appeared less frequently in the morning and were seldom seen in numbers till about 4 p.m., by which time they visited the traps freely and were nearly as numerous as the males on golden-rod blossoms.

We did not discover that quassia would retain the majority of moths that visited a trap till too late in the season for this to supply us with many data.

In the laboratory, however, and with a few bottle traps, we found that the deterrent effect of quassia is very slight and that it is readily overcome by the addition of a little saccharine to the bait.

The effect of quassia on moths is very variable, and it cannot be predicted for the individual. Moths captured feeding on flowers, were offered a choice of formulæ. Those containing quassia and saccharine were preferred to straight molasses. This was also demonstrated in the field. At a strength of two ounces to a quart of solution quassia kills about 65% of all moths that feed on it. In some cases death is rapid, and within ten minutes of feeding either sex of *P. orthogonia* loses all power of locomotion, lies on its back and response to stimulation becomes continually less apparent till it ceases entirely. Death in such cases appears to be gradual and progressive. In other cases moths feed freely on the bait for a few minutes and suddenly flop around the receptacle as though in great pain, till sudden death puts an end to their activity.

On the other hand some 35% of the moths which have imbibed quassia solution, sometimes more extensively than have those which die, become either very sluggish or quite inactive a few minutes after feeding and they may remain in this condition for two or three days. Sometimes females, which have been quite inactive for over 24 hours, will laboriously struggle to their feet, lay a few eggs, and relapse into inactivity. Recovery in other cases appears to be complete, and since it permits oviposition, we have retained the use of fly pads in addition to quassia. Our experiments indicate that very few moths will recover from the effects of the latter before they succumb to the arsenical poison of the former.

At present our poisoned bait formula, therefore, consists of:—a 10% solution of cane molasses, the diluent being water in which quassia chips have been soaked overnight at the rate of two ounces to the quart. In each bottle of this solution is inserted one fly pad, sufficient saccharine to cover a Canadian 5 cent piece (1 gram), and eight drops of amyl acetate.

This formula undoubtedly can be improved considerably both as regards its attractiveness and poisoning quality. As it stands, all of the materials, with the exception of amyl acetate, which is not essential, can be obtained in any village.

The present retail cost of materials for a dozen traps, including the bottles, is approximately $2.65.

We have no definite data as to what distribution of traps will give the greatest returns for money expended, but believe that one to every ten rods of fencing around a field that is free from flowering weeds should be sufficient to reduce an outbreak very materially. On weedy fields subsidiary posts erected in the field might be necessary.

Poisoned molasses traps give more promise for controlling noctuid moths than do other methods tried because:—

1. They require attention, at the most, once a week.

2. Females are attracted as readily as males to bait and they are usually gravid.

3. With a combination of quassia and arsenic very few females that feed on the bait are able to lay eggs subsequently.

4. Quassia is non-poisonous to stock and is distasteful to them.

5. Individual traps attract more moths than do corresponding troughs of molasses.

6. All materials are cheap and are readily obtainable anywhere.

7. The bait is effective by day as well as by night and its efficacy is not reduced by moonlight.

8. Climatic conditions affect the traps very little.

THE WESTERN WHEAT-STEM SAWFLY IN CANADA.

Norman Criddle, Dom. Entomological Laboratory, Treesbank, Man.

The Western Wheat-stem Sawfly—*Cephus cinctus* (Nort.) is a native insect that has become a pest because of the introduction of cereals such as wheat and rye. It originally lived in various native grasses such as *Agropyron, Elymus, Calomogrostis* and *Bromus*. While confined to these food plants it fluctuated from year to year according to the prevalence of flowering stems in which the larvæ lived, or to the presence of natural enemies. These two factors usually kept the insect well in hand until the grains mentioned above were introduced when abundance of new food became available. The sawfly, however, was slow in adapting itself to the new conditions and it was only towards the beginning of the present century that it finally became established in our grain fields. Since then it has steadily increased. To begin with, only the edges of wheat fields were attacked by the overflow from native grasses but gradually the adults flew further afield until, eventually, whole fields became infested and in some instances more than eighty per cent. of the wheat stem was cut by the larvæ. Both Saskatchewan and Manitoba suffered heavy loss in 1921, the total amounting to several million bushels and in south-west Manitoba exceeding twenty-five per cent. of the crop. The insect is steadily spreading and so far as we can judge, it will continue to do so until the entire spring wheat area is invaded.

Natural Control. The Wheat-stem Sawfly appears to have been kept well under control in the past by various natural factors which include natural enemies and meteorological conditions. Of the natural enemies Hymenopterous parasites seem to have played the leading part though there was, at times, quite a high death rate brought about by an unknown cause apparently of a fungus origin. The rainfall has always been an important factor because it has controlled the insect's food supply by governing the number of flowering stems in which the larvæ live.

The sowing of cereals over large areas of country has entirely upset the control conditions that previously existed. Factors that were then of the utmost value have been almost eliminated, the available stems of grain having done away with the check of limited food supply, while for reasons that are only beginning to be understood, the parasites so prevalent in grasses are unable to follow their hosts into the grain fields. On account of these conditions the sawfly has practically a free hand, and as a result it has spread over large stretches of country.

PARASITES. Two hymenopterous parasites were reared by Ainslie in North Dakota and Utah namely *Microbracon cephi* Gahan and *Pleurotropis utahensis* Crafd. The same insects have been taken by us in Manitoba, while two others *Eupelmus allynii* French and a species of *Eurytoma* also are present in some numbers. All these parasites are natives of the country and they occur whereever infested grasses are met with. Cultivated grasses which are attacked by the sawfly have proved equally suitable to the parasites, but when it comes to fields of grain there is a sudden check which practically leaves the sawfly free of enemies.

The sudden check of the parasites when they come to grains is the most important and interesting of the problems before us and a number of details will have to be supplied before we can ultimately define what the causes are that bring about this change. There are, however, several significant facts to be taken into consideration; firstly, both *Eupelmus* and *Eurytoma* emerge in large numbers during August and September, the *Cephus* larvæ being at this time in their winter quarters in the stubs below the ground where it is doubtful whether the parasites would find them. If this is so, in what do the above parasites oviposit during the Autumn months or do they hibernate and remain inactive until the following July? If the parasites breed in their hosts then they would obviously have to return to the plants harbouring them and consequently leave the grain fields. This might well account for the insects' abundance in wild grass lands, but it would only partly explain the problem before us. We know that *Microbracon* hibernates in cocoons, either as larvæ or pupæ, to emerge as adults sometime during the following spring, in this case there being probably no secondary host. We must, therefore, look to other causes for the absence of this parasite in infested grain fields.

Turning to *Pleurotropis utahensis* we find that this parasite is late in maturing, and that it is even more restricted in its habits than *Microbracon.* It has been found in most of the *Cephus* infested grasses and once in fall rye, but not in wheat. It was comparatively rare in 1921.

The third parasite *Eupelmus allynii* (French) is a very general one, being known to attack various other grass-infesting insects, but it has not previously been recorded from *Cephus.* Our specimens emerged in September. The fourth *Eurytoma* sp. appears in August. It has been reared from both grain and grasses as a host of *Cephus.*

The second point is that sawfly-infested winter rye is quite thickly inhabitated by parasites when said rye is found growing as a volunteer crop amid other grasses and weeds of various kinds, but not when it is growing alone.

Thirdly, infested wheat and spring rye are both found to contain *Microbracon* and *Eupelmus* around the edges of fields next to grass areas but very rarely towards the centres of fields. All of which points strongly to the parasites having their home among the grasses, in which they find necessary factors not present in the growing grain. We are still at a loss to know what these factors are, but it is significant that parasites of sawfly larvæ may be found in both grain and grasses when those plants are growing together on land that has been left uncultivated.

CLIMATIC CONTROL. It is noteworthy that there is a marked fluctuation in the yearly development of the sawfly, even though the species has gradually become more numerous. In North Dakota, for instance, the infestation of 1921 did not apparently exceed that of 1917, whereas had the insect developed at what might be termed a normal ratio it must have wiped the wheat crop out of existence. We have noted similar conditions in Manitoba more than once, which have led us to suspect that meteorological factors play an important part in the development of the sawfly. This has been still further borne out by a survey of the province and by an examination of the reports issued by the Manitoba and Saskatchewan governments, together with those of the Manitoba Free Press. We found in these surveys that the greatest prevalence of *Cephus* followed very closely the areas of least rainfall, and that where the moisture was ample the injury fell to a marked degree. This fluctuation, apparently due to humidity, was even well marked over local areas. It was also apparent that the low, moist, portions of a field were much less infested than the high drier parts. More data is necessary before definite conclusions can be arrived at but judging from our experiments, rain in itself is not harmful except during the adults' life. It would seem, therefore, that the cause of the greater immunity lies in the quicker growth, this in its turn perhaps providing an excess of sap that is detrimental to the sawfly larvæ. In any case the facts of this flutuation are hopeful because they indicate that with the passing of dry seasons the sawfly menace may become less acute.

Remedies. The remedies for the Western Wheat-stem sawfly are entirely cultural, and the most important of them consists of ploughing down the infested stubble any time between August 1st and June 5th of the following year. In order to be thoroughly effective the ploughing must be well turned so that there is no overlapping edge to the furrows, and it should be not less than six inches deep. A wide furrowed plough is better than a narrow one for this purpose. Fall ploughing will pack during the winter, but that done in the spring should be packed by machinery.

In addition to the destruction of larvæ by ploughing a good deal can be accomplished by sowing immune, or partly immune, crops. Oats, for instance, are perfectly free from attack; barley, owing to its rapid growth escapes, with small injury, while winter rye is able to withstand the insects' effort to a marked degree and, on account of its early ripening, is cut before loss occurs. Indeed, there are indications for the belief that winter rye may prove one of the most important checks to the development of the sawfly owing to the fact that it is often heavily infested but the sawfly larvæ are usually unable to mature in it. Moreover, even should they develop normally, the early ripening of the rye enables it to be harvested before the larvæ can get below the point where the straw is cut by the binder and as a result they perish.

Trap Crops. We have noted that volunteer wheat on land intended for summerfallow is often a great attraction for adult sawflies that have emerged in the vicinity. On one such plant we counted 14 of these insects at rest, while on another three were attempting to oviposit at the same time. It is probable, therefore, that a single plant of this nature might be the receptacle for many eggs, especially as it is not uncommon to find the remains of two or more larvæ in one stem. For this reason we believe that a narrow strip of thinly sown wheat round the edges and across the middle of a field intended for summerfallow, might attract and be the means of destroying a large number of these insects.

Crop Rotation. Should the sawfly continue to maintain its present proportions or increase still further, then it will be necessary to consider more drastic measures of control and make an initial sacrifice in order to reduce the pest sufficiently to make wheat growing profitable. To do this farmers in infested districts will have to discontinue wheat and spring rye growing for a year, and in their place sow crops that are free, or nearly so, from the insects' attack. Crops that can be recommended for this purpose are: Oats, winter rye, barley, corn and any broad-leafed vegetable or fodder plant, including flax.

GRAINS THAT SUFFER MOST. Spring wheat is the most severely infested, with spring rye a close second. Durum wheat, according to Ainslie, suffers almost as much as common wheat, and our own observations made over restricted areas, bear out this contention. Some of our correspondents in North Dakota, however, claim a much greater immunity for durum than other wheats, but it is necessary to know more about the conditions under which it was grown before we can reach definite conclusions as to its utility. Speltz also is badly infested

As a general rule, it seems that quickly maturing crops are safer to sow than late ones, and in this respect it might be worth while testing one or more of the new early wheats. A winter wheat hardy enough to stand our climate would probably prove an ideal factor in overcoming the sawfly depredations.

THE DESTRUCTION OF GRASSES. It was C. N. Ainslie who first questioned the utility of destroying infested grasses owing to the fact that these harboured large numbers of parasites. The problem is a moot one and requires careful study. In 1921, we found Brome grass (*B. enermis*) infested with sawfly to the extent of 70 per cent but from these infested stems not more than 5 per cent of the larvæ reached maturity and of those that cut and plugged the stems, not more than 6 per cent survived. In other words there was a death rate of 94 per cent very largely through parasites. To cut the grass in July for the purpose of destroying the larvæ would, under such circumstances, be of no practical value, and might do considerable harm. Judging from our work of 1921 other grasses mature a larger number of sawflies than does brome. A field of *Agropyron tenerum,* for instance, showed a parasitism of about 35 per cent in a total infestation of 72 per cent, and practically the same death rate was recorded in *Agropyron richardsonii.* In these there would seem to be an overflow of adults sufficient to infest nearby crops, leaving their enemies to attend to those that remained to breed in the grass; whereas if these grasses were cut early in July all the sawfly larvæ would be killed while the parasites which had not yet oviposited might be induced to fly to infest hosts in the growing grain.

From the evidence so far obtained we believe Brome grass can safely be left to rear sawfly parasites, but that other grasses should be cut before the middle of July to kill the sawfly larvæ infesting them.

HARDINESS OF LARVÆ. The larvæ are capable of great endurance, and for that reason we have been unable to discover any practical method of destroying them in the fall. Immersing the infested stubs in water for three days merely produced a torpor which passed off after a few hours. Exposing the stubs to all the vicissitudes of autumn, winter and spring on top of the ground was also of no avail. Burning the stubble is likewise abortive.

In conclusion, it is my pleasure to acknowledge the help I have received from Mr. C. N. Ainslie, both personally and through his publication. I am indebted to Mr. W. R. Walton for his kindness in arranging for the determination of parasites, and to Mr. M. P. Tullis of the Department of Agriculture, Regina, for information concerning the sawfly outbreak in Saskatchewan. Finally, I have to acknowledge the assistance of my fellow worker, Mr. P. N. Vroom, who has been with me during the last two summers.

TABLE SHOWING PERCENTAGE INFESTATION OF VARIOUS GRASSES AND MORTALITY AMONG THE CEPHUS LARVÆ.

WINTER RYE.

Sown in 1920 but not cut; 21 per cent. of stems not infested.	
Larvæ matured	19
Larvæ dead	81
Volunteer crop among other grasses; 19 per cent. of stems not infested.	
Larvæ matured	11
Larvæ dead; cause unknown	78
Larvæ parasitized	11

BROME GRASS (*B. Enermis.*)

Collected in August; 12 per cent. of stems not infested.	
Larvæ mature	23
Larvæ dead, cause unknown	37
Larvæ parasitized	40
Collected in October; 14 per cent. of stems not infested.	
Larvæ mature	8
Larvæ dead, cause unknown	44
Larvæ parasitized	48
Collected in late October; 13 per cent. of stems not infested.	
Larvæ mature	2
Larvæ dead, cause unknown	44
Larvæ parasitized	54

Agropyron tenerum

Collected in October; 32 per cent. of stems not infested.	
Larvæ mature	42
Larvæ dead, cause unknown	20
Larvæ parasitized	38

Agropyron richardsonii

Collected in August, 24 per cent of stems not infested.	
Larvæ mature	40
Larvæ dead, cause unknown	19
Larvæ parasitized	41
Collected in October; 21 per cent. of stems not infested.	
Larvæ mature	32
Larvæ dead, cause unknown	7
Larvæ parasitized	61

LYME GRASS (*E. canadensis.*)

Collected in August; 24 per cent. of stems not infested.	
Larvæ mature	30
Larvæ dead, cause unknown	34
Larvæ parasitized	36
Collected in October; 16 per cent. of stems not infested.	
Larvæ mature	26
Larvæ dead, cause unknown	37
Larvæ parasitized	37

The above tables are compiled from the examination of several hundred stems in each instance.

THE EUROPEAN CORN BORER (*Pyrausta nubilalis* Hubn.): LIFE HISTORY IN ONTARIO.

H. G. CRAWFORD, ENTOMOLOGICAL BRANCH, OTTAWA, AND

G. J. SPENCER, ONTARIO AGRICULTURAL COLLEGE, GUELPH, ONT.*

The apology for presenting so incomplete a study rests upon the fact that this is a recently introduced and already widely distributed insect, spreading with great rapidity and capable of doing very serious damage. Consequently, its reaction to Canadian conditions where it has demonstrated its ability to increase over 300 per cent. in a single year, and where its presence results in severe damage to our corn crop, cannot but be of interest and value.

* A joint progress report of the life history studies carried on at the laboratories of the Dominion and Ontario Departments of Agriculture in the season of 1921.

The larvæ of the European corn borer normally winter in corn stalks or stubble, either standing or lying on the ground. Almost any other not absolutely submerged shelter, from a corn leaf in the ground to the centre of the cob in the crib, will serve for successful wintering. In the spring as soon as the weather warms up, the larvæ do a variable amount of boring and possibly feeding in preparing the pupal chambers from which an outlet for the escape of the adult is made.

Pupation in the field in 1921 began on May 27th being practically complete by June 22nd, though one or two larvæ were taken in the following week. Adults began to emerge June 16th, and by July 4th 90 per cent. of the moths had issued, the balance following more slowly; a small percentage failed to develop.

In the laboratory where the whole process of development was delayed, pupation did not begin until June 6th, ten days later. The males began to pupate 7 days before the females, outnumbering them until just before the end of the pupation period. Similarly with the moths the males began to emerge about 4 days before the females, and exceeded them in number until just before the end of the emergence period, which extended from June 29th to August 12th. The duration of the pupation period of the males varied from 8 to 18 days, an average of 12.33 days, while for the females it was distinctly less, from 7 to 17 days, an average of 11.29. At the laboratory located a little further inland the average durations, however, were 12 days for males and 10.19 for females, a distinctly more rapid rate.

The male moths lived in confinement for from 6 to 21 days, averaging 13 days, while the females lived for from 10 to 31 days, averaging 17.4 days, with a pre-oviposition period (20 females) of from 3 to 9 days, averaging 4 days. After this period they laid from 95 to 988 eggs per female, at the rate of from 12-231, an average of 75.3 eggs per day, in masses containing from 1-64 eggs, an average of 33 per mass. All of the eggs kept under observation hatched. The duration of this stage was from 3 to 8 days, averaging for the period between June 28th and August 2nd 4.71 days.

In the field a study of the incidence of egg laying on corn planted on May 31st in a field adjacent to the northern margin of an old corn patch of 1920, at this time in oats and barley, was started. The moths began to emerge on June 18th from the old stubble in the standing grain, and eggs were not found until July 1st when 5 masses were secured from 100 plants, though a most careful search was maintained in the intervening period of 14 days; on July 3rd 15 masses were secured on approximately 200 plants, at which time egg laying was becoming general, and some masses were observed to be hatching. The corn at this time was from 9-20 inches high. No eggs were laid until the corn averaged about 15 inches in height. In the interval the adults were, without doubt, flying southwest to another field planted on May 18th which, at this time, was markedly in advance of the field under observation in development and finally suffered a loss of 65%. The field under study in the north, however, was but 63.2% infested and the loss would not exceed 5%.

The first eggs taken in the season, however, were found in the field June 21st, and by July 15th hatching was general, and the infestation was shown up very clearly on the unrolling leaves where the newly hatched larvæ were feeding at the base. The evidence of attack became clearly marked in the first week in July, and by the second week the tassels were falling on the early planted flint and sweet corn. As the plant increased in length and the larvæ on the rolled up leaves were exposed to light, they bored into the stalks, which by the end of July in the early planted corn began to break over.

By the third week in July in the very early sweet corn, and to a much less extent in the flint, the majority of the larvæ were full grown. At that time a very small second brood developed in the very earliest planted sweet corn, involving but a fraction of one per cent. of the larvæ. In this sweet corn 10 pupæ in all were collected between July 21st and 26th and 4 pupæ were secured from larvæ collected at the same time. From these pupæ, after a period of 13 days, 2 male moths and 1 female moth were reared. The female laid fertile eggs, the larvæ from which established themselves on a corn plant in an experimental cage. The only other evidences of the second brood were 1 pupa and 2 female pupal cases from the earliest flint corn, an adult male in late July, an egg mass found on August 9th and a few 3rd instar larvæ taken late in August.

The larvæ in all varieties of the later corn, matured distinctly later on the average and showed no signs of developing a second brood, but prepared for winter about the middle of August and where not disturbed, would probably not move until spring. At harvest time about the last of August and in early September in a flint corn field showing 70% total loss, the estimated number of larvæ per acre was 191,800. Of these 27% were within 12 inches of the ground and a four inch stubble carried 28,079 *larvæ*, 6.82% of the larval population.

There was no movement of any import in the standing field corn in the fall, the distribution in the middle of October being practically the same as at the end of August. However, there is a noticeable movement outward and downward in the stalks in shock, but none of any importance from the shock to the ground and neighbouring stubble.

The date of sowing was closely correlated with the degree of infestation, the larval population and the total loss both in experimental and field conditions. In general, corn sown before May 24th was either practically ruined or suffered severe loss; that sown between May 24th and June 1st was heavily infested, but suffered relatively less or but slight actual loss, depending of course upon the type of corn; while the corn sown after June 1st, although in some cases showing a fairly high percentage of infestation carried few larvæ and practically no loss except in the case of sweet corn. Thus, on one farm of three corn patches within 100 yards of each other, the sweet corn sown April 25th carried a larval population of 234,200 per acre with a loss of 100%; sweet corn planted June 1st developed an infestation of 75% and carried a larval population of 80,000 per acre with a loss of 20%; while flint (smut nose yellow) planted May 22nd, only carried 54,400 per acre, a stalk infestation of 67% and a total loss of not more than 10%. The sweet corn here doubtless protected the flint by attracting a large number of the moths.

In the experimental plots the effect of the date of planting shows up most clearly, as can be seen in the tabulation below, though here the loss was slight and the larval population meagre, the corn all being planted after May 24th.

Variety	Date	Per cent of stocks infested	Per cent of stocks broken over	Per cent of cobs infested
Golden Bantam sweet corn	May 24	30.18	16.93	16.9
	May 31	34.4	20.00	2.14
	June 3	15.33	7.66	1.89
	June 9	7.52	4.30	1.19
Dent Corn Early Leaming	May 31	24.30	69.44	.4
	June 3,	13.45	1.50	.99
	June 9	8.11	1.62	1.17
Golden Glow	May 28	53.42	17.81	2.12
	June 3	21.08	9.73	.99
	June 9	7.44	4.65	.63
Wisconsin No. 1	May 28	54.44	16.14	2.65
	June 3	15.61	5.35	1.29
	June 9	3.66	2.44	1.16
Flint Corn Salzers' North Dakota	May 28	70.9	20.77	13.31
	June 3	10.62	10.12	3.77
	June 9	14.74	2.17	4.11
Compton's Early	May 28	82.4	50.00	10.47
	June 3	44.14	17.79	9.68
	June 9	15.10	4.17	3.45
Smut Nose Yellow	May 31	30.14	11.41	6.10
	June 3	28.57	14.29	4.11
	June 9	3.45	.86	1.89

The larval population in badly infested fields attained enormous magnitudes; a dent corn field sown May 18th carried an estimated total of 294,152 per acre, a flint field sown on the same day suffered a total loss of at least 65%, supported a total of 258,400 per acre and left when cut, in the stubble (less than 4 inches in height) and the crop refuse, a residue of 43,487 caterpillars going into the winter.

In general, all things considered, there seems to be no marked preference for any particular type or variety of corn; the severe loss associated with sweet corns and the flint varieties being due to the early planting, the ability of the larvæ to establish themselves and the small dimension of the stalks. The obvious relatively slight loss in the dent corns is due to the later planting, its vastly greater bulk and its harder and coarser texture preventing a large proportion of the larvæ establishing themselves in the first instance.

The Infestation of Plants Other Than Corn.

About the middle of July in the very severely infested fields of early sweet corn, to a less extent in severely infested flint and to a very slight extent in dent corn except in the one severely injured field, the nearly full grown and full grown larvæ become restless. At this time large numbers of them leave the now breaking, shrivelling and drying corn stalks and carry on an apparently haphazard migration throughout a period of about two weeks. In the course of this migration as many as 24,400 larvæ per acre found their way into the weeds in one field of sweet corn sown April 25th. Others doubtless returned to the corn plants. Considerable feeding was done in the larger weeds, the pigweeds, the lamb's quarters and barnyard grass breaking over in a high percentage of cases. The barnyard grass was infested as high as 88% and in one instance a plant with 26 stems was found to contain 17 larvæ. The weeds infested in this field in the order of frequency were: barnyard grass (*Echinochloa crus-galli,* Beauv.), redroot pigweed (*Amaranthus* *retroflexus* L.), yellow fox-tail (*Setaria glauca* Beauv.) Lamb's quarters (*Chenopodium album* L.), tumble weed or Russian thistle (*Salsola* var. *tenuifolia* G.F.W. Mey), green fox-tail (*Seteria viridis* Beauv.), Lady's thumb (*Polygonum persicaria* L.), wild buckwheat (*Polygonum convolvulus* L.) ground cherry (*Phrysalis heterophylla* Nees.); other weeds present but not infested were: purslane, Canada thistle, bitter sweet, milkweed and crab grass. However, throughout the district of the weeds found to be infested in addition to the above the following can be listed: orchard grass (*Dactylis glomerata* L.), Canada thistle (*Cirsium arvense* Scop.) wild sunflowers (*Helianthus* sp.), blue weed or vipor's bugloss (*Echium vulgare* L.), ragweed (*Ambrosia artemisiifolia* L.); mullein (*Verbascum thapsus* L.), goldenrod (*Solidago* sp.), old witchgrass (*Panicum capillare* L.), yarrow (*Achillea millefolium* L.), burdock (*Arctium minus* Bernh.).

In cultivated crops and flowers larvæ have been secured in the field feeding on dahlia, geranium, aster, golden glow, beets, mangolds, tomatoes (fruit), beans, oats, squash, vines, broom corn, sudan grass, early amber sugar cane, Hungarian grass and Mann's Wonder sorghum.

No success was achieved in establishing larvæ upon a long series of common weeds by attaching eggs laid upon a slip of corn leaf. The eggs hatched but the larvæ rarely were able to infest the plant. In a series of experiments with paired adults caged over 35 common cultivated vegetables and flowers the larvæ in very small numbers established themselves upon mangels, potatoes, celery, cauliflower, peas, beans, peppers, eggplant, radish (gone to seed) salvia and aster. Summing up, however, the entire infestation in the open of plants other than corn, with the exception of the dahlias, and possibly barnyard grass and Mann's Wonder sorghum was due entirely to the migrating larvæ. These larvæ, particularly in the weeds, together with those in corn stalks, stubble and refuse have gone into the winter in very large numbers with every prospect of coming through successfully and giving rise to an increased infestation in 1922.

THE SPREAD OF THE EUROPEAN CORN BORER IN SOUTHERN ONTARIO.

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When the European Corn Borer was realized to be a serious pest, that is, in the summer of 1918, the Canada Department of Agriculture took steps to warn the general public of the danger of introducing this insect into Canada, and also carried on investigations to determine the amount of corn, and other products likely to harbour the borer, that had been imported into the Dominion from the infested districts in Massachusetts. As a result of these investigations scouting for the pest in the maritime provinces was carried on during the summer of 1919.

With the discovery of the insect in western New York in the fall of that year, the attention of the Department was directed to the possibility of the pest having spread into the province of Ontario. Some scouting was done in Welland County and along the Niagara River that fall, but was soon discontinued on account of the lateness of the season and the unfavourable climatic conditions. Plans were made, however, to resume the scouting in this territory the following summer.

On August 10th, 1920, the first infestation was found near Lorraine Station, Humberstone township, Welland county. The larvæ were small in size and were collected in a field of ensilage corn. A preliminary survey of the infestation showed that it was exceedingly light, but widely scattered. On August 22nd, a farmer living near St. Thomas, Ontario, submitted some samples of larvæ found in his field corn which were readily identified as caterpillars of the European Corn Borer. A prompt examination of this district showed the degree of infestation to be much greater than that in Welland county.

With the co-operation of the Ontario Department of Agriculture extensive scouting was started at once. The extent of the infestations exceeded by far anything that had been anticipated, and as the season was advancing rapidly, the scouting had to be carried on at undue speed.

At the close of the scouting work it was found that there were two distinct infestations in southern Ontario, the first centering about Welland county, and the second centering about Middlesex and Elgin counties. During the scouting seasons one hundred and five townships in thirteen counties were examined, thirty-five of which were found infested by this insect. The area found infested covered approximately 2,780 square miles.

The season of 1921 was unusual in several respects, the continued hot dry weather in June and July causing all vegetation to develop with abnormal rapidity. and it was necessary to start the scouting work two weeks previously to the time originally planned. The scouting was actually started on August 1st and completed by October 3rd. During this period one hundred and ninety-seven townships were scouted, of which sixty-five were found infested; these added to the thirty-five townships found infested in 1920 make a total of one hundred townships infested to date. The area found infested by the scouting this past season is approximately 4,910 square miles, which, in addition to the 2,780 square miles infested in 1920, make a total of 7,690 square miles now infested by the European Corn Borer in this district.

The following townships in Ontario are infested at the present time: Oakland, Brantford, Burford, and Onodaga in the county of Brant; the seven townships in Elgin county; Gosfield South, Mersea and Pelee Island in Essex county; nine out of ten townships in Haldimand county, the tenth township was not scouted on account of the small amount of corn grown, but was included in the quarantine; Goderich, Hay, Stephen, Tuckersmith and Usborne in Huron county; Gore of Camden, Harwich, Howard, Orford, Raleigh, Romney, Tilbury East and Zone in Kent county; Brooke, Euphemia and Warwick in Lambton county; Clinton, Grantham, Louth and Niagara in Lincoln county; the fifteen townships of Middlesex county; the eight townships in Norfolk county; Pickering in Ontario county; the eleven townships in Oxford county; Blanshard, Downie, Easthope North, Easthope South, Ellice, Fullerton, Hibbert, Logan and Mornington in Perth county; Waterloo, Wilmot and Woolwich in Waterloo county; the eight townships in Welland county; Guelph in Wellington county; and Lancaster in Wentworth county.

The degree of infestation is heaviest in Elgin and Middlesex counties, and on the outer edges of the infested area borers were very hard to find.

It is also to be hoped that the past season was an unusually favorable one for the European corn borer, for there has been a general spread from practically all points of the 1920 area, but the most noticeable spread has been north, northeast and east.

The scouting work of 1920 showed that there are two distinct infestations in the province at this time, and the results of this past summer's work appear to bear out that conclusion. This season the scouts had no difficulty in making several collections of larvæ in the townships adjacent to the western end of the old

Welland infestation, and in townships adjacent to the eastern end of the Middlesex and Elgin infestation, whereas great difficulty was encountered in locating borers in the centre townships, that is, between the two infestations.

The infestation is exceedingly light on the extreme western edge of the infested area, that is, in Kent and Essex counties, in fact the only collections in the townships found infested in these counties this year, were taken along the main highway which runs east and west. The spread into this area may be due to artificial spread, either from carriers such as automobiles, or from infested corn refuse washed up on the shore of the lake, as the highway is adjacent to the lake in this district.

The discovery of the borer on the Lake Huron shore was made late in the season, and only a single collection of larvæ was taken in the township of Gooderich. As the neighboring township was found to be lightly infested, it appears as if the infestation in Goderich township may be due to an exceptionally long flight of the adult moths.

The only isolated infestation was found in Pickering township, about twenty miles east of Toronto and bordering Lake Ontario. The collection of larvæ was made in the town of Pickering. Although the entire township, as well as the neighboring townships were carefully re-scouted, no further collections were taken The nearest infestation to this point is in Lincoln county approximately forty-five miles away.

Upon the completion of the scouting season in 1920, a domestic quarantine was placed on the infested area prohibiting the movement of corn stalks, broom corn, green sweet corn, roasting ears, corn on cob and corn cobs from the area placed under embargo. Exception was made, however, to seed corn on the cob consigned to recognized fairs and exhibition, which were inspected immediately upon arrival at destination. This quarantine was amended in May 1921, and three additional amendments were passed during the summer and early fall, quarantining the additional townships found infested.

In order to bring the attention of the general public to this embargo, warning notices were placed at the intersection of every road leading out of the quarantined area. In addition, large canvas banners 2½ feet by 11 feet were stretched across the main automobile highways leading out of the district. Automobiles were stopped and searched on the main highways on Sundays and holidays for evasions of the quarantine. A careful watch was also kept on all markets and fall fairs. It was found that live stock men were in the habit of taking corn stalks as fodder for their live stock exhibits at the larger shows, thus making it necessary to station inspectors at such fairs.

Although no direct evidence has been secured as to the origin of the outbreak of the European corn borer, this may have been due in Elgin and Middlesex counties to importations of broom corn from Europe. From correspondence it has been learned that all Canadian broom manufacturers prefer to use broom corn grown on this continent, but in 1909-10 there was apparently a shortage of this product and one firm at least, located in this district, imported large quantities of corn from Central Europe.

THE IMPORTED ONION MAGGOT IN BRITISH COLUMBIA WITH NOTES ON ITS LIFE HISTORY AND CONTROL UNDER "DRY BELT" CONDITIONS.

R. C. TREHERNE, DOMINION ENTOMOLOGIST IN CHARGE FOR B.C., AND M. H. RUHMANN, ASSISTANT PROVINCIAL ENTOMOLOGIST.

The imported Onion Maggot, *Hylemyia antiqua,* (Meigen), is known to have been present in British Columbia for many years. William Couper, writing in the 1875 Report of the Ontario Entomological Society, states that this species "is a terrible pest throughout the extent of the Dominion." Inasmuch as this date was ten years before railway connections were made with the Prairies and only five years after British Columbia entered Confederation, the record is of interest. Dr. James Fletcher in his first Annual Report as Dominion Entomologist in 1884 records the Onion Maggot as having been very injurious in many districts in Canada. His correspondent, Mr. Homer of New Westminster, in this year, however, makes no mention of the Onion Maggot in British Columbia. In the second Annual Report for 1885 the Onion Maggot is dealt with in detail and particular attention is drawn to the serious attacks of this insect in Ontario and Quebec, but no reference is made to British Columbia. In view of the lack of published data, it is possible that this insect did not occur in British Columbia at this early date. This belief is based on the lack of references to British Columbia in Dr. Fletcher's Annual Reports between the years 1885 and 1903. In the 1904 report, however, we find the first direct suggestion that this insect occurred in British Columbia. It was not until the year ending 1909 that direct proof that this insect occurred in British Columbia was received, according to these same reports.

During the past ten years reports of injuries caused by this insect have been common in the humid transitional areas of the Pacific Coastal region, but they have been confined usually to garden and small vegetable plantations. In the arid transitional areas or in the so-called "dry belt" of the province, onion growing on a commercial basis has been in vogue for about eight years, but the first specimens bred to maturity were obtained in 1912. In 1914 this insect had become very injurious and extremely numerous especially in the north end of the Okanagan Valley. The acreage in onions during the past few years comprises between 500 and 800 acres at the two settlements of Vernon and Kelowna. During 1914 and 1915 some growers were literally forced to abandon commercial onion growing and to-day are undecided as to the value of the crop with this insect prevalent in the country.

In the year 1917, in the Okanagan Valley of British Columbia, the demand for information as to the control of this insect became so insistent that the senior author decided that some action was necessary. Consequently in the year 1918, review of the literature on this insect under North American conditions was undertaken. A surprising lack of detailed information both as regards the life-history and the control was revealed. The sodium arsenite and molasses bait as a remedial measure was receiving prominence at the time and while several authors were subjecting this method of control to certain criticisms, the method seemed to possess the weight of authority behind it.

We were unable to conduct any material investigations in 1918, owing to the pressure of other duties, but we felt justified in advising our growers to apply the sodium arsenite bait using the open "pie dish" method of application, believing this method to be better suited to our low humidity conditions than the broadcasting of the bait in coarse drops across the plantations. Several leading growers adopted this method in 1918, and without exception each one reported a very serious loss by the onion maggot, the poisoned bait apparently having failed to influence the degree of infestation. An average field of three acres, for instance, grown under the ordinary cultural methods and treated with the bait in open "pie dishes" yielded only 900 lbs. when a total crop of sixty tons should have been received. Twenty "pie dishes" were used to the acre and they were kept continually moist with bait renewals for the best part of six weeks commencing at the time when the seedling onions were three inches high.

These results severely tested our faith in the poisoned bait method of control under irrigated conditions, but with no information as to the habits of the fly under such conditions we decided to test the bait more fully in the following years. Hence during 1919, 1920 and 1921, certain life history notes have been obtained at Vernon, B.C., and we take pleasure in presenting them in summarized form together with further results on control operations.

Life History.

The individual egg stage lasted from 3 to 8 days. The number of eggs laid in clusters, evidently the product of an individual female's deposition during the height of the spring oviposition period, varied from 3 to 27 on seedling onions and from 11 to 59 on volunteer onions, growing from the remains of the previous year's crop. Solitary eggs were common, clusters of 10 to 15 eggs were frequent, but clusters of 5 to 7 eggs were most usually seen. The most interesting records, which in principle were ordinary, were 59 eggs laid in the soil in a single cluster two inches away from the nearest plant and 39 eggs laid in a cluster on a leaf three inches above the soil surface.

The individual larval stage varied from 14 to 29 days, during spring and early summer, while the puparium stage lasted approximately the same length of time. Puparia were usually seen between the roots of the plants during the summer but, later in the season and in stored onions, pupation frequently occurred between the outer fleshy layers of the bulb or beneath loose epidermis.

Adult male flies, bred, held and fed in confinement lived from 3 to 13 days and females from 3 to 33 days. Sweeping and breeding records indicated that the sexes were about evenly divided throughout the year.

During the past three years the first adults to develop from over-wintering puparia in the field appeared at the same time i.e. between May 10th and May 15th, at the time when the seedling onions were 1 to 1½ inches high. In the same three years oviposition commenced in the field between May 16th and May 19th and continued into September or until the crop was harvested.

Second generation adults, developing from the spring deposition of eggs first made their appearance under field conditions on July 7th, 1919; on June 29th, 1920, and on June 17th, 1921, and in each year continued to appear until late in August. Second generation eggs, larvæ and puparia were present in the field during July, August and September.

Third generation adults, developing from eggs laid during the first two weeks of July appeared, under field conditions, between August 13th and August 20th and deposited eggs, a few resulting puparia overwintering.

While the studies necessary to prove the existence of the third generation were successfully negotiated, we are unable to give the exact percentage of second generation puparia that produced third generation adults. Suffice it to say that, in 1920, from material bred in sequence from eggs laid in May and recovered during July, 55% of the July second-generation puparia hibernated while 45% emerged as third generation adults in mid-August. Second-generation puparia, of course, were being produced during August and September, hence only a fraction of the second generation really produced a third generation.

From our records we are able to state, therefore, that two generations are complete at Vernon, B.C., while in certain years, a partial third generation occurs.

Nature of Injuries.

While adults were extremely active on the wing on bright sunny days and very sluggish on dull, cloudy days, weather conditions did not seem to affect the rate or degree of oviposition per diem. Eggs were laid most frequently on the strongest growing seedlings in the early spring, and at this time of the year oviposition nearly always occurred at or just below the surface of the soil on or in the vicinity of a plant. After the end of June the leaves and leaf sheaths were most favoured, particularly those of the weaker plants or those previously injured by the first generation larvæ. Eggs were rarely laid on those plants with the bulb showing and seldom on plants with a prominent 'neck.'

In the earlier part of the growing season larvæ hatching from eggs laid on the soil surface enter the plant at the junction of the roots and the forming bulb, presumably finding their way down through the soil and not, so far as we have been able to determine, entering the plant in the stem and then passing down to the bulb. The larvæ, after feeding at the base of the bulb, gradually work their way towards the top, causing the plant to decay and wilt. Partly grown larvæ also migrate from one plant to another in a row and have frequently been observed entering the stem of the new plant just below the surface of the soil. These larvæ do not necessarily descend to the roots, although this downward movement is usual, but occasionally burrow upwards to the tops, causing the leaves to wilt, leaving a sound and uninjured bulb below.

When eggs are laid on the leaves or in the leaf sheaths the larvæ usually find their way to the bulb as soon after hatching as possible by passing down inside the sheath. Larvæ have frequently been taken within the hollow stems from one to six inches above the soil surface, as many as one to sixteen maggots being found at times in a single leaf, but these doubtless have been forced up by the decomposition of the bulb and stem below ground rather than have hatched and lived together in the leaves. Larvæ, even in small seedling onions, will continue to feed in the plant they are attacking, passing up into the leaf above the soil surface before they migrate to another plant in the same row.

In general, this insect causes loss by the direct destruction of seedling onions in the early spring, by the decay or rot of developing bulbs in early summer and by a reduction in weight in the marketable crop as a result of larval feeding which has not been sufficient to cause the death of the plant.

Control Measures.

From records under North American conditions it appears to be conceded that soil treatments with gaseous substances, dry and wet applications to the soil surface and such like treatments are of no value under commercial methods of onion growing. Commercial fertilizers have had the effect of increasing the tonnage and have to some extent enabled plants to withstand an attack. The poisoned bait mixture consisting of sodium arsenite, molasses and water, applied in the form of coarse drops and placed in open "pie-dishes" finds favour in many sections of North America. In such sections this bait is regarded as the most satisfactory commercial control operation, but it must be conceded that even it has not always been successful in preventing infestation. Too much rain during the spring oviposition period or adverse climatic factors are offered as excuses for such failures. Nevertheless, judging from information at our disposal, onion growers, particularly in Eastern Canada and United States, are being advised to use the sodium arsenite bait. Under conditions that prevail at Vernon, B.C. and doubtless applicable to all "dry belt" conditions, we are clearly of the opinion that this bait is of no practical value, possibly owing to the presence of irrigation water in ditches or furrows. This statement is based on four years' records in its use at Vernon. In 1918, the ordinary "pie dish" method of application was employed and the growers took a decided loss following its use. In 1919, an improved "pie-dish" was devised containing a bait-saturated felt pad over which was arranged an air tight reservoir capable of holding a half gallon of water. The felt pads were thus maintained in a continuous moistened condition for about two months with occasional renewals of water and bait. The same dishes were used in 1920 and 1921 and records on oviposition in baited and non-baited areas were carefully kept each year. No variable weather condition affected these baits and twice-a-week tests of liquids yielded 100% mortality with flies when fed in confinement. Dead flies were also seen in the field, but the simple fact remains that under field conditions results of value were not obtained, and we are now forced to abandon the poisoned bait control measure as a recommendation to growers in the "dry belt" of British Columbia.

We have, however, been able to devise another control operation which judging from results thus far obtained, is more efficient and less expensive. This operation takes advantage of the selective habits of the adults for oviposition. It was noticed that any volunteer onion growth present in the field invariably attracted the first flies during the May oviposition period and further it was observed that the stronger growing seedling onions, near an irrigation ditch, attracted the adults during June. As pointed out in the life history notes oviposition commences in the middle of May when the onions are only 1½ inches high. At this time the volunteer onion growth was four to eight times that of the seedlings. In other words, the volunteer onion growth of May was equal to the seedling onion growth of June and both attracted flies for the purpose of oviposition.

We learnt, therefore, to recognize the fact that these volunteer onions were a powerful factor in trapping the first generation flies for oviposition and, on developing this idea, we also found out that a great deal depends on the type of growth produced. We have already mentioned the fact that in mid-summer, during the flight period of the second generation flies, the weakest plants or those often previously attacked, proved more attractive to the adults than the strong growing bulbs. This observation, as it applies to the mid-summer habits of the flies also applies to the spring habits as it relates to the type of volunteer onion growth. In short, the volunteer onion which shows a bulb or "neck" with the leaves arising some distance from the soil was not chosen for oviposition. The type of growth which proved most attractive was produced by a cull bulb in which the leaves grew flaccid and which arose at the ground level. As a matter of experience less than 10% of the volunteer onion growth under normal conditions yielded the most suitable type of growth, but on such plants practically the entire first generation of flies oviposited. On this information we laid down the following plan which has been followed now for three years on commercial plantations of from eight to ten acres and results have been checked against the poisoned bait experiments. At the time the seed is being sown in the main plantation or following the seeding operations, plant a row of cull onions, held over from the previous year's crop, every 100 feet through the plantation, setting them about four inches deep and about six inches apart in the row. Allow these culls to sprout and grow so that when the seedlings are an inch high, the volunteer growth is 6 to 8 inches. Pull up and burn these volunteers about June 15th or at the time when the greatest number of first generation larvæ are present in them and before pupation occurs.

Time and space does not allow us to present the data covering this "trap crop" method of control or the records on the poisoned bait measure as obtained at Vernon, B.C., but we hope at some later time to do so.

(A) Showing pallid, sickly appearance of mite-injured plum foliage; (B) Normal plum foliage. (Reduced)

NOTES ON THE PLUM SPIDER MITE OR EUROPEAN RED MITE.

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The following paper on the Plum Spider Mite is largely based on orchard observations made from 1914 to 1921, and on life history studies conducted during 1921 by the junior writer.

History and Distribution.

The Plum Spider Mite or European Red Mite (*Paratetranychus pilosus* Can. and Fanz.) is an European species which doubtless was introduced into Canada on imported nursery stock. It was first noticed in Ontario in 1912 by Caesar (1), and this appears to be the earliest record of its appearance in North America. Since then, it has been reported from Pennsylvania and Connecticut (2) and last summer (1921) specimens of the mite were forwarded to us from Vernon, B.C.

The spider mite occurs in all the fruit growing districts of Ontario, but is especially troublesome in the Niagara district. In view of its wide-spread occurrence in this province, it appears to the writers that it must have been introduced many years before its discovery, and that it must have a much wider distribution in North America than that recorded in literature. It is highly probable that in many cases *P. pilosus* has been mistaken for the common red spider *T. telarius* or for the clover mite *Bryobia pratensis* and has been reported under one or the other name.

Host Plants and Nature of Injury.

We have taken the mite on European and Japanese plums, apple, sour and sweet cherries, pear and peach. According to Caesar, it also occurs on hawthorn, and Garman (3) records its occurrence on rose. The European plum is by far the favourite host plant with apple next and then sour cherry. In Connecticut the mite has caused severe injury to apples, particularly Baldwin trees, but in Ontario it has proved to be, so far, only of importance as a pest of European plums.

In the Niagara fruit belt, the mite is one of the major pests of the plum orchard. It attacks both surfaces of the leaves and, by means of its mouthparts, punctures the tissues and withdraws the plant juices. At first this results in a speckling of the leaves, due doubtless to the withdrawal of chlorophyll. Later on, if the infestation is severe, all the leaves become pallid, sickly in appearance, tough and largely functionless. From a distance the foliage on badly attacked plum trees looks as if it were coated with road dust.

The injury to the leaves naturally robs the trees of vigour, and, when severe, checks the growth of the wood, dwarfs the fruit and retards its ripening. Two years ago the following data (table No. 1), showing the loss in weight and size of fruit and in growth of wood due to mite injury, was secured by comparing the trees in an infested block of plums with those in an uninfested block. The trees were the same age, and were grown under the same conditions, apart from the fact that the uninfested trees had been sprayed with lime sulphur and the others with bordeaux mixture.

TABLE No. 1—Showing Loss in Weight and Size of Fruit and in Growth of Wood Due to Mite Infestation

Variety	Loss in Weight of Fruit	Loss in Size of Fruit	Loss in Terminal Growth of Wood
Gueii	41.5%	40.3%	23.9%
Pond's	20.6%	24.3%	45.6%
Lombard	27.3%	19.1%	22.3%
Reine Claude	28.7%	24.8%	35.0%

On apple trees, according to Garman, the infested foliage becomes brownish or assumes a dull leaden appearance, and later in the summer many of the leaves drop. The same author reports a marked reduction in the size of the fruit on infested Baldwin trees.

Life History.

The Egg.

Description: The egg is flattened spherical in shape, and measures .15 mm to .16 mm in diameter. When newly laid, it is pearly to pink in colour, and later on becomes a dull dark red. At the apex there is a hair-like process about as long as the diameter of the egg.

The overwintering and summer eggs are similar in size, shape and colour.

Location: The overwintering eggs are located on the bark anywhere from the tips of the twigs to the trunk, usually on rough bark and in the axles of shoots and spurs.

The summer eggs, in the early part of the season, are laid on any part of the upper or lower surface of the leaves and on the petioles. Later on, some of them are deposited on the bud scales and on the bark.

Hatching of Overwintering Eggs. The eggs commence to hatch at the time European plums are in full bloom. In the plum orchard (situated near the lake shore) which we had under observation this past season, the period of hatching extended from May 2nd to May 9th.

Incubation Period of Summer Eggs: The period of incubation in our experiments varied according to the temperature, from 13 days in the spring, to 6 days in midsummer. The average for the season was about 9 days. More precise data on the duration of the egg stage is given in table No. 2:

TABLE No. 2—Showing Duration of Incubation

Brood	No of Exp's	No of Eggs	Time of year	Incubation Period			Temperature		
				Min.	Max.	Aver.	Min.	Max.	Mean
2nd	10	72	May 23rd. to June 10th	10	13	10.5	40	85	61
3rd	13	81	June 19th to July 8th	7	8	7.5	48	97	74
4th	13	134	July 11th to July 26th	6	8	7.0	60	91	77
5th	16	110	July 30th to Aug. 19th	8	11	9	52	85	69
6th	14	89	Aug. 24th to Sept. 12th	8	11	10	48	92	60

Stage of Growth when First Summer Eggs are Laid: The first generation adults commenced laying eggs about May 25th, or, in other words, at the time the calyces on early varieties of plums were beginning to fall.

Immature Forms.

During its growth the spider mite moults three times and thus passes through three immature stages. The newly hatched mite is termed the larva, after the first moult it is the so-called first nymph or protonymph and after the second moult the deutonymph.

Description: The larva is oval in shape, sparsely clothed with long bristles delicate, pearly pink to dull red in colour and measures about .16 mm by .088 mm. It has only three pairs of legs.

The protonymph has four pairs of legs and is somewhat darker in colour than the larva. It measures .198—.270 mm. x .162—.198 mm.

The deutonymph in shape and colour resembles the other immature forms. The legs are translucent and sparsely covered with hairs. Like the larva and first nymph, the deutonymph is very delicate and soft-bodied. In size it is .32 mm. —.36 mm x .23 mm.

Habits of Immature Forms: The larvæ and nymphs feed principally on the lower surface of the leaf, generally close to the veins. They may remain feeding in one spot for several hours.

Each moult is preceded by a quiescent period of one or two days during which time the larva or nymph remains attached to the leaf and shows indication of life.

Length of Larval-nymphal Period: In our studies this period varied from 17 days in the spring to 7 days in June and July, the average being 10.7 days. Fuller data covering the six generations are shown in Table No. 3.

(*a*) Fellenburg plum severely injured by mite. (Reduced)

TABLE No. 3—Showing Duration of Larval-nymphal Period

Brood	No. of Exp's	No. of Nymphs	Time of year.	Nymphal Period			Temperature		
				Min. Days	Max. Days	Aver. Days	Min.	Max.	Mean
1st	11	48	May 3rd. to May 21st	16	18	17	34	75	53
2nd	12	60	June 5th to June 20th	8	11	9	42	87	64
3rd	13	72	June 20th to July 13th	7	10	8	48	98	77
4th	12	82	July 18th to Aug. 3rd	7	10	9	52	91	76
5th	15	58	Aug. 7th to Sept. 29th	8	13	11	46	86	66
6th	13	35	Sept. 1st to Sept. 23rd	11	15	13	48	90	66

THE ADULT.

After the third and final moult the mite reaches the adult stage.

Descriptions: The female is oval in shape and rather stout; carmine in colour with dark red to black blotches on the abdomen; and measures .36—.46 mm x .25—.28 mm. The legs are cream to dusky yellow in colour. On the dorsal surface there are 26 setose bristles, each of which is set in a conspicuous white tubercle.

The male is considerably smaller than the female and measures about .20 mm. —.28 mm x .14 mm—.16 mm. The cephalothorax is pearly pink to reddish with a median crimson eye-spot; the abdomen is dark red to purplish black and the legs are translucent.

Egg Laying Activities of the Female: In our insectary studies, the female mites commenced to deposit eggs 2 to 5 days (the average was three days) after reaching maturity. Each female laid from 11 to 90 eggs with an average of 38.6, (table No. 4). The daily rate of deposition per female varied from 1 egg to 12 eggs, and the egg-laying period ranged from 3 to 29 days. (Table No. 5).

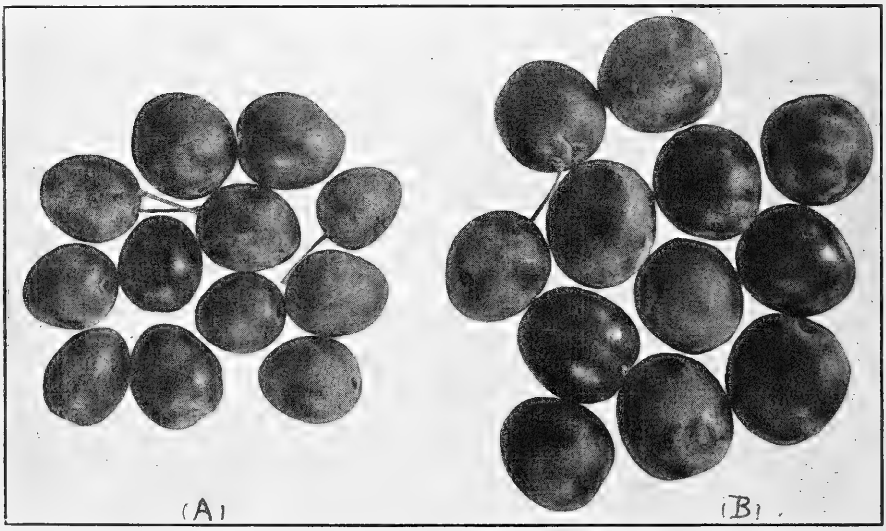
TABLE NO. 4—SHOWING DAILY NUMBER AND TOTAL NUMBER OF EGGS LAID PER FEMALE

Brood	No. of Pairs	Eggs Laid Daily			Total Eggs Laid			Time of Year	Temperature		
		Min.	Max	Aver.	Min.	Max.	Aver.		Min.	Max.	Mean
1st	6	1	12	3	12	39	29	May 19th to June 14th	38	90	1
2nd	7	1	9	4	11	62	42	June 15th to July 14th	48	98	74
3rd	7	1	9	3	41	90	66	July 7th to Aug. 6th	52	95	77
4th	7	1	9	3	38	75	52	July 26th to Aug. 30th	46	92	75
5th	7	1	8	3	13	52	31	Aug. 19th to Sept. 16th	46	92	60
6th	8	1	8	3	11	20	15	Sept. 14th to Sept. 29th	45	80	58
Average throughout season:				3.4			38.6				

Length of Adult Life of Female: As shown in table No. 5, the adult females lived from 6 to 33 days, with an average covering the six generations of 17.7 days.

TABLE No. 5—SHOWING EGG LAYING PERIOD AND LENGTH OF ADULT LIFE OF FEMALE

Brood	No. of Pairs	Egg Laying Period			Length of Life			Time of Year	Temperature		
		Min. days	Max. days	Aver. days	Min. days	Max. days	Aver. days		Min.	Max.	Mean
1st	6	3	13	9	8	25	18	May 19th to June 14th	38	90	61
2nd	7	4	20	12	6	25	16	June 15th to July 14th	48	98	74
3rd	7	6	24	19	19	27	23	July 7th to Aug. 6th	52	95	77
4th	7	12	29	19	18	33	24	July 26th to Aug. 30th	46	92	75
5th	7	6	17	12	10	29	18	Aug. 19th to Sept. 16th	46	92	50
6th	8	3	9	5	7	12	9	Sept. 14th to Sept. 29th	45	80	58
Average throughout season:				12.5			17.7				



(*a*) Typical Gueii plums from mite-infested trees compared with (*b*) plums from uninfested Gueii tree. (Reduced)

Habits of Male and Length of Adult Life: The males are active, and appear to be engaged most of the time running nimbly over the leaf surface in search of females. They are occasionally found attending quiescent female deutonymphs.

In mating, the male crawls under the female, extends his genital parts upward and curving slightly forward engages with the female. Several males may gather around a female, and each may in turn mate with her.

The male is short-lived. In our studies, the average length of life was 3 days, the maximum 5 days and the minimum 2 days.

Parthenogenesis. In order to determine whether this species is parthenogenetic, six female deutonymphs were placed in separate cages and were kept isolated during their entire life. Four days after reaching maturity, all the females commenced to lay eggs, and each deposited from 10 to 41 eggs, the average being 25 eggs. All the progeny proved to be males.

Proportion of Males to Females: At no time, during the past season, did our observations in various orchards show a preponderance of males over females. Counts made in the orchard at different times gave an average ratio of about 1 male to 10 females. In the insectary, the ratio was 1 to 4. This would indicate that, under normal conditions, most of the females are fertilized.

Number of Generations.

The activities of the mite extended this past year from May 2nd when the overwintering eggs commenced to hatch, to mid-October, when the last eggs were laid. During this period—5½ months—a maximum of six ("first hatched series") and a minimum of three generations ("last hatched series") developed in the insectary. This, of course, means that under our conditions, there are three full generations and three additional partial generations.

Overlapping of Broods.

Except for two weeks in the spring, namely, from May 11th to 25th, when only immature forms were found, all stages from eggs to adults were present in the orchard throughout the season. The overlapping of the different generations is shown in table No. 6.

TABLE No. 6—Showing Number, Duration and Overlapping of Generations.

Winter 1920-21	May	June	July	Aug.	Sept.	Oct.	Winter 1921-22
1st. Gen.	2.....	23					
2nd. Gen.	25..	......	....	..3			
	3rd Gen.	19..	....	....	....	..14..	....
		4th Gen	11..	....	....	..14..	....
			5th Gen. 30	....	....	..14..	....
				6th Gen 24..	....	..14..	....

Period of Maximum Infestation.

From the first appearance of the mite in early May until the middle of June, the degree of infestation was very light. However, during the month of July the mites increased marvellously, at this time as many as 800 to 1,200 eggs being found on a single plum leaf. The mites spread throughout the trees and attacked every leaf. From the third week in August to the end of the season their numbers fell even more rapidly than they had increased. The explanation of this is noted under the heading of Natural Control.

Comparative Susceptibility of Varieties of Plums.

Notes made on the comparative susceptibility of over fifty varieties of European plums are presented herewith in tabular form.

TABLE No. 7—Showing Comparative Susceptibility of European Plums to Mite Injury.

Severe	Moderate	Light	Very Light
Smith Orleans	Arch Duke	Duane	Reine Claude
German Prune	Victoria	Quackenboss	
Shipper's Pride	Gueii	Lombard	
Shropshire Damson	Washington	Grand Duke	
McLaughlin	Hand	Diamond	
Pond	Monarch	Tennant Prune	
King Damson	Yellow Egg	Warner's Late	
Moore's	Imperial Gage	Latchford	
French Damson	Kingston	Bleeker's Gage	
Ancaster	Bradshaw	Hulling's Superb	
Emerald	Fellenburg		
Riley Damson	John A.		
Belgium	Field		
Wyedale	Lawson		
Pearl	Klondyke		
	Early Rivers		
	Moyer		
	Blue Prolific		
	Early Transparent Gage		
	Canada Orleans		
	Hudson		
	Large Golden Prolific.		
	Curlew		
	Sugar Plum		
	Pacific Prune		
	Improved Lombard		

Control.

Natural Control.

Depletion of Food Supply: The depletion of the food supply was undoubtedly the most important natural check on the multiplication of the spider mite this past season. The leaves of severely attacked trees became tough and dry in midsummer, and ceased to provide the mites with sufficient nourishment, consequently most of them on such trees perished. Trees, which in July had been infested with countless numbers of mites, became almost free towards the end of August. Thus it happened that the smallest number of overwintering eggs were deposited on the most severely infested trees.

Weather: The mites, feeding as they do on the upper and lower surfaces of the foliage, are not afforded very much shelter by the leaves during the storms. Rains wash them off the upper surface, and heavy rains accompanied by strong winds, wash them from the lower surface. Immediately after a heavy rain storm last summer, infested trees were examined and it was found that approximately 90% of the mites had been washed off the upper surface, and approximately 70% from the lower. The eggs, of course, remained attached to the leaves.

Predaceous Enemies: In view of the fact that the mite was so very abundant this past season, it was very surprising to find that predaceous enemies were remarkably scarce. The minute, black ladybird beetle, *Stethorus punctum* Lec. was found in small numbers feeding on the mites. The well-known two-spotted ladybird beetle, *Adalia bipunctata* Linn. was also observed on infested foliage apparently attacking the mites. But so far as we could judge, no predaceous enemies had any appreciable effect in reducing the numbers of the spider mite.

Mortality Due to Location of Overwintering Eggs: In cases where the overwintering eggs were located a considerable distance from the leaves, for example, near the crotch or on the trunk, it was observed that quite a number of the minute, newly-hatched larvæ perished before reaching the leaves.

Artificial.

Lime Sulphur: It is very fortunate that, in order to successfully combat the spider mite on plum trees, it is not necessary to make any special applications or to use any special spray material. Our experiments have shown definitely that the pest can be controlled by spraying twice with commercial Lime Sulphur 1-40,

Overwintering eggs on plum twig. X 10.
Plum Spider Mite; male and female. X. 10. (Inset)

at the times recommended for the control of Brown Rot, Curculio, etc. viz: (1) when the fruit is set and most of the calyces have dropped and (2) two weeks later. Needless to say the spraying must be done very thoroughly.

The results secured in a Vineland orchard in 1920 were very striking. One large block of plum trees was sprayed with Lime Sulphur and another adjoining block, with the same varieties in it, was sprayed with Bordeaux mixture. By midsummer the foliage on the trees sprayed with Bordeaux mixture was pallid, largely functionless and stood out in very marked contrast to the healthy, green foliage in the blocks sprayed with Lime Sulphur.

Sulphur Dust: Preliminary experiments indicate that heavy applications of sulphur dust will control the mite.

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INSECTS OF THE SEASON IN ONTARIO.

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ORCHARD INSECTS.

CODLING MOTH (*Carpocapsa pomonella*). The very hot weather throughout July aroused fears that there would be an abnormally large percentage of second brood larvæ and consequently a much greater amount of injury to apples and pears.

Lygus injury on peaches. Note the unsightly scars.

Fortunately these fears were not realized to any marked extent, apparently because the weather became comparatively cool in early August and remained moderately cool throughout that month.

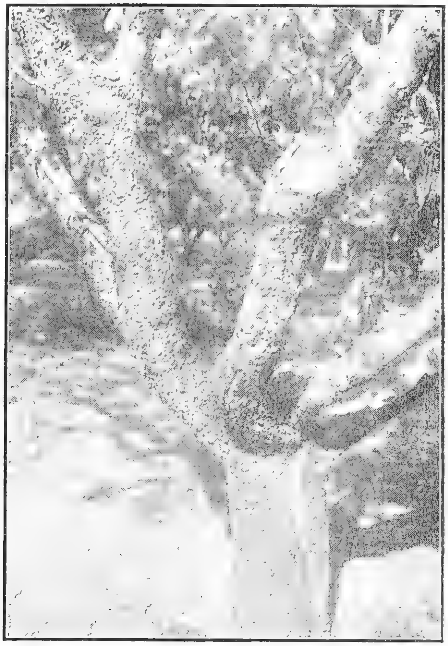
PLUM CURCULIO (*Conotrachelus nenuphar*). In some localities this pest did much harm, but in most parts of Ontario it was not more troublesome than usual.

CIGAR AND PISTOL CASE-BEARERS (*Coleophora fletcherella and C. malivorella*). These two insects, usually considered minor orchard pests, were remarkably abundant in the Newcastle district. Almost every apple orchard which had not been well-sprayed the previous year, or which had only received the post-blossom application, was badly infested. In June many of the trees were almost completely defoliated and what foliage was left was brown and ragged. In one case about 30 acres of Stark trees were so severely damaged that the brown, blighted appearance of the trees was conspicuous a mile away. A cursory examination this fall of affected trees indicated that the outbreak was over.

BUD MOTH (*Tmetocera ocellana*). In the Newcastle apple orchards, infested with case-bearers, the bud moth was also quite abundant and contributed its share of injury to the foliage. In other parts of the province it was not especially conspicuous.

CANKER WORM WORK (*Paleacrita vernata and Alsophila pometaria*). The spring canker worm was abundant in several parts of the provinces—notably in Huron and Pell counties. The fall canker worm was also present in large numbers, especially near the southern end of Halton county. It will not be surprising if there are several outbreaks of these insects this coming season.

GREEN APPLE BUG (*Lygus communis*). In last year's report we stated that this insect had been discovered in a few orchards near Newcastle, and that it had done much harm to pears and apples, especially to the former. This year we conducted experiments on the control of the bug in the two worst infested pear and apple orchards. Most of the trees were sprayed with nicotine sulphate, 1 pint to 100 gallons of the regular spray mixture, and the others were dusted with a sulphur contact dust, containing 2% nicotine. High pressure, 225 lbs. was used for liquid applications, and the trees were thoroughly drenched. Most of the spraying and all the dusting was done just after the blossoms fell, but some of the spraying could not be completed until four days later. The results on all the early sprayed trees were excellent, scarcely a pear and very few apples showing any green bug injury. On the later sprayed pear trees, at least 50% of the fruit was injured by the bug. The dust proved to be very unsatisfactory; for instance, practically all the fruit on two rows of pears which were well dusted, was so deformed that it was unsaleable.



Peach tree severly attacked by fruit-tree bark-beetles.

FRUIT TREE LEAF ROLLER (*Tortrix (Cacoecia) argyrospila*). This destructive pest, unfortunately difficult to control, seems to be increasing and spreading more widely than in the past. Many fruit growers in the apple growing sections from Whitby to Trenton now consider it the worst insect pest in their orchards.

Approximately one-half of the crop in an apple orchard near Trenton was damaged by the leaf-roller this year. According to the owner, this particular orchard was badly infested about eight years ago, then it became nearly free from the insect.

THE PLUM SPIDER MITE (*Paratetranychus pilosus*). There was another severe outbreak of the Plum Spider Mite in the Niagara district, and more plum orchards were injured by it than in any other previous season. To some extent

Plum trees injured by leaf hoppers. Note the defoliation of the terminal growth.

at least, this was undoubtedly due to the fact that, because of the very light crop of plums, many orchards did not receive the regular applications of lime sulphur. The life-history, habits, economic status and control of this pest are discussed elsewhere in this report.

THE PEAR PSYLLA (*Psyllia pyricola*). This destructive pest was again very abundant and injurious in pear orchards at Burlington and Queenston and in other parts of the Niagara fruit belt.

OAK PLANT BUGS (*Lygus quercalbae and L. omnivagus*). In last year's report we mentioned that in a peach orchard at St. Davids the fruit was quite seriously injured by *Lygus quercalbae*. This year the same species and another plant bug *L. omnivagus* were found in June attacking peaches near St. Catharines. Later on peaches injured by *Lygus* were observed in fourteen other orchards in the section between Beamsville and St. Davids. In one planting, about 75% of Elberta and St. John peaches were more or less damaged. As one would expect, only orchards close to oak trees were affected.

It is of interest to note that according to Prof. P. J. Parrott of Geneva, *L. quercalbae* and *L. caryae* were taken this year feeding on peaches in New York State.

Knight* states that *L. quercalbae* has been found breeding only on white oak (*Quercus alba*), and that *L. omnivagus* is most abundant on oaks, particularly *Q. alba, Q. rubra, Q. coccinea, Q. prinus* and *Q. velutina*. Knight has also reared specimens from chestnut (*Castanea dentata*), *Cornus florida, C. circinata* and *Virburnum acerifolium*. *L. caryae* breeds on various kinds of hickory.

Fruit-Tree Bark-Beetle (*Eccoptogaster rugulosus*). In the Niagara fruit belt and in Lambton county this species was decidedly more troublesome than usual on fruit trees, particularly on cherry and peach. In most of the cases we investigated, wood-piles and brush-piles proved to be the source of infestation. During late summer bark beetles were quite commonly found on cherry trees, boring into the spurs, which bear the leaf clusters, causing in this way what some growers referred to as a new "fire-blight." Similar leaf injury was observed on apples and peaches.

Orchard Aphids: Apple aphids, *Aphis pomi* and *A. sorbi* caused no appreciable injury this year in most orchards.

In the Fenwick district, sweet cherries were heavily infested with the black cherry aphis, *Myzus cerasi*, but in the other fruit growing sections, this species was not especially troublesome.

Pear Blister Mite (*Eriophyes pyri*). We are glad to report that this pest has not increased, as we were afraid it would, to any marked extent.

The Ribbed Cocoon-Maker (*Bucculatrix pomifoliella*). Last winter the white cocoons of this species were sufficiently abundant and conspicuous on apple trees in a Simcoe orchard to seriously alarm the owner. He, of course, imagined that his trees were infested with a new and dangerous pest.

Leaf Hoppers on Fruit Trees. The outbreak of rose leaf hopper, *Empoa rosae*, referred to in our reports for 1919 and 1920, was to a very large extent brought under control, no doubt by natural agencies, and this year the insect, although common on apples, was of little importance.

The apple or potato loaf-hopper, *Empoasca mali*, was very abundant on apple and plum trees throughout the Niagara district. On apples the feeding activities of the insect caused all the tender foliage on the terminal growth to become curled. In the case of plums the foliage not only became curled, but a leaf-burn, similar to hopper-burn on potatoes, developed, and on badly attacked trees many leaves on the terminal growth fell prematurely.

Peach Tree Borer (*Sanninoidea exitiosa*). More inquiries than usual were received from the Niagara district regarding the control of this borer. Observations made in Lambton county indicate that the borer is much more injurious in that county than in other Ontario peach growing sections.

*Bul. 391, Cornell Agr. Exp. Sta., May, 1917.

Grape and Small Fruit Insects.

The Grape Leaf Hopper (*Typhlocyba comes*). There was a serious outbreak of the grape leaf hopper in the Niagara district, particularly in the section between Grimsby and the Niagara river. During late summer and autumn badly infested vineyards were conspicuous from a distance on account of the brownish, or, as some growers put it, "rusty" condition of the foliage. The severe injury to the leaves naturally affected both the size and quality of the fruit.

Agawam grapes.—A. Typical bunch from sprayed vines.
B. Typical bunch from hopper-infested vines.

As a general rule, the leaf hopper is only troublesome in the vicinity of wood-lots and waste land, where the fallen leaves, long grass, weeds, etc. afford the insect favorable hibernating quarters, but this year it was abundant and injurious even in vineyards with comparatively clean surroundings.

Immense numbers of hoppers went into hibernation in the fall and no doubt, if the winter is favorable for the insect, there will be another outbreak next year.

Rose Chafer (*Macrodactylus subspinosus*). A severe outbreak of the rose chafer occurred at Fenwick, and in the affected section graperies, which were not sprayed, were completely or almost completely stripped clean of blossoms and newly-set fruit. The chafers were present in the vineyards for some three weeks.

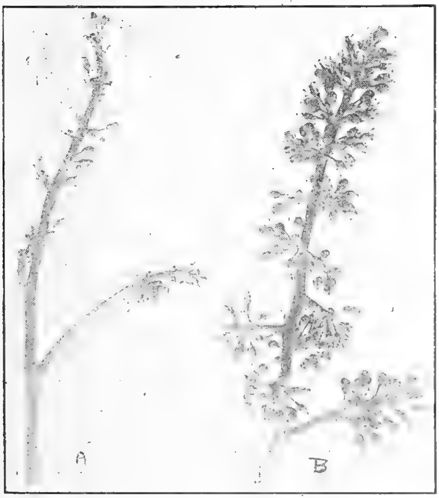
There was also a small outbreak of the chafer near Beamsville.

Strawberry Leaf Beetle (*Paria canella*). Strawberry leaf beetles occurred in exceptionally large numbers last spring in the Vineland-Jordan district, and attacked and riddled the foliage of strawberries. They also attacked the opening buds of raspberries and in some cases destroyed them. The larvæ were commonly found feeding on strawberry roots, and, to some extent on the crowns. However, on account of the prevalence of "black-root" (winter injury) we found it impossible to gauge the injury caused by the root-worms.

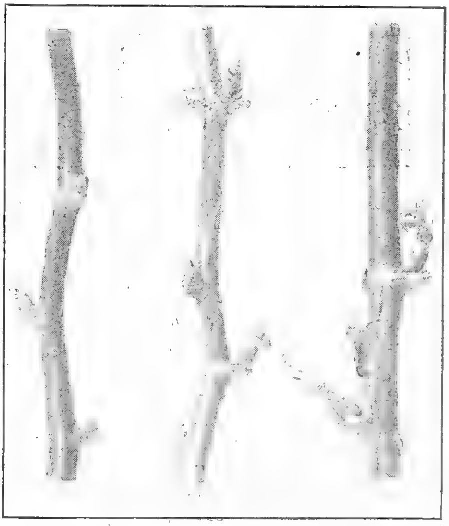
Rose chafers feeding on apples.

STRAWBERRY WEEVIL (*Anthonomus signatus*). This pest was again injurious in some strawberry fields in the Niagara district.

RASPBERRY SAW-FLY (*Monophadnoides rubi*). This insect was very abundant in a number of places, notably at Burford, Waterford and Brighton. At Burford several acres of raspberries were nearly defoliated by it.



A. Grape blossom cluster destroyed by rose chafers. B. Normal blossom cluster.



Strawberry leaf beetles feeding on and destroying opening raspberry buds.

RASPBERRY CANE MAGGOT (*Phorbia rubivora*). At Brighton and Port Hope the maggot of this fly caused considerable alarm by boring into and killing the young raspberry shoots. It is seldom that injuries from this insect in Ontario are reported. The variety affected was Columbia.

Blackberry Leaf Miner (*Metallus bethunei*). This miner was abundant in most of the blackberry patches in the Niagara and Burlington districts. We regret to report that all our efforts to discover a satisfactory method of controlling this pest have so far met with failure.

Vegetable Insects

Cabbage Maggot (*Phorbia brassicae*). There was about the usual amount of cabbage maggot injury in the early part of the season. The very hot weather in the first part of July apparently had the effect of reducing the insect to insignificant numbers, because from that time to about the first of October scarcely a fly could be found.

Cabbage Worms (*Pieris rapae* and *Autographa brassicae*). The cabbage worm was apparently not more injurious than it is in the average season, but the cabbage looper was unusually abundant, at least in the Niagara district on cabbage, cauliflower and turnips. In a turnip field at Jordan Harbor, the looper practically stripped off all the leaves.

Turnips nearly defoliated by cabbage looper.

The Cabbage Aphis (*Aphis brassicae*). This plant louse was quite abundant and injurious in the Niagara and Burlington districts.

Onion Thrips (*Thrips tabaci*). The thrips was again injurious in the onion growing sections of southern Ontario.

The Corn Ear Worm (*Heliothis obsoleta*). There was a remarkable outbreak of the corn ear worm in Ontario, undoubtedly the worst outbreak of this insect that has ever occurred in the province. From almost every part of the province, even from Port Arthur and Northern Muskoka, the same story came that practically every ear of the late corn was infested with caterpillars. In certain districts, canning factories were closed down because there was not sufficient uninjured corn to keep them going. At Port Dover, Simcoe and Vineland, the ear worm was found on greenhouse tomatoes, boring into the fruit, and in this way making it absolutely unfit for consumption.

The Striped Cucumber Beetle (*Diabrotica vittata*). This species was abundant and injurious in the Niagara district.

The Brown Fruit Chafer (*Euphoria inda*). For the first time in our experience, this insect was commonly found in different parts of southern Ontario attacking the ears of sweet corn. Enquiries regarding its economic status were received from the Niagara fruit district, Norfolk county, Burlington, Clarkson and St. Thomas. The insect was also found, as it has been in previous years, feeding on ripe fruit, particularly on peaches and pears.

Bean Weevil (*Bruchus obtectus*). In June living specimens of this weevil were received from Ford, Ontario, where they were causing considerable damage to beans. Mention of this is made because injuries from the weevil are seldom reported.

Cutworms: Cutworms were again very destructive in the Niagara district. At Port Dalhousie asparagus was badly injured by them.

Asparagus Beetle (*Crioceris asparagi*). Judging by the reports we received, this beetle was more troublesome than usual. A grower at Queenston had splendid success in controlling the beetle in his large asparagus fields by dusting with arsenate of lime and hydrated lime. A power potato-duster was used in making the applications.

Potato Insects: The potato leaf hopper (*Empoasca mali*) was undoubtedly the most important pest of potatoes this year. Experiments and field observations indicated that practically all the so-called blighting of early potatoes, in the Niagara district at least, was caused by the hopper. It is very fortunate that thorough applications of poisoned bordeaux mixture will control most of the major fungus and insect pests of the potato, including the leaf hopper.

The potato beetle (*Leptinotarsa decemlineata*) and potato flea-beetle (*Epitrix cucumeris*, were abundant in most parts of the province. In the Niagara peninsula the three-lined beetle (*Lema trilineata*) was common on potatoes.

Greenhouse Insects.

The Rose Midge (*Dasyneura rhodophaga*). It is very gratifying to find that the tobacco dust treatment (see last year's report) will wholly eradicate this pest. In the two large greenhouse establishments at Grimsby no maggots have been found since the rose beds were treated in 1920.

The Chrysanthemum Midge (*Diarthronomyia hypogaea*). We are pleased to report that experience has shown us that this pest can be eradicated by spraying with nicotine and soap every second day for a period of about six weeks.

The Cyclamen Mite (*Tarsonemus pallidus*). This mite was again decidedly troublesome in Ontario greenhouses, and on account of its depredations, great difficulty was experienced in growing cyclamens successfully. Conflicting reports have been received regarding the efficacy of systematic spraying with a nicotine-soap solution as a means of controlling the mite.

Earthworms: Last September there was a veritable plague of earthworms in the rose beds of a large greenhouse at Grimsby. The earth was literally alive with worms; the manure disappeared rapidly; the soil lost its friability and became lumpy, porous and somewhat "sticky"; and the worms apparently disturbed the roots of the roses.

At our suggestion the beds were given a very light dressing of hydrated lime, and the lime was then washed in. This treatment was successful; it destroyed most of the worms and at the same time caused no injury to the rose plants.

Forest and Shade Trees.

Canker Worms (*Alsophila pometaria and Paleacrita vernata*). The prevalence of these worms has already been mentioned under orchard insects.

Birch Leaf Skeletonizer (*Bucculatrix canadensisella*). Last year the work of this small caterpillar was very conspicuous in the Eastern part of the province. This year it was conspicuous in forests between Galt and London where in September the brown appearance of the birch foliage was very noticeable.

Oak Twig Pruner (*Elaphidion villosum*). In the Muskoka district great numbers of dead twigs and branches, killed by this insect, were everywhere to be seen.

Imported Poplar and Willow Curculio (*Cryptorhynchus lapathi*). This destructive insect has now spread almost everywhere through the province and has destroyed great numbers of native willows and poplars. Considerable damage has also been done to Carolina poplars set out for shade or ornamental purposes.

THE CABBAGE MAGGOT (*Phorbia brassicae* Bouche).

L. Caesar, Ontario Agricultural College, Guelph.

This paper is a brief statement of some of the more interesting results obtained from a study of the cabbage maggot during the four years, 1918 to 1921. These are as follows:—

There was no evidence to indicate that the insect winters in any other way than as a puparium in the soil or occasionally in the stumps of cabbage, cauliflower or other similar plants.

Adults from these puparia begin to emerge in April or May and the great majority are out by the end of May, a few, however, continue to emerge over a long period—in 1918 up to the end of August, in 1919 and 1920 to the middle of July and in 1921 to the 21st of June. Later broods have also a prolonged emergence period.

The shortest preoviposition period in our cages was a little over four days. Fifty per cent. of the flies that oviposited in the cages did so inside of six days. There is considerable evidence to indicate that in the field the preoviposition period may be as short as two days. This would not be at all surprising since we know that females can mature eggs at the rate of 20 or 30 a day.

The largest number of eggs laid by any one fly was 117. These were deposited on six different days over a period of nine days—June 17th to June 25th. Another fly laid 103 eggs as follows:—May 28th, 51, May 29th, 29, May 30th, 23. Thus it is evident that egg laying may continue over a considerable period and that 20 or more eggs may be deposited each day. It would, therefore, not be surprising if at least some individuals laid 200 eggs or more.

The length of life of the flies is apparently, as Schoene suggested, three weeks or more. In cages situated in the north-east corner of pine woods males of the first brood averaged 19.1 days and of the second brood 16.6 days: females of the first brood 22.7 days and of the second brood 22 days.

No fly was in any case seen to lay eggs where these would be exposed to the sunlight but always in the shade.

The shortest incubation period for the eggs was slightly under 48 hours, 22 out of a total of 475, or 4.6 per cent. hatching in this time. In 1918 the average period of incubation was 5.5 days: in 1919 3.8 days: in 1920 6 days; and in 1921 5.7 days. Under normal conditions nearly all eggs hatch inside of a week.

Sunlight and dryness of the soil or surroundings are destructive to eggs, approximately 90 per cent. of eggs under these conditions failing to hatch. Shade and moisture are favorable to them.

The number of broods a year has not been worked out, but we have been able to trace three and believe there may be a fourth, because third brood adults normally begin to emerge by at least the middle of August and as flies continue to emerge throughout most of September and are some years common to the 1st of October or later, there is very little doubt that some of these will be fourth brood. As implied above adults of all three broods may be present together in August and September.

It is interesting to learn that no brood, not even the first, is a full one; for a small percentage, some years about 4%, of the overwintering puparia fail to produce adults that year and pass through a second winter before doing so. Strange to say these adults in our test were not among the earliest to emerge the second year, the first of them coming out the first week in June, and the last the last week. Professor Brittain tells me he, too, has found that there is a two-year life cycle for a few individuals.

The exemption, with a few exceptions, of late crops of cabbage and cauliflower from serious injury would appear to be due to—first, the greatly increased number and activity of predaceous enemies, chiefly rove beetles, ground beetles and a large red mite, which destroy the eggs or larvæ or both; second, to the greater dryness and heat of the soil which lessens the percentage of eggs hatching; and third probably, as Schoene suggested, to the harder texture of the root tissues themselves at this season of the year.

Prolonged wet, cold weather when adults are about to emerge seems to lessen greatly the number that do so; for instance in 1919, May was very wet and cold and only 21.9% of the overwintering puparia produced adults, compared with an average of 85% the other three years.

Very hot weather seems also to have a great effect upon puparia. Last July was exceptionally hot, especially the first half of it, and from the middle of the month to the end of our work—October 1st—scarcely a fly emerged, radishes being 100% clean. Other years flies were present all through this period and radishes always somewhat wormy.

Control Measures

(1) *Cabbage and Cauliflower*:—From all over Canada and from New York, New Jersey and Indiana reports of excellent success from the use of corrosive sublimate have been received. I need not give figures to prove this but simply state that careful treatment will give from 80% to 100% control even in the worst years. Moreover, growers will use this treatment where they would not use tarred felt-paper discs.

Number of treatments: One, well-timed, will give fair results; two, well-timed, are better and are all that should be necessary, but if the timing, especially of the first application, is not well chosen three will be desirable.

Length of interval between treatments: On the average, one week seems about right. It should not be longer, a day less would not, as a rule decrease its value much, and sometimes would even increase it.

Strength of corrosive sublimate: If only one treatment is given use 1 to 1000 i.e. 1 oz. to 6¼ gallons; if two treatments or more 1 to 1280 or 1 to 1600; i.e. 1 oz. to 8 or 10 gallons. The weaker strength, 1 to 1600, probably will be preferred by most men but should be applied a little more liberally than the stronger and the soil around each plant very thoroughly saturated.

Time of the first application: This should be just as the earliest eggs are beginning to hatch, which is usually about four days after egg-laying begins. This time seems to correspond with the date when European plums are almost, but not quite, in full bloom or when American plums are just beginning to bloom. Hence, if plants are set out early postpone treatment until this date. If plants are not set out until European plums are in full bloom or American plums are beginning to bloom or even later, treat in four days after setting out. If three treatments are to be used, the grower, even if he sets out his plants early may make the first treatment four days after setting out and the others at intervals of a week. A good plan and one that is being gradually adopted by growers is to watch for the first eggs and to begin treatment the second or third day after their discovery.

(2) *Radishes and Seed Beds of Cabbage and Cauliflower*: We have found that two treatments of radishes and also of seed beds of cabbage or cauliflower will give an average of about 80% or more absolutely clean plants, most of the remainder being only very slightly injured.

The first treatment of radishes should be in three or not more than four days after egg-laying begins; so treatment should begin preferably one day before the earliest treatment of cabbage. If radishes come up after European plums are in bloom make the first treatment on the fourth day after the first plants appear above the soil and the second five days or not more than six days later. The same recommendations apply to seed beds of cabbage or cauliflower.

Implements used in Treating: For very large fields probably the best method is a wooden tank or barrel supplied with two lines of thin rubber hose and one man to attend to each, controlling the flow by means of his thumb. For ordinary plots up to 12,000 to 25,000 cabbage plants we find that a wooden bucket or pail and a tomato can with a wooden handle about two feet long fastened firmly by tacks to the folded-over top of the can is a very cheap and rapid method. For radishes use a watering can with the knob removed.

How corrosive sublimate Controls: It does this in three ways; first it destroys nearly all of the eggs in contact with the moist treated soil; second, it kills many of the smaller larvæ and some of the larger; and third, it repels larvæ and thus by warding them off from the plant causes them to perish from lack of food. Larvæ once buried inside the root tissues usually escape injury. Corrosive sublimate does not deter flies from laying their eggs around the plant.

ECONOMIC ENTOMOLOGY IN QUEBEC DURING THE PAST DECADE

Father Leopold, Director of the Oka Agricultural Institute, La Trappe, Que.

The history of Economic Entomology in the Province of Quebec is intimately related with two Societies in our Province: The Quebec Society for the Protection of Plants from Insects and Fungous Diseases and the Pomological and Fruit growing Society of the Province of Quebec. I had first intended to deal with economic entomology in its relation with fruit growing only, but the Dominion Entomologist suggested that I should widen its scope and deal with economic entomology in general, with special references to fruit-growing. I have, indeed, no pretention of being an entomologogist, but primarily a pomologist. Fruit-growing in one of its important phases, spraying and dusting trees, is intimately related with economic entomology. That was a sufficient reason to become a practical entomologist in my leisure hours.

As I said, our two societies mentioned above are intimately related, the scope of their endeavours coming into contact on more than one point. Economic entomology is that phase of entomology which relates to the control of injurious insects. Considering the great variety of insect forms, their diverse methods of food habits, the larger number of kinds of hosts which supply them with food, and the enemies which tend to destroy them, it becomes evident that the problem of insect control is a complex one. "The subject matter of this science is not insects alone, nor plants alone, nor farming alone. One may be a most excellent entomologist or botanist, or he may have the whole theory and practice of agriculture at his tongue's end, and at his finger's end as well, and yet be without knowledge or resources when brought face to face with a new practical problem in economic entomology. The subject is essentially the relation of things to each other; of insect to plant and of plant to insect, and of both these to the purposes and operations of the farm or orchard, and it involves some knowledge of them all." This definition by Dr. S. A. Forbes of economic entomology in its wider scope suffices to give the reasons why the Province of Quebec has not exclusively an Entomological Society but a Society "For the Protection of Plants from Insects and Fungous Diseases."

If we go rapidly over the history of our Society we will know what Quebec has done for the advancement of economic entomology in the past decade.

It is now a little over twelve years ago that the Society was founded with two or three definite objects in view:

1st. To bring together annually the biological workers of the Province who are interested in the study of economic entomology and fungi. Much inspiration, encouragement and help are gained at such meetings where workers have an opportunity of listening to papers and talking over matters in common. New view-points are presented, valuable information is frequently obtained, concerted action and mutual help are more likely secured, and fresh enthusiasm aroused.

2nd. To spread abroad among the people the new gospel of insect and plant disease control so that larger crops might be harvested and greater profits secured by the farmer. The need for such was evident from the annual loss to the oat crop of Quebec of over two million dollars; "blights" to the potato crop of over three million dollars; "scab and codling-moth" pest to the apple crop of over half a million etc. This information is given especially by the Annual Reports, are now in the hands of its members: The Lepidoptera, complied by Mr. printed in both languages, English and French. The twelve reports published up to date have received favorable recommendations from co-workers in the same field of endeavours in other Provinces and the United States.

3rd. The promotion of sciences of Entomology, Botany and Plant Pathology in the Province of Quebec. Three lists, published as supplements to the Annual Reports, are now in the hands of its members: The Lepidstera, compiled by Mr. A. F. Winn of Montreal; The Diptera, by Messrs Beaulieu (Montreal) and Winn; the Coleoptera by Mr. C. A. Chagnon, also of Montreal.

Remarkable progress has been made in economic entomology and plant pathology in our Province, thanks to such men as our President, Prof. W. Lochhead, professor of Biology at Macdonald College, who has occupied the chair of the Quebec Society for Protection of Plants since its very inception; Mr. C. E. Petch, an enthusiastic worker at the Federal Entomological Station of Hemmingford; the following professors of Macdonald College; Messrs W. S. Blair, who organized the spraying work done in our several demonstration orchards; P. I. Bryce and W. P. Fraser, who ably seconded Prof. Lochhead, T. G. Bunting, who succeeded Prof. Blair as Horticulturist at Macdonald College and who is responsible for the good work done there in spraying annually, seconded by such men as D. M. Straight, E. M. DuPorte, A. H. Maclennan, A. C. Gorham, E. M. Ricker and Mr. Tawse. Dr. J. C. Chapais and Mr. Auguste Dupuis, besides being charter members of the Society, have always taken a keen interest in entomology, Dr. Chapais not having missed reading a paper annually.

At Oka also, entomology had played an important part in the history of the College: In 1913, Mr. Firmin Letourneau, was made professor of Entomology, and the writer ever since 1911 has had charge of the spraying operations in the Oka extensive orchards, over 60 acres, being appointed vice-President of the Society in 1917, and since. I may add that we were the first to use Lime-Sulphur wash on our trees as well as the first commercial fruit-growers to dust orchards in the Province.

Dr. J. M. Swaine was appointed the first secretary of the Society at its inception and occupied the post until he resigned on account of his duties as Dominion Entomologist in charge of Forest Insects. Since 1919, Professor B. T. Dickson has ably succeeded Dr. Swaine as Secretary-Treasurer of Quebec Society.

It would not be just if I did not mention here that other remarkable men have played a very important part in the dissemination of entomological economic knowledge in our Province, as the Dominion Entomologists, the late Dr. G. Hewitt and his successor Mr. Arthur Gibson, who have always been in the front at every meeting of our Society. One may judge of their co-operation by the following papers read during the past ten years:

1911: The Care of the Farm Wood-Lot, by J. M. Swaine, C. E. Farm, Ottawa.
Cutworms and how to Control Them, by Arthur Gibson, the Chief Ass. Ent., Otta.

1912: The Role Played by Bees in the Fertilization of Flowers, by F. W. L. Sladen.
Some Insects which Attack the Roots of Vegetables, by A. Gibson.

1913: Some Insect Enemies of Shade Trees, by J. M. Swaine.
Injurious Flea-Beetles of Quebec, by A. Gibson.
Let us Instruct the Farmers, by G. Beaulieu, Ent. Branch, Ottawa.
Insects and the Forest, by J. M. Swaine.
Bee Diseases, by F. W. L. Sladen.
Notes on the Life-History and Control of the Bee-Moth, by J. I. Beaulne, Ottawa.

1914: The Brown-Tail Moth in New Brunswick, by E. H. Strickland, Ottawa.
Forest Insects in Stanley Park, B.C., by R. N. Chrystal.
Insects Affecting Ornamental Stock in Quebec, by J. M. Swaine.

1915: Grasshoppers and their Control, by A. Gibson.
Three Injurious Locusts of Nova Scotia, by C. B. Hutchings.

1916: Carriers for Dusting, by C. E. Petch, Hemmingford.
Cabbage Insects, by A. Gibson.
The White Weevil in Quebec, by J. M. Swaine.
Twe Destructive Shade Tree Borers, Locust Borer and the Bronze Birch Borer, by C. B. Hutchings.

1917: Warbles and Bots, by Dr. A. E. Cameron, Ottawa.
The Control of the White-Marked Tussock Moth, by J. M. Swaine.

1918: Dusting and Spraying Suggestions for Quebec, by C. E. Petch.
The Imported Alder Leaf Miner, by C. B. Hutchings.
Some Insects Injuries in Wood Lots, by J. M. Swaine.

1919: There were only pathological papers from Ottawa.
1920: The Entomological Branch in Canada, by A. GIBSON.
The European Corn Borer in Ontario, by L. S. MCLAINE.
Spraying vs Dusting, by C. E. PETCH.

Quite a few distinguished entomologists have come from time to time from the United States as speakers at our Society, and we note among others, Professor C. R. Crosby of Cornell who gave us in 1914 a synopsis of his work in the control of insects during that season, both in dusting and spraying. In 1918, Dr. W. H. Rankin from Cornell, also gave us a paper on efficiency factors in potato spraying.

Until 1913, Quebec had no Provincial Entomologist. Canon V. A. Huard, well known as the Editor of *Le Naturaliste Canadien* was made the first Provincial Entomologist, and held this position until 1916, when he resigned and Mr. George Maheux, the present titular, was appointed to the office. The Provincial Entomologist does not have the means of doing any actual field work, but co-operates with the Federal Department in their work at Hemmingford, P.Q.

Besides our Society for the Protection of Plants, the horticulturists and pomologists of the Province, members of the Pomological Society have always shown very keen interest in spraying problems of all sorts. As particularly interested in fruit-growing in our Province you will forgive me for insisting a little on this phase of economic entomology in Quebec during the past decade.

The most important work, during the first part of the last decade was accomplished through experimental work of a high practical value in the five demonstration orchards of the Province of Quebec. The original committee of these demonstration orchards comprised Prof. Blair, Mr. Peter Reid, Mr. Robert Brodie and the writer. Practical demonstrations were begun in 1911 and continued for five years, to determine the value of paris green and arsenate of lead as insecticides and lime sulphur and bordeaux mixture as fungicides. The different mixtures were put on in all the possible combinations in the same orchard, on practically the same dates with very different results. The conclusion was that arsenate of lead was a much superior insecticide for biting insects, and lime sulphur wash did not burn the foliage of the apple trees nor deteriorate the fruit when applied in the quantity and density then recommended by the committee. Anybody visiting the demonstration orchards came back with the firm resolution of substituting lime sulphur wash for bordeaux. After the departure of Prof. Blair for Kentville, Prof. Bunting took over the continuance of his work on the committee of demonstration orchards.

The good results obtained in the orchards did much to expand the spraying in the province of Quebec and soon the large growers were possessors of gasoline spraying rigs of all description when they were the exception before.

Soon we found out that a good substitute for arsenate of lead was arsenate of calcium and the writer did not take much time to adopt this new insecticide generally in his orchards. Arsenate of calcium was eventually found to be a safer combination with lime sulphur wash than the arsenate of lead mixed with the same fungicide.

In a paper read before the Pomological and Fruit-growing Society of the Province of Quebec, the writer took up the importance of dusting for the control of the Codling Moth, one of the most destructive pests around our district, and at the same time enumerated the advantages dusting seemed to have. My resolution was suddenly taken to get a large, powerful duster, and after the fire that consumed our monastery and my spraying gasoline outfit, which was wintering in our cellars, I bought a Niagara Dusting machine and have had no reason since to regret it. Since then we used this outfit in our orchards and on our potatoes with great success and on account of an educational point of view, I have purchased a powerful bean spraying rig. I am satisfied that in a large orchard like ours, and especially in certain seasons, when the time factor is the all-important one, dusting has come to stay in our Province. Let me say again that in our orchards the Codling moth is the most destructive pest we have to control, in other districts it is the Curculio. but at home we have no trouble with the latter pest.

Things were running rather smoothly in our Province, and Mr. Petch and myself were making comparisons in dusting and spraying our orchards. and we had all confidence in lime sulphur wash as a fungicide, when our friend Mr. George Sanders sprung a surprise on us, in a paper he read before our Society in convention at Macdonald College, on the 5th of December 1917. Mr. Sanders, in due justice to this paper, took the precaution to state that what he told us was applied to Nova Scotia conditions as he could not pronounce himself about conditions in Quebec. However, his stand against lime sulphur wash, especially in combination with arsenate of lead, was so strong and his talking for Bordeaux so convincing that we could not help thinking that his opinion would have some strong weight upon such practical fruit-growers and Entomologists as were there hearing him. I can but mention Prof. Macoun and Dr. Hewitt. You remember that his thesis was that lime sulphur did actually spray the apples of the trees.

I went back to Oka with the idea of putting on again some practical experiments to determine, for my own use, if that thesis was true even in using the new spray gun and power behind it. I will not relate here that experiment, which you can find in full in the report of the Entomological Society of Ontario in 1919. The orchard was well chosen, all varieties being the same (Wealthies), the bloom on all plots being excellent. On the first plot, we used Boardeaux mixture, 4-4-40, the usual one, sprayed on the trees; we dusted sulphur-talc and arsenate of lead, 40-50-10 on the second plot, sprayed lime sulphur-arsenate of lead on the third plot; dusted dry Bordeaux and calcium arsenate on the fourth plot; sprayed the new formula of Bordeaux mixture, 2-10-40, on the 5th plot, and dusted my own combination of sulphur-hydrated lime and arsenate of lime, 15-80-5. on the 6th and last plot. The cheapest dusting mixture was the last one. No injury whatever was noticed either on the lime-sulphur-arsenate of lead plot or the dusted sulphur-hydrated lime and calcium arsenate plots. We cannot therefore advocate returning to Bordeaux mixture in our Province, as we had such a large crop of apples that year on the lime sulphur plot that we had to thin them.

We use exclusively now in our sprayings or dusting propositions arsenate of lime as a contact poison in combination with either lime sulphur or the dry sulphur when dusted on the trees, adding hydrated lime in the last case to safeguard the application and reduce the costs as a filler. In orchards where the scab is not really bad, we do not use much sulphur and find that 5 lbs. of calcium arsenate will control effectively Codling Moth when we do not get, like the past season, an outbreak of a second brood.

I may add that dry Bordeaux is freely used also in the Province but even there we get the russetting from the Bordeaux which we avoid with the lime sulphur spray.

Last year a committee appointed by our Society, with Prof. Bunting of Macdonald College as chairman, Prof. Dickson, Prof. Lochhead, Mr. Petch and the writer on the board, printed a Calendar which Macdonald College sent out all over the Province.

THE ENTOMOLOGICAL RECORD, 1921.

NORMAN CRIDDLE, OTTAWA.

The Entomological Record was begun in the year 1901 by Dr. James Fletcher, then Dominion Entomologist. It was originated, primarily, with the idea of encouraging Canadian collectors and of bringing them in closer contact with each other's work. It included in its scope the recording of rare species, a list of persons actually engaged in insect studies, a review of entomological books issued during the year, and such other matter as was considered of special value to Canadians.

The original scheme has been maintained in all the succeeding issues with such modifications as seemed desirable or became necessary, and we believe the publication has fully served the purpose its originator had in view. Many things have taken place during the twenty years the Record has been in existence. Its founder, that "Prince of Good Fellows", has gone, and with him many of the handicaps which he and other entomologists then laboured under. Entomology has advanced by leaps and bounds since then, and it has largely become a professional rather than an amateur pursuit. In other words, the labour of love has to some extent become a labour for dollars and cents. Nevertheless, I believe the old spirit is still with us; but are our needs the same?

Active societies are now publishing their own lists of species; collectors in some instances are doing likewise; publications once few in number and difficult to procure, are now scattered broadcast over the land; hundreds of species have been described that were unknown in 1901, and untold numbers more have been identified for collectors.

Noting all these changes the question arises as to whether the Record has fulfilled its place and in the course of entomological evolution has ceased to be of practical value to its readers. We leave this question in their hands.

The preparation of the Entomological Record is a task of considerable labour, and it occupies time that might be profitably employed in other ways. Collectors could assist considerably in reducing this labour by putting records in as good order as possible. In many instances there are local lists available. In such cases it is as easy for the collector to sort out his new records from those already published as it is for the compiler. Secondly, many of the check lists are numbered and in these cases adding the number to the species is desirable. Thirdly, lists of captures should be arranged as nearly as possible in the order of check lists. In addition localities should be supplied and authority given for the determination of species. By following these outlines the collector would save the compiler much time and labour and unless some aid is supplied the Record must cease for lack of time to prepare it.

We are again under deep obligation to our many friends in the United States and Great Britain for assistance in the determination of specimens. There is hardly a specialist that has not helped us in some way and we extend to all hearty appreciation.

The 1920 Record has been delayed beyond all expectation by the printers' strike and since at the time of writing it is still in the hands of the printers, we fear that this paper will also be retarded.

It has been thought advisable to discontinue the book review for lack of time and space. As a rule all such publications are reviewed in the various entomological periodicals. We cannot, however, refrain from noting the appearance of Leng's List of Coleoptera published by John D. Sherman, Mount Vernon, N.Y. This important publication is indispensable to Coleopterists.

The season of 1921 does not appear to have been a good one for collecting. This applies particularly to the east and extreme west. On the Prairies insect prevalence seems to have been maintained though there was a scarcity of Noctuid moths in Manitoba.

NOTES OF CAPTURES.

Species preceded by an asterisk (*) described during 1921).

Lepidoptera.

(Arranged according to Barnes and McDunnough's Check List of the Lepidoptera of Boreal America, 1917).

Pieridæ

40. *Euchloe ausonides* Bdv. Slave Falls, Winnipeg River, May 24, 1921, (J. D. Suffield).

57c. *Eurymus hecla pallida* S. & M. Nordegg, Alta., June, 1919, (K. Bowman).

65. *Eurymus alexandra* Edw. Nordegg, Alta., July, 1917, (Bowman); 1921. (McDunnough).

69. *Eurymus nastes streckeri* Gr. Lillooet, B.C., August, (G. O. Day).

Nymphalidæ

187. *Brenthis myrina* Cram. Godbout, Que., (E. M. Walker).

305. *Basilarchia arthemis* Dru. Waugh, Man., July 1, 1921, (R. S. Brooks).

305a. *Basilarchia arthemis rubrofasciata* B. & McD. Waugh, Man., July 1, 1921, (Brooks).

306. *Basilarchia lorquini ab. eavesi* Hy. Edw. Hillcrest, Alta., June, 1921, (Bowman).

Lycaenidæ

393. *Erora læta* Edw. 16 Island Lake, Que., May 18, (Miss J. B. Muir).

394. *Callipsyche behri* Edw. Penticton, B.C., June 2, (J. A. Corcoran).

411. *Heodes cupreus* Edw. Lillooet, B.C., August, 1921, (Day).

* *Strymon melinus atrofasciata* McD. Wellington, B.C., July 12, 1904, (G. W. Taylor); Duncan, B.C., (C. Livingstone); Royal Oak, B.C., May 26, 1917; Victoria, B.C., May.
Can. Ent., Vol. LIII. No. 2, 1921.

426. *Plebeius scudderi* Edw. Winnipeg Beach, Man., July 20, (J. D. Suffield).

437. *Plebeius lupini* Bdv. Blairmore, Alta., June, 1918; Hillcrest, Alta., June, 1921; Mt. McLean, B.C., (Hanham).
Acmon in Dod's list is probably this (Bowman).

449. *Glaucopsyche lygdamus columbia* Skin. Hillcrest, Alta., June, 1920-21, (Bowman).

Hesperiidæ

598. *Atrytone lagus* Edw. Aweme, Man., July 15, 1921, (N. Criddle).

Sphingidæ

691. *Sphinx canadensis* Bdv. Winnipeg, Man., (Whitehead).

742. *Pholus labruscæ* Linn. Winnipeg, Man., October 20, (J. B. Wallis).
753. *Proserpinus flavofasciata* Wlk. Victoria Beach, Man., June 20, (Wallis).

Ceratocampidæ

* *Anisota manitobensis* McD. Aweme, Man., June-July, (N. and E. Criddle); Winnipeg, Man., (Whitehead and Suffield).
Can. Ent. Vol. LIII; No. 4, 1921.

Arctiidæ

* *Neoarctia sordida* McD. Banff, Alta., June 13, 1914, (N. B. Sanson).
860. *Crambidia casta* Sanb. Quamichan, B.C., September, 1921, (Day).

Noctuidæ

1210. *Canthylidia scutosa* Schf. Lethbridge, Alta., July 12, 1921, (Strickland and Seamans).
1226. *Orosagrotis incognita* Sm. Mt. McLean, B.C., 7,000 feet, August, (Hanham).
1274a. *Euxoa rufula basiflava* Sm. Lake Louise, Alta, August, 1921, (Bowman).
1315. *Euxoa quinquelinea* Sm. Mt. McLean, B.C., 7500 feet, August, (Hanham).
1342. *Euxoa colata* Grt. Mt. McLean, B.C., 7500 feet; August, (Hanham).
1525. *Anytus evelina* French. Lethbridge, Alta., (Seamans).
* *Anomogyna partita* McD. Banff, Alta., July 4, (Wallis); Kalso, B.C., July 24 and August 7, (J. W. Cockle); Nordegg, Alta., June 23, 1921, (McDunnough).
* *Anomogyna homogena* McD. Banff, Alta., Sept. 5, 1911. (Sanson); Pocahontas and Nordegg, Alta., August, (Bowman).
Can. Ent. Vol. LIII, No. 8, 1921.
1548. *Mythimna olivata* Harv. Lake Louise ,Alta., August, 1921, (Bowman).
1642. *Anarta hampa* Sm. Mt. McLean, B.C., 7500 feet, August, (Hanham).
1652. *Lasionycta subfuscula* Grt. Hillcrest, Alta., June, 1921, (Bowman).
1653. *Lasionycta sedilis* Sm. Mt. McLean, B.C., 7500 feet, August, (Hanham).
1789. *Trichoclea fuscolutea* Sm. Lethbridge, Alta., (Strickland and Seamans).
1905. *Orthosia mys* Dyar. Quamichan, B.C., October, 1917, (Day).
2018. *Oncocnemis hayesi* Grt. Mt. McLean, B.C., August, (Hanham).
2061. *Oncocnemis atrifasciata* Morr., Mt. McLean, B.C., (Hanham).
2064. *Oncocnemis major* Grt. Lethbridge, Alta., (Strickland and Seamans).
2096. *Feralia jocosa* Gn. Hudson, Que., May 7th, (Winn).
2439. *Acronycta marmorata* Sm. Quamichan, B.C., (Day).
2513. *Merolonche ursina* Dyar. Aweme, Man., 1921, (Criddle).
2559. *Hadenella pergentilis* Grt. Lethbridge, Alta., (Seamans).
2588. *Platyperigea anotha* Dyar. Lake Louise, Alta., August, 1921, (Bowman).
2615. *Xylomoea didonea* Sm. Lethbridge, Alta., (Seamans).
2930. *Spragueia leo* Gn. Aweme, Man., (Criddle).
3222. *Syngrapha alticola* Wlk., Mt. McLean, B.C., 7500 feet, August, (Hanham).
3227. *Autographa diasema* Bdv. Nordegg, Alta., 1916, (Bowman); July, 1921, (McDunnough and Bowman).
3245. *Autographa v-alba* Ottol. Mt. McLean, B.C., 6000 feet, August, (Hanham).

Lymantriidæ

* *Hemerocampa pseudotsugata* McD., Chase, B.C., (W. B. Anderson).
Can. Ent. Vol. LIII, No. 3, 1921.

Lasiocampidæ

3750. *Malacosoma pluvialis* Dyar. Nordegg, Alta., July, 1921 (McDunnough and Bowman).

Geometridæ

3945a. *Carsia paludata alpinata* Pack. Lake Louise, August, 1921, (Bowman); Mt. McLean, B.C., (Hanham).

3984. *Lygris atrifasciata* Hlst. Quamichan, B.C., August, 1919, (Day).

4002. *Dysstroma formosa* Hlst. Lillooet, B.C., July 1919, (Day).

4601. *Aethaloptera anticaria fumata* B. & McD. Edmonton, Alta., May, 1921. (D. Mackie).

4627. *Erannis vancouverensis* Hlst. Edmonton, Alta., 1921, (Bowman and Mackie).

4670. *Plagodis approximaria* Dyar. Quamichan Lake, B.C., May 30, 1920, (Hanham).

Pyralidæ

4933. *Diastictis argyralis* Hbn. Lethbridge, Alta., 1921 (Seamans).

4994. *Evergestis subterminalis* B. & McD. Lillooet, B.C., August, 1921. (Day)

4996. *Evergestis simulatalis* Grt. Lillooet, B.C., August, 1921, (Day).

5182. *Noctuelia thalialis* Wlk. Edmonton, Alta., July, 1921, (Bowman).

* *Crambus tutillus* McD., Victoria B.C., May 12-28, (W. Downes).

* *Crambus awemellus* McD. Aweme, Man., August 8, 1920, (N. Criddle). The above two species described in Can. Ent. Vol. LIII, 1921.

5473. *Jocara breviornatalis* Grt. Lethbridge, Alta., (Strickland).

Pterophoridæ

5859. *Oxyptilus ningoris* Wlshm. Cowichan Lake, B.C., June 18 1913, (Day).

5862. *Platyptilia edwardsii* Fish. Lillooet,, B.C., August, 1921, (Day).

5888. *Platyptilia modesta* Wlshm. Aweme, Man., June, 1921, (Criddle).

* *Platyptilia albertae* B. & L. Laggan, Alta., August; Mt. Cheam, B.C., August, (Blackmore).

* *Oidaematophorus corvus* B. & L. British Columbia, July and August. The above two species described in Cont. Nat. His. Lep. Vol. IV, No. 4, 1921, by Barnes and Lindsey.

5898. *Pterorphorus mathewianus* Zell. Lillooet, B.C., August, 1921, (Day).

Oecophoridæ

* *Agonopteryx blackmori* Busck. Victoria, B.C. (Blackmore). Can. Ent. Vol. LIII, No. 12. 1921.

Aegeriidæ

6751. *Paranthrene polistiformis* Harris. Calgary, Alta., July, 1920, (Hincke); Hillcrest, Alta., June, 1921, (Bowman).

Eucosmidæ

6864. *Argyroploce campestrana* Zell. Lillooet, B.C., July, 1919, (Day).

7100. *Eucosma montanana* Wlshm. Lillooet, B.C., August, 1921, (Day).

7224. *Laspeyresia albimaculana* Fern. Aweme, Man., May 11, 1921, (Criddle).

Tortricidæ

* *Cacoecia victoriana* Busck. Victoria and Goldstream, B.C., (Blackmore). Can. Ent. Vol. LIII, 1921.

7402. *Cnephasia argentana* Cl. Mt. McLean, B.C., 5000 feet, August, (Hanham.

Yponomeutidæ

* *Argyresthia monochromella* Busck. Victoria, B.C., (Blackmore). Can. Ent. Vol. LIII, No. 12, 1921.

Glyphipterygidæ

* *Hilarographa youngiella* Busck. Departure Bay, B.C., (Young); Victoria, B.C., (Downes).
Can. Ent. Vol. LIII, No. 12, 1921.

Elachistidæ

* *Elachista (Aphelosetia) cygnodiella* Busck. Victoria, B.C., (Downes). Can. Ent. Vol. LIII, No. 12, 1921.

Hepialidæ

8487a. *Hepialus pulcher macglashani* Hy. Edw. Mt. McLean, B.C., 7500 feet, August 21, 1920, (Hanham).

COLEOPTERA

Arranged according to Leng's Catalogue of the Coleoptera of America north of Mexico—1920.

Carabidæ

241. *Loricera caerulescens* Linn. Edmonton, Alta., May 12, 1919, (F. S. Carr).
274. *Nebria metallica* Fisch. Peachland, B.C., July 17, 1921, (W. Metcalf).
276. *Nebria sahlbergi* Fisch. Godbout, Quebec, (E. M. Walker).
346. *Dyschirius pallipennis* Say. Berthierville, Quebec, June, (J. Ouellet).
540. *Bembidion transversale* Dej. Edmonton, Alta., Sept. 4, 1920, (F. S. Carr).
681. *Bembidion dentellum* Thunb. Edmonton, Alta., May 7, 1917, (F. S. Carr).
683. *Bembidion insulatum* Lec. Baldur, Manitoba, (N. Criddle).
902. *Patrobus septentrionis* Dej. Peachland, B.C., August 17, 1919, (W. Metcalf).
1489. *Pristodactyla impunctata* Say. Peachland, B.C., July 27, 1919, (Metcalf).
1548. *Platynus corvus* Lec. Edmonton, Alta., May 5, 1919, (Carr).
1586. *Platynus gemellus* Lec. Edmonton, Alta., June 3, 1918, (Carr).
1642. *Lebia pulchella* Dej. Edmonton, Alta., Oct. 21, 1919, (Carr).
1646. *Lebia atriceps* Lec. Aweme, Man., October 17, 1921, (N. Criddle).
1742. *Cymindis planipennis* Lec. Brooks, Alta., August, 1921, (Carr).
Stenolophus fidelis Csy. Peachland, B.C., July 18, 1919, (Metcalf).
2087. *Anisodactylus harrisi* Lec. Cawston, B.C., May 24, 1917, (Metcalf).

Dytiscidæ

2414. *Coelambus sellatus* Lec. Castar, Alta., September, (Carr).
2428. *Deronectes depressus* Fabr. Edmonton, Alta., August 29, 1919, (Carr).
2454. *Hydroporus consimilis* Lec. Castar, Alta., October, 9, 1920, (Carr).
2466. *Hydroporus sericeus* Lec. Castar, Alta., October 9, 1920, (Carr).
2616. *Rhantus binotatus* Harr. Edmonton, Alta., September 11, 1920, (Carr).
2649. *Hydaticus piceus* Lec. Winnipeg, Man., May 8, 1920, (J. B. Wallis); Edmonton, Alta., August 4, 1917, (Carr).
2660. *Graphoderes fasciatocollis* Harr. Peachland, B.C., August 7, 1919, (Metcalf).

Gyrinidæ

2685. *Gyrinus confinis* Lec. Berthierville, Que., June, (J. Ouellet).
2701. *Gyrinus opacus* Sahl. Edmonton, Alta., April 27, 1919, (Carr).

Hydrophilidæ

2754. *Hydrochus scabratus* Muls. St. Renni, Que., May, (J. Ouellet).

Silphidæ

2945. *Catoptrichus frankenhaeuseri* Mann., Peachland, B.C., Aug. 16, 1919, (Metcalf).

2947. *Choleva luridipennis* Mann. Peachland, B.C., Aug. 16, 1919. In fungus. (Metcalf).

2949. *Choleva gratiosa* Blanch. Peachland, B.C., Aug., 1919. In fungus. (Metcalf).

2951. *Choleva spenciana* Kby. Peachland, B.C., Aug., 1919. In fungus. (Metcalf).

2953. *Choleva horniana* Blanch. Peachland, B.C., Aug., 1919. In gungus. (Metcalf).

2955. *Choleva terminans* Lec. Peachland, B.C., Aug., 1919. In fungus.

Schydmæninæ

3066. *Euconnus similis* Blatch. Edmonton, Alta., June 28, 1919, (Carr).

Staphylinidæ

4314. *Gyrophypnus pusillus* Sach. Outremont, Que., May—June, (J. Ouellet).

4638. *Oxyparus occipitalis* Fauv. Cawston, B.C., May 13, 1919. (Metcalf).

4739. *Bolitobius cincticollis* Say. Edmonton, Alta., Aug. 27, 1919, (Carr).

4840. *Placusa tacomae* Csy. Peachland, B.C., July 13, 1919; Victoria Beach, Man., June 19, 1920. (Wallis).

4936. *Goniusa obtusa* Lec. Aweme, Man., May 17, 1919, (Criddle).

Gyrophaena rara Payk. Peachland, B.C., July 13, 1919, (Wallis).

5068. *Trichiusa postica* Csy. Winnipeg, Man., April 21, 1917. New to Man., (Wallis).

5102. *Atheta coriaria* Kr. Peachland, B.C., Aug. 16, 1919. In fungus. (Wallis).

5119. *Atheta oregonensis* Bnhr. Peachland, B.C., Aug. 16, 1919, (Wallis).

5120. *Atheta frosti* Bnhr. Peachland, B.C., Aug. 16, 1919. Fenyes reports this as not quite typical (Wallis).

5124. *Atheta metlakatlana* Bnhr. Peachland, B.C., July 13, 1919, (Wallis).

5125. *Atheta relicta* Csy. Peachland, B.C., July—Aug., 1919. In fungus. (Wallis).

5288. *Atheta militaris* Bnhr. Peachland, B.C., Aug. 16, 1919, (Wallis).

5296. *Atheta impressipennis* Bnhr. Rosebank, Man., June 16, 1917; Stonewall, Man., April 27. In ants' nests. (Wallis).

Dinaraea angustula Gyll. Winnipeg, Man., May 25, 1920, (Wallis).

5417. *Metaxya subpolaris* Fenyes. Stonewall, Man., May 2, 1920. Determined by Fenyes with some doubt. (Wallis).

5504. *Datomicra celata* Er. Peachland, B.C., Aug. 16, 1919, (Wallis).

5540. *Dimetrota macklini* Feny. Peachland, B.C., Aug. 16, 1919. In fungus (Wallis).

5544. *Dimetrota cursor* Makl. Peachland, B.C., Aug. 16, 1919. Winnipeg, Man., Oct. 4, 1919. In fungus. (Wallis).

5545. *Dimetrota recondita* Er. Peachland, B.C., July 6, 1919. (Wallis).

5709. *Gnypeto helenae* Csy. Peachland, B.C., July, 1919. (Wallis).

* *Cyphea wallisi* Feny. Winnipeg, Man., April 15, 1916.

* *Strophogasta penicillata* Feny. Stonewall, Man., Aug. 18, 1918. In fungus.

* *Aleochara purturbans* Feny. Treesbank, Man., May 18, 1918, (Wallis). The above three species described in Bull. Mus. of Comp. Zoology, Harvard, Vol. LXV, No. 2, 1921.

6028. *Phloeopora inquilina* Csy. Stonewall. Man., April 27, 1919. Among ants. (Wallis).

Histeridæ

6766. *Plegaderus nitidus* Horn. Peachland, B.C., July 13, 1919. In galleries of Ipidae. (Wallis).

6827. *Saprinus lugens* Er. Edmonton, Alta., June 28, 1921. (Carr).

6830. *Saprinus profusus* Csy. Aweme East, Man., July 9, 1920. New to Man., (Wallis).

Melyridæ

7203. *Collops hirtellus* Lec. Cawston, B.C., May 18, 1917. (Metcalf).

* *Listrus provincialis* Blais. Spinous Creek, B.C., (Ralph Hopping). Can. Ent. Vol. LIII, No. 6, 1921.

7430. *Listrus interruptus* Lec. Cawston, B.C., May 18, 1917. (Metcalf).

Mordellidæ

* *Mordellistena incommunis* Lilj. Aweme, Man., June 19, (Criddle). Can. Ent. Vol. LIII, No. 8, 1921.

Elateridæ

8557. *Adelocera brevicornis* Lec. Winnipeg, Man., (F. Dolman).

8966. *Elater socer* Lec. Onah, Man., July 13, 1920, (Wallis).

* *Melanotus hislopi* Zwal. Toronto, Ont., May 22, (R. J. Crew). Proc. Ent. Soc. Wash. Vol. 23, No. 9, 1921.

Buprestidæ

9207. *Chrysophana placida* Lec. British Columbia. Previously recorded as *Melanophila gentilis* (Hanham).

9338. *Dicerca pectorosa* Lec. Peachland, B.C., June 17, 1920, (Metcalf).

9360. *Buprestis sulcicollis* Lee. Godbout, Que., (E. M. Walker).

9397. *Anthaxia deleta* Lec. Lillooet, B.C., July, 1919, (Hanham).

Dryopidæ

9586. *Lara avara* Lec. Lillooet, B.C., July, 1919, (Hanham).

9604. *Helichus fastigiatus* Say. Treesbank, Man., August and October, 1921, (E. and N. Criddle).

Helmidæ

9615. *Helmis vittata* Melsh. Edmonton, Alta., July 9, 1920, (Carr).

Heteroceridæ

9646. *Heterocerus undatus* Melsh. Peachland, B.C., July 18, 1919, (Wallis).

9648. *Heterocerus brunneus* Melsh. Peachland, B.C., July 18, 1919, (Wallis).

Dascillidæ

9657. *Macropogon piceus* Lec. Cawston, B.C., June 17, 1917, (Metcalf).

Dermestidæ

9757. *Novelsis perplexus* Jayne. Peachland, B.C., July 24, (Metcalf).

Ostomidæ

9994. *Tenebroides corticalis* Melsh. Castor, Alta., April 11, 1920, (Carr).

Nitidulidæ

10013. *Catcretes sericans* Lec. Cawston, B.C., July 2, 1917, (Metcalf).

10024. *Meligethes aeneus* Fab. Cawston, B.C., July 5, 1917, (Metcalf).

Cucujidæ

10273. *Brontes dubius* Fab. Cawston, B.C., July 17, 1917, (Metcalf).

Mycetophagidæ

10503. *Mycetophagus bipustulatus* Melsh. Aweme, Man., Aug. 30, 1921, (E. Criddle).

Colydiidæ

Aulonium longum Lee. Peachland, B.C., Aug. 13, 1919, (Wallis).

Endomychidæ

Mycetina idahoensis Fall. Cawston, B.C., April 15, 1917, (Metcalf).

Coccinellidæ

10874. *Hyperaspis lateralis* Muls. Cawston, B.C., Aug. 17, 1917, (Metcalf).
10954. *Hyperaspis vittigera* Lec. Cawston, B.C., July, 1917, (Metcalf).
10972b. *Brachyacantha uteela* Csy. Edmonton, Alta., June 5, 1920, (Carr).
11076. *Scymnus coniferarum* Cr. Cawston, B.C., March 11, 1917, (Metcalf).
11096. *Scymnus naviculatus* Csy. Edmonton, Alta., June 18, 1919, (Carr).

Alleculidæ

11322. *Mycetochara fraterna* Say. Aweme, Man., July—August, (E. and N. Criddle).
11324. *Mycetochara megalops* Csy. Aweme East, Man., July 5, 1920, (Criddle).

Tenebrionidæ

* *Eleodes vandykii* var. *modificata* Blais. Vernon, B.C., April 6, 1920, (Hopping).
Can. Ent. Vol. LIII, No. 6, 1921.

12298. *Eleates explanatus* Csy. Peachland, B.C., Aug. 7, 1919. On fungus. (Wallis).
12372. *Hypophloeus substriatus* Lec. Peachland. B.C., July; Winnipeg, Man., August, (Wallis).
12374. *Hypophloeus parallelus* Melsh. Peachland, B.C., July 15, 1919, (Wallis).

Melandryidæ

12566. *Scotochroa basalis* Lec. Peachland, B.C., Aug. 3, 1919, (Wallis).

Anobiidæ

12689. *Sitodrepa panicea* Linn. Edmonton, Alta., March, 1920, (Carr).

Cerambycidæ

14123. *Tetropium abietis* Fall. Victoria, B.C., July 9, 1915, (Wallis).
14396. *Acmaeops pratensis* Laich. Edmonton, Alta., July 2, 1920, (Carr).
14420. *Anthophilax mirificus* Bland. Hillcrest, Alta., June 19, 1920.
14514. *Leptura nigrella* Say. Nordegg, Alta., August.
14584. *Molorchus longicollis* Lec. Lillooet, B.C., July, 1919, (Hanham).
14625. *Callidium frigidum* Csy. Thornhill, Man., July 19, (J. South).
14968. *Leiopus variegatus* Hald. Edmonton, Alta., July 18, 1921.

Chrysomelidæ

15204. *Donacia curticollis* Knob. Rigaud, Que., July, (J. Ouellet).
15239. *Lema brunnicollis* Lac. Edmonton, Alta., June 29, 1918, (Carr).
15481. *Cryptocephalus sanguinicollis* Suffr. Cawston, B.C., July, (Metcalf).
15703. *Gastroidea cyanea* Melsh. Peachland, B.C.
15713. *Phytodecta arctica* Mann. Mt. McLean, B.C. 7500 feet, (Hanham).
15724. *Trirhabda canadensis* Kby. Brooks, Alta., Aug. 21, (Carr).
15733. *Trirhabda convergens* Lec. Rigaud, Que., August, (J. Ouellet).
15745. *Galerucella sexvittata* Lec. Aweme, Man., Aug. 15, 1921. On Solidago. (Criddle).
16016. *Chaetocnema confinis* Cr. Stonewall, Man., Sept. 6, 1918. New to Man. (Wallis).
16086. *Dibolia borealis* Chev. Norman, Ont., July-August, (B.M. Bradshaw).

Mylabridæ

16232. *Mylabris fraterculus* Horn. Edmonton, Alta., July 3, 1919, (Carr).

Curculionidæ

16392. *Apion pennsylvanicum* Boh. Cawston, B.C., July 29, 1917. On wild parsnip. (Metcalf).

16480. *Apion centrale* Fall. Cawston, B.C., June 15, 1917, (Metcalf).
16584. *Panscopus aequalis* Horn. Cawston, B.C., June 3, 1917, (Metcalf).
16679. *Brachyrhinus rugifrons* Gyll. Mission. B.C., On strawberry (R. Glendenning).
16872. *Hyperodes humilis* Gyll. Edmonton, Alta., June 6, 1918, (Carr).
16897. *Dorytomus parvicollis* Csy. Edmonton, Alta., July 9, 1915, (Carr).
16910. *Dorytomus vagenotatus* Csy. Edmonton, Alta., June 12, 1920, (Carr).
16922. *Notaris puncticollis* Lec. Edmonton, Alta., June 12, 1918, (Carr).
17036. *Bagous restrictus* Lec. Peachland, B.C., July 18, 1919, (Wallis).
17334. *Elleschus scanicus* Payk. Edmonton, Alta., April 4, 1915, (Carr).
17338. *Orchestes salicis* Linn. Cawston, B.C., July 15, (Metcalf); Edmonton, Alta., June 26, 1918, (Carr).
17345. *Orchestes pallicornis* Say. Edmonton, Alta., July 2, 1919, (Carr).
17842. *Rhinoncus pyrrhopus* Boh. Peachland, B.C., July 27, 1919, (Wallis).
18209. *Phthorophloeus piceae* Swaine. Edmonton. Alta., Sept. 2, 1916, (Carr).

DIPTERA

Arranged according to a Catalogue of North America Diptera by J. M. Aldrich. The numbers refer to the pages of the catalogue.

Tipulidæ

* *Tipula beaulieui* Dietz. Ottawa, Ont., 1912, (G. Beaulieu). Ent. News, Vol. XXXII, No. 10, 1921.

Culicidæ

Culex tarsalis Coq. Aweme, Man., July 28—31, 1921, (H. A. Robertson). New to Manitoba.

Culex territans Walk. Aweme, Man., Aug. 1, 1921, (H. A. Robertson). New to Manitoba.

Aedes intrudens Dyar. Aweme, Man., May 23—26, 1921, (Robertson).

Aedes canadensis Theo. Douglas and Glenora, Man., July, 1921, (Robertson).

Aedes curriei Coq. Aweme and Delta, Man., August—October, 1921, (Robertson).

Ades campestris D. & K. Aweme, Oberon and Westburne, Man., June, August, 1921, (Robertson).

Mycetophilidæ

139. *Platyura elegans* Coq., Joliette, Que., July 13, 1921, (J. Ouellet).

Tabanidæ

* *Tabanus trepidus* McD. Ottawa, Ont., (W. Metcalf); Shelburne, N.S., July, (A. Gibson); Harcourt, N.B.; Fort Coulonge, Que., (J. I. Beaulne); Aweme, Man., (Criddle); Peachland, B.C., (Wallis).

* *Tabanus nudus* McD. Mer Bleue, Ont., June, 1908; Fredericton and St. Stephen, N.B.; Ottawa. Ont.; Aweme, Man.; Saskatchewan; British Columbia.

* *Tabanus rupestris* McD. Cowley, Alta., (R. N. Chrystal).

* *Tabanus atrobasis* McD. Mt. Lehman, B.C., June 30; (S. Hadwen); Victoria and Royal Oak, B.C..

The above four species described in Can. Ent. Vol. LIII, No. 6, 1921.

Bombyliidæ

* *Calopelta fallax* Green. Royal Oak, B.C., May 9, 1917, (R. C. Treherne). Proc. Ent. Soc. Wash., Vol. 23, No. 1, 1921.

Asilidæ

262. *Stichopogon argenteus* Say. Onah, Man., July-August, 1920, (Vroom and Criddle).

Empididæ

318. *Syneches rufus* Loew. Joliette, Que., July 13-17, 1921, (J. Ouellet).

319. *Leptopeza flavipes* Mg. Mount Royal, Que., May 28, 1921, (J. Ouellet).

Dolichopodidæ

375. *Hilara mutabilis* Loew. Joliette, Que., July 13, 1920, (J. Ouellet).

Lonchopteridæ

339. *Gymnophora arcuata* Stein. Joliette, Que., July 13, 1920, (J. Ouellet).

Syrphidæ

We are indebted to Mr. C. Howard Curran for the following list of Syrphidæ.

353. *Chilosia plumata* Loew. Orillia, Ont., May-June. (Curran).
353. *Chilosia petulca* Will. Guelph, Ont.
352. *Chilosia capillata* Loew. Orillia, Ont., June, (Curran).
Chilosia prima Hunter. Orillia, Ont., May 7-29, 1921, (Curran).
* *Cnemodon carinata* Curr. Guelph and Jordan, Ont., June, (Curran)
* *Cnemodon longiseta* Curr. Jordan, Ont., June-July; Orillia, Ont., June, 1921. (Curran).
* *Cnemodon squamulæ* Curr. Jordan, Ont., May 16, 1920. (Curran).
* *Cnemodon cevelata* Curr. Guelph, Jordan and Orillia, Ont., (Curran).
* *Cnemodon elongata* Curr. Orillia, Ont., June 22; Jordan, Ont., June 15, 1919. (Curran).
* *Cnemodon coxalis* Curr. Guelph, Orillia and Jordan, Ont., May-September, (Curran).
350. *Cnemodon pisticoides* Will. Orillia and Jordan, Ont., June, August, (Curran).
* *Cnemodon auripleura* Curr. Cranbrook, B.C., (C. B. D. Garrett).
* *Cnemodon carinata* Curr. Guelph and Jordan, Ont., June, (Curran).
* *Cnemodon venteris* Curr. Jordan, Ont., June, (Curran).
* *Cnemodon myerma* Curr. Jordan, Ont., June, (Curran).
* *Cnemodon ontarioensis* Curr. Guelph and Jordan, Ont., June, (Curran).
* *Heringia canadensis* Curr. Guelph, Ont., June 15, 1919, (Curran).
* *Heringia intensica* Curr. Jordan, Ont., June 15, 1919, (Curran).
* *Pipiza vanduzeei* Curr. Cranbrook, B.C., June, (C. B. D. Garrett).
350. *Pipiza puella* Will. Orillia and Jordan, Ont., May, June, (Curran).
Pipiza quadrimaculata Pz. Orillia, Ont., June 8, 1914, (Curran).
* *Pipiza tricolor* Curr. Orillia and Jordan, Ont., May, June, (Curran).
* *Pipiza severnensis* Curr. Severn, Ont., July 31, 1913, (Curran).

The above new species were described in Proc. Calif. Acad. Sci., Vol. XI, pp. 345-393, 1921.

* *Melanostoma squamulæ* Curr. Victoria, B.C., April-May.
* *Melanostoma chilosia* Curr. Banff, Alta., (N. B. Sanson).
* *Melanostoma lata* Curr. White Horse Yukon Territory, (A. P. Hawes).

The above three species described in Can. Ent. Vol. LIII, No. 12, 1921.

Paragus auricaudatus Bigot. British Columbia, 1919, (E. R. Buckell). Distinct from *P. tibialis* (Curran).

Crysogaster texana Shan. Orillia, Ont., May, June—on Crataegus blossoms (Curran).

Platychirus perpallidus Verrall. Ogema, Sask., June 17, 1916, (Criddle); Fredericton, N.B., July 5, 1913, (J. D. Tothill).
Platychirus scutatus Meig. British Columbia, (Garrett).
Platychirus discimanus Loew. Orillia Ont., April 24, 1921, (Curran). Aylmer, Que., May 13, 1921, (J. McDunnough).
Syrphus venustus Meig. Orillia, Ont., May 3, 1921, on bloom of *Osmorrhiza claytoni* (Curran).
367. *Syrphus pauxillus* Will. Orillia, Ont., May, 1921. On *Caltha* (Curran).
366. *Syrphus mentalis* Will. Orillia, Ont., May, On plum flowers, (Curran).
Syrphus cinctus Fall. Orillia, Ont., April. A European species not previously recorded for North America.
* *Syrphus invigorus* Curr. Orillia, Ont., May 5-30. On Wild Plum (Curran).
Syrphus americanus var. *vinelandi* Curr. Jordan and Orillia, Ont., May to August (Curran).
* *Syrphus americanus* var. *pomus* Curr. Jordan and Orillia, Ont., June 29, 1919, (Curran).
Syrphus nitidicollis Meig. Orillia, Ont., May, 1921, (Curran).
* *Syrphus rectoides* Curr. Cranbrook and Bull River, B.C., (Garrett).
366. *Syrphus mentalis* Will. Orillia, Ont., May, On plum flowers, (Curran). May 5, (J. McDunnough).
* *Syrphus transversalis* Curr. Orillia, Ont., May to September, (Curran).
* *Syrphus reflectipennis* Curr. Orillia, Ont., May 26, 1913, (Curran).
The above six species described in Can. Ent. Vol. LIII, Nos. 7 and 8, 1921.
Syrphus lineola Zett. Glacier, B.C., July 5, 1915, (J. B. Wallis). A European species not previously recorded for North America (Curran).
Syrphus medius Jones. Orillia, Ont., May-June, (Curran).
362. *Leucozona lucorum* L. McDiarmid, Ont., (N. K. Bigelow).
Didea laxa O. S. McDiarmid, Ont., June 10, 1921, (N. K. Bigelow). New to Ontario, (Curran).
355. *Baccha cognata* Loew. Orillia, Ont., June 28, 1921, (Curran).
357. *Ocyptamus fuscipennis* Say. Point Pelee, Ont., (Bigelow).
* *Toxomerus occidentals* Curr. British Columbia.
Can. Ent. Vol. LIII, No. 11, 1921.
375. *Ascia metallica* Will. Orillia, Ont., April-May. This is apparently quite a distinct species. (Curran).
374. *Sphegina keeniana* Will. Orillia, Ont., May-June. Abundant on flowers of *Osmorrhiza claytoni*. (Curran).
Sphegina infuscata Loew. Lillooet, B.C., 1919, (A. Phair); Orillia, Ont., May 30, 1921, (Curran).
Sphegina lobata Loew. Orillia, Ont., May to July, 1921, (Curran).
Sphegina petiolata Coq. Orillia, Ont., May to July, 1921. (Curran).
Sphegina campanulata Robert. Joliette, Que., (J. Ouellet).
354. *Myiolepta bella* Will. British Columbia. April to July, (Treherne and Keen).
375. *Hammerschmidtia ferruginea* Fall. Orillia, Ont., May, 1921, (Curran).
Brachyopa diversa Johns. Orrilia, Ont., May, 1921., (Curran).
Brachyopa flavescens Shan. Orillia, Ont., May 5, 1921, (Curran).
Brachyopa media Will. Orillia, Ont., May 5, 1921. (Curran).

Brachyopa gigas Lovett. British Columbia, (Treherne).
* *Ceria ontarioensis* Curr. Orillia, Ont., May 30, 1921. (Curran). Can. Ent. Vol. LIII, No. 8, 1921.
381. *Volucella vesiculosa* Fabr. Toronto, Ont.
Sericomyia sexfasciata Loew. Orillia, Ont., May 29, 1921, (Curran). Cheticamp, B.C., June 30, 1917, (F. Johansen); Barker, N.B., June 24, 1914, (J. D. Tothill).
387. *Eristalis nemorum* L. Vernon, B.C., (M. Ruhmann); Banff, Alta., (N. B. Sanson).
387. *Eristalis obscurus* Loew. Orillia, Ont., May 5-20, 1921, (Curran).
385. *Eristalis compactus* Walk. Orillia, Ont., April-May, 1921, (Curran).
392. *Helophilus dychei* Will. McDiarmid, Ont., (N. K. Bigelow).
393. *Helophilus groelandicus* O. Fabr. Lillooet, B.C., (C. H. Young).
392. *Helophilus bilinearis* Will. Orillia, Ont., April-May, (Curran).
393. *Helophilus lunulatus* Meig. Orillia, Ont., April-June, **(Curran).**
Criorhina luna Lovett. Wellington, B.C., April 17, 1903, (R. N. Harvey); Ucluelet, B.C., (Young).
Criorhina aurea Lovett. Penticton, B.C., April 21, 1919, (E. R. Buckell).
401. *Pocota bomboides* Hunter. Victoria, B.C., May 6, 1919, (W. Downes).
402. *Cynorhina armillata* O. S. Orillia, Ont., May 18, 1921, (Curran).
403. *Milesia virginiensis* Drury. Point Pelee, Ont., (Bigelow).
405. *Sphecomyia vittata* Wied. Orillia, Ont., May 16, 18, 1921, (Curran).
401. *Brachypalpus frontosus* Loew. Ottawa, Ont., May 23, 1908, (J. Fletcher).
401. *Brachypalpus parvus* Will. Penticton, B.C., April 21, 1919, (Buckell); Duncan, B. C., (A. W. Hanham).
383. *Arctophila flagrans* O. S. Lake Louise, Alta., Aug. 15, 1915, (J. B. Wallis).

Tachinidæ

* *Ernestia nigropalpis* Toth. Stickeen River, Savary Island, B.C., (Townsend, Wicham, Sherman).
* *Ernestia johnsoni* Toth. Fry Creek, B.C.
* *Ernestia frontalis* Toth. Cranbrook, B.C., (Harrington and Garrett).
* *Ernestia platycarina* Toth. Savary Island and Bear Lake, B.C.
* *Ernestia sulcocarina* Toth. Cranbrook, B.C., Lillooet, B.C., (Garrett and Bird); Husavick, Man., (Wallis).
* *Ernestia bicarina* Toth. Bear Lake, B.C.
The above six species described in Can. Ent. Vol. LIII, Nos. 11 and 12, 1921.
476. *Metopia lateralis* Macq. Quebec, (J. Ouellet).

Dexiidæ

504. *Ptilodexia harposa* Walk. Joliette, Que., July 13, 1920, (J. Ouellet).

Anthomyiidæ

538. *Fennia corvina* Verr. Mt. Royal, Que., Joliette, Que., May, June, 1920, (Ouellet).
543. *Mydaea occidentalis* Mal. Mt. Royal, Que., May 31, 1920, (Ouellet).
Hydrotaea militaris Macq. Mt. Royal and Lauzon, Que., May-June, 1920, (Ouellet).
552. *Hylemyia johnsoni* Stein. Outremont, Que., May 28, 1920, (Ouellet).
553. *Hylemyia trivittata* Stein. Joliette, Lauzon and St. Remi. Que., June-July, (Ouellet).
553. *Hylemyia testacea* Stein. Mt. Royal, Que., June 20, 1920, (Ouellet).

553. *Prosalpia silvestris* Fall. Mt. Royal, Que., May 28, 1920, (Ouellet).
558. *Pegomyia lipsia* Walk. Outremont, Joliette, and St. Louis, Que., June-August, (Ouellet).
558. *Pegomyia vittigera* Zett. Mt. Royal, Que., May 28, 1920, (Ouellet).
559. *Hoplogaster nigritarsis* Stein. Joliette, Que., July 13, 1920, (Ouellet)
560. *Coenosia compressa* Stein. Joliette, Que., July 10, 1920, (Ouellet).
560. *Coenosia flavicosa* Stein. Mt. Royal, St. Louis, Que., June-August. (Ouellet).

Scatophagidæ

566. *Chactosa punctipes* Macq. Joliette, Que., July 15, 1920, (Ouellet).

Sapromyzidæ

* *Palloptera albertensis* John. Calgary, Alta., (Owen Bryant). Psyche, Vol. XXVIII, p. 22, 1921.

Oscinidæ

Elachiptera costata Loew. Outremont, St .Louis, Que., May-July, (Ouellet).

Geomyzidæ

645. *Anthomyza tenuis* Loew. Joliette, Que., July 13, 1920, (Ouellet).

Hemiptera.

Arranged according to a Check List of the Hemiptera excepting the Aphididæ, Aleurodidæ and Coccidæ of America, North of Mexico by E. P. Van Duzee.

Aradidæ

Aradus parshleyi Van D. Vernon, B.C., April 28, 1915, (M. Ruhmann).

* *Aradus implanus* Parsh. Trenton, Ont., June 18, 1907, (J. D. Evans); Montreal, Que., May 15, 1906, (J. I. Beaulne).

* *Aradus medioximus* Parsh. Vancouver Island, B.C., May 21, 1897, (G. W. Taylor).

* *Aradus uniannulatus* Parsh. Edmonton, Alta., April 17, 1919, (F. S. Carr).

* *Aradus cinnamonus* sub. sp. *antennalis* Parsh. Kelowna, B.C., 1917, (Treherne); Vernon, B.C., April 12, (Ruhmann).
The above four species described in Trans. Am. Ent. Soc. No. 1, Vol. XLVII, 1921.

Lygæidæ

461. *Ortholomus longiceps* Stal. Aweme, Man., Aug. 21, 1920, (Criddle).
Kolenetrus plenus Dist. Ottawa, Ont., July 20, 1912, (J. I. Beaulne).
588. *Stignocoris rusticus* Fall. Hemmingford, Que., Aug. 30, 1916, (C. E. Petch).

Membracidæ

1611. *Carynota stupida* Walk. Onah, Man., July, 1920, (P. N. Vroom).
1633. *Telamona westcotti* Godg. Aweme, Man., June 26 and July 15, 1920, (Criddle).

Cicadellidæ

2181. *Eutettix strobi* Fitch. Aweme, Man., Aug. 13, 1921, (Criddle).
2251. *Thamnotettix kennicotti* Uhl. Aweme, Man., Aug. 13-22, 1920, (Criddle).

Aphididæ

Schizineura ulmo Linn. Chilliwack and Agassiz, B.C., on elm and currant. (R. Glendenning).

Orthoptera.

Mantidæ

Litaneuria minor Scudd. Osoyoos, B.C., Aug. 23, 1920, (Eric Hearle).

Oedipodinæ

Aulocara elliotti Thom. Lethbridge, Alta., July, 1920, (Strickland and Seamans).

Trimerotronis brunneri McNeill. Lethbridge, Alta., July 29, 1912, (J. B. Wallis).

Acrididæ

Melanoplus flabellifer Scudd. Lethbridge, Alta., July 7, 1921, (Strickland).

Odonata.

Arranged according to Muttkowski's Catalogue of the Odonata of North America.

Dr. E. M. Walker has supplied the following list of Species which he considers of sufficient interest to be reported upon.

Coenagrionidæ

Lestes disjunctus Selys. Revelstoke, B.C., July 19, 1921, (E. M. Walker).

Lestes uncatus Kby. Revelstoke, B.C., July 17, 1921, (Walker).

Enallagma hageni Walsh. Caron, Sask., June 26, 1921, (Walker).

Enallagma ebrium Hag. Verden, Man., June 23, 1921; Herbert, Sask., June 28, (Walker).

Enallagma civile Hag. Lepelletiar, Man., June 18, 1921, (Walker).

Enallagma carunculatum Morse. Nebrom, B.C., July 22, 1921, (Walker).

Ischnura cervula Selys. Revelestoke, B.C., July 19 ,1921; Nelson, B.C., July 21, (Walker and Whitehead).

Æshnidæ

Ophiogomphus severus montanus Selys. Nelson, B.C., July 19, 1921; Nelson, B.C., July 21, (Walker and Whitehead).

Ophiogomphus rupinsulensis Walk. Griswold and Virden, Man., June, (Walker).

Æshna sitchensis Hag. Field, B.C., Aug. 5th, 1921, (Walker).

Æshna interrupta Walk. Nelson, B.C., July 22, 1921, (Walker).

Æshna umbrosa occidentalis Walk. Kootenay Lake near Nelson, B.C., July 22, 1921, (Walker).

Libellulidæ

Cordulia shurteffi Scud. Revelstoke, B.C., July (Walker); Nelson, B.C., (Walker and Whitehead).

Somatochlora albicincta Burm. Vancouver, B.C., 4500 feet, July 30, (Walker).

Somatochlora hudsonica Hag. Banff, Alta., July 13, 1921, (Walker).

Sympetrum madidum Hag. East of Portage la Prairie, Man., June. Manitoba record. (Walker). Piapot, Sask., June 29, (Walker).

Leucorrhinia hudsonica Selys. 10 miles west of Portage la Prairie, Man., June, 1921. Field and Vancouver, B.C., (Walker).

Ephemeridæ

* *Bætis intercalaris* McD. Ottawa, Ont., June 11-14, 1920, (McDunnough).

* *Bætis flavistriga* McD. Ottawa, Ont., June 14, 1920, (McDunnough). These species described in Can. Ent. Vol. LIII; No. 5, 1921.

Collembola

* *Friesea sublimis* MacNam. Arnprior, Ont., April and October (C. MacNamara). Can. Ent. Vol. LIII; No. 6, 1921.

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Ontario Department of Agriculture

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CONTENTS

TO HIS HONOUR HENRY COCKSHUTT, ESQ.,
Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

I have the honour to present herewith for your consideration the Report of the Entomological Society for 1922.

Respectfully submitted,

MANNING W. DOHERTY,
Minister of Agriculture.

Toronto, 1923.

Entomological Society of Ontario

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Delegate to the Royal Society of Canada—The President.

FINANCIAL STATEMENT

For the Year Ending October 31st, 1922.

Receipts.

Cash on hand, 1921	$55 25
Subscriptions	442 25
Members' Dues	82 50
Advertisements	54 65
Back Numbers	57 31
Bank Interest	45
Exchange	15
Cuts	11 91
Contributions	187 15
Life Members	175 15
Government Grant	1,000 00
	$2,066 77

Expenditures.

Printing	$1,284 28
Expense	65 37
Cuts	66 97
Salaries (arrears)	200 00
Annual Report	25 00
Insurance	36 00
Exchange	4 76
Balance Cash on Hand	384 39
	$2,066 77

Accounts Receivable.

Advertising	$338 17
Back Numbers	8 10
Cash on Hand	384 39
	$730 66
By Accounts Receivable	$730 66
To Accounts Payable	560 00
Net Balance	$170 66

Accounts Payable.

Printing	$460 00
Salary	100 00
	$560 00

Auditors {J. A. Flock. L. Caesar.

Respectfully submitted,
A. W. Baker,
Secretary-Treasurer.

Entomological Society of Ontario

ANNUAL MEETING

The Fifty-ninth Annual Meeting of the Entomological Society of Ontario was held at the Ontario Agricultural College, Guelph, on Friday and Saturday, November 24th and 25th.

The general meetings of the society were held in the lecture room of the Department of Entomology. On Friday evening a dinner was held in the College cafeteria, after which the members and visitors adjourned to the Common Room of Mills Hall for a smoker and social evening, when the President, Mr. Morris, read an interesting paper on a collecting trip to Rondeau Park and Point Pelee.

Among the members present were: Mr. N. K. Bigelow, Toronto, Ont.; Messrs. A. Gibson, L. S. McLaine, R. C. Treherne, H. G. Crawford, C. Hutchings, Dominion Entomological Branch, Ottawa, Ont.; Profs. L. Caesar, A. W. Baker and Mr. G. J. Spencer, Ontario Agricultural College, Guelph, Ont.; Mr. F. J. A. Morris, Peterborough, Ont.; Mr. W. E. Biggar, Hamilton, Ont.; Mr. J. A. Hall, Guelph, Ont.; Father Leopold, La Trappe, Que.; and the following officers of the Dominion Entomological Branch: Messrs. W. A. Ross, Vineland Station, Ont.; H. F. Hudson, Strathroy, Ont.

The officers of the society were re-elected save that Mr. J. A. Flock was elected curator in place of Mr. Spencer.

REPORT OF THE COUNCIL

The Council of the Entomological Society of Ontario begs to present its report for the year 1921-1922.

The Fifty-eighth Annual Meeting of the Entomological Society of Ontario was held at the University of Toronto during the week of December the twenty-eighth. The meeting was held at this time in order that our members might have an opportunity of meeting with the members of the Entomological Society of America and of the American Association of Economic Entomologists.

Many members of the society were present from the various provinces of the Dominion and from the United States. The meetings were also well attended by members of the Entomological Society of America, the American Association of Economic Entomologists and others.

On Wednesday afternoon a meeting was held with the Entomological Society of America in Room 10, Medical Building. The following papers were contributed by members of the two societies:

"Algonquin Days," F. J. A. Morris, Peterborough, Ontario; "Hatching in Three Species of Neuroptera," Roger C. Smith, Kansas State Agricultural College; "Ecdysis in Tmetocera Ocellana," S. W. Frost, Arendtsville, Pa; "Cocoon Spinning by Species of Bucculatrix," O. A. Johannsen, Cornell University; "The Ventral Pro-thoracic Gland of the Red-humped Apple Caterpillar (*Schizura Concinna*)" J. D. Detwiler, Western University; "Observations on a New Species of Chrysops from Central New York," Raymond C. Shannon, Cornell University; "Are there Two Species of the Oyster Shell Scale?" Grace H. Griswold, Cornell University; "A Classification of the Larvae of Tenthredinoidea," H. Yuasa, University of Illinois; "The Phylogeny of the Gall Mites and a New

Classification of the Suborder Prostigmata of the Order Acrina," H. E. Ewing, United States National Museum; "The Syrphid Genera Hammerschmidtia and Brachyopa in Canada," C. Howard Curran, Orillia, Ontario; "Taxonomic Results From a Study of the Genitalia of Male Syrphidæ," C. L. Metcalf, University of Illinois; "Report of the Lepidoptera of the Cornell Expedition of 1919-1920," Wm. T. M. Forbes, Cornell University; "An Extreme Case of Delayed Fall Emergence of Hessian Fly (*Phytophaga destructor*)," W. H. Larrimer, United States Bureau of Entomology; "Importance of Insects in the Food of the Brook Trout," W. A. Clemens, University of Toronto; "The effects of Vitamines on the Growth of Ephestia Kuehniella in Wheat Flour," Charles H. Richardson, United States Bureau of Entomology.

On Friday afternoon the society met with the American Association of Economic Entomologists when the following programme was delivered:

"One Year of the Crop Protection Institute," W. C. O'Kane, Durham, N. H.; "Poisoned Molasses for the Destruction of Noctuid Moths," E. C. Strickland, Ottawa, Canada; "The Western Wheat Stem Sawfly in Canada," Norman Criddle, Treesbank, Manitoba; "Progress in Hessian Fly Control," H. A. Gossard, Wooster, Ohio, and T. H. Parks, Columbus, Ohio; "European Corn Borer—Life History in Ontario," H. G. Crawford, Ottawa, Canada; "European Corn Borer—Present Distribution in Ontario," L. S. McLaine, Ottawa, Canada; "European Corn Borer; Control Under Ontario Conditions," G. J. Spencer, Guelph, Ontario; "The Corn Borer Problem in New York State," E. P. Felt, Albany, N.Y.; "Chemotropism of Chinch Bug," H. Yuasa, Urbana, Ill; "Observations on Insects Attacking Sorghums," Wm. P. Hayes, Manhattan, Kansas; "The Onion Maggot in British Columbia Under Irrigated Conditions," R. C. Treherne, Ottawa; "The Cabbage Root Maggot," L. Caesar, Guelph, Canada; "A Forest Insect Survey From the Air," J. M. Swaine, Ottawa, Canada; "Forest Sample Plot Studies in a Spruce Budworm Outbreak," F. C. Craighead, Ottawa, Canada; "The Life History, Habits and Injuries of the Maple Case-bearer," Glenn W. Herrick, Ithaca, N.Y.

On Friday evening, an Entomologists' Dinner was held at the Prince George Hotel under the auspices of the American Association of Economic Entomologists. Many members of our society accepted the kind invitation of this society to be present.

The Canadian Entomologist, the official organ of the society completed its fifty-third volume in December last. The volume contained 342 pages, illustrated by seventeen full page plates and nineteen original figures. The contributors to these pages numbered fifty-three and included writers in Ontario, British Columbia, Alberta, New Brunswick, sixteen of the United States, South Africa and New Zealand. Six papers were published during the year on popular and practical entomology.

REPORT OF THE MARITIME BRANCH

The Eighth Annual Meeting of the Acadian Entomological Society was held in Amherst, N.S., on Thursday, December 14th, 1922. In the absence of the President, the Vice-President, Dr. Brittain, occupied the chair. A short business meeting was held and last year's officers were all re-elected as follows:

Honorary President.............................Dr. A. H. McKay, Halifax, N.S.
President.............................Mr. Wm. McIntosh, St. John, N.B.
Vice-President.............................Dr. W. H. Brittain, Truro, N.S.
Secretary-Treasurer.............................Mr. A. B. Baird, Fredericton, N.B.
Assistant Secretary.............................Mr. W. E. Whitehead, Truro, N.S.
Member of Council.............................Dr. Edna Mosher, Kempt Shore, N.S.

The remainder of the day was devoted to the discussion of entomological problems and the reading of the following papers:

Some Notes on Entomophthora sphaerosperma, a Fungal Parasite of the Apple Sucker—A. G. Dustan, Entomological Laboratory, Fredericton, N.B.
Some Notes on the Natural Control of the Pine Bark Aphid in New Brunswick—A. H. McAndrews, Entomological Laboratory, Fredericton, N.B.
Insect Pests of the Year in Nova Scotia—Prof. W. H. Brittain, College of Agriculture, Truro, N.S.
Insect Pests of the Year in New Brunswick—R. P. Gorham, Entomological Laboratory, Fredericton, N.B.
The Results of Further Experiments on the Control of the Cabbage Maggot—Prof. W. H. Brittain, Truro, N.S.
Sulphur Dust as an Insecticide—A. Kelsall, Entomological Laboratory, Annapolis, N.S.
Some General Results of Natural Control Studies in Canada, Applying Particularly to the Spruce Budworm, Forest Tent Caterpillar and Larch Sawfly—Dr. J. D. Tothill, Entomological Laboratory, Fredericton, N.B.
The Use of Aluminium Sulphate in Place of Copper Sulphate in Insecticide-Fungicide Combinations—A. Kelsall, Annapolis, N.S.
Some Notes on the Larch Sawfly and Larch Case Bearer and Their Natural Control in New Brunswick—A. B. Baird, Entomological Laboratory, Fredericton, N.B.

Since our last report was presented we have published the seventh number of our "Proceedings" which comprises some 88 pages and includes all the papers presented at our last annual meeting. An informal field meeting of the Society was held at Wolfville, N.S., on Friday, August 11th. Our membership remains about the same from year to year, twenty-four paid-up members being now on our list.

A. B. Baird, *Secretary-Treasurer.*

REPORT OF THE MONTREAL BRANCH

The Forty-ninth Annual Meeting was held on May 13th, 1922, in the Lyman Entomological Room, Redpath Museum, McGill University.

Eight meetings were held during the season with an average attendance of nine.

The following papers and talks were given:

The Brighter Side of Entomology	A. F. Winn.
Phoebe Bird Catching a Green Veined White	J. W. Buckle.
Early Appearance of Some of Our Common Butterflies	J. W. Buckle.
Common Yellow Butterfly	A. F. Winn.
Protective Colouring	A. F. Winn.
The Hemipterous Genus, "Deræocoris"	Geo. A. Moore.
Albinism in the Female of C. Philodice	A. F. Winn.
Hemiptera-Homoptera Taken at Peaks Is., Me., 1921	Geo. A. Moore.
Notes on the Gypsy Moth at Portland, Me.	A. F. Winn.
Report of the Seventy-fourth Meeting of the American Association for the Advancement of Science	Dr. Corcoran.
Erora Laeta Edwards	A. F. Winn.
"The Edge of the Jungle," by Beebe	Geo. A. Moore.
The White Border of Euvanessa Antiopa L.	A. F. Winn.
The Cicadellidae Taken at Peaks Is., Me., 1918-1920	Geo. A. Moore.
Some Notes on Silkworm Larvae	T. C. Baines.

The Treasurer reported a balance on hand of $165.27.

The following were elected officers:

President	A. F. Winn.
Vice-President	G. Chagnon.
Secretary-Treasurer	Geo. A. Moore.
Librarian	J. W. Buckle.
Council	Dr. Corcoran, E. H. Hall, A. C. Sheppard.

Geo. A. Moore, *Secretary.*

THE ANNUAL REPORT OF THE TORONTO BRANCH FOR 1921-1922

The Twenty-sixth Annual Meeting of the Toronto Branch was held in the Biological Building on October 18, 1922.

The report of the council showed that during the past season eight regular meetings were held at which there was an average attendance of fourteen persons. The following papers and addresses were given:

A Trip to the Rocky Mountains..Prof. E. M. Walker.
Nipigon..Dr. W. A. Clemens.
Rambling by the Grand River....................................Miss Mary Pettigrew.
Education and Instinct...Mr. C. W. Nash.
The Free Larval Chamber Gall......................................Dr. A. Cosens.
The Wasps of the Nipigon Region.................................Mr. S. Logier.
Arctic Butterflies...Prof. E. M. Walker.
Syrphidae in the Collection of the Royal Ontario Museum.............Mr. N. K. Bigelow.
An Interesting Ant from Muskoka.................................Mr. S. Logier.
The Planidium Stage of Parasitic Hymenoptera......................Miss Norma Ford.
New Records in Odonata and Orthoptera from Southern Ontario......Prof. E. M. Walker.
The Occurrence of the Strawberry Petiole Gall, *Diastrophus fragariae*, on Cultivated Plants...Dr. A. Cosens.
Insects of the Nipigon Region.....................................Mr. N. K. Bigelow.

One new member was elected, viz., Mr. E. C. Corfe.

The Treasurer's report showed a balance of $23.96.

For the season of 1922-23 the following officers were elected:

President...Mr. S. Logier.
Vice-President..Dr. E. M. Walker.
Secretary-Treasurer...Mr. A. H. Leim.
Librarian...Miss Norma Ford.
Council.............................Dr. Cosens, Dr. Clemens, Mr. Bigelow, Mr. Hall.

Norma Ford, *Secretary-Treasurer*.

REPORT OF THE BRITISH COLUMBIA BRANCH

The Twenty-first Annual Meeting was held in Victoria on Saturday, January 21, 1922.

The President, L. E. Marmont, was in the chair, and fourteen members were present.

The Secretary's Report and Financial Statement was read by Mr. R. Glendenning, Assistant Secretary, in the absence of Mr. Downes.

The business and discussions upon it occupied nearly the whole of the morning session, the subjects being:

The continuance of the Entomological Record; the Society's Cup, offered for school competition; the by-laws revised for incorporation, and the proposed increase in subscription to the parent society. The following motion was passed relative to the last subject: "That this Society thinks a subscription of $1 to the Ontario Entomological Society is sufficient, in view of the decrease in prices."

The following papers were read:

The Use of Spreaders in Poison Sprays......................A. L. Lovett.
Hemisarcoptes Malus and Its Relation to Oyster Shell Scale....E. P. Venables.
Economic Insects of the Year in the Lower Fraser Valley......R. Glendenning.
A Talk on the Chilcotin Country and Its Orthoptera..........E. R. Buckell.
(Illustrated with lantern slides.)
The Teaching of Entomology in the Public Schools...........J. W. Gibson.
Aerial Surveys as an Aid to Entomological Investigation.......E. Hearle.
The Life History of the Poplar Sawfly........................W. Downes.
The European Earwig in British Columbia....................R. C. Treherne.
Incidental Observations Regarding Certain Insects............W. H. Lyne.

The election of officers resulted as follows:

Honorary President..F. KERMODE.
President..L. E. MARMONT.
Vice-Presidents..{R. S. SHERMAN (Coast). M. H. RUHMANN (Interior).

Advisory Board—The above and E. H. BLACKMORE, W. H. ROBERTSON, J. W. GIBSON, W. H. LYNE, E. HEARLE.

Honorary Secretary-Treasurer................................R. GLENDENNING, Agassiz, B.C.

A hearty vote of thanks was accorded to Mr. W. Downes, the retiring secretary, for his valuable services.

It was decided that the next meeting would be held in Vancouver.

R. GLENDENNING,
Secretary-Treasurer.

ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA

At the Twenty-second Annual Meeting the President, L. E. Marmont, occupied the chair and fourteen members were present. The report of the Secretary-Treasurer and the Financial Statement were adopted, the latter showing a credit of balance of $73.

The discussion on general business and policy resulted in three motions being carried:

1. To proceed with Incorporation.
2. To hold a summer meeting in the Okanagan this year.
3. To discontinue the offering of a cup or other prizes for school competition for the present.

The election of officers resulted as follows:

Honorary President..F. KERMODE.
President..L. E. MARMONT.
Vice-Presidents..{R. S. SHERMAN. M. H. RUHMANN.
Honorary Secretary-Treasurer................................R. GLENDENNING, Agassiz, B.C.
Honorary Auditor..W. S. MOORE, J.P.
Advisory Board—The Officers and J. DAVIDSON, W. DOWNES, E. HEARLE, W. H. LYNE, E. P. VENABLES.

The following papers were presented:

Presidential Address..L. E. MARMONT.
Collecting in Sage Brush of S. Okanagan........................E. R. BUCKELL.
Key to Vespini..C. B. GARRETT.
Control of Oyster-shell Scale with Oil Sprays....................M. H. RUHMANN.
The Peach Twig Borer in British Columbia......................R. C. TREHERNE.
Economic Entomology in the Dry Belt of British Columbia....E. P. VENABLES.
Notes on Economic Insects in 1922............................W. DOWNES.
New Records of British Columbia Hemiptera....................W. DOWNES.
Effect of Fumigation on Certain Insects........................W. H. LYNE.
The Elm-Currant Aphis—(With lantern slides)..................R. GLENDENNING.
Forest Entomology..R. HOPPING.
Mosquito Control at Banff....................................E. HEARLE.
Relation of Botany to Entomology............................W. B. ANDERSON.

Under the microscope were shown slides of Mymaridæ by O. Whittaker.

It was decided to hold next year's meeting at Victoria, B.C.

R. GLENDENNING,
Hon. Secretary-Treasurer.

REPORTS ON INSECTS OF THE YEAR

Division No. 3 Toronto District—A. Cosens

The relatively low temperature of the past summer must have acted as a check on the insect pests, as some of them were less troublesome than usual. The Aphids were not so plentiful on the roses and spiræas, a very little spraying serving to keep the bushes immune from attack. The Cutworms were much less in evidence, even in the sandy gardens of the northern part of the City, and there also seemed to be a smaller percentage of the fruit on unsprayed trees infected by the codling-moth.

After three years in which the Monarch Butterflies were only rarely seen, they have again been very numerous this summer. They congregated in High Park during the latter part of August, but left that locality early in September.

The introduced Ground Beetle, *Carabus nemoralis*, is becoming so common that anxious inquiries have been made as to whether it is harmful or not. These large, dark-coloured beetles, so often found under leaves and other garden debris are among the most beneficial of our insects. That they are not recognized as such is owing to their habit shared by their larvæ, of hunting at night and remaining in hiding during the day. They are closely related to other of our beetle friends, the blue-winged Caterpillar Hunters, *Calosoma*.

In July my attention was drawn to Lepidopterous larvæ feeding in the flower buds of a cultivated Evening Primrose, *Oenothera biennis*. The buds were swollen, especially in the stalks, and were also much shortened. The adult moths were sent to Mr. A. Busck, Washington, and were kindly identified by him as *Mompha stellella* Busck.

Although the Strawberry Petiole Gall, *Diastrophus fragariae* Beutm. is fairly common here, I have not found it on cultivated plants until this season. The gall consists of an elongated, cylindrical swelling of the petiole. The enlargement, when dry, has a regularly beaded appearance, owing to a constriction occurring between every two larval cells. The gall-bearing leaves die early in the season.

Two other species of the gall-producing genus *Diastrophus* infect both the wild and cultivated species of their hosts. *Diastrophus turgidus* Bass. forms irregular, pithy swellings around the stems of the raspberry, and *Diastrophus cuscutæformis* O.S. deformities on the stems of bramble. The latter gall is made up of a large number of small galls clustered together. Each of these consists of a small, hard spherical mass of tissue surrounded by a rosette of minute filaments.

THE DISTRIBUTION OF THE EUROPEAN CORN BORER IN ONTARIO DURING THE SUMMER OF 1922

L. S. McLaine, Division of Foreign Pests Suppression, Department of Agriculture, Ottawa

The results of the scouting work for the European Corn Borer carried on in southern Ontario during the summer of 1922, show that although this insect has spread over quite a large area during this past season, the amount of spread is not quite as large as was the case in 1921. It is to be hoped that the latter year was an unusually favourable one for the European Corn Borer owing to the long dry summer and excessive heat.

The scouting was carried on under the same co-operative scheme which was adopted when this insect was first found in the Province, that is, the work was under the immediate supervision of the Canada Department of Agriculture, but the Ontario Department of Agriculture assisted by delegating four men and two Ford cars for the scouting work. A total of fifteen men and five Ford cars were engaged on the scouting which commenced on July 24th, and was completed September 20th. During this period one hundred and sixty-five townships were carefully examined, and of these forty-five were found to be infested by the European Corn Borer.

This insect has spread during the past year over Kent, Essex and Lambton counties, and the important corn growing area of Ontario may now be said to be infested by this pest. The infestation in the counties mentioned is, fortunately, extremely "light," and up to the present time no actual damage has resulted to the corn crop in these areas, although the same cannot be said for the "heavily" infested districts in Elgin and Middlesex counties. In 1921 a single township (Pickering) was found infested on the north shore of Lake Ontario, but the scouting carried on during the past summer adds nine additional townships to the infested area. The greater portion of these have undoubtedly been infested by the natural dispersion of the insect, but the cause of infestation in two townships (Clarke and Brighton) at least, is unknown. The infestations in these counties were very light and isolated, and may possibly have been due to importing infested corn or corn stalks.

There was very little spread of this insect in a northerly or northeasterly direction, which may be due to the fact that there is comparatively little corn grown in this area. In addition the infestation found in the northern territory in 1921 was very slight.

The area known to be infested by the European Corn Borer up to October 1922 is as follows:

The entire county of Brant, Elgin, Essex, Haldimand, Kent, Lambton, Middlesex, Norfolk, Oxford, Perth, Waterloo, and Welland; and the following townships, Culross in Bruce county, Clarke in Durham county; Trafalgar in Halton county; all but Ashfield, Wawanosh East, Wawanosh West and Howick in Huron county; all but Caistor in Lincoln county; Brighton in Northumberland county; Pickering, Whitby East and Whitby West in Ontario County; Albion, Chinguacousy, and Toronto in Peel county; Guelph in Wellington county; Ancaster, Barton, Flamborough East and Flamborough West in Wentworth county; and York and Scarborough in York county. A total of one hundred and fifty-two townships covering approximately eleven thousand seven hundred and eleven miles is represented by the above area.

The following table indicates the spread of the European Corn Borer in southern Ontario since its discovery in 1920, together with the number of townships and square miles infested up to October, 1922:

Year	Townships Infested	Square Miles Infested
1920	35	2,780
1921	65	4,910
1922*	7	524
1922	45	3,497
	152	11,711

*Seven townships were added to the quarantined area in February, 1922, in order to provide markets and straighten the quarantine line.

In February, 1922, the European Corn Borer[1] quarantine was amended. By this amendment a double quarantine was established which prevented the movement of corn on the cob, corn stalks, etc., from the heavily infested areas (Elgin and Middlesex counties), to the lighter infested districts. This was done in order to prevent shipments, heavily infested with European Corn Borer larvæ, being forwarded to newly or very lightly infested areas, and thus to start up new and possibly heavy infestations on the border of the quarantined area. The advisability of taking this step can best be illustrated by the results obtained from the making of field counts to determine the degree of infestation in different districts. Port Stanley was taken as the centre for this work, three circles were drawn with a radius of approximately eight, sixteen and thirty miles. Fields of corn were examined at frequent intervals on these circles. The degree of infestation in the inner circle showed a variation of from ten to one hundred per cent., whereas the variation in the middle circle was from seven to seventy-seven per cent., and in the outer circle from one to seven per cent. The percentages were secured by counting the number of stalks infested in lots of one hundred stalks, three counts were made in each field and the results averaged.

During the summer quarantine on the movement of corn and corn products was maintained in various ways. Warning notices were placed at all road intersections leading out of the quarantined area. Large banners were placed on the main automobile highways, warning motorists not to take corn from the infested area. Inspectors were stationed at Toronto, Hamilton, Sarnia and Windsor to watch for evasions, in the case of shipments of sweet corn on trains, boats, via express and freight, etc. At Hamilton 15,000 dozen and at Toronto 47,000 dozen ears of corn were examined and traced. When it is realized that sweet corn from southern Ontario goes as far east as Cape Breton, N.S., and as far west as the Soo and Port Arthur, the necessity of keeping a close watch on all shipments of corn to prevent the spread of the European Corn Borer can readily be understood. In addition, a close watch was kept on Fall Fairs, as it has been customary in the past to send green corn for fodder with exhibits of live stock. The general public is co-operating with the Department of Agriculture in a very gratifying manner. During the entire season it was only necessary to prosecute six individuals for evading the quarantine by shipping corn on the cob from the quarantined area.

In July, 1921, the United States Department of Agriculture placed a quarantine[2] on the province of Ontario, which prohibited the importation into the United States of certain cut flowers and vegetables unless the same were accompanied by a certificate of inspection, stating that the shipment was free from infestation by the European Corn Borer. Between February 15th and November 11th, 1922, nine hundred and sixty-five certificates were issued. The articles inspected and covered by these certificates included the following:

Oats and Rye Straw	440 tons.
Cut Flowers	2,059 dozen.
Beets with tops	26,850 dozen bunches.
Rhubarb	200 dozen bunches.
Beans (green)	3,060 bushels.
Celery	290 crates.
	100 acres inspected in the field.
Spinach	115 bushels.
Miscellaneous Plants	150.

[1] Quarantine No. 2, Domestic, (Revised), *Canada Gazette*, Vol. LV., No. 34, February 18th, 1922, page 3440.

[2] Notice of Quarantine No. 41, with Regulations (Revised), United States Department of Agriculture, July 21st, 1921.

In regard to the European Corn Borer infestation in the United States it may be said that, since its discovery in 1917, the insect has spread over a large area, and particularly in Massachusetts has been responsible for a great deal of damage not only to corn but also to other crops. When first discovered in Massachusetts, Vinal[3] reports corn as "the only valuable commercial crop seriously attacked by this pest." He mentions it as also attacking pigweed, barnyard and foxtail grass and dahlia stems. But conditions have changed, and the insect is now doing serious damage to beets, celery, beans, chrysanthemums, etc. In fact the list of host plants in the Massachusetts area is now one hundred and seventy.[4]

The following table illustrates the spread of the European Corn Borer in the United States:[5]

Year	No. Twp. Inf.	States Infested
1918........	32	Massachusetts
1919........	122	Mass., southern New Hampshire, central and western New York, and Pennsylvania (1).
1920........	105	Mass., N.H., and N.Y.
1921........	127	Mass., N.H., N.Y., Penn., Ohio and Michigan.
1922........	177	Mass., N.H., N.Y., Penn., Ohio, Mich., Maine, and Rhode Island
Total...	563	

Now that the European Corn Borer has invaded the corn growing sections of Ontario, it is to be hoped that it will continue to confine its activities to corn and not attack other plants to the same extent as it has done in Massachusetts, for up to the present time in Ontario corn has been the only plant seriously injured; but time alone will solve this question.

PLOUGHING AS A FACTOR IN THE CONTROL OF THE EUROPEAN CORN BORER IN ONTARIO

H. G. Crawford, Entomological Branch, Dominion Department of Agriculture, Ottawa

During the preliminary investigation of the European Corn Borer it was noted that the larvæ, when buried with infested corn stalks under certain conditions, subsequently came to the surface of the ground. This was inferred in 1921, and clearly demonstrated in 1922. The weakness in the 1921 data was that the larvae emerging from below ground were not recovered.

With this shortcoming in mind, the 1922 studies were carried on with a view to recovering the larvæ as they came to the surface after the corn refuse had been buried or ploughed down.

The technique of the study was simple. It consisted in burying, by hand

[3] S.C. Vinal, The European Corn Borer, Bulletin 178, Massachusetts Agriculture Experiment Station, December, 1917.

[4] E. P. Felt, The European Corn Borer, Extension Bulletin 31, New York State College of Agriculture, Revised March, 1922.

[5] W. N. Keenan, The Distribution of the European Corn Borer in Canada and the United States. Ann. Rept., Que. Soc. Prot. Plants, 1921-22. Also from Quarantine No. 43 of the United States Department of Agriculture (2nd Revision), May 1st, 1922, with amendments to November 16th, 1922.

in single or double layers, infested stalks containing an unknown number of larvæ, at a uniform depth of six inches, in variety of soils; as well as of other series of experiments by ploughing down the undisturbed crop refuse of stubble and stalk in a field from which the crop had been cut and which was known to have been severely infested. This material contained large numbers of larvæ. Traps were placed on the soil surface surrounding the material thus disposed of for the recovery of the caterpillars. About the burials, the traps were arranged to recover larvæ only on the inner side, while on the ploughed areas they were designed to capture the larvæ wandering about the surface on both the inner and the outer sides. These recovery traps were constructed to present to the wandering larvæ a suitable place in which to spin up for the winter, where the larvæ, thus taken, would be easily available for daily examination and removal. A description of this trap will appear in the *Canadian Entomologist* for 1923.

Of the studies carried on between 1920 and 1922, the series of ploughings in the fall of 1922 most directly bear upon and illustrate the conditions to be met with in the field. This paper thus takes the form of a progress report and deals with the autumn activities of the corn borer larvæ ploughed down with the crop refuse left in the field after a severely infested crop had been harvested in the regular manner, that is, to say, with the binder cutting the corn at a height of approximately six inches.

The study was carried on at Dexter, Ontario, upon the eastern edge of the area of most severe infestation in 1921. It consisted of a four acre sand loam field, planted on May 27th, 1922, to smut-nose, white and yellow Flint corn in hills 3′ 6″ square. By the end of the season it had sustained a stalk infestation of 100 per cent. and a farm loss of 40 per cent. The crop was cut early in September and the stalks stooked in the field throughout most of the fall experiments. The larvæ under study were those normally present in the stubble and pieces of broken stalk left by the crop. The ploughing was done with an ordinary single furrow walking plough and skimmer about seven inches deep in strips about fifteen feet wide running north and south, at intervals across the field, of from 35-42 feet. The ploughings began on September 28th and were carried out at weekly intervals till November 9th. The work was done very carefully, and though there was present an average of 18.29 feet of stalk and 20 stubble per 36.75 square feet of surface, the surface of the ground was exceedingly clean. It was with difficulty that 25 feet of refuse for study was found on the surface of 1/10 of an acre. In 1921 a similar field, ploughed between September 19th and 24th and seeded to wheat, had practically all the larvæ leave the material below ground and come to the surface before the freeze-up in November. Hence, in 1922, it was of particular interest to determine the reaction under the later fall conditions.

Seven ploughings were made, one upon each of the respective dates; September 28, October 6, 12, 19, 26, November 2, and November 9, each strip involving the space between a row of stooks.

On top of each ploughed strip a two-way recovery trap 8 feet square was placed, enclosing 64 square feet and supposed to surround nine hills of stubble and the associated refuse. The traps were placed in position immediately after the ploughing and were looked at daily, in the early morning until the nights became frosty, after which time the recording was done later in the day.

The narrowness of the ploughed strip resulted in that the east and west outer sides of the trap were not as favourably situated for recovering larvæ in numbers as the other two sides and hence cannot be used in attempting to determine the direction of migration. The numbers recovered on the inside of the trap can readily be looked upon as those coming out of the material ploughed down and surrounded by the trap. The observations were made early in the morning and scant opportunity was given for moving from one side of the trap to the other. The numbers recovered by the trap, together with those later recovered from the enclosed refuse from below ground, reasonably approximated the expectation upon an area of this size. Any lateral movement underground would be of little consequence and would equalize itself.

Table I summarizes the weekly recoveries from each entire trap of the series for the period under observation. Table II summarizes the records of the larvae recovered from the inside of the traps and from the material below ground within the area enclosed. The percentages are based upon the assumption that the larvæ recovered from the inside of the trap were those coming up from enclosed stalks and stubble.

TABLE I—Summary of Larvæ Recovered in Two-way Recovery Traps above a Series of Ploughings in 1922.

Date of Ploughing	Total Larvæ Recovered in Traps by Weeks.								Total
	Sept. 28 to Oct. 5	Oct. 6 to Oct. 12	Oct. 13 to Oct. 19	Oct. 20 to Oct. 26	Oct. 27 to Nov. 2	Nov. 3 to Nov. 9	Nov. 10 to Nov. 16	Nov. 17 to Nov. 21	
Sept. 28	39	19	3	3	1	4	0	2	71
Oct. 6	..	23	12	6	7	3	2	2	55
Oct. 12	..	..	49	39	9	24	3	2	126
Oct. 19	..	..	..	18	17	16	1	4	56
Oct. 26	..	..	..	..	4	10	1	3	18
Nov. 2	..	..	..	..	..	2	1	2	5
Nov. 9	..	..	..	..	..	..	1	4	5
	Total larvæ involved								336

TABLE II—Summary of Larvæ Recovered *inside* Two-way Recovery Traps above a Series of Ploughings in 1922. The recoveries are from the trap itself and from the material below the ground, examined November 20th, 1922.

Total Number of Larvæ Recovered Inside Traps.				
Above Ground		Below Ground		Total Recovered
No.	Per cent.	No.	Per cent.	No.
35	85.36	6	14.63	41
27	61.36	17	38.63	44
52	67.53	25	32.46	77
23	29.87	54	70.12	77
11	12.5	77	87.5	88
3	10.0	27	90.0	30
4	12.5	28	87.5	32

A study of the totals, recovered from inside the traps, indicates a progressive increase of from 41 to 88 larvæ from the ploughings up to October 26, thereafter a marked decrease in totals. This is due, in a large measure at least, to the fluctuating larvæ population and to the amount of refuse in different parts of the field. It need not seriously interfere with the general value of the percentages.

The tables, as a whole, indicate clearly some interesting general correlations. The first and most important is the fact, as shown in Table I, that a large proportion of the larvæ come to the surface when ploughing is done early in the season. Even when ploughed as late as September 28, 85.36 per cent. of the larvæ left the buried material. The later ploughings were markedly less effective in this respect, the operation but a week later causing but 61.36 per cent. to come up. Oddly enough the experiment of October 12, two weeks later, was somewhat more effective than that of October 6, 67.53 per cent. of the larvæ being recovered at the surface. With the four later ploughings the proportion attaining the surface decreased still further, so that for the study started on October 19, 29.87 per cent., from that of October 26, 12.5 per cent., from that of November 2, but 10 per cent., and from November 9, 12.5 per cent. were recovered. The last two studies dealt with relatively small numbers of larvæ, and the value of the figures should be discounted somewhat.

The second important point, as shown in Table I, is that the first week following ploughing is the most important in respect to the numbers of larvæ coming to the surface. This is particularly true in the early season when the soil is warm. As the season advances a progressingly decreasing proportion moves in the first week and the proportion coming up on the second and third week increases. These late moving larvæ in an early fall would be very apt to be retained underground by the rapid cooling of the soil.

The reaction of the larvæ below ground in the spring was studied somewhat sketchily in the same way in 1922. The larvæ were recovered at the surface in traps in fairly large numbers both from material ploughed down in the spring of 1922 and also from a field ploughed late in the fall of 1921.

The general reaction of the larvæ was very similar to that in the fall, though the activity following immediately after turning down was not at all characteristic of the spring conditions. Warm rains on the other hand in early May were followed by very prompt appearance at the surface of relatively large numbers of larvæ.

The larvæ which were below ground all winter came through surprisingly successfully. A characteristic count demonstrated a mortality of 11.1 per cent. in stalks and 26.8 per cent. in stubble below ground, while the material on the surface of the same field suffered comparatively lightly, the death rate in stalks being 5.76 per cent. and that in stubble lying on the surface but 4.65 per cent. The spring studies were not prosecuted with the thoroughness of the fall operations, and it will not be till the summer of 1923 that a detailed knowledge of the reaction at this season will be available.

That the larvæ in Ontario in an essentially one-brooded area actually come to the surface in important proportions when ploughed down in the fall, and that this proportion increases with earliness of ploughing, has been clearly demonstrated. What, however, becomes of these larvæ after being brought to the surface is not at all clear. For the most part they simply disappear, all trace of the bulk of them so far being lost.

The subsequent history of these larvæ is a most important matter and has been given a great deal of study both by the Federal and Provincial investigators, with as yet very little definite result. This study has shown that beetles, ants and even birds in the fall, account for relatively few, as none of these predators are particularly active. The missing larvæ could not be found among the clods of soil on the surface of the ploughed area, they did not again dig into the soil having once come to the surface, nor could they even be demonstrated in the grass about the margins of heavily infested fields after ploughing, either in 1921 or 1922.

A general survey of some other experimental results bearing upon the probable behaviour of the larvæ when moving from a given experimental concentration, indicates that they wander for short distances and establish themselves rather promptly in available suitable material in the immediate vicinity.

Thus in the dead and hollow weeds, both standing and on the ground, about a series of burials in 1921, 155 larvæ were recovered, which had emerged from buried material and were found almost entirely within six feet of the source of supply. In another experiment in which 1,000 larvæ were buried in stalks in the centre of a weed patch in 1922, all the larvæ recovered were within ten feet of the edge of the burial. Where the material in the surroundings made it possible, the larvæ established a sharp density of population gradient. This was well illustrated by a study on a two-foot strip from the margin of this burial at a point where there happened to be a continuous supply of refuse suitable for accommodating borers. Here a count in areas two feet wide and one foot deep, extending westward in a straight line from the edge of the burial for ten feet, gave a count per area of 11, 4, 2, 1, 0, 0, 0, 0, 0, 0, caterpillars.

There is no decided preference evidenced for movement in any given direction, at least as shown by the recoveries in the traps. There was a somewhat greater number taken on the south side when the larvæ within the cage only were considered. However, the total number moving north or south, as indicated by the total count both inside and out, is remarkably evenly divided.

The following table indicates the distribution of the larvæ recovered on the several sides of the traps throughout the season:

TABLE III.—Summary of the Direction of Travel of the Larvæ Recovered Above a Series of Ploughings in 1922.

Side of Trap	Inside of Trap		Outside of Trap		Total Going in Given Direction	
	No.	%	No.	%	No.	%
North	33	22.2	49	38.2	112	51.6
South	56	37.3	79	61.7	105	48.3
East	27	18.0	17*	....	64*	....
West	34	22.6	37*	....	51*	....

*East and West numbers from outside of the trap cannot be used on account of the narrowness of the strips ploughed.

With these general behavior studies in mind it is most surprising that it has not been possible to find any indication of migration from ploughed surfaces to adjacent refuse and stubble-littered, unploughed parts of the same field.

The expected evidence of this migration would be increased larval count in the refuse surrounding the ploughed area, a gradient in density of larval population radiating from the centre of migration and an increment in the number of larvæ found spun up in the leaves associated with refuse about this area. These likewise, in the later season, would be expected to be present in somewhat of a gradient. To date none of these relations of the missing larvæ present in numbers up to the rate of 30,000 per acre have been established in the areas adjacent to ploughings from which the larvæ have disappeared.

A small proportion of the larvæ do find their way into the material left upon the surface of the ploughed ground. These in a given experiment raised the count of this material from an expectation of 0.8 larvæ per foot to 5.92

per foot by the end of the season. But as there was little of this refuse on the surface but a small proportion of the larvæ were thus accounted for. Further, in connection with this experiment in which the ploughing had been done October 12, and the count made November 20, the refuse in the eastern dead furrow was found to have had its average population per foot of stalk and associated leaves raised to but 1.33 larvæ and that of the western dead furrow to 1.107 larvæ, both inexplicably small. This count is more to be wondered at in that practically all larvæ leaving the ploughed land must have passed through the refuse lying in these dead furrows. It is estimated that on this ploughed strip 3,748 larvæ came to the surface. Did they migrate equally east and west there were sufficient to raise the larval content of the refuse in the first 3.5 foot strip of unploughed area by 3.3 larvæ per foot. By actual count of a 12.29 foot section of this strip the population was found to be but one larvæ per foot on the eastern edge and 1.769 per foot on the western edge. A further study in the unploughed areas between the experiments shows no clear indication of any general migration.

Further studies will, of course, be made, using uninfested stalks in the intervals between the ploughings. This was not done in these experiments owing to the large number of larvæ involved and their apparent tendency to enter the first suitable hiding place encountered.

The whole matter of the final resting place of the larvæ is still in the realm of conjecture and the work will have to be repeated, using uninfested cornstalks to finally settle how serious is the danger of wholesale migration of the larvæ to wintering or pupating quarters from land ploughed in spring or fall.

FURTHER NOTES ON THE LIFE HISTORY OF THE EUROPEAN CORN BORER IN ONTARIO

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The winter of 1921 had very little effect upon the larvæ of the European Corn Borer and only between 4 per cent. and 5 per cent. were killed by all causes. However, this was more than in the winter of 1920, when a fraction less than 3 per cent. was killed. In addition to winter killing, the numbers of larvæ in some fields of corn stubble were reduced by woodpeckers which in one field were found to have taken 60 per cent. of the larvæ (H. G. Crawford's notes). The Downey woodpecker is the chief bird concerned in this reduction during the winter, although the Hairy woodpecker may be seen attacking cornstalks in the fall. Birds are too uncertain an element to be depended upon to have any material effect on the numbers of borers in the country.

In spring, as soon as the weather warmed up, it was found that small greyish red ants were taking many borers out of experimental cages. These ants were kindly indentified by Dr. Wheeler of Harvard, as *Lasius niger*, Linn, var. *americanus*, the common garden ant, and we found that they stung any borers they came across and dragged them down their holes. As high as 62 per cent. of borers in their shelters of corrugated paper placed in covered tin cans, were found to have been killed by these ants in a single night, and were being bitten to pieces and hauled out of the can. In the field also, it was found that the ants entered the tunnels in corn stalks and killed and removed the borers. However, when the borers were completely covered up in their silken cases, the ants generally left them alone, although it was found that even these were removed when all the freely exposed larvæ had been taken. In 1921 these same ants had been observed to be eating the borers in cages, and from one series alone had taken 1,200 borers, but no observations were made at the time on their methods of attack. It is possible that these ants may have some slight effect in springtime, in reducing the numbers of borers in any field where they might occur. The Tachinid fly, *Exorista nigripalpis* Towns, which was found in 1921 to be a parasite on from four to eight per cent. of larvæ in one field, was practically absent in 1922, and a very small and practically negligible number of larvæ were destroyed by it.

It will be seen that we have found very few natural enemies of the borer in Canada so far, and that the attacks of these parasites have very little effect in reducing the number of larvæ. Consequently it was found this spring that there were enough borers in the areas under observation to practically ensure a heavy infestation of the 1922 crop.

Pupation

Pupation began this year about two days later than last year, but the pupal periods showed certain differences, as tabulated below:

	1921	1922
1. Length of pupal period, in days:		
Males only, average	12	15.72
Females only, average	10.19	14.63
Both sexes, average	11.7	15.29
2. Shortest pupal period, either sex	8	11
Longest pupal period, males only	16	21
3. Season of shortest pupal periods	June 24 to July 14	July 7 to 12
Average temperature for these periods	86°-87° F.	75° F.
4. Relative numbers of each sex.—		
Males only	56.38%	51.08%
Females only	43.62%	48.92%

Rates of Pupation under Various Conditions

Experiments conducted over both years, showed that the rates of pupation of the corn borer larvæ varied under different conditions.

1. *Extreme Dryness.* In the autumn of 1921, thirty-nine larvæ were placed in a corrugated roll of paper in which they had spun up, in a dry can with a ventilated lid, and were kept indoors in a dry place all winter. They were examined from time to time all during the summer of 1922. By August 17 twenty-nine had dried up; by September 30, one only showed very slight movement and was very shrivelled. The rest were dead.

2. *Exposed to Outside Conditions.* As opposed to the experiment above, nearly one hundred larvæ were placed in a can with a perforated lid in precisely the same way as above, but the can was left outside on a window sill all winter, exposed to all conditions of weather, By the end of the emergence season in 1922, less than a dozen larvæ had failed to come through as moths and had died.

3. *In Piled Stalks.* In the case of stalks which had been in stooks in the field all winter, as opposed to stalks which had been lying loose on the ground during the same period, it was found that the moths emerged sooner from the loose-lying and damper stalks, than from the former drier material.

4. *Debris Gathered from the Field.* From debris and stubble picked in early spring from a cornfield and heaped in a pile under the shade of an apple tree,

the moths emerged at almost the exact rate at which they emerged from identical material left lying in the field, which was later sown to oats.

General pupation in the field started about June 7th and reached its maximum about June 25th, although the first pupa found occurred on May 31st. Last year the first pupa was found on June 2nd. The daily count in 1922 showed that a high point of pupation was reached on June 16, which was the date on which the first moths were found in the field in 1921. Although pupation was fairly uniform all over the oat field kept under observation, it was found that the emergence of moths from the lowest and dampest areas was considerably delayed. In fact in this low, damp north corner of the field, many borers died after pupating and the moths did not emerge. This was the only instance found where larvæ that had pupated failed to come through to moths unless the pupæ were eaten by ants.

Emergence of Adults. The emergence of adults started this year about June 26 in the oat field and by July 12, 80 per cent. of the moths had emerged from the corn debris and stubble in this field.

	1921	1922
Period of Max. Emergence............	June 26–July 1	July 2–18
Zenith of Emergence..................	June 28	July 8–12

This later date July 12, 1922, for emergence in the field, coincided with the result obtained from material kept in cages in the open, exposed to the elements.

Oviposition Records. There was a slight difference this year, compared to last, in the number of eggs laid per moth and in the fertility of the eggs. This is summed up by the following figures:

	1921	1922
Pre-oviposition period................	3-9ds. Av. 4 ds.	1½-8 ds. Av. 3.5 ds.
Egg-laying capacity per moth..........	95-988. Av. 442.	37 to 1,210. Av. 642.07.
Longevity of females..................	10-31 ds. Av. 15.4 ds.	7-28 ds. Av. 17.07.
Fertility of eggs......................	100%.	99%.
Mortality of embryos.................	nil.	About 1% just before time to hatch.

Habits of Moths. This year's observations confirmed those of last year, when it was found that most moths emerged from the pupæ between 5 a.m. and 9 a.m. In some cases they emerged before 5 a.m., but generally they did not begin to appear above the top of the stalks in the cages until that time. The process of emergence was watched in several cases between 7 and 9 a.m.; it occupied only a few minutes and in less than half-an-hour they were able to fly. Occasionally moths come out later in the day, and but rarely in the afternoons or evenings. One would expect that nocturnal insects such as these are, would emerge at dusk, but such seems not to be the case in this instance.

If the moths are confined in wire cages exposed to wind, they must have water to drink soon after emerging or else they die. We have reared them better on water alone than on sugar solutions. Moths have been kept alive for from two to four days without food in tightly closed cans, but in open cages they must have food or else they die. As soon as they take flight after emergence, they seek cover on the under side of leaves and will remain there all day unless disturbed, or unless the sun should happen to strike them, when they will move into shade.

It was found that in the field they do not begin to move freely until about 9 p.m., although a few will commence to move just after dusk. In cages they would commence to flutter between 8.30 and 9 p.m. every night.

The few records kept in 1922 regarding the flight habits confirmed those of 1921 and nothing new was found out. The moths fly into a slight wind and with a high wind, although they will always try to battle against it at first. When there is no wind, they are liable to soar up above the tops of the tallest trees near-by and may then go in any direction.

When engaged in egg laying at night, the moths hover about three feet above ground, and take no notice of bright light. In 1921, a 300 candle power lantern was used to try and attract them but only a few males were taken, and those arrived at great speed.

Having tried in 1921 to attract moths at night with brilliant lights of several colours, the Strickland liquid poison bait of quassia, arsenic and molasses was tried this season, with exactly the same negative results that attended the light experiments. An effort was made on several occasions to attract male moths to females confined in a trap of the lobster pot type, into which males could enter but from which the females could not escape, but without any success.

During the day both sexes rest in the thickest clumps of corn, and in instances where they occur in oat fields sown on the previous year's corn stubble, they may be found most easily in the tallest, darkest oats. At the maximum period of their emergence, they may be found generally distributed over any field of evenly growing corn except in the first few yards around the edges, where they are seldom found.

Egg-laying. It was found from observations on moths kept in square paper cages in the laboratory, that eggs are laid rather late at night chiefly on the sides of the cases; in a few instances only, were eggs laid before 11 o'clock. Moths oviposit freely on corn or other leaves inserted into the cages, but they seem to lay just as freely on the paper. The number of eggs laid per night was about the same in 1922 as in 1921, in masses of from 1, 3, 8 or 12, to about 60 eggs per mass. In the field the average egg mass contains between 20 to 30 eggs.

As far as our field counts show, moths seem to lay equally freely on flint corn and on dent. The difference that exists between the respective larval infestations per stalk of these varieties, must be attributed to some other factor than preference during oviposition. In the earlier part of the season the finding of eggs coincides with the finding of moths, and the latter occur most commonly on the tallest corn or thickest clumps. In a rolling field, the tops of the knolls are laid on first, even though the corn in the hollows may be nearly twice as tall as that on the knolls. Later in the season, however, eggs may be found equally all over a field. Curious exceptions to this have been found. In one case the eggs were laid in one end of a field first, then in the opposite end and finally in the centre. The larval infestation in September in this field, was greatest in the centre. In another instance eggs occurred first in a field in the side farthest from the source of infestation, and then equally all over. In 1921, in one field, the infestation remained throughout the season on the south side of the field only, close to a wood; the rest of the field was only very slightly infested.

Moths lay at all heights from the ground, from 1½ inches up to 4 feet. However, if tall and short stems occur side by side, they lay on the tall stems first, although they may lay very low down on them. The under side of the crown of leaves is the favorite laying place, though this year (1922) eggs were frequently found on the upper surface of the leaves. These eggs failed to hatch, although in some of them the embryos nearly reached maturity before being killed by the sun.

HABITS OF YOUNG LARVÆ. As stated previously, practically 100 per cent. of all eggs kept under observation during both seasons, hatched. The only instances of complete sterility occurred where males were not introduced into the cages containing females, for periods of six days after the emergence of the females, and though the latter laid freely, none of the eggs hatched.

The emergence of all the young larvæ from any given hatch of eggs, occurs at practically the same time, and usually within 20 minutes all eggs have hatched. The typical action of young larvæ on hatching, is to travel in all directions and to rapidly make for the shelter of rolled up leaves, or to remain quiescent for varying lengths of time on the under side of the leaves on which they were hatched. Observations at intervals of a few minutes, extended over three hours in one case and over two hours in each of three other cases, showed that larvæ for some unknown reason sometimes leave the under side of the leaf where they have taken shelter and will come into the sunlight on top of the leaf.

Soon after being hatched, and during their wanderings over the leaves, many begin to die, some of them just curling up and in a few seconds, dropping off the leaf; others are blown off by the wind and die on the ground; some reach a leaf below and enter the stem at its axil, and others find shelter alongside the mid-rib of the leaf and stay there passively for hours. In three hours after hatching, only nine larvæ out of 39 that were seen to hatch from a mass of eggs, could be found on a corn plant under observation; in six hours after hatching, only four larvæ could be found. This result was obtained proportionately in four cases and only about one-tenth of all larvæ that hatched survived the day and passed into the night. The plants on which these records were made had no tassels. When larvæ hatch in the immediate neighbourhood of young tassels into which they can readily work their way and find shelter soon after hatching, it is probable that a larger majority of them will survive the first 24 hours. This seemed to be the case in two instances where seven and nine larvæ, respectively, all of the same instar, were dissected out of two tassels. First instar larvæ readily eat their way into the individual flowers of a tassel; it is usually not until the third instar that they tunnel into the stem of the tassel and cause it to fall over.

Although the young larvæ find their way into some sort of shelter soon after they hatch and do no feeding on the upper surface of the leaf at this time, they have been seen, even half an hour after emergence, to have eaten very shallow areas out of the under surface of the leaf. The work could not be detected by the naked eye, but required a hand lens to show it up. However, by next morning, they had apparently emerged from the shelters of the day before, to eat small easily seen areas out of the top and under sides of the nearest leaves. In some cases these external feeding areas perforated the leaf like small shot-holes, being done the first night and to a lesser extent the following night, but not afterwards. Many observations showed that this injury is done the first part of the season only, when the corn leaves are young and tender and the corn plant not over three or four feet high; thus later in the season one may find larvæ of early instars established in the tassels and upper stem of tall corn plants, and the only visible injury to the leaves is that which was done in the early part of the season to the lowest leaves. Poisoned spray or dust applied at this time may help to control many of the early borers, especially on sweet corn plots. Occasionally larvæ of instars later than the second, may be found apparently basking in the sun on the surface of leaves or on grass outside burrows. This unusual habit of otherwise nocturnal insects, seems to be the only loophole in their behaviour which leaves them open to attack by our common diurnal hymenopterous or dipterous parasites. It also leaves them exposed to predaceous insects such as Chrysopid larvæ and adults of the pink, 12-spotted ladybird beetle (*Megilla maculata*). The squeezing of a stem or breaking of it at the point where a borer is working, will cause the latter to hurriedly crawl out and to lower itself down by a silken thread. The action of wind may sometimes do this.

Except on the occasions mentioned, borers remain feeding in the stems they originally entered, until they reach the fifth and sometimes the sixth instar, and then they develop a sort of wanderlust which causes them to leave the stems where they have been feeding, and to migrate to near-by hills of corn or to weeds growing among or alongside the corn. Inspection by night of badly infested corn at the fifth or early sixth instar periods of the larvæ, reveals many of them wandering around. By this migration, and subsequent eating of new holes in cornstalks, the damage in a field is materially increased towards harvest time. The new entrance holes are generally low down and frequently occur among the adventitious or prop roots; from this position, the borers often work down in late autumn right into the tap roots, especially in the case of flint corn.

By the end of July, or at any rate by the middle of August, by which time the borers are full grown, this migration ceases, as was proved several times in experiments by placing absolutely untouched hills of corn alongside heavily infested hills, and then cutting up both series at various times to determine the lateness of migration. Each test was guarded by recovery traps and tanglefoot barriers. Just how far these migrating larvæ will wander was not determined, but it is probably not beyond the range of the nearest corn plants.

This migration, which ceases by the middle of August, of mature or nearly mature larvæ, cannot account for the fact that the larval population of a field diminishes more and more the later the season advances. For instance: In 1922, in a small patch of sweet corn of some 1,000 stalks, sown May 13th, there was by the end of July a carefully estimated and re-checked average infestation of 4.6 larvæ per stalk throughout the plot. By the middle of August, two weeks later, this infestation had dropped to a fraction over three larvæ per stalk through the plot, and had not increased in corn growing near-by nor in the few weeds among the corn. By the middle of September the infestation was reduced to just two larvæ per stalk.

This same peculiarity was noted in 1921 in flint corn, which at time of cutting and stooking contained approximately four larvæ per stalk, but only just over one larvæ per stalk in one month's time. Also in stalks that were stooked outside the laboratory in the first week of October, 1921, the larval population was greatly reduced when counts were made in spring, 1922, and no trace of the larvæ could be found in grass or weed stems or pieces of stalk around the pile.

A secondary movement of larvæ is noticeable under certain conditions of stooking and storing cornstalks. Thus borers will leave the inner stalks of a stook within a week of the stooking and will migrate to the outer stalks. The rapidity of this movement depends upon the dryness of the stalks and upon the closeness of piling; the drier the stalks the less the migration, and the closer the stalks are piled the more rapid the migration. Also in thoroughly dry stalks piled in a mow in a barn the larvæ will remain in their burrows without migration. This was the case in one instance even where the stalks were covered later by a layer of hay. Such larvæ in very dry material have been found to pupate very slowly throughout the season, and to emerge as moths as late as the first week in September.

In closely piled corn that is left outside all winter, whether it is stooked tightly or shredded and then piled closely, the larvæ leave the dense damp centre of the mass and will be found entirely in the outer six to eight inches of the pile.

Varietal Infestation of Corn. As far as we have determined at present, there does not seem to be any variety more subject than another to the deposition of eggs by Corn Borer moths. During the egg-laying season, comparative counts were kept on various plots of flint, dent and sweet corn and the larval population of these plots was determined at time of harvest. It was found that the results were somewhat contradictory, but on the average in the first part of oviposition period the sweet corn was free from eggs while the taller flint and dent varieties were freely laid on. By harvest time, the sweet corn was generally more heavily infested than the other varieties. In some cases, however, the flint corn did have more eggs on it than the dent and the larval population was higher. But on an average through the season eggs were laid equally on all varieties.

Artificial Infestation of Plants other than Corn. The following plants other than corn, were used in garden plots to see if moths would oviposit on them under natural conditions and if larvæ could mature in them. These plants were grown right amongst the corn plots, under identical conditions.

Plants used: Zinnia, snap dragon, salvia, mignonette, gladiolus, potato, tomato, cosmos, bachelor's button, barnyard grass, green fox-tail, yellow fox-tail, pigweed, ragweed, lambs quarters. Also two other plants with thick soft stems, commonly grown in gardens, whose names were not recorded.

On none of these plants did moths lay eggs and to none of them did larvæ migrate from infested corn alongside. Therefore they were all covered with wire cages in which moths were liberated in numbers from three pairs (male and female) to 16 pairs at a time. With the exception of cosmos, tomato and tobacco, the caged moths laid eggs freely on all plants, especially on the snap-dragon, pigweed, lambs quarters, dahlia and the grasses, and the larvæ flourished and reached maturity, although most of them died in the first instance, as on corn.

This failure on the part of larvæ to arrive at maturity, was especially noticeable on weeds such as pigweed (an apparently ideal host as far as softness and thickness of stem is concerned) and lambs quarters, where out of a total of 224 eggs on one large plant of pigweed five larvæ reached maturity and out of 744 eggs laid on one plant of lambs quarters no larvæ reached maturity. The cosmos became infested by larvæ which hatched from eggs laid on the sides of the cage, but the potato, tobacco and tomato plants were untouched to the end.

Field Infestations of Plants other than Corn. Of plants growing among corn or immediately contiguous to cornfields, the following were found at different times in 1921 and 1922, to be infested by corn borer larvæ: White sweet clover (only one very slight infestation) golden rod, mullein, Canada thistle, wild sunflower, blueweed, wild raspberry, burdock, yarrow, ground cherry, lady's thumb, pigweed (favorite host) ragweed and tumbling pigweed. The borer was also found in apples on the ground and tomato fruit. It is practically certain that all the above infestations were from migrating larvæ only, never by larvæ from direct oviposition. It was never found in tomato, tobacco or potato stems, in red clover, beans, pumpkins and garden sunflowers, although these were grown right amongst infested corn.

In 1922, a heavy infestation was found in oats growing in a field which had contained very heavily infested corn in 1921. This oat infestation was suspected in 1921 as being probable but it was not confirmed until this year, when it was found that larvæ of all instars up to the fifth, were abundant in the oats, feeding right inside the stems or between the stems and the leaf sheaths, so as to rob the oat heads of proper nourishment and to kill and bleach them. The estimated loss of grain from these bleached and unfilled heads (in this one field only) amounted to half bushel per acre. At the time of oat harvest, no larvæ were over the fifth instar, and when the oats were cut all larvæ died within two days after cutting. In some cases it was found that the more mature larvæ had left the cut oat stems and had attempted to enter weed stems in the field, but even these all perished within three days. Thus what threatened at first to be a serious situation ultimately amounted to nothing. Within 300 yards of this oat field which was so heavily infested, was a large early-planted field of dent corn which was lightly infested, at harvest, even for dent. Thus the infestation of oats promises to be a fortunate occurrence as far as corn is concerned, because if moths will oviposit freely on oats, they will be content to remain there and neighboring cornfields will escape what would otherwise be an added infestation.

Also in 1922, a slight infestation was found on sugar mangels growing alongside a fairly heavily infested cornfield. With the exception of three caterpillars found in one mangel, which all circumstances pointed to having been hatched from eggs laid on that mangel—all the larvæ found in this field had migrated from the corn alongside. The total damage to the mangels was negligible. Experiments conducted all through September, of trying to establish mature borers on large mangels, amounted to nothing, although as many as 40 larvæ were caged over a single tuber. The borers did not seem sufficiently attracted to induce them to make more than temporary tunnels in the leaves, which they vacated shortly afterwards.

In reply to a vote of thanks moved by Mr. GIBSON and Prof. CAESAR, and carried, the following was said:

MR. CRAWFORD: The expression of appreciation of the work and results obtained in the Corn Borer investigations were most encouraging to all those directly engaged in the work. That for myself, I am glad of this opportunity to publicly thank the Federal Ministry of Agriculture and Dr. Grisdale, Deputy Minister of Agriculture, for their support of the work, Mr. Gibson, Dominion Entomologist, Mr. Treherne, Chief, Division Field Crop and Garden Insects, for their never ceasing encouragement, support and directive suggestions, and Mr. L. S. McLaine, Chief Division Foreign Pests Suppression, for support, suggestion, and loan of assistants. In particular, I wish to mention that in a large measure the quality and quantity of work has been due to the tireless application and effort of my two assistants, Mr. Painter and Mr. Oliver. Further, the professional value of the remarkably close inter-relation between the Federal and Provincial Investigations cannot be too greatly stressed. Nor can the contribution to the study arising out of the constant discussion, comparison of notes and inspiration due to our intimate association, personal and professional, with Prof. Caesar and Mr. Spencer, be too highly evaluated.

MR. SPENCER: I greatly appreciate what Mr. Gibson and Mr. Caesar have said. The work on the borer has been largely inspired by them. Mr. Caesar especially has helped us in every way and at all times; I cannot thank him sufficiently. Mr. Crawford has helped me tremendously—he knows that I appreciate it. Continuous co-operation with him has alone made possible what results we have obtained. I would like to thank my assistants, Mr. Twinn in 1921, and Messrs. Brink and Wishart, this year, for their never-failing loyalty, hard work and keenness, sometimes to all hours of the night. The farmers in the neighbourhood, too, helped us in every way; we all owe them thanks.

THE ECONOMIC IMPORTANCE OF INSECTS AS FOOD FOR THE COMMON WHITEFISH

Wilbert A. Clemens, Department of Biology,
University of Toronto

During the summer of 1921 a field party from the Ontario Fisheries Research Laboratory of the University of Toronto commenced an intensive study of fishery problems in Lake Nipigon. One phase of the investigations has had to do with the food supply for fish in the lake and the percentages of the various food organisms in the diets of the fish as revealed by the examination of stomach contents. Special attention has been given to the common whitefish, *Coregonus clupeaformis*, as it is the most important of the commercial fishes taken in Lake Nipigon.

The writer desires to express his appreciation of the assistance given by Messrs Dymond, Bigelow, Adamstone, and Harkness, who as members of the party assisted in various ways in the work.

During the first season the stomachs of 209 whitefish were examined. The results show that this fish is almost entirely a bottom feeder and its diet consists chiefly of Chironomid larvæ and pupæ, snails and small clams, Hoy's fresh water shrimp, *Pontoporeia hoyi*, mayfly nymphs, caddis larvæ, corixids, water mites, Ostracods, terrestrial insects and occasionally small fish such as ciscoes, sticklebacks and miller's thumbs. The following examples will illustrate*:

Whitefish size	Shrimps (*Pontoporeia*)	Caddis larvæ	*Chironomidæ*		Snails	Miscellaneous
			larvæ	pupæ		
14.0 cm.	..	..	80%	10	6	4
14.5	20	..	30	5	25	20
22.0	..	..	2	85	..	13
28.0	30	..	70	..	..	..
35.0	..	2	3	..	15	75 (fish) 5 (misc.)
35.0	..	..	..	..	..	70 (terrestrial insects) 30 (misc.)
37.0	50	..	40	..	10	..
38.0	25	..	25	3	40	7 (Mayfly Nymphs, etc.)
40.0	..	..	..	3	2	95 (terrestrial insects)
45.0	..	...	..	..	99	1 (terrestrial insects)

It is evident that the insects form very important items in the food of the whitefish. Calculations for the 209 fish examined show that they constitute 53 per cent. of the food—roughly 50 per cent. Chironomids, particularly the larvæ, are by far the most important of the insects and constitute 35 percent. of the food of the whitefish, while mayfly nymphs form approximately 6 per cent., terrestrial insects 6 per cent. and miscellaneous insects such as caddis larvæ, corixids etc. 3 per cent.

These percentages are particularly significant when the catch of whitefish is considered. In 1919 (the latest available statistics) 1,620,970 lbs. of white-fish were taken from Lake Nipigon. At the wholesale price to the fisherman of 10c per lb., the value of this catch was $162,097. It appears to be a reasonable

*The stomach contents of 65 whitefish are described in detail in a paper now in press, University of Toronto Studies, Publications Ont. Fish. Research Laboratory, by Messrs. Clemens, Dymond, Bigelow, Adamstone and Harkness.

deduction, therefore, that the insects of Lake Nipigon as food for whitefish were worth half this amount, namely $81,000. The Chironomids would contribute $56,000.

If the whitefish in all lakes feed upon insects in like proportions, then we have these figures for the Province of Ontario in 1919:

Total catch whitefish	6,625,304 lbs.
Value at 10c. per lb	$662,530.00
Value of the insects as food	$330,000.00
Value of the Chironomids	$230,000.00

These calculations appear to be reasonable and are not essentially different from those used by stockmen. Cattle are fed certain feeds in definite ratios and later are sold at a certain amount per pound. The feeds have been worth to the stockman the amount which he obtains from his sale of steers. There is this difference between the two cases, however, in that the food crop for the fish has cost the fisherman absolutely nothing, whereas the food-stuffs, for the cattle have cost the stockman a considerable sum. Some day when aquiculture has advanced along lines similar to those of agriculture the fisherman may pay more attention to his crops of food-stuffs.

Do the results of our investigation of the occurrence of the food animals on the bottom of Lake Nipigon correspond with the results of the examination of the stomach contents of the whitefish? During the summer of 1921, Messrs Adamstone and Harkness operated a small Ekman dredge and obtained bottom samples in various parts of the lake in depths from two to 275 feet.* The area of bottom brought up was 81 square inches, and the animals in this area were sifted out, classified and counted. They found the following average number of animals per square yard, irrespective of depth:

Chironomidæ	Shrimps *Pontoporeia*	Snails, etc.	Mayflies
256	144	128	16

At this rate there would be for the whole lake in the neighbourhood of 1200 billion Chironomid larvæ, which on the basis of calculations used by Richardson† for the Illinois river, would amount to about 100 million pounds or about 100 pounds per acre of bottom. Further, using the ratio of five pounds of food to one pound of fish as developed by certain European investigators, whose publications the writer has not seen but which are referred to by Richardson (loc. cit.), it is evident that the Chironomids alone occur in numbers sufficient to support a very large fish population.

The bottom inhabiting insects form one of the most important sources of food supply for bottom-feeding fish such as the whitefish. Here is a crop which grows without cost of money, time or labour on the part of man and of which very few people, very few fisherman especially, have any appreciation. In our investigation we are trying to get at all the facts concerning this crop, especially the factors which have to do with its development, and some day we may be able to develop methods for exerting some measure of control. It is apparent from the data already at hand, that the crop should be very carefully protected from destructive industrial wastes and from any smothering materials.

*For complete account see forthcoming report by Messrs. Adamstone and Harkness, in University of Toronto Studies, Publications Ont. Fish Research Laboratory.

†Richardson, Robert E. The Small Bottom and Shore Fauna of the Middle and Lower Illinois River and its connecting Lakes, Chillicothe to Grafton, its Valuation, its Sources of Food Supply and its Relation to the Fishery. Bull. Nat. Hist. Survey Illinois, vol. XIII, article XV.

PROVANCHER, THE CANADIAN LINNÆUS—HIS LIFE AND WORKS

George Maheux, Provincial Entomologist, Quebec

During the last five years, Canadian naturalists and scientists have heard more about Provancher than during the previous quarter of century; scientific societies, reviews of all kinds and even the daily papers, have in succession paid warm tribute of admiration to the high value of the late Abbé Provancher as a priest, citizen and naturalist.

One day, in August 1918, a large group of friends, admirers and disciples gathered in the Provincial Museum at Quebec. The object of the meeting was the celebration of the 25th anniversay of the death of Provancher, and the unveiling of a tablet presented by the Quebec Society for the Protection of Plants and bearing the following inscription:

A LA MEMOIRE DE
PROVANCHER
NATURALISTE ET ENTOMOLOGISTE
1820-1892.

A few months before, in the church of Cap Rouge, where the remains of Provancher have been piously kept, Canon Huard erected another memorial with the financial aid of the Ontario Entomological Society and numerous other institutions. Nevertheless, all the publicity accorded to the name of Provancher fails to give anything like a complete idea of his career; the entomologist regards him as an entomologist, the botanist as a botanist, while the man was really the Linnæus of Canada; that is to say a true naturalist in the broadest sense of the word, having been interested in and written competently on the various kingdoms of Nature. The complete list of his works reveals a great similitude with Linne's Systema Naturæ, at least, as to the subjects treated and the division into classes, orders, genera and species. The resemblance is much more striking when we come to compare the means of study followed by both naturalists, though separated by more than a century of marked progress in the field of natural sciences. Like Linnæus, Provancher might have said at the end of his life: "Ea quæ fecimus sunt pars minima eorum quæ ignoramus," but we know that his life was well filled, and that his work added substantially to the sum of human knowledge.

Born at Bécancourt, province of Quebec, on March 10th, 1820, Provancher received his education in the newly erected college at Nicolet. There, under the shade of lofty pines, he picked up some flowers which determined his passion for the things of Nature. There, on the dusted shelves of the library he discovered, by chance, an old text-book of botany that helped him greatly in his new studies. These studies were quite private, for until about 1835 the teaching of natural sciences was still in the womb of the future.

At the end of his classical course, in 1840, Provancher decided to become a priest, and he refrained for a while from his scientific ambitions. He occupied various positions in many parishes between 1844-1847. In 1847 he devoted himself to the service of some hundreds of Irish immigrants, stricken down with an epidemic of typhus. His heroism upon this occasion gives an idea of his unselfish character. Though nervous and rather irascible, he concealed under a coarse appearance the heart of a true friend, always frank and generous.

The active scientific life of Provancher began in 1848 with some essays on grafting that met at first with failure, but that brought back his attention to botany through the channels of horticulture. When transferred, in 1855, to St. Joachim at the foot of Cape Tourmente, Provancher was chiefly interested in botany, and we see from his writings in various papers that he strongly advocated the teaching of natural sciences in all schools. To give a proof of his convictions along these lines, and to help to realize this plan, three years later he published a "Traité élémentaire de Botanique," which was soon adopted by numerous educational institutions.

With this first production Provancher took rank among educators. In 1859 his "Tableau chronologique et synoptique de l'histoire du Canada" was published with the same object in view. While at St. Joachim, Provancher with his devouring activity, commenced experiments on the varietal resistance of fruit trees that can be grown successfully around Quebec. In the newspapers of those days he wrote many articles to convince the farmers of the necessity and advantage of growing fruit trees. His untiring efforts resulted in the planting of a very large area with apple and plum trees, most of which lasted over half a century, the last survivors being killed a few years ago by a severe winter.

Transferred to Portneuf in 1860, Provancher continued his horticultural experiments with great success, even establishing a fruit tree nursery for the advantage of the farmers of this county. Two years later, he was ready to make known the results of his experience as a fruit grower. His new work published in 1882 and entitled: "Le Verger Canadien" has been until lately the classic guide of fruit culture in the province of Quebec. This little book reached its fifth edition in 1885. For the economic entomologist it contains a very interesting section, namely the chapter dealing with the insect pests of the orchards, and describing the means of controlling them. This was, in all probability one of the first expressions of applied entomology ever presented in book form in Canada. But it is not the first in date. Provancher is known almost exclusively as a systematist. Nevertheless, the first paper he published in his life was a discussion on "Insectes et maladies nuisibles au blé," an essay prepared for a competition on this subject organized by the Department of Agriculture for which Provancher received a third prize (under the *nom de plume* of Emilien Dupont).

The first important work of our great naturalist was published in the year 1862. It was the voluminous "Flore Canadienne," the first and only complete work dealing with Canadian plants. Heretofore, no other worker has dared undertake the gigantic task of revising and completing this now old treatise.

Every Canadian and American entomologist knows Provancher as a pioneer entomologist, and it is as such that he merits fame. His systematic classification of insects modestly entitled "Petite Faune Entolomogique du Canada" fills four compact volumes making a total of 2506 pages as follows:

Vol. I.—Coléoptères and additions.
Vol. II.—Orthoptères, Nevroptères, Hymenoptères.
Vol. III.—Hémiptères.
Vol. IV.—Additions and corrections to Hymenoptères.

There may be found the description of all the Canadian species contained in his collections, many hundreds of which were unknown to science. In the order of Hymenoptera alone, Provancher described 923 new species. Rohwer and Gahan, of the Washington Bureau of Entomology have pronounced the accuracy of his descriptions, and pointed out some mistakes in referring species to the wrong genera.

From 1868 until his death in 1892, Provancher devoted much of his time and resources to the maintainence of his review "Le Naturaliste Canadien." The editor filled with his own pen most of the 20 volumes of this publication (nearly 8,000 pages). Apart from insect studies that were later published in book form, this collection contains an elaborate classification of vertebrates, a study on the birds of Quebec, vermes, etc. A volume on Mollusks was published about 1888, and two years later two volumes of travels, one to Jerusalem, the other to the West Indies.

Besides all these occupations Provancher found time to contribute regularly to such weekly papers as "La Minerve" and "La Gazette des Campagnes." These articles discuss a great variety of subjects, especially agricultural and educational. Sometimes he severely criticized public authorities, for instance when the government cut off the annual grant given by previous administrations for sustaining the "Naturaliste Canadien." The life of the publication was seriously menaced three times by such decisions; in 1880, 1883 and again in 1890.

Provancher's activity never knew any limit and left its distinctive mark in many fields. He was known as a very successful organizer, as well in building churches, as in organizing two Canadian pilgrimages to Jerusalem, and promoting a steamship company, etc. In 1888, he started a new publication, "La Semaine Religieuse" a weekly review that is still in existence. During his life he had the pleasure of seeing a large group of learned men interested in natural sciences, many of them being his own disciples, whose studies he directed personally. Such were: Canon Huard, his successor as editor of "Le Naturaliste Canadien," and now curator of the Public Museum, Quebec; Abbé Laflamme, late professor of natural history at Laval University and a geologist of wide reputation; F. X. Bélanger, entomologist, late curator of the Zoological Museum of Laval University; Dr. Crevier, microbiologist; Dr. St. Cyr, geologist, and many others.

When Provancher died at Cap Rouge, March 23rd, 1892, at the age of 72, he could see the realization of the dream of a life time; the natural sciences being then taught in all the colleges and many young men interested in various branches of nature study.

He has been honoured by Laval University with the degree D. Sc.; he was a charter member of the Royal Society, and member of many European and American scientific societies.

His three collections of insects may be found at the College de Lévis and at the Quebec Public Museum. All other specimens collected by Provancher have been kept with care by Rev. Canon Huard, who for the last thirty years has kept alive the memory of the Canadian Linnæus.

RELATION OF THE BIOLOGICAL AND TAXONOMIC STUDIES IN SYRPHIDÆ*

C. Howard Curran, Ottawa

With regard to the relationships between the biological and taxonomic aspects of entomology, it is hoped that the question as here dealt with will not be considered in general as laying down any definite policy which must be followed. It is my hope that the subject is treated in such a manner that the suggestions

*Contribution from the Entomological Branch, Department of Agriculture, Ottawa.

offered may be of assistance to some one who has both the time and inclination to investigate and reach more definite conclusions in the problems which are as yet but slightly known. An attempt has been made to limit technical phraseology to the minimum. Certain obvious facts stand out above all others; we have yet to furnish the details and connections.

In discussing the relationships which exist between the immature stages of insects, and the value which their study may be to the taxonomist, it is necessary to first consider in general the prevailing views which are held by prominent entomologists at the present time. It is almost impossible to draw any separating line between the two schools of thought if we consider them as "schools," for the reason that there is complete intergradation. The one extreme holds that the immature stages are an adaptation for the purpose of distributing the various members of the insect world over all the available food plants, and thus guaranteeing against the extermination of plants which might be most desirable as food. Therefore, it is argued, the immature stages, being secondary, cannot indicate relationships of the adults to any great extent. The other view is that the immature stages are a direct indication of relationship. Various modifications of both views exist, and it is very doubtful if any entomologist today holds either extreme as practicable. Rather there is a tendency toward an equal balance between the two, and this would seem to be the obvious basis for all studies pertaining to a stable classification.

So many factors enter into a study of this nature, many of them wholly conjectural, that one must advance with the greatest caution. What may be considered as a definite group of causative factors bearing upon the development of one tribe of insects possessing similar biological habits may not apply or must be greatly modified in another tribe having very similar immature stages yet possessing definite though small differences in the imagines. It has been argued by many, among them some of the foremost students of zoology, that a character, once lost, can never be regained. If such were the case the problems confronting us in the systematic arrangement of insects would be very simple in their solution. We may consider that a character lost through the various environmental conditions will never recur as long as those conditions exist, but the whole scheme of nature is so complex that the very causes which brought about the change are themselves altered because of changes involved. Life in one form reacts upon life in another form, animal life upon vegetable life, vegetable life upon animal life, animal upon animal and vegetable upon vegetable. To exemplify this well-known but always remarkable phase of existence, it is merely necessary to point out that a superabundance of a given species of plant life induces an abundance of enemies, both plant and animal, else the plant species would develop to such an extent that other plants would find life impossible.

In the case of life the prime object is the perpetuation of the species. The result is that environmental influences bear upon insects in such a way that they always react to the slightest changes either in food or temperature. Such changes may or may not be sufficiently marked to cause the fauna or any one member to become specialized to such a degree as to be quite distinct from its ancestors of many generations previous. If certain environmental conditions are more or less local, and do not cover the whole range of a species what is considered a new or distinct species may be developed.

It seems reasonable to suppose that similar environment will, in many cases, develop stimuli along certain lines in more than one species of insect, indeed in insects belonging to moderately or widely separated groups. Where the outstanding nature of the surroundings is very marked in contrast to the general habitus it is reasonable to believe that the whole fauna inhabiting such a region will develop to a marked degree along similar or parallel lines, although the method of combating strange conditions may not manifest itself in the same way. Still, a similarity must be expected.

I have said that environment is changed by the modifications it produces. All the laws of nature move in cycles and environment is no exception although exactly similar conditions may not recur. Nevertheless they may approach each other closely, and thus cause development along lines similar to those which previously existed, and we may thus find insects receiving very similar stimuli at widely divergent periods and developing much the same characters, although their ancestors may have been distinct, but closely related, species, and those forms resulting from the somewhat similar environment may resemble each other closely. At any rate we should have two distinct series of insects developed along parallel or similar lines, many of which would resemble each other much more closely than did their ancestors, or more closely than they themselves and their ancestors.

It will be seen that it is therefore impossible to devise a lineal classification of insects from either the imagines or immature forms, but at the same time it must be realized that much reliance can be placed upon lineal descent, probably in the majority of cases. This applies especially in what we are pleased to term the families of insects, but becomes more obscure and less reliable as the groups are enlarged, until, when we reach the orders and consider the near relatives of insects we must trust entirely to deduction. I say this notwithstanding our ever increasing knowledge of fossil forms, a complete understanding of which is necessary in order to arrive at definite conclusions. These forms, their relationship to each other and the changes manifest in the various strata in which they are found will eventually lead to a more or less definite understanding of the environmental conditions, and the changes in these conditions which influenced and produced the stimuli causing insect modifications.

It is, I think, an indication of progress when we are able to attain a classification of the adult forms of any family which corresponds as well to the larval classification. It seems that we have reached this condition in the Syrphidæ, and while much still remains to be done, and several discordant factors are apparent, it is a matter of great satisfaction. No group is better adapted for such study nor does any family present such a diverse and yet remarkably consistent group of characters from both the biologic and taxonomic aspect.

Speaking generally, we have now grouped the genera in such a way that all the Aphidophagous (species predaceous upon aphids), all the wood-boring larvæ, (the short-tailed maggots) and all the liquid or semi-liquid feeding larvæ (long-tailed maggots) fall naturally together. There are of course, as must be in the case, exceptions. The remaining groups are varied in their habits. Some species live in the nests of ants and termites, others in the nests of bees. Those in which the larvæ are dwellers in ants' nests form a compact group. In the case of the second group, the adults form a moderately homogenous group, but the larvæ are very diversified in habits: some live in bees' nests, while, so far as is known the majority bore in juicy plants, although it is by no means certain that healthy plants are attacked. I have observed many adults of one of these species (*Volucella fasciata* Macq.) about cactus plants in Kansas and all the plants visited by the females had been previously injured by other insects.

Among the Syrphidæ which contain almost all the aphid eating larvæ I have found it practically impossible to distinguish several of the adults with certainty, but the larvæ are wholly different. In one case (*S. americanus* *pomus*) the larvæ feed upon aphids which are exposed to the sun, (*Aphis pomi*) and are unique in this respect as Syrphid larvæ rarely are able to survive under such conditions, but must seek the shade of a leaf or stem. The adult is small and dark in colour as compared to the typical form (*S. americanus*). The other form (*S. americanus vinelandii*) has a green larva while that of *americanus* is greyish yellowish. While there are evidently three distinct species, it was considered advisable to consider them merely as varieties. I cite here only the one instance, where such a condition occurs in our Syrphidæ, as an illustration of the problems confronting the student and the need of further study. I might point out that Barnes and McDunnough (Mem. Am. Mus. Nat. Hist., III, Pt. 1, p. 4) have found that they have been unable to definitely satisfy themselves as to the limits of certain species of *Catacola* without referring to the biological peculiarities and distinctions.

I have dealt in more detail, in a paper which will be published within the next few months, with the influence of larval food upon the appearance, habitus and deportment of the adult insect and therefore feel that the subject may be lightly dealt with here. I may say that is very often possible to ascertain by the appearance of an imago, whether the larva is predaceous, parasitic or a scavenger, omitting entirely our knowledge of the habits of the species or genus as conveyed by familiarity with it. Such a thing is possible because the larval habits have influenced the adult to develop along definite lines. With the aphid feeding forms the adult has a compressed, light abdomen, or a long slender one, due to the relative paucity of food, the thorax is large and well supplied with muscles and the head large, the eyes being unusually well developed, apparently in order that the insect may readily discern aphids and deposit their eggs. On the other extreme the forms living in liquid media are robust, the head is relatively smaller, and while they are also excellent hoverers, they have a much stronger wing venation in order to carry their weight. Those living in decaying wood are, generally speaking, intermediate; while predators and parasites all have a quite different shape of abdomen, with the exception of Tachinids, which really are allied to those living in liquid media because of the succulence of the larval host.

INSECTS OF THE SEASON IN ONTARIO

L. Caesar and W. A. Ross

Orchard Insects

Codling Moth (*Carpocapsa pomonella*). In orchards east of Toronto and also around Burlington there was more than the usual amount of loss from side-worm injuries, Kings in some orchards having as high as 50 per cent. of injury and Snows 30 per cent. In Niagara, Norfolk and several other districts the amount of injury of this kind was not nearly so great and was scarcely up to the average.

Fruit-Tree-Leaf-Roller (*Tortrix* [*Cacoecia*] *argysrospila*). There was a considerable diminution in the numbers of this troublesome insect this year compared with the years 1920 and 1921.

Apple Maggot (*Rhagoletis pomonella*). From Burford very badly infested apples were sent in with the statement that some varieties had been almost ruined by this insect. Taking the province however, as a whole our observations tended to show that the apple maggot had not done so much damage as it often does.

CHERRY FRUIT-FLIES (*Rhagoletis cingulata* and *R. fausta*). These insects were not abundant this year.

BUD MOTH (*Tmetocera ocellana*). CIGAR CASE-BEARER (*Coleophora fletcherella*) and PISTOL CASE-BEARER (*Coleophora malivorella*). In the orchards around Newcastle where these insects were so abundant last year very few could be found this year. This was apparently due to parasitism or else unfavourable weather conditions in the summer of 1921 and not to the effect last of winter, because in the fall of 1921 an examination of the trees showed that there were very few insects of the new generation.

CANKER WORMS (*Paleacrita vernata* and *Alsophila pometaria*). In several of the districts where canker worm outbreaks occurred last year there was considerable trouble again this year, but on the whole they did much less damage than in 1921. From the number of females of the fall canker worms to be seen this November in some districts it would not be surprising if considerable injury were done next year by this species.

LEAF HOPPERS OF THE APPLE (*Empoa rosæ* and *Empoasca mali*). In the orchards around Brighton these hoppers, especially the rose hopper, were exceptionally abundant and almost every leaf on the apple trees was severely blotched and whitened by their work. In the Niagara district the hoppers were also abundant, but in Norfolk where they had been very abundant a few years before there was not nearly so much evidence of their work. In the Niagara district observations indicated that the hoppers had played an important part in the spread of pear blight.

LEAF BUGS OR PLANT BUGS (*Miridæ*). Almost every year one or more species of leaf bug causes serious loss to fruit, especially to apples in one or more of the fruit districts of the province. Last year a well cared for apple orchard of nine acres at Lucknow had 25 per cent. of the fruit so injured by a species of Red Bug (*Lygidea mendax*) that it had to be graded as domestic or culls. This year, though many of the nymphs could be seen when the blossoms were just bursting, the owner, following instructions on control, harvested a good crop which graded nearly all under number 1 and 2.

THE GREEN APPLE BUG (*Lygus communis*) at Newcastle this year was kept under good control both on pears and apples by careful spraying with nicotine sulphate.

In the Niagara district the peach orchards which in 1920 and 1921 had been attacked by *Lygus quercalbæ*, *Lygus caryæ* and *Lygus omnivagus* were not much injured this year. The terms Oak Plant Bug and Hickory Plant Bug are suggested as appropriate names for *Lygus quercalbæ* and *Lygus caryæ* respectively.

APPLE APHIDS. Aphids this year in some districts did considerable damage to apples, for instance, in one orchard visited, the fruit in the centre and lower parts of Greening trees was all deformed by the rosy aphis. In most districts, however, there was comparatively little damage done to bearing trees by this or the green apple aphis. On young apple trees in the Niagara district the latter species was fairly abundant.

BLACK CHERRY APHIS (*Myzus cerasi*). The stem mothers of this species were more numerous than usual in Niagara; Owing however, to spraying and no doubt to weather conditions also the aphis did not become sufficiently abundant at any time to cause serious loss.

GREEN PEACH APHIS (*Myzus persicæ*). As quite frequently happens in the Niagara district the air on bright warm days the last week in September was full of returned migrants of this species.

PLUM MITE (*Paratetranychus pilosus*). This mite was not so abundant as last year. Heavy washing rains apparently did much to hold it in check.

PEAR PSYLLA (*Psylla pyricola*). There were fewer of these insects this year than last and consequently control was easier.

ROSE CHAFER (*Macrodactylus subspinosus*). These beetles were very common and destructive in many localities.

SAN JOSE SCALE (*Aspidiotus perniciosus*). An examination of infested fruit and twigs indicates that parasites of this insect are becoming more numerous. This may help to explain the slow increase of this scale since the severe winter of 1917-18.

THE PEAR AND CHERRY SLUG (*Eriocampoides limacina*). A young pear orchard at Vineland was partially defoliated by this pest, but generally speaking, the slug was exceedingly scarce. On account of the rarity of the male fly, it is worth mentioning that one was captured at Vineland by Mr. Garlick.

THE WHITE-MARKED TUSSOCK-MOTH (*Hemerocampa leucostigma*). This pest was present in several Niagara orchards in sufficient numbers to be noticed, but in no case, which came under our observation, did it cause any serious injury.

THE PLUM CURCULIO (*Conotrachelus nenuphar*). This Curculio was not particularly troublesome.

PEAR BLISTER MITE (*Eriophyes pyri*). In the 1919 report we expressed the opinion that this species was coming back into prominence as an orchard pest, but what we looked for at that time has failed to happen. The mite is still of very minor importance.

INSECTS AFFECTING GRAPES AND SMALL FRUITS

GRAPE LEAF-HOPPERS; Discussed elsewhere in this report.

ROSE CHAFER (*Macrodactylus subspinosus*). Discussed elsewhere.

BLACKBERRY LEAF MINER (*Metallus bethunei*). This insect was decidedly less abundant and injurious than last year. Parasites were more prevalent than in 1921, but they were hardly sufficiently numerous to account for the very marked decrease in the number of miners.

Blotched mines containing larvæ very similar to the blackberry leaf-miner were noticed in many raspberry patches at Vineland. In no case was the injury serious, but it was conspicuous enough to attract attention. Some larvæ were collected by Mr. Garlick of the Dominion Entomological Laboratory, and adults which could not be distinguished from *M. bethunei* were reared. These flies readily laid eggs on blackberry leaves.

The blackberry leaf miner apparently occurs wherever blackberries are grown in the province. It has been found as far north as Collingwood, and this year it was fairly troublesome at Brighton.

GOOSEBERRY SAW-FLY (*Diphadnus appendiculatus*). This rather uncommon insect was found defoliating red currants and gooseberries in the Vineland district. According to Mr. Garlick this insect when present does more damage than the common currant worm.

RASPBERRY SAW-FLY (*Monophadnus rubi*). This saw-fly was present in many raspberry patches, but, generally speaking, did not cause much injury. However, in one large patch at Vineland, the canes were almost completely defoliated by it before the owner noticed the injury.

The saw-fly is very easily controlled by spraying with arsenate of lead 1½ lbs. powder, 5 lbs. hydrated lime, 40 gallons of water.

RASPBERRY BYTURUS (*Byturus unicolor*). This small pale-brown beetle was quite plentiful in the spring, and several reports were received, particularly from Jordan, to the effect that it was seriously injuring raspberry blossom buds.

Mr. Garlick found the eggs of this species tucked in between the glandular hairs on the pedicel of the flower and close to the bud or just on it. On hatching the larvæ bore into the receptacle, and as the berries ripen, they are found tunneling in the white hull or feeding on the berry. Infested hulls turn black and soft, the berry becomes soft and is easily shaken off.

Raspberry Leaf-Roller (*Exartema permundanum*). Leaves webbed together by this species were quite commonly found in raspberries and blackberry patches in the Niagara peninsula, particularly at Fenwick. However, in no instance was the injury serious.

Gooseberry Fruit Worm (*Zophodia grossulariae*). It is seldom that one finds any trace of this insect in Ontario, hence it seems worth recording that it was found doing considerable damage to red currants in one locality in Carleton County and was sent in from Russell County with the report that it was injuring gooseberries.

Strawberry Weevil (*Anthonomus signatus*), and the Strawberry Leaf Beetle (*Paria canella*) were again abundant in some strawberry patches in the Niagara district. The latter was very abundant also at Campbellville.

Insects Affecting Vegetables or Truck Crops

Cabbage Maggot (*Phorbia brassicae*). There was less injury than usual this year from the Cabbage Maggot.

Onion Maggot (*Hylemyia antiqua*). This insect was relatively more abundant and destructive than its close relative, the Cabbage Maggot.

Onion Thrip (*Thrips tabaci*). On the whole there appeared to be less injury from this thrip than last year, as one would expect from a comparison of the amount of moisture in the two seasons.

Striped Cucumber Beetle (*Diabrotica vittata*). The beetles varied greatly in numbers in different parts of the province, and even in different fields in the same part. In Norfolk and Niagara there were several fields of cucumbers severely injured while other fields were scarcely at all attacked, the worst attacked fields being those in which cucumbers had been grown the previous year or those situated close to where they had been grown. A study of the life history and control of the insect has been begun by the senior writers, and will be continued next year. It may be mentioned in passing that so far neither of the writers has found the nicotine dust satisfactory. It stupefies the insects, but almost all recover later.

Melon Aphis (*Aphis gossypi*). This aphis was decidedly injurious to melons and cucumbers at Vineland.

Imported Cabbage Worm (*Pieris rapæ*). This year, as in 1921, these worms were abundant towards the end of the summer, and along with Cabbage Looper did great damage to the leaves of cabbage, cauliflower and in some cases turnips.

Cabbage Looper (*Autographa brassicæ*). As just mentioned this looper was very abundant this fall; in fact, it has been more abundant in 1921 and 1922 than at any time for the last ten or twelve years.

Rhubarb Curculio (*Lixus concavus*). Usually this insect is difficult to find, and does insignificant damage, but this year from several localities it was reported as being so abundant as almost to ruin the crop. One plot near Cayuga was visited and the complaint found to be justified, many of the leaf stalks having from six to twelve feeding or egg-laying punctures. The tissues around these injuries had in some cases died out and in others become diseased, so that the stalks readily broke with very little strain. Eggs were found in some of the punctures, but as usual no larvæ were present.

CORN EAR WORM (*Heliothis obsoleta*). The almost total disappearance of this insect in 1922, after the remarkable outbreak in 1921, was very interesting. Only about half-a-dozen larvæ in all were seen by the writers this summer. Experiments with larvæ in the fall of 1921 and the great scarcity of the insect this year tend to confirm the theory that the insect does not winter in Ontario, or if so, only to a very slight extent.

EUROPEAN CORN BORER (*Pyrausta nubilalis*). Discussed elsewhere in this report.

SPOTTED CUTWORM (*Agrotis c. nigrum*). This cutworm was much more numerous than usual, and during the latter half of July in several localities, especially in Norfolk, Lambton, Peel and Lennox and Addington counties, there were outbreaks of considerable importance. The newspapers erroneously referred to these as "Army Worm Outbreaks." The outbreaks were not unexpected, because in Norfolk on April 26th the senior writer saw fields in which the early brood of this same cutworm was abundant. At this date some of the larvæ were almost full-grown and others only half-grown, the average being about one inch long.

POTATO INSECTS. The Potato Leaf Hopper (*Empoasca mali*) was perhaps the most important potato pest in Southern Ontario. Flea Beetles (*Epitrix cucumeris*) were very numerous, in some localities almost destroying potato leaves and injuring considerably leaves of tomatoes. The Colorado Potato Beetle (*Leptinotarsa decemlineata*) was not of its usual importance.

MISCELLANEOUS INSECTS

TARNISHED PLANT BUG (*Lygus pratensis*). This pest, although less troublesome than usual on asters, was again injurious to chrysanthemums in some greenhouses.

The most effective method of preventing plant bug injury in greenhouses is to screen the ventilators and doors with wire cloth. This past summer the Dale Estate people at Brampton screened one of their chrysanthemum houses and in reference to the results secured from this the Assistant General Manager wrote under date of October 12th as follows:

"There seems to be little question that the screening of the ventilators has been very beneficial. In the house where this was carried out the tarnished plant bug has been practically eliminated, while in the other houses the bugs have been as bad this year as ever. Further, we have noticed no detrimental effect in the matter of ventilation."

COILED ROSE WORM (*Emphyctus cinctipes*). There was an outbreak of this species in two large greenhouses near Grimsby. In both houses the larvæ were most abundant on the variety Premier. The slugs were easily destroyed by an application of arsenate of lead.

GRASSHOPPERS. In Manitoulin Island there was the most extensive and severe outbreak of grasshoppers which the senior writer has seen in Ontario. The chief species involved was the Roadside Grasshopper (*Camnula pellucida*). Almost every farm throughout the whole length of the island, over 100 miles, was more or less infested. So numerous were the nymphs in the middle of June, when the writer visited the district, that there seemed no doubt that, if not combated, they would totally destroy the grain crop and also much of the hay and pasture.

Manitoulin is unfortunate in having a great deal of very shallow soil, in many fields the rock being only from two to five inches below the surface. As such fields are not cultivated they afforded ideal breeding places for the grasshoppers.

Meetings were held in the worst infested areas, at which the situation was discussed and control measures outlined. These were followed by field demonstrations on the making and applying of the poison bait. The work was then left in charge of local committees and of the agricultural representative.

The formula for the bait recommended was:—

Bran	12 lbs.
Sawdust	an equal quantity to 12 lbs. bran.
White Arsenic	1 lb.
Salt	1 to 1½ lbs.
Water	about 2½ gals.

The total amount of arsenic purchased was 29,218 lbs., which gives some idea of the extent or severity of the outbreak.

The result of treatment was that in spite of some of the arsenic being delayed in shipment, a fairly good crop was harvested, and the farmers, from being sceptical of the possibility of combating the grasshoppers, became convinced of the efficiency of the bait and to quote the words of R. E. Cumming, the agricultural representative, "Are all ready to use poison at the first sign of a grasshopper outbreak."

CICADA (*Okanagana canadensis;* det. by Wm. T. Davis). While driving through the woods in Manitoulin Island on June 16th, in connection with the grasshopper outbreak, a loud hissing noise was heard. On investigation this was found to come from numerous Cicadas of the above species. Many of these were on low bushes; others were higher up in the branches of trees, still others were on the trunks, some of them just emerging from their nymphal skins, while others had not yet begun to emerge. The cast skins were much in evidence, some of them six feet or more up on the trunk, but most right at the crown, a few being on the ground a foot or more away from the trunk. Seventy-five of these skins were counted on or close to a single poplar tree, (*Populus tremuloides*). The singing was heard from various woods that day from 11.00 a.m. to 4.30 p.m., though it may have begun earlier and lasted later. In each case the greatest volume of sound appeared to come from the part of the woods where poplars were most abundant. This may be of interest to entomologists, because the species is supposed to have a strong preference for pitch pine.

I regret that I had only one comparatively small cyanide bottle with me, into which I could crowd only a dozen specimens. Had I time and anything to put the Cicadas in, I think it would not have required long to capture one hundred or more; for while many were very shy others could be captured with fair ease by placing the hand quickly over them where they sat.

CHINCH BUG (*Blissus leucopterus*). In the third week in July the corn growers in Essex county became alarmed by the migration of what proved to be the Chinch Bug from wheat to corn. On July 21st all stages, or almost all stages, of the insect could be seen on the corn, though the third and fourth instars seemed the most common. Later the infestation became more general, and farmers said there were millions of the bugs to be seen in a single field. That the outbreak was fairly serious there is no doubt, for Mr. Justus Miller in his final report to the writer estimated that the total injury would be about 10 per cent of the corn crop of the county.

This is apparently much the worst outbreak of Chinch Bug in Ontario on record, and must be attributed to the very favourable climatic conditions, especially during the winter of 1921-22. So far the dry weather of this fall has given almost ideal conditions for the hibernating insects, and should the winter prove mild and fairly dry it will not be surprising if next year will witness much greater injury even than this; though in the past outbreaks have usually lasted only one season in this province.

Instructions for guarding against an attack next year have been sent to the agricultural representative and by him published in the local press.

ANTS. There have been more requests for information on how to control ants in houses and lawns this year than at any time in the writer's experience. The most troublesome house species to deal with has been Pharaoh's Ant, (*Monomorium pharaonis*), which is evidently spreading rapidly.

BUFFALO CARPET BEETLE (*Anthrenus scrophulariæ*). Many requests for information on how to rid buildings from this pest have been received.

MILL AND STORED GRAIN PESTS. The mild weather of the last three winters would appear to have something to do with the greatly increased numbers of insects affecting stored grain. The chief species involved are the Indian Meal Worm (*Plodia interpunctella*), the Rice Weevil (*Calandra oryzæ*), and the Saw-toothed Grain Beetle (*Silvanus surmamensis*).

CLOVER MITE (*Bryobia pratensis*). A correspondent from Melbourne, Ontario, writes of this mite: "This vermin comes out around the foundation of our dwelling house every year about May 1st, and continues to infest the outside and get inside the house by thousands on warm days for a period of three weeks or a month, and then all disappear until the next year. They crawl all up on the pine siding and all over the windows, both upstairs and downstairs."

Hitherto these mites have been sent in in the fall instead of the spring.

MOSQUITOES. Tourists in Muskoka and many other parts of the province were unanimous in declaring that mosquitoes were never so numerous or bit so viciously as this year. The claim was made that this year the mosquitoes were much smaller than usual and worked their way into houses through screened windows. The species was not determined, but the writer observed that many specimens were indeed very small.

HEEL FLY (*Hypoderma bovis*). There were not so many complaints as usual of cattle being tormented by this fly.

NOTES ON FRANKLINIELLA TRITICI (FITCH)

R. C. TREHERNE, ENTOMOLOGICAL BRANCH, DOMINION DEPARTMENT OF AGRICULTURE

The Order Thysanoptera is rapidly assuming an important place in economic entomology, and many members to-day are recognized as among the most important injurious insects of cultivated crops. In Canada the pear thrips, *Tæniothrips inconsequens* Uzel, the onion thrips, *Thrips tabaci* Lindeman, the greenhouse thrips, *Heliothrips hæmorrhoidalis* Bouche and *femoralis* Reuter, the grass thrips, *Anaphothrips obscurus* Muller, are known and have been recorded in our literature as major pests of the crops they attack. To these we must unquestionably add *Frankliniella tritici* Fitch and its two closely allied species (which may ultimately be classed as "forms" or "subspecies") *occidentalis* Pergande and *californica* Moulton. All three commonly occur in Canada; the last named, thus far, is only recorded from Central and Western Canada, but doubtless will be found in Ontario and the Maritime Provinces in a suitable environment. Practically all of the injurious species of thrips are contained within the family Thripidæ, and they all appear to have similar feeding habits though the parts of plants they affect may differ. The average length of North American species is about 1 mm., and their mouth parts are suctorial. There is a forward and a backward movement of the head which enables the minute styliform mandibles to pierce the epidermal cells of the plant, after which the mouth parts are inserted into the opening formed, pressed down to the labrum and sucking commences. A minute or so is apparently sufficient to remove all the available sap within reach, after which a new location is taken up and the same process of insertion proceeds again. It will not be necessary for me to describe in detail the mouth parts of these minute insects. This has been done on former occasions by several writers. It is only necessary to receive an impression on the general motions undertaken and to appreciate the nature of the injuries. In addition to the often pronounced injuries caused by direct feeding, which may cause "blasting" of the buds and flowers, leaves and seed pods, the oviposition habits must also be noted. Members of the Thripidæ are provided with a saw-like ovipositor which is used to cut a cavity in the delicate portions of plant growth, such as the pistils, stamens, developing ovules, fruit and leaf petioles, before an egg is inserted. Microtome sections of such plant portions may frequently disclose as many as 8-10 egg cavities. This habit naturally greatly weakens the plant tissue and it is not surprising to find developing fruits, seed pods, etc., failing to mature or dropping off completely as the season advances, due to oviposition injuries alone. More injury is caused by the feeding habits than by oviposition but, in examination, the latter form of injury must not be ignored.

There is a third consideration worthy of mention at this point that relates to the plant breeders. I have seen supposedly careful experiments conducted in the cross-breeding of vegetables under cheesecloth and cheap calico screens which, if they were not entirely negatived, were at least severely endangered by the presence of innumerable thrips within the cages to which the screening presented practically no obstacle. Thrips, particularly on bright sunny days, may be observed passing in and out through the screen meshes and although no immediate examination has been made at the time under the binoculars, it is certain that they carried pollen grains attached to their measurably hairy bodies and fringe-like wings, for pollen grains may be quite commonly seen on live thrips gathered from blossoms under somewhat similar conditions.

It is strange that up until the present time in Canada we can only record one crop which is severely affected by *Frankliniella tritici* and its allied species, despite the fact that these insects occur so commonly. This crop is alfalfa, and Mr. H. L. Seamans, of the Dominion Entomological Branch, is now making an exhaustive study of the economic relationship of *F. occidentalis* to alfalfa in the alfalfa seed-producing areas of Alberta. He has already found that in certain seasons fully 80 per cent. of the young florets and seed pods are destroyed or fail to mature by reason of the activities of this species. It seems possible that the future may show these insects to be of more than passing interest in Canada. There are, however, some observations made in the United States. In California, Arizona and Montana, both *F. tritici* and *occidentalis* are known to cause much damage to alfalfa, much in the manner already mentioned, wherein the floral parts are attacked, causing the premature falling of the flower, or the ovaries or tender stigmas are injured, preventing the development of the seed pod. In New York State, *F. tritici* is not usually injurious though a common species in orchards. Parrott, however, in 1909, noted very extreme injury to pear orchards in Western New York State wherein "the injured blossom clusters turned brown as if blighted, while the leaves became discoloured about the wounded areas and curled." Similar injury to deciduous fruits has been noted by Morril in the Salt River Valley of Arizona and in California young developing apricots have been, on occasions, severely injured. The floral parts of blackberries and raspberries have been injured also in the mid-central United States, and Quaintance even presented the name of the Strawberry Thrips to *F. tritici* in Florida from its pronounced injuries to this crop. It is probable, however, in this connection that the species involved was *F. bispinosus* or its variety *projectus* and not *F. tritici* as imagined in Florida, a belief that is supported by a later study given the matter by Watson, of Florida, who draws attention to the fact that *F. bispinosus* usually finds its habitat in flowers of an open structure, while *F. tritici* prefers blossoms and parts of plants that are closed. To wheat, oats, peas and like crops notable injury has been caused not only in the United States, but also in Europe at various times. Lastly, attention must be drawn to the possible relation of insects of this class to the distribution of plant diseases, and to the fact that many species, including *F. tritici*, may be predaceous on insect eggs. In our own experience in Canada *F. tritici* has been incriminated as a carrier of blossom infection of Fire Blight, but in the Rogue River Valley of Oregon this species is said to rank high in this connection. Sufficient has been said to indicate the possible relationship of these exceedingly common insects to cultivated crops. It is only necessary to close this phase of the subject by stating that all plants are liable to be infested, but that the typical habitat of *F. tritici* is among the florets of composite flowers, in clusters of young leaves, in any crevice where the tissue is not too tough to be pierced provided the situation is concealed. Shull, in the American Naturalist, Vol. 48, has drawn attention to this fact and records, for example, that the species is usually very abundant in the flowers of white clover (*T. repens*) and red clover (*T. pratense*), while it is rarely found in the related yellow and white sweet clovers (*M. officinalis* and *alba*). The larvæ, likewise, frequents a similar habitat.

The Systematic Position

It would be well to briefly mention the characters of this insect which has such potentialities as a pest. The term *Euthrips* may have a familiar sound to many present, as it was under this genus that the pear thrips *Euthrips pyri* was dealt with in American literature. *Tritici*, *occidentalis*, *floridensis*, *gossypii*, *helianthi*, *runneri*, *insularis*, *cephalicus*, *fuscus*, *nicotianæ*, *minuta*, *nervosa*, etc., have all been dealt with under the genus *Euthrips*. The genus *Euthrips* now no longer exists, or, if it is employed, is usually applied synonymously with *Anaphothrips*, Uzel. Its use was shown by Hood to be a contravention to Article 9 of the International Code of Zoological Nomenclature. The genera *Tæniothrips* Serville, *Frankliniella* Karny, *Parafrankliniella* Priesner, *Kakothrips* Williams, *Odontothrips* Serville and others are now erected by their respective authors to take care of former members of the genus *Euthrips*. Dr. Karny, in a recent issue of Treubia, has given us some suggestions in key form which assist us materially in separating the related genera of the *Thripinæ*. For our purposes this key is adapted and modified as follows:—

Antennæ 7 or 8, or apparently 9, segmented.

a. Fore tibia unarmed;

b. Anterior angles of prothorax on each side with a long, strong bristle;

c. Prothorax with a rather long bristle in the middle of each. *Scolothrips* Hinds.

cc. Sides of prothorax without bristles;

d. Interocellar bristles located on the sides of the ocellar triangle;

e. The inner of the two prominent bristles on the anterior margin of the prothorax nearly twice as long as the outer.

Parafrankliniella Priesner.

ee. The outer of the two bristles the longer.

Frankliniella Karny.

dd. Interocellar bristles between the posterior pair of ocelli.

Kakothrips Williams.*

bb. Anterior angles of prothorax without a strong bristle;

c. Posterior angles of prothorax with only one strong bristle on each side;

d. Head little broader than long; fore wings not regularly set with bristles.

Scirtothrips Shull.

dd. Head one and one-half times as long as broad. Fore wings with a continuous row of bristles on both wings. *Pseudothrips* Hinds

e. Antennæ apparently 9 segmented. *Pseudothrips*.

ee. Antennæ clearly 8 segmented. *Glaucothrips* Karny.

cc. Antennæ clearly 8 segmented. Posterior angles of prothorax with two strong bristles on each side;

f. The front and the eyes greatly enlarged. The 8th abdominal segment without comblike teeth on the posterior margin.

Cricothrips Trybom.

ff. Shape of the head normal. A comblike structure usually present on the posterior margin of the 8th abdominal segment.

Tæniothrips Serville.†

g. Sixth antennal segment normal.

Tæniothrips.

gg. Sixth antennal segment sharply pointed.

Rhopalandrothrips Priesner.

aa. Fore tibiæ armed at the end with one or two teeth;

g. Antennæ 8 segmented.

Odontothrips Serville.

gg. Antennæ 7 segmented.

Sminyothrips Uzel.

Of the genus *Frankliniella* erected by Karny in 1910, over forty species are now recognized. *Thrips intonsa* Trybom was erected by Hood as the genotype, but there is a question whether it is correctly designated. *Frankliniella tritici* Fitch, the species we are concerned with at this time, is briefly described as follows:

FEMALE: Length 1.1-1.2 mm.; width .2-.26 mm.

HEAD: three-fourths as long as broad; back of head transversely striated; ocelli subapproximate pale yellow, margined inwardly with reddish-orange crescents; interocellar spines long, postocular spines shorter, both conspicuous; antennæ, about two and a half times as long as

*Dr. Karny separates these three genera on the presence or absence of abdominal processes on the 8th segment. Inasmuch as certain reduced but recognizable processes may be found in certain female species of *Frankliniella* this character would not appear to be so useful in differentiation as the location of the interocellar bristles.

†Dr. Karny separates *Physothrips* Karny from *Tæniothrips* Serville by the presence or absence of transverse bands on the fore wings. This character is not well stabilized; hence *Physothrips* falls within the genus *Tæniothrips*. *Amblythrips* Bagnall and *Pezothrips* Karny were both erected for wingless species. Information has been received that winged forms have been taken, hence, the characters being the same, the two genera also fall within the genus *Tæniothrips*.

the head; segment 1 pale yellow; segment 2 light brown, dusky, sometimes yellowish as base, symmetrical in outline, without bristle bearing hump and no bristles markedly enlarged; segment 3, light brown or dusky at apex, light yellow in basal half (the longest joint of the antennæ); segments 4 and 5, dusky, brown, light yellow in basal half, 4 about 1½ times longer than the 5th joint; segment 6, brown, about equal in length to 4; segments 7 and 8 (style) brown, the last segment nearly twice the length of the 7th; spines in segments 2-5 usually stout and conspicuous.

PROTHORAX: three-fourths as long as broad, slightly longer than the head, normal; wings, slightly shaded, costa bearing 26-28 evenly placed spines, fore vein 20-22, hind vein 15-18, scale 5, interior 1; legs concolourous with body, usually pale yellow or slightly shaded light brown, a pair of stout spines at extremity of each tibia, spines on inside of hind tibiæ rather weak.

ABDOMEN: Normal in shape, in the darker forms there is usually a brown stripe on anterior edges of segments 2-7, dorsal plates also more or less brown, tip of abdomen slightly darker than other segments, without any pale areas on abdominal sternites, spines prominent and shaded brown on lighter coloured portions of the abdominal segments.

It is well to point out, however, that the species is very variable in colour, as is to be expected in one with such a wide distribution with so many different types of habitat. There are some very complex relationships to *F. occidentalis* Pergande and *F. californica* Moulton, which will only be properly settled by an exact morphological study or by breeding.

SOME NOTES ON THE BIOLOGY OF TWO BUPRESTIDS INFESTING BLACKBERRY AND HAZEL

Agrilus ruficollis and *A. politus.*

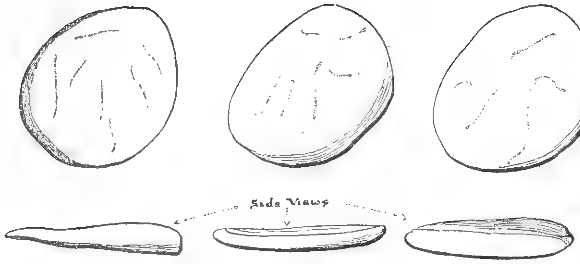
C. B. HUTCHINGS, ENTOMOLOGICAL BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA

During the past summer we had an opportunity of observing the activities of *Agrilus ruficollis* upon Blackberry (*Rubus villosus*), and *Agrilus politus* on Hazel (*Corylus rostrata* Ait). In a plot adjoining our field laboratory at Queen's Park, Aylmer, were scattered thick clumps of brambles and hazel shrubbery upon which the beetles were discovered in considerable numbers. A study of these was begun and the notes taken have been embodied in this paper.

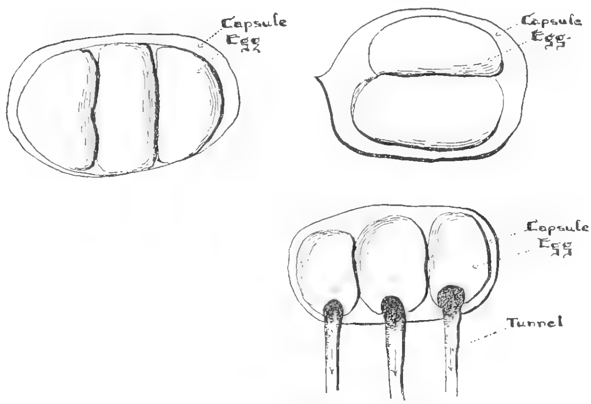
I am indebted to my field assistant, Mr. Reginald Balch, for his help in this connection.

Agrilus ruficollis Fab. The adults were first seen about the third week in June feeding freely upon the upper leaf surfaces of blackberries and raspberries, and also, sparingly, upon the purple flowering raspberry, *Rubus odoratus;* a decided preference being shown for blackberries. When approached cautiously the beetles could be taken easily by hand, but if one failed to catch them then they would promptly feign death, or dodge beneath the underside of the foliage, or quickly seek other feeding grounds by short rapid flights. While an occasional beetle might be seen on the bushes almost at any time of a bright day, the noon hours and early afternoon when the sun was brightest and hottest, favoured their appearance in large numbers. The method of feeding was for the most part upon the central areas of the leaf surfaces, where holes irregular in size and outline were made, but the edges of the leaves were also well eaten into. The presence of the small, dark, dry excrement pellets upon the leaves were always good indications of the presence of *ruficollis.* Mating began soon after emergence and pairs were constantly found *in copula.*

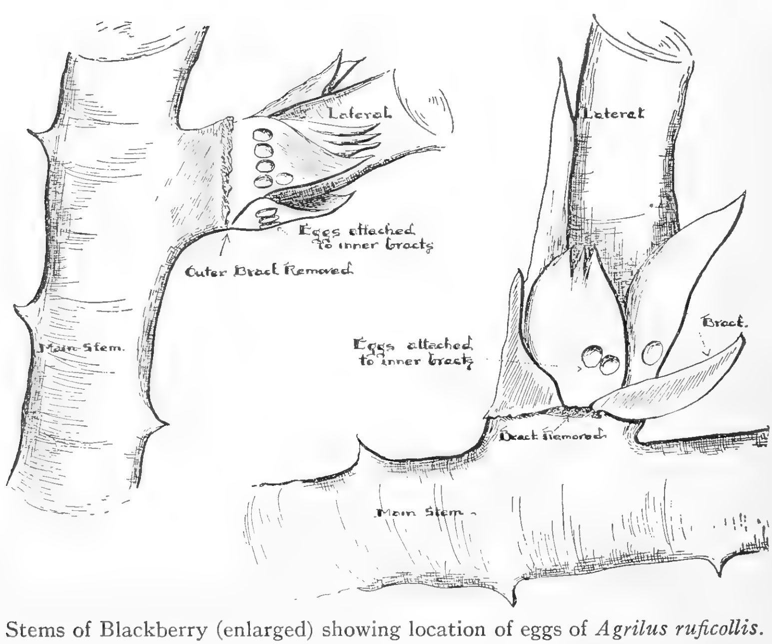
The adult is somewhat cylindric in outline, and rather active, buprestid, measuring from 7 to 8 mm. long and about 1.75 mm. broad across the wing covers. A striking characteristic of this species is the dull coppery bronze



Eggs of *Agrilus ruficollis* (enlarged).



Eggs of *Agrilus politus* (enlarged).



Stems of Blackberry (enlarged) showing location of eggs of *Agrilus ruficollis.*

colour of the prothorax from which it derives its name. The head is decidedly dark and the wing covers dull black.

The eggs are irregularly oval in outline with two sides flattened, and measure, on an average, from 1 to 1.5 mm. across. They are dirty-white in colour with brownish edges, of soft shell, and are deposited either singly or in groups of from two to six, at the axils of the branches, being inserted chiefly between the outer and inner bracts close to the main stem. Hatching begins in three weeks. The young larva on emerging approximates 1.5 mm. in length, is dull white in colour and flat headed. It always enters the branch from beneath the egg, usually at a point near the centre, although 25 per cent. of the larvæ leave at the edge. The empty case is made the receptacle for the first borings, which are of very fine brown dust. After working spirally around the branch, the larva continues on to the main stem of the plant, which it tunnels two or three times in the outer bark tissues before entering the pith. This girdling work causes the stem at this point to crack longitudinally in many places, producing an elliptical swelling, commonly known as gouty-gall and results in killing the branch the following year. Once the pith is entered, the tunnel becomes straightened out and is packed with castings and the larva proceeds to bore upwards. It attains a length of 16 to 18 mm. and is a flat, slender, white, legless grub. Winter is passed in the stem and pupation occurs in May in a specially enlarged cell. The adult then gnaws its way to the surface and escapes through an exit semi-lunar in shape. The tunnels vary considerably in length, from three to six inches or more.

Cutting out the galls in spring and destroying them is a simple and ready method to control this pest. Do this soon after the leaves appear.

Agrilus politus Say. This species is of less importance economically than *ruficollis*. It is a serious enemy of the hazel (*Corylus*), and does much injury by forming ugly, knot-like galls on the branches, killing back all attacked parts.

The adult is more robust, less trim in outline, and somewhat shorter than *ruficollis*, averaging about 6.5 mm. in length and 2 mm. in breadth, and is of a dull, uniform bronze colour, the tips of the wing covers being forked.

The eggs are oval in outline, of soft shell, shiny, transparent white in colour, and each about 1.5 mm. long and half as wide. They are laid singly and in small groups of two or three, and covered afterwards with a protective secretion which hardens into a capsule, brown in colour of a shade a little lighter than the bark, being quite conspicuous scale-like objects on the branches. The female, in laying, appears to have no special choice of location, and will deposit a group of eggs near the axil of a small shoot, another group beside a raised portion of bark or lenticle, and others quite often upon the clean, exposed bark surfaces. This habit differs from *ruficollis* in that the last mentioned tucks its eggs safely behind the bracts at the axils of the branches. The period of incubation requires approximately three weeks, hatching beginning about July 20th. The larva eats its way out at the smaller end of the egg, without disturbing the capsule and enters the bark beneath, expelled frass being packed away into the empty shell case. Several groups were under observation, and it was found that the larvæ left at the same end of each egg and bored, side by side in the same direction, for 7 to 10 mm. lengthwise of the twig; then branching out began to tunnel around the twig, near the surface, each circuit being close to the previous one. The branch is consequently completely girdled. This action sets up an abnormal stimulation of growth, cracking the outer bark surfaces and producing ugly, knot-like swellings or galls, eventually killing the branches affected in this way.

The pupal cell is constructed well down in the woody tissues of the stem, and the adult comes to the outside by way of a D-shaped hole, quite characteristic of the genus.

Pupation occurred this year during the last week in May and continued to about the middle of June, the largest number of adults being taken between the 16th and 20th of the month.

The control is the same as in *ruficollis;* viz., cut out the gall-infested branches in spring and destroy.

INSECTS OF THE SEASON IN QUEBEC IN 1922

Georges Maheux, Provincial Entomologist, Quebec

The summer of 1922 has been a heavy season for injurious insects. Except perhaps for the field crops, all other groups of plants have had to suffer from the intrusion of numerous enemies.

Fruit Trees. Fruit tree insects were at work early, and kept on attacking the various parts of the trees during the whole season. Tent caterpillars were easily three times as numerous as last year. Both species, *Malacosoma americana* and *M. disstria* have been recorded from different districts. These pests could hardly be seen in the same orchard; their distribution was local and rarely coalesced. In Quebec district the chief offender was outstandingly the Forest Tent Caterpillar, while around Montreal it was the Apple Tent Caterpillar. Large numbers of apple trees were defoliated everywhere where spraying had been omitted or too much delayed.

Tmetocera ocellana, *Cacoecia rosaceana*, *Aphis mali*, *Carpocapsa pomonella*, *Conotrachelus nenuphar* were also prominent. From the ordinary list of fruit tree insects the only exception came from the late summer caterpillars; though fairly abundant in some localities, *Datana ministra*, *Schizura concinna*, *Hemerocampa leucostigma* determined by no means serious conditions.

Vegetables. It was a good season for *Leptinotarsa decemlineata*, which started its work early and seemed hard to control in many instances, due to too long intervals between two consecutive sprayings. Large losses from cutworms were experienced by tobacco planters. Maggots in general, cabbage and onion especially, made a good season. *Pieris rapæ* kept last year's good average. *Diabrotica vittata*, *Epitrix cucumeris* and sometimes *Macrobasis unicolor* had to be watched carefully to avoid serious damages.

Field Crops. An outbreak of grasshoppers, about the same size as last year's, was a serious menace to many oat fields. Damage was cut down to a trifle after a large educational campaign substantiated with field demonstrations carried on in every locality interested. Samples of sweet corn sent to the office proved to be severely attacked by *Heliothis obsoleta*, but this was not general, although this pest seems to be on the increase and may prove troublesome next year in the Montreal district.

Small Fruits. Strawberries were affected by white grubs and *Ancylis comptana*, a leaf roller; no damage to blossoms and fruits were reported. Currants and gooseberries again suffered from *Pteronus ribesii*, that is in gardens where the use of arsenical is not a matter of regular practice.

Shade Trees. Our records show nothing worth mentioning as insect pests; on the contrary, diseases were very important and their injuries very conspicuous on maples especially.

We look on 1923 as a very favourable season for Tent caterpillars and grasshoppers particularly.

THE FEATHER MITE—A NEW PEST OF POULTRY

L. CAESAR, ONTARIO AGRICULTURAL COLLEGE, GUELPH

The presence of a new mite (*Liponyssus bursa*) in this province was brought to my attention by Mr. F. C. Bishopp, of the U.S. Bureau of Entomology, last December at the annual meeting in Toronto, when he informed me that he has seen birds badly infested with the mite which had been shipped into the United States by a certain Ontario poultryman. At once I wrote to this man, informed him of what I had been told, and urged upon him the prompt application of effective control measures as outlined in Circular 79 of the United States Department of Agriculture, of which Mr. Bishopp had given me a copy. Then as soon as my college work permitted I visited his plant and inspected a large number of his birds, but found only one mite, and that one on a feather in a nest. The owner, however, informed me that the birds in one section of his plant had been infested, but that by thorough applications of zenoleum he had, he believed, exterminated the mites. He certainly had at least come very near doing so.

By this poultryman I was given the address of another man, about fifty miles away, who was having trouble with the same mite. This poultryman was then visited, and the mites were found in one of his houses, but as treatment had been carried on here too the birds were not badly infested, though the owner and his wife both said that a few weeks earlier the mites had been abundant in this particular house.

I endeavoured to find the origin of the infestation. The first poultryman said he had got the mites from birds shipped in from the Southern States, but Mr. Bishopp was of the opinion that this must be a mistake. The other poultryman thought he got his from exhibiting at a poultry show in one of our cities.

I have not since had any complaints of trouble in other flocks, but would not be surprised if it should turn out that the mite was somewhat widely spread both in Canada and the United States.

All the adult mites seen were blackish in colour with some white areas, chiefly around the head. Some of the young were blackish like the adults, others were nearly white. The adults look to the naked eye like mere black specks, and, as one of the poultrymen said, when on a bright winter day they cluster upon the tail feathers of a white bird to bask in the sunshine, they make the feathers appear as if dusted with black pepper.

Unlike the common red mite (*Dermanyssus gallinae* De Geer), which attacks poultry only at night, hiding in crevices in roosts and in other places by day, this species usually remains both night and day upon its host. They can be found most easily in the feathers around the vent, but may occur almost anywhere among the feathers. Some of them, however, may also be found in the nest on feathers and other substances.

The eggs are oval, and glossy white, and, so far as observed, were situated in the feathers near the base where they could easily be dislodged by tapping the feathers.

The mites are able to endure a great deal of cold, as I discovered by placing several feathers with mites on them in a bottle and exposing this overnight to a temperature which reached 7° F. Next day, after carrying the bottle in my pocket for a couple of hours, I examined it and found almost all the mites alive and quite active. These same mites were kept in this bottle for 18 days before they all died. These facts show that the pest might easily be transported long distances even in cool weather in the packages around eggs, even apart from the ease with which they could be transported on the birds themselves. It is possible sparrows may also be a means of spreading them.

How destructive the mites are was not observed, but Mr. Bishopp considers them a serious pest, and one of the poultrymen said that when they became abundant on a bird they quickly caused it to droop and become valueless.

Fortunately control measures do not appear to be specially difficult. Mr. Bishopp found that by thoroughly cleaning out the houses, nests and brooders, burning the nesting material and placing the manure where birds could not reach it, then thoroughly spraying the houses, nests and brooders with carbolineum and dusting the birds heavily with sulphur, the mites could be exterminated.

In this country carbolineum in most places is not easy to procure, hence it seems to me that creosote oil could be substituted. I am also of the opinion that owing to the presence of lice on most poultry it would pay to combine sodium fluoride with the sulphur in the proportions of about four parts sulphur to one part sodium fluoride. A test was made on twenty-one birds, including several breeds, with two parts sulphur to one part sodium fluoride, and, though the dusting was purposely done very heavily, no injury followed, and every louse present was killed. (There were no mites in this case to begin with.)

THE GRAPE LEAF-HOPPER

W. A. Ross, and W. Robinson, Dominion Entomological Laboratory, Vineland Station

The Grape Leaf-hopper, *Erythroneura comes* Say, a native American species, apparently occurs in North America wherever grapes are grown. It has been recorded from the eastern states, from California in the west, from Texas and New Mexico in the south, and from Ontario and Quebec in the north. Named and described for the first time by Say in 1825, it has long been known as a pest of grape vines, and has at times caused very serious losses, notably in California and in the Chautauqua and Erie grape belts.

In Canada the hopper is only of importance in the Niagara peninsula—the only section where grapes are grown on an extensive scale. In the past there have been many severe local outbreaks of the insect in the Niagara district, particularly in graperies adjoining bushland, wasteland and other places favourable for hibernation, but prior to 1921, as far as we can learn, there was no general outbreak throughout the district.

The 1921-22 Outbreak.

Early in July, 1921, we noticed that the Grape Leaf-hopper was present in injurious numbers in several graperies near Vineland, but we did not realize that there was a general outbreak of the insect until the end of the month, at which time the hopper made its presence known in different parts of the peninsula by the mottled and unthrifty condition of the grape foliage. Conditions were favourable for the increase of the pest, and by the time grapes were being cut the adults were so abundant in many vineyards that they annoyed the cutters by getting into their eyes and mouths. The adults went into hibernation in immense numbers, and this spring they emerged in full force, the mild winter having had little if any effect in diminishing their numbers. By the time the grapes were in leaf, most of the graperies were literally alive with leaf-hoppers. During the period the overwintering adults were on the vines, there were several heavy washing rains. For example, on May 25th there was a rainfall of 1.23 inches, on June 11th 3.08 inches, and on June 17th 1.38 inches. These rain storms reduced the number of adults to some extent (we found hoppers washed into the soil) but not to a sufficient extent to prevent a serious outbreak. During late June and early July hopper nymphs were present in immense numbers, as many as 100 to 800 being found on a leaf, and spraying had to be resorted to in order to prevent serious injury.

The badly infested area extended from the Niagara river to Grimsby—west of Grimsby the insect was abundant in some vineyards, but generally speaking it was of little importance.

It would not be out of place here to say a word about the campaign which was conducted in the Niagara district against the leaf hopper. By means of meetings, short timely articles and circular letters, practically every grape grower in the district was made acquainted with the leaf hopper situation and also with the methods of combating the pest. The success we had in disseminating this information was due largely to the co-operation of the Niagara District Grape Growers' Association, a selling organization with a membership of over 900 growers, covering over 90 per cent. of the total acreage of grapes. The association held meetings at different points for the purpose of discussing the leaf-hopper outbreak, and they sent out copies of the short circular letters, which we prepared, to all their members. As a result of this publicity campaign, most of the grape growers between the Niagara river and Grimsby sprayed their vineyards. In some of the worst affected sections from 95 per cent. to 100 per cent. of the growers treated their vines.

Life History.

The Overwintering Adult.

Description: See page 55.

Hibernation. The Grape Leaf-hopper passes the winter in the adult stage under fallen leaves, logs and rubbish; among clumps of grass and weeds; and in decayed tree stumps, etc. Woods and waste places, neglected road sides, headlands and ditches; old fence rows and hedges all afford the insect favourable quarters for wintering.

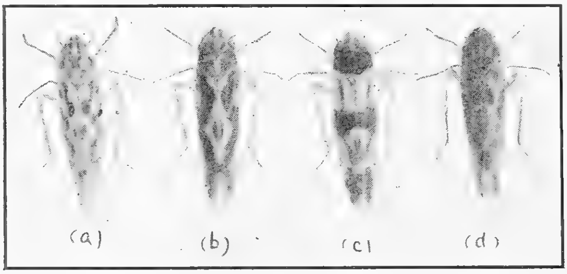
Activities in Early Spring. This spring during March and early April, the adult hoppers were quite active in their hibernating quarters on mild days, when the temperature was in the neighbourhood of 42 degrees F. to 50 degrees F. They jumped readily when disturbed; however, they did not commence to emerge from hibernation until the last week in April, about the time grape buds were commencing to swell. As shown by cage experiments and field observations, they continued to emerge over a period of three weeks.

Spring Food Plants. As there are no grape leaves at the time of emergence, the hoppers after their long winter siege are forced to feed on other plants. This spring they were observed first on the leaves of grasses, chickweed, dandelion, strawberry and raspberry, but later on they were found feeding on a large number of other plants, viz.: Sweet cherry, sour cherry, apple, peach, plum, white sweet clover, alsike clover, lucerne, yarrow, catnip, sheep sorrel, Canada thistle, shepherd's purse, hound's tongue, common plantain, wild geranium, bellwort, trillium, violet sp., daisy fleabane, dandelion and curled dock. Strawberry, raspberry and sweet cherry, however, appeared to be the favourite food plants. In a large cherry orchard near Beamsville the hoppers were present in myriads, and in walking among the trees one would hear a continual "rustle, rustle, rustle," made by the jumping insects. The leaves in this orchard became quite badly mottled as a result of the insects feeding activities.

MIGRATION TO GRAPES. About May 21st, or in other words, at the time the third leaf on the grape was showing, the hoppers commenced to migrate to the vineyards. The migratory period extended until about the second week in June; the majority of the hoppers, however, were on the grapes ten days after the migration began.

FEEDING HABITS. The leaf-hoppers feed on the under side of the grape leaves—a decided preference being shown for the lower leaves—and by means of their sucking mouthparts withdraw the juices from the plant tissues. As a result of this feeding, the leaves become mottled, and when badly affected, large, brown, dead areas develop on them. This spring the injury caused by the overwintering adults was sufficiently conspicuous to seriously alarm many of the growers.

MATING. Pairing takes place both on the spring food plants and on the grape. The hoppers copulate frequently and the mating season is extended over a considerable period.



Grape leaf hoppers x 10.
(a) E. comes. (b) E. comes ziczac. (c) E. tricincta.
(d) E. vulnerata.

Mating is accomplished by the male and female bringing the caudal ends of their abdomens together, so that their bodies form a straight line.

EGG-LAYING. By means of her sharp lance-like ovipositor, the female deposits her eggs just beneath the epidermis, almost altogether on the underside of the leaf.

Owing to the fact that the lower epidermis of the grape leaf on most of our commercial varieties is densely covered with pubescence, the eggs can be located only with the greatest difficulty. For this reason we found that the simplest method of ascertaining the duration of the egg-laying period was to subtract the period of incubation from the dates when the first and last hatched nymphs appeared. In this way we learned that in the graperies egg-laying commenced about May 24th,* (three to four days after the first adults arrived on the vines), reached its height about June 7th and ceased during the last week of June (June 28th.).

In the insectary, the egg-laying period of eleven females ranged from 18 to

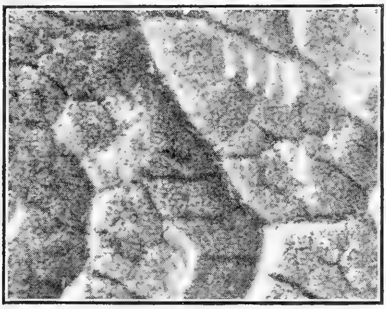
*On *Ampelopsis* eggs laid by *E. comes ziczac* were first observed on May 9th.

33 days, the average being 26 days; and the daily rate of deposition per female varied from one to nine eggs.

FECUNDITY. Quale, in California, found that the female leaf-hopper will lay from 40 to 121 eggs. In our experiments with eleven couples, only the eggs which actually hatched were counted (it was found to be impossible to do otherwise without mutilating the insectary plants) and the results were as follows: Maximum 89, minimum 38, average 70 eggs.

LENGTH OF LIFE IN SPRING. In the insectary, females lived from 77 to 87 days after emerging from their winter quarters, and males from 63 to 78 days. They commenced to die off about June 26th, and all had perished by July 20th.

In the field the adults began to disappear during the latter part of June, and most of them were gone by the second week in July. On account of the overlapping of the first brood adults with the hibernating forms, we were unable to ascertain just when the latter completely disappeared.



Grape leaf hopper eggs laid in an Ampelopsis leaf x 10.

THE EGG.

DESCRIPTION. The egg is an elongate, slightly bean-shaped, soft body. It is translucent creamy white in colour, and measures .63 mm. to .70 mm. long, by .16 mm. to .20 mm. wide.

LOCATION. As previously mentioned, the eggs are inserted just beneath the epidermis chiefly on the underside of the leaf, and on any part of the leaf surface. As many as one-hundred to over five hundred eggs may be deposited in a single leaf. They are generally laid singly; the variety *ziczac*, however, commonly lays its eggs in parallel rows with three to ten eggs in each group.

On smooth-leaved varieties of grapes and on the leaves of *Ampelopsis*, the eggs cause little blisters to form, and these egg blisters make it a very simple matter to locate the eggs with the unaided eye. However, on most common varieties of grapes, the eggs are completely hidden from view by dense pubescence.

PERIOD OF INCUBATION. In seven experiments with approximately 200 eggs of the first brood, and in nine experiments with about 200 eggs of the second brood, the period of incubation varied only slightly, viz., from 25 to 27 days.

DURATION OF EGG-HATCHING PERIOD. The period during which the eggs of the first brood hatched extended from June 19th, at which time the grape was coming into full bloom, to about July 24th. The majority of the eggs hatched before the second week of July. In table No. 1, the hatching of the eggs on nine marked leaves is shown. Nos. 1 to 3 were old leaves in which the earliest egg would be deposited; Nos. 4 to 9 were younger leaves:

TABLE No. 1, SHOWING DURATION OF HATCHING PERIOD OF 1ST. BROOD EGGS.

Date	Leaf No. 1	Leaf No. 2	Leaf No. 3	Leaf No. 4	Leaf No. 5	Leaf No. 6	Leaf No. 7	Leaf No. 8	Leaf No. 9
June 20	3	3	1	..	..	..	..	..	..
21	8	9	6	..	..	..	..	..	..
22	11	13	17	..	..	..	..	..	..
23	7	9	8	..	..	..	..	..	..
24	19	5	16	..	..	..	..	..	..
25	22	17	18	6	8	8	..	..	..
26	7	9	4	12	16	10	..	..	..
27	23	10	9	8	12	12	..	..	..
28	20	11	22	11	18	16	..	..	..
29	19	17	10	17	12	21	..	..	..
30	51	21	16	28	22	17	6	9	2
July 2	48	39	31	57	29	31	5	8	7
3	46	45	28	44	38	45	18	11	9
4	14	11	8	45	20	61	26	18	17
5	10	4	3	20	19	16	12	18	27
6	6	8	5	41	13	26	6	8	10
7	..	..	..	26	13	9	5	2	4
8	..	..	..	8	10	26	7	8	14
10	..	..	..	17	21	14	10	8	13
11	..	..	..	6	4	7	3	7	6
12	..	..	..	7	5	3	6	6	7
13	..	..	..	7	10	8	7	5	6
14	..	..	..	5	4	4	6	3	7
15	..	..	..	3	3	6	4	3	4
17	..	..	..	9	9	12	10	0	12
18	..	..	..	0	2	2	3	0	2
19	..	..	..	0	0	3	3	0	3
20	..	..	..	0	0	3	2	0	1
21	..	..	..	0	5	8	1	0	4
22	..	..	..	9	4	5	2	0	0
24	..	..	..	6	0	3	0	0	0
Totals—	314	231	202	503	287	376	142	114	145

Eggs of the second brood commenced to hatch about August 15th, and all had hatched by September 10th.

THE NYMPH.

Like other species of *Cicadellidæ* the grape leaf-hopper passes through five nymphal stages, or in other words it moults five times. Descriptions of the five nymphal instars are presented herewith:

First Instar. Size .79 to .84 mm. long by .25 mm. to .27 mm. wide. Body very frail and soft, translucent white with crimson eyes; head and thorax slightly broader than the abdomen which tapers to the caudal end; antennæ, thread-like; legs, translucent white; wing pads absent.

Second Instar. Size 1.36 mm. to 1.45 mm. long by .32 mm. to .36 mm. wide. Same as first instar except: Body creamy white, eyes becoming pearly; abdomen nearly as broad as thorax; light-yellow irregular spot toward the lateral margins of each thoracic segment, continued on to the head behind each eye; wing pads beginning to appear.

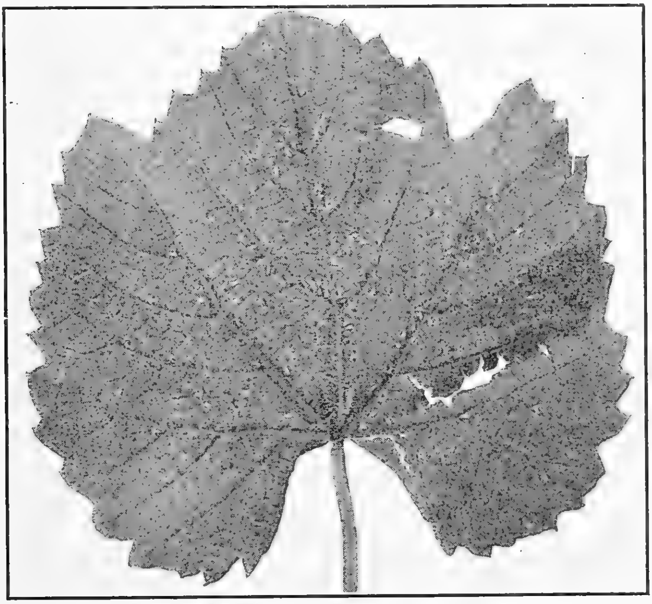
Third Instar. Size 1.72 mm. to 1.80 mm. long by .50 mm. to .55 mm.

wide. Same as second instar except the thoracic colour markings more pronounced, and the wing pads extend beyond the first abdominal segment.

Fourth Instar. Size 1.98 mm. to 2.16 mm. long, by .54 mm. to .72 mm. wide. Same as second instar except wing pads extend to posterior margin of second abdominal segment.

Fifth Instar. Size 2.61 mm. to 2.70 mm. long, by .72 mm. to .81 mm. wide. Same as second instar except wing pads extend to the fourth abdominal segment.

EMERGENCE FROM EGGS. When hatching occurs the shell of the egg and the leaf epidermis are ruptured, and the soft, round, glossy nymphal head begins to appear slowly—oozing out as it were, like a globule of sap. The nymph gradually wriggles its way out; the appendages which are folded beneath the body slowly become free, and the nymph walks off with a wobbling gait.

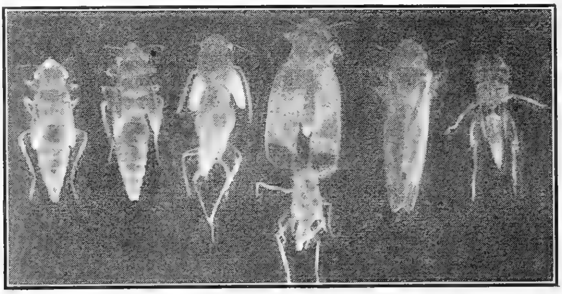


Recently hatched leaf hopper nymphs on grape leaf (natural size).

HABITS. The nymph inserts its mouth parts into the leaf tissues and commences to imbibe the plant juices an hour or two after it emerges from the leaf; and it continues to feed throughout its entire life except when moulting or when disturbed. It feeds altogether on the underside of the leaf, preferably alongside a vein or in the junction of two veins; but under crowded conditions it will insert its proboscis anywhere on the lower leaf surface.

Ordinarily the nymph will remain until reaching maturity on the leaf on which it was hatched out. It was commonly observed in the insectary that, even on the plants with fresh uninfested leaves, a small colony of nymphs would remain on one leaf until they reached the adult stage. On badly infested vines, however, the nymphs undoubtedly migrate to some extent. In making observations on the hatching of the eggs, it was frequently observed that leaves from which all nymphs had been removed became infested overnight with a few third, fourth and fifth instar nymphs.

Moulting. When about to moult the nymph attaches its claws to the surface and also inserts its mouthparts into the leaf tissue. The old skin splits along the middle of the front, vertex and prothorax, and the nymph with a slight wriggling motion gradually works its way out head foremost. The whole process takes between five and fifteen minutes, and the nymph shortly after moulting resumes feeding.



Last moult of grape leaf hopper nymph.

In the final moult the wings expand to full size as the body emerges from the old skin. The hopper then moves away a short distance and rests until the thin, transparent wings dry. The entire process takes about thirty minutes. The colour markings may not develop for several hours.

The exuviæ of the first four instars are lightly attached to the leaf and are soon blown away. The last moulted skin remains upon the leaf indefinitely.

Length of Nymphal Life. The duration of each instar and the total length of nymphal life of first and second brood nymphs reared in the insectary are shown in the following table:

First Brood	Minimum	Maximum	Average
First Instar	4 days	7 days	5.7 days
Second Instar	4 days	6 days	5.3 days
Third Instar	4 days	5 days	4.2 days
Fourth Instar	3 days	5 days	4 days
Fifth Instar	3 days	7 days	5 days
Total Nymphal Life	22 days	26 days	24 days

Second Brood	Minimum	Maximum	Average
		14 Individuals	
First Instar	4 days	5 days	4.2 days
Second Instar	4 days	6 days	4.5 days
Third Instar	4 days	6 days	4.5 days
Fourth Instar	4 days	5 days	4.5 days
Fifth Instar	4 days	5 days	4.5 days
Total Nymphal Life	21 days	25 days	24 days

Time of Occurrence of First Brood Nymphs. Newly hatched nymphs were first observed on June 19th, at the time grapes were coming into bloom. From three to ten nymphs to a leaf, the number rapidly increased until by the end of June 200-300 nymphs could be found on a leaf. During the first and second weeks of July, the inner and lower leaves on the vines were literally alive with nymphs—on leaves picked at random from 500 to 800 nymphs to a leaf were counted.

As shown in table No. 1, the nymphs continued to hatch out until about July 24th, and it was not until the latter part of August that all the nymphs of the first brood matured.

Time of Occurrence of Second Brood Nymphs. Second brood nymphs first appeared on August 15th; they continued to hatch out until about September 10th, and all had transformed to adults by October 9th.

The Summer Adult

Description. Say's description is as follows:

"Body pale yellowish; head, a transverse sanguineous line, profoundly arcuated in the middle, and a smaller transverse spot before; eyes fuscous; thorax with three sanguineous spots, the lateral ones smaller, and the intermediate one arcuated; scutel, a sanguineous spot at tip; hemelytra yellowish white spotted with sanguineous; spots arranged two at base, of which the outer one is small and the inner one elongated and abruptly dilated on the inner side at tip; two upon the middle, of which the outer one is elongated in a very oblique line; two behind the middle, of which the inner one is obliquely elongated, and the outer one smaller and interrupted; and a transverse linear one near the tip, ramose upon the nervures; feet whitish.

"Length to the tip of the hemelytra one-ninth of an inch.

"The line and spot on the head and the spots of the thorax are sometimes obsolete, but always visible, and the latter are sometimes connected by curving toward the anterior edge of the thorax. The spots of the hemelytra are also sometimes slightly interrupted, or connected into four oblique bands."

Colour Changes. During the summer the colour markings of the adults are yellowish. With the approach of autumn the coloured areas become salmon or light reddish, and when the insects go into hibernation the markings deepen into a conspicuous blood red, which colour is maintained throughout the winter. However, when the adults emerge in spring and begin to feed on the grape this colour fades to the light yellow, characteristic of the summer adults and remains light throughout life.

Egg Laying. In insectary experiments with six first brood couples, oviposition commenced six to nine days after the adults reached maturity, the average pre-oviposition period being seven days. Each female deposited from 22 to 46 viable eggs, the average being 29 eggs.* The period of oviposition of the individual varied from eleven to twenty-two days. As determined by subtracting the incubation period from the dates when the earliest and last newly hatched nymphs appeared, the egg-laying period of first brood adults in the vineyards extended from about July 20th to August 17th.

Length of Life. The adults which give rise to a second brood succumb before winter; the others go into hibernation, and, as previously stated, many of them survive until the following July. In the insectary all second brood progenitors perished before the end of September. The females lived from twenty six to forty-seven days with an average length of life of thirty-eight days, and the males from six to seventeen days, the average being fifteen days.

Proportion of Sexes. The males and females of this species are practically equal in numbers. In a collection of 2827 leaf hoppers captured in different vineyards throughout the district, the sex ratio was 48 males, 52 females.

*It should be mentioned that here again only the eggs which actually hatched were counted.

Number of Broods

There are two broods of the grape leaf hopper, but under our conditions the second brood is only a partial one. This season apparently only the first brood adults which matured during July gave rise to a second brood. In the insectary 7 colonies of leaf hoppers which reached the adult stage during the period July 15th to July 27th reproduced; on the other hand, 11 colonies which matured from July 26th to August 17th failed to lay any eggs and went into hibernation.

Nature of Injury

The leaf hopper both as a nymph and an adult feeds almost exclusively on the underside of the leaves, preferably close to the veins. The feeding results in the appearance of minute white points on the upper surface of the leaf, no doubt due to the destruction of the chlorophyl. These points coalesce and form white spots, which, as feeding progresses, become more numerous and form

Grape foliage injured by leaf hoppers.

pallid areas, until the whole leaf is mottled and pallid. On badly affected leaves brown dead areas form as a result of the death of the tissues, and in due course these areas may spread until the whole leaf is brown and dry. Severely injured foliage falls prematurely.

Early Injury. This year mottling caused by the feeding activities of the overwintering adults was quite noticeable on the inner and lower leaves by the end of May, and later on in many instances dead brown areas appeared on these leaves. This injury, although confined to the older leaves, made many vines look very unthrifty and was sufficiently conspicuous to alarm many growers.

Summer Injury. During July the feeding of myriads of nymphs and adults in unsprayed graperies gradually deprived the leaves of their green colour, and the vines became conspicuously pallid. The following month the foliage commenced to turn brown and to become dry and curled. Badly damaged leaves dropped prematurely, and as a result of this many vines were largely denuded of their foliage at the time the grapes were ripening.

RELATION OF LEAF INJURY TO THE QUALITY OF FRUIT. The injury to the leaf naturally affects the growth of the wood, but what is still more serious, it affects both the size and quality of the fruit. This season we noticed that grapes on badly infested vines did not attain their full size, and that they failed to ripen properly. Concord grapes instead of having the normal dark blue colour were reddish. As Hartzell has demonstrated by chemical analyses, grape leaf hopper injury has the effect of reducing the sugar and of increasing the acid content. In his experiments he found: (1) "That every sample of Concord from a sprayed section gave a gain in sugar over its mate in the adjoining unsprayed section. These increases varied from 8.4 per cent. to 68.1 per cent., an average of 27.0 per cent." (2) "That in every sample of unsprayed grapes except one, the amount of acid was greater than in the corresponding sample from a sprayed vine. The excess of acid in the unsprayed grapes as compared with those sprayed varied from 0 per cent to 20.6 per cent., an average of 11.2 per cent."

Analyses of Concord grapes this year gave the following results:

No.	Treatment	Brix Saccharometer	Dextrose Per Cent.	Acid Calculated as Tartaric Per Cent.	Sugar Ratio Dextrose Acid	B. A. R.
1	Sprayed.........	16.4	13.41	.855	15.7	19.18
2	Sprayed.........	16.4	13.75	.879	15.6	18.66
3	Unsprayed.......	11.1	8.62	1.121	7.7	9.90
4	Unsprayed.......	12.3	9.76	.892	10.9	13.79

ASSOCIATED SPECIES AND VARIETIES OF ERYTHRONEURA COMES

Along with *E. comes* two other species of *Erythroneura* and three varieties of *E. comes* were involved in the outbreak of leaf-hoppers, viz: *E. tricincta*, *E. vulnerata*, *E. comes vitis*, *E. comes ziczac*, *E. comes octonotata*. The distribution and proportionate occurrence of the different species and varieties in the Niagara peninsula are shown in table No. 3.

E. tricincta Fitch. Fitch's description is as follows:

"Pale yellow with three broad bands, the anterior velvet black, occupying the thorax and basal half of scutel; the middle bright ferruginous ending outwardly in black, forward of the middle of the elytra, the posterior dusky brown on the apex. Length, 0.12 inch."

Between St. Catharines and the Niagara river *tricincta* was the dominant species, in fact in some vineyards near the river it almost completely displaced *comes*.

Field observations and preliminary insectary experiments indicate that the life history of this species is very similar to that of *comes*. Some data, secured from a comparative study of two colonies of each of the three species of grape leaf-hoppers, are shown in table No. 2.

TABLE NO. 2—SHOWING SIMILARITY OF LIFE HISTORIES OF THE THREE SPECIES.

First Brood	E. Comes	E. Tricincta	E. Vulnerata
Eggs Commenced Hatching...........	June 20th	June 21st	June 23rd
Earliest Nymphs Matured............	July 14th	July 13th	July 18th
Duration of Nymphal Stage...........	23-25 days	22-23 days	26-27 days
Second Brood			
Eggs Commenced Hatching...........	Aug. 15th	Aug. 13th	Aug. 19th
Earliest Nymphs Matured............	Sept. 8th	Sept. 4th	Sept. 16th
Duration of Nymphal Stage...........	25-26 days	24-26 days	27-29 days

E. vulnerata Fitch. Fitch's description is as follows:

"Fulvous brown, spotted and lined with whitish; elytra with an abbreviated yellowish-white vitta on the outer margin, interrupted near the middle by an oblique black line, and toward the apex by an oblique sanguineous one; tips dusky, with whitish nervures and spots; a whitish medial line common to the vertex, thorax and scutel; beneath black, legs pallid. Length, 0.12 inch."

This species occurred in considerable numbers at and east of Vineland (see table No. 3). Apart from the fact that the nymphs of *vulnerata* mature somewhat more slowly than those of *comes*. there are apparently no outstanding differences between the habits and life histories of the two species.

E. comes vitis Harris. Description:

"Mostly red above, with two transverse yellow lines on the elytra, surrounding a large central red or brown spot."—(Gillette.)

Vitis was taken in large numbers only in one vineyard (Port Dalhousie) and here it was found breeding almost exclusively on Clinton vines.

E. comes ziczac Walsh. Description:

"Like *comes*, except that the zigzag line running from the humerus to the inner margin and thence to the cross-nervures of the elytron is broad and smoky or blood brown in colour."—(Gillette.)

This variety occurred on grapes in comparatively insignificant numbers but it was very abundant on and injurious to *Ampelopsis* vines. On *Ampelopsis* the first brood nymphs hatched out and reached the adult stage two weeks earlier than those of *comes* on grape vines. In spite, however, of the early maturing of the first brood nymphs the second brood was surprisingly small. The eggs of variety *ziczác* were commonly found laid parallel to each other in groups of from three to ten eggs.

Table No. 3—Showing Proportionate Occurrence and Distribution.

Locality	Number Examined	E. comes	Var. 8-notata	Var. Ziczac	Var. Vitis	E. Tricincta	E. Vulnerata	Empoasca mali
Queenston (Ramsay)	387	5%	....	....	3%	90%	2%	....
Virgil (Taylor)	710	15%	....	....	....	80%	....	5%
Niagara Township (Bufton)	800	15%	....	....	....	85%	....	....
Niagara Township (Lee)	391	18%	....	....	....	75%	....	7%
St. Catharines (Counsell)	408	15%	....	....	....	85%	....	....
St. Catharines (Davis)	510	37%	....	....	....	58%	....	5%
St. Catharines (Coles)	500	51%	....	1%	....	48%	....	....
Port Dalhousie	612	20%	....	3%	*38%	35%	2%	2%
(Barnesdale)	695	36%	....	2%	2%	55%	....	7%
Vineland (Arnott)	605	82%	4%	2%	....	....	10%	2%
Vineland (H. E. S.)	402	52%	....	12%	....	3%	5%	28%
Vineland (Rittenhouse)	470	98%	1%	....	....	....	....	1%
Beamsville (Hobden)	483	65%	7%	5%	....	8%	15%	....
Beamsville (Cox)	419	76%	2%	1%	....	7%	14%	....
Grimsby "Mountain"	210	91%	3%	....	....	....	4%	2%
Winona "Mountain"	310	80%	3%	....	....	....	16%	1%
Winona (Carpenter)	487	48%	4%	3%	....	29%	16%	....
Vinemount	380	56%	1.5%	5%	....	....	35%	2%

*Clinton variety of grape.

CONTROL

Spraying

Spray Material. The grape leaf-hopper nymph is very susceptible to nicotine sprays, and is easily destroyed with as weak a dilution of nicotine sulphate as 1-1600. Spraying experiments conducted during the past two years with nicotine sulphate 1-1600 in combination with different materials, indicate that the addition of lime, soap, kayso or bordeaux does not increase the efficiency of the spray to any marked degree, at least it does not when the spraying is done very thoroughly. However, in spite of this, we would not advise growers to use nicotine sulphate alone. This year we urged them to combine the nicotine with bordeaux mixture, and most of them did so. We believe that the bordeaux more than paid for itself by checking to a greater or lesser extent fungus diseases, and by stimulating the vines.

Time of Application. With reference to the time when the hopper spray should be applied, the usual recommendation in the past has been to spray when the maximum number of nymphs are present and before many have transformed to adults; or in other words, when the vast majority of the eggs have hatched. It is not a particularly simple matter (as we found out from experience) to ascertain when the majority of the eggs have hatched, in view of the fact that the eggs are hidden within the leaf tissues. This year we decided that the maximum number of nymphs were present by the end of the first week of July, at which time a few first brood adults had commenced to appear in early graperies, and we advised the growers to spray their vineyards the following week, July 10th to 15th. In all cases where the spraying was thoroughly done during the second week of July, excellent commercial control was secured, but our experience indicates that spraying a week earlier, especially in the early sections, would have been still more effective. Two badly infested graperies at Vineland were thoroughly sprayed on July 3rd and 4th. At this time the most advanced nymphs were on the point of changing from the 4th to the 5th instar. The majority, however, were first and second instar nymphs. This spray destroyed practically all the hoppers, and much to our surprise it also apparently destroyed most of the eggs, because, although the eggs were hatching in large numbers on adjoining vines, only an insignificant number hatched in the two early sprayed graperies. In order to secure confirmatory data regarding the ovicidal value of nicotine sulphate, we sprayed leaves on July 8th with nicotine sulphate, (1) 1-1600, (2) 1-1200, (3) 1-800 and marked some other leaves as "checks." In each experiment lime was added to the nicotine sulphate. On the leaves sprayed with 1-1600 no eggs hatched for 11 days, and after that only 4.4 eggs per leaf hatched. On the leaves sprayed with 1-200 and 1-800, 3.2 and 1.8 eggs per leaf hatched respectively, but no nymphs appeared until 12 days after the application. On the "check" leaves 88.2 eggs per leaf hatched. The evidence secured from these tests and from the two early sprayed graperies that nicotine sulphate destroys the eggs and that eggs on the point of hatching are most susceptible, appears to us to be pretty conclusive, however, in order to secure more positive information regarding this matter, we have planned to conduct a series of experiments in the laboratory with definite numbers of eggs and with eggs of known age.

And now to come back to the question of when the leaf-hopper application should be made, we are of the opinion that it should be put on when the most advanced nymphs are in the fifth instar. In cases where it takes a week or longer to spray the vines, spraying operations might well be started when the earliest nymphs are in the fifth instar. Spraying at the time we recommend gives just as good, if not better, control of the first brood nymphs as later spraying; it practically eliminates the second brood; in dry seasons it should lessen the danger of staining the fruit; and most probably it would prove to be of greater value in preventing fungus diseases than later spraying.

SPRAYING RESULTS IN THE INFESTED DISTRICT. As previously mentioned, a very large percentage of the growers in the leaf-hopper affected district sprayed their vines with bordeaux mixture and nicotine sulphate, or lime and nicotine sulphate. In most graperies the bordeaux-nicotine combination was used. As we expected, the results varied from almost perfect control to practically no control; however, we are pleased to say that in the majority of cases, good results were obtained. For example, in thirty-two graperies which we inspected in the Vineland-Beamsville section, good commercial control was secured in no less than twenty-six of them. In the other six, the results were unsatisfactory, due to lateness or to carelessness in making the application.

The most important lessons learned from this year's experience are as follows:

(1) That thoroughness in spraying is more than half the battle. In order to do thorough work, it is essential to use angle nozzles, good pressure and liberal quantities of the spray mixture. By liberal quantities we mean sufficient material to wet practically all the under surface of the foliage—the exact amount required to do this may vary from 120 to 250 gallons per acre, depending on the density of the foliage.

(2) That early spraying i.e. before any nymphs have transformed to adults, will give the most clean cut results.

DUSTING

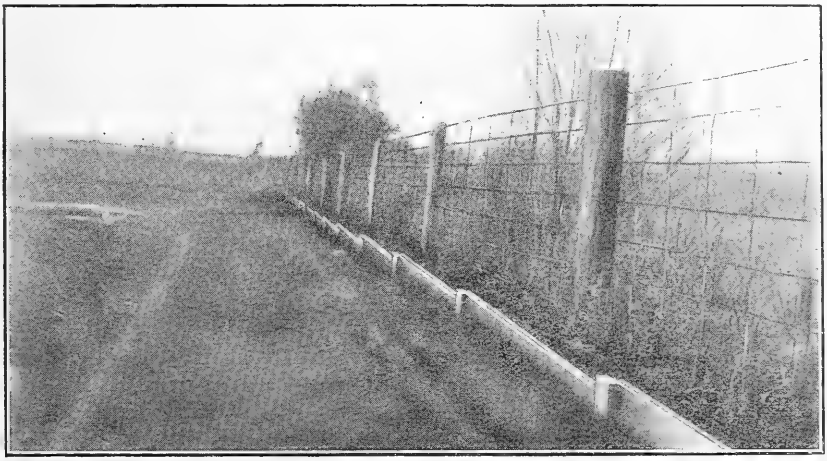
This year lime-nicotine dust containing 2.2 per cent. nicotine was tested on a fairly extensive scale when the hoppers were in the nymphal stage. The dust was applied by means of a Niagara power duster with a vineyard distributor. When the application was made under ideal weather conditions, the dust brought most of the nymphs to the ground, and results comparable with those secured from thorough spraying were obtained. It was observed that a considerable percentage of the nymphs brought to the ground recovered, and that some of them returned to the vines by crawling up the posts and grape trunks. However, only an inconsiderable number of them actually got back to the leaves. (In one dusted grapery we noticed ants carrying the nymphs off). Different amounts of dusts varying from 20 to 60 lbs. per acre were used, but out experience indicated that 35-40 lbs per acre was the most economical and effective dosage. With improved dusts and machinery, we are of the opinion that this amount could be cut down very materially.

With our present outfits effective work can only be done with contact dusts when the atmospheric conditions are very calm. Unfortunately, as we found out from experience, these conditions, in sections bordering the Lake Ontario, are seldom present when wanted. Only too frequently this past season dusting operations had to be suspended even at night and early in the morning because the air was not sufficiently calm. Dusting is largely a fumigation process—it is the nicotine fumes which kill the insects—and if some means could be devised whereby the fumes could be held longer among the foliage, the efficiency of contact dusts would be greatly increased. It is possible that this could be effected by shooting the dust into a light canvas structure with a top and two side pieces, suspended over the grape row from a boom. This idea is given for what it is worth.

MECHANICAL DEVICES AS AIDS IN THE CONTROL OF THE STRAWBERRY ROOT WEEVIL (*O. ovatus* L.)

W. Downes, Gordon Head, B.C.

Experimental work on Stawberry Root Weevil control has been carried on during the last four years at Gordon Head near Victoria, British Columbia, and one of the principal features of this work has been the trial of various weevil-proof barriers. It was realized early in the work that while the established methods of keeping the weevil in check by the use of proper crop rotation, and by ploughing up infested fields in the fall, were efficient enough so far as they went, yet these methods did not prevent the weevils from passing from one plantation to another and re-infesting newly-planted fields. Moreover, efficiency in control by cultural methods only, is dependent very largely in a closely settled district upon co-operation between neighbouring growers, and with the varying opinions held by many as to the best cultural practices and weevil control methods, such co-operation is nearly impossible to bring about. The desirability

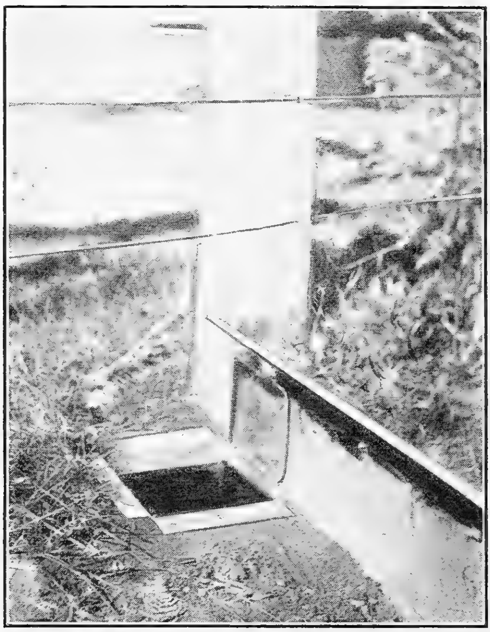


Crude oil barrier at Gordon Head, B. C.

was apparent, therefore, of providing some barrier or device which would make a grower independent of his neighbour's plans. Also, weevil control by cultural methods entails the replanting of fields every third year, as even with the best of care it is generally found that only two crops of berries can be depended upon.

To meet this deficiency in our weevil control methods two types of weevil-proof barrier have been tried at Gordon Head. Both of these barriers have given excellent results, in that it has been found possible not only to keep plantations nearly free from attack, but by their use to destroy the hordes of adult weevils passing from one plot to another or from adjoining infested land, so that the menace from their presence is removed and the risk of infestation annually becomes less.

The first kind of barrier tried was of the tanglefoot type, as first suggested in 1912 by Prof. Lovett in Oregon. It is constructed of 1″ x 12″ lumber, set on edge about two or three inches in the soil and supported at the joints by 2″ x 6″ posts eighteen inches in length to which the boards are nailed or bolted. Bolts are preferable to nails as warping is thereby largely overcome and the barrier can be readily taken apart. Those portions of the lumber that enter the ground are tarred. A band of tanglefoot is smeared along the upper edge. Since the wood absorbs a certain amount of the tanglefoot it is a good plan to give the upper two inches a coat of paint and if cedar lumber is used this is essential. On the sides chiefly exposed to the sun it has been found a good plan to place an overlap of half inch by four inch wood. Staples are driven into the edge of the overlap and other staples passed through them and then driven into the top of the barrier, thus forming a hinge so that the overlap can be raised when the sticky band requires attention. One or two nails are driven through the tanglefoot to keep the overlap from touching. It was found that a band protected in this way lasted three times as long as one without, as the effect of exposure to the direct rays of the sun is to dry out the tanglefoot. About every fortnight the tanglefoot must be scraped to keep the surface in good condition or as often



Trap No. 2 at Keatings, B.C., which captured 17,000 weevils.

as it becomes dust coated and when it has been in use about three months it should be removed entirely and a fresh band spread. If properly constructed and kept in good condition this is an entirely efficient barrier, but it was found almost at the outset that it could be immensely improved by placing traps to catch the weevils at intervals along the outside of the barrier. Strawberry Root Weevils cannot fly and coming to the barrier they have a natural tendency to follow it along on the soil surface rather than attempt to cross it, so that if traps formed of shallow flat sided tins filled with coal oil and water are sunk in the ground against the side of the barrier, the weevils fall in and are drowned by thousands.

The trap I have used with much success is formed of half a coal oil tin sunk in the soil against the side of the barrier. The edges should be turned back at right angles for about an inch and pressed down flat on the surface of the soil. At the back, against the side of the barrier a sheet of glass is fixed by two or three small nails, and the tanglefoot strip brought down to meet the glass, so that the weevils crawling along the barrier are forced to walk onto the glass. The tin is partly filled with water and about a cupful of coal oil is poured on top. The traps are more effective if the glasses are kept well cleaned. The weevils either fall directly into the trap or walking on the glass slip off that into the water. It has been found necessary to fix a "leader" or strip of wood at each side of the glass to induce the weevils to walk on it. These strips are the same thickness as the glass where they touch it and are bevelled to a thin edge at the other side.

Recently the efficiency of these traps was strikingly illustrated. A grower had placed a tanglefoot barrier around two sides of a badly infested plot of about one acre in extent to prevent the weevils from crossing onto newly planted land adjoining. A trap as above described was placed at each end of the barrier and one in the angle at the corner of the plot. The corner trap (No. 1) was put down in the first week in July and those at the ends (Nos. 2 and 3) on the 12th of August. The number of weevils destroyed was extraordinary. The traps were cleaned out on September 1st and about two quarts of weevils were taken out of No. 1 and half the quantity out of No. 2. After the weevils had been dried and foreign matter removed, the numbers were computed by dividing the weight of 6,000 weevils, carefully counted, into that of the bulk. According to this method there were approximately 44,660 weevils in trap No. 1, and 17,000 in trap No. 2. Trap No. 3 was not counted, owing to the putrid condition of the contents, but there were fully as many as in trap No. 2. Consequently the total number of weevils caught in these three traps could not be far short of 80,000. In each trap there were several dead mice, and in one the remains of a bird and a lizard. Their putrefying bodies gave an odour to the entire contents which made the job of counting a most unsavoury one, so that after completing the examination of traps 1 and 2 the writer concluded that he had done enough.

The following is an analysis of the different kinds of insects caught and it shows that the number of useful species destroyed is not very appreciable:

TRAP NO. 1 (in use for 2 months)

O. ovatus	44,660	Spiders	15
Other weevils	33	Hymenoptera	5
Carabidæ	77	Hemiptera	4
Silphidæ	11	Termites	4
Staphylinidæ	1	Coccinellids	6
Sow Bugs	60	Grasshoppers	3
Lamellicorns	19		

TRAP NO. 2 (in use for 3 weeks)

O. ovatus	17,000	Sow Bugs	32
Other weevils	17	Spiders	4
Carabidæ	33	Hemiptera	26
Silphidæ	5	Coccinellids	2
Staphylinidæ	8	Diptera	1

The second type of barrier combines the advantages of a barrier and trap in one. It is constructed of heavy lumber, usually 2″ x 10″ with a V-shaped groove in the upper edge. The groove is 1½ inches deep and 1 inch wide. It is supported at the joints by 2″ x 6″ posts, and the ends of the groove are blocked and rendered oil tight. The groove is filled with crude oil of the type used for spreading on roads. This kind of barrier needs very little attention, beyond seeing that the groove contains sufficient oil and that leaks do not occur. It has the disadvantage that it can only be used on level or nearly level land and on sloping land it must be built in steps to keep the troughs level and a little tanglefoot is placed at the joints where the weevils might cross. It is almost impossible for weevils to cross such a barrier. They have been seen to crawl through the oil but they never survive. This type of barrier is at present the one most generally used by growers in the Victoria district. It was first used at Gordon Head by Mr. G. Vantreight who placed a barrier of this description between two of his plots and thereby saved his young plantation from destruction by the weevils crossing from the old plot. Later we used an improved form of this barrier on our experimental plots. Access to the field is by means of a panel which can be removed to allow a team to pass.

The cost of these devices is an important matter, and hitherto there has been a certain amount of objection to them on the score of expense. The costs have now been greatly reduced, and one important fact must not be lost sight of, that these costs are not an annual charge, because the barriers last for a number of years. The barriers can now be erected for a sum of from $60 to $78 for one acre including labour, the cost for several acres being proportionately less. The annual upkeep in the case of a tanglefoot barrier would be $25 and for an oil barrier $10 per acre. The *minimum* time that the barriers would be expected to last is three years, and thus the total expense for three years would be approximately from $90 to $120 or from $30 to $40 per acre per year. But as a matter of fact the barriers will last very much longer than this and there is no reason to suppose that given ordinary care and protection against decay when first erected that the lumber would not last for five or six years. We are still using at Gordon Head lumber that has been in use for four years which only received a coat of paint and it appears to be still in serviceable condition.

It has been difficult, owing to the fact that growers have had two unprofitable years in succession, to induce them to spend anything at all on weevil control, and they do not realize that the expense is spread over a number of years. The average value of a full crop of strawberries in this district is $800 per acre, so that the annual charges suggested above are not by any means high. Growers who are using barriers are unanimously in favour of their use. As one of them, who had at first been rather sceptical, remarked to me the other day: "I can see now that this thing is going to pay for itself many times over."

To sum the matter up, it appears as if the growing of strawberries between barriers in a weevil infested territory was coming to be a recognized necessity. Local growers are becoming strongly impressed with the idea, and recognize that the immunity from weevil attack which the barriers provide will abundantly justify the outlay. One of the principal advantages claimed for the barriers is that a grower can now depend on obtaining more than two crops from one planting and owing to freedom from weevil the fields may remain in strawberries for four years or even longer. The presence of other pests than weevils, however, may upset this comfortable belief, but at present there seems to be no doubt that the adoption of these aids to weevil control will be of the greatest value in obtaining larger returns for the strawberry grower.

RECENT WORK ON THE ROSE CHAFER IN ONTARIO

W. A. Ross and J. A. Hall, Dominion Entomological Laboratory, Vineland Station

In certain sandy sections of Ontario, such as at Fenwick, Oakville and Simcoe, the rose chafer has proved to be an extremely troublesome and destructive pest of grapes, other fruits, flowering plants, etc. At Fenwick the rose chafer has been particularly injurious for a number of years. For example, in 1921 it destroyed practically the whole crop in several graperies in that district, besides injuring other crops. The high prices obtained for grapes in 1921 made the growers feel this loss very keenly, and at a meeting held in Pelham Centre on March 15th, they passed a resolution strongly urging the Dominion Department of Agriculture to send an Entomologist to their district to investigate the chafer problem. A petition to the same effect was forwarded to the Deputy Minister of Agriculture by the Pelham Township Council. In response to these requests, the junior writer was sent to Fenwick the latter part of May, and for the next three months or so, devoted his whole time to a study of the rose chafer and its control. The following notes are based on this study and on observations made in previous years.

Rose chafers feeding on apples.

Food Plants and Nature of Injury

The rose chafer feeds on the blossoms, fruit and leaves of a host of plants; in fact, it is almost omnivorous. It destroys the blossoms and newly-set fruit of grapes, and skeletonizes the foliage, although this leaf injury is seldom important. It eats out holes in apples, peaches and other fruits—we have found as many as twelve beetles clustering on one small apple. It may defoliate sweet cherry and peach trees. It may skeletonize strawberry plants, as it commonly did this past year; and much to the distress of amateur gardeners, it plays havoc with the blossoms of roses, peonies and some other ornamentals. Generally speaking, it shows a preference for the blossoms of its food plant, if these are present. The following list of food plants, in which the plants are presented more or less in the order of their susceptibility, will give some idea of the catholic taste of the chafer.

Grapes, Roses, Peonies, Sumac, Sweet Cherries, Strawberries, Milkweed, Wild Grape, Apples, Peaches, Raspberries, Blackberries, Virginia Creeper, Corn, Beans, Rhubarb, Ox-eye, Daisy Bracken, Dock, Sorrel, Beets, Cabbages, Peppers, Chestnut, Walnut, Sour Cherries, Plums, Birch, Mountain Ash, Grasses, Poison-Ivy, Smartweed, Mullein, Red and White Clovers. The beetle is also said to attack: Quince, Magnolia, Poppy, Hollyhock, Foxglove, Willow, Alder, Tulip Tree, Sassafras, Sour Gum, Oak, Hawthorn, Dogwood and Elder.

In the Fenwick infested area no chafers were found on the following cultivated plants: Currants, Gooseberries, Potatoes, Tomatoes, Onions, Tobacco, Sweet Clover and Peas.

Chafers Poisonous to Chickens. Chittenden and Quaintance in Farmer's Bulletin No. 721, U.S.D.A., state that cases have been reported of hundreds of chickens being killed by eating rose chafers. They refer to experiments conducted by Lamson, which indicate that the body of the rose chafer contains a neurotoxin, probably derived from the plants on which it feeds, and that this poison affects the hearts of small animals such as chickens. Last June we received a report from Oakville to the effect that a large number of chickens had died as a result of eating chafers. On investigating this, we found that considerably over 100 range chickens from five to six weeks old had been killed. In a post-mortem examination, 68 chafers were found in one chicken, and 32 in another. Only one chicken older than six weeks died, and it was about four months old. According to the owner of the flock, hens and young turkeys refused to eat the beetles.

A. Grape blossom cluster destroyed by rose chafers. B. Normal blossom cluster.

LIFE HISTORY

The Adult

The adult is an ungainly, somewhat slender, long-legged beetle about 3-8 inch long. The wing covers are reddish-brown, the head, thorax and ventral surface are blackish in colour; and the whole body is densely covered with small yellowish hairs, which make the beetle look as if it were fawn-coloured.

Emergence. In 1921 the beetles were first noticed at Fenwick on June 2nd. This year they commenced to emerge from the soil on June 4th, five days before Concord grape blossomed; they continued to emerge for almost two weeks, and by mid-June they were present in immense numbers. After emerging, and before invading the graperies and gardens, the beetles generally clung for sometime to the grass and weeds growing near the place of emergence, hence it was no uncommon sight to see the grass and weeds in a neglected field literally alive with chafers.

Habits. The beetles are very voracious—they feed and keep on feeding and do not even allow mating to interfere with their feeding. As mentioned before they show a decided preference for the blossoms when these are present.

Mating commences shortly after the adults emerge, and copulating couples may be found almost as long as any beetles are present. It would appear that up to the time egg-laying commences, mating is almost continuous.

EGG-LAYING. The females deposit their eggs in sandy soil—in grain and grass lands, in neglected fields, and to a lesser extent in cultivated land such as cornfields, raspberry patches and graperies. So far as we could ascertain they do not oviposit in heavy soils.

In egg-laying the chafers burrow into sandy soil and lay the eggs at a depth of from three to six inches. The females apparently are not very prolific. Smith found that the number of eggs deposited by a female varied from 24 to 36, and in our experiments with eight couples, the average was 27 eggs per female.

According to our field observations oviposition commenced on June 15th, that is, eleven days after the earliest beetles emerged.

DURATION OF CHAFER SEASON. The beetles were present in large numbers for about three weeks and then they commenced to disappear and some four weeks later they were all gone. The length of adult life apparently varies from about three to five weeks.

THE EGG

The egg is oval, smooth, shining-white in appearance, and is about 1.2 mm. long.

We found the eggs laid in groups of from six to 25 at a depth of from three to six inches in the soil—each egg in a separate pocket.

HATCHING AND PERIOD OF INCUBATION. The duration of the period of incubation is about two and one-half weeks. The earliest hatched larvæ were found in the field on July 3rd, that is 18 days after the first eggs were deposited. Eggs kept in pill boxes hatched in from 15 to 16 days.

THE LARVA

The larva is very much like a small white grub. When full grown it is about three-quarters of an inch long.

HABITS. The larvæ feed on the roots of grasses, grains and some weeds, and our observations indicate that they also feed to some extent on the roots of clovers. During the summer they occur in uncultivated land at a depth of from one to three inches. They are almost full grown by fall, and on the approach of winter, they descend to a depth of six to 16 inches*, and there they spend the winter. In spring they come near the surface again and resume feeding. During the latter part of May they transform to the pupal stage. Pupation commences about the time the third leaf of the grape is showing. This past year on May 20th—our first day at Fenwick—a very large percentage of the larvæ had pupated.

In heavily infested sections the larvæ are present in the soil in very large numbers. We frequently found over 100 larvæ to the square yard, and in one field at Fenwick we counted 549 larvæ in one square yard and 510 larvæ in another.

*On November 11th, 1922, out of a total of 1,176 larvæ 970 or 82.48 per cent. were found in the top 6 inches of the soil, 202 or 17.18 per cent. between 6 and 8 inches, and only 4 or .34 per cent. between 8 and 10 inches. On December 23rd, 1922, out of a total of 723 larvæ only 3 or .41 per cent. were found in the top 6 inches, 286 or 39.55 per cent. at a depth of 6 to 10 inches, 344 or 47.58 per cent. at a depth of 10 to 14 inches, 73 or 10.1 per cent. at a depth of 14 to 18 inches and 17 or 2.36 per cent. at a depth of 18 to 24 inches. 689 larvæ or 95.29 per cent. were located between 6 and 16 inches from the surface.

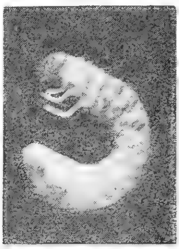
The Pupa

The pupa is about one-half inch long, is yellowish-brown in colour and has the shrivelled larval skin attached to the posterior end. It is found in the soil in a little earthen cell, at a depth of three to seven inches.

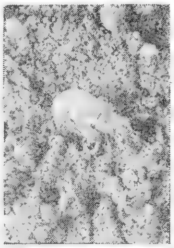
Duration of Pupal Stage. An attempt was made to determine definitely the duration of this stage. Larvæ and pupæ were reared in pill boxes, but all succumbed before reaching the adult stage. Our observations in the field indicate that the insects are in the pupal stage about three weeks.

Breeding Grounds

During the latter part of May, a survey was made of sections of the infested area at Fenwick, in order to locate the principal breeding grounds. As a rule, in doing this work, the owner of the farm which was being surveyed was requested to accompany us, and in this way we were able to show the growers where the insects were breeding.



Rose chafer larva or grub x 2.



Rose chafer pupa (natural size).

Some of the data secured from this survey are as follows:

Neglected raspberry patches: Six plots (1 square yard) were examined and from 68 to 177 larvæ and pupæ per square yard were found, the average being 115.

Uncultivated graperies: Seven plots were examined and from 16 to 135 insects per square yard were found, the average being 84.

Land in grass during 1821-22: Nine plots were examined, and from 18 to 105 insects per square yard were found, the average being 45.

Land in oats or wheat during 1921: Six plots were examined and from 20 to 51 insects per square yard were found, the average being 30.

Well-kept lawns proved to be practically free.

Rather to our surprise only an insignificant number of insects were found in roadsides at Fenwick. However, this fall at Oakville, roadside plots yielded from 40 to 184 larvæ per square yard, with an average of 84.

In land which had been planted to corn, potatoes or grapes, and which had been well cultivated during the season of 1921, no pupæ or larvæ were found.

No insects were located in clay, clay loam or in gravelly soils.

The breeding places were largely confined to areas near graperies.

Surveys of sections of the Fenwick and Oakville infested areas made this fall, furnished us with additional evidence that neglected sandy fields are the all-important breeding places, and that the rose chafer does not breed at all in heavy soils. It is of interest to note here that in a common at Fenwick, 549 larvæ were counted in one square yard.

Control

Cultivation

It is very evident from what has been said that the importance of cultivation as a means of combating the rose chafer cannot be over-emphasized. We have mentioned that the ovipositing adults are not attracted to cultivated fields to the same extent that they are to uncultivated land, and we have also referred to the fact that land in which cultivated crops such as corn and potatoes are grown, will be free or practically free from larvæ and pupæ the following spring. We have no information so far relative to the value of fall ploughing or of early spring cultivation, but we do know that the ploughing and cultivating of infested fields during the latter part of May and early June, or in other words, during the period the insect is in the pupal stage, is very fatal to the chafer. The pupæ are very readily destroyed by cultivation. Our field observations last spring indicate that all or practically all the pupæ which were disturbed by the plough and cultivator died. In eight cage experiments stirring the soil destroyed 100 per cent. of the pupæ.

Spraying

In 1921 two spray mixtures, *viz:* (1) arsenate of lead powder three lbs, molasses one gallon, water 40 gallons and (2) self-boiled lime sulphur (8-8-40), were tested in three graperies at Fenwick, the growers making the applications themselves. The sweetened arsenate of lead gave good commercial control on grapes, and was found to be even more effective on sweet cherries. On the other hand self-boiled lime-sulphur proved to be absolutely useless, and where it was applied practically the whole crop was destroyed by the beetles. This was rather surprising in view of the fact that self-boiled lime-sulphur is used for repelling rose chafers in New Jersey. Personally, we could not see that it had any value as a deterrent, as we found the beetles attacking blossom clusters and foliage well coated with spray.

This year we made a special effort to get all the growers in the affected district to spray their grapes, and our efforts met with a very large measure of success. Several growers expressed themselves as being skeptical about the value of spraying. They informed us that experience had shown them that the chafer "grew fat" on arsenate of lead. However, they were willing to give what we suggested a trial. The spray mixture we recommended and the one which was generally used consisted of four lbs. arsenate of lead powder, one gallon molasses, 40 gallons of water. We increased the dosage of arsenate of lead to four lbs, in order to increase the liability of the beetles consuming a killing dose before they were repelled by the toxic effects of the arsenical. For psychological reasons we wanted to make it possible for the grower to readily find dead beetles near his sprayed vines, and we are glad to say that the increased dosage had the desired effect. The growers, even the skeptics, had no trouble in finding fairly large numbers of dead beetles in the sprayed graperies.

The number of applications given varied from one to four, depending on the severity of the infestation, and on the weather conditions. We had several heavy rains during the chafer season, and this made it necessary in most cases to put on extra applications. In the average season one or two sprays should be sufficient.

The spray mixture proved very effective in saving the crop of grapes. In twenty-four sprayed graperies the average estimated loss was three per cent., while in seven unsprayed graperies the estimated loss was 84 per cent.

In the grapery which we sprayed, three applications of sweetened arsenate of lead gave almost perfect protection. The chafer injury was so trifling that we did not attempt to express it in terms of a percentage.

Sweet cherry trees, one-year-old strawberry patches, cabbages and peppers were also sprayed with sweetened arsenate of lead, and in all cases the spray gave good results.

OTHER SPRAY MATERIALS. Three applications of bordeaux mixture with an excess of lime (4-25-40) proved to be useless as a deterrent. Practically all the blossoms were destroyed on the row sprayed with this material. Calcium arsenate (three lbs. powder, five lbs. hydrated lime, 40 gallons), was quite ineffective in protecting the crop. A 10 per cent. nicotine sulphate dust was also tested, but failed to kill the beetles.

Recommendations for Control

Our present recommendations for the control of the rose chafer are as follows:

In affected districts an organized effort should be made to reduce waste sandy land to a minimum. As much of the land as possible should be worked, and, if possible, fields should not be left in grass for longer than one season.

As much as possible of the land surrounding the vineyards should be kept in cultivated crops, such as corn and potatoes.

Old neglected fence rows should be broken up.

All breeding places should be ploughed and cultivated frequently at the time the chafers are in the pupal stage, that is, from about May 20th to June 10th.

Grape vines, sweet cherry trees and one-year-old strawberry patches should be sprayed as soon as the beetles attack them with arsenate of lead powder four lbs., cheap molasses one gallon, water 40 gallons. Especially in the case of graperies one, two or more extra applications may be necessary, the number of sprays of course depending on the severity of the infestation and also on the weather conditions, in view of the fact that heavy rains wash the material off. We have no information relative to the value of this spray as a means of protecting apples.

OVIPOSITION OF HYPERA PUNCTATA

H. F. HUDSON AND A. A. WOOD, DOMINION ENTOMOLOGICAL LABORATORY, STRATHROY

During our preliminary studies on the life history of the clover leaf weevil, the opportunity to study the act of oviposition has occasionally occurred. So far as the present writers are aware the published data on this rather interesting point is somewhat meagre, and these observations may add something to our general knowledge. They have all been made under insectary conditions, at different hours of the day and night, and may to a certain extent coincide with conditions as met with in the field. In choosing a suitable location for egg deposition unusual care is exercised. The fresh succulent petioles with a more or less solid stem are never chosen unless to deposit a mass on the side of the stem. A petiole that is mature or slightly withered, having a partially hollow centre, is usually selected. Generally eggs are introduced into the petiole through a very small puncture, just above the sheath, or about ¾ inch below the leaflets, although they may be placed anywhere along the stem. Large masses may be laid outside on the petiole or in the sheath; in the latter case a small puncture is made in the side and the eggs introduced. Eggs may sometimes be laid on the glass, but this is rather unusual except with the first batch of eggs, which is usually infertile. When opportunity was given eggs were freely laid in wheat stems. Temperature perhaps is a more important factor in egg laying than darkness. A cold night will retard egg laying, in fact at a temperature between 45° and 50° egg laying ceases. Cool nights also retard feeding, but with the morning sun the beetles become active and egg laying may be accomplished at any hour of the day. Were it not for these daytime ovipositions these observations would never have been recorded, for to approach the breeding cage at night with a light will instantly cause the female to leave the plant and seek seclusion. But in the daytime when the female has started in earnest to lay, the hand lens may be safely used for she will not leave her work or position. The following are some notes made during the act of oviposition:

Morning of September 15th. The female in breeding cage No. 17 was noticed to be very uneasy walking up and down the plant, and carefully surveying the situation. Having selected a petiole that seemed suitable to her liking the leaf was severed in six minutes. After accomplishing this she secreted herself beneath the leaf. Remaining there only a few minutes she proceeded up the stem again. Bracing herself to the petiole, she began rasping a small hole. She did not feed. Just a minute was required to make the opening. Thirty-six movements of the body were noted in the placing of nine eggs. The time occupied was a little over seven minutes. Contrary to the observations of some authors the eggs are forced up or down the stem by the ovipositor not by the rostrum. The beetle under observation did not change her position, and when the stem was opened it was found there were five eggs above the puncture, two below, and the balance inserted at the puncture. Those at the base and nearest the puncture were more compressed than those higher in the petiole. This is quite frequent, and can be commonly observed in splitting open a small stem. An egg puncture is quite different to a feeding puncture. In the latter case the puncture is larger and smooth, while in the former it is much smaller and the opening is left rough.

September 19th. Visiting the insectary at 12.45 p.m. a female was observed completing an egg mass of nine eggs on a green petiole, near the base of the plant. An egg puncture had been made, but for some reason did not prove satisfactory, and the mass was laid at the side of the puncture. She was hanging on the stem, head downwards, just below the egg mass, and for nearly one minute continued to probe the eggs with the genital plates until they were adhering to each other and to the plant. They were noticed to be quite "rubbery," indentations made by each thrust of the plates were quite deep, but the egg instantly regained its shape, no mark being left on the shell. Contrary to expectations the beetle did not inspect her completed work, but walked away without turning around. After a tour around the cage she ate nearly half a clover leaf and retired to seclusion. The elasticity of the egg was tested with a needle and found to be very great, fully equal to the strain of being pushed up a hollow petiole. In hundreds of eggs examined which were laid inside the petiole not a single egg was found to be broken.

October 10th. At 8.24 a.m. a female was observed making a puncture in the under side of a horizontal petiole. She reversed her position, inserting her ovipositor immediately, and in three minutes laid a single egg in the cavity. After withdrawing the ovipositor two minutes were spent in sealing the aperture. In an egg puncture no material is eaten out. A small hole is chiselled through and the opening made by bending back the little flap of tissue like a hinge. If no egg is left in the opening this is all smoothed down and usually sealed tight with a glue-like secretion used on the eggs. The present instance, however, was the only one noted where no liquid was used in the operation. Whether due to the position of hanging under the petiole or not could not be seen. The plant was throughly examined but found to contain only three eggs. Feeling certain that all eggs for the day had not been laid the beetles were transferred to a more inviting plant. The female at once proceeded to make a puncture in a petiole one-half inch above the sheath. This operation took five minutes, then the position was reversed with head down. One egg was laid in three and one-half minutes. Very little movement of the body was noted in the process. After the egg had passed into the ovipositor it was forced out by pressure from the genital plates. When the ovipositor was withdrawn two eggs were on the surface laid in one and one-half minutes. The most remarkable feature of external oviposition is the drastic treatment given the egg mass after being laid on the outside of the plant. The genital plates are partially opened, to be used as a battering ram, the eggs being pounded about with such apparent carelessness, that it seems strange they are not all broken. A copious flow of liquid, and a rubbery pliant egg shell is all that saves them from destruction. This cementing process occupies two to three minutes, a little fluid being secreted at intervals on the eggs, and the plant surface where the eggs are to be fastened. This continual battering of the eggs finally forces them all together, and in close contact with the freshly glued stem surface. where they are fairly secure after the liquid dries. This beetle, which had been under close observation with the hand lens, rested a few moments, then made a puncture in the sheath of the same petiole, reversed her position and at once began to lay a mass. Twenty-four eggs were deposited in twenty-five minutes. The mass was well coated with fluid. The eggs were all introduced through the puncture in the same way, each egg pushing the one before it farther in.

THE SUNFLOWER MAGGOT (*Straussia longipennis* Wied.)

J. Eric Brink

The cultivated sunflower is coming to hold a very important place as a silage crop in Western Canada and in other regions where corn does not thrive. The utilization of this plant as a feed for dairy cows is economically important, not only for the reason that it is well adapted for soiling and silage purposes, but because it is suited to a wide variation of climatic and soil conditions. It is an exceptionally hardy plant, even resisting 5° or 6° of frost.

Corn has always been looked upon as the king of silage crops in sections where it is grown. But the European Corn Borer is proving to be a serious pest to the corn grower. The wave of the Chinch Bug northward in the great corn belt has made farmers in certain sections actually abandon its cultivation. So far the sunflower has been immune to the ravages of the European Corn Borer and also of the Chinch Bug.

From this one can readily see that the sunflower is gaining recognition as a silage crop. As the old saying is "There is a bug for everything," so the sunflower has its enemy in the sunflower maggot. The earliest record found in regard to this fly was in 1887, when it was discovered in the State of Maine ovipositing in sunflower stalks. Since then it has been recorded in California, Maine, New York, Alberta, and Ontario, showing that it is generally distributed over the North American continent. Its host plant is almost entirely the sunflower, both cultivated and wild. It has however, been found attacking Jerusalem artichokes (*Helianthus tuberosus* L).

The sunflower fly is a true dipterous fly belonging to the family Trypetidæ. The general colour of the adult is yellow; a few black hairs on both the upper and lower surface of the thorax; legs medium length resembling the body in colour. The abdomen is a little narrower than the thorax, and is slightly darker in appearance, owing to the numerous black hairs that cover it. On an average the wings are seven m.m. long and three m.m. wide; the entire margin is armed with small black bristles. The banding of the wings resembles somewhat the letters "U F," as you may see from the specimens passed around.

The time at which the first flies emerge would depend somewhat on the temperature and moisture conditions. It would also vary in different localities. At Port Stanley this summer the first fly was found on the 29th of May. The maximum emergence was from June 3rd to June 14th; adults may, however, continue to emerge up to August. Of all the flies throughout the season approximately 60 per cent. were females. The average length of life of the flies is 21 days, although some lived in cages for a much longer time. It was very difficult to find out definitely the pre-oviposition period but it is believed to be about 13 days.

Before laying the female moves from plant to plant in a very nervous and restless manner until she finds a suitable spot. She then rises on her feet and inserts her sharp sting-like ovipositor by repeated thrusts. The whole operation requires from 30 to 40 seconds.

In 14 feet of wild sunflower stalk there were 53 punctures and only 31 eggs, showing that only 58.5 per cent. of the punctures contain eggs.

The egg is very small, semi-transparent, almost elliptical, and about three times as long as wide. It is perfectly smooth. The egg requires from five to six days to hatch.

The larva is cream coloured. The body consists of 13 segments and is stout, tapering gradually to the anterior end. It is from seven to eight m.m. long when full grown and 1.5 to 2 m.m. wide.

The injury is caused by the larvæ. They scratch the pith with two small black hooks, and then suck up the juice, soon causing the pith to turn brown or black. As the larvæ grow they work towards the ground, and by the end of the season in many stalks the whole of the pulp is eaten out, thus weakening the stalk and causing many to fall over. On September 27th fully 1,400 stalks were counted, and 10.4 per cent. of them had broken over. In many of the stalks a mold sets in where the pulp has been destroyed. We tried to have the infested stalks analysed to find the actual loss in food value. But the chemistry department said that they could not determine that.

Counts were also made of the seeds in the heads of the infested sunflowers. Approximately 50 per cent. of the seeds were empty. Counts were also made of the heads in uninfested stalks and 13 per cent. of the seeds were empty. This shows that 37 per cent. of the seeds fail to develop, directly due to this fly.

The maggots remain in the stalk from the time they hatch until the fall, when they leave the stalk, and enter the ground to pupate. This year they began to pupate the 8th of September, and all had left the stalks by the 21st of September. The larvæ near the base enter the ground right through the stalk, while others further up bore their way out wherever they are and drop to the ground.

No control measures have as yet been worked out. At the California Experimental Station attempts were made to control these flies with the hydrocarbons and oil of citronella, but this was a complete failure. Since the adult flies have similar feeding habits to the cherry fruit flies, I believe that the same control could be used, *i.e.*, spraying with arsenate of lead. However, this is still to be tested.

NOTES ON THE SEED POTATO MAGGOT

(*Hylemyia trichodactyla* Rond.)

G. H. Hammond, Entomological Branch, Department of Agriculture, Ottawa.

There are few records of injury by the Seed Potato Maggot from North America, and, so far as can be determined, there are no records of injuries by this insect to turnips.

The following notes are now presented in reference to this crop as the result of some observations made during the past summer (1922) at Ottawa.

On August 2nd, a report was received by the Dominion Entomological Branch of severe root injury to turnips in a field near Ottawa. Investigation showed that the tap root of the plants was being cut through about the ground level. The injured surfaces were found to be rather evenly cut, the root being completely separated from the plant in many instances. In all the plants examined there was no evidence of direct tunneling into the turnips. On the date above mentioned the roots were approximately two inches in diameter and the injured seedlings were, in the majority of cases, already shrivelled and dying, and some which survived the initial injury were throwing out a lateral root system. In an acre fully 65 per cent. of the plants were attacked and approximately 50 per cent. of the plants were injured beyond hope of recovery. In many cases all of the plants in ten feet of row were destroyed. The injury was not localized, but was distributed generally throughout the field. The owner, Mr. W. F. Bell, stated that the injury had been noted for over a week and that the type of injury was new to him.

In an examination of the injured roots, puparia were found in the sandy soil two inches deep and within half-an-inch from the root. These puparia resembled those of the Cabbage Maggot (*H. brassicæ*), but were somewhat smaller. Some larvæ were also found feeding in the slight hollows on the upper portions of the main root at the ground level. These larvæ, on a superficial examination, resembled the Seed-corn Maggot (*Hylemyia cilicrura*).

Adults were reared in due course and they have been identified by Mr. H. C. Huckett, of the Agricultural Experiment Station, Geneva, N.Y., as *H. trichodactyla* Rond.

From an article by Johanssen in the Journal of Economic Entomology, Vol. XIV., December, 1921, this insect is recorded in Canada from Truro, N.S., and Sandford, Ont. In the Canadian National Collection of insects there are eleven specimens of *Hylemyia trichodactyla*, three collected by Mr. W. Metcalfe, at Brockville, dated September 13th and 20th, 1903; seven by the late Dr. James Fletcher, at Ottawa, dated August 25th, 1908, and one from Chateauguay Basin, dated August, 1910, probably collected by J. F. Jack. The specimens collected by Dr. Fletcher were taken off asters, according to information on the pinned specimens; it seems unlikely that they were reared from asters, but were probably taken from these plants in general collecting.

To these records we may now add those reared from turnips at Ottawa, which became adult on August 21st and 22nd, 1922, after a puparium stage of approximately seventeen days.

In Europe, reports of injury from this species apparently are common. Young cucumber vines, beans, asparagus and seed potatoes are recorded as being injured. In America the seed potato seems to be most commonly attacked, hence the name.

Johanssen, in the former reference, states that the species is "widely distributed," but reports of injury to crops are rare and very little is known of the life-history in America.

Females of *H. cilicrura* and *H. trichodactyla* are difficult to distinguish, but the males may be separated by the armature of the middle tarsus, which in the latter species has a few long bristly hairs on the upper (extensor) side of basal segment.

The larval characters, of which an account is given by Johanssen, show the close relationship of this species to *H. cilicrura*, *H. brassicæ* and *H. antiqua;* but from the structure of the mouth hooks *H. trichodactyla* is probably more closely allied to *H. brassicæ* than the others.

THE ENTOMOLOGICAL RECORD, 1922

NORMAN CRIDDLE AND C. HOWARD CURRAN, ENTOMOLOGICAL BRANCH, DOMINION DEPARTMENT OF AGRICULTURE, OTTAWA

We regret that the records of rare captures available for the Entomological Record of 1922, are largely from collectors in the Dominion Government service; in other words, from professional rather than from amateur collectors. A few exceptions occur, however, more noticeably in Manitoba, and we have to particularly express our appreciation of Mr. J. B. Wallis, who has sent in a long list carefully arranged in order for inclusion in the Record.

As is well known, the Entomological Record was originated by the late Dr. James Fletcher largely to aid and encourage amateur collectors, and its maintainance has been mainly with that object in view. We hope, therefore, that the present number will prove useful in that respect. We would urge once again the necessity of sending in records in good time in order that we may have the manuscript in the printers' hands by the first of February.

It should be of general interest to Canadian collectors to know that the Systematic Staff of the Entomological Branch has now made sufficient headway in arranging the collections to be able to determine the species of several orders with accuracy. This is now true of Lepidoptera, Diptera, with some exceptions, Ephemeridæ, Odonata, Orthoptera and certain Coleoptera. We hope this fact will be taken advantage of by those who find difficulty in determining insect material.

There is still a great deal to be done by Canadian collectors before the many rich entomological fields have been adequately explored. Hundreds of new species await the collector and many others will have to be taken before an accurate idea of our insect fauna is available.

We wish once again to express our indebtedness to our fellow-workers in the United States and in Europe for assistance in determining species in various groups and for that courtesy which we believe is proverbial among Entomological workers.

There has been some overlapping in years due to publications not appearing on time. Several of the 1922 numbers have not been issued at this date.

NOTES OF CAPTURES

Species preceded by an asterisk (*) described since the last Record was prepared.

LEPIDOPTERA

Pieridæ

63. *Eurymus interior* Scud. Algonquin Park, Ont., June 17, (J. McDunnough); Victoria Beach, Man., (G. S. Brooks).

Lycænidæ

430. *Plebeius sæpiolus* Bdv. Algonquin Park, Ont., June 17, (McDunnough).
432. *Plebeius yukona* Holl. Edmonton, Alta., July (D. Mackie).

Sphingidæ

749. *Amphion nessus* Cram. Victoria Beach, Man., May 24, (Brooks).

Arctiidæ

955. *Diacrisia vagans kasloa* Dyar. Lethbridge, Alta., (Seamans).

Noctuidæ

1097. *Rhodophora gauræ* A. & S. Lethbridge, Alta., (Seamans).
1191. *Schinia jaguarina* Gn. Lethbridge, Alta., (Seamans).
1215. *Copablepharon longipennis* Grt. Lethbridge, Alta., (Seamans).
1241. *Euxoa brevipennis* Sm. Lethbridge, Alta., (Seamans). New to Canada.
1272. *Euxoa detersa* Wlk. Lethbridge, Alta., (Seamans).
1273. *Euxoa intrita* form *strigilis* Grt. Edmonton, Alta., Aug., (D. Mackie).
1503. *Lycophotia nanalis* Grt. Lethbridge, Alta., (Seamans). New to Canada.

* *Xylotype arcadia* B. & B. Digby, N.S., Sept. 1907, (J. Russell). Barnes and Benjamin, Cont. Nat. Hist. Lep. N.A., Vol. V, No. 1, 1922.

* *Oncocnemis lepipoloides* McD. Lethbridge, Alta., Aug. 24, (H. L. Seamans).

* *Oncocnemis youngi* McD. Departure Bay, B.C., Aug., (C. H. Young).

* *Oncocnemis columbia* McD. Salmon Arm, B.C., July, (W. R. Buckell).

* *Trachea pluraloides* McD. Lethbridge, Alta., July, (Seamans).

* *Euplexia veresimilis* McD. Ottawa, Ont., (J. McDunnough). The above five species described in Can. Ent., Vol. LIV, No. 10, 1922.

2160a. *Graptolitha tepida atincta* Sm. Edmonton, Alta., Aug., (Mackie).
2211. *Conistra signata* Frch. Lethbridge, Alta., (Seamans). New to Canada.

* *Escaria homogena* McD. Lethbridge, Alta., June 28, (W. Carter). Can. Ent., Vol. LIV, No. 10, 1922.

2586. *Acopa perpallida* Grt. Lethbridge, Alta., (Seamans). New to Canada.
2613 *Menopsimus caducus* Dyar. Edmonton and Nordegg, Alta., (Bowman).
2759. *Stiria rugifrons* Grt. Lethbridge, Alta., (Seamans). New to Canada.
2790. *Bellura diffusa* Grt. Edmonton, Alta., June, (R. Atcheson).
3012a. *Sarrothripus revayana lintnerana* Spey. Edmonton, Alta., July, (Mackie).
3055. *Catocala parta* Gn. Lethbridge, Alta., (Seamans).
3056. *Catocala luciana* Stkr. Lethbridge, Alta., (Seamans). New to Canada.
3094. *Catocala gracilis* Edw. Victoria Beach, Man., (Wallis aud Brooks); Malarche, Ont., (L. H. Roberts).
3013. *Catocala ultronia* Hbn. Rosebank, Man., (Davidson and Wallis); Victoria Beach, Man., Aug., (Brooks and Wallis).

* *Catocala orion* McD. Lethbridge, Alta., Aug. 31., (Seamans). Can. Ent., Vol. LIV, No. 12, 1922.

3333. *Syneda alleni* Grt. Victoria Beach, Man., June, (Brooks).
3562. *Bomolocha bijugalis* Wlk. Edmonton, Alta., July, (Mackie).
3571. *Bomolocha toreuta* Grt. Edmonton, Alta., July, (Atcheson).

Notodontidæ

* *Cerura occidentalis gigans* McD. Calgary, Alta., (Wolley Dod). Can. Ent., Vol. LIV, No. 6, 1922.

Drepanidæ

3758. *Oreta irrorata* Pack. St. Vital, Man., July (J. D. Suffield).
3760. *Drepana arcuata* form *geniculata* Grt. Victoria Beach, Man., Aug., (Wallis).

Geometridæ

* *Lygris lugubrata bowmani* Swt. and Cass. Cadomin, Alta., Aug.. 1919, (Bowman). Lepidopterist, Vol. III, No. 9, 1922.

* *Xanthorhoe aquilonaria* Swt. and Cass. Atlin, B.C., June, 1914.
* *Xanthorhoe incursata harveyata* Swt. and Cass. Vancouver, B.C., July, (R. V. Harvey).
These two species described in Lepidopterist, Vol. III, No. 8, 1922.
* *Xanthorhoe ramaria delectaria* Swt. and Cass. Atlin, B.C., June 28, 1914, (E. H. Blackmore).
Lepidopterist, Vol. III, No. 9, 1922.
4148. *Eupithecia obumbrata* Taylor. Edmonton, Alta., July, (Mackie).
* *Eupithecia nordeggensis* Swt. and Cass. Pocahontas, Alta., June, 1918, (Bowman).
* *Eupithecia stikineata* Swt. and Cass. Stikine, B.C., May, 1905, (Blackmore).
* *Eupithecia anataria* Swt. and Cass. Goldstream, B.C., Sept., (Blackmore).
The above described in Lepidopterist, Vol. III, 1922.
4486. *Nepytia canosaria* Wlk. Victoria Beach, Man., Aug., (Wallis).
4654. *Ellopia fiscellaria* Gn. Edmonton, Alta., Sept., (Atcheson).

Pyralidæ

5415. *Thaumatopsis pectinifer* Zell. Aweme, Man., Aug., (Criddle).
Pyraustra ainsliei Hein. Wawanesa, Man., (E. Criddle); in wild parsnip; Rockcliffe, Ont., (Young).
5585. *Glyptocera consobrinella* Zell. Aweme, Man., June, (Criddle).
* *Scoparia truncatalis* McD. Norway Point, Lake of Bays, Ont., July, (McDunnough).
* *Acrobasis alnella* McD. Ottawa, Ont., July, (McDunnough).
The above in Can. Ent., Vol. LIV., No. 2, 1922.

Gelechiidæ

6355. *Trichotaphe flavocostella* Clem. Aweme, Man., June, (Criddle).
6376. *Trichotaphe fernaldella* Busck. Aweme, Man., May, (Criddle).

Eucosmidæ

* *Exartema troglodanum* McD. Meach Lake, Que., June, (Young).
* *Exartema furfuranum* McD. Ottawa, Ont., June, (Young).
* *Exartema rusticanum* McD. Onah, Man., July, (Criddle).
* *Exartema fraternanum* McD. Ottawa, Ont., July, (Young).
* *Exartema terminanum* McD. Ottawa, Ont., July, (James Fletcher).
* *Argyroploce apateticana* McD. (*deceptana* McD.). Ottawa, Ont., July, (Young).
* *Argyroploce tertiana* McD. Ottawa, Ont., June 15, (Young).
* *Argyroploce buckellana* McD. Salmon Arm, B.C., May 28, (W. R. Buckell).
* *Argyroploce sordidana* McD. Nordegg, Alta., July, (McDunnough).
* *Argyroploce thallasana* McD. Aweme, Man., July, (Criddle).
* *Argyroploce aspasiana* McD. Mer Bleue, and Ottawa, Ont., July, (Young).
* *Argyroploce castorana* McD. Nordegg, Alta., July, (McDunnough).
* *Argyroploce polluxana* McD. Nordegg, Alta., July, (McDunnough).
* *Argyroploce carolana* McD. Ottawa, Ont., June, (Young).
* *Argyroploce vulgana* McD. Nordegg, Alta., July, (McDunnough).
* *Argyroploce nordeggana* McD. Nordegg, Alta., July, (McDunnough).
The above new species described in Can. Ent., Vol. LIV, No. 2, 1922.

6974. *Eucosma transmissana* Wlk. Aweme, Man., June, July, (Criddle).
7102. *Thiodia octopunctana* Wlshm. Tressbank, Man., July, (Criddle).
7203. *Ancylis tineana* Hbn. Aweme, Man., May 25, (Criddle).

Tortricidæ

7282. *Adoxophyes furcatana* Wals. Aweme, Man., June, (Criddle).
Tortricodes horariana Wals. Aweme, Man., Sept. 20, (Criddle).

Coleoptera

(Arranged according to Leng's Catalogue of the Coleoptera of America North of Mexico—1920.)

Cicindelidæ

45. *Cicindela limbalis* Kl. Ft. Norman, N.W.T., Aug. 9, (C. H. Crickmay). Not quite typical.
45b. *Cicindela limbalis spreta* Lec. Ft. Wrigley, N.W.T., July 23, (Crickmay).
53. *Cicindela tranquebarica* Hbst. Ft. Norman, N.W.T., Aug., 14, (Crickmay).
59. *Cicindela longilabris* Say. Victoria Beach, Man., July-Aug., (Roberts, Brooks, Wallis).
* *Cicindela fulgida wallisi* Cald. Penticton, B.C., Aug. 13, 1909, (J. B. Wallis); Okanagan, B.C., Aug, 22, 1914, (Tom Wilson).
* *Cicindela fulgida westburnei* Cald. Westburne, Man., Aug. 14, (Wallis). The above two species described in Can. Ent., Vol. LIV, No. 3, 1922.

Carabidæ

* *Elaphrus chairivelli frosti* Hipps. Terrace, B.C., (W. W. Hippesley). Can. Ent., Vol. LIV, No. 3, 1922.
* *Dyschirius perversus* Fall. Miami, Man., (Wallis).
* *Dyschirius interior* Fall. Baldur, Man., June-July (Wallis and Criddle). Can. Ent., Vol. LIV, No. 8, 1922.
435. *Bembidion cheyennense* Csy. Baldur, Man., July, (Wallis, Davidson, Criddle).
590. *Bembidion dilatatum* Lec. Treesbank, Man., Aug. 7, (R. M. White).
* *Bembidion obtusidens* Fall. Baldur, Man., June-July, (Criddle, Vroom, Wallis, Roberts).
Can. Ent., Vol. LIV, No. 8.
603. *Bembidion salinarium* Csy. Baldur, Man., July, (Wallis, Criddle, Roberts, Robertson, White).
725. *Bembidion muscicola* Hayd. Aweme, Man., Aug. 29, (Criddle).
1575. *Platynus bembidoides* Kby. Aweme, Man., (Criddle).
1646. *Lebia atriceps* Lec. Lethbridge, Alta., May 26, (H. L. Seamans).
1712. *Calleida purpurea* Say. Kamloops, B.C., Apr. 20, (P. Vroom); Whitla, Alta., Sept. 10, 1922 (W. Carter).
1806. *Chlænius tomentosus* Say. Aweme, Man., Sept. 25, (E. Criddle).
1878. *Geopinus incrassatus*, Dej. Winnipeg, Man., June 23, (Wallis).

Dytiscidæ

2539. *Agabus seriatus* Fab. Aweme, Man., Sept. 20, (R. M. White).
* *Agabus sharpi* Fall. Winnipeg, Man., (Wallis); Grimsby, Ont., (Pettit).
* *Agabus triton* Fall. Edmonton, Alta., May 1917 (F. S. Carr); Winnipeg, Man., May 1911 (Wallis).

2547. *Agabus confertus* Lec. Mile 17, H.B. Ry., Man., July, 1917, (Wallis). Determined with some doubt by Prof. Fall.

2555. *Agabus bicolor* Kby. Mile 214, H.B. Ry., Man., July 1917, (Wallis).

2559. *Agabus inscriptus* Cr. Mile 332, H.B. Ry., Man.; Peachland, B.C., Aug., 1919 (Wallis).

* *Agabus canadensis* Fall. Aweme East and Winnipeg, Man., July and June, (Wallis).

* *Agabus ontarionsis* Fall. Makinak, Man., (Fanshaw); Belleville, Ont.

* *Agabus ajax* Fall. Waghorn, Alta.; Aweme East, Man., (Wallis and Roberts); West St. Modest, Labrador, (Sherman).

2560. *Agabus congener* Payk. Winnipeg, Man., (Wallis).

2562. *Agabus ambiguus* Say. Winnipeg, Man., April; Stonewall, July, Aweme East, July, (Wallis).

2563. *Agabus confinis* Gyll. Mile 214, H.B. Ry., Man., (Wallis).

2564. *Agabus discolor* Harr. Mile 332, H.B. Ry., Man.; Onah and Winnipeg, Man., July (Wallis).

2565. *Agabus lutosus* Lec. Peachland, B.C., Aug. 1919, (Wallis).

2566. *Agabus phæopterus* Kby. Winnipeg, Stonewall, Aweme East and Mile 332, H. R. Ry., Man., also Peachland, B.C., (Wallis).

2571. *Agabus infuscatus* Aube. Mile 332, H.B. Ry., Man., (Wallis).

2573. *Agabus morosus* Lec. Peachland, B.C., August 1919, (Wallis).

2575. *Agabus anthracinus* Mann. "Widely distributed in Man." (Wallis).

2576. *Agabus arcticus* Payk. Mile 214, H.B. Ry., Man., July, (Wallis).

* *Carrhydrus crassipes* Fall. Edmonton, Alta., June 14, 1916, (F. S. Carr).

The above genus has recently been revised by H. C. Fall—A Review of the North American Species of Agabus, John D. Sherman, Jr., publications—in which the above new species are described. Mr. Wallis has also made a special study of the group and we include these records on the joint authority.

2598. *Ilybius biguttulus* Germ. Thornhill, Man., July 1, 1916, (Wallis).

Gyrinidæ

2700. *Gyrinus analis* Say. Onah, Man., May 24, 1912, (Wallis).

* *Gyrinus latilimbus* Fall. British Columbia, (Keen); Searchmont, Ont.

2702. *Gyrinus opacus* Sahl. Mile 332, H.B. Ry., Man., July, (Wallis).

2706. *Gyrinus impressicollis* Kby. Mile 214, H.B. Ry., (Wallis).

2707a. *Gyrinus lagens* Lec. Mile 214, 332, H.B. Ry., Man., (Wallis).

* *Gyrinus befarius* Fall. Le Pas and Mile 332, H.B. Ry., Man., July, (Wallis); St. Dennis, Que. (Ouillet).

* *Gyrinus wallisi* Fall. Le Pas, Mile 214, 256, H.B. Ry., Man., July, 1917, (Wallis); Ontario (Evans).

* *Gyrinus lecontei* Fall. Toronto, Ont.

* *Gyrinus pleuralis* Fall. Lethbridge, Alta., (Wallis).

The above new species of Gyrinidæ are from Trans. Am. Ent. Soc., Vol. XLVII, No. 4, 1921.

Hydrophilidæ

2852. *Cymbiodyta lacustris* Lec. Stonewall, Man., May 25, 1919, (Wallis).

2875. *Cercyon ocellatus* Say. Miami, Man., June 17, (Wallis).

Staphylinidæ

4553. *Ontholestes capitatus* Blan. Aweme, Man., (R. M. White).

Corynetidæ

7696. *Phyllobæus dislocatus* Say. Aweme, Man., (E. Criddle).

Meloidæ

* *Macrobasis subglabra* Fall. Edmonton, Alta., (F. S. Carr). Can. Ent., Vol. LIV, No. 8, 1922.

Buprestidæ

9318. *Chalcophora angulicollis* Lec. Victoria Beach, Man., July, (B. and G. S. Brooks, L. H. Roberts).
9333. *Dicerca divaricata* Say. Aweme, Man., June 22. In Prunus, (Criddle).
9353. *Pæcilonota thureura* Say. Aweme, Man., July 1920, (Criddle).
* *Pæcilonota montanus* Chamb. Makinah, Man., (J. M. Swaine).
* *Pæcilonota fraseri* Chamb. Fraser River, B.C., (Weldt). The above two species described in the Jour. N.Y. Ent. Soc., Vol. XXX, No. 1, 1922.
9369. *Buprestis subornata* Lec. Faulkland, B.C., July 26, 1922, (P. Vroom).
9372a. *Buprestis nuttalli consularis* Gory. Victoria Beach, Man., (Wallis).
9373a. *Buprestis læviventris alternans* Lec. Victoria Beach, Man., July 9, (Wallis).
9513. *Agrilus ruficollis* Fab. Victoria Beach, Man., July, (Brooks, Roberts, Wallis). On raspberry.

Helmidæ

9615. *Helmis vittatus* Melsh. Treesbank, Man., July 6, (Criddle).
9618. *Helmis quadrinotatus* Say. Glen Souris, Man., July, Sept., (Criddle and White).

Tenebrionidæ

12008. *Embaphion muricatum* Say. Grassy Lake, Alta., (H. L. Seamans).

Bostrichidæ

12898. *Lichenophanes armiger* Lec. Treesbank, Man., (T. Criddle).

Scarabæidæ

13345. *Trox atrox* Lec. Lethbridge, Alta., June, (Seamans).
13654. *Dichelonyx testacea* Kby. Lethbridge, Alta., (Seamans).

Cerambycidæ

14384. *Acmæops subpilosa* Lec. Peachland, B.C., June 20, (W. Metcalf).
14391. *Acmæops longicornis* Kby. Peachland, B.C., June, (Metcalf).
14486. *Leptura plagifera* Lec. Peachland, B.C., July, (Wallis).
14518. *Leptura præstans* Csy. Peachland, B.C., July 22, (Wallis).
* *Leptura aspera parkeri* Hipps. Terrace, B.C., (W. W. Hippisley). Can. Ent., Vol. LIV, No. 3, 1922.
14984. *Leiopus cinerus* Lec. Aweme, Man., (Criddle and White).
15118. *Saperda imitans* Felt and J. Treesbank and Glen Souris, Man., (H. A. Robertson).

Chrysomelidæ

15305. *Exema gibba* Oliv. Aweme, Man., June 20, 1922, (R. M. White).

Diptera

(Arranged according to "A Catalogue of North American Diptera" by J. M. Aldrich. The numbers refer to the pages of the catalogue.)

Tipulidæ

* *Chionea canadensis* Garrett. Cranbrook, B.C., Nov. 22, 1921, (Garrett). Proc. Ent. Soc. Wash., Vol. XXIV, Feb. 1922.
100. *Tipula apicalis* Lœw. Hemmingford, Que., (C. E. Petch).
101. *Tipula caloptera* Lœw. Hemmingford, Que., (C. E. Petch).
102. *Tipula fragila* Lœw. Hemmingford, Que., (C. E. Petch).
* *Alexandriaria suffusca* Garrett. Cranbrook, B.C., Oct. 9, 1920, (Garrett).
* *Alexandriaria intermedia* Garrett. Cranbrook, B.C., July 10, 1920, (Garrett).
* *Alexandriaria kootenensis* Garrett. Cranbrook, B.C., July 15, (Garrett). These three species described in Proc. Ent. Soc. Wash., Vol. XXIV, No. 2, Feb. 1922).

Mycetophilidæ

* *Macrocera trivittata* Johns. Farewell Creek, Sask., Aug. 1887, (Mrs. V. A. Armstrong).
Occ. Pap. Bost. Soc. Nat. Hist., Vol. V, p. 21, 1922.

Culicidæ

Aedes nigromaculis Lud. Aweme, Man., Aug., (Robertson and Criddle).
122. *Anopheles walkeri* Theo. Westbourne, Man., Aug. 24, 1922, (Robertson, Criddle).

Blepharoceridæ

* *Bibiocephala kelloggi* Garrett. Cranbrook, B.C., July 13, 1921, (Garrett).
* *Blepharocera canadensis* Garrett. Wilson Creek, B.C., 5,400 ft., Aug. 26, 1921, (Garrett).
These species described in Ins. Ins. Mens., Vol. X, No. 4-6, 1922.

Stratiomyidæ

179. *Sargus elegans* Lœw. Hastings Co., Ont., April, 1896, (Evans).
* *Stratiomyia discaloides* Curran. Chilcotin, B.C., June 4, 1920, June 10, 1920, (E. R. Buckell); Kelowna, B.C., July 2, 1914, (M. H. Ruhman).
* *Stratiomyia velutina* Curran. Aspen Grove, B.C., June 15, 1922, (P. N. Vroom); Lillooet, B.C., May 24, 1917, (A. W. Phair).
These two species described in Can. Ent., Vol. LIV, p. 279.
185. *Odontomyia hieroglyphica* Oliv. Orillia, Ont., May 30, 1920, (C. H. Curran).
186. *Odontomyia pilimana* Lœw. Ottawa and Trenton, Ont., (Jas. Fletcher), (Evans).
186. *Odontomyia hoodiana* Big. Banff, Alta., May, June, (C.B.D. Garrett).
Odontomyia plebeja Lœw. Belleville, Ont.
187. *Odontomyia varipes* Lœw. (*alberta* Curran). Banff, Alta., Aug., Sept., (Garrett and Sanson).
188. *Euparyphus quadrimaculata* Cresson. Banff, Alta., June 1, (C. B. D. Garrett).

Tabanidæ

196. *Chrysops fallax* O. S. Hemmingford, Que., (C. E. Petch).
* *Tabanus metabolus* McD. Nordegg, Alta., June 15, (McDunnough).
* *Tabanus laniferus* McD. Banff, Alta., July 24, (McDunnough).
These two species described in Can, Ent., Vol. LIV, No. 10, 1922.

Bombyliidæ

238. *Ploas obesula* Lœw. Nicola, B.C., May 25, (E. R. Buckell).
Systœchus solitus Walker. Lethbridge, Alta., July 9-13, 1921, (E. H. Strickland).

Asilidæ

259. *Dioctria nitida* Willist. Victoria, B.C., June, 1919, (P. N. Vroom).
259. *Cyrtopogon bimacula* Walk. Douglas, Man., June 10, 1921, (N. Criddle).
260. *Cyrtopogon leucozona* Lœw. Aspen Grove, B.C., June 28, (P. N. Vroom).
* *Cyrtopogon willistoni* Curran. British Columbia, various localities, and Banff, Alta.
* *Cyrtopogon albitarsis* Curran. Banff, Alta., July 17, 1916, (C. G. Hewitt); July 23, 1909, (N. B. Sanson).
Can. Ent., Vol. LIV, No. 12, 1922.

Dolichopodidæ

The following records of Dolichopodidae are based on material in the Canadian National Collection.

Sciapus pilicornis Ald. Vernon, B.C., July 16, 1920, (N. Cutler); Penticton, B. C., July 24, 1916, (R. C. Treherne). June 19, (W. B. Anderson).
Sciapus flavipes Ald. Glen Souris, Man., July 24, (H. A. Robertson).
293. *Nothosympycnus nodatus* Lœw. Aweme, Man., Sept. 4, (H. A. Robertson).
297. *Hydrophorus altivagus* Ald. Treesbank, Man., Aug. 29, (H. A.. Robertson); Lethbridge, Alta., July 20, (H. L. Seamans).
298. *Scellus monstrosus* O. S. Aweme, Man., June 26, 1920; Washoda, Man., Aug. 3, (H. A. Robertson).
Dolichopus nigrimanus V. D., C. & A., Banff, Alta, July 1, (C. B. D. Garrett); Aweme, Man., July 6, (H. A. Robertson); Ottawa, Ont., June 6, 1900.
303. *Dolichopus myosota* O. S. Royal Oak, B.C., July 31, 1917, (W. Downes).
Dolichopus adæquatus V. D., C. & A. Banff, Alta., June 1, (C. B. D. Garrett); Chilcotin, B.C., June 30, 1920, (E. R. Buckell).
303. *Dolichopus paluster* Mel. & Br. Banff, Alta., May 29, Aug. 4, (C. B. D. Garrett).
Dolichopus manicula V. D., C. & A. Banff, Alta., July 1, (C. B. D. Garrett).
Dolichopus acuminatus Lœw. Elkhorn, Man., Aug. 9, (N. Criddle).
* *Dolichopus albertensis* Curran. Banff, Alta., (C. B. D. Garrett).
* *Dolichopus vanduzeei* Curran. Banff, Alta., (C. B. D. Garrett).
* *Dolichopus diversipennis* Curran. Banff, Alta., (C. B. D. Garrett).
These three species were described in Can. Ent., LIV, No. 12, 1922.
Dolichopus conspectus V. D., C. & A. Chilcotin, B.C., June 3, (E. R. Buckell).
301. *Dolichopus gratus* Lœw. Banff, Alta., May 5, June 15, (C. B. D. Garrett).
305. *Dolichopus xanthocnemus* Lœw. Vernon, B.C., June 18, (N. S. Cutler), Ottawa, Ont., June 10 (G. Beaulieu); Trenton, Ont., June 30, 1902, (J. Evans).

Dolichopus retinens V. D., C. & A. Trenton, Ont., June 24, 1906, Port Hope, Ont., May 30, 1897.

Dolichopus umbrosus V. D., C. & A. Port Hope, Ont., June 13, 1897, (W. E. Metcalfe).

299. *Dolichopus apheles* Mel. & Br. Ogema, Sask., June 16, (N. Criddle).

Dolichopus trisetosus V. D., C. & A. Norway Pt., Lake of Bays, Ont., June 28, (J. McDunnough); Kentville, N.S., June 19, 1916.

Dolichopus virga Coq. Truro, N.S., July 11, 1913.

303. *Dolichopus pachycnemus* Lœw. Treesbank, Man., June 22, (H. A. Robertson); Hemmingford, Que., (Petch).

300. *Dolichopus brevipennis* Meig. Sask., June 30, 1917, (A. E. Cameron); Banff, Alta., June, July, (C. B. D. Garrett).

Dolichopus brevimanus Lœw. Cottage Beaulieu, Que., July 7, 1906, (Beaulieu); Ottawa, Ont., July 2, (Beaulieu); Winnipeg, Man., July 6, 1908, (J. B. Wallis).

Dolichopus indigina V. D., C. & A. Hull, Que., July 18, 1914, (J. I. Beaulne).

Dolichopus canadensis V. D., C. & A. Roberval, Que., July 28, 1915, (G. Beaulieu).

Dolichopus defectus V. D., C. & A. Roberval, Que., July 28, 1915, (G. Beaulieu).

Dolichopus decorus V. D., C. & A. Strathroy, Ont., June 10, (H. F. Hudson).

304. *Dolichopus setosus* Lœw. Truro, N.S., June 19, 1914.

304. *Dolichopus renidescens* Mel. & Br. Banff, Alta., May and Aug., (C. B. D. Garrett).

302. *Dolichopus marginatus* Ald. Youghall, N.B., July 7, 1908, (J. Fletcher); Algonquin Park, Ont., June 19-21, (J. McDunnough); Dauphin, Man., (Mrs. W. W. Hippisley).

304. *Dolichopus reflectus* Ald. Ft. Coulonge, Que., July 6, 1917, (J. I. Beaulne); Jordan, Ont., July 8, 1914, (W. A. Ross).

Dolichopus albicoxa Ald. Cottage Beaulieu, Que., June 19, (G. Beaulieu); Banff, Alta., Aug. 24, (C. B. D. Garrett).

Dolichopus pilatus V. D., C. & A. Banff, Alta., Aug. 23, (C. B. D. Garrett).

Dolichopus porphyrops V. D., C. & A. Truro, N.S., July 8, 1913; Robervale, Que., July 28, (G. Beaulieu); Algonquin Park, Ont., July 28, (J. McDunnough).

Dolichopus pollex O. S. Banff, Alta., July 7, (C. B. D. Garrett).

303. *Dolichopus obcordatus* Ald. Nordegg, Alta., July 5, 1921, (J. McDunnough); Banff, Alta., June, July, (C. B. D. Garrett).

303. *Dolichopus pernix* Mel. & Br. Banff, Alta., July 7, 30, (C. B. D. Garrett).

Dolichopus blandus V. D., C. & A. Ontario, June 9, 1900.

305. *Dolichopus vigilans* Ald. Youghall, N.B., July 7, 1908, (J. Fletcher).

301. *Dolichopus flagellitenens* Wheeler. Aylmer, Que., June 15, (C. B. Hutchings).

303. *Dolichopus pugil* Lœw. Youghall, N.B., July 6, 1908, (Jas. Fletcher); Hantsport, N.S., June 15, 1913, (H. G. Payne).

Dolichopus uxorcula V. D., C. & A. Banff, Alta., July 1, (C. B. D. Garrett).

301. *Dolichopus fulvipes* Lœw. Kentville, N.S., June 14, 1914; Aweme, Man., June 24, (H. A. Robertson); Banff, Alta., July 1, (C. B. D. Garrett).

Dolichopus variabilis gracilis Ald. Banff, Alta., July 1, (C. B. D, Garrett).

305. *Dolichopus wheeleri* Mel. & Br. Trenton, Ont., Aug. 17, 1902, (Evans); Aweme, Man., July 6, Baldur, Man., July 29, (H. A. Robertson); Maniwaska, Que., June 13, 1917, (Arthur Gibson).

302. *Dolichopus longimanus* Lœw. Meach Lake, Que., June 21, 1916, (Arthur Gibson).

305. *Dolichopus subciliatus* Lœw. Truro, N.S., July 8, 11, 1913; Algonquin Park, Ont., June 19-21, (J. McDunnough).

303. *Dolichopus nudus* Lœw. Banff, Alta., Aug. 16, 1922, (C. B. D. Garrett).

Dolichopus speciosus V. D., C. & A. Banff, Alta., July and Aug., abundant, (C. B. D. Garrett).

Dolichopus procerus V. D., C. & A. Cowley, Alta., June 16, 1918, (R. N. Chrystal); Banff, Alta., Aug. 27, (C. B. D. Garrett); Lethbridge, Alta., June 25, (W. Carter); Baldur, Man., July 29, (H. A. Robertson).

Dolichopus completus V. D., C. & A. Royal Oak, B.C., June 20, 1917, (W. Downes).

Dolichopus æratus V. D., C. & A. Banff, Alta., July 1, (C. B. D. Garrett).

Dolichopus subflavus V. D., C. & A. Banff, Alta., Aug. 21, (C. B. D. Garrett).

300. *Dolichopus coloradensis* Ald. Roberval, Que., July 28, 1915, (G. Beaulieu); Banff, Alta., June, August, (C. B. D. Garrett).

Dolichopus omnivagus V. D., C. & A. Banff, Alta., June 26, (C. B. D. Garrett).

300. *Dolichopus chrysostoma* Lœw. Kentville, N.S., June 24, 1914.

Dolichopus slossonæ V. D., C. & A. Roberval, Que., July 28, 1915. (G. Beaulieu).

Dolichopus bakeri Cole. Banff, Alta., June, July, (C. B. D. Garrett).

Dolichopus domesticus V. D., C. & A. Norway Point, Lake of Bays, Ont., July 28, 1919, (J. McDunnough).

301. *Dolichopus eudactylus* Lœw. Truro, N.S., July 11, 1913.

Dolichopus versutus V. D., C. & A. Lanoraie, Que., June 21, 1915, (G. Beaulieu).

301. *Dolichopus dakotensis* Ald. Aweme, Man., June 17, 1921, (P. Vroom).

299. *Dolichopus batillifer* Lœw. Truro, N.S., July 11, 1913.

305. *Dolichopus tener* Lœw. Trenton, Ont., Sept. 6, 1903, (Evans).

Dolichopus sicarius V. D., C. & A. Kentville, N.S., June 24, 1914.

304. *Dolichopus scopiarius* Lœw. Kentville, N.S., June 24, 1914.

Dolichopus ainsliei V. D., C. & A. Hull, Que., July 19, 1914, (J. I. Beaulne).

Dolichopus frauditor distinctus V. D., C. & A. Ottawa, Ont., July 12, 1919, (J. McDunnough).

305. *Dolichopus tenuipes* Ald. Saanich, B.C., June 22, Aug. 13, (W. Downes).

* *Dolichopus delicatus* Ald. Ungava Bay and Fort Chimo, Labrador, (Turner).
Proc. U.S.N.M., Vol. LXI, May, 1922.

* *Xiphandrium femoratum* Ald. Skagway, June 10, 1921, (Aldrich).
Trans. Am. Ent. Soc., Vol. XLVIII, No. 1, March, 1922.

Empididæ

310. *Phoneustica maculipennis* Walker. Ontario, Manitoba, Alberta, June to Aug.

Drapetis armata Melander. N.S., Ont., Man.

Drapetis scissa Melander. Chilcotin, B.C., May 7, (E. R. Buckell); Ogema, Man., June 16, (N. Criddle).

Drapetis septentrionalis Melander. Truro, N.S., Sept. 25, Belleville, Ont.

314. *Tachydromia winthemi* Zett. Nordegg, Alta., July 25, (J. McDunnough).

313. *Tachydromia brachialis* Mel. Ottawa, Ont., July 20, (Beaulieu).

314. *Hemerodromia albipes* Walker. Ottawa, Ont., June 9, 1904, (W. E. Metcalf.)

317. *Clinocera simplex* Lœw. Banff, Alta., Sept., (C. B. D. Garrett).

318. *Syneches thoracicus* Say. Brockville, Ont., Aug. 12, 1903, (W. E. Metcalf); Kingsmere, Que., July 18, 1919, (R. H. Chrystal).

320. *Brachystoma occidentalis* Mel. Saanich, B.C., June 22, 1918, (W. Downes).

327. *Hormopeza brevicornis* Lœw. Fort Wrigley, N.W.T., July 27, (C. H. Crickmay).

327. *Hormopeza bullata* Mel. Ottawa, Aug. 18, 1912, (Beaulieu).

327. *Hormopeza nigricans* Lœw. Banff, Alta., June-Sept., (C. B. D. Garrett); Cairncross, Y.T., July 28, 1919, (A. P. Hawes).

Syrphidæ

Heryngia comutata Curran. Victoria, B.C., May, 1916, (R. C. Treherne); Victoria, May 3, 1919, (W. B. Anderson).

Heryngia canadensis Curran. Ft. Coulonge, Que., July 6, 1917, (J. I. Beaulne).

Heryngia californica David. Victoria, B.C., May 3, 1919, (W. B. Anderson).

Pipiza quadrimaculata Panz. Banff, Alta., June 16, 24, (C. B. D. Garrett).

* *Pipiza atrata* Curran. Chilcotin, B.C., June 18, 1920, (Buckell).

* *Cnemodon nigricornis* Curran. Banff, Alta., June 15, 1922, (Garrett).
These two species described in Can. Ent., Vol. LIV, No. 12, 1922.

Chilosia variabilis Panz. Lillooet, B.C.

Chilosia ferruginea Lovett. Duncan, B.C., April 12, (W. B. Anderson).

Chilosia nigrovittata Lovett. Banff, Alta., May 5-June 9, (C. B. D. Garrett).

352. *Chilosia chalybescens* Willist. Agassiz, B.C., May 22, (R. Glendenning)

* *Chilosia hunteri* Curran. Teulon, Man., May 17, 1920, (A. J. Hunter).

* *Chilosia orilliaensis* Curran. Orillia, Ont., May, June, (Curran).

* *Chilosia robusta* Hine. (*columbiæ* Curran), Cranbrook, B.C., May 8, 1920, (Garrett).
This species described in Can. Ent., Vol. LIV, No. 1 and 3.

352. *Cartosyrphus lævis* Big. Banff, Alta., July 5, (C. B. D. Garrett).
* *Cartosyrphus ontario* Curran. Orillia, Ont., May 5, 1921, (Curran).
* *Cartosyrphus rita* Curran. MacDiarmid, Ont., June 7, 1921, (Bigelow).
* *Cartosyrphus sensuus* Curran. Orillia, Ont., May 5, 1921, (Curran).
Those species described as *Chilosia,* in Can. Ent., Vol. LIV, No. 1 and 3.
Platychirus discimanus Lœw. Aweme, Man., May 1, (R. M. White).
Platychirus scutatus Meig. Banff, Alta., June 2-29, (C. B. D. Garrett).
Platychirus albimanus Fabr. Vernon, B.C., May 11, 1920, (M. H. Ruhmann), Victoria, B.C., April 28, 1917, (A. E. Cameron).
Platychirus podagratus Fabr. Banff, Alta., May to July, (C. B. D. Garrett).
All the above are European species; some have been previously recorded from North America.
365. *Stenosyrphus contumax* O. S. Hopedale, Labrador, July, Aug.; Banff, Alta., June 2, July 17, (C. B. D. Garrett).
368. *Stenosyrphus sodalis* Willist. Banff, Alta., May 29, (C. B. D. Garrett); Chilcotin, B.C., July 29, (E. R. Buckell).
* *Syrphus grossulariæ* var. *melanis* Curr. Orillia, Ont., Sept. 18, 1921, (Curran).
Can. Ent. Vol. LIV, No. 4, 1922.
Neoascia metallica Will. Banff, Alta., May, June, (Garrett). Distinct from *globosa.*
376. *Brachyopa notata* O. S. Kentville, N.S., June 9, 1915.
* *Brachyopa perplexa* Curran. Orillia, Ont., June 2, 1921 (Curran).
Can. Ent., Vol. LIV, No. 5, 1922.
Sericomyia bifasciata Willist. Bathurst, N.B., June 15, (J. N. Knull); McDiarmid, Ont., (N. K. Bigelow); Lac la Peche, Que., June 30, 1919, (M. B. Dunn).
* *Cynorhina robusta* Curr. British Columbia.
* *Cynorhinella canadensis* Curr. Inverness, B.C., July, 1910, (Keen).
* *Mallota columbiæ* Curr. Penticton, B.C., June 5, 1919, (Treherne).
* *Mallota diversipennis* Curr. (Probably Canadian.)
These species described in Can. Ent., Vol. LIV, No. 1, 1922.
401. *Brachypalpus frontosus* Lœw. Bathurst, N.B., April to June, (J. N. Knull).
Brachypalpus inarmatus Hunter. (*apicaudus* Curran). Cranbrook, B.C., June 2, 1921, (Garrett).
400. *Xylota vecors* O. S. Aweme, Man., July 25, 1917, (N. Criddle).
398. *Xylota flavitibia* Lœw. Banff, Alta., July, Aug., (C. B. D. Garrett).
405. *Temnostoma obscura* Lœw. Montreal, Que., June 10, 1906; Ottawa, Ont., June 21, 1913, (J. I. Beaulne); Bathurst, N.B., July 27, (J. N. Knull), (*bombylans* of Ald. Cat.).
405. *Temnostoma trifasciata* Robertson. Ont., Quebec; May, June.

Helomyzidæ

* *Amœbaleria bisetata* Garr. Teulon, Man., May 31, 1920, (Hunter).
* *Anorastoma currani* Garr. Teulon, Man., Aug. 28, 1920, (Hunter).
* *Leria serrata* var. *nigricana* Garr. Cranbrook, B.C., June 6, 1921. (Garrett).
* *Leria serrata* var. *vinus* Garr. Cranbrook, B.C., Mar. 20 to April 8; Michel, B.C., Aug. 2, (Garrett).
Insec. Inscit. Mens., Vol. X, Pt. 10-12, Dec., 1922.

Scatophagidæ

* *Amaurosoma nuda* Mall. Cape Charles, Labrador, July 30, 1906. Bull. Brook. Ent. Soc., Vol. XVII, No. 3, 1922.

Hymenoptera.

Ichneumonidæ

* *Phytodietus fumiferanæ* Roh. Lillooet, B.C., (A. B. Baird), Can. Ent., Vol. LIV, No. 7, 1922.

Braconidæ

* *Rogas hyphantriæ* Gah. Fredericton, N.B., Sept., 1917, (A. G. Dustan).

* *Micropletus stigmaticus* Gah. Vancouver, B.C.

* *Microgaster canadensis* Gah. Canada, (C. F. Baker).

* *Apanteles olenides* Museb. Vernon, B.C., (E. P. Venables).

The above four species described in Proc. U.S. Nat. Mus., Vol. LXI, 1922.

Hemiptera.

(Arranged according to "A Check List of the Hemiptera (excepting the Aphididæ, Aleurodidæ and Coccidæ) of America North of Mexico," by E. P. Van Duzee).

Miridæ

* *Labops hirtus* Kgt. Chilcotin, B.C., (E. R. Buckell); Edmonton, Alta., (Carr); Parry Sound, Ont., (H. S. Parish); and Strathroy, Ont., (H. G. Crawford).

* *Labops tumidiformis* Kgt. Chilcotin, B.C., June 15, 1920, (R. C. Treherne).

The above two species described in Can, Ent., Vol. LIV, No. 11, 1922.

Neuroptera.

Perlidæ

* *Kathroperla perdita* Banks. Kaslo, B.C., (Taylor).

Sialidæ

* *Sialis rotunda* Banks. Bon Accord, B.C., May, (J. Russell).

Raphididæ

* *Raphidia bifurca* Banks. Wellington, B.C., (Taylor).

Limnephilidæ

* *Limnephilus adustus* Banks. Banff, Alta., Aug., (N. Sanson).

* *Limnephilus kennicotti* Banks. Great Stone Lake, N.W.T., (Robert Kennicott).

* *Limnephilus elongatus* Banks. Fort Resolution, N.W.T., (Kennicott).

* *Homophylox crotchi* Banks. Vancouver Island, B.C., (G. R. Crotch).

The above species were described in Bull. Mus. Comp. Zool., Harvard, Vol. LXIV, No. 3, 1920.

Orthoptera.

Prepared by E. R. Buckell.

Tryxalinæ

Pseudopomala brachyptera Scudd. Vernon, B.C., (E. R. Buckell).

Amphitornus nanus R. & H. Chilcotin, B.C., July, 1920, (E. R. Buckell). New to Canada.

Orphulella salina Scudd. Fairview, B.C., Aug. 7, 1919, (E. R. Buckell). Previously recorded as *O. pelidna*, Ent. Rec. 1919.

Ageneotettix occidentalis Brun. Southern Okanagan Valley, B.C., 1919, (E. R. Buckell). New to Canada.

Mecostethus lineatus Scudd. Chilcotin, B.C., Aug., 1920, (E. R. Buckell).

Mecostethus gracilis Scudd. Chilcotin, B.C., Aug., 1921, (E. R. Buckell).

Chorthippus oregonensis Scudd. Penticton and Chilcotin, B.C., 1920, (E. R. Buckell). New to Canada.

Oedipodinæ

Pardalophora apiculata Harris. Chilcotin, B.C., June, 1920, (E. R. Buckell).

Xanthippus leprosus Saussure. Chilcotin, 1920, (E. R. Buckell). New to Canada.

Metator nevadensis Bruner. Osoyoos, 1919; Chilcotin, 1920-21, (E. R. Buckell). New to Canada.

Mestobregma kiowa Scudd. Okanagan Landing, B.C., 1919, (E. R. Buckell).

Trimerotropis ferruginea McNeill. Vernon, B.C., 1919; Chilcotin, B.C., 1920-21, (E. R. Buckell). New to Canada.

Locustinæ

Asemoplus montanus Bruner. Rockcreek, B.C., 1922, (E. R. Buckell).

* *Bradynotes chilcotinæ* Hebard. Chilcotin, B.C., June 7th, 1920, (E. R. Buckell).
Trans. Am. Ent. Soc., Vol. XLVIII, 1922, No. 821.

Bradynotes pinguis Scudd. Rockcreek, B.C., Aug., 1922, (E. R. Buckell). New to Canada.

Melanoplus flabellifer Scudd. Chilcotin, B.C., 1921, (E. R. Buckell).

Melanoplus flavidus Scudd. Aweme, Man., Aug. 23, 1922, (R. M. White). New to Canada.

Melanoplus confusus Scudd. Chilcotin, B.C., 1920, (E. R. Buckell).

Melanoplus washingtonianus Bruner. Nicola, B.C., 1922, (E. R. Buckell).

Tettigoniidæ

Neoconocephalus triops Linn. Cote St. Paul, Montreal, Que., July 22, 1900, (G. Beaulieu).

Stenopelmatus fuscus Haldeman. Fairview, B.C., 1919, (E. R. Buckell). New to Canada.

Ceuthophilus agassizii Scudd. Chilcotin, B.C., 1921, (E. R. Buckell).

Pristoceuthophilus celatus Scudd. Vernon, B.C., 1919, (E. R. Buckell).

Steiroxys trilineata Thomas. Chilcotin, B.C., 1920, (E. R. Buckell)

Apote notabilis Scudd. Fairview, B.C., 1922, (E. R. Buckell).

Thysanoptera

Thripidæ

Sericothrips standordi Moult. Victoria, B. C., May, 1918, (R. C. Treherne).

Sericothrips variabilis Beach. Lillooet, B.C., 1917, (Treherne).

Parthenothrips dracænæ Heeger. Vancouver, B.C., (J. W. Eastham).

Tæniothrips albus Moult. Kelowna, B.C., 1917, (Treherne).

Tæniothrips pallipennis Uzel. Lillooet, B.C., June; Treesbank, Man., May, (Treherne).

Phlœothripidæ

Haplothrips verbasci Osb. Vineland, Ont., (W. A. Ross).

Haplothrips faurei Hood. Beamsville, Ont., 1918, (W. A. Ross).

Collembola

* *Achorutes nothus* MacN. Arnprior, Ont., April, (MacNamara).

* *Achorutes pannosus* MacN. Monteith, Ont., (J. D. Allen).

The above two species described in Can. Ent., Vol. LIV, No. 7 1922.

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Ontario Department of Agriculture

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CONTENTS

Entomological Society of Ontario

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Editor of "The Canadian Entomologist"—DR. J. MCDUNNOUGH, Entomological Branch, Ottawa.

Delegate to the Royal Society of Canada—THE PRESIDENT.

FINANCIAL STATEMENT

FOR THE YEAR ENDING OCTOBER 31ST, 1923.

Receipts		*Expenditures*	
Cash on hand, 1922	$384 39	Printing	$1,750 00
Subscriptions	612 22	Salaries	200 00
Members' Dues	174 95	Expense	84 43
Advertisements	308 67	Annual Meeting	8 40
Back Numbers	54 09	Library	5 00
Contribution	2 00	Exchange	7 89
Bank Interest	4 32	Balance Cash on Hand	484 92
Government Grant	1,000 00		
	$2,540 64		$2,540 64

By Cash on Hand	$484 92
To Printing Account, payable	115 00
Net Balance	$369 92

Auditors {L. CAESAR. / J. A. FLOCK.

Respectfully submitted,

A. W. BAKER,
Secretary-Treasurer.

Entomological Society of Ontario

DIAMOND JUBILEE MEETING

The Diamond Jubilee Meeting of the Entomological Society of Ontario was held in Ottawa on Thursday, Friday and Saturday, November 1st, 2nd, and 3rd, 1923.

The morning and afternoon meetings were held in the exhibition room of the Dominion Entomological Branch. The Thursday evening meeting was held in the assembly hall of the Normal School, when Dr. A. F. Burgess delivered the public address on "The Value of Natural Enemies of Injurious Insects." On Friday evening the members and visitors met at dinner in the University Club. After dinner the gathering was addressed by Mr. J. A. Ruddick, of the Dominion Department of Agriculture, and Mr. Morris delivered the presidential address: "Nature's Clairvoyant; a Study of W. H. Hudson." A short paper from Dr. Bethune, entitled "The Early Days of the Entomological Society of Ontario," was read by Mr. Gibson. An interesting feature of the meeting was the visit to the Parliament Buildings and Central Experimental Farm on Saturday morning. During the meeting motion picture films entitled "Where the Moose Runs Loose," "A New Yorker's Canadian Week-end," and "The European Corn Borer," were shown through the kindness of the National Parks Branch, Department of Interior, the Motion Picture Branch, Department of Trade and Commerce, and the Provincial Motion Picture Bureau.

The meetings were very well attended by members of the society and visitors and were highly successful. Much credit must be given to the local committee in charge for the splendid arrangements made for the convenience and entertainment of visiting members.

The officers for the year 1923-24 were elected as follows: President, Dr. J. M. Swaine; Vice-President, Mr. R. C. Treherne; Director of District No. 1, Mr. C. B. Hutchings. The remaining officers were re-elected.

A. W. Baker, *Secretary.*

REPORT OF THE COUNCIL

The Council of the Entomological Society of Ontario begs to present its report for the year 1922-1923.

The Fifty-ninth Annual Meeting of the Society was held at the Ontario Agricultural College, Guelph, on Friday and Saturday, November 24th and 25th.

The meeting was well attended by members of the society from various provinces of the Dominion and by members of the staff of the Ontario Agricultural College and other visitors. The members of the Council were gratified to see a number of the older members of the society present in the persons of Messrs. Evans, Dunlop, Southey and Brimley.

On Friday evening a dinner was held in the College cafeteria, after which the members and visitors adjourned to the common room of Mills Hall for a smoker. During the evening the President, Mr. Morris, read a very interesting paper on a collecting trip to Rondeau Park and Point Pelee.

During the rest of the time of meeting the following papers were presented:

The Spread of the Corn Borer in 1922 .... L. S. McLaine.
Further Notes on the Life History of the European Corn Borer .... G. J. Spencer.
Revised Control Measures for European Corn Borer .... H. G. Crawford.
The Economic Importance of Insects as Food for our Common Whitefish. Dr. W. A. Clemens.
The Haunts and Habits of Somatochlora .... Dr. E. M. Walker.
Mechanical Devices used in the Control of the Strawberry Root Weevil .. W. Downes.
Provancher—his Life and Works .... George Maheux.
Observations on the Oviposition of *Senotainia trilineata* V. der Wulp (Tachinidae) .... C. H. Curran.
Insects of the Season in Quebec .... George Maheux.
The Relationship of Biological and Taxonomic Studies of Syrphidae (Diptera) .... C. H. Curran.
Insects of the Season in Ontario .... Prof. L. Caesar, W. A. Ross.
Notes on *Frankliniella tritici* Fitch .... R. C. Treherne.
Biological Notes on two Buprestid Beetles (*Agrilus ruficollis* and *A. politus*) .... C. B. Hutchings.
The Outbreak of Grape-Leaf Hoppers .... W. A. Ross and W. Robinson.
The Feather Mite—A New Poultry Pest .... Prof. L. Caesar.
Some Observations on the Oviposition of *Hypera punctata* .... H. F. Hudson.
Recent Developments in the Dominion Entomological Service .... Arthur Gibson.
The Sunflower Maggot .... J. E. Brink.
Recent Work on the Rose Chafer .... W. A. Ross and J. A. Hall.
The Occurrence of the Potato Seed Maggot, *Hylemyia trichodactyla*, in Ontario .... G. H. Hammond.

An interesting feature was the presentation by the Ontario Provincial Motion Picture Bureau of a motion picture film on the European corn-borer.

The Canadian Entomologist, the official organ of the society, completed its fifty-fourth volume in December last. The volume contained 294 pages, illustrated by eleven full-page plates and nineteen original figures. The contributors to these pages numbered fifty-three and included writers in British Columbia, Alberta, Ontario, New Brunswick, seventeen of the United States and the Hawaiian Islands. Twelve papers were published during the year on popular and practical entomology.

REPORT OF THE MARITIME BRANCH

The ninth annual meeting of the Acadian Entomological Society was held in Amherst, N.S., on December 12th, 1923. The regular business session was held and the following officers were elected for 1924:

Honorary President .... Dr. A. H. MacKay, Halifax.
President .... Dr. J. D. Tothill, Fredericton.
Vice-President .... Mr. J. P. Spittall, Annapolis Royal.
Secretary-Treasurer .... Mr. W. E. Whitehead, Truro.

The remainder of the day was devoted to an informal discussion of entomological problems.

During the past year "Proceedings" No. 8 had been published, which contains 182 pages and 25 plates, the increase in size of this number being made possible by a surplus of funds which the society had on hand. Our membership is about the same as that of last year.

W. E. Whitehead, *Secretary-Treasurer.*

REPORT OF THE MONTREAL BRANCH

The fiftieth annual meeting was held on May 12th, 1923, in the Lyman Entomological Room, Redpath Museum, McGill University.

Eight meetings were held during the season, with an average attendance of eight members.

A very successful field day was held at St. Hilaire on May 24th.

The following papers were read during the year:

The Trials of an Entomologist..A. F. WINN.
Bee Disease..G. H. HALL.
Work of the Amateur Entomologist.....................................GEO. A. MOORE.
Notes on *Arge pectoralis*—the Birch Sawfly..........................J. W. BUCKLE.
The Stilt Bugs...GEO. A. MOORE.
Notes on some flies commonly seen in our dwellings...................BRO. OUELLET.
Notes on the genus Batocora..G. CHAGNON.
Gelastocoridae—Toad-Shaped Bugs......................................GEO. A. MOORE.
Some Pentatomidae from China...G. CHAGNON.
Clastoptera..GEO. A. MOORE.
Notes on the Dipterous family Bombyliidae............................BRO. OUELLET.
On the larval and pupal stages of *Chironomus*.......................T. W. BARNES.
The Chinch Bug...GEO. A. MOORE.

The treasurer reported a balance on hand of $176.28.

The following were elected officers:

President..GEO. A. MOORE.
Vice-President...G. H. HALL.
Secretary-Treasurer..J. W. BUCKLE.
Council................................G. CHAGNON, A. C. SHEPHERD, and J. WARREN.

J. W. BUCKLE, *Secretary.*

REPORT OF THE TORONTO BRANCH

The twenty-seventh annual meeting of the Toronto Branch was held in the Biological Building, University of Toronto, on October the 24th, 1923. The President, Mr. S. Logier, occupied the chair.

The report of the Council showed that during the past year eight regular meetings were held at which there was an average attendance of eleven persons. The following papers and addresses were given at the meetings.

Odonata and Orthoptera collected at Rondeau Park and Point Pelee....PROF. E. M. WALKER.
Collecting at Lake Nipigon...MR. N. K. BIGELOW.
The Strawberry Petiole Gall, *Diastrophus fragariae*..................DR. A. COSENS.
Metallic Wood Borers...MR. N. K. BIGELOW.
Bird Lice..PROF. A. W. BAKER.
Haunts and Habits of Somatochlora....................................PROF. E. M. WALKER.
Food of Lake Nipigon Fishes..PROF. W. A. CLEMENS.
Beetles Frequenting the Household....................................MR. N. K. BIGELOW.
Aphids...MR. W. A. ROSS.
Grylloblatta.................................PROF. E. M. WALKER, DR. N. H. C. FORD.

Four new members were elected, namely, Sister Lilian, Sister Ruth, Mr. G. N. Bird and Mr. H. H. MacKay. One member was dropped from the roll.

The treasurer's report showed a balance of $25.72.

The report of the librarian noted that forty-six publications had been added to the library during the year. These had been catalogued and filed.

The following officers were elected for 1923-24:

President .... MR. SHELLEY LOGIER.
Vice-President .... PROF. E. M. WALKER.
Secretary-Treasurer .... MR. H. H. MACKAY.
Librarian .... DR. N. H. C. FORD.
Council .... PROF. W. A. CLEMENS, DR. A. COSENS, MR. N. K. BIGELOW, MR. A. H. LEIM.

A. H. LEIM, *Secretary-Treasurer.*

REPORT OF THE BRITISH COLUMBIA BRANCH

The twenty-second annual meeting was held in the Court House, Vancouver, on Saturday the 17th of February, 1923.

The President, Mr. L. E. Marmont, was in the chair, and from twelve to fifteen members were present throughout the meeting.

At the business session in the morning, three new members were proposed and accepted, Mr. K. F. Auden, Mr. A. O. Hope, and Mr. O. Whittaker.

A redraft of the by-laws was passed upon for incorporation purposes.

It was decided not to provide another cup this year for school competition.

Upon the motion of Mr. Venables, it was decided to hold a summer meeting at Vernon during the visit of the Dominion Entomologist.

The following papers were read:

Presidental Address .... L. E. MARMONT.
Collecting in the Sagebrush of the Southern Okanagan Valley .... E. R. BUCKELL.
Key to the Vespini* .... C. D. GARRETT.
Control of Oyster-shell Scale with Oil Sprays* .... M. H. RUHMANN.
The Peach Twig Borer in B.C.* .... R. C. TREHERNE.
Economic Entomology in the Dry Belt .... E. P. VENABLES.
Notes on Economic Insects in 1922 .... W. DOWNES.
New Records of B.C. Hemiptera .... W. DOWNES.
Effect of Fumigation on Certain Insects .... W. H. LYNE.
The Elm-Currant Aphis .... R. GLENDENNING.
Forest Entomology* .... R. HOPPING.
Mosquito Control at Banff* .... E. HEARLE.
Relation of Botany to Entomology* .... W. B. ANDERSON.

Slides, showing the beauties of the Mymaridæ were shown under the microscope by Mr. Whittaker.

The election of officers for 1923 resulted as follows:

Honorary President .... E. KERMODE.
President .... L. E. MARMONT.
Vice-President (for Coast) .... R. S. SHERMAN.
Vice-President (for Interior) .... M. H. RUHMANN.
Honorary Secretary-Treasurer .... R. GLENDENNING, Agassiz, B.C.
Honorary Auditor .... W. S. MOORE, J.P.
Advisory Board—The Officers and J. DAVIDSON, W. DOWNES, E. HEARLE, W. H. LYNE, E. P. VENABLES.

It was decided, according to precedent, to hold the 1924 meeting in Victoria, B.C.

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*Read by proxy.

During 1923 one number of "Proceedings" (Nos. 17 and 19 combined) was published, containing the following papers:

The summer meeting in the Okanagan was not held, coast members finding it impossible to attend.

R. GLENDENNING, *Hon. Secretary-Treasurer.*

REPORTS ON INSECTS OF THE YEAR

DIVISION NO. 3, TORONTO DISTRICT.—A. COSENS

Only a few insects were noted as particularly plentiful this year. Two leaf rollers were among these. The species, *Anacampsis populella* Clemens, that feeds upon the foliage of the large-toothed aspen, *Populus grandidentata* Michx, had infested the trees in High Park to such an extent that some branches had almost every leaf rolled. The larvæ of this form appeared to be almost mature on June 22nd. The other leaf-roller, *Cacoecia hewittana* Busck, was feeding upon second-growth soft elm, *Ulmus Americana* L. The moths emerged the last week of June. The latter species was kindly identified for me by August Busck, Smithsonian Institution, Washington. He states that the pest is common to both Europe and America. On the same specimens of Ulmus, on which were the leaf-rollers, galls were fairly common. These were on the foliage and consisted of a thickening of the leaf blade along the lines of the veins. The infected leaves were also folded with the upper surfaces within. The gall-producer in this instance is a gall gnat, *Phytophaga ulmi* Beutm.

On June 30th, the rose chafer, *Macrodactylus sub-spinosus*, was noted in large numbers feeding upon wild roses and other plants in High Park. About the same date, rose growers in the vicinity of the park stated that the beetles were plentiful upon their cultivated roses. These beetles are easily recognized. The body is slender and thickly clothed with fine, yellow hairs, which give it a yellow colour. The legs are long, slender and pale red. This pest is difficult to combat. A poison spray is not very effective and about the only other plan suggested is to jar the beetles off the bushes into a dish of kerosene, a method that would be applicable only on a small scale. These beetles do considerable injury to plants as not only do the adults feed upon the foliage but the larvæ also feed upon the roots.

Along the beach at Kincardine, during the month of August, that curious Hymenopterous insect, *Pelecinus polyturator*, was quite numerous.

This insect, which is glossy black in colour, has short wings with only a few veins. The female can be readily recognized by its long, slender abdomen, nearly five times the length of the head and thorax together. This elongated abdomen is doubtless of use to the insect in boring into the ground to reach the larvæ of the May beetles, upon which the parasite is said to deposit its eggs. The abdomen of the male is club-shaped, and not more than twice the length of the head and thorax. The males are seen only rarely, and are supposed to fly high in the air. The females, on the contrary, fly near the ground and often alight, apparently to rest.

As usual the green aphis was troublesome on the rose bushes. In this connection I wish to place on record that from two independent sources I was informed that English sparrows were seen feeding upon the pests and destroying large numbers of them. This is at least one good deed that stands to the credit of these successful little colonizers.

Division No. 6.—H. F. Hudson

The season of 1923 on the whole has been a light insect year. So far as known to the writer, the insect loss to the staple crops has been generally light. There are, however, one or two entomological features worth noting.

Field Crop Insects

Wireworms.—In Elgin county, as well as in Perth county, considerable injury was done by various species of wireworms. Around the outskirts of Stratford, covering an area approximately five square miles, wireworm injury was very marked. Replanting was necessary in many fields. Several cornfields in Elgin county had to be replanted owing to the ravages of these pests.

Cutworms.—On the lighter soils extensive injury to oat and cornfields has been noted. In Middlesex county, approximately one hundred acres of corn land had to be replanted. The identity of the cutworm is not known.

The Hessian Fly.—Reports of injury to the wheat crop was received from Huron, Waterloo, and Middlesex counties, but injury generally was light.

The European Corn Borer.—There appears to be a slight general increase of this pest but on the whole the general injury was not as marked as in previous years. It seems to be gaining headway around London, in Middlesex county, especially in early sweet corn, while a similar condition prevails around Aylmer, in Elgin county.

The Colorado Potato Beetle.—The spring brood of this insect was heavy, and very injurious, but the second brood was light.

Truck Garden Insects

The most important truck insect of the year was the cucumber beetle. Cucumbers stood the attack better than melons which were in some cases totally destroyed. Some efficient control measure is needed. Dusting with hydrated lime helps in control, but too frequent dusting appears to injure the foliage.

The Cabbage Maggot.—Injury was less marked this year than for several years, although near Port Stanley there was a fifty per cent. loss in a commercial plantation.

Shade Tree Insects

The White-Marked Tussock Moth.—This was quite abundant around London, Ontario. In the fall as many as twenty egg masses were noted on a single tree-trunk.

The Walnut Datana.—These caterpillars were more abundant than I have noted for several years. Wherever walnut trees were present they were in many cases defoliated.

Special Features

THE SEED CORN MAGGOT.—Specimens of potato sets were received from Perth county, heavily infested with maggots. A trip was made to the affected field to secure additional material. Infestation appeared to be limited to a single five-acre field. The maggots were reared to the adult flies and were kindly determined by Mr. Curran of the Dominion Entomological Branch as *Hylemyia cilicura.*

SOD WEBWORMS.—A note was received from Mr. W. H. Sands of the Provincial Experimental Farm at Ridgetown, that several fields of corn had been destroyed by one of the webworms, apparently a species of crambid. No material was received and the exact identity of the insect is not known.

ONION THRIPS.—Reports from the onion marsh at Leamington, Ontario, indicate that this pest was unusually abundant and injurious this year.

THE EARLY DAYS OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO

REV. C. J. S. BETHUNE, TORONTO

It is gratifying to me, as one of the founders of the Entomological Society of Ontario, that it should be celebrating its "Diamond Jubilee," and that it should have continued to grow and flourish during so long a period of time.

Sixty-one years ago, two young men—the late Dr. William Saunders and I—who were enthusiastically devoted to the collection and study of insects, and spent all their spare time in the pursuit, after a good deal of correspondence decided that it would be a good thing to organize a society and gather together the few, widely-scattered people who shared with them a deep interest in entomology.

Our first proceeding was to procure the names and addresses of all those who shared with us an interest in the subject. After a good deal of correspondence we were able to make a list of thirty-six persons, four of them ladies, who collected insects. This was published in the seventh volume of *The Canadian Naturalist and Geologist* of Montreal, in June, 1862. In the autumn of that year a meeting was held at the residence of Prof. Croft, of the University of Toronto. After some discussion it was decided that as there were only ten persons present, it would be better to postpone any action until a larger number could take part in the proceedings. Later on we called another meeting, which was held in the rooms of the Canadian Institute of Toronto, on the 16th of April, 1863. There were only twelve present, but we had letters approving of the project, and so we decided to go on. A constitution was adopted, and the society was named "The Entomological Society of Canada." Prof. Croft was elected president; Dr. Saunders, secretary-treasurer; and Mr. J. Hubbert, curator.

At this time Canada consisted of Upper and Lower Canada, now the provinces of Ontario and Quebec, and we had members resident in both. In 1864, Dr. Saunders was elected president, and I became secretary-treasurer, an office that I held for seven years. In 1868, when I was living at Erindale on the river Credit, after much consultation, I began the publication of *The Canadian Entomologist*, an eight-page periodical, which has grown and flourished, and for a long time has been recognized as one of the leading publications on entomology in America.

The next event of importance took place in 1870, when we were asked to prepare a report on injurious insects. This was undertaken by Dr. Saunders, Mr. E. Baynes-Reed (one of our original members), and myself. Three articles were prepared: Insects Affecting the Grape, the Plum, and the Apple-tree. The report was published by the Department of Agriculture early in the following year, and was widely distributed. So useful was it considered that it was reprinted twenty-five years later. This was the beginning of the issue of the Annual Reports of the Society which have regularly appeared for more than fifty years.

One good result of the first report was a grant of $400 to the society from the Department. Soon afterwards, as the result of a report on the Colorado potato-beetle, by Dr. Saunders and Mr. Reed, the grant was increased to $1,000, and has been continued ever since. A further result was the incorporation of the society by the Legislature of Ontario, and the change of its name to its present designation, though it was by no means restricted in its operations to this province.

For nine years the society was kindly permitted to use the rooms of the Canadian Institute in Toronto for its meetings, and the housing of its library and collections. The headquarters were then removed to London where a flourishing branch had been established. In 1906 the removal was made to the Ontario Agricultural College at Guelph.

To many this brief record is an old story, but I trust that it may be of interest to our younger members to learn of our days of small things, and to realize how our operations have extended over the whole Dominion, with active branches in Montreal and Toronto, the Maritime Provinces, and British Columbia.

Ten years ago a delightful celebration of the jubilee of the society was held at Guelph. It is sad to recall the losses that we have sustained by death since then. Dr. Saunders, who, however, was not able to be present at the meeting, died a few months afterwards. We have to deplore also the deaths of Dr. Fyles, Dr. Hewitt, Mr. and Mrs. Henry Lyman, and Mr. Sladen; and amongst our visitors, Prof. Webster and Mr. Meade-Waldo, of the British Museum.

I regret very much that, owing to the infirmities of old age, I am unable to be present at the Diamond Jubilee of the society. May it continue to grow and flourish, and to extend, as the years go by, the knowledge and application of systematic and economic entomology.

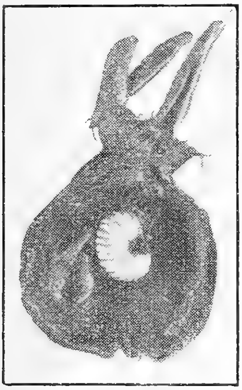
THE ROSE CURCULIO IN MANITOBA—WITH NOTES ON OTHER INSECTS AFFECTING ROSES

H. Alex. Robertson, Entomological Laboratory, Treesbank, Man.

The destructiveness of the Rose Curculio, *Rhynchites bicolor* Fab., has been brought forcibly to our attention on many occasions in Manitoba, particularly during the past few summers. The characteristic puncturing of the young rosebuds and the failure of the petals to open are now familiar to most people who take an intelligent interest in rose-growing. The injury caused has given rise to frequent inquiries, and it is as a result of these that a brief preliminary study of the insect has been undertaken.

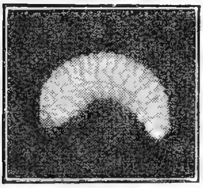
This beetle, which is widespread in North America, has sometimes been confused with the Rose Chafer (*Macrodactylus subspinosus* Fab.) because of the general nature of its work. While there is little justification for this, it might perhaps be explained by the fact that the adult Curculio is not readily seen unless one is careful when approaching rosebushes. If the bushes are shaken at all, the beetle, which is easily alarmed, will let go and fall to the ground. The adult is conspicuously marked, as its name would suggest, and may be observed, if some caution be taken, resting upon the foliage or at work devouring the buds. Once seen, there is, of course, no likelihood of associating the prominently beaked Curculionid with the above-named Scarabaeid, which, moreover, is not found on the Canadian prairies.

It is usually the depredations and seldom the insects themselves which first attract the attention of rose-growers, and for the most part the destruction of rose blossoms goes forward unchecked, so elusive and yet persistent are the

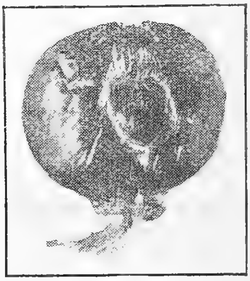


Dipterous larva in rose hip.

Larva, *R. bicolor*, showing position in hip.



Fully developed larva, *Rhyncites bicolor.*



Rose hip, showing emergence hole of larva of *R. bicolor.*

attacks of the little invaders. Experiments, however, have shown us that a very appreciable control may be realized by combating either the early larval or adult forms.

Life Cycle. The life cycle of *R. bicolor* as it occurs in Manitoba may be summarized by the following dates:

Adult emergence	June 1
Egg-laying	June 14
Hatching	July 8
Desertion of hips	Sept. 4
Pupation	May 16

The above dates are the earliest recorded for each stage, the averages being from one to two weeks later. The period of emergence for the adult may be especially prolonged in some cases; certain apparently healthy larvæ, after hibernating, having failed to pupate as late as the next September. It would seem, therefore, that, as an additional means of preservation of the species, some individual members may hibernate for a second time.

Plants Attacked. All of our native roses as well as various cultivated ones, such as *Rosa rugosa*, are attacked by the Curculio. While none appear to be immune there is yet a marked difference in the degree to which plants are infested, the location as well as varietal susceptibility causing variations.

Thus in early September larvæ have been found in as many as 63.3 per cent. of the hips of *R. pratincola* on an open southern slope, while along a roadside in Bottineau county, N.D., *R. pratincola* was found infested to as high as 74 per cent. In the case of plants partially protected by trees the percentages were distinctly lower, probably because of the preference of the insect for bright sunshine. At the edge of a wood *R. acicularis* and *R. blanda* have been found infested to the extent of 29.6 per cent., while for plants entirely shaded within the wood, 6 per cent. was the highest for any species. The relative susceptibility of *R. macounii* has not been determined because of its rareness in Manitoba. Injury to small fruits such as blackberries and raspberries, as mentioned by some observers, has up to the present been negligible here.

Natural History and Habits. In southern Manitoba the first adults appear promptly about June 1st and are most abundant by the middle of the month. They disappear rather suddenly in July but specimens have been seen by us as late as August 7th, this being due, as has been mentioned, to the late pupation of some of the larvæ.

Upon emerging, the Curculio ascends a convenient rosebush and, after sunning for a while, begins to feed on the buds by making deep punctures with its well-adapted beak, often eating twenty or more holes in the same bud and sometimes a few additional ones in the hip. When not feeding it rests upon the foliage a great deal, but on bright, warm mornings it is never idle. Copulation is common a few days later and egg-laying begins towards the end of June.

The eggs are laid in the punctures and are inserted sufficiently to be almost concealed. Only one, or more rarely two eggs, are laid in each bud.

Hatching commences the second week in July and the young larvæ live for a short time within the flowers, then desert the flowers for the hips where they are found the latter part of August feeding on the seeds. Here they develop rapidly. Only one fully developed larva has been found to survive in each hip. Beginning about September 4th, the larvæ bore their way out of the hips, fall to the ground and bury themselves to a depth of 1½ to 4 inches in the soil where they hibernate. By the middle of the following May the first pupæ are being formed in the soil and, after a period of two weeks, the first adult Curculio emerges.

Egg. Pale yellow, shiny, somewhat translucent, distinctly narrower at one end than the other and varying a little in size. Length: 0.9-1.2 mm.; width: 0.6-0.9 mm.

Larva. Colour pale yellowish, except the portion of the head above the epistoma, which is dark-brownish, the coloration extending farther along the mid-line; clypeus and labrum pale; mandibles black with three teeth; antennæ one-jointed and situated at the bases of the mandibles, slightly darker than the body colour. Body with many small hairs, legless and strongly curved, conforming with the position assumed in the hips. One pair of spiracles on the prothorax and eight on abdomen, each with two lobes. Larval movements are extremely awkward and effected by means of the two extremities and the longitudinal contractions of the body. Length of larva: 5-6x2.5 mm.; width of head: 1 mm.

PUPA. Resembles the larva in size and colour and responds to gentle stimulation with quick but purposeless jerks.

ADULT. General appearance is as described by Blatchley and Leng (Rhyncophora of N.E. America, p. 58) except that the head frequently is entirely black. This was the case in 26 per cent. of a large series of the beetles collected by sweeping in the same vicinity.

"Robust, convex, pyriform. Elytra, thorax and head behind eyes bright red; under surface, femora and beak black; tibiæ, tarsi and antennæ piceous black. Beak as long as head and thorax, rather sparsely marked with elongate punctures; antennæ inserted at its middle, their grooves distinct. Thorax cylindrical, as long as wide, rather densely and finely punctate. Elytral striæ indistinct, their punctures but little coarser than those of intervals, which are very dense. Beak of female shorter and stouter than in male. Length: 5 to 6.5 mm."

CONTROL. The control of the Rose Curculio is difficult, particularly so when the adults are not anticipated or discovered early enough, for a very few will cause extensive mutilation. Others, moreover, are likely to migrate from neighbouring bushes. When small numbers occur, hand-picking, net-sweeping or shaking into an umbrella, etc., will suffice, but for a severe outbreak heavy applications of spray, using lead arsenate in the strength of 3 to 5 lbs. per 50 U.S. gallons of water is the most efficient procedure. By this method a 95 per cent. kill has been obtained. Spraying has the advantage of also destroying certain other larvæ which feed upon the foliage at the same time of the year.

If an examination of the hips in the autumn shows a fair percentage of infestation, e.g., 20 per cent., of larvæ present, then spraying might well be begun the first week of the following June, even before the beetles have been noticed. Still more certain is the practice of picking and burning all the hips before the first of September, thus catching the larvæ before they have fallen to the ground. In any event, very careful observation is a necessary factor in their control.

OTHER INSECTS AFFECTING ROSES. In addition to the Curculio there are several insects which at one or more stages of their life histories produce injury to roses. These include a dipterous and a chrysomelid larva which infest the hips, a Scarabæid which feeds upon the leaves, and other chrysomelidæ which feed largely upon the flowers.

Noteworthy among these is the pretty green and black Scarabæid, *Dichelonyx backi* Kay, which exhibits a distinct fondness for rose foliage. As many as thirteen of these beetles have been seen feeding simultaneously upon a single small plant of *R. acicularis* in the Kennedy district of Saskatchewan.

To be noted also are certain chrysomelids, including *Haltica tombacina* Mann., and *Calligrapha lunata* Fab., as well as a fly *Spilographa setosa* Doans, which has been found in its larval state to inhabit the rose hips during the autumn, not infrequently along with *R. bicolor*. Later it passes to the ground, where it forms its puparium and emerges as an adult late the following June. In the hip the larva is confined more to the juicy outer wall than to the seeds as in the case of the Curculio. A hymenopterous parasite has been reared from this interesting fly and it is hoped that further investigations of both, as well as the other species mentioned, may yet be carried out. In conclusion, grateful acknowledgment is made of the generous assistance rendered in this study by Mr. Norman Criddle, Entomologist in Charge for Manitoba.

TWO PROBLEMS IN NATURAL CONTROL

Norman Criddle, Dominion Entomological Laboratory, Treesbank, Man.

The study of natural control has always been of great fascination to me. There are so many intricate byways to be traversed and so many inter-relations to be studied before the links begin to form a chain and the chain is joined to other chains, thus eventually giving us an insight into the great web of life.

When we view natural control in this way we see that it goes beyond the realms of any one science—Entomology, ornithology, mammalogy and botany are all involved in its kingdom, which stretches out over the entire world.

It is not my intention, however, to involve myself in all the intricacies of natural control in this paper. I wish, rather, to touch upon one or two of the more important problems with which I have come in contact during the last few years.

One of the major problems that has engaged our attention in Manitoba during the present century has been that of controlling the Wheat-stem Sawfly, *Cephus cinctus* Nort. The insect began its career as a pest more than twenty years ago and from that time on it has occasioned enormous losses to farmers of the Prairie Provinces. Its spread was slow at first, but later it made rapid inroads into the grain fields, and to-day it is found over practically the entire wheat-growing areas of Manitoba, over much of Saskatchewan and part of Alberta. It is also a common pest in North Dakota.

Now *Cephus cinctus* was originally a grass-stem inhabitant and any stem might accommodate the larvæ, providing it was large enough. Consequently, the only limit to the insect's increase was the number of suitable stems and the prevalence of its natural enemies. Of the two I think the latter were the most efficient in keeping it within bounds, but in spite of its enemies the sawfly managed to hold its own without much difficulty and when man began to upset the natural balance, as he is always doing, the sawfly soon took advantage of the new plants provided. Thus it came to pass that the sawfly became a pest, but what had become of its natural enemies? Had natural control, in this instance, lost its effectiveness? Temporarily, yes, but there is reason to hope, not permanently. When the sawfly invaded the wheat and rye fields it succeeded in leaving its parasitical enemies behind and in consequence it spread with far greater rapidity than would otherwise have been possible. For a long time it appeared as though the parasites, so common in grasses, could not follow their hosts into the new food plants; perhaps due to certain cultural methods, or to some other causes imperfectly understood. Gradually, however, odd stems of *Cephus*-infested grains were found to contain the parasites. They were found chiefly on the edges of fields, at first, just as the first sawflies had been, as if constituting an overflow from the grasses round about. Ultimately one parasite, *Microbracon cephi* Ghn., began to spread farther afield and such was its progress by

1923 that Ainslie, of the U. S. Bureau of Entomology, and I found a fifty per cent. parasitism in certain fields near Bottineau, North Dakota. In Canada, K. M. King, of the Dominion Entomological Branch, discovered a ten per cent. infestation in plots near Saskatoon, Sask., and we in Manitoba found the parasite to be quite widely prevalent in grain fields, though still mostly on the edges of the crop. Hence a beginning has been made, but the parasite will have to make far greater progress before we can expect to reap much benefit from its activities. Once a start has been made, however, and a foothold obtained, we can hope for further gains. There is this consolation, too, that the *Cephus* damage in North Dakota during 1923 was less than half what it was some years ago.

There are other parasites of the Wheat-stem Sawfly which, as yet, have been very rarely recovered from grain stems. There are also, I regret to say, some secondary parasites, one of which, *Eupalmus alyni*, we have reared from *Microbracon cephi*. There is also a much smaller Hymenopteron, probably a parasite on *Eupalmus*. Thus the wheels within wheels complicate our problem of natural control, though they obviously add to its interest.

I have some hesitation in appearing as a student of forest insects, but we have been so long without adequate investigators of shade-tree and forest insects on the prairies that it has seemed absolutely necessary to study some of the more important forms with which our people have had to contend.

Two of these insects have been forced upon me with particular emphasis during the last two years, namely, the Forest Tent Caterpillar, which has defoliated more than a hundred square miles of trees in Saskatchewan, and the Fall Webworm, which has cleaned up local areas of trees with equal thoroughness.

I am not going into details of these outbreaks other than to state that the insects involved have certain parasites in common. One in particular has turned up quite frequently, namely, *Itoplectis conquisitor* Say. We reared it last year from the Fall Webworm in small numbers. This year it parasitized tent caterpillars to the extent of about twenty per cent., and it occurred in great numbers among the *Hyphantria* this fall. Another species, *Ephialtis pedalis* Cress., has been reared from the *Malacosoma* larvæ and has been seen amid the fall webworms, so we may suspect that there is a linkage between the two hosts and the two parasites. Other Hymenopterous parasites as well as certain Tachinidæ have been reared or collected from, or near, one host or the other, but I am emphasizing *Itoplectis* because of its commonness and because of its dependence upon at least two hosts for its perpetuation. In the shrubby or semi-wooded country its usual hosts appear to be *Malacosoma fragilis* and certain *Tortricidæ*, all tent-building species. In the more wooded country it may attack the insects already mentioned but readily infests as alternatives both *Malacosoma disstria* and *Hyphantria textor*.

Judging from the number of *Itoplectis* present it would seem as if this and other parasites will practically eliminate the webworm outbreak next year, but we cannot predict as much for the tent caterpillar, because the two pests have occurred at widely separated places and we do not know what intermediate hosts are present in the tent caterpillar region, or whether *Itoplectis* is a strong enough flier to migrate long distances in search of hosts.

If we could only transport the heavily parasitized *Hyphantria* pupæ to the *Malacosoma*-infested area much good might result. Perhaps, however, it would be better still to have actually shipped the healthy webworm pupæ to the tent caterpillar district in order to insure a supply of alternate hosts for the parasite.

The shipping of a healthy pest to a comparatively free region may seem a rather risky recommendation, and doubtless it would be were we to transport such pests beyond their known range, but within the range little harm should result, while much good might be accomplished. It seems reasonable to suppose that the shipping of healthy webworm pupæ would be particularly appropriate in this case, because of the fact that the second generation of *Itoplectis* would be more numerous than the first and on this account the imported *Hyphantria* would probably be the first to become exterminated by the parasite. If, on the other hand, the tent caterpillars were the first to go, the abundance of parasites issuing from them would almost surely be sufficient to finish up the remaining webworms.

As pointed out above there are a third series of secondary hosts for *Itoplectis* in the tent-making *Tortricidæ* from which the parasite has frequently been reared by us but we have not yet been able to discover any alternate hosts for the spring generation other than the various species of *Malacosoma*. *Itoplectis*, however, is known to have a very wide range of hosts in the United States and it is possible, therefore, that it will yet be found infesting canker worms and other spring larvæ. In any case *Itoplectis conquisitor* seems to be an extremely important parasite and a knowledge of its full life-history is surely desirable.

I have in conclusion to acknowledge the assistance of Mr. R. M. White, who has handled most of the rearing in the *Hyphantria* studies.

THE PRESENT STATUS AND DISTRIBUTION OF THE APPLE AND THORN SKELETONIZER (*Hemerophila pariana* Clerck, Lepid.)

M. D. Leonard, Associate State Entomologist, Albany, N.Y.

In the fall of 1917 it was discovered that a new apple pest had become well established in Westchester and Rockland counties in the lower Hudson River valley, and so another undesirable was added to New York's already too long list of insect immigrants. Dr. Felt has called this the apple and thorn skeletonizer.

Just how this pest may have been introduced into New York or just how long it may have been present is not definitely known. It has long been known, however, as a minor pest to apple in Europe, and also occurs in Turkestan and Western Asia,

The direction of spread in this country has been mostly to the north and east. By the end of 1918 it was definitely known to occur in Rockland county from Yonkers to Yorktown Heights, a distance of almost twenty-five miles. At the close of 1921 there had been only a moderate extension of the infested territory in New York northward. In the fall of 1920, however, it was observed at Orient Point at the far eastern end of Long Island, and was also found to have become established in Greenwich and Stamford, Connecticut, and at the close of 1921 had apparently spread all over that state except along the northern border.

According to the reports available it was first noticed in Massachusetts in the fall of 1922 in small numbers in the vicinity of Huntington and Chesterfield and also at Amherst. In the opinion of Mr. B. A. Porter, of the U.S. Bureau of Entomology, it had probably been present in the first two above-mentioned localities for a year or two. At Amherst the abundance of moths was probably due to a migrating flight northward from Connecticut. In New York, 1922 saw the extension of the range of the pest northward into Albany and Rensselaer counties with severe damage throughout most of the infested territory on neglected or poorly-sprayed trees. In 1923, it is reported for the first time from Rhode Island and New Jersey.

So far as I have been able to ascertain through personal examination and from reliable sources, the apple and thorn skeletonizer occupies the following territory in this country at the close of this season—1923:

New York—From Orient Point, at the extreme east end of Long Island, northward up the Hudson River valley practically to Whitehall in Washington county. It extends eastward from the Hudson to the Connecticut and Massachusetts and Vermont line. The pest is established from Glenn Falls southward throughout the whole of Schenectady and Albany counties, is on the west slope of the Catskills in Greene county, is probably in the western part of Ulster county and is present throughout the whole of Orange and Rockland counties. We have found it this year scatteringly as far west in Scoharie county as Cobleskille, a point about fifty-five miles almost due west of Albany.

Careful search earlier in the season failed to disclose the presence of the pest at Johnstown, a point about fifty miles up the Mohawk from Albany. Apparently, from all reports, the insect is not yet present in Essex or Clinton counties—the latter adjoining the Canadian border. Also, none was found by Mr. P. M. Eastman, of the New York Department of Farms and Markets, after a thorough search of neglected apple trees at Malone.

Connecticut—It is now reported present in all parts of the state.

Massachusetts—Prof. A. I. Bourne reports (September, 1923, Insect Pest Survey, p. 280) that apparently the skeletonizer had spread clear across the state and that, while not yet in large numbers, there undoubtedly would be an increased abundance throughout the state as a whole another year.

Rhode Island—Prof. A. E. Stene (Insect Pest Survey, September, 1923, p. 228) reports that it has been found this season from the Connecticut line to a point three-fourths of the distance across the state.

New Jersey—Known to be present so far only in a small orchard at Pompton, which is about eight miles north of Paterson and almost fifteen miles southwest of Suffern, New York, on the border of Rockland county.

Vermont—The skeletonizer is probably present along parts of the western border of Vermont since it has been found within a mile of the border at several points in Washington county, N.Y. I have, however, received no definite report as yet of its occurrence in this state.

Canada—This past summer, Mr. J. P. Spittall, of the Annapolis Royal Laboratory in Nova Scotia, wrote me that he thought the pest was present up there, but understand from Dr. McDunnough, in charge of the national collection at Ottawa, that specimens submitted for determination were undoubtedly not this species. The caterpillars were feeding on thorn.

Such is the brief history of the introduction, spread and present distribution of the apple and thorn skeletonizer in this country. My purpose has been simply to record all that could be ascertained to date concerning its occurrence here.

Food Plants. The apple and thorn skeletonizer seems to prefer to feed upon apple in this country, but has been recorded as also injuring, to a lesser extent, thorn and pear, and, in one instance, peach, sweet cherry and strawberry.

Damage. The injury of the apple and thorn skeletonizer is not equally severe in all parts of its present range, but it is reasonable to conclude that its numbers will undoubtedly increase to a considerable extent in a season or two in the now lightly-infested territory. The foliage of severely injured trees appears, at a short distance, to be scorched by fire, and in late summer or early fall many of the leaves drop to the ground. The exposed feeding of the caterpillars, their susceptibility to arsenicals and to reduction in numbers by several native parasites, together with the fact that much of the injury is done late in the season, all seem to point to the skeletonizer as an apple pest of only second-class rank. However, the damage is so severe in neglected or poorly sprayed orchards and on roadside trees that it emphasizes the necessity for thorough, consistent spraying wherever the pest is present.

During the past season there were apparently three full broods and a fractional fourth in the Hudson River valley in New York. Occasional moths were still found in houses in Albany as late as October 30th.

Control. The caterpillars feed for the most part on the upper side of the leaves in an exposed manner, and are readily susceptible to even light applications of arsenate of lead. Trees which receive the regular apple spray schedule through the season are but little troubled by the skeletonizer, and it is not a pest to be feared by the commercial grower who gives his orchard reasonable care. It would seem that the calyx application made just after the petals fall is the most effective, but in the Hudson River valley in New York, experience points to the advisability of another application about three weeks later on. In many cases, however, where this later spray has been omitted or where the calyx spray has not been thoroughly applied, an application about the third week in August should be made. This was advised for the control of the third brood of caterpillars in the Hudson River valley during the past season and many growers adopted the recommendation with apparently good results.

TAXONOMIC AND SYNONYMIC TENDENCIES WITH ESPECIAL REFERENCE TO DIPTERA

C. H. Curran, Entomological Branch, Ottawa

To entomologists of every degree and complexion there is, perhaps, nothing so discouraging—or perhaps I should say annoying—as the continual shuffling of species from one genus to another, or the frequent changes of names of many of our common insects. All of us look forward to the day when stability in nomenclature will be a realization. Such hope is not vain, yet we must all feel that it will be some time in the distant future, an era of which we can only visualize as one of vast scientific knowledge, ruled by men who, in all probability, will smile indulgently when they peruse for some obscure detail the works setting forth our own small contributions. Be that as it may, it in nowise alters the conditions of the present, nor has it, in fact, any connection with the subject under discussion.

I hope I may not bore you by the use of technical phraseology; at the same time may I be pardoned if I use such as little as possible. It is not my intention to go into minute detail, but to discuss, as the title indicates, tendencies in systematic entomology and, perhaps to some extent, the influences responsible for them. It is not necessary to dwell upon the work of the pioneers, nor to expose their shortcomings. Such a course would imply perfection in ourselves, and no one knows better than I how imperfect our knowledge and work is at the present time.

Since the appearance of Darwin's "Descent of Man" and "Origin of Species," propounding theories which came as a great shock to mankind, and stimulated those interested in the subject to greater research, the search for "missing links" between the families and orders in the biological fauna has been greatly intensified. While many have striven, none have succeeded in proving or disproving the theories of Darwin to the satisfaction of all and there we will let the matter rest. It has been mentioned merely because of the great influence it has had upon entomological studies.

From the time of Linne entomologists have attempted to perfect a classification of insects without avail. To-day we have a classification which is, if anything, worse than that of the founder of our science. We have advanced, yes, but in our progress we have become so enmeshed in the complexities of nature that we know not which path to take to find relief. There is no stability in our classification; nor is there any relief in sight so long as the present tendencies prevail. It is safe to say that all the paths which appeared traversible to the students of fifty years ago have been fairly well surveyed, and, in so far as progress is concerned, we have been, until recently, almost at a standstill. It is true that we are finding new forms—new connecting links—in fact, a great many new things to add to the complexity of our problems.

During the past few years new fields have been explored. We have realized the value of the genitalia as a guide to species. Many have over-emphasized it. Just what its ultimate value will be in the tracing of relationships, it is impossible to surmise. Dealing now with the flies in particular, I must say that a great deal has been accomplished quite recently. There has been some effort devoted by American Dipterists to the discovery of new characters which would serve to definitely limit certain groups. Such researches have not been in vain and it appears likely that within the next few years these discoveries will be embodied in a reclassification of the Order which will greatly simplify the determination of species and result in more sharply defined groups, and another step taken towards stability in classification.

It is remarkable, when we look back, to observe that during the past half-century or more, entomologists have been playing the game of "follow the leader." Dipterists have followed Meigen and have used the same means of separating families as prevailed in 1820. Once more I do not mean that we have not advanced, but entomology as a science must be considered as one of the least progressive of all. To-day the implements of agriculture do not in any way resemble the primitive methods of a century ago. In agriculture we have different types of seed to those employed even by our great-grandfathers, but in systematic entomology we are using the same seed and securing the same uncertain results.

Many systems for the classification of the wing veins of insects have been devised and many names have been proposed, but to-day we are no more certain about the origin of a vein in Diptera than was Linne, and probably he did not even consider the matter. For example, the anterior crossvein in the Syrphidæ, or at least in some of them, is not wholly a crossvein, but is a fusion of what is termed the fifth radius and the crossvein. This may not be true in the Muscoid groups, but we have no proof that it is or that it is not, but it is certainly true in the Syrphid genus *Stilbosoma* Philippi from Chile. No classification of the wings of insects is possible without thoroughly considering the world fauna, and anything based upon a regional fauna must be erroneous and misleading, and can only be a centre of controversy. But, nevertheless, all such systems are a means to an end—they do their bit towards attaining the final goal. At the same time most of us prefer a simple terminology, and such must, in the long run, serve the larger number of people and result in greater interest and advancement.

There appear to be entomologists who take the greatest delight in surrounding their specialization with a barricade of complex terminology, perhaps hoping thus to eliminate all contenders for their crown. They have the habit of describing their pets in such a manner that it is next to impossible to penetrate their meaning and arrive at even a remote understanding of their subject. Perhaps I am one of them, and if so I condemn myself without reservation. No one who has had occasion to refer to the monographs by Loew and Osten Sacken can find fault with the simple, concise, clear phraseology. These men knew how much to say and how much to omit, an accomplishment which we should to-day attempt to emulate. Many of us appear to lose sight of the fact that we are not, or at any rate should not be, working for our own glory. If by doing good work we accomplish glory, that is another matter, and something to our credit, but to work solely for that glory and to fancy we have attained it, is an admission that we have failed in an unworthy cause. The main need in entomology to-day is not the building up of obscure terminology, but a comprehension of English, or whatever language we speak, which will enable us to place our findings before the world in such a manner that they may be comprehended by even the poorest student.

Most entomologists have had frequent occasion to use keys or tables of species, genera or families, and few, I think, have not raved at the inconsistencies of the delineator. No doubt I have caused some such scenes myself, and if I have not, it is through no fault of my own. The making of a key is, in my opinion, the most difficult task we must face. It is easy to concoct one which will suit our own enlightened mind, but others may be left almost entirely in the dark. The trouble, I believe, is due to the lumping of various characters in the antitheses, instead of relying upon one character, and the failure to place doubtful specimens under more than one section.

There are tendencies to "lump" and to "split." What is their effect? Which is the more desirable? In my opinion the lumping of species has done much more to confuse the student than any other procedure. This is especially true in the Muscoid groups where, very often, many legitimate species have been placed in the synonymy merely because the descriptions read alike. Unfortunately some workers will do their utmost to make a description fit a species when they are sure it does not, and there are others who will insist upon arriving at a conclusion that the author was in error in not mentioning characters which the specimen under examination exhibits, or that the colours were wrongly given, and the specimen must be that species, and so determine it. Why it should be concluded that an author meant yellow when he said brown, or grey when he said green, I do not know, but I do know that such is often the case, judging by determinations I have seen. Of course, some writers do appear to mean reddish when they say yellow or yellow when they say white, so perhaps there is some excuse for the aforementioned conclusion. One of the requirements for all taxonomists should be the passing of a test for colour-blindness.

The "splitters" are often roundly condemned, yet they do not create nearly as much trouble as the "lumpers." The chief cause of complaint against the "splitter," who is really advancing science by looking deeper than the average person, lies in the persistency of the student to make two species out of one. I have spent many hours trying to make slight variants fit the description of one or two apparently closely allied forms, only to feel like kicking myself soundly at such time as the other species came to hand. The "splitter" is a keen student as a rule, and even if his enthusiasm does sometimes carry him beyond a reasonable limit, he may be excused, as he does not as a rule cause the confusion of the "lumper." I do not think, however, that there is any excuse for carrying on the splitting of genera to such an abnormal degree as has been done in the Muscoidea. I gather from my studies in this group that some students consider that there can be only one species in a genus, unless it should happen by some inavoidable accident that it is practically impossible to tell the two species apart, in which case there *might* be two. At any rate it must be admitted that if we are to follow the lead shown here, we shall have to entirely discard genera and know the myriads of insects by their Christian names. What we need is not numerous genera, but more definite generic limitations. We must not lose sight of the fact that families and genera are an aid in determining the species—the species is the ultimate, the genus, family, and order the means of attaining it.

Thus far I have not dealt with synonymy, a phase of entomology which is extremely perplexing. It is discouraging to discover that an old and well-known genus is not that genus at all, but some other one, or that some other one is that one and that one cannot be it. If I do not make myself clear it is entirely because the subject is complex and rather inexplicable. At any rate, the rules of nomenclature demand that the oldest valid name for a genus or species be used and many changes are due to this fact. In other cases the name may be pre-occupied. This practice is, of course, to give honour where honour is due and as such is a commendable one.

I am of the opinion that a great many of the changes are unwarranted. Certainly great caution should be used before proposing an older name to replace a well-known one. I believe that a great many species attributed to the older writers and considered as genotypes are unrecognizable, either from the description or due to the fact that the writer had more than one species before him in describing a species or in placing it under a generic name. Verrall has remarked upon the large number of Linne's species which are recognizable. I do not agree, but consider that the majority of the species described by the first systematist are recognizable due to the courtesy of subsequent students. I heartily agree that the names should be attributed to Linne—we cannot do sufficient to honour him—but I repeat that every care should be taken before invalidating a popular genus in favour of a genus founded on a species proposed by an early worker.

There are few people in America who can separate the species of *Syrphus* accurately and I venture to say that anyone founding a genus on one of the species allied to *S. ribesii* would find, upon close examination, if he had a large series of specimens, that there was more than one species in the series. Further, if the specimens were distributed, so that only two or three remained, all of the same species, and they were examined, it might be found that they did not agree with the generic description in some respect, yet being the alleged genotype, the generic concept would be changed to agree with them, whereas the actual genotype would be lost. I admit that this is possibly a far-fetched example, but it is certainly not any more erroneous to believe that such a case has often happened than to accept determinations over a hundred years old, or genera based upon such determinations. And even to-day we sometimes determine species wrongly! It is a simple matter.

No one takes more pleasure than I in tying down an old name. I glory in the fact that I have accomplished something much better than the addition to the lists of several species new to science. But at the same time I do not believe in *making* things fit a description and am sure that in such cases a grave error is committed. I believe that there is a tendency to-day to ignore for the present unrecognizable species and to describe as new those insects which might be the species described, or might not. Such a course permits us to gain a complete knowledge of our fauna, but it creates work for those who take pleasure in establishing described species. I believe that such a course is desirable at the present time, provided sufficient care is used by the student. Unfortunately the European species of insects are not well understood—there are hundreds of valid species in the synonymy—and many types of American species are in Europe, so that one must always bear in mind the fact that a new American species may have been described years ago in Europe and placed in the synonymy. The securing of European specimens is not always of the supposed value, because one might easily be sent a species, which is not typical, although it may agree insofar as the European concepts of the species is concerned. By this I mean that there are often included under one name a great many species. I have found eight species of *Ocyptera* included under the name *carolinæ* and fifteen species of *Echinomyia* under the name *algens*, as understood by Coquillett. So I ask, is there not a chance of receiving any one of fifteen species when representatives of an European Tachinid are requested.

We cannot overcome the need of changing names; we must have regulations which will ultimately give us stability, but we can at least use discretion before proposing a change, and we can also hope that the fund of undiscovered works and obscure genera, species, and preoccupied names of old genera may soon become exhausted.

MISCELLANEOUS NOTES ON GRAPE LEAF HOPPER CONTROL

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In discussing the control of the grape leaf hopper at the last annual meeting of the Entomological Society of Ontario, we referred to certain field tests and observations which indicated that nicotine sulphate will destroy leaf hopper eggs. In order to secure more precise data regarding the susceptibility of the eggs, some ninety spraying and dusting tests with a total number of 9,617 eggs of known age were conducted by Mr. W. Robinson in the laboratory last winter. On account of the fact that *Erythroneura comes ziczac* was present in large numbers in the immediate vicinity of the laboratory, this variety was used in most of the experiments, only a few comparative tests being conducted with *E. comes*. The hoppers were placed on one-year-old Clinton vines, and were confined by means of celluloid cages. As the Clinton grape has little pubescence on the under sides of the leaves, no difficulty was experienced in locating and counting the eggs. The sprays were applied with a hand sprayer, care being taken to thoroughly coat the under sides of the leaves, and the nicotine dust with a hand blower. The results obtained from these tests are presented herewith in tabular form:

Effect of Nicotine on Eggs of E. Comes Ziczac

Table 1—Nicotine Sulphate 1-1600, Hydrated Lime 5 Pounds—40 Gallons.

No. of tests	No. of eggs	Age of eggs when treated	% killed in egg stage	% nymphs which died while hatching*	% total mortality
9	511	1-2 days	29.7	48.9	78.6
4	533	4 "	61.9	36.3	98.3
9	480	9-10 "	68.5	1.5	100
5	558	18-19 "	84.4	15.6	100
27	2,082				

* Nymphs succumbed in process of hatching. None of them actually emerged from the eggs.

Table 2—Nicotine Sulphate 1-1600, and no Lime.

3	378	1-2 days	15.1	49.7	64.8
2	354	9-10 "	22.6	46.6	69.2
5	732				

Table 3—Nicotine Sulphate 1-1200, Hydrated Lime 5 Pounds—40 Gallons.

6	568	1-2 days	47.2	52.8	100
5	513	9-10 "	57.3	42.7	100
2	538	18-19 "	67.6	32.4	100
13	1,619				

Table 4—Nicotine Sulphate 1-800, Hydrated Lime 5 Pounds—40 Gallons.

2	477	1-2 days	63.5	36.5	100
3	519	9-10 "	71.8	28.2	100
2	491	18-19 "	78.4	21.6	100
7	1,487				

Table 5—†Nicotine Dust—2.2 Per Cent. Nicotine.

No. of tests	No. of eggs	Age of eggs when treated	% killed in egg stage	% nymphs which died while hatching*	% total mortality
3	482	1-2 days	8.8	20.1	28.9
3	508	8-9 "	20.2	33.0	53.2
4	528	18-19 "	26.9	46.7	73.6
10	1,518				

Table 6—Checks.

8	602	....	5.7	6.3	12.0

EFFECT OF NICOTINE ON EGGS OF E. COMES

Table 7—Nicotine Sulphate 1-1600, Hydrated Lime 5 Pounds—40 Gallons.

No. of experiments	No. of eggs	Age of eggs when treated	% killed in egg stage	% nymphs which died while hatching *	% total mortality
5	516	9-10 days	85.7	14.3	100
6	480	Newly laid	65.0	26.0	91.0
5	477	About to hatch	67.1	32.9	100
16	1,473				

Table 8—Checks.

2	104	....	11.5	0	11.5

These laboratory experiments demonstrated that newly-laid eggs are somewhat less susceptible to nicotine than those over eight days old; that nicotine dust is unsatisfactory as an ovicide; that the addition of lime apparently increases the ovicidal value of the nicotine sulphate‡; that nicotine sulphate

* Nymphs succumbed in process of hatching. None of them actually emerged from the eggs.
† Niagara D-11.
‡ See tables 1 and 2. A shortage of plants made it impossible to carry on a larger series of tests of nicotine sulphate without lime.

1-1,200 in combination with lime will destroy the eggs in all stages of development, and that this strength of nicotine is 100 per cent. effective.

Having satisfactory evidence that the eggs are as readily destroyed as the nymphs, our next step was to ascertain when the leaf hopper spray may be applied to best advantage. With this object in view, three infested blocks of grape vines at Barnesdale, St. Catharines, were sprayed at different times with nicotine sulphate (¾ pint—100 gals.) and Bordeaux mixture. The first block was sprayed on July 6th, about eight days after Concord blossoms fell, and the other two blocks were treated on the 13th and 20th respectively. The spray mixture was applied by means of a triplex Bean outfit, with two short rods and angle nozzles, and pains were taken to thoroughly wet the undersides of the leaves. The results* secured from this experiment were very gratifying —in the three blocks the leaf hopper was reduced to negligible proportions. Even in late summer only odd leaf hoppers could be found on the vines, and the foliage remained green all season, whereas, in the "check" grapery, the foliage showed severe leaf hopper injury from early August to the end of the season.

The majority of Niagara grape growers with infested vineyards sprayed their vines as recommended by us during the period July 11th to the 21st, and in all cases where the work was done properly the hopper was reduced to insignificant numbers. At Barnesdale, for example, where there are some seventy acres in grapes, and where conditions, in the form of bush-land adjoining the vineyards, are particularly favourable for leaf hopper, early and thorough spraying almost completely eradicated the insect.

From our experience in combating this insect during the past two years we have learned several things of importance, viz.:

(1) That it is inadvisable to postpone spraying until the majority of the eggs have hatched, because this permits too many of the nymphs to transform to the adult stage.

(2) That as hopper eggs are susceptible to nicotine, *the spray may be applied shortly after the overwintering adults cease egg-laying.* Our observations indicate that egg-laying ceases about the time Concord grape blossoms drop, so that, allowing a safety margin of several days, *spraying operations may be commenced about one week after the fruit sets.*

(3) That there is a period of at least two weeks when very effective work can be done (1923—July 6th to 21st). The fact that there is a considerable amount of latitude as to when the application may be put on, makes it possible, in sections where the root worm is a serious pest, to kill two birds with the one stone by combining the nicotine with one of the root worm sprays, thus saving the time and labour of a special application. Likewise, in vineyards infested with the grape berry moth, the leaf hopper spray can be made to coincide with the second application for the moth.

(4) That, in addition to those mentioned above, the "egg-spray" (applied after cessation of egg-laying) has the following advantages over the "nymph spray" (applied when the vast majority of the eggs have hatched): it practically eliminates the second brood; it lessens the danger of staining the fruit with Bordeaux mixture; it is usually of more value in checking plant diseases; it simplifies spraying operations, and saves material, because it is put on before the heavy new growth is made.

* We had planned, as suggested by Mr. Van Dine, Pennsylvania State College, to present the results in the form of brix readings of grape juice, but we were unable to do this because a severe hail storm on August 24th seriously injured the crop in our experimental plots.

THE NEW REGULATIONS UNDER THE DESTRUCTIVE INSECT AND PEST ACT

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The complexities that have arisen in the past twenty-five or fifty years in connection with the exchange of commodities throughout the entire world, also the increase in the diversity of established trade routes, and the danger that naturally results from the movement of products infested with pests and diseases, have made it necessary for man to take every reasonable precaution to prevent, in so far as possible, the introduction of new species of pests and diseases into uninfected areas. Whether it is due to a keener sense of observa- on the part of the general public, or whether it may be regarded as an established fact, nevertheless, there has been apparently a great increase in the amount of damage caused by insect pests and plant diseases during the past few decades.

Although it is realized that all the pests responsible for damage on this continent are not of foreign origin, many of our worst enemies are not native to this hemisphere. It is also known that there are many very serious pests present in the older portions of the world which might prove to be most undesirable guests if they were permitted to gain a foothold on our soil. Apparently one of the most feasible means of controlling the introduction of menaces such as these is by enacting laws which restrict or prohibit the importation of products and commodities likely to harbour these insect pests and plant diseases. It has been frequently stated that we on this side of the water are suffering from too much legislation, of all kinds and description, and while that may be true, I am afraid that we shall have to continue being burdened by pest legislation, or until such time as it is realized by all nations and peoples that only products free from pests and diseases shall be offered for exchange. A step in this direction was made in 1914 by the International Phytopathological Conference, which was held in Rome. Very unfortunately the Great War made it impossible to continue the discussions or bring into general operation some of the resolutions that were passed at that time.

Questions in relation to legislation, however, were discussed at the recent International Conference on Entomology and Phytopathology, convened by the Dutch Government at Wageningen, Holland, in June, 1923, and the Dominion Entomologist, Mr. Arthur Gibson, who attended this conference and took part in the discussions, has informed me that the following resolution was adopted:

> "The representatives of all nations assembled at this International Entomological and Phytopathological Conference, June 25th-30th, 1923, at Wageningen, desire to place themselves on record as in full agreement with the essentials of international trade and commerce in living plants and plant products, namely, reasonable freedom from all insect pests and plant diseases of all kinds of materials imported into, or exported from any country."

The history of the introduction of the major foreign pests now present on this continent is too well known to need repetition, and it is also recognized that all the pests and diseases were not imported on such products as nursery stock. An excellent example is the European Corn Borer, which circumstantial evidence showed was imported on broom corn from Europe. This has been substantiated by the finding of an outbreak of this insect at one of the ports of importation for broom corn and where it was held for sterilization. As a consequence, pest legislation should only be passed and brought into force after a careful study of the entire situation has been made. This will entail an investigation of the product from its source to its ultimate destination, the trade routes it has to follow and whether it is an essential commodity or not. Until this is done, mistakes are likely to be made and disastrous results follow. Crises arise, however, which make it imperative to take immediate action and financial loss may result, but such cases are very fortunately comparatively infrequent. Care must also be taken to base the legislation on a strictly scientific foundation and not to be influenced by commercial possibilities. This is a point which needs special attention in these days of keen trade rivalry and competition.

Insect legislation in Canada dates back to 1883, when an Act was passed in Prince Edward Island to prevent the spread of the Colorado potato beetle. With the appearance of the San Jose scale in British Columbia, legislation was passed in 1894, empowering the Horticultural Board to inspect and treat plants and plant products for pests and diseases. Four years later the first Federal Act was passed, known as the San Jose Scale Act. This law, together with the regulation, prohibited the importation of host plants of this insect from the United States, Australia, Japan and the Hawaiian Islands. With the discovery of effective fumigation methods, the law was modified in 1900 and permitted the importation of fruit stocks, etc., provided they were treated at one of the several Federal fumigation stations.

As a result of a serious outbreak of the brown-tail moth in France, and the finding of many nests on shipments of imported nursery stock, an active campaign was started to inspect all foreign shipments of this character. The following year, 1910, the Destructive Insect and Pest Act was passed and all Federal legislation since that time has been issued as regulations under this law.

The Act stands as a monument to the men who were responsible for its preparation, for although innumerable regulations have been passed in accordance with its authority, and on all manner of subjects, it has never been necessary to recommend an amendment to the Act itself.

Two years ago it was realized that the question of insect and pest legislation had assumed such a complicated aspect and involved so many different problems, not only as regards plant life but also trade and manufacturing interests, that in order to better co-ordinate opinion and effort it was deemed advisable to create an Advisory Board to consider such matters. On April 21st, 1922, the Destructive Insect and Pest Act Advisory Board was constituted, and five officials of the Department of Agriculture were appointed members. The Board is not empowered to pass legislation, but may recommend to the Minister of Agriculture any changes which are considered advisable and in the public interest and, in addition, may call upon other officials of the Department of Agriculture or other persons to act in an advisory capacity. Furthermore, the Board does not administer the various regulations under the Act, their administration being left to the Branch particularly concerned.

After careful consideration covering more than two years, including much investigation, and advice sought from the horticultural interests from one end of Canada to the other, including public hearings, the Board recommended to the Minister of Agriculture a general revision of the regulations.

On September 1st, 1923, the new regulations went into effect. These consist of a series of general regulations and fifteen foreign and six domestic regulations. The general regulations consist of fourteen sections and are more or less comprehensive, but are of particular interest in that they empower the Department to inspect or examine any plants or plant products offered for entry into Canada, which if found infested with pests or diseases may be refused entry, treated or destroyed. They also are of particular value in connection with the handling of shipments not covered by any special regulation or order, such as grains infested with weevils, broom corn, dried fruits, etc. Provision is also made for the inspection of export shipments, the powers of inspectors, interfering with an inspector in the performance of his duties, holding of infested shipments, the right to trespass, the selling of infested material, the importation of plants for scientific purposes, and the paying of compensation.

The foreign and domestic regulations deal with specific problems; they may be increased in numbers, amended or modified as occasion demands. They are issued in separate form and, it is hoped, are worded so as to be readily understood by the general public.

In adopting this form, the Department is of the opinion that the average individual may take a greater interest in the safeguards that have been enacted for his benefit. An inquirer will be able to see just what he may or may not do without the necessity of wading through endless pages of laws which are of no particular interest to him.

Under the foreign regulations the importation of nursery stock from foreign countries is governed. All plants for ornamental purposes or propagation, except seeds, are now classified as nursery stock and permits are necessary to import such shipments. Nursery stock from countries other than the United States may enter only through certain ports, and all shipments are subject to inspection. It is hoped by this means to prevent, if possible, the further introduction of noxious pests and diseases.

The foreign regulations also restrict the importation of plants from the Hawaiian Islands on account of the Mediterranean fruit-fly; the importation of nursery stock, forest and quarry products from the New England states on account of the gipsy and brown-tail moths; the importation of corn, cut flowers and other plants from the European corn-borer areas in the United States. A total prohibition has been placed on the importation of potatoes from countries and localities infected with the potato wart disease; all five-leaved pines and currants and gooseberries from all parts of the world on account of the white pine blister rust, chestnuts and chinquapins from Asia and the United States on account of the chestnut bark disease; European buckthorn and certain species of barberries from all countries on account of the crown rust of oats and the black-stem rust of wheat; alfalfa hay from the alfalfa-weevil-infested districts; plants with soil from Asia on account of the Japanese beetle and other soil-infesting insects; all species and varieties of douglas fir, hemlock, and larch from countries other than the United States on account of the newly discovered douglas fir disease; peach stock and hazel, cob and filbert from certain states into British Columbia on account of peach yellows and eastern filbert blight.

The domestic quarantines deal with the movement of nursery stock in the apple-sucker-infested areas in Nova Scotia; the movement of corn from the European corn-borer areas in Ontario. They also coincide with the foreign regulations prohibiting the movement of pines and currants and gooseberries into Western Canada from the white pine blister rust areas in the east, and similarly with the importation of European buckthorn and certain barberries on the prairies, and peach stock and hazel, cob and filbert into the Province of British Columbia from Eastern Canada.

THE VALUE OF NATURAL ENEMIES OF INJURIOUS INSECTS

A. F. Burgess

A belief has become firmly established in the public mind that insects are held in check by parasites under ordinary conditions. This has been taught in the colleges and institutions of learning and has been given prominence in the published works of many entomologists. The usual formula proposed is that when an insect is abundant its parasites increase enormously and bring about control, after which enormous mortality results to the parasites on account of scarcity of the proper host and that after a period of years the latter increases again and damage results. It is a well known fact that some insects, which are innocuous in certain parts, at least, of the regions which are their native homes, become excessively abundant and cause havoc after becoming established in a new environment. The above statements indicate the reasons for the attempts that have been made in this country and elsewhere to introduce natural enemies to control insect pests.

We must all admit that this subject has been given scanty consideration when its importance and complexity is considered. It is the purpose of this paper to consider some of the factors involved in the hope that more attention may be directed to some phases of this difficult problem.

Everyone understands that the food supply of any organism is one of the determining factors of its survival, but it is fair to assert that the food and feeding habits of many injurious insects have been studied only in a casual way.

Intensive study of the food preferences and what might be called the incidental food of each pest is often of great importance, not only as a means of deciding effective methods of control but of weighing the influence of parasites or predatory enemies on the abundance of any pest.

As a result of a careful study of the food plants of the gipsy moth in New England carried on for several seasons prior to 1900, it was determined that the larvæ of this insect fed upon foliage of most of the trees and shrubs in the region where it was then present. The possibility of the food being unsuitable to newly hatched caterpillars, although entirely satisfactory to those of a later stage, was not considered. Later experiments conducted by Mr. F. H. Mosher and his assistants at the Melrose Highlands Laboratory, supplemented by careful records made of the feeding habits of these caterpillars in the field, have demonstrated that a very decided preference is exhibited by different larval stages of this insect. This has given valuable suggestions as to control methods that are feasible and will be useful when an attempt is made to determine the proper role that parasites will play in gipsy-moth control.

These experiments have made possible the division of the food plants into various classes based on the food preference of the larvæ in different stages and indicate clearly that some plants are merely incidental hosts of this insect. It is easy to accumulate a long list of food plants of an insect if all plants that may be nibbled a little here and there are recorded. Such information is frequently inaccurate, and may be misleading unless the details are carefully worked out. Because a few individuals feed on a given plant when the circumstances are such that no other food is available, it does not necessarily follow that normal reproduction of a pest or continued damage will result.

One of the essentials of having a basis for determining the normal increase of an insect under field conditions must rest on a thorough knowledge of its food plants and feeding habits. Accurate and detailed information on this phase of insect control is in many cases incomplete.

The entomologist is also confronted with climatic conditions which in many sections of the country are most variable. Meteorological data is often most difficult to interpret satisfactorily in so far as its effect on insect increase is concerned.

Few seasons are comparable as to weather conditions, and when information is tabulated covering a decade or more showing the effect of any control measure, be it natural or artificial, which indicates that all the results point in the same direction, there is evidently something wrong, either with the compiler or the compilation.

It is said that statistics can be used to prove almost anything that is desired, and we as entomologists should exercise great care so that the conclusions that are drawn will be well balanced and will stand the test of time.

In some sections of North America weather conditions remain rather constant for considerable periods, and this simplifies the weather factor. In most sections, however, these conditions are not so stable and more complications result.

Both temperature and humidity are important, and react on the insect in all its stages. Our knowledge is very limited along these lines, although here and there attention has been given to the behaviour of some of our insect pests from this angle.

There is great variation in different species in this respect. Our experience in shipping parasites and predaceous insects has been that lack of a reasonable amount of moisture usually causes high mortality. This is particularly noticeable when the insects are not dormant.

Certain Tachinid puparia do not require moist conditions. They can be shipped without special precautions of this sort, and can be handled successfully with a minimum amount of care. Excessive temperatures often cause high mortality among insects. In the case of the gipsy moth, high temperatures, particularly if accompanied with insufficient or unsatisfactory food, furnish conditions favourable to an outbreak of the wilt disease which frequently sweeps away large numbers of the caterpillars.

Late frosts shortly after hatching, particularly if accompanied with heavy, beating rains, frequently result in the destruction of many small larvæ, due to temporary shortage of food supply or the inability of the small caterpillars to reach food after they have been washed or blown from it. The best records that we have been able to obtain indicate an enormous rate of mortality in the first and second larval stages. When weather conditions are very unfavourable in the spring it is doubtless true that only the most vigorous larvæ survive. In the winter, when the temperature drops below 20° F., gipsy moth eggs are killed unless they are protected by snow or ice or have been deposited in concealed situations. This has been demonstrated by the experimental work conducted by Dr. J. N. Summers.

I have referred to the gipsy moth because of more intimate personal knowledge of this insect. The same factors are present and affect other insects to a greater or less extent.

There are other factors which have a bearing on the increase of insect life, but those already mentioned are among the most important.

From what has already been said it would appear to most persons, except the trained entomologist, that insect life would be sufficiently held in check without help from other sources. This is not the case, however. The novice needs only to make collections of insects that are attracted to strong lights during the summer to be convinced that widespread havoc would result were no other checks on their increase available. Frequently thousands of specimens of a single species of leaf-defoliating insects may be taken at a single light trap, in spite of the fact that no appreciable injury to its favoured food plants is noted throughout the year.

The answer is that natural enemies hold these species in adjustment so that none but the expert fully realizes their presence. Because no serious damage is done, there is little demand or opportunity to study the battle for survival that is continually being waged by these contending forces.

Because of insufficient study of these problems, which must of necessity be carried on for a series of years, it is difficult to speak with assurance of the value of any particular natural enemy.

Again my remarks will be directed to the gipsy moth investigation.

From 1869, when the insect first became established in North America, until 1889, when it became so destructive that its identity became known, there was a relatively slow increase, and all the native natural factors that might function in its control were operative. During the next ten years the State of Massachusetts made an attempt to exterminate the insect, which was found to occur in an area of about 200 square miles. This work resulted in an enormous decrease of the species, and when the work was discontinued by the state, not only was it impossible to find defoliated trees in the infested area but the egg clusters and caterpillars were so scarce that the public deemed the expense unnecessary. In fact a special committee of the Massachusetts Legislature reported, after numerous hearings, that the insect need not be considered a serious pest and that "we find no substantial proof that garden crops or woodlands have suffered serious or lasting injury or are likely, with that precaution or oversight which prudent owners are disposed to give their own interests, to be subjected to that devastation which one would have the right to anticipate from these reports. It appears to us that the fears of the farmers throughout the State have been unnecessarily and unwarrantably aroused, evidently for the purpose of securing the effect of those fears upon the matter of annual appropriations. . . . We do not share these exaggerated fears and the prophecies of the devastation and ruin are unwarranted and in the most charitable view are but the fallacies of honest enthusiasts."

During this period a small force of experts made careful studies, both in the field and in the laboratory, to determine the value of natural enemies and the part they were playing in gipsy moth control. The results were not promising. A number of birds that feed on hairy caterpillars were found to attack the gipsy moth, and toads and skunks were occasionally reported as feeding on the species. A few native parasitic and predaceous enemies were noted, but their abundance and the frequency of their attack gave little promise of relief.

The wilt disease must have occurred in the field during this period, but the records of its presence are very meagre. At any rate it was not abundant enough to attract the notice of experts or give promise of decreasing the severity of bad infestations.

No attempt was made to introduce the natural enemies of the gipsy moth from Europe during the years when extermination was being attempted, as it was believed that the chances of control by parasites would be negligible when exterminative work was under way.

In the five years following the discontinuance of the work (1900 to 1905) the insect increased and spread enormously and experience showed that it could not only defoliate and kill trees, but that it was a veritable scourge to the people in the region that was heavily infested.

Work was again resumed by the state of Massachusetts in order to control the insect. The territory infested had increased from 200 to over 2,200 square miles, and it was soon found that the insect was present in eastern New Hampshire and in Rhode Island. Native natural enemies during the period when no field work was done had failed to increase and data collected from 1905 to 1907 was very similar to that secured from 1890 to 1900. The wilt disease was more prevalent, however, particularly in heavy infestations where overcrowding and shortage of food occurred.

The brown-tail moth, a European insect which was discovered in the suburbs of Boston in 1897, became extremely abundant and destructive by 1905 and field control and the introduction of natural enemies was attempted as a part of the gipsy moth work.

Beginning in 1905 an effort was made to import the natural enemies of the gipsy moth from Europe and Japan. This was arranged as a co-operative project between the State of Massachusetts and the U.S. Bureau of Entomology and later this project was turned over to the Bureau.

It was organized in Europe by Dr. L. O. Howard, Chief of the Bureau of Entomology, who secured the co-operation of many prominent European entomologists, and under their direction various parasites and predatory insects were shipped to Massachusetts.

During the next few years considerable material was sent as a result of this arrangement, and a number of experts were sent abroad by the Bureau to obtain parasites of the gipsy moth and the brown-tail moth.

Mr. W. F. Fiske spent two seasons on this work, most of his collections being made in Italy. He was assisted during one season by W. R. Thompson, Harry S. Smith and L. H. Worthley. The latter spent a good share of his time in Germany. Professor Trevor Kincaid spent one summer each in Japan and Russia on similar work. As a result of arrangements which he made with Japanese entomologists, it was possible to introduce *Schedius kuvanæ*, a parasite of the gipsy moth eggs. Dr. J. N. Summers continued the parasite work in Germany during the summer of 1914. The work was interrupted during the war but was resumed in 1922, Mr. S. S. Crossman carrying on work in European countries, particularly in Germany, and Dr. Summers similar work in Japan. The latter returned to Japan in 1923 and Messrs. Crossman and R. T. Webber took up work in Germany, extending operations to Spain, Austria, Hungary and Poland.

As a result of all these operations many parasites of the gipsy moth have been shipped to Massachusetts. Some of the most noteworthy were large shipments of *Chalcis flavipes* and *Apanteles melanoscelus* that were sent by Fiske from Italy, and a large number of Tachinid puparia that was secured by Crossman and Webber in Austria during the present year and *Apanteles fulvipes* shipped by Summers from Japan. A large percentage of the material from Austria was *Parasetigena segregata*, a species that has not yet become established in America. Of the large shipments sent by Fiske, *Chalcis flavipes* has not become established, while *Apanteles melanoscelus* is increasing satisfactorily in the infested region. *Apanteles fulvipes* has been colonized but whether it will survive and increase is problematical. Other parasites together with the predaceous beetle, *Calosoma sycophanta*, were received from European collectors and some of them have become firmly established.

The accompanying chart indicates species that have been imported and those that have become established.

FOREIGN PARASITES OF *Porthetria dispar* L. AND *Euproctis chrysorrhœa* L. LIBERATED IN AMERICA
First column of figures shows the number of parasites of foreign origin actually liberated.
Second column of figures shows the number of parasites subsequently liberated.
Third column of figures shows the total number of parasites liberated.

Name of Parasite	Foreign stock	New England stock	Totals
Anastatus bifasciatus Fonsc.	138,680	53,032,500	53,171,180
*Apanteles fulvipes Hal.	87,040	....	87,040
Apanteles lacteicolor Vier	55,000	245,000	300,000
Apanteles melanoscelus Ratz	23,000	58,508	81,984
Apanteles solitarius Ratz.	22,546	....	22,546
Blepharipa scutellata R. D	5,109	71,081	76,190
Carcelia gnava Meig	15,788	....	15,788
Chalcis flavipes Panz.	20,154	....	20,154
Compsilura concinnata Meig	9,000	104,831	113,831
Crossocosmia sericariæ Corn. and C. flavascutellata Shiner	700	....	700
Dexodes nigripes Fall.	5,212	....	5,212
Ephialtes examinator Fabr. and E. compunctor L.	402	....	402
Eudoromyia magnicornis Zett.	4,568	....	4,568
Eupteromalus nidulans Foerst	354,000	....	354,000
Hyposoter disparis Vier	12,543	....	12,543
Masicera silvatica Fall.	23	....	23
Meteorus versicolor Wesm	3,113	7,697	10,810
Pales pavida Meig	582	....	582
Parasetigena segregata Rond	1,187	....	1,187
Parexorista cheloniæ Rond	9,742	....	9,742
**Schedius kuvanæ How*	†45,382	20,206,091	20,251,473
Tachina japonica Towns.	471	....	471
Tachina larvarum L.	2,036	....	2,036
*Telenomus phalænarum Nees.	4,650	....	4,650
*Trichogramma, spp	76,000	....	76,000
Tricholyga grandis Zett.	8,766	....	8,766
Zenillia libatrix Panz	161	....	161
Zygobothria gilva Hartig.	7,502	....	7,502
Zygobothria nidicola Towns	3,500	....	3,500
Totals	917,633	73,725,708	74,643,341

Some of these species were new to science and, in the case of most of them, the life history and habits had not been thoroughly investigated. This has required much work in order that they might be handled with the greatest effectiveness.

Time will not permit a discussion of the value of the individual species concerned, but a few points should be mentioned to illustrate the importance of having full information concerning the biology of natural enemies.

Calosoma sycophanta feeds upon caterpillars and pupæ of numerous insects, but particularly on the gipsy moth. The adults climb trees freely where they do most of their feeding. In New England there are several native species of Calosoma that are good climbers and their larvæ are also predaceous. The reason why *Calosoma sycophanta* is more effective than any of the native species as an enemy of the gipsy moth is because the larvæ of this beetle are able to climb trees that have rough bark and feed upon gipsy moth caterpillars or pupæ that may be massed on the trunks or at a point where the limbs branch therefrom.

† These 45,382 Schedius were developed at the laboratory in seven generations from twelve adults which were obtained from Gipsy Moth eggs from Japan.

* Species marked with asterisk were greatly increased in number by breeding at laboratory before colonizing. Species in italics are positively established.

The larvæ of native Calosomas do not climb well and secure practically all their food on the ground. This habit limits their ability to increase rapidly and renders them ineffective as an enemy of the gipsy moth.

The females of *Compsilura concinnata* puncture the integument of the caterpillars and deposit their larvæ in the body cavity. This Tachinid attacks upwards of 100 different species of native larvæ. It should be no more effective as an enemy of the gipsy moth than some of our native species such as *Tachina mella*, except for the fact that the latter deposits eggs on the caterpillars, and these usually are cast off with the molted skins before the maggots hatch and attack the host.

Anastatus bifasciatus attacks the eggs of the gipsy moth and the females may frequently be found busily engaged in ovipositing as the eggs are being laid by the gipsy moth female.

In fact, all of the species that have become established are fitted by special adaptation or habit to prey upon the gipsy moth as their principal host.

What then has been the effect of the introduction of natural enemies on the gipsy-moth problem?

It is true that the area known to be infested has increased rather rapidly during the last few years. This is due to a considerable extent to particularly favourable seasons for dispersion of the small larvæ of the insect by windspread. Shortage of men and low purchasing power of funds during and since the World War have also rendered the problem of prevention of spread of the insect unusually difficult.

In the area that has been longest infested there has been a heavy reduction of the number of favoured food plants, due to their injury or death caused by the insect, or by cutting operations carried on by owners. This has not been sufficient of itself to bring about control. There has been during the past few years a gradual increase in the numbers and effectiveness of most of the well-established introduced natural enemies and during the past season the records show a greater percentage of benefit than at any time heretofore. This statement does not apply to most of the territory that has become infested in the last ten or fifteen years, although the different parasites are being colonized as rapidly as possible in the lightly infested region.

These facts indicate that natural enemies are of great value, and show that the work that has been done thus far has been extremely beneficial. The question naturally arises as to what the future results will be. While it is possible to theorize along this line, the problem is so complicated that predictions are almost pure guesswork. We know what has been done in the past. We hope for even better results in the future, but we must never lose sight of the fact that in spite of the natural enemies the gipsy moth has in its native home, it is a pest of prime importance.

Heavy defoliations occur in Europe periodically. The best information that has been secured indicate that they come at five to eight-year intervals. The conditions under which the gipsy moth increases to a point where it causes extensive defoliation in Europe have not been studied as thoroughly as the importance of this problem demands. A start has been made along this line during the last two years and it is hoped that sufficient data may be secured in the future so that the value of the different factors favouring increase or decrease may be more accurately measured. With this knowledge available, it may be possible to come to a more accurate conclusion as to the ultimate status of the gipsy moth in America after its natural enemies have been introduced and reach their maximum of efficiency. It is possible to speculate and theorize indefinitely as to which enemy is the most promising and which in the end may be the most effective. What is needed in this respect is facts and these can only be secured by experimentation, the methodical collection and proper weighing of field data and good judgment in drawing conclusions.

The policy has been followed of securing all natural enemies of the gipsy moth that gave any promise of becoming successfully established in America, in the hope that as great or possibly greater measure of control by natural enemies can be secured than exists in the native home of the insect.

Few will doubt the wisdom of this policy, and probably fewer would adopt a different plan were they responsible for the management of the work.

I have dwelt at some length on the problem of natural enemies as applied to the gipsy moth work. Time has made it impossible to mention details. The project is the largest of its kind that has ever been attempted, and the data that has been obtained and the results thus far secured should be useful to all interested in the control of insects by natural means. The work thus far indicates that enormous progress has been made along this line and demonstrates it to be one of the promising and valuable fields that should be thoroughly investigated by economic entomologists.

A brief summary may be helpful:

1. Natural enemies are a powerful means of controlling most insects.

2. Insects imported from foreign lands leave their natural enemies behind and under favourable conditions are capable of more rapid increase and destructiveness than is usual in their native environment.

3. If the major factors favouring control of an insect are to be utilized it is necessary to make a careful study of the fluctuations of the pest, and the damage done in its native home, preferably before, rather than after, it becomes located in a new country.

4. Until such work has been thoroughly done so that the prime factors which bring about the natural control of the insect in its native home have been thoroughly determined, it is desirable to secure and colonize all neutral enemies that give promise of assisting in the problem of control.

5. While theoretical considerations may sometimes be of value, definite facts are needed as a basis for securing the greatest benefit by natural enemies.

THE ONION MAGGOT IN ALBERTA

H. E. Gray, Entomological Branch, Dominion Department of Agriculture

Previous to the season of 1922, the Onion Maggot, *Hylemyia antiqua* Meig., had been reported from only a few localities in Alberta, including Edmonton, Red Deer and Lacomb. The infestation in 1922 was general over the area south of Calgary and somewhat localized to the north. The sudden increase over such a large area caused considerable consternation among the gardeners, and the heavy infestation late in the season of 1922 indicated that more trouble could be expected in 1923. With these facts in mind, the study of the onion maggot was made the major garden-insect problem at the Lethbridge Entomological Laboratory during the season of 1923.

This season will long be remembered in Alberta not only as a wet year, but as the year which broke a five years' drought. The rainfall for May, June and July was well over the twenty-year average for these months, and some of the storms were very severe, as wind and hail were combined with the rain. The excessive moisture made much of the observation work disagreeable, and oviposition very irregular. In at least one instance a hailstorm was undoubtedly responsible for the destruction of many of the flies.

Seasonal History

Flies and eggs were first observed in the field on May 15th. At this time seedling onions were about three inches high, but there were several volunteer onions scattered throughout the garden and ten of these were selected for oviposition records. Eggs were collected every day and counted until oviposition ceased. The daily average number of eggs per plant for the first generation was 24.6 with the height of oviposition centred on May 22nd and 23rd, no eggs of this generation being found after July 7th. Some of the first and last eggs of this generation were taken to the laboratory to get the limits of the generation.

The first larvæ hatched in the laboratory in three days, and the average larval period of 54 individuals which reached maturity was 16.35 days, with a range of from 12 to 22 days. The last larvæ to hatch from eggs of this generation had the same incubation period, but the larval period averaged 18 days with a range of from 15 to 26 days.

The first larva pupated on June 2nd and the earliest fly emerged on June 22nd, the average pupal period of the 54 flies being 20.37 days with a range of from 19 to 22 days. The last larvæ of this generation pupated on the first of August and emerged on the 20th of August, having the same average pupal period as the first.

The first eggs of the second generation were secured in the field on July 13th. Adult flies had been collected earlier than this and many had been reared, but no eggs were secured in the breeding cages and the weather was not suitable for extended searches in the field. From this date on, eggs were found until the 22nd of August with the height of oviposition on the 23rd of July. The daily average number of eggs per plant for this generation was 7.25 based on observations made on ten seedling plants.

None of the first eggs of the second generation collected in the field were fertile and in general the fertility of this generation was much lower than that of the first generation. The eggs of the first generation hatched over 80 per cent. healthy maggots, whereas barely 35 per cent. of the eggs of the second generation hatched at all. This may possibly be due to the destruction of numbers of the male flies by a severe hailstorm which occurred on July 1st, thus forcing the females to deposit infertile eggs. The above figures are based on records obtained by hatching eggs on wet blotting paper in petri dishes.

The first larvæ of the second generation were secured on July 26th from eggs collected three and four days previously, the larval period averaging 18.2 days. These larvæ pupated and the first flies emerged twenty days later, on the 31st of August.

There is considerable evidence of a third generation, but this point was not proved. The examination of onions harvested during the third week in September revealed the presence of numbers of nearly mature maggots, and several very small ones which could easily have come from eggs laid since the emergence of the third generation of flies. The examination of sets on the 18th of October revealed large numbers of pupæ and many half-grown larvæ. There is little doubt that the pupæ developed from the last larvæ of the second generation, but the larvæ can hardly be considered as belonging to that generation.

Several experiments were conducted to determine the method used by the maggots to get into the onion bulb. Seedling plants were used and newly-hatched maggots were placed within half an inch of the plant. Within two and a half hours all the maggots had burrowed into the soil but none were found within the bulb in less than twenty-two hours. The first maggots entered the bulb at a point about 6 mms. above the root attachment. The puncture was roughly oval in shape, about 1.5 mms. by .7 mms. After the opening had been used by the maggots and the tissues had shrunk, it materially increased in size.

Only one case was observed where the maggots entered by the leaves. The eggs had been laid well up on the plant at the junction of two leaves. When the larvæ hatched they penetrated the leaf and worked down the inside to the bulb. Twenty-four hours after penetrating the leaf the maggots were about 5 cms. below the point of entry and forty-eight hours after hatching they had reached the bulb.

Control Experiments

During the season of 1922 crude naphthalene was used on rows of onions after the damage had begun to appear. The results were rather surprising as the mixture of naphthalene and furnace ash had only been cultivated into the soil close to the plants and had killed over 80 per cent. of the maggots in four days. In 1923 it was decided to try some more experiments with this material, but unfortunately most of the onions were seeded before the work could be started. Mixtures containing crude naphthalene were worked into the soil in the preliminary cultivation, but it was only in the case of a small late-seeded plot, and the results were not satisfactory.

Other mixtures were tried after seeding, and when the damage first appeared. Some of these showed promise, and will be tried again next year, using larger plots. Each plot this season consisted of a single row of onions with check rows between the plots, and the damage was very nearly the same on all the rows with a few exceptions. It is very evident that to get any definite results from soil-fumigant work the plots must be larger, and separated by a greater distance than exists between rows as laid out in the ordinary garden.

The fact that the volunteer and early-sown onions were most heavily infested, and that eggs were found on them earlier than on any of the other plants, demonstrates the possible value of using onions in a trap-crop method of control. The later sown onions were almost free from eggs until about the end of the oviposition period of the first generation.

The females almost invariably select plants of heavy flaccid growth for oviposition. Volunteer onions or sets that are rather deep in the ground, so that the leaves branch before reaching the surface, will carry the bulk of infestation. Plants that have a pronounced neck with the leaves branching an inch or more above the surface of the soil are seldom chosen by the females for oviposition, and an examination of several plants showed this type of onion to be almost free from infestation.

There is a distinct relationship between rainfall and oviposition which requires further study. This season it was observed that oviposition dropped off materially before a storm and ceased until a day or so afterwards. It is hoped that another year will amplify our records on the life-history and natural control factors.

THE ONION MAGGOT IN THE OTTAWA DISTRICT

G. H. Hammond, Entomological Branch, Dominion Department of Agriculture, Ottawa

Since the latter part of the 19th century the onion maggot has been regarded as an insect pest of primary importance in the Ottawa district. Early records indicate that in 1875 Mr. William Couper found the maggots to be destructive throughout Ontario, as well as in other parts of eastern Canada. Dr. James Fletcher, in his annual report for 1885, mentioned a case in which a Nepean farmer experienced a loss of 75 per cent. from the onion maggot. During more recent years losses from the onion maggot in fields near Ottawa have ranged from 1 per cent. to 95 per cent., but the average annual losses during 1922 and 1923 have been comparatively light, not exceeding 25 per cent.

At Ottawa the eggs of the onion maggot have been taken on garlic, leek and onion. During July and August, 1922 and 1923, it was observed that many more eggs were taken on leek than on onion under garden conditions; nevertheless, it should be stated that fewer larvæ feeding in garlic and leek material matured.

The attack of first generation larvæ to the plants in June is by far the most important form of injury. In the field during 1923, at Ottawa, such injury in the form of a distinct wilting readily seen by the naked eye first became apparent on June 12th in seedling plants, but was most evident between June 20th and June 30th. Larval attack in midsummer and autumn produced malformations of the bulbs and losses in weight. Secondary flies, such as *Fannia* sp., *Muscina stabulans* and *Muscina assimilis* were found in decaying onions associated with the larvæ of the onion maggot but in no case were these secondary flies of primary importance.

Life History

Two distinct generations of the onion maggot and a partial third generation were reared during 1923. Only 89 second generation puparia out of 766, or 13 per cent., produced adults during the latter part of the season; the greater number of the third generation larvæ resulting from these adults, failed to pupate by November 1st. The season of 1923 was cooler than normal and considerably more moist. In an open and warm year doubtless a higher percentage of the third generation adults would have developed.

In 1922 eggs were collected first on May 24th, and in 1923 on May 26th. The last eggs taken in the field during 1923 were collected on October 20th. Of 16,000 eggs collected in 1923 from a stated area, 2 per cent. were deposited in May; 48 per cent. in June; 11 per cent. in July; 25 per cent. in August; 12 per cent. in September, and 2 per cent. in October. The majority of these eggs were laid in the soil, but on fine days immediately after a heavy rain, fully 95 per cent. of the eggs were laid on the foliage of the plants, the size of the plants having no appreciable relation to the location of the eggs at any period during the season.

The egg stage averaged five days. The larval stage of first-generation individuals varied from eleven to twenty-two days, but the great majority of them took from eighteen to nineteen days to mature. The puparium stage varied from eleven to twenty days, the average being fifteen days.

The individual second-generation larval period varied from fourteen to forty-eight days, with an average between July 25th and August 15th of twenty-one days, and between August 15th and September 15th of twenty-eight days.

The average individual pupal period of the second generation was seventeen days, with a minimum of fourteen and a maximum of twenty-five days. Success attended our efforts to rear flies in continuous series from eggs collected in the spring, and from these it was observed that second-generation adults oviposited between July 20th and September 20th from the first female emergence on July 6th, while the third generation adults deposited eggs between September 10th and October 17th.

First-generation eggs were laid between May 26th and June 30th with first-generation larvæ present in the field between May 30th and July 15th.

Many larvæ were observed emerging from the egg. Emergence occurred most frequently about 8.30 a.m., and took place through a narrow opening extending from near the anterior end to about one-third the length of the egg. The maggot when just hatched is glistening pearly white in colour and somewhat longer than the egg. When full-grown it attains a length of 10 mm. and retains the pearly colour without the lustre.

The pre-oviposition period of adults under observation was thirteen days in the third generation and fourteen days in the case of the second. Hibernation occurs in the puparium stage, as has been noted by other investigators.

Control

Staphylinid beetles were observed to be predaceous upon eggs and larvæ of the onion maggot in confinement and their close association with infested onions in the field leaves little doubt that they are also predaceous under natural conditions. Furthermore, certain individual parasites belonging to this important group of beetles were reared from first and second generation puparia. Unfortunately these internal parasitic Staphylinids have not as yet been definitely identified but from their appearance and habits it is probable they are the species known as *Baryodma ontarionis* Casey, which is an important parasite of the cabbage-root maggot and which has been noted by Gibson and Treherne (Bulletin No. 12 of the Dominion Entomological Branch). During 1923, only .4 per cent. of the onion maggot puparia under observation were found to be infested with this parasite, but in 1919 as high as 25 per cent. were parasitised. This beetle is apparently the most important parasitic natural control factor of the onion maggot in the Ottawa district, but seems very variable in its degree of prevalence.

Among the Ichneumonids, **Aphaereta muscæ* Ashm., was reared from first-generation puparia in 1923. The first adult parasites emerged on July 25th, five appearing from a single puparium. Small, irregular holes in the anterior end of the puparium, marked the place of exit. The Figitid, *Cothonaspis gillettei* Wash., was also reared from second-generation puparia in August and September, eight specimens (all males) emerging from two puparia. The percentage of parasitism of this latter species from material under observation was .83 per cent.

Mites were also taken on adults of the onion maggot, being attached to the abdomen and to the front legs. These were determined by Mr. H. E. Ewing, of the United States National Museum, as probably *Microtrombidium* sp.

Spiders are undoubtedly important enemies of the adult fly, some of the experimental work during the last year being affected through their depredations.

Remedial Measures

In the Ottawa district the sodium arsenite poison bait method of control has for several years been experimented with, but in some years this method of control

* Both parasites were kindly determined by Mr. H. L. Viereck.

has not been satisfactory. In 1923, for instance, in one field in which the poison bait was set out in pans ten feet apart, so as to give the method every possible chance of success, the plantation suffered a 12 per cent. loss which was second highest degree of infestation noted in the Ottawa district this year. In this connection it is well to emphasize the extreme difficulty in obtaining satisfactory check-fields. Sufficient attention has not, it is believed, been given to such factors as dates of planting, soil fertility, soil moisture, and the existing degree of infestation in relation to the results obtained from experimental work and life-history studies.

As eggs may be taken in the field on May 24th in a normal year, poison bait cans would necessarily need to be set out about May 15th in the Ottawa district, or conjointly with the dates of germination of the onion seeds and the pans would have to be kept filled until about June 30th, or after the termination of the first-generation egg deposition period. From our egg records there was no discontinuance of the egg deposition during June, hence at least eight refillings of the poison-bait cans would need to take place during a year of heavy infestation to obtain satisfactory results. Unfortunately, since the writer undertook these studies, he has not experienced a year of heavy attack during which close observations were kept, and has therefore not been able to demonstrate this method of control applied under conditions entirely in harmony with the life-history records.

As regards the trap crop or cull onion method of control developed as a result of studies made in British Columbia by Messrs. R. C. Treherne and M. H. Ruhmann, the light infestation records at Ottawa during the last few years have not enabled us to pronounce upon the value of this method which, however, undoubtedly shows much virtue as the following records show.

As a possible improvement in the trap-crop method of control, as described on page 33 of the Fifty-second Annual Report of the Entomological Society of Ontario for 1921, a number of cull onions were planted in soil in flat boxes, ten inches wide and of a convenient length, with sides six inches high and fitted with galvanized wire screen bottom. These flats were set thirty feet apart through two fields of seedling onions during the summer of 1923. The percentage of loss (estimated by comparing the number of original seedlings in the row with the number of infested plants from an actual count), at the close of the season in one field was 6.55 per cent., and in the other 1.08 per cent. Both fields were heavily infested during 1922, the former being more heavily infested than the latter. In three untreated fields during 1923 losses of 25 per cent., 12 per cent., and 6.8 per cent. were observed as bases of comparison. An average count of eggs taken from ten trap boxes equalled the number of eggs collected from 376 feet of seedling rows between May 26th and June 30th.

As previously mentioned, the loss in a certain baited field was 12 per cent. This may be regarded as a fair basis of comparison with the other fields mentioned. The other records obtained in baited fields were interfered with by secondary factors which made them unsafe to use in a comparison of this description, but in each case the degree of infestation was higher than in the fields where bait onions were used.

Evidence is now available from a long series of notes which we could present if time permitted, that in the use of trap onions we have a remedy which is apparently more satisfactory than poison bait. A combination of the two systems, using a poison bait with the cull onions in flats, may prove ultimately to be the solution of the problem on onion-maggot control.

ONION MAGGOT STUDIES IN THE DISTRICT OF MONTREAL, QUEBEC, 1923

T. ARMSTRONG, ENTOMOLOGICAL BRANCH, DOMINION DEPARTMENT OF AGRICULTURE

During recent years the market gardeners on the Island of Montreal have suffered heavy losses in their onion crops due to the ravages of the onion maggot. This year (1923) an effort has been made to study the life history and habits of the insect and to determine an effective method of control.

Dr. J. M. Swaine,[1] writing in the Second Annual Report of the Quebec Society for the Protection of Plants, states that at Macdonald College, maggots appeared last season (1909) for the first time and a number of plants were destroyed.

In the Montreal district serious losses were occasioned in 1920, and during the past three years the successful growing of onions has been menaced by this insect.

Mr. Arthur Gibson,[2] in 1916-17, made use of a poison-bait spray consisting of sodium arsenite, molasses, and boiling water, and apparently secured satisfactory results. These experiments were conducted near Rivermead, Quebec, and it was recommended that commercial growers test out the value of the mixture under their immediate local conditions.

In the United States, commencing with the year 1913, the use of sodium arsenite as a bait received considerable attention, which resulted after several years' experimentation, in the belief that the onion maggot could be successfully controlled by poisoned attractive baits.

In the spring of 1921, control work with sodium arsenite bait was carried on in the Montreal district by Prof. W. Lochhead and Mr. W. J. Tawse, of Macdonald College, in co-operation with the Dominion Entomological Branch. A number of fields were treated, making use of the two methods of application which were being advised at that time, the use of bait pans, and the diagonal sprinkling method. Fair control was secured according to the evidence produced by Messrs. Lochhead and Tawse, more especially with the use of the bait pans. The sprinkling system proved to be unsatisfactory.

LIFE HISTORY AND HABITS

In 1923, at Montreal, the first onion maggot fly was noticed on the wing on May 20, and ten days later, May 30, the first eggs were taken on a group of volunteer onions. Flies continued to emerge throughout the month of June from overwintering puparia. The maximum emergence occurred from June 10th to 13th, at which time from twenty to forty flies were seen to a pan and the greatest numbers were taken sweeping.

Eggs collected on May 30th hatched on June 5th, a period of six days. These maggots reared in vials in the hollow of onion leaves commenced pupation fourteen days later, with the majority going into the resting stage after sixteen days. These puparia gave rise to second-generation adults between July 4th and 10th, the pupal stage lasting from fifteen to eighteen days. Oviposition of the first generation was definitely in progress between May 30th and July 4th, but continued in all probability at least until July 20th. Second-generation

[1] 1909: Swaine, J. M.: Second Annual Report of the Quebec Society for the Protection of Plants. P. 53.

[2] 1917: Gibson, Arthur: Annual Report of the Entomological Society of Ontario. Pp. 30-33.

adults commenced egg-laying on July 19th, and continued until September 8th, giving rise in turn to maggots and puparia. Adults of the third generation first appeared in the vials on August 21st and continued to emerge until October 3rd.

The average larval life of the first generation, estimated from twelve separate series of egg collections, was determined as being thirteen days; the average pupal life being estimated as 15.77 days.

The larval and pupal life of the second generation was increased somewhat. For the larval period the average was 16.4 days, and for the pupal stage 19.8 days, in cases where flies did emerge.

From material reared in series from July until October, 81.4 per cent. of the second-generation puparia did not produce adults during 1923 but hibernated.

From egg counts made at regular three to four-day intervals throughout the season it was determined that the greatest number of eggs were laid during June and August. In May 2.3 per cent. of the total number of eggs were laid; in June, 36.1 per cent.; in July, 8.9 per cent.; in August, 39.6 per cent.; and in September, 13.1 per cent.

In short, first-generation eggs, larvæ and puparia were present in the field from May 30th until August 4th. Second-generation eggs, larvæ and puparia were present from July 23rd until October 4th, 81.4 per cent. of these puparia overwintering.

Attempts made to breed second-generation adults in a large field cage (6 ft. x 6 ft. x 3 ft.) proved unsuccessful. However, third-generation flies placed in this cage on August 24th, 27th and 29th, respectively, bred and laid eighteen eggs on September 17th, and forty-two eggs were collected from the onions in the cage on September 24th.

Some maggots were reared successfully on onion agar, more especially on agar to which a little hydrochloric acid had been added. Out of twenty maggots fed on this agar three went into pupation and one fly emerged.

As regards the oviposition habits of the flies it was observed that during the spring and summer, until the plants all attained a size of approximately six to eight inches, practically all of the eggs laid were deposited in the soil within one or two inches of the plant. Towards the end of August and during September eggs were commonly laid on the leaves, as many as eight to fifteen eggs being taken at one time on a single plant. It was observed during midsummer that those onions injured or attacked by first-generation larvæ were frequently chosen by second-generation adults for oviposition. Plants affected by onion smut also proved attractive for the flies in August.

These selective habits are doubtless of great importance in view of the possible use that may be made of volunteer onion growth as a means of control during the spring months.

Remedial Measures

In applying the sodium arsenite poison bait according to the formula laid down in Pamphlet 32 of the Dominion Entomological Branch, two methods of application are suggested, viz.: the sprinkling of the bait across the field in large coarse drops, or the setting out of suitable containers at regular intervals throughout the field filled with the liquid.

Prof. Lochhead and Mr. W. J. Tawse,[1] in conducting experiments in the Montreal section in 1921, using these two methods, found that the sprinkling of the bait was not nearly so successful as where bait pans were used alone. In

[1]1921: Lochhead, W., and Tawse, W. J.: Fourteenth Annual Report of the Quebec Society for the Protection of Plants. Pp. 43-48.

view of this, in 1923 our experiments in control only considered the value of these pans, and in order to give the method every opportunity to prove successful they were kept refilled for the entire period from May 22nd until July 10th. The commercial aspect bearing upon the point as to how many times refillings were necessary was not specially considered. Five acres were treated by the pan method, using about thirty pans to the acre. At the close of the season an 8 per cent. loss was observed in the plantation, and a total of 405 eggs and eggshells were actually taken on ten feet of row in twenty-three separate observations between June 11th and September 5th.

In a two-acre check or untreated field adjoining the above the net loss was 3.3 per cent., with a very much lower egg count throughout the season. To account for this negative result it would be only fair to state that while the conditions were as nearly comparable as it was possible to make them, the untreated field had not been manured so heavily and this fact may partly account for the lower degree of infestation if the attractiveness of the poison bait pans in the adjoining field is discounted.

As mentioned in Pamphlet 32 of the Dominion Entomological Branch, Mr. W. J. Tawse made a suggestion that possibly encircling the bait pans with a number of growing cull onions would prove a more satisfactory and reliable remedy than where pans are used alone. This recommendation was based very largely on the suggestion made by Messrs. R. C. Treherne and M. H. Ruhmann,[1] where trap onions are used alone in British Columbia, coupled with his belief in the value of sodium arsenite baits.

In order to test the value of this combination method, six acres were set out with pans and traps in adjoining fields to the plantation referred to above. At the close of the season the loss due to onion maggot attack was noted, as 5.4 per cent. with 408 eggs and eggshells being taken in ten feet of row in twenty-three separate observations between June 11th and September 4th as before. Occasional observations during the season indicated that eggs were being laid in fair numbers around the trap onions, but no definite count of eggs or record was kept.

However, from ten trap onions especially set for oviposition counts, a total of 2,450 eggs were taken between May 30th and September 19th, 1,038 of these eggs being first generation, 1,163 second generation, and the remainder, in all probability, third generation. The degree of infestation this year has unquestionably been light which accounts for the slight damage that was caused and for the low oviposition counts. The comparative value of the various control measures is obtainable, however, from these records.

In addition to the above, two acres of onion field were set out with the special British Columbia poison-bait can, which only differs from the ordinary open pie dish by the addition of a water reservoir and felt mat. No records of oviposition or loss by onion-maggot attack were kept in this field, as the main object was to test the value of this special pan over the open dish from a mechanical point of view. As a result of this experiment it was shown that the method did not prove any more desirable than the open dish with excelsior or straw floats, and the trouble of refilling in a field where water was not easily obtainable detracted very greatly from their use.

As a result of this year's experiments it was unfortunate, from our point of view, that a greater degree of infestation was not registered. In a broad, general, commercial scale all fields used this year yielded equal returns and suffered a

[1] 1921: Treherne, R. C., and Ruhmann, M. H.: Fifty-second Annual Report of the Entomological Society of Ontario. Pp. 29-33.

like loss, only one untreated field at Cote des Neiges, showing a loss of 9.9 per cent., the highest observed in the vicinity. Sufficient has been seen, however, to indicate that the use of cull or trap onions does offer a suitable base for experimental studies of the future, and that in combination with a poison bait liquid will probably prove the most satisfactory measures for control of the onion maggot.

NOTES ON THE LIFE HISTORY OF THE CLOVER LEAF WEEVIL (*Hypera punctata*)

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This paper is a very brief resumé of the more important facts concerning the life history of the clover leaf weevil as it occurs at Strathroy, Ontario. Clover insects do not appear to have caused much damage in recent years in this locality. This may be due to two causes; either the insects have not been sufficiently abundant, or more likely, they have received little or no attention.

The clover-leaf weevil would appear to be the major clover pest which has come under our observation in recent years. Our first acquaintance with this insect was in the spring of 1917, when several hundreds of acres of clover and timothy meadows were severely injured in Delaware township. The depredations of the larvæ, however, did not last long, for a fungous disease broke out which wiped out the entire infestation. Since that time they have again become abundant. Among food plants, red and sweet clover appear to be favourite, with some preference being shown for red clover.

The beetles do not become sexually active until about the third week of August. Eggs are deposited quite regularly until the middle of November, the bulk of eggs being laid in September and October. Few, if any, beetles hibernate. From the time the beetles emerge from the cocoon until sexual activity commences, the beetles lead a very inactive existence, and feed sparingly.

In our studies of the eggs over thirty pairs of beetles were used. The egg capacity of the female varied from 34 eggs to 667 eggs. The female with a record of 667 eggs oviposited over a period of 76 days with 46 days of oviposition. Other females laid 133, 240, 278, 324, 360 and 378 eggs, respectively. With 4,500 eggs under close study it was found that 55 per cent. were deposited within the petiole of the clover plant, 27 per cent. in masses on the outside of the main stem of the plant, and the balance on the soil surface or on the sides of the cage. Under field conditions the percentage of eggs laid in the stems would have been high, but in our experimental work young plants were used having no stems. In a few cases wheat or oat stubble was introduced. Stubble was in all cases preferred for oviposition. Eggs laid in stubble had the highest percentage hatch, due perhaps to the shrinkage of the green clover petioles removed with the eggs.

The Egg. The egg period varies considerably. Those deposited during the week of August 25th averaged 18.5 days, with the period lengthening out until the week of September 22nd when the average was 31.3 days. The shortest period obtained was 14 days, and the longest, aside from the over-wintering eggs, was 42 days. A mass deposited November 10th hatched April 23rd.

The freshly-laid egg is pale yellow. The shell is semi-transparent, and shows the yolk indistinctly, the ends appearing watery and lighter in colour. A viscid liquid is voided with the egg, by the female ovipositing. This liquid dries quickly when exposed to the air, adding gloss to the shell. When the egg is laid on the outside of the plant the shade intensifies to a clear light yellow in about two hours, showing evenly over the whole egg, continuing so for from one to three days when a faint tinge of green appears. This gradually deepens until from the second to the sixth day the ends darken slightly giving a general appearance of pale olive green. Usually the next day (although sometimes simultaneously) the shell begins to show slight sculpturing, becoming complete in a day or two. All gloss then leaves the egg, and it becomes quite dull, and slightly darker. The pattern of the sculpturing is more evident on eggs laid on the outside of the plant, and is of a very even hexagonal form. No particular change is seen after this until the head of the embryo begins to show. Usually this takes place in from three to five days after sculpturing, depending very much on the weather. Even in early fall it may last fourteen days. At first the head shows faintly as a dark mark, then soon darkening to a plainly visible circular black spot. In most cases this is about one-third distant from either end, but may be anywhere along the egg, as the larva moves about before hatching. With eggs laid inside the petiole, coloration is less marked. Just before hatching, the egg is a very pale green colour, the head of the larva within showing plainer than in eggs exposed to the air. The egg enlarges considerably before hatching, becoming slightly distorted in outline.

The Larva. The newly-hatched larvæ remain for a short time near the egg mass, but soon ascend the stem, to begin feeding on the leaflets. Being legless, a large number fall to the ground. In the insectary most of these perished unless they were assisted back on to the leaf. In the field this fact doubtless results in considerable larval mortality, especially if hatching occurs during a rain or heavy wind. The first instar larvæ do not retire to the base of the plant in the daytime, but remain on the underside of the leaf near where they were feeding, curled tightly, the last segment just covering the head. An epidermal hair or two of the leaf is usually embraced to help anchor the larva. In the field many of the young larvæ feed within the unopened leaflets at the base of the plants, thus obtaining ample cover during the day without leaving their feeding-ground. The propensity of the young larvæ to remain in the one location until some growth is made can be observed very noticeably under insectary conditions. With two hundred specimens observed in vials not a single one voluntarily left a dried, withered leaf for a fresh one without being transferred to it bodily. Before the first moult the feeding is confined to the centre of the leaves, the injury showing as small round holes. After the larva has attained the third and fourth instar it feeds from the leaf margin as well. They feed at night only, dropping to the ground to spend the day curled up under the refuse at the base of the plant.

With careful searching some larvæ may be found in the field any time from the second week of September until the third week of June of the following year. They are not difficult to identify, and are not likely to be confused with other insects in the clover field. The green larva with its pale dorsal stripe and its habit of curling up when not feeding is easily distinguished. Although the colour is usually green it may be cream, bluish, or with a tinge of pink. The percentage of cream-coloured larvæ was 2.6 per cent., and they produced normal-coloured adults.

Three moults were observed, the length of instars being very variable on account of the intermittent feeding of the larvæ, due largely to adverse weather conditions. The first instar (fall observation) averaged 17 days, the second instar (fall observation) 21 days, the third (spring observation) 13.11 days, and the fourth (spring observation) 17.01 days. A very great increase in food consumption is noticed after the second moult. They winter in all four larval stages as well as in the egg stage.

THE PUPA. The larvæ cease feeding a day or two before they commence spinning cocoons, which operation requires one or two days. The usual location for the cocoon is just below the surface of the soil, but it may be over an inch deep in the soil, where there is lack of moisture, or on the surface under debris. The cocoon is not woven from one continuous thread, the silk being cut off at each end, at a length of from three-eighths to five-eighths inches. A rest is always taken after the spinning of each thread (for about the same length of time as the work) and a new supply of silk material is taken before resuming spinning. Sometimes the supply appears to run low, when the larva kneads the underside of the last two body segments with its head, as if forcing the secretion to the opening. This substance is very adhesive, adhering to the sides of the pupal chamber and to the threads already spun very securely. Curiously enough it does not seem to adhere to the body of the larva, when too large a supply is taken. Slightly over six inches of silk is spun in one hour. The prepupal period lasts from three to eight days and the pupal from five to thirteen days.

THE ADULT. After the pupal skin is shed the adult remains within the cocoon for one to four days. With specimens emerging in vials not supplied with food, the cocoon is always eaten, but this is not the case in the field where there is an abundance of food, only sufficient being eaten from one end to permit the beetles to emerge. After emergence they feed regularly for two weeks, then become dormant until August. The feeding habits of the adults are somewhat different during oviposition, for then the petioles as well as the blades are eaten. There appears to be only one generation in Western Ontario, the beetles dying soon after oviposition is completed.

The spread to new fields occurs during the latter part of August. On a bright sunny day the beetles may be seen in flight and running rapidly from plant to plant over the bare spaces on the ground surface.

Although hundreds of larvæ have been reared and collected from the field we have never observed any natural parasite. In years of excessive abundance the outbreak seems to be controlled naturally by a fungous disease known as *Empusa sphaerosperma*.

WINDS AND GIPSY-MOTH SPREAD

E. P. FELT, CHIEF ENTOMOLOGIST, CONSERVATION COMMISSION, ALBANY, N.Y.

It is well known that wind-spread is an important factor in the dissemination of the gipsy moth (*Porthetria dispar* Linn.). The earlier investigations in eastern Massachusetts, by agents of the United States Bureau of Entomology, have shown that the recently-hatched caterpillars may be carried considerable distances—as much as twenty or twenty-five miles over water.

The proposed barrier zone in which the gipsy moth should not be allowed to establish itself made it very desirable to study the winds of western Massachusetts and eastern New York during the period when conditions were favourable for wind-spread.

Five temporary weather stations equipped with self-recording instruments for registering wind direction and velocity and temperatures were established at approximately equal distances along the Mohawk Trail from North Petersburg, N.Y., to East Charlemont, Mass. They were located, in addition to the two above mentioned, one at a point about midway between Williamstown and North Adams, Mass., one on the east summit, Whitcomb Summit, elevation 2,200 feet, of Hoosac mountain, and the other in western Charlemont, just east of the grade up the mountain and about four miles east of Hoosac tunnel. The western two stations are in the Hoosick River valley, and the eastern two in the Deerfield River valley. The records of these stations were supplemented by hourly observations of wind direction and velocity and temperature at Sheffield, Mass., and Copake Falls, N.Y., the two being separated by a well-marked ridge of the lower Berkshires. Data were also obtained, through the co-operation of the various meteorologists, from those United States weather stations in New England and eastern New York state possessing information most likely to assist in solving the problem.

The following tabulations shows a very small eastward component at any of the stations in or near the Berkshires, either in western Massachusetts or eastern New York.

Summary of Percentages of Principal Wind Components, May 10th to June 8th, 1923

Locality	North	South	East	West
No. Petersburg, N.Y.	37.8	19.9	5.5	56.1
No. Adams, Mass.	48.5	13.9	12.1	55.5
Hoosac Mountain, Mass.	31.3	7.1	11.5	69.5
Charlemont, Mass.	57.6	12.6	6.9	51.7
Sheffield, Mass.	60.8	25.5	7.9	27.1
Copake Falls, N.Y.	40.0	24.9	10.9	40.6
Average percentage	46.6	17.3	9.1	50.0

On the other hand, there is perceptibly more east wind in the Connecticut valley, as shown by the following tabulation:

Locality	North	South	East	West
East Charlemont, Mass.	42.4	17.4	17.1	51.8
Amherst, Mass.	44.6	31.5	16.3	33.7
Hartford, Conn.	24.1	44.9	16.6	37.9
New Haven, Conn.	19.4	47.8	15.1	41.1
Average percentage	32.6	35.4	16.3	41.1

A still greater prevalence of east wind, and consequently westward drift for this period, is shown at the Concord, N.H., and Boston, Mass., stations, the east wind at the latter stations being especially marked.

Locality	North	South	East	West
Concord, N.H.	36.2	18.4	18.2	46.6
Boston, Mass.	15.0	18.8	26.7	52.2
Average percentage	25.6	18.6	22.4	49.4

The figures for 1923 show a distinctly smaller probability of the pest being swept westward from the New York state boundary line than is the case in the Connecticut valley and most evidently so in eastern Massachusetts. Furthermore, it has taken over twenty years for the gipsy moth to spread from the vicinity of Boston, Mass., to the New York state line, and if the wind is an important factor, as is doubtless the case, we must conclude that the westward spread into New York state will be still slower.

The records of the United States Weather Bureau for New England and eastern New York stations are the basis for the following:

The eastern component for Albany for the past nine years, May 16th to June 8th, has ranged from 1.4 to 22.8 per cent., the average being 11.9. Similar figures for Burlington, Vt., show a range from 2.1 to 12.5 per cent., and an average of 6.4 per cent. Records for a six-year period for Northfield, Vt., indicate a range of 5.4 to 11.2 per cent., with an average of 7.4 per cent.

It is evident from the above that east winds are much less prevalent in western Massachusetts and eastern New York than on the eastern coast of New England and consequently less likely to carry gipsy moth caterpillars westward.

In view of the recently discovered infestation in northwestern Vermont, our tabulation of the principal wind components from Burlington and Northfield, Vt., stations for the period when wind-spread is likely to occur is of special interest to Canadians and is reproduced below:

SUMMARY OF PERCENTAGES AND PRINCIPAL WIND COMPONENTS
7 A.M. TO 7 P.M., MAY 16TH TO JUNE 8TH.

	Burlington, Vt.				Northfield, Vt.			
	North	South	East	West	North	South	East	West
1915	34.1	28.2	8.3	29.4	....	....	....	....
1916	24.9	61.9	8.2	15.5	....	....	....	....
1917	36.01	52.11	5.06	14.65	....	....	....	....
1918	15.7	64.1	2.1	26.3	27.3	56.7	5.4	30.7
1919	29.7	57.5	12.5	11.0	43.9	45.4	5.8	17.0
1920	26.8	54.43	6.5	23.6	40.8	53.7	6.0	5.1
1921	36.2	43.9	4.5	26.6	45.8	36.3	11.2	21.6
1922	23.4	60.5	5.8	22.6	29.5	56.9	8.2	22.3
1923	39.7	40.5	4.7	29.5	48.6	36.4	8.0	23.7
Average percentage	29.61	51.46	6.4	22.13	39.3	47.5	7.4	19.9

The southern component is especially important to Canada. This averages for Burlington 51.46 per cent., the range being from 64.1 per cent. to 28.2 per cent. The average for Northfield is 47.5, the extremes being 56.7 per cent. and 36.3 per cent.

The weather records were supplemented by releasing from the weather stations named above and localities in Bradford, Vt., Deerfield, Easthampton, and Sheffield, Mass., East Granby, Conn., and Copake Falls, N.Y., nearly 7,000 hydrogen-inflated toy balloons for the purpose of obtaining records of actual drift. The balloons were liberated at hourly intervals from 7 a.m. to 6 p.m., eastern standard time, additional balloons being released on the quarter hours between 9 and 11 a.m. and 3 to 5 p.m., and on the half hours from 11 a.m. to 3 p.m., and at 5.30 p.m., except when temperatures were below 60°F., or during the prevalence of rain. Observers were also instructed to go on to a fifteen-minute schedule during the prevalence of an east wind, so that no opportunity of securing records of western drift would be lost. Inflation was for a minimum buoyancy as far as possible. We desired records of the lower air currents. There was attached to each balloon a numbered tag requesting the finder to give his name, address, the date and place where found and he in turn would be informed as to the time and place of liberation. Records were kept of the locality, time and wind conditions when each balloon was released. The balloon work extended from May 11th to June 8th.

The following tabulation gives some general items of interest:

Table of Balloons Released and Tags Returned

Locality	Balloons released	Tags returned	Per cent. returned	Balloons drifting		5 miles or more
				Number	Mileage	Average mileage
No. Petersburg, N.Y.	794	34	4	33	1,368	41
No. Adams, Mass.	551	20	3	42	1,426	34
Hoosac Mountain, Mass.	575	22	4	21	1,393	66
W. Charlemont, Mass.	807	75	9	10	305	30
E. Charlemont, Mass.	648	33	5	27	653	24
Bradford, Vt.	298	8	3	5	165	33
Deerfield, Mass.	586	35	7	29	630	22
Easthampton, Mass.	495	45	9	39	861	22
East Granby, Conn.	597	50	8	43	1,290	30
Sheffield, Mass.	459	25	6	20	696	35
Copake Falls, N.Y.	537	31	6	19	660	35
Miscellaneous localities	611	44	7	28	1,347	48
Totals and averages	6,958	422	6	316	10,794	34

The percentage of returned tags ranges for the various stations from over three to nine, the average for all stations being over six. The records show that of 298 balloons where the data were sufficiently detailed, 74, or 25 per cent., continued to drift in the direction they started, the others diverging to various degrees, even to the extent of drifting finally in a directly opposite direction. One balloon, No. 3,611, released at Easthampton, Mass., at 10 a.m., May 23rd, dropped at 4.15 p.m. on the same day within fifteen feet of the point of release, evidently carried back by counter currents. Another remarkable record was that of balloon No. 3,468, released at Easthampton, Mass., at 5 p.m. on May 16th, and recovered by the observer at the next station north, Deerfield, some fifteen miles distant, the following morning.

There were considerable variations in the distances covered by the balloons. The longest known was from New Lebanon, Columbia county, New York, to five miles off Yarmouth Cape, Nova Scotia, about 400 miles. This was the second balloon released in the preliminary work. Seven balloons drifted from 110 to 145 miles, twenty-two from 85 to 100 miles, and eighteen from 60 to 75 miles, the greater proportion presumably dropping at shorter distances. The velocities for sixty-one balloons found the date of liberation average 17.9 miles per hour, the averages for the various stations ranging from 14 to 27 miles per hour. The records indicate that one balloon drifted 65 miles at the rate of 100 miles per hour, and another covered 65 miles in one hour.

The records of returned tags show a general distribution of the balloons in southern New England, most of them, as might be expected, being found within thirty miles of the various points of liberation. The drift was largely southeasterly, widely scattering individuals landing here and there over the intervening territory to both eastern and southern New England coasts. Several were found on Long Island. There were 285 balloons which drifted a total of 9,419 miles, less than 2 per cent, being in a westerly direction. The distribution of the recovered tags is shown on a map of New England published in the Thirteenth Annual Report of the New York State Conservation Commission for 1923. See insert facing page 168.

The important point in this work is that practically all the drift was easterly, northerly or southerly, there being less than two per cent. in a westward direction. An examination of the data, see page 165 of above cited report, shows perceptibly more westward drift from the Connecticut valley stations than from any on either the eastern or western sides of the Berkshire Hills, and this in spite of the fact that a number of balloons released west of the range drifted over it. One was observed drifting over the summit of Mt. Everett, elevation 2,624 feet, in southwestern Massachusetts.

Both wind records and balloon data of 1923 indicate considerable less probability of young gipsy-moth caterpillars being carried westward by the prevailing winds than in any other direction, and present indications in this respect are therefore favourable to the maintenance of a barrier zone.

WILL THE GIPSY-MOTH CROSS THE INTERNATIONAL BOUNDARY ?

H. L. McIntyre, Supervisor, Gipsy-Moth Control, New York State Conservation Commission, Albany, N.Y.

It is possible that this has already happened, or will in the near future. If it has not, it surely will unless immediate action is taken to determine whether or not it is present, and necessary funds furnished for extermination, wherever it is located.

The traveller, regardless of his mission, if crossing the international boundary is subjected to certain international regulations. Will insects be privileged in this respect, especially so in the case of the gipsy moth, which has already located near the border?

International laws can be quite efficiently enforced in so far as the public is concerned. Insects seem to make a special effort to evade laws and regulations. An immediate exceptionally strenuous effort must be made if the gipsy moth is to be prevented from becoming firmly established in the Dominion of Canada.

There are at this time in New England many who have been continuously engaged in gipsy-moth work for twenty or more consecutive years. It is doubtful that one can be found who, twenty or in fact ten years ago, realized that we would be continuing the gipsy-moth fight on the northern border of the United States to-day.

As reference has been made to the period of years that gipsy-moth suppression work has been carried on in the New England states, it is only natural that many will consider—is this problem worth further consideration?

Probably a few figures on the cost of the gipsy-moth suppression campaign in New England will clearly indicate that the problem is not only worth consideration, but more serious consideration than it has ever received.

Figures, or even estimates, for the total cost of this campaign in New England are not available, or at least are unknown to me. I will, therefore, quote figures on the expenditures in part of Massachusetts, which is the state in which the pest was first located, and which has always been the leader in the suppression campaign.

Since 1905 there has been expended by the State Department charged with the work of moth suppression, other state departments, cities and towns, private individuals and corporations, about $15,000,000. Although now practically the entire state of Massachusetts is infested to a more or less degree, I think it is safe to say that 75 per cent. of the amount mentioned has been expended in about one-half the area of the state, or 16,520 square miles. These figures, in so far as corporation and individual are concerned, are partially estimated. They do not, however, include an unestimable amount, which certainly runs into the millions, for the loss due to retardation of the growth in the area where defoliation by the gipsy moth is frequent, or loss due to the cutting of unmatured growth, the latter being necessary in order to avoid a total loss by repeated defoliation of many valuable forest areas in the infested section of New England.

The area in which this amount has been expended, represents the greater part of the commercial and industrial section of the state, and as the agriculturist, for his own protection, must bear the greater part of the burden, it is rather difficult to determine exactly what percentage of the cost should be charged to each individual.

An extermination campaign against the gipsy moth had been carried on in Massachusetts a few years previous to 1900. So successful had they been in their efforts to exterminate the pest, that the State Legislature considered further funds for the continuance of the campaign inadvisable. The amount asked for that year by the State Board of Agriculture was $200,000. Had that been granted the millions expended since would, without question, not have been necessary. Neither would New York State and Canada be asked to join in the fight to establish a barrier zone to prevent this insect from becoming established within their borders.

Massachusetts has sincerely regretted the mistake that was made in 1900, which was proven an expensive one to that state, as well as the balance of New England. New York State has taken advantage of the experience of New England, we hope timely advantage, to prevent the further spread of this insect. We ask Canada to do likewise.

The most important part to New York State in its attempt to establish this barrier zone is the assistance we can secure from the United States and Canadian Governments, and the New England States adjacent to our border.

The United States Bureau of Entomology is now conducting an extensive gipsy moth suppression campaign in northern and western New England. They must be given immediate assistance. Their work is of mighty importance to the adjacent territory. Work in eastern New York and southern Canada near New England and New York border is equally important to them.

The prompt attention of New York State to the alarming condition that was approaching its borders, has already resulted in locating three small gipsy moth colonies. It is possible that the same, or even more serious conditions, exist in Canada to-day. So far, the colonies located in New York are at present easily exterminated, but if left for a few years unnoticed would mean that we had allowed to become established, without an effort to prevent it, a pest which would undoubtedly later necessitate an expenditure of millions of dollars.

It might be well to include here a paragraph of a paper prepared by the writer for presentation at a meeting of the United States Committee on Reforestation, recently held at Albany, N.Y.:

> "I believe a Gipsy Moth barrier zone can be established, and I believe it will be established. The date we can say this has been accomplished, and the location where it is established, depends entirely upon the recognition that requests for present and future Gipsy Moth appropriations receive."

The above fully applies to the present Canadian situation. A serious gipsy-moth infestation has been located less than a mile from your southern border.

The present and future action that is taken regarding further funds for protective work against this pest will alone determine whether or not it will permanently cross the international boundary.

Very few can be found to-day who do not believe in insurance. Expenditures for protective work against an invasion of the gipsy moth should not be considered other than a most valuable insurance.

I regret that I am not familiar enough with Canadian resources to quote intelligently on the amount of money that could be wisely expended as insurance in protecting Canada from ravages of the gipsy moth such as have been experienced in New England.

It has been said by some, even by those entirely familiar with the gipsy-moth situation in New England, that there was a question whether the gipsy moth would ever become of economic importance in northern New England or Canada. An illustration of this is now evident at Alburgh, Vermont. You can there very clearly see as great a reproduction in an unmolested colony as ever was found in any section where gipsy-moth colonies have been located in the United States.

It has again been mentioned, or at least the fact has often been considered, why defoliation of forest areas is not more prevalent in northern New England during feeding period of the gipsy-moth larvæ. If more serious thought were given this matter, or if those interested in the problem care to look back a few years, they would readily find that no colony of gipsy moth, except in a residential section, ever became publicly noticeable, or caused extensive defoliation in less than ten years. Wooded areas, as a rule, are not found infested until the isolated growth in the surrounding open territory is found generally infested.

The suppression work that has been carried on in that territory has naturally prevented rapid increase of the infestation and likewise retarded the development to a degree that would yet cause easily noticeable defoliation in the vast wooded areas of that section. A timely suggestion here would probably not be misplaced.

Keep the gipsy moth out of Canada.

Even though climatic or other conditions would retard to some extent the increase of the insect, it surely will, if allowed to become firmly established in your territory, become of enormous economic importance.

New York State did not undertake the problem of establishing a gipsy-moth barrier zone without due consideration and expert advice, which resulted in a unanimous decision that such was the only practical method to adopt.

Canada was ably represented at the conference at which the decision mentioned was reached. The situation at that time did not appear especially alarming to Canada, and a direct appeal for immediate action by you was not made. The situation has changed, and is to-day as alarming to you as it is to New York.

The work that is being done by the United States Department of Agriculture adjacent to the New York border is to assist in establishing a barrier zone. The work they are doing south of the international boundary will assist you.

If colonies of the gipsy moth are allowed to become established in Canada on the New York border, the possibility of successfully ending the barrier zone work that has been attempted will be an effort in vain.

We, therefore, ask your co-operation.

In reply to questions, Mr. McIntyre stated that scouting, to be effective, should cover a territory of at least a 30-mile radius from the last infestation found. It was formerly supposed that wind-drift was limited to 12 miles, but this is now thought to be low and that the 30-mile distance is necessary in careful scouting. He estimated that scouting in Quebec area would cost at least $20 per lineal mile of road, in addition, of course, to the overhead. The border scouting along the New Hampshire line should embrace a strip 30 miles wide. He further stated that in scouting, with remarkably few exceptions, solid blocks of woods are not infested till after the isolated and scattered trees in the margin of the block are fairly generally infested.

The meeting then adjourned and the discussion was continued after lunch, as follows:

Dr. Swaine: The question of the distribution and spread of the gipsy moth is exceedingly interesting to us in Canada. We should do everything we can to prevent it entering Canada and becoming a nuisance to our neighbours. How would the United States view the failure of Canada in their work to prevent the gipsy moth becoming well established along our southern border? How would that affect work in New York State?

Mr. McIntyre: I would say that if Canada did not undertake the proposition of keeping down the infestation adjacent to the New York border, our attempt to establish a barrier zone in New York will be useless. No doubt many consider that New York is a large state and a wealthy one. I doubt that there is a state that would finance an extermination campaign over an area as great as that of New York State. The gipsy-moth campaign will undoubtedly, however, be continued, but if our attempt to establish a barrier zone is not successful, the problem would be carried on as an individual one, the property-owners themselves financing whatever work was undertaken. The attempt to establish a barrier zone is the first attempt of controlling the gipsy moth in this manner.

In a paper which I read this morning, I mentioned the amount of money expended in the State of Massachusetts for gipsy-moth work in approximately one-half the area of the State. The money that has been spent by the Federal Government in New England has been principally to establish a quarantine line to protect as much as possible the remainder of the country by preventing the shipping of infested material from that area to outside uninfested areas. The amount of money that they have received for this work has not been sufficient to attempt to carry on an extermination campaign.

At the present time the area in which the barrier zone work is being conducted under the direction of the United States Department of Agriculture and the New York State Conservation Commission, comprises approximately a fifty-mile strip from the Canadian border to Long Island Sound. If the work can be continued in that section and Canada sees fit to join in the proposition, I think a barrier zone can be established.

The present line, as mentioned, is surely the shortest line on which this problem can ever be attempted in the United States.

MR. MCLAINE: I should like to ask Dr. Burgess to give us some information as to the success of the extermination work in New Jersey; the total number of egg clusters found in the first year of the infestation and the number found each year since the extermination work was started.

MR. BURGESS: I do not recall the number of egg clusters reported the first year the gipsy moth was found in New Jersey. The information came early in July and it was necessary to have some data about the first of August as to how much money would be necessary to carry on the work. Very rough scouting work was done and it was found that the insect had spread over 100 square miles and the estimates for carrying on the work were based on 100 square miles—$100,000 from New Jersey; $100,000 from the Federal Government. After the money had become available in the fall, work was carried on and by the following spring it was determined that the infested area had been greatly underestimated. Four hundred square miles were found to be infested. The New Jersey funds were increased to $125,000 and the Federal funds increased also. We have been carrying work on in New Jersey since that time—400 square mile proposition on a 100 square mile financing, and the second year the area was practically the same as the first year. The area now so far as determined by last spring's work is approximately 200 square miles, a marked decrease.

MR. MCLAINE: What was the actual amount of funds expended to bring about this result?

MR. BURGESS: New Jersey—first year, $100,000; second year, $125,000; third year, $125,000. Federal Government—first year, $122,495; second year, $101,672; third year, $167,207. The work in New Jersey has been extremely encouraging and I think anyone who has visited the work is very much encouraged at the progress that has been made.

MR. KEENAN: What is the distance between the Alburg infestation and the one nearest to it?

MR. BURGESS: About thirty-five miles.

DR. SWAINE: I went over the New Jersey outbreak last spring with Dr. Headlee and it certainly is surprising how successful the work has been. Almost unbelievable that such excellent results could be obtained.

MR. KEENAN: When an infestation such as Alburg is discovered, do you adopt a policy of recording the wind direction from the viewpoint of larval spread?

MR. BURGESS: This matter will be studied, but, of course, it will be necessary to study the wind records from the nearest point where accurate records are kept. A great many of the local weather stations only take temperatures twice a day and the wind velocity is not recorded.

MR. FINNAMORE: What time of the year would it be advisable to scout?

MR. BURGESS: Scouting ought to be done immediately. Scouting is most effective after the leaves have fallen and from then until you get deep snow. When you get deep snow you are apt to overlook infestations below snow-line. The most effective time for scouting is right now.

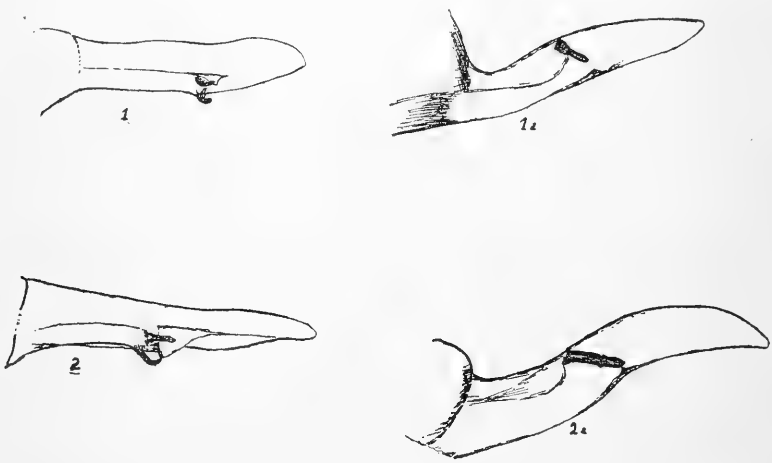
RHAGOLETIS POMONELLA AND TWO ALLIED SPECIES

(*Trypaneidæ, Diptera*)

C. Howard Curran, Ottawa

In volume fifty-one of the *Canadian Entomologist* (1919), Mr. W. Downes, of the Entomological Branch, gave a complete historical account of the occurrence of a species of Trypaneidæ, supposedly *Rhagoletis pomonella*, in British Columbia and mentioned also five specimens from California which had been described as *R. zephyria* by Snow. In view of the excellent published account by Mr. Downes, it is unnecessary to again cover this field fully, but it seems advisable to mention the main points and add such information as I have received from Mr. Treherne, who first discovered this insect at Penticton, B.C., in 1916.

In the first place both Dr. Doane and Dr. Aldrich have considered the two species found on the Pacific coast identical with *R. pomonella*, the true apple maggot. I have a type specimen of *R. zephyria* Snow before me, very kindly loaned for study by Prof. S. J. Hunter, of the University of Kansas. It is



evidently quite distinct from the other species as is hereinafter shown. The species found in British Columbia is readily separated from *pomonella* and in addition to slight external characters I find tangible differences in the genitalia of the male.

The outstanding fact concerning *R. symphoricarpi*, the species found in British Columbia, is its striking monophyllic habit. According to Downes and Treherne it never attacks apple and is found in the larval stage only in the fruit of the snowberry (*Symphoricarpus racemosus* Michx.). Extensive search was conducted to determine whether the insect attacked apples, haws or other fruits such as often serve as hosts for the apple maggot, but no trace of the maggots was found in anything but the snowberry.

Mr. Downes suggested that *P. symphoricarpi* represented a biological race, but it is quite evident that the species is distinct. Dr. Aldrich stated that he could see no tangible difference between the western and eastern specimens, but I believe they may readily be separated in almost all cases, and the males assuredly can be by dissection of the hypopygium. There are, in many species, what may be considered biological races, but our knowledge of insects is so meagre in comparison to what is to be learned that we are not able, at the present time, to arrive at positive conclusions as to the status of certain forms. We know that many species are much more easily separated in the larval than imaginal stage and it therefore seems possible that many insects may be most readily determined by their host, and that careful study will reveal imaginal distinctions not previously suspected.

The three species of *Rhagoletis* which have been included under *pomonella* may be separated as follows:

R. pomonella. (MALE) Genital claspers, as in Figs. 2 and 2*a*. The lobe of the clasper opposite the hooks is almost transverse towards the base of the clasper and the hooks are longer, the lower hook being much more evidently curved; the spot on the scutellum usually occupies the apical half and extends on the disc, well beyond the apical bristles; size usually over 4 mm. (FEMALE) The white scutellar spot occupies two-thirds or more of the length of the scutellum and is very prominent to the naked eye. Size usually over 4.5 mm.

R. symphoricarpi. (MALE) Genital claspers, as in Figs. 1 and 1*a*. The shapes of the parts as well as of the clasper itself are quite different, the hooks are shorter, the lobe tapers towards the base of the clasper, which is always less curved, wider and more compressed beyond the hooks; the spot on the scutellum is much smaller and usually does not extend very much laterad of the apical bristles; size seldom over 3.5 mm., usually slightly less. (FEMALE) The white scutellar spot seldom occupies more than the apical half of the scutellum and is usually very distinctly narrower than in *pomonella*; length 3.5 to 5 mm., the average length slightly over 4 mm.

R. zephyria. (FEMALE) The scutellar spot occupies less than the apical half of the scutellum and reaches well laterad of the apical bristles. The paler lateral margins of the front at the middle extend as far inside the frontal bristles as the distance from the base of the bristles to the orbit. In both the preceding species the pale stripe scarcely extends inside the base of the bristles and these are also slightly closer to the orbit.

I must confess that the differences enumerated as separating the first two species, except those of the hypopygium, appear slight. However, they are rather constant. *R. zephyria* is more readily distinguished in the female sex than are the other two.

It would be very interesting to know the host of *R. zephyria*, but we have no indication. A strange thing about *symphoricarpi* is that the first two specimens were taken by Mr. Treherne on the leaves of apple in an orchard.

INSECTS OF THE SEASON

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ORCHARD INSECTS

CODLING MOTH (*Carpocapsa pomonella*). Side-worm injury was again quite severe in several sections of the Province; whereas in other parts such as in Norfolk County the injury was negligible, even in orchards which were only sprayed once for codling moth control (post-blossom application).

The Spring Canker Worm (*Paleacrita vernata*). Many neglected apple orchards in the Province were completely or almost completely defoliated by this species. Reports of severe damage were received from Welland, Wentworth, Peel, Northumberland and Durham Counties, and no doubt the insect occurred in injurious numbers in other parts of the Province. Elms as well as apple trees were stripped—one elm grove of about 2,000 trees near Brampton lost nearly every leaf. This particular grove, according to residents of the district, has been defoliated three years in succession, and it is feared that further injury will result in the death of a number of the trees.

The Yellow Tussock Caterpillar (*Halisidota tesselaris*). In late summer and fall this insect was present in immense numbers in southwestern Ontario. The caterpillars attacked various trees and shrubs, but the main injury was done to apples, whole orchards being defoliated in several instances, *e.g.*, at Dixie, North Toronto, Oshawa, Owen Sound and Elmira. The caterpillars began to appear in August, and in early September trees were stripped as a result of their feeding activities.

This is the first time in our experience that *Halisidota tesselaris* has been sufficiently abundant to cause much injury.

San Jose Scale (*Aspidiotus perniciosus*). This pest is still increasing in the warmer sections of the Province, and requires better attention in many orchards than it has been given in recent years. In parts of Elgin County, parasites appear to have had a marked effect in checking the San Jose scale.

The Apple Maggot (*Rhagoletis pomonella*). Reports of injury from this pest were received from several localities. We are glad to say that wherever (except under village or town conditions) a real effort has been made to combat the maggot, no difficulty has been experienced in bringing it under control.

Apple Aphids. The green apple aphis (*Aphis pomi*) appeared in outbreak form about midsummer in several localities in southwestern Ontario. On badly attacked trees the wood, leaves and fruit became literally covered with honey-dew, and with the black honey-dew fungus. During September the insect largely disappeared, and heavy rains cleaned the apples in most orchards. However, at a few places the aphis was abundant to the close of the season, and much of the fruit was badly smutted with the honey-dew fungus. It is of interest to note that in one orchard, consisting of alternate rows of McIntosh and Fameuse, the former was only slightly infested, whereas the latter was badly attacked.

The rosy apple aphis (*Anuraphis roseus*) was responsible for considerable injury in a few orchards in the Niagara district, but, generally speaking, this species was of little importance.

Cigar and Pistol Case Bearers (*Coleophora fletcherella* and *C. malivorella*). These insects were abundant in apple orchards east of Toronto, especially in the Bowmanville-Newcastle district, where the severe outbreak of case bearers occurred in 1921. Elsewhere they were of no importance.

The Apple Tent-Caterpillar (*Malacosoma americana*). In most parts of the Province this insect was scarce, but around Morrisburg numerous webs were found on trees along the roadside, indicating that possibly another outbreak will occur in eastern Ontario in a few years.

THE ROSE LEAF HOPPER (*Empoa rosæ*). Some apple orchards, particularly in the Burlington district, were again heavily infested with this species. However, in most parts of the Province the leaf hopper was present in smaller numbers than it has been for some time past. In eastern Ontario and in the Niagara peninsula, leaf hoppers parasitized by a dryinid were very commonly observed.

APPLE PLANT BUGS. Apples seriously deformed by plant bugs were received from several new localities. Specimens from the Fonthill district were injured by *Lygidea mendax*, but in most cases it was impossible to determine what species were responsible for the injury.

Although the fruit in individual orchards is sometimes practically ruined by plant bugs, the total yearly injury from these insects is not large in Ontario.

PEAR PSYLLA (*Psyllia pyricola*). Weather conditions must have been particularly favourable for the multiplication of the psylla this year, because, although the over-wintering flies were comparatively scarce in spring, the insect increased at a remarkable rate, and in summer and fall, pear orchards in the Niagara and Burlington districts, and as far east as Newcastle, were very heavily infested. At Burlington the pears on practically all Kieffer trees which did not receive a late application of nicotine, were covered with honey-dew fungus, and in harvesting the crop the pickers likewise became coated with the sticky, sooty material.

PLUM CURCULIO (*Conotrachelus nenuphar*). For some reason unknown to us, this insect, although abundant as usual in spring, was very scarce this autumn. Unsprayed apples, which ordinarily would show considerable puncturing due to the insect's feeding activities, were more or less free from this injury.

CHERRY FRUIT FLIES (*Rhagoletis cingulata* and *R. fausta*). At Niagara-on-the-Lake several orchards of Montmorency cherries were quite badly infested with fruit fly maggots, but elsewhere the insects were not common.

PLANT BUGS INJURIOUS TO PEACHES (*Lygus caryæ, L. quercalbæ* and *L. omnivagus*). The hickory and oak plant bugs were much more injurious to peaches in the Niagara district than they were in 1922.

In two orchards, one with hickories and the other with oaks growing near by, a few damaged peaches were found as far as 200 yards from the host trees, but in both cases the plant bug injury was only severe on the fruit in the immediate vicinity of the oaks or hickories.

THE BLACK CHERRY APHIS (*Myzus cerasi*). This plant louse was very abundant on sweet cherry trees throughout the Niagara peninsula.

With reference to the control of this pest, experience has shown that, in addition to spraying with nicotine sulphate, it is advisable to remove and destroy aphid-infested water-sprouts in June.

THE GREEN PEACH APHIS (*Myzus persicæ*). In spring this species was sufficiently abundant in some peach orchards near Winona to alarm the growers. However, the outbreak was brought under control by natural agencies before any serious damage was done.

To anyone who has observed the myriads of returned migrants of *Myzus persicæ* which appear practically every fall in the Niagara peninsula, it is surprising that this louse is so seldom injurious to peach trees.

The European Red Mite (*Paratetranychus pilosus*). By the middle of July many plum orchards throughout the Niagara district were quite heavily infested with this mite, but the outbreak did not increase in severity to the degree we at first anticipated.

At Vineland the mite was easily controlled by spraying with wettable sulphur or lime sulphur.

Grape and Small Fruit Insects

The Rose Chafer (*Macrodactylus subspinosus*). This insect has seldom, if ever, been more prevalent than it was this year. Severe outbreaks occurred in most of the sandy sections of southwestern Ontario. Grapes, fruit trees, ornamentals, etc., were attacked and seriously injured. It is worth while recording that at Fonthill, according to a correspondent, a brood of ducklings died as a result of eating the beetles.

It is of interest to note that Mr. Hall's investigations at Fenwick have furnished us with satisfactory evidence that the chafer only breeds to a very slight extent in clover sod. Along with the other control measures, it would therefore seem to be advisable to recommend the substitution of clovers for grasses in chafer-infested districts.

It is highly probable that serious outbreaks of the rose chafer will occur again next year, judging by the immense numbers of grubs which were found in sandy soils this fall at Fenwick, Dixie and Simcoe. In this connection we might mention that the densest rose chafer grub population we have on record, namely, 1,052 larvæ per square yard, was found at Dixie in the Hydro-Electric right-of-way.

Grape Leaf Hoppers (*Erythroneura comes* and *E. tricincta*). Leaf hoppers were again present in large numbers in Niagara vineyards. On the whole, this year's outbreak was not so severe as that of 1922, but a larger area was affected, viz., from the Niagara River to Hamilton.

The Grape Berry Moth (*Polychrosis viteana*). During the past two years the grape crop in a large vineyard near St. Catharines has been seriously damaged by this pest. This season a very considerable percentage of the fruit was infested—in many of the rows practically 100 per cent. of the bunches.

The berry moth occurs in all parts of the Niagara peninsula, but it is very rarely sufficiently numerous to cause any appreciable loss. As exposed pupæ of *P. viteana* are said to succumb quite readily to low temperatures, the Ontario winter most probably accounts for our comparative immunity from injury.

The Grape Blossom Midge (*Contarinia johnsoni*). What we take to be this species destroyed a considerable percentage of the blossom buds in a vineyard near Fruitland. The affected buds, according to the grower, were swollen and watery in appearance, and when opened were found to contain maggots. The crop in this vineyard has been poor for several years back, and most of the bunches have been thin and ragged.

Colaspis flavida. This leaf beetle was commonly observed feeding on grape foliage in the Niagara district, but only in a few cases did it cause sufficient injury to attract the attention of the growers.

The Red Spider (*Tetranychus telarius*). Favoured by exceptionally dry weather, this pest appeared in outbreak form in the Niagara and several other districts of southwestern Ontario. During July the mite was present in extraordinary numbers on bush fruits and, as a result of its feeding activities, the foliage in many black currant and in several raspberry plantations was largely destroyed. In one raspberry patch at Beamsville, all the leaves on the bearing canes were brown and dead before the berries were picked, and consequently the crop was almost a complete failure. In a few instances strawberries were also badly infested with the mite.

Blackberry Leaf Miner (*Metallus bethunei*). A few blackberry plantations near Vineland were fairly heavily infested with this species but, generally speaking, the miner was less abundant in the Niagara and Burlington districts than it has been for several years.

Striped Tree Cricket (*Œcanthus nigricornis*). Although complaints of tree-cricket injury to raspberry were received from all parts of the province, it is doubtful if this insect was more troublesome than usual. So-called winter-killing of the canes was remarkably prevalent, and many persons no doubt erroneously attributed this injury to the tree cricket.

The Raspberry Saw-Fly (*Monophadnoides rubi*). This pest was again somewhat injurious in several localities. At Vineland the emergence period of 698 adults extended from May 28th to June 22nd, the last flies appearing approximately four weeks before Cuthbert berries ripened.

The Strawberry Root Weevil (*Otiorhynchus ovatus*). On three fruit farms near Dixie portions of strawberry fields were heavily infested with this insect. On account of the prevalence of winter-killing, it was impossible to gauge the extent of the damage caused by the root weevil. This is the first time we have seen *O. ovatus* present in injurious numbers, and it is worthy of note that the farms on which it occurred are models for cleanliness—well cultivated and remarkably free from weeds. On July 4th approximately 75 per cent. of the insects had reached the adult stage but were still in the ground and were still pale brown in colour. Almost all the others were in the pupal stage, hence it would appear that the new generation is a cleancut and not a straggling one.

The Strawberry Leaf Beetle (*Paria canella*). For several years the adults of this species have done considerable damage to the foliage of strawberries in southwestern Ontario. This season in most places the injury was not so great as it was last year, but there were a few striking exceptions, notably at Georgetown, Campbellville and Simcoe. At the last place raspberries as well as strawberries were very severely injured on some farms, one plot of raspberries having practically every leaf destroyed. In this case the plantation was weedy and neglected.

The Strawberry Weevil (*Anthonomus signatus*). This pest was troublesome in a few Niagara strawberry fields.

Truck Crop Insects

The Onion Thrips (*Thrips tabaci*). Dry weather conditions were favourable for the multiplication of this insect, and it caused much loss in the onion marsh at Point Pelee and in other parts of the province.

Striped Cucumber Beetle (*Diabrotica vittata*). Cucumber beetles were very abundant in the Brighton district this fall, and caused some loss by eating out holes in pumpkins. In some instances 40 per cent. to 50 per cent. of the pumpkins were badly injured. One field which should have produced fifty tons of pumpkins, yielded only ten tons fit for canning. In most sections, however, the beetle was quite scarce.

THE SQUASH BUG (*Anasa tristis*). This bug is usually only destructive in small gardens, but this season it was decidedly troublesome in commercial fields at Vineland. Cucumbers as well as squash and pumpkins were injured.

THE BUMBLE FLOWER BEETLE (*Euphoria inda*). The flower beetle was somewhat common again on ripe fruit, and to a greater extent on corn, especially sweet varieties.

THE ZEBRA CATERPILLAR (*Mamestra picta*). This insect occurred in sufficiently large numbers on turnips and other plants to be conspicuous. At Aylmer it was responsible for considerable damage to gladioli.

THE EUROPEAN CORN BORER (*Pyrausta nubilalis*). Discussed elsewhere in this report.

MISCELLANEOUS INSECTS

GRASSHOPPERS. In most parts of the province grasshoppers were of very little importance. At Sudbury, however, the roadside grasshopper (*Camnula pellucida*) appeared in such large numbers that the crops would have been ruined if timely applications of poisoned bait had not been made under the supervision of Mr. Robicheau, the Agricultural Representative. The poisoned mixture which was applied was prepared according to the formula given in last year's report, and some three and a half tons of white arsenic were used in making it.

WHITE GRUBS. White grubs were destructive in the vicinity of Fonthill. At the Fonthill nurseries, nursery stock, particularly apples and cherries, was severely injured. According to the man in charge, the apples and cherries were planted on clover sod.

THE BLACKWALNUT CATERPILLAR (*Datana integerrima*). Over most of southwestern Ontario, black walnuts and butternuts were wholly or partially defoliated by this caterpillar. In some cases it is claimed that walnut trees which have been defoliated by the insect several years in succession are dying.

SPINY OAK CATERPILLAR (*Anisota senatoria*). In southwestern Ontario, from St. Thomas to near Brantford, many oak trees were completely or partially defoliated by this species.

LILAC LEAF MINER. Lilac leaves severely mined by some insect were received from several places in Toronto, and also from Newmarket and Guelph. The complaint was made that if this insect increased further it would make the lilacs so unsightly that they would be better removed. The dates on which the leaves were sent in were June 16th, 28th, July 31st and August 10th. The larva was lepidopterous and it is possible that it was the same one as troubled lilacs in England, namely, *Gracilaria syringella*.

COLUMBINE BORER (*Papaipema purpurifascia*). In the latter part of July complaints were sent in from various sources stating that a large borer, working in the base of the plants, was destroying the columbines. On examination the insect proved to be the above species. It is only rarely that outbreaks of this insect are found in Ontario. Mr. Arthur Gibson reported it as being troublesome in 1893 and in 1904.

IRIS BORER (*Macronoctua onusta*). Specimens of iris infested by what we believed to be this insect were received from Windsor and Sombra on July 7th and September 5th, respectively.

Silver Fish (*Lepisma domestica* and *L. saccharina*). In bakeshops the former of these two insects is very common; in fact, it is claimed by some bakers that practically every bakeshop is more or less infested. The other species is found here and there in private homes, but is not yet very common.

Horn Fly (*Hæmatobia irritans*). In Middlesex and Elgin, horn flies seemed to be exceptionally abundant this summer.

Heel Fly (*Hypoderma bovis*). More trouble was reported from cattle gadding as a result of the attacks of this warble fly this year than last.

A STUDY OF THE PUPAL CASE OF PRIONOXYSTUS MACMURTREI.

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Prionoxystus macmurtrei Guer-Men., commonly known as the Lesser Carpenter Worm, is a serious enemy of the red oak in parts of Eastern Canada. The larva makes large winding tunnels in the wood and requires three seasons to mature.

Pupation takes place, usually, in the fall of the year within a silk-lined cell at the further end of the tunnel. The pupa is dark, mahogany-coloured and shining. The average female case is 45.5 mm. long and 10.8 mm. wide; the male being 24.5 mm. long and 6.0 mm. wide.

About the last few days in May or early in June, the pupa leaves its chamber and begins to move forward on its back into the tunnel. By a number of contractions and expansions of the abdomen, it makes its way along the passage to the mouth of the burrow, where it projects itself sufficiently to the exterior to expose the head, thorax and one or two segments of the abdomen. The remainder of the case rests within the tunnel walls, anchored there securely by means of the numerous spine-like processes which appear on the abdomen. A few violent pulsations and the head shell splits open, allowing the moth to gain its freedom.

The following is a study of the principal features of the external morphology of the case.

The Head

Vertex. The vertex is represented by a narrow chitinous band which is not clearly visible before dehiscence.

Front. Dorsally, the front bears two conspicuous setæ which are set in slight depressions near the epicranial suture; ventrally, four indistinct punctures arranged in an irregular row.

Genæ. The genæ are probably represented only by a slight rugosity near the fronto-clypeal suture.

Clypeus. In most specimens the suture separating the frons from the clypeus is not clearly marked. The lateral margins of the clypeus are strongly curved outwardly. The clypeus is truncate anteriorly and bears two setæ.

Labrum. The labrum is small, not so strongly chitinized as the frons, and slightly bilobed.

Mandibles. The mandibles are situated laterad of the clypeus and labrum; they are of a dark brown colour, present a rough surface, and are distinctly elevated.

Antennæ. The antennæ are pectinate and reach to the tip of the tibia of the second paid of legs.

Labium. The labium approaches a rectangle in shape. The palps are triangular and very distinct.

Maxillæ. The maxillæ are subtriangular and the tips meet about on the same level as those of the labial palps. The lateral extensions are folded and are blunt at the apex.

The Thorax

Prothorax. The prothorax is short, has a distinct pronotum which is quadrangular in shape and is bisected by a longitudinal ridge. The patagia are subtriangular.

Prothoracic Legs. The coxæ are exposed. They are located caudad to the maxillæ and are contiguous to same. The articulation between the tibiæ and tarsi is indistinct.

Mesothorax. The mesothorax is four times as long as the pronotum. The caudal margin of the mesothoracic spiracle appears as a rugosity situated under the posterior edge of the patagia.

Mesothoracic Legs. The coxæ are caudad to those of the prothoracic legs; the femora are not exposed, the joint between the tibiæ and tarsi is located near the tip of the prothoracic legs. The tarsi do not quite reach the apex of theforewings, which extend to and cover the anterior part of the third abdominal segment.

Metathorax. The length of the metathorax is about that of the pronotum. There is a longitudinal ridge on the meson. The greater part of the metathoracic legs is not exposed except a small portion of the coxæ appearing near the tips of the prothoracic legs and a few of the tarsal joints projecting beyond the wing covers.

Only a small part of the hind wings is visible on the dorsum; ventrally, they are covered by forewings.

Abdomen

The abdomen is slightly curved toward the posterior end. The curvature is determined by the fixed segments, these beginning at segment 7 in the female and 8 in the male.

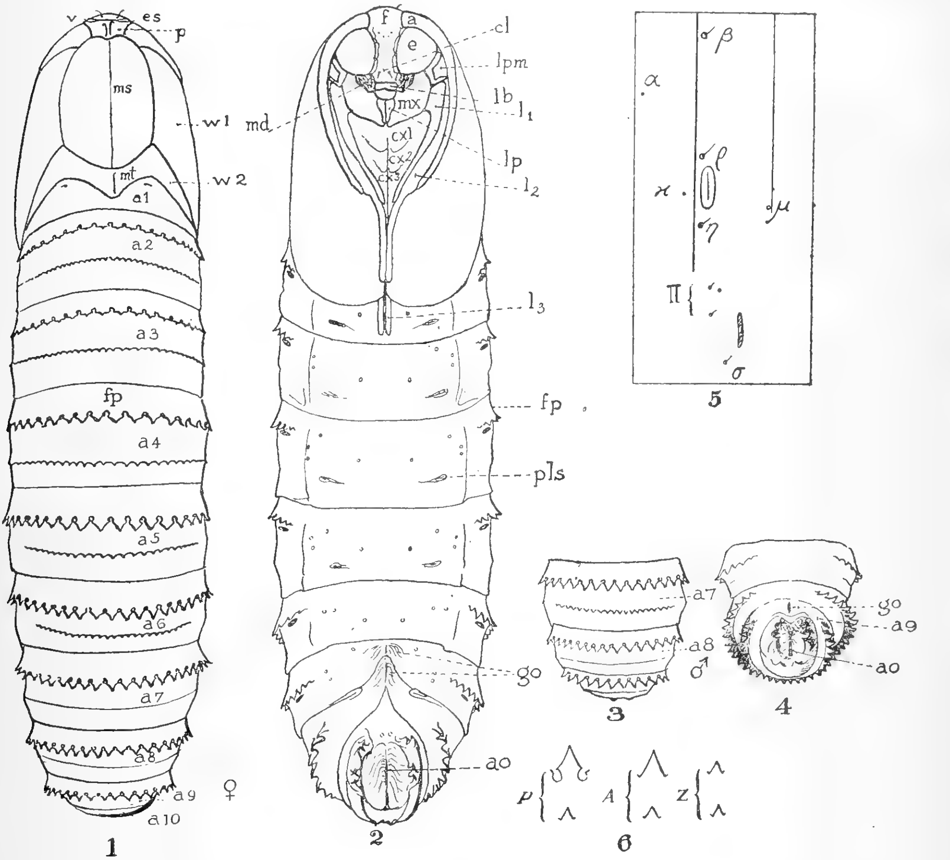
The segments support an armature of large and small processes which assist the pupa to reach the exterior. They are divided into three areas, as follows:

1. The first, or anterior, area is a flanged plate thickly chitinized, and has a row of prominent flattened spear-shaped spines across its posterior border. Under the high power of the microscope, small fine depressions can be seen on its surface.

2. The second, or median, area is of a thinner chitin. It has a row of fine toothed spines on its posterior border. The surface markings are somewhat elongated and suggest a fibrous structure.

3. The third, or posterior, area is thinly chitinized and covered with a fine reticulation which may provide for any expansion or contraction of the pupal case.

Spiracles. The spiracles are large, elevated and quite prominent in both sexes; those of segment 8 being atrophied. They are tureen-shaped with the outer edges smooth and rounded, the interior being lined with fine bristles.



Explanation of Plate

Fig. 1: Dorsal view of female pupal case.
- es—epicranial suture.
- v—vertex.
- p—prothorax.
- ms—mesothorax.
- mt—metathorax.
- w1—Mesothoracic wing.
- w2—metathoracic wing.
- a1-a10—abdominal segments, 1-10.
- fp—flanged plate.

Fig. 2: Ventral view of same:
- f—front.
- a—antennæ.
- e—eyes.
- cl—clypeus.
- lpm—lateral projections of maxillæ.
- md—mandibles.
- mx—maxillae.
- lb—labrum.
- l1—prothoracic leg.
- l2—mesothoracic leg.
- l3—metathoracic leg.
- cx1—coxa prothoracic leg.
- cx2—coxa mesothoracic leg.
- cx3—coxa metathoracic leg.
- fp—flanged plate.
- pls—proleg scar.
- go—genital openings.
- ao—anal opening.

Fig. 3: Part dorsal view of male pupal case:
- a7—abdominal segment.
- a8—abdominal segment.

Fig. 4: Ventral view of same:
- go—genital opening.
- ao—anal opening.
- ag—abdominal segment.

Fig. 5: Arrangement of setæ on abdominal segments:

Fig. 6: Type of dorsal spines in cossid genera.
- *P*—Prionoxystus.
- *A*—Acossus.
- *Z*—Zeuzera.

Spines. The chitinous dentations or spines are arranged transversely on the segments, pointing away from the head. The arrangement is slightly different in each sex.

Segment 1, which is reduced in size, shows only one row of very fine spines. On segments 2 to 9 are the larger, rounded, somewhat spear-shaped teeth, darkly tinted on the outer margin, each tooth being clearly visible to the naked eye. There is also an additional row of much smaller, finer, spine-like processes arranged transversely caudad to the larger and which can be seen only with the aid of a hand lens. These appear on segments 2 to 6 in the female and on segments 2 to 7 in the male. Segment 10 has several coarse spines, irregular in size, arranged somewhat semi-circularly, the largest being situated ventrally.

In both sexes the large, coarse teeth are fairly regular in outline. The largest of these in each row are situated mid-dorsally and taper off gradually as they run out laterally, passing down some distance *beneath* the spiracular line and *in front* of the spiracle on all segments except the first three. In segment 1 the entire row is absent; in 2 they terminate just above the spiracle; and in 3 they run to the *top* of the spiracle.

Genitalia. The anterior genital opening of the female is situated on the posterior border of the 8th segment; the caudal opening appears on a heavily chitinized area of the 9th segment (see figure).

The genital opening of the male is associated with the 9th segment (see figure).

Anal Opening. The anal opening situated near the caudal margin of the 10th segment is slit-like and surrounded by prominent folds.

Abdominal Setæ. The abdominal setæ, Fig. 5, are inconspicuous and occupy positions slightly different from those of the larva. The following is a tentative homology based on the nomenclature of the larval setæ introduced by S. B. Fracker in "The Classification of Lepidopterous Larvæ" of Illinois Biological Monographs, Vol. II, No. 1, July, 1915.

α very small, close to the cephalic border of the flanged plate, about half way between the dorso-meson and the spiracle.

β under the anterior row of spines nearer the dorso-meson than α

ρ under the same row of spines close to and dorsad of the spiracle.

κ on the posterior border of the flanged plate directly cephalad of the spiracle.

η under the anterior row of spines close to and ventrad of the spiracle.

μ on the posterior border of the median area, caudad of the spiracle (very indistinct, and absent in many cases).

π Group—usually bisetose, cephalad and slightly laterad of the proleg scar.

σ is between the prolegs scars.

α, κ and μ are represented by punctures only; elliptical in outline. Certain depressions or scars, the nature of which could not be determined occur dorsad of the spiracle and might easily be mistaken for setal vestages. (See Fig. 5.)

GENERIC KEY TO THE PUPÆ OF COSSIDÆ OCCURRING IN NORTH AMERICA.

As will appear from the following key, the pupal cases of Prionoxystus are easily distinguishable from those of other cossid genera.

A. Abdominal spines irregular in shape and equal in size on both cephalic and caudal rows.—*Zeuzera*.
AA. Abdominal spines regular, larger in cephalic than in caudal row.

B. Cephalic spines pyramidal in outline.—*Acossus*.
BB. Cephalic spines flat; spear-shaped.—*Prionoxystus*.

The writer is indebted to Mr. J. J. de Gryse for criticisms and suggestions.

NOTES ON LICE WITH SPECIAL REFERENCE TO THE CHICKEN LOUSE (*Lipeurus heterographus*)

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Insects are usually regarded as ubiquitous parasites whose persecutions, while annoying and distracting, are of little moment from the standpoint of general health.

This viewpoint, *per se*, appears more or less correct, but when considered in relation to infectious diseases, as vectors or intermediate hosts, their presence portends an ominous state of affairs fraught with grave possibilities.

Lice appear to be the least harmful of the insects, yet experimental evidence incriminates several varieties in the transmission and propagation of specific maladies.

Thus it has been conclusively demonstrated that the causative organism (*Spirocheta recurrentis*) of relapsing fever is transmitted from man to man through the intervention of two species of human lice, *Pediculus capitus* and *Pediculus vestimenti*.

The findings of the Royal Commission appointed to investigate trench fever also incriminate the human head louse, *Pediculus capitus*, in the transmission of this malady, while the clothes louse, *Pediculus vestimenti*, is a known carrier of typhus fever.

In view of the foregoing it is reasonable to expect that future research will establish a connecting link between many of the infectious diseases of domesticated animals and the lice parasitic upon them.

Apart from their role in the transmission of infectious disease, what harmful influence do lice exert on the host, when viewed from a purely parasitic standpoint? It is generally agreed that a more or less intense pruritis or cutaneous rash is caused by the presence of lice upon the body, varying according to the number and variety as well as the age and condition of the infected animal. Their presence upon young animals is supposed to result in a stunted growth, while older animals harbouring them become emaciated and unthrifty. Whether they alone are capable of producing death by irritation without the intervention of some contagious disease is problematical.

Formerly it was thought that this loss of condition was due to the small traumata resulting from the activities of lice while feeding, or the minute injuries produced by the sharp claws with which the feet of all these parasites are furnished; but experimental work conducted by Moore, of the Division of Entomology, University of Minnesota, throws a new light upon the subject.

In a paper which appeared in the *Journal* of the American Medical Association, Vol. 2, 1918, he describes an interesting reaction to louse bites where symptoms similar to trench fever were observed. May I be permitted to quote the following from this very interesting communication?

"Whereas, Miss Wentz had started feeding with a small number of lice which gradually increased, I started feeding about 700 to 800 twice a day. Almost immediately a general tired feeling was noticed in the calf of the legs and along the shin bones, while on the soles of the feet and underneath the toes this tired feeling was so intense as often to prevent sleep until late in the night. An irritable and pessimistic state of mind developed. May 7th, an illness resulted with symptoms very similar to grip, and a rash similar to German measles was present, particularly over the shoulders and abdomen. As German measles were prevalent in the community at that time, it was considered German measles; and after remaining in bed for several days I returned to work and again took up the feeding of the lice. The general feeling previously noted was present with increasing intensity. By May 15th, the number of lice in our reserve stock had increased to about 1,200, and May 28th, I was again forced to remain in bed. The family physician was called and diagnosed the case as possibly grip. The next day he was again called since a distinct rash was present all over the body. The rash was considered quite typical of German measles, but other symptoms of measles were absent. The heart was normal, the pulse about 90, and the temperature varied from 100 to 102. A blood count revealed a normal number of leukocytes and red corpuscles. A severe headache was experienced, accompanied with pains in the legs, not only along the shins but also in the calves of the legs and the soles of the feet, while intense pain was present in all the joints of the body. The appetite was lost for several days, and the tongue was heavily coated. Dr. A. D. Hirschfelder, who has been assisting on the louse problem, saw me at this time and considered that it was not German measles, nor was it grip, but might be trench fever. Glandular enlargement was absent and no enlargement of the spleen was noted. Recovery was complete except for a general weak condition by June 4th.

"I again took up the feeding of the lice, June 6th, with the hope of producing the symptoms again and deciding if the illness was really caused by the lice, and, if possible, whether it was trench fever. The lice numbered about 800 adults, which gradually died off while young lice hatched from the eggs until by June 22nd about 1,800 young lice were being fed. During the early period between June 6th and 15th, no lassitude was noticed, but from about the 17th on, it gradually returned as the number of lice increased, until the 27th and 28th when it was pronounced. On the 29th I was feeling so miserable that it was a decided effort to get up in the morning and again feed the lice. The symptoms were the same as in the two previous illnesses. If the illness was due to the organism of trench fever, a day or two spent in the open with plenty of exercise would hardly prevent the attack, but if it was due to a toxin or toxins, it might be possible, by plenty of fresh air and exercise, to throw off the toxins and escape the attack; hence the 29th and 30th were spent in the open, rowing and fishing. During the 29th the symptoms were still quite pronounced, but gradually disappeared on the 30th, although a general tired feeling persisted for several days. Since that time the lice have not been fed, and two weeks in July were spent on a vacation in the open. The result has been the total disappearance of the peculiar tired feeling in the legs and feet and a return to perfectly normal health."

The foregoing is suggestive that the clothes louse, if present in large numbers, may produce an illness, which appears to be an intoxication of the system, with some toxin that they are capable of introducing at the time of feeding. It is also suggestive that some of the symptoms of trench fever encountered in certain cases may not be due to the organism of trench fever but to certain toxins introduced by the lice.

Without entering into a classification of the Anoplura in which four families including fifteen genera are recognized, they may be regarded as falling into two orders, *Siphunculata, Sucking Lice* and *Mallophaga, Biting Lice.*

While most mammals may harbour both varieties, the biting lice appear to be less harmful to the host, owing to their methods of feeding on epidermal scales and products of exfoliation, instead of puncturing the skin for the sustaining blood and lymph.

Bird lice are all included under the order *Mallophaga*, and live by feeding on the epidermal products such as feathers, scales, etc. Blood dried on the skin may be eaten, but bird lice are not bloodsuckers.

Since they do not pierce the skin their depredations may be less inimical to the welfare of the host than the activities of the suctorial variety.

While these prefatory remarks may seem rather foreign to the subject in hand, they appear relevant in view of the fact that a traditional belief exists amongst poultrymen that the head louse, *Lipeurus heterographus*, is responsible for a heavy mortality amongst young chicks.

This parasite is well called the head louse, because of its predilection for this portion of the body. Infestation is most prominent on the feathers of the head and neck, although a few lice are occasionally found on the feathers of the wings. It has often been stated that lice dig into the flesh and even eat the brains of chickens. Undoubtedly this is the species that has caused this misconception. Often it is found on a feather with its head close to the body of the chicken but apparently never imbedded in the skin.

The head louse is much darker in colour than the ordinary body lice of poultry, *Menopon pallidum* and *Menopon biseriatum*, and is quite easily seen when the feathers, especially if white, are separated. The body is edged with dark bands and there are markings of the same shade across the abdomen. The first segments of the antennæ of the male are very large and the third segments are branched, while the antennæ of the female are more slender. This louse averages slightly less than one-tenth of an inch in length.

It is much less active than the body lice, but can easily slip between the barbs of the feathers and disappear from sight. It can live away from the fowl at normal temperatures for a longer period than the body lice, probably because it is accustomed to the cooler region of the feathers.

The eggs are glued to the feathers of the head and neck, being attached to the barbs often between the shaft and aftershaft. Observation has shown that the eggs hatch in from four to five days during warm weather, but the period may be extended during the cold months of the year. Our own experience shows that the time necessary to complete the life cycle from egg to adult during moderately warm weather is about twelve days but this is undoubtedly subject to seasonable variation.

To determine whether or not the head louse was capable of causing a heavy mortality amongst young chicks, experiments were undertaken during the summer of 1922.

On June 17th, two chicks sent in for autopsy were found to be infested with head lice, and on the following day three chicks about one month of age were infected to propagate a sufficient number for experimental work, an average of six to eight mature lice being placed upon each bird.

On July 7th, these three chicks were found to be heavily infested, making the further carrying on of experimental work possible.

On August 12th, thirty chicks were selected from a newly-hatched bunch of incubator birds and were divided into two pens of fifteen birds each.

These chicks were fourteen days of age and had been carried through to this period to eliminate weaklings.

On August 12th, one pen comprising fifteen chicks were infected with head lice from the older birds, from six to ten adult lice, males and females, being placed upon each chick, by pulling the feathers with adhering lice from the older chicks and allowing the lice to transfer naturally to the fluff of the head. In addition to this, two infected birds were placed under the hover at night and removed the next morning.

The following table illustrates the comparative results, viz., the weekly weights, feed consumed, etc.:

INFECTED PEN NO. 1

Chicks hatched July 30, 1922.
Infected Aug. 12—14 days old.

Week of Aug. 12-19

Number of birds living, 15.
Total weight, Aug. 12, 1 lb. 8 oz.
Total weight, Aug. 19, 2 lb. 12 oz.
Total gain for week, 1 lb. 4 oz.
Average gain per bird, 1.33 oz.
Feed consumed "Mash," 7 lb.
Mortality, nil.

Week of Aug. 19-26

Number of birds living, 13.
Total weight, Aug. 19, 2 lb. 12 oz.
Total weight, Aug. 26, 3 lb. 15 oz.
Total gain for week, 1 lb. 3 oz.
Average gain per bird, 1.46 oz.
Feed consumed "Mash," 10½ lb.
Mortality, 2 birds.
1 died Aug. 23, 1 died Aug. 24.

Week of Aug. 26—Sept. 3

Number of birds living, 13
Total weight Aug. 26, 3 lb. 15 oz.
Total weight Sept. 3, 5 lb. 2 oz.
Total gain for week, 1 lb. 3 oz.
Average gain per bird, 1.46 oz.
Feed consumed "Mash," 12 lbs.
Mortality, nil.

Week of Sept. 3–10

Number of birds living, 12.
Total weight Sept. 3, 5 lb. 2 oz.
Total weight Sept. 10, 6 lb. 2 oz.
Total gain for week, 1 lb.
Average gain per bird, 1.33 oz.
Feed consumed "Mash," 10¾ lb.
Mortality, 1 chick died on Sept. 8.

CONTROL PEN NO. 2

Chicks infected July 30—14 days old.

Week of Aug. 12-19

Number of birds living, 15.
Total weight, Aug. 12, 1 lb. 6 oz.
Total weight, Aug. 19, 2 lb. 2 oz.
Total gain for week, 1 lb. 2 oz.
Average gain per bird, 1.2 oz.
Feed consumed "Mash," 6 lb.
Mortality, nil.

Week of Aug. 19-26

Number of birds living, 14.
Total weight, Aug. 19, 2 lb. 8 oz.
Total weight, Aug. 26, 3 lb. 12 oz.
Total gain for week, 1. lb. 4 oz.
Average gain per bird, 1.42 oz.
Feed consumed "Mash," 9¼ lb.
Mortality, 1 bird killed by rats on August 25.

Week of Aug. 26—Sept. 3

Number of birds living, 14.
Total weight Aug. 26, 3 lb. 12 oz.
Total weight Sept. 3, 4 lb. 13 oz.
Total gain for week, 1 lb. 1 oz.
Average gain per bird, 1.21 oz.
Feed consumed "Mash," 10.8 lb.
Mortality, nil.

Week of Sept. 3–10.

Number of birds living, 13.
Total weight Sept. 3, 4 lb. 13 oz.
Total weight Sept. 10, 6 lb.
Total gain for week, 1 lb. 3 oz.
Average gain per bird, 1.46 oz.
Feed consumed "Mash," 12 lb.
Mortality, 1 bird died on Sept. 3.

When the weighings were discontinued on September 18th, 1922, the total aggregate weight of the twenty-five birds was found to be 12 lbs. 8 ounces, or an average weight per bird of 8 ounces.

Upon summarizing these results it will be noted that there was very little to choose between the infected and control pens, the average gain and mortality rate being about equal.

Paradoxical as it may seem, the chicks in the infected pen at the end of the experiment appeared to the casual observer to be more virile and in better condition than the birds in the control pen.

A second experiment was started on September 27th, 1922, fifty chicks being selected for the purpose.

These chicks were picked from a flock numbering about 300 birds, all of which were two weeks of age and were selected for virility, etc. Twenty-five chicks were used for a control pen and twenty-five were infected, from six to ten adult lice being placed upon each bird.

On the 29th of September it was discovered that twenty of the original 300 chicks had previously been in contact with adult fowls and these were subsequently placed in contact with the entire number which resulted in all of them becoming infested with head lice. This unfortunate circumstance necessitated treatment of all controls, blue ointment being used for the purpose. The ointment used was the ordinary commercial preparation diluted to half normal strength. One application only was necessary to clean up the infection and no untoward effects were observed in any of the treated birds.

Without burdening you with full details of weighing, feeding, etc., it may be sufficient to state that our results were somewhat similar to the first experiment, the mortality rate being average and practically the same for both pens. The remaining 250 chicks were kept under observation until late in November and during this period no inordinate death rate was noted. Upon actual count some individual chicks were found to harbour over one hundred adult lice and as time progressed and the chicks grew, the numbers diminished until only a few lice could be detected.

References to the head louse of chicks are mostly contained in popular bulletins and check lists of animal parasites, and it is therefore little to be wondered at that this parasite has been given a pathological role to which it is little entitled, this impression being based upon the personal observations of practical poultrymen little familiar with the many factors contributing to the heavy death rate amongst early-hatched chicks. When it is considered that out of every four eggs incubated, an average of only one chick is raised to maturity, and that in many cases of early spring hatching by artificial methods, the mortality amongst hatched chicks may run well over 50 per cent. during the first ten days of life, due to such conditions as aspergillosis or brooder pneumonia, white diarrhœa, defective incubation, etc., we have little reason for holding head lice responsible for the heavy mortality during this hazardous period. Admittedly, parasitism of any nature or degree must be considered in relation to susceptibility to disease, for undoubtedly a lowered resistance resulting from a heavy infection tends to a fatal issue. In many cases, however, a heavy degree of infestation is an index of lowered resistance from debility and faulty metabolism, or in the case of fowls, from confinement, overcrowding and a withdrawal of the natural means of defense, and in such instances, the presence of parasites may be regarded as the result and not the cause of impaired vitality.

While our investigations concerning this parasite are limited, sufficient experimental work has been done to satisfy the writer that the head louse of chickens is a much maligned parasite from whose passivity has been created a role of activity which from personal observation or analogy I judge to be little warranted.

INSECTS OF THE SEASON IN QUEBEC IN 1923

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The summer of 1923 has been a very heavy season for insect pests, and damages, as a whole, easily double last year's figure. Sometimes it appeared as if insects of normally very little importance thought it compulsory to show, in a brighter light, their noxious power. This explains why the ordinary short list of important pests is so greatly extended.

Vegetable Insects

Cutworms have been very active in all vegetable-growing sections. Apart from the customary victims (cabbage, tobacco, tomato), they have destroyed entire fields of onions around Quebec city (May 27-June 20).

Onion Maggot (*Phorbia ceparum*). A remarkable outbreak of this pest was recorded and great damages registered (June 15-30). Sodium arsenite (half-ounce per gallon) gave very satisfactory results in our ten experimental fields.

Cabbage Worm (*Pieris rapæ*) kept steadily at work from June 20th until the very end of the season, cabbages and cauliflowers suffering equally.

Cabbage Maggot (*Phorbia brassicæ*). Very active during the last part of June. Fields treated with corrosive sublimate, even when found in bad condition, came back wonderfully well. An unprotected field around Three Rivers suffered a total loss of 1,500 plants. Radishes were also among the chief victims.

Potato Beetles (*Leptinotarsa decemlineata*) were abundant in most parts of the province and were aided in their work of destruction, in many scattered localities, by the blister beetle (*Macrobasis unicolor*). Beans were also affected by the last-named pest, which is certainly on the increase in Quebec.

Flea-beetle (*Epitrix cucumeris*) showed a decrease over last year and was not seen so early in the fields (June 3-10).

Cucumber Beetle (*Diabrotica vittata*), scarcely noticeable in 1922, did important damage to cucumbers in Montreal, Three Rivers, Quebec and Rimouski districts. (June 20-July 25.)

Field Crop Insects

Grasshoppers (*Melanoplus atlanis* and *M. femur-rubrum*). Last year the Saint Maurice river valley had been seriously infested with swarms of grasshoppers but the control work, started in due time, gave very good results and this year that district had no trouble from that source. The counties of Charlevoix and Pontiac had, last summer, some sections badly affected with the plague. These sections of poor sandy soil, on account of a continuous drought, had only a very light crop of grain. Grasshoppers had an easy task to destroy these few signs of vegetation.

White Grubs (*Lachnosterna sp.*) are becoming a serious menace to old pasture lands. Reports from some localities in Eastern Townships and south of Montreal show that entire fields are ruined by white grubs. Around Drummondville counts give an average of six grubs to the square foot. Once more farmers should see the dangers of a "long range" rotation.

Orchard Insects

Apple Maggots (*Rhagoletis pomonella*) have spread considerably this season and caused serious damage to apples. A change in spraying operations will have to be made to control this pest.

Plum Curculio (*Conotrachelus nenuphar*) was, in importance, second on the list in the whole province.

Apple Aphis (*Aphis pomi* and *A. sorbi*) did not seem to be so numerous as last year or to cause as much damage.

Pistol and Cigar Case-Bearers (*Coleophora malivorella* and *C. fletcherella*) were so abundant around the city of Valleyfield as to almost completely defoliate the trees and ruin the apple crop in many orchards. Lack of regular and thorough spraying explains this local outbreak. Elsewhere, a few reports have been made concerning the same pest, but damages were not so important.

Bud Moth (*Tmetocera ocellana*) showed in about the same numbers as last year. No special case of heavy infestation were reported.

Apple Tent Caterpillar (*M. americana*). Important damage in June.

Fruit Tree Leaf-rollfr (*Cacœcia argyrospila*) was widely spread and was certainly more abundant than the previous season (June 5-20).

Apple Borer (*Saperda candida*). More numerous than usual in some nurseries. One orchard around Quebec city was cut down on account of that pest.

Shade-Tree Insects

Tent Caterpillars (*Malacosoma americana* and *M. disstria*). Important outbreak of these pests for the second successive year: showed large increase over 1922. Distribution general along the St. Lawrence river. The Apple Tent Caterpillar was chiefly injurious to poplars, maples, apple and cherry trees. The Forest Tent Caterpillar defoliated poplars and maples and seemed more abundant than the other species. First hatching at Quebec, May 17th.

Spiny Elm Caterpillar (*Euvanessa antiopa*). Found more numerous than usual, between June 20-July 20, on elms and poplars. First adults seen May 7th; first eggs, May 8th.

White Tussock Moth Caterpillar (*Hemerocampa leucostigma*). A decrease over the two last years (Quebec, July 15-August 10).

Adults of *Eulype hastata* were found in the woods, on the north shore of the St. Lawrence, in tremendous numbers from July 1st to 20th. In Charlevoix county horses were scared to enter the bush; specimens seen in Quebec at night in large numbers.

Fall Webworm (*Hyphantria textor*). Seen in good numbers during September. Not important on shade trees. Mostly confined to wild-cherry trees along roads.

Miscellaneous Insects

Important Currant Worm (*Pteronus ribesii*). Last part of June, in about the usual number.

Currant Aphis (*Myzus ribis*). Widely spread and in large numbers.

Three-lined Beetle (*Lema trilineata*). Locally observed on various vegetable and ornamental plants.

Tortoise Beetles (*Coptocycla bicolor* and *C. signifera*) damaging convolvulus, eating holes in the leaves. Two cases reported.

THE SPREAD AND DEGREE OF INFESTATION OF THE EUROPEAN CORN BORER IN ONTARIO IN 1923

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The first year, 1920, that the corn borer was discovered in Ontario, thirty-five townships were found infested, covering an area of 2,780 square miles. In 1921, seventy-one additional townships were added to the quarantine; in 1922, forty-five more were infested and eleven were included in the quarantined territory on account of their situation. The area under quarantine in Ontario at the beginning of this season, 1923, totalled 12,616 square miles, as compared with 13,857 square miles similarly affected in the various infested portions of the United States.

This season, 1923, scouting of the border territory was again carried on during the months of August and September. All the corn-growing townships between Lake Huron, Georgian Bay and Lake Simcoe were examined as well as the remaining unquarantined townships of the counties of York, Ontario, Durham, Victoria, Northumberland, Peterborough, and Prince Edward. On account of the possibility of water distribution, all the shore townships along the St. Lawrence river, as far down as Cornwall, were inspected and portions of the county of Carleton were also scouted.

As a result of the above inspection, only eight additional townships were found infested; one in Huron county, three in Bruce, two in Wellington, one in York, and one in Durham county. All of the above townships adjoin the quarantined territory with the exception of Saugeen and Kincardine in Bruce county. The Saugeen township infestation represents the most northern point of infestation in Canada and in this connection it is interesting to note that several hills of corn were found infested in the field, whereas at the other points discovered this year, only isolated stalks were found infested. The northern spread along Lake Huron again demonstrates the relative importance of lake shore conditions in corn-borer distribution and an effort will be made to watch the development of the pest in the township of Saugeen.

Possibilities of Further Spread

From the viewpoint of food supply, it is, of course, possible that the European corn borer may spread over a much larger area in the province of Ontario than it covers at the present time. The reports of the foremen of the scouting parties, who worked Grey county in the past two seasons, would indicate that the interior of this county does not grow corn to any extent. Dufferin county is also unimportant as well as northern and western Simcoe county in general. Northern Ontario county, Victoria county, and northern Peterborough county may be similarly classified, but corn is a sufficiently important crop in various other uninfested sections of the province to warrant efforts being made to retard the spread. An important portion of Wellington county is still uninfested. A large amount of corn is grown in the shore townships of Lake Simcoe, the townships bordering the quarantined territory in the counties of York, Ontario, Durham, Northumberland, southern Peterboro, and Prince Edward county usually grow a large acreage of corn, and the townships along the St. Lawrence river would supply a sufficient amount of corn to favour the development of an outbreak. The counties of Glengarry, Prescott and Russell are somewhat important. The county of Lanark grows about 11,000 acres and the county of Carleton ranks fifth in importance in the province in silage-corn production, with about 18,000 acres.

Degrees of Infestation in Infested Territory

With the exception of a limited area in the centre of the infestation where accurate records were made by Messrs. Crawford and Spencer, during the investigational work, no special effort was attempted until last year to record the actual degree of infestation in the older portions of the infested territory. The work in this connection last season was carried on after the completion of the border-scouting in late September. Observations were made at various points in three concentric circles surrounding Union village, the centre of the infestation. On account of the small staff available, and the fact that the corn was then being cut, the records were taken from only one field at each locality. An effort was made to locate the most heavily-infested field at each point and the degree of infestation was obtained from 300 representative stalks together with relating data regarding the history of the field. This method did not show the average conditions but substantiated the original decision regarding the centre of the outbreak and verified established opinions concerning the benefit of late planting.

In 1923 a definite system of recording the development of the infestation was inaugurated with the intention of continuing the work for several seasons to supply accurate information regarding the importance of the pest under the varied soil and crop conditions which are encountered in the large territory affected and to locate local outbreaks. Definite points in approximately the same three circles as used last year were chosen and include the counties of Elgin and Middlesex and the western parts of Oxford and Norfolk. In addition various points in the counties of Essex, Huron, Perth, Oxford, Welland, and Lincoln have been included in this season's records.

The method of crop-handling and climatic conditions are apparently very favourable for the corn borer in a large proportion of the infested territory. In 1920, the first year of discovery, accurate infestation records were taken from only a small area, due to the late date investigational work was started. One field near Port Stanley showed 99 per cent. of stalks infested. Ten miles west the heaviest infestation to be found was one per cent., and beyond that the degree diminished rapidly. The north and northeastern spread were somewhat greater than the above, and New Sarum, about ten miles from Union, showed approximately five per cent. stalk infestation. A marked increase occurred in all sections in the central area in 1921 and as noted above, the infested territory extended to sixty-five additional townships.

In 1922, 100 per cent. stalk infestation was very common near the control area, and in the records taken on the inner concentric circle, within a radius of six to eight miles from Union, the per cent. stalk infestation varied from 10.6 per cent. on the northeast and 90.3 per cent. on the west to 100 per cent. on the east. The second circle radiating about fifteen miles from Union, showed degrees of infestation varying from 7 per cent. to 77 per cent., the highest occurring on the west, in Dunwich township. The third circle, covering localities within a radius of thirty miles of Union, showed infestations ranging from zero to 6 per cent., the highest being on the west, in Aldborouth township.

As stated previously, our 1923 records were obtained in a different manner from those of 1922. It is possible that individual fields between the record points would show a greater degree of infestation than any of those studied. Nevertheless the survey will represent as near as possible the average intensity of infestation. This season's circle records cannot be compared accurately with last year's, but they will serve as a basis for standard records in future seasons.

In obtaining the 1923 records, the five nearest fields to a definite "cross-road" point were examined. One hundred stalks were examined from three different parts of the field, in the case of the records from the three circles. One thousand stalks were examined from various parts of the fields concerned at the several points in the other counties. The following is a summary of the conditions noted:

Area	Highest Per Cent. Infestation	Lowest Per Cent. Infestation	Average Per Cent. Infestation	Total Fields Examined
Circle No. 1 (6-8 miles from Union)	68.0	4.33	30.16	55
Circle No. 2 (15 miles from Union)	47.0	0.	16.97	80
Circle No. 3 (30 miles from Union)	7.66	0.	1.93	135
Essex County (80-110 miles from Union)	13.66	0.	1.31	48
Huron County (50-70 miles from Union)	1.4	0.	0.30	12
Lincoln County (95-115 miles from Union)	0.6	0.	0.20	15
Norfolk, east (45 miles from Union)	1.2	0.	0.32	5
Oxford (40-45 miles from Union)	2.8	0.	0.93	15
Perth (50-60 miles from Union)	1.3	0.1	0.57	10
Welland (95-115 miles from Union)	4.4	0.	1.06	45

NOTE.—Mileage stated represents distance from centre of infestation. Welland county first found infested in 1920 and apparently a separate infestation.

In comparing this season's records of circle No. 3 with those of last year, a very marked increase is evident, especially in a north and northeast direction and in the districts near the lake on both of the eastern and western edges. The increase, in the outside circle, is also demonstrated by the fact that the average infestation in the 135 fields in the outside circle is now 1.93 per cent., whereas two and three years ago, our inspectors had to search the majority of the field in most cases to find an infested stalk.

This season, 1923, a careful consecutive field examination, chiefly in the counties of Elgin and Middlesex, has been carried on under the direction of Professor Caesar, Provincial Entomologist of Ontario. Records were taken from every field along the main road running south to north between Union and Lucan, a distance of thirty-five miles, and also west to east between St. Thomas and Delhi, a distance of thirty-six miles. The following is a summary of the results:

District	Distance Miles	Average Per Cent. Infestation	No. Fields Inspected
North and South—			
Union—St. Thomas	5	25.9	30
St. Thomas—north	5	26.2	26
St. Thomas—north 5-10 miles	5	18.3	22
St. Thomas—north 10-15 (London)	5	21.5	16
Vicinity of London	..	20.8	16
London—north	5	6.1	20
London—north 5-10 miles	5	1.6	9
London—north 10-16 miles	6–7	1.6	8
East and West—			
St. Thomas—New Sarum	5	25.9	18
New Sarum—Aylmer	6	26.5	31
Aylmer—east	8	19.1	36
East to Tillsonburg	8	12.8	6
Tillsonburg—east	5	2.1	10
East to Delhi	5	1.6	12

As Essex county is the greatest corn-growing county of the province, with a corn acreage of 80,000 acres, the conditions there will naturally be of interest. Mersea township was found infested in 1921 and infested stalks were difficult to locate. The remainder of the county was scouted but nothing was found. In 1922, collections were made in each remaining township. Many fields of corn were examined in the central and northern townships before larvæ were discovered, but in the southern townships collections were more easily made, although the infestation was extremely light. Our records in Essex county this season show a decided increase. Standard records were taken from five fields at eight points in the shore townships, and also at Pelee Island, the results of which are as follows:

Township	Locality	Highest Per Cent. Infestation	Lowest Per Cent. Infestation	Average Per Cent. Infestation
Mersea	Hillman	5.5	2.2	3.48
Gosfield—south	Ruthven	1.2	0.3	0.86
Gosfield "	Arner	0.4	0.0	0.14
Colchester—south	Oxley	0.8	0.0	0.34
Colchester "	Harrow	0.4	0.2	0.28
Colchester "	Marshfield	0.9	0.0	0.42
Malden	Comet	0.9	0.0	0.42
Malden	Malden Center	0.6	0.0	0.3
Pelee Island	Misc. (8 fields)	13.66	0.33	5.89

Pelee Island was found infested in 1921. The degree of infestation was very low at that time. In 1922, the Pelee Island conditions were not studied, but the survey of 1923 showed a remarkable increase and the infestation was much more intense than that of the neighbouring mainland.

The infestation in Welland county, first found in 1920, is increasing, but much more slowly than in the western territory. The results of the records in the other counties listed also indicate an increase, although an exact degree of comparison is impossible, owing to the lack of necessary information.

In reference to the 1923 increase, in territory near the centre of the outbreak, it has been most important to the north and east. The relation of the corn borer to the corn-canning industry in general has always been regarded with anxiety. This recent development is unfortunate in that it has affected canning-corn crops in the Aylmer region very seriously. The infestation in all other canning districts is as yet comparatively light.

In 1920, the degree of infestation in the districts from which the Aylmer canning factory received its corn supply would average five to ten per cent. stalk infestation. In 1921, various canning-corn fields ran from 21 per cent. to 74 per cent. ear infestation. In 1922 the factory refused material with ten per cent. ear infestation, with the result that corn was refused from one or two fields and two loads from other fields were turned back. This year the situation became serious. Corn delivered to the factory by twenty-two growers on September 4th was examined. Notwithstanding the fact that practically all growers had already culled from five to thirty per cent. in the field, the corn presented to the factory varied in ear infestation from six to fifty-six per cent., and from two to forty-three per cent. of the cobs showed actual feeding. As a result of this condition, a special control campaign has been started in the district under the personal direction of Prof. L. Caesar, Provincial Entomologist.

The European corn borer has already established its importance as a serious corn-crop pest in approximately one thousand square miles of territory in Ontario. In Massachusetts, it is causing serious financial losses, through infestation in other crops in addition to corn, and the development of similar conditions in portions of the Ontario infested area is regarded as possible.

Greater efforts were made this season in the enforcement of the quarantine which gave further assurance of the importance of infested table-corn transportation as a means of spread. One phase of the quarantine work consisted of automobile inspection. During the week-ends a total of 1,434 automobiles were held up at different points on the quarantine border from which ninety dozen ears were seized. Seventeen ears were found infested.

In 1921, the township of Pickering in Ontario county was found infested, and in 1922 a collection of the borer was taken in Brighton township, Northumberland county. These outbreaks were situated some distance from the nearest infestation discovered in the years mentioned and were very probably due to the movement of infested material. The difficulty of teaching control methods and the financial outlay involved is naturally associated with the size of the infested territory and the extent of crop losses is likewise similarly affected. A large corn-growing acreage in Ontario is still uninfested and southwestern Quebec grows corn abundantly. It is therefore necessary to expend every effort possible to prevent the artificial spread of the pest to new districts, by means of strict quarantine enforcement.

THE STATUS OF THE CONTROL PRACTICE FOR THE EUROPEAN CORN BORER IN ONTARIO

(*A Progress Report*)

H. G. Crawford, Entomologist, Division of Field Crop and Garden Insects, Entomological Branch, Department of Agriculture, Ottawa

The preliminary scouting and investigations of the European corn borer in Canada indicated that the focus of the most intense infestation in 1920 lay in the region surrounding the village of Union, midway between St. Thomas and the Lake Erie shore, in the county of Elgin, Ontario. The indications in 1920 were amply confirmed in 1921 by a devastating increase of the injury caused by the pest in this vicinity. Hence the area in which control measures could be tried with greatest benefit and with most clear-cut results was selected in this region. Here a block of farms two miles square, referred to as the control area with the village of Union in the centre, was decided upon as the area of most pressing need. The area involved was very representative and presented a great variety of conditions in the immediate vicinity both physiographic and agricultural, the corn varying from that in household kitchen gardens and a considerable acreage of early market sweet corn to general farm croppings.

Within this area ever since the fall of 1921 every reasonable effort has been made to ensure that the general control measures were put into practice by the growers. Considering the short time during which the operations have been carried on, the lack of care on the part of farmers here and there, the character of the methods themselves, the small size of the area, and the motility of the moths, the results have been most encouraging. The co-operation of the farmers has been wholehearted and with the exception of some assistance in the spring of 1921 in the cleaning up of the barnyards, the work has all been done by the growers.

The suggestions made for the control were those indicated as likely to be of the greatest value by the investigations carried out by the Departments of Agriculture of the Dominion of Canada and the Province of Ontario, and reported upon to this society in 1921 by Mr. G. J. Spencer. Briefly, they may be referred to as the farm clean-up and the practice of late planting. The clean-up implied that all refuse from one year's crop is either underground or burned by the first of June of the following year, while the planting was advised to be as late as was safe in the community with the assurance of getting a good crop. The early fall frosts were the chief limiting factors in determining lateness of planting.

In general in the area between St. Thomas and the Lake Erie shore, the attack in 1920 was the most intense suffered until that time and was a decided increase over any previous attack. Farmers had become worried and the first volunteer information was received late in the season from near St. Thomas. By this time, however, farmers in the Union area were growing corn with 99 per cent.* infestation without official complaint, and the sweet corn in the district was most severely infested.

The next year the investigations opened with vigour and the area was brought under constant and careful study. Hence our information from this time on is much more detailed.

In 1921, the attack increased very markedly in intensity, the average infestation for six farms studied in 1920 rose from 77.2 per cent. to 85 per cent, and the stalk infestation for the field corn in the whole control area (four square miles—45 fields) was 58.17 per cent. Many fields of flint corn were 100 per cent. infested and ruined. Dent corn attained an infestation of 78 per cent., and from over twenty acres of early market sweet corn the product was a total loss, as it was not worth while culling the crop for the few saleable ears.

In 1922 (37 fields), conditions within the control area following the first control efforts in the fall of 1921 and spring of 1922 presented an entirely different aspect. The average infestation dropped to 26.25 per cent., and the cob injury and other manifestations of the attack decreased markedly. Comparing the attack with that of 1921 there was a most remarkable decrease in intensity and loss. The infestation of the market sweet corn was still high where planted early, though where planted late was commercially profitable. However, as there was almost no sweet corn grown on account of the destruction of 1921, it hardly serves for valid comparison.

Throughout the general district surrounding the control area there was a marked increase in the infestation. This was most noticeable to the west in the Fingal region, and to the east in the Dexter region. To the north the increase was not as abrupt though it was quite distinct; southward the infestation decreased as a large proportion of the few growers in this region were putting the control methods into operation. In general, although careful systematic studies were not made in the fields surrounding the control area, it was conspicuous that the infestation definitely increased upon the northern, western and eastern sides of the area. Fields much more intensely infested than any within the control area were easily found even within a few hundred yards of its margin.

*The percentage infestation of stalks refers to ear-bearing stalks unless otherwise noted.

In 1923, conditions within the control area (34 fields), with an average stalk infestation of 36.48 per cent., indicated an increase in intensity of about 10 per cent. in the stalks and a somewhat higher increase in percentage of injury to plant structures such as cobs and shanks over the 1922 conditions. This increase was generally distributed throughout the whole control area. Even this increase was still 22 per cent. less than the 1921 average. None of the sweet corn of 1923 was ruined, the highest losses in the most severely infested fields not exceeding 50 per cent.

As was the case in 1922, the infestation in the control area was distinctly less intense than that in the surrounding areas. The most severely infested fields in the district were all outside the control zone. This is in marked contrast with the former distribution of intensity, when the focus for most intense infestation and loss was within this area, as in 1920 and 1921.

No definite figure has been developed to indicate exactly the actual loss in any year. However, an idea of the relative annual losses and severity of attack can be secured if we assume as an estimate that the loss as a farm crop in the control area was about 15 per cent. in 1921, that in 1922 would be about 2 per cent., and that in 1923 not over 4 per cent.

The general trend of infestation in the surrounding district has been in marked contrast to the situation within the control area. To the west for six or seven miles the infestation increased very abruptly during the years 1921 and 1922 when very severe losses were suffered. The intensity, however, in 1923 in this region decreased quite markedly from this high point. Just why is not known. To the north the infestation has increased steadily, but not nearly as abruptly as in other directions, throughout the period from 1920 to 1923. To the northeast and east the trend of the infestation has been steadily upward, both in percentage infestation and in total population of larvæ. At the present time, November, 1923, the focus of highest infestation and loss has shifted to the north and east and comprises a more or less oval area beginning at the northeast corner of the control area and extending for about 20 miles in a general northeasterly direction. The increase in infestation in this area was most conspicuous in 1923, both in flint corn and in canning sweet corn.

Very little mention has been made of the narrow strip of country to the south of the control area. It consists of a zone one mile wide, which does not comprise many corn growers, lying between the control area and the lake shore. These growers in the cases where they have instituted the practice of late planting have been experiencing a clear decrease of infestation, though in other cases they have suffered very severe losses. In general the trend is downward, both on account of the control practice and also doubtless on account of the protection afforded by the destruction of larvæ in the control area to the north.

The control suggestions made to the farmers in the observation area by the personal canvass were reinforced by the increasing losses being suffered and resulted in a noteworthy change in certain phases of handling the corn crop in the area. In 1922, the last year of normal planting, 55.5 per cent. of the corn crop was of the flint type, the most susceptible type to European corn borer infestation and damage. Of this part of the local crop 45 per cent. was planted by the 24th of May, 78 per cent. by the 1st of June and 85 per cent. by July 6th. Of the dent corn of this year 10 per cent. only was planted by May 24th, 85 per cent. by June 1st and 90 per cent. by June 6th.

In 1922, after the first late planting suggestion, the planting dates were materially changed. The following tabulation summarizes the general situation:

Tabulation Showing the Proportion of Each Type of Field Corn Grown and the Seasonable Distribution of the Planting Dates in the Control Area For the Years 1921-1923

Year	Type of Corn	Per Cent. of Crop by Type	Per Cent. of Crop planted by May 24	Per Cent. of Crop planted by June 1	Per Cent. of Crop planted by June 6	Per Cent. of Crop planted after June 6
1921..............	Flint	55.5	45	78	85	15
	Dent	44.5	10	85	90	10
1922..............	Flint	24.5	10	26	60	40
	Dent	75.5	0	28	60	40
1923..............	Flint	38.5	0	20	55	45
	Dent	61.8	0	46	53	47

From the above table the abrupt drop in the percentage of flint corn grown is clear, particularly in 1922. This change in variety of corn used was accompanied by a retardation in the date of planting, the most important change being in the amount of corn planted before the 1st of June. As can be noted, in 1923, though the proportion of flint corn increased, the average planting dates for the whole crop were, if anything, even a little later than in 1922. The increased planting of flint corn was due to the increased confidence of the farmers which followed the excellent results of the control operations in 1922.

In very large measure the freedom of the corn in 1922 from severe loss could be ascribed to the late planting, while that of 1923 was due in largest measure to the reduction in numbers of moths and the dilution of the attack associated with the late season.

As has been noted above, the control was not as effective in 1923 as in 1922 in spite of the still further retardation of the planting dates due in this case, both to design and weather conditions. This increase in infestation was due chiefly to the very late spring. The cool weather held the development of the insect back even more than it retarded the development of the corn, with the general result that much of the corn was in condition to serve as good egg-laying quarters from the time that the moths began to fly. Egg-laying in 1923 did not begin till July 4th, which was at least 13 days later than in 1921 or 1922, and continued in appreciable quantities till August 2nd; even after that date scattered eggs were being laid. This resulted in distributing the attack and reduced the extreme infestations. There were but two fields in the control area which suffered measurable damage, and at the end of the season the control area as a whole contrasted most favourably with the surrounding country.

Sharp contrasts in the demonstration of the value of control efforts were difficult to obtain owing to the fact that a great deal of publicity for control practice has been carried on. Growers throughout the whole of the originally severely infested area have, to a greater extent than they realize, put the suggestion into practice. This is particularly true of the practice of late planting. The general quality of the ploughing has also improved greatly, and the habit of cleaning out the barnyards and the burning of miscellaneous corn refuse is increasingly prevalent.

Keeping in mind that throughout the period the infestation in the immediately surrounding territory has been in general steadily increasing, there is little doubt that the control measures have had a very definite effect and have caused a material reduction of losses in the area under study. This was in spite of the fact that the area was relatively very small and was surrounded by country with heavy infestation in which little or nothing of a systematic nature was done to reduce the number of larvæ.

The results attained to date leave no doubt that in any year the widespread practice of the published control would reduce the European corn borer population to a point where field corn would be grown with practically no loss. And were these measures practised for three or four years the planting date of May 24th or earlier could again serve as the standard and early sweet corn in the most severely infested areas could probably be grown once more as a reasonably profitable enterprise. Sweet corn for the early market, on the other hand, will suffer severe losses for years after field corn can be grown free from appreciable loss.

STUDIES IN THE LIFE-HISTORY, BIONOMICS, AND CONTROL OF THE CABBAGE WORM IN ONTARIO

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The cabbage white or imported cabbage butterfly, *Pieris rapæ* L., was first taken in Canada in 1860 in the vicinity of Quebec by Mr. William Couper. Its subsequent spread south and west throughout the North American continent was surprisingly rapid, its first appearance being recorded in the United States in 1865, at Norway in the State of Maine.[1]

Before the advent of arsenicals as a popular method of controlling leaf-eating insects, the cabbage worm caused considerable losses. Even now, when spraying and dusting of cruciferous crops is so general, and despite the usual high mortality among the larvæ due to natural factors, the damage is by no means inconsiderable.

During seasons when the cabbage butterflies are very numerous the late varieties of cabbage and cauliflower may suffer considerably, large irregular holes being eaten out of the leaves, which in addition become scattered with masses of dark green excrement. The larvæ also have a tendency to concentrate on the tender leaves forming the "head," often making the latter quite unfit for market.

Chittenden[2] estimated in 1916 that at least one-tenth of the entire cabbage crop of the United States was annually destroyed by the cabbage worm, and this statement would probably apply equally well to Canada.

Seasonal History

In Ontario the butterflies may be seen on the wing from the latter part of May until the end of September. In 1923 none were seen until May 24th, when they suddenly became common. During July, August and early September they were extremely abundant in the vicinity of Ottawa, on one or two occasions several hundreds being counted at one time over a single acre of cabbages.

At Ottawa there are three well-defined generations. The butterflies of the first generation reach the height of their emergence before the middle of June; those of the second appearing first in early July, increase rapidly in numbers so that by the middle of the month they are common everywhere; the early butterflies of the third generation mingle with the last of the second during the middle of August, and continue to emerge until the end of September. It is almost certain that no butterflies emerge from third generation pupæ until the following spring.

Host Plants

The host plants of the cabbage worm are not numerous, but represent four plant families. The most favoured belong to the Cruciferæ family, including such crops as cabbage, cauliflower, radish and horse-radish. Cruciferous weeds are sought after, especially in the spring, and the flowering plant *Alyssum maritimum*, which is much used for garden borders, is also an occasional host. The garden plants *Cleome pungens* and mignonette, of the families *Capparidaceæ* and *Resedaceæ* respectively, and the canary vine and nasturtium of the family, *Tropæolaceæ*, are also attacked, but not to any serious extent. Larvæ were successfully reared on all these plants during this summer (1923) at Ottawa.

Frequent mention has been made in literature of lettuce as a food plant of the cabbage worm, but numerous attempts to induce the larvæ to feed on it at Ottawa in 1923 failed, and no lettuce showing signs of injury could be found, although many of the plants were exposed to large numbers of butterflies throughout the season.

The Life of the Individual

The male butterflies are found most commonly in the vicinity of flowers, and the females in the neighbourhood of their favourite host plants. They are conspicuous insects on account of the general colour of their wings, which is white, finely powdered with yellow. The spring generation butterflies are lighter in colour than those of the summer generation.

The tips of the forewings are marked with black, the forewings of the female in addition possessing two distinct black dots which readily distinguish it from the male, which has only one. The wing expanse measures about one and three-quarters of an inch, the female usually being slightly larger than the male.

Both sexes feed upon the nectar of flowers without which they cannot live. The flowers of dandelion, *Viola arvensis*, radish, red clover, vetch and garden stocks are the most favoured, but frequent visits are also made to pennycress, field mustard, white sweet clover, burdock and Canada thistle, and to the flowers of garden plants such as *Erysimum*, *Scabious*, *Centranthus macrosiphon*, *Clarkia*, *Hydrangea paniculata* and cultivated sneezeweed.

The flight of the butterflies is slow, irregular and usually low, but when disturbed they can travel rapidly, and often rise thirty to forty feet from the ground.

Mating and egg laying occur within twenty-four hours after emergence. While mating the male flits awkwardly from plant to plant, the female remaining passive with wings folded. In depositing her eggs the female hovers on the leaf for a moment, the tip of the abdomen being pressed firmly against the surface of the leaf and withdrawn, leaving the egg adhering. The eggs are deposited singly on any part of the plant above ground, but usually on the lower surface of the leaves close to the leaf veins. Each female is capable of laying a considerable number of eggs, as many as 499 having been deposited on cabbage by a single female under observation.

The egg is pale greenish yellow to orange yellow in colour, elongate and somewhat bullet-shaped, tapering to a flattened point. It measures approximately 1 mm. from the base to the apex and a little less than 0.5 mm. at its greatest diameter. The surface is raised into ten longitudinal ridges accentuated by numerous small transverse markings.

The process of hatching occupies about twenty minutes. The larva tears a hole in the shell of the egg, about one-third of the distance from the apex, large enough to admit the passage of its body. On hatching it is pale-yellowish orange in colour and measures 1.5 mm. in length. Shortly after hatching the larva usually completely devours the egg-shell, often eating out a shallow circular depression in the leaf tissues where the egg had rested. Within forty-eight hours after hatching it commences to feed on the leaf tissues, the intestinal tract showing green through the integument due to the ingestion of chloroplasts.

Feeding takes place fairly slowly up to the third moult, after which the larvæ eats voraciously until just before pupating. For some hours previous to moulting the larvæ cease to feed and spin a fine platform of silk on which to rest. The actual process of moulting occupies about three or four minutes. The head of the larva is forced through the old skin immediately behind the head-capsule so that the latter remains attached to the anterior ventral surface of the head. The moulted skin is meanwhile forced back from the body by an undulating forward movement. The larva then frees itself from the discarded head-capsule by pressing it against the leaf surface while vigorously jerking its head from side to side. The discarded skin remains grey and shrivelled, firmly attached to the leaf. As it invariably disappears a few hours after moulting takes place it seems probable that the larva devours it.

When nearing maturity the larvæ often measure over 30 mm. (1¼ inches) in length and 4 mm. in width. They are dark green in colour, often showing a tinge of blue; a narrow yellowish stripe extends mid-dorsally along the back, and the spiracles are edged with yellow. Before pupation they cease to feed and migrate in search of a favourable place to transform, rarely remaining on the plants. Pupation takes place in sheltered nooks on fences, or under the loose bark of trees, the larvæ almost always exhibiting a tendency to ascend. The larva spins a pad of silk to which it attaches its caudal end and a thread of silk is also passed over the body about one-third of the distance from the head and securely fastened at each side. The larva gradually becomes shorter and thicker. Shortly after moulting the characteristic thoracic and abdominal projections develop and pupation is complete.

The chrysalids measure 18 mm. in length and 4 mm. in width. They vary considerably in colour, apparently depending somewhat on the colour of the object to which they are attached and to the amount of light to which they are subsequently exposed. Overwintering chrysalids found on exposed surfaces were pale yellowish gray, whereas those taken from dark situations were dark brown. Summer generation chrysalids on the leaves of cabbage are usually a bright green in colour, the thoracic and abdominal projections being yellow tinged with mauve. Rarely they were found coloured pale mauve tinged with yellowish green. Twenty-four hours before the imago emerges the wing pads become bright yellow and the black wing markings of the adult can be clearly seen.

The butterfly emerges by splitting the chrysalid dorsally between the lateral chitinous projections and along the mid-dorsal line forward to the head. In two to three hours it is capable of active flight.

Average Duration of Life Stages, 1923

Stage	1st Generation	2nd Generation	3rd Generation
Egg Stage	5.1 days	4.8 days	6.1 days
Larval Stage	18.0 days	16.0 days	26.5 days
Chrysalid Stage	11.1 days	9.0 days	Overwintering
Life to Adult life cycle	34.2 days	29.8 days	Overwintering
Number of 2nd Individuals Reared	23	9	13

The maximum life of the butterflies in outside rearing cages was found to be 12 days, but the majority of them lived only seven days.

Artificial Control

Control experiments, involving the treatment in three series of 5,000 early and late cabbages, with Pyrethrum powder and lead and calcium arsenate dusts and sprays, lead to the conviction that under local conditions dusting with lead arsenate and hydrated or air-slaked lime in the proportion of one part to fifteen parts is the most satisfactory form of treatment. The dusts were found more satisfactory than the sprays in that they can be mixed and applied with the aid or ordinary hand dusters, in one-fourth the time occupied in spraying. They spread and adhere well if applied when the leaves are wet with dew, whereas sprays to which soap has been added as a sticker have a low surface tension and much of the liquid is lost in the soil.

In these experiments calcium arsenate dusts gave less satisfactory results than the arsenate of lead dust, the latter giving perfect control. Calcium arsenate applied in the liquid form gave extremely poor results as well as causing some burning to the foliage. Pyrethrum powder used with four times its weight of hydrated lime proved satisfactory, but can hardly be used on a commercial scale as it costs ten times as much as the arsenate of lead dust.

Judging by this season's observations early market cabbages escape serious injury and whether treatment is ordinarily necessary or not must be left to the grower's discretion. For late cabbages and cauliflowers two applications should be sufficient in a normal season, the first about the middle of July and the second four or five weeks later. When the butterflies are very abundant a third application may be necessary early in September.

Natural Control

Despite the fecundity of the cabbage butterfly and the favourable conditions for its development presented by satisfactory climatic conditions and an abundant food supply, its numbers fluctuate greatly from season to season. This is largely due to important natural control factors which yearly account for large numbers of the pest.

Probably one of the most important of these is a larval disease known as "flacherie," which is usually present to some extent every year, occasionally occurring in epidemic form. Larvæ affected with this disease turn muddy-gray in colour or become mottled with black, green, yellow and grey and remain attached to the plant, soft and limp, or hang suspended by the prolegs, a grayish or blackish fluid exuding from the mouth and anus. The body contents become liquid, and dead larvæ soon blacken and collapse; their juices spread over the leaves and together with their excrements serve to disseminate the disease among healthy larvæ which ingest the virus when feeding.

In 1886 Forbes[3] experimented with this disease in Illinois. He spoke of it "as a frightfully contagious and destructive disease of the European cabbage worm," and came to the conclusion that the causal organism was a micrococcus. Glaser and Chapman,[4] working more recently with a very similar disease affecting larvæ of the gypsy moth, found numerous micrococci, but concluded that the disease was due to a filtrable virus. During the past season (1923) this disease killed large numbers of larvæ used in life-history and host selection experiments, but was rarely met with in the field until late in the season, when dead larvæ became common.

In addition to disease the cabbage worm is subject to the attacks of two important hymenopterous parasites, *Apanteles glomeratus* L. of the family *Vipionidæ*, and *Pteromalus puparum* L., a small Chalcid fly. Of these the latter is probably the more useful.

Pteromalus puparum overwinters in the larval condition within its host, the adults emerging early in June, as many as 43 having been counted from a single cabbage butterfly pupa. Some of the flies reared in the insectary and fed on a weak molasses solution lived well over a month.

The host is parasitized while in the larval stage, but pupates before dying, the flies during the summer months emerging two to three weeks later through a small hole punctured in the wall of the chrysalid. Large number of cabbage worms are undoubtedly destroyed by this insect, but this fact is not readily apparent in the field because parasitized larvæ on nearing pupation migrate to locations where they are not easily found.

Apanteles glomeratus also attacks the larva of the cabbage butterfly, such larvæ being left shrivelled and dying before reaching maturity. The parasites spin up in small lemon-yellow elongate-oval cocoons held together in an irregular pile by a fine meshwork of silk close to the dying host. This year parasitized larvæ were found from July to October, but only in small numbers.

Another larval parasite is the Ichneumon fly, *Itoplectis conquisitor** Say., a specimen of which was observed on September 1st from a cabbage butterfly chrysalid at Ottawa.

Certain species of common wasps attack the larvæ, *Polistes pallipes** LeP. and *Vespula germanica** Fab. having been observed in early August devouring almost full grown specimens on cabbage foliage.

Spiders also take toll of the butterflies, many being devoured in our experimental cages during the season.

References

1. Scudder, Mem. Boston Soc. Nat. Hist. IV, 3, 1887.
2. Chittenden, U. S. F. B., 766, 1916.
3. Forbes, Bull. Ill., State Lab. Nat. Hist., 1886, Vol. II, pp. 260-276.
4. Glasser & Chapman, Jr. Econ. Ent. VI, 479, 1913.

*Species kindly determined by Mr. H. L. Viereck.

THE ENTOMOLOGICAL RECORD, 1923

Messrs. Criddle, Curran, Viereck and Buckell, Entomological Branch, Dominion Department of Agriculture

In perusing the older copies of the "Entomological Record" it will be noted that Lepidoptera occupy by far the largest space. Within a few years, however, Coleoptera assumed an equally prominent position and from that time on these two orders have remained as dominant features of the "Record."

In 1922, for the first time, Diptera exceeded all other orders in importance, and now we have Hymenoptera assuming its just place in our pages. We mention these facts because they should be gratifying to Canadian entomologists as showing that we have at last secured specialists who are able to work up nearly all our insect orders, thus giving an impetus to entomological studies so long retarded due to the impossibility of identifying our specimens.

For the information of those not fully informed of the practice originally laid down, we may state that the "Record" does not include species already listed elsewhere. On the other hand an effort is made to include all Canadian species that have been described during the year and to give a reference to the publication in which the description appeared. Any records of captures that extend the known range of a species to a marked degree are desirable but local records of insects already listed from adjacent parts are not considered of sufficient general interest to record in this publication.

Some collectors are still apparently reluctant to send in their records, but on the whole the material sent in has been very gratifying and it has added considerably to a knowledge of insect distribution.

We have again to express our indebtedness to various specialists in different parts of the world for their assistance in determining specimens. Our Coleopterists in particular owe much to Dr. Fall in this respect.

NOTES OF CAPTURES

Species preceded by an asterisk (*) described since the last Record was prepared.

Lepidoptera

(Arranged according to Barnes and McDunnough's Check List of the Lepidoptera).

Lycænidæ

* *Plebeius sæpiolus insulans* Blackm. Victoria and Gold Stream, B.C., (E. H. Blackmore).
* *Plebeius icariodes montis* Blackm. Mt. McLean, Mt. Cheam and Hope Mountains, B.C., (A. W. Hanham and R. V. Harvey).
Can. Ent., Vol. LV, No. 4, 1923.

Sphingidæ

* *Sphinx mordecai* McD. Penticton, Wellington, Vancouver and Vernon, B.C., (Anderson, Taylor, Livingstone and Venables).
Can. Ent., Vol. LV, No. 6, 1923.
749 *Amphion nessus* Cram. Victoria Beach, Man., May, (Miss B. Brooks).

Arctiidæ

942 *Hyphoraia parthenos* Harr. Transcona, Man., June, (Eric Brooks).

Noctuidæ

* *Euxoa lindseyi* Blackm. Victoria and Goldstream, B.C., (Blackmore); Calgary, Alta. Can. Ent., Vol. LV, No. 9, 1923.
* *Euxoa dodi* McD. Lethbridge, Alta., (Seamans and Strickland); Calgary, Alta., (Wolley-Dod).
* *Euxoa clausa* McD. Lethbridge, Alta., July, (Strickland and Seamans).
* *Oncocnemis parvinigra* Blackm. Kaslo, B.C., (Cockle); Mt. McLean, B.C., August, (Hanham).
* *Litholomia napæa umbrifasciata* Blackm. Victoria, B.C., (Blackmore); Fraser Mills, B.C., (Marmont).
The above four insects described in Can. Ent., Vol. LV, Nos. 7 and 9.
3236. *Autographa rectangula* Kby. Victoria Beach, Man., July, (G. S. Brooks).

Geometridæ

* *Dysstroma mackieata* C. & S. Bilby, Alta., June, (D. Mackie).
* *Eupithecia bowmani* C. & S. Nordegg, Alta., July, (K. Bowman).
* *Eupithecia inclarata* C. & S. Alberta, (Swett).
* *Eupithecia divinula* C. & S. Alberta, July, (Swett).
* *Nepytia canosaria* form *fuscaria* B. & B. Meach Lake, Que., September.
* *Enypia venata* ab. *elaborata* C. & S. Wellington, B.C., July, (Taylor).
The above six insects described in the Lepidopterist, Vol. IV, Nos. 2, 3 and 4.

Pyralidæ

* *Crambus edmontellus* McD. Edmonton, Alta., July, (Bowman); N.W.T., 1907, (Fletcher); Calgary, Alta., (Bowman).

Pterophoridæ

* *Pterophorus evansi* McD. Trenton, Ont., (J. D. Evans); Aweme, Man., (Criddle).
* *Stenoptilia bowmani* McD. Nordegg, Alta., June, (McDunnough).
* *Oidæmatophorus lindseyi* McD. Aweme, Man., August, (Criddle).
The above species described in Can. Ent., Vol. LV, No. 4, 1923.

Olethreutidae

* *Exartema nigranum* Hein. Hamilton, Ont.
* *Exartema quebecensis* Hein. Quebec, (A. W. Hanham).
These two species described in Proc. Ent. Soc., Wash., Vol. XXV, Nov. 25, 1923.
* *Argyroploce dextrana* McD. Ottawa, Ont., July, (Young); Calgary, Alta., (Wolley-Dod); Edmonton, Alta., (Bowman).
* *Argyroploce bowmanana* McD. Nordegg, Alta., July, (Bowman).
Can. Ent., Vol. LV, No. 7, 1923.
* *Pammene felicitana* Hein. Montreal, Que., and St. Hilaire, Que., (A. F. Winn).
Proc. Ent. Soc., Wash., Vol. XXV, No. 5, 1923.
* *Eucosma metariana* Hein. Victoria, B.C., July, (Blackmore).
* *Eucosma palabundana* Hein. Aweme, Man., July, (Criddle); Regina, Sask., (Willing).
* *Thiodia influana* Hein. Avenue, Man., July, (Criddle); Regina, Sask., (Willing).
* *Thiodia sororiana* Hein. Aweme, Man., September, (Criddle).
* *Thiodia misturana* Hein. Oxbow, Sask., (F. Knab); Aweme, Man., (Criddle).
* *Thiodia fertoriana* Hein. Goldstream, B.C.
* *Thiodia modicellana* Hein. Aweme, Man., July, (Criddle).

* *Thiodia festivana* Hein. Aweme, Man., June, (Criddle).
* *Gypsonoma substitutionis* Hein. Aweme, Man., July, (Criddle).
* *Epinotia digitana* Hein. Kaslo, B.C. (H. G. Dyar).
* *Epinotia bicardana* Hein. Aweme, Man., March, (Criddle).
* *Epinotia meritana* Hein. Victoria, B.C., July, (W. R. Carter).
* *Epinotia vagana* Hein. Victoria, B.C., (Blackmore); Duncan, B.C., (Hanham).
* *Epiblema periculosana* Hein. Mt. McLean, B.C., August, (Hanham).
* *Ancylis carbonana* Hein. White River, Ont.
These species described in Rev. N. A. Moths of the Subfamily Eucosminæ of the Family Olethreutidae. Bull. 123, U.S. Nat. Mus.
* *Homona negundana* McD. Aweme, Man., and Winnipeg, Man., (Criddle).
* *Cacœcia eleagnana* McD. Aweme, Man., July, (Criddle).
* *Cacœcia myricana* McD. Algonquin Park, Ont., July, (McDunnough).
* *Cacœcia columbiana* McD. Salmon Arm, B.C., July, (W. R. Buckell).
* *Tortrix alberta* McD. Nordegg, Alta., August, (McDunnough).
* *Tortrix trentonana* McD. Trenton, Ont., (Evans).
* *Tortrix flavidana* McD. Aweme, Man., July, (Criddle).
These six species described in Can. Ent., Vol. LV, No. 7, 1923.

Coleoptera

(Arranged according to Leng's Catalogue of Coleoptera, 1920)

Carabidæ
169b *Carabus tædatus candicus* Roes. Medicine Hat, Alta., March, (Carr).
222 *Elaphrus clairvillei* Kby. Medicine Hat, Alta., (Carr).
284 *Nebria obtusa* Lec. Medicine Hat, Alta., Sept., (Carr).
416 *Bembidion carinula* Chd. Cobalt Lake, Labr., (Waugh).
431 *Bembidion bifossolatum* Lec. Medicine Hat, Alta., April, (Carr).
460 *Bembidion funereum* Lec. Peachland, B.C., August, (Wallis).
581 *Bembidion consanguineum* Hayw. Peachland, B.C., July, (Wallis).
732 *Bembidion æneicolle* Lec. North of Kisbey, Sask., July, (Criddle).
741 *Bembidion dubitans* Lec. Peachland, B.C., July, (Wallis).
902b *Patrobus septentrionis lecontei* Chd. Pelican Lake, Man., July, (Criddle).
1522 *Platynus viridis* Lec. Victoria Beach and Winnipeg, Man., (Wallis and Roberts).
1543 *Platynus propinquus* G. & H. Darlingford, Man., August, (Criddle).
1650 *Lebia divisa* Lec. Cassils, Alta., (W. Carter); Medicine Hat, April, (Carr).
1821 *Chlænius tricolor* Dej. Medicine Hat, Alta., May, (Carr).
1860 *Brachyloleus lethophilus* Say. Medicine Hat, Alta., (Carr).
2218 *Stenolophus ochropezus* Say. Darlingford, Man., August, (Criddle).

Amphizoidæ
2280 *Amphizoa insolens* Lec. Spious Creek, B.C., May, (R. Hopping).

Omophronidæ
2287 *Omophron tessellatum* Say. Medicine Hat., Alta., (Carr).

Haliplidæ
2324 *Peltodytes tortulosus* Robts. East Ont., (Evans).

Dytiscidæ
Laccophilus inconspicuus Fall. Medicine Hat, Alta., (Carr).
Cœlambus lumidiventris Fall. Medicine Hat, Alta., (Carr); Vernon, B.C., (Hopping).
2405 *Cœlambus farctus* Lec. Winnipeg, Man., not quite typical, (Wallis).
Cœlambus compar Fall. Aweme North, July, new to Canada, (Wallis).
2410 *Cœlambus lutescens* Lec. Cawston, B.C., July, (Metcalfe).
Cœlambus canadensis Fall. Medicine Hat, Alta., March, (Carr).
2412 *Cœlambus patruelis* Lec. Medicine Hat, Alta., March, (Carr).
2414 *Cœlambus sellatus* Lec. Medicine Hat, Alta., April, (Carr).
2421 *Cœlambus unguicularis* Cr. Medicine Hat, Alta., September, (Carr).
* *Hydroporus pangus* Fall. Cochrane, Ont., (Notman); Bay of Islands, Newfoundland, (Sherman); Aweme, Man., (Wallis).
* *Hydroporus planiusculus* Fall. Aweme, Man., (Wallis); Peachland, B.C., (Wallis).
* *Hydroporus pacificus* Fall. Massett, Queen Charlotte Island, B.C., (Wickham); Metlaktla, B.C., (Keen).
* *Hydroporus sinuatipes* Fall. Fraser Valley, B.C., and Ben Accord, B.C., (Sherman).
* *Hydroporus columbianus* Fall. Golden, B.C., (Sherman); Kamloops, (Wickham); Aweme, Man., (Wallis).
* *Hydroporus similaris* Fall. Fraser Valley, B.C., (Sherman).
* *Hydroporus badiellus* Fall. Bay of Islands, Newfoundland, (Sherman); Mile 214 to 332 H.B. Railway, Man., (Wallis).
* *Hydroporus polaris* Fall. Bernard Harbour, N.W.T., (F. Johansen).
The above species described in "A Revision of N.A. species of *Hydroporus* and *Agaporus*," 1923.

2551 *Agabus punctulatus* Aube. Medicine Hat, Alta., (Carr).
2610 *Coptotomus interrogatus* Fab. Medicine Hat, Alta., September, (Carr).

Hydrophilidæ
2784 *Barosus striatus* Say. Medicine Hat, Alta., (Carr).
2792 *Dibolocelus ovalis* Ziegl. Lethbridge, Alta., September, (Seamans).
2802 *Hydrobius fuscipes* L. Medicine Hat, Alta., (Carr).
2876 *Cercyon prætextus* Say. Peachland, B.C., (Wallis).
2888 *Cercyon tristis* Ill. Peachland, B.C., (Wallis).

Silphidæ
3001 *Anisotoma punctatostriata* Kby. Winnipeg, Man., (Wallis).

Orthoperidæ
3266 *Sacium lunatum* Lec. Aweme, Man., May, (R. M. White).

Scaphidiidæ
6489 *Scaphisoma convexum* Say. Victoria Beach, Man., June, (Wallis).

Hesteridæ
6860 *Saprinus cribum* Csy. Melita and Aweme, Man., May, (Criddle).

Melyridæ
7203 *Collops hirtellus* Lec. Medicine Hat, Alta., (Carr).
7227 *Collops quadrimaculatus* Fab. Caradoc, Ont., June, (A. A. Wood).

Cupesidæ
7746 *Priœma serrata* Lec. Creston, B.C., July, (C. S. Lallamand).

Mordellidæ
7927 *Mordellestena æmula* Lec. Ashdown, Man., June, (Criddle and White).

Meloidæ
8177 *Nemognatha dubia* Lec. Medicine Hat, Alta., June, (Carr).
8179 *Nemognatha piezota* Fab. Aweme, Man., July, (Criddle).

Elateridæ
9089 *Cardiophorus gagates* Er. Victoria Beach, Man., July, (Wallis).

Buprestidæ
9368 *Buprestis maculipennis* Gory. Victoria Beach, Man., July, (G. S. Brooks).
9369 *Buprestis subornata* Lec. Victoria Beach, Man., August, (Wallis).
9578 *Taphrocerus gracilis* Say. Medicine Hat, Alta., (Carr).

Heteroceridæ
9653 *Heterocerus auromicans* Kies. Victoria Beach, Man., July, (Wallis and Brooks).

Helodidæ
9708 *Scirtes tibialis* Guer. Onah and Aweme, Man., July, (White).

Dermestidæ
9728 *Dermestes tristis* Fall. Medicine Hat, Alta., March, (Carr).

Lathridiidæ
10664 *Cartodera filum* Aube. Ottawa, Ont., (A. Gibson).

Coccinellidæ
10981 *Brachyacantha albifrons* Say. Medicine Hat, Alta., (Carr).
Hippodamia minuta disjuncta Thum. Lethbridge, Alta., (W. Carter).
11181 *Coccinella perplexa* Muls. Hopedale, Labr., July, (Perrett).
11206 *Neomysia subvittata* Muls. Metashquin, S. Labr., (Waugh).
11225 *Exochomus septentrionis* Weise. Medicine Hat., Alta., April, (Carr).

Tenebrionidæ
11872 *Asidopsis polita* Say. Medicine Hat, Alta., (Carr).
12219 *Blapstinus oregonensis* Coq. Vernon, B.C., (Hopping).
12480 *Strongylum tenuicolle* Say. Treesbank, Man., July, (T. Criddle).

Ptinidæ
12613 *Ptinus fur* L. Medicine Hat, Alta., (Carr).

Scarabæidæ
13041 *Canthon praticola* Lec. Medicine Hat., Alta., (Carr).
13048 *Canthon lævis* Dau. Medicine Hat, Alta., (Carr).
13290 *Geotrupes balyi* Jek. Victoria Beach, Man., (C. G. Wright, B. Brooks, Brooks and Wallis).
13298 *Geotrupes semiopacus* Jek. Victoria Beach, Man., July, (Brooks and Wallis).
13409 *Diploloxia tristis* Kby. Aweme and Baldur, Man., (Wallis).
13993 *Cremastochilus bifoveatus* Van D. Peachland, B.C., (Wallis). Recorded in error as *crinitus*.
14008 *Cremastochilus wheeleri* Lec. Aweme, Man., (White).

Cerambycidæ
14424 *Judolia sexmaculata* L. Hopedale, Labr., July, (Perrett).
14537 *Bellamira scalaris* Say. Aweme, Man., July, (Criddle).
14548 *Typocerus lugubris* Say. Hull, Que., (Curran).
14550 *Typocerus balteata* Horn. Medicine Hat, Alta., (Carr).
14619 *Merium proteus* Kby. Hopedale, Labrador, (Perrett).
14666a *Cyllene infusata* Lec. Lethbridge, Alta., (Seamans).
14672 *Hihopalus fulmans* Fab. Pelican Lake, Man., (Hill).
14679 *Xylotrechus colonus* Fab. Darlingford, Man., August, (G. E. White).
14830 *Crissidus pulchellus* Lec. Medicine Hat, Alta., (Carr).
14877 *Moncilema annulata* Say. Medicine Hat, Alta., (Carr).
15109 *Saperda obliqua* Say. Victoria Beach, Man., August, (C. E. Wright).
15110 *Saperda mutica* Say. Oliver, B.C., June, (Garrett).

Chrysomelidæ
15232 *Zeugophora puberula* Cr. Onah, Man., July, (Wallis).
15296 *Coscinoptera vittigera* Lec. Medicine Hat, Alta., (Carr).
15686½ *Chrysomela flavomarginata* Say. Medicine Hat, Alta., April, (Carr).
15759 *Monoxa sordida* Lec. Medicine Hat, Alta., (Carr).
15858 *Belepharida rhois* For. Medicine Hat, Alta., (Carr).
16068 *Phyllotreta robusta* Lec. Peachland, B.C., July, (Wallis).
16072 *Phyllotreta albionica* Lec. Thornhill, Man., (Wallis); Medicine Hat, Alta., (Carr).
16135 *Microrhopala cyanea* Say. Medicine Hat, Alta., (Carr).

Curculionidæ
16331 *Auletes uter* Lec. Winnipeg, Man., (Wallis).
16519 *Ophryastes tubercosus* Lec. Medicine Hat, Alta., (Carr).
16523 *Ophryastes sulcirostris* Say. Medicine Hat, Alta., (Carr).
16558 *Melamomphus alternatus* Horn. Medicine Hat, Alta., April, (Carr).
16641 *Strophosoma coryli* Fab. Agassiz, B.C., June, (R. Glendenning).
16782 *Lestronotus tessalatus* Czy. Medicine Hat, Alta., (Carr).
16784 *Lestronotus sulcirostris* Lec. Darlingford, Man., August, (Criddle).
16810 *Hyperodes ulkei* Dietz. Medicine Hat, Alta., (Carr).
17376 *Cleonus plumbeus* Lec. Medicine Hat, Alta., (Carr).
17377 *Cleonus crestatus* Lec. Medicine Hat, Alta., (Carr).
17391 *Cleonus frontalis* Lec. Medicine Hat, Alta., (Carr).

17398 *Cleonus modestus* Mann. Lethbridge, Alta., (Seamans).
17405 *Lexus rubellus* Rand. Medicine Hat, Alta., (Carr).
17439 *Lexus terminalis* Lec. Medicine Hat, Alta., (Carr).
17961 *Gersteckeria basalis* Lec. Medicine Hat, Alta., (Carr).
18005 *Thecesternus affinis* Lec. Medicine Hat, Alta., (Carr).
18098 *Sphenophorus ulkei* Horn. Winnipeg and Stoney Mountain, Man., August, (Wallis).

Scolytidæ
18252 *Dendroctonus borealis* Sw. Victoria Beach, Man., (Wallis).
18307 *Typodendron lutulæ* Sw. Aweme, Man., (Criddle); Onah, Man., (White).
18310 *Hylurgops borealis* Sw. Victoria Beach, Man., (Wallis).
18400 *Gnathotrichus materiarius* Fitch. Victoria Beach, Man., (Wallis).
18458 *Pityogenes knechteli* Sw. Victoria Beach, Man., May, (Wallis).
18479 *Ips parroti* Sw. Aweme, Man., July, (Wallis).
18488 *Pityokteines sparsus* Lec. Victoria Beach, Man., (Wallis).

Diptera

Species described as new in "The Canadian Entomologist" during 1923 are omitted from the "Record" owing to lack of space. The number given before the name of species refers to the page in Aldrich's "Catalogue" on which the name of the genus appears.

Psychodidæ
106 *Psychoda albitarsis* Banks. Hull, Que., June, (Curran).

Culicidæ

136 *Wyeomyia smithi* Coq. Aweme, Man., (Criddle and Robertson).

Mycetophilidæ

139 *Asindulum montanum* Roeder. Ft. Coulonge, Que., July, (Beaulne); Sudbury, Ont., (Evans); Aweme, Man., August, (Vroom).
145 *Exechia absoluta* John. Megantic, Que., June, (Curran).
146 *Mycetophila quatuornotata* Lw. Megantic, Que., June, (Curran).

Bombyliidæ

240 *Lepidophora ægeriiformis* Westw. Victoria Beach, Man., July, (G. S. Brooks).

Therevidæ

*246 *Psilocephala frontinalis* Cole. Maniwaki and Montreal, Que., (Beaulieu); Ottawa, Belleville, (Gibson); Jordan, Ont., (Curran); Toronto, (C. W. Johnson).
* *Psilocephala canadensis* Cole. Trenton, Ont., (Evans); Ottawa, Montfort, (Que.), (Johnson).
* *Psilocephala latifrons* Cole. Prince Edward Co., Ont., (Evans).
* *Tabuda borealis* Cole. Gull Lake, Sask., April, (T. N. Willing).
*247 *Thereva cinerascens* Cole. Savary Island, B.C., July, (R. S. Sherman).
* *Thereva cockerelli* Cole. Aweme, Man., June, (E. Criddle).
* *Thereva brunnea* Cole. Victoria, B.C., (Downes and Anderson); Vancouver, B.C., (Treherne).
* *Thereva nigripilosa* Cole. Victoria, B.C., (Downes); Cranbrook, B.C., (Garrett). Proc. U.S. Nat. Mus., Vol. LXII.

Apioceridæ

253 *Apiocera haruspex* O.S. Oliver, B.C., July, (Buckell, Garrett, Vroom).

Asilidæ

259 *Cyrtopogon vulneratus* Melan. Coniston, Ont., July, (H. S. Parish). Psyche, Vol. XXX, Nos. 3-4, 1923.
Buckellia cyrtopogona Cole. Revelstoke Mt., B.C., Aug. 12, (Buckell). (Described as *Cophura;* follows *Cyrtopogon.* C.H.C.).
272 *Laphria ferox* Willist. Bathurst, N.B., July 26, (J. N. Knull).
Laphria janus McAt. Revelstoke Mt., B.C., Aug. 12, (Vroom).
274 *Proctacanthus occidentalis* Hine. Oliver, B.C., (Buckell, Vroom).
275 *Erax bicaudatus* Hine. Lethbridge, Alta., August, (Seamans); Oliver, B.C., September, (Garrett).
Erax zonatus Hine. Oliver, B.C., July, (Buckell, Vroom).
281–283 *Asilus nitidifacies* Hine. Moraine Lake, Alta., July, (McDunnough); Hopedale, Labr., August, (Perrett).
Asilus antimachus Walk. Taber, Alta., July, (Carter).
Asilus montanus Hine. Victoria, B.C., July, (Anden).

Dolichopodidæ

288 *Diaphorus snowii* V.D. Banff, Alta., August, (Garrett).
289 *Chrysotus discolor* Loew. Truro, N.S., July; Fort Coulonge, Que., July, (Beaulne); Orillia, Ont., August, (Curran); Aweme, Man., July, (Criddle, Robertson).
298 *Liancalus limbatus* V.D. Fort Churchill, B.C., Sept. 11, (Anderson).
291 *Argyra robusta* Johns. Ottawa, Ont., June, (Curran).
Argyra albicans Lw. Hull, Que., Ottawa and Orillia, Ont., June, July, (Curran).
Argyra calceata Loew. Orillia, Ont., July, (Curran).
291–292 *Rhaphium (Xiphandrium) dubium* V.D. Hull, Que., Ottawa, Ont., May, June, (Curran).
Rhaphium (Xiphandrium) femoratum V.D. Banff, Alta., May, June, August, (Garrett); Waterton, Alta., June, July, (McDunnough).
Rhaphium (Porphyrops) crassipes Mg. Megantic and Hull, Que., June, (Curran).
Rhaphium (Porphyrops) rotundiceps Loew. Hull, Que., June, (Curran).
Rhaphium (Porphyrops) nudus V.D. Hull, Que., Ottawa, Ont., June, July, (Curran).
Rhaphium (Porphyrops) fascipes Mg. Hull, Que., June, (Curran).
Rhaphium (Porphyrops) melampus Lw. Hull, Que., July, (Curran).
Rhaphium (Porphyrops) signifer O.S. Orillia, Ont., July, (Curran).
292 *Syntormon tricoloripes* Curran. Oliver, B.C., April, (Garrett); Hull, Que., and Ottawa, Ont., May, June, (Curran).
292 *Sympycnus cuprinus* Wheeler. Banff, Alta., Aug., (Garrett).
Sympycnus marcidas Wheeler. Banff, Alta., July, Aug., (Garrett).
293 *Neurigona albospinosa* V.D. Oliver, B.C., May, (Garrett).
Neurigona tridens V.D. Keremeos, B.C., June, (Garrett).
290 *Campsicnemus americana* V.D. Ottawa, Ont., Orillia, Ont., May, July, (Curran).
Campsicnemus degener Wheeler. Ottawa, Ont., Hull, Que., April, June, (Curran).

296 *Hydrophorus philombrius* Wheeler. Aweme, Man., September, (Criddle).
Hydrophorus altivagus Ald. Lethbridge, Alta., July, (Seamans).
Hydrophorus algens Wheeler. Banff, Alta., July to September, (Garrett).
Hydrophorus gratiosus Aldrich. Chin, Alta., May, (Carter, Seamans).
Hydrophorus amplectens Ald. Hemmingford, Que., June, (Curran).
Hydrophorus extrarius Ald. Ottawa, Ont., April, (Curran).
Hydrophorus æstuum Lw. Hemmingford, Que., June, (Curran); Aweme, Man., August, (Robertson); Lethbridge, Alta., June, (Seamans).
Hydrophorus chrysologus Walker. Ontario, Quebec, (Curran), common.
*298 *Dolichopus uliginosus* V.D., Nanaimo, B.C., June, (E. P. Van Duzee). Psyche, XXX, No. 2.
Dolichopus viridis V.D. Oliver, B.C., May, (Garrett).
Dolichopus nigricauda V.D. Osoyoos and Oliver, B.C., May, June, (Garrett).
Dolichopus burnesi V.D. Covey Hill, Que., June, (Curran).
Dolichopus conspectus V.D. Chin and Lethbridge, Alta., May, (Seamans); Osoyoos and Oliver, B.C., May, June, (Garrett).
Dolichopus gratus Loew. Hemmingford, and Hull, Que., June, (Curran).
Dolichopus calcaratus Ald. Covey Hill, Que., June, (Curran).
Dolichopus melanderi V.D. Osoyoos, B.C., May, (Garrett).
Dolichopus barbicauda V.D. Hemmingford and Covey Hill, Que., June, (Curran).
Dolichopus æqualis V.D. Megantic, Que., June, (Curran).
Dolichopus remipes Wahl. Orillia, Ont., July, Covey Hill and Hemmingford, Que., June, (Curran); Sandridge, Man., June, (Hunter and Cumming).
Dolichopus incongruus Wheeler. Orillia, Ont., July, (Curran).
Dolichopus laticornis Lw. Hull, Que., June, (Curran).
Dolichopus apheles Mel. & Br. Hull, Que., June, (Curran).
Dolichopus genualis V.D. Covey Hill, Que., Ottawa, Ont., June, (Curran).
Dolichopus trisetosus V.D. Covey Hill and Megantic, Que., June, (Curran).
Dolichopus comatus Loew. St. Cecile, Woburn and Covey Hill, Que., June, (Curran).
Dolichopus virga Coq. Covey Hill, Que., June, (Curran).
Dolichopus flaviciliatus V.D. Sudbury, Ont., (Evans).
Dolichopus renidescens Mel. & Br. Oliver, and Osoyoos, B.C., May, June, (Garrett).
Dolichopus porphyrops V.D. Hull, Que., June, (Curran).
Dolichopus plumitarsus Fall. Ottawa, Ont., June, (Curran).
Dolichopus fulvipes Loew. Covey Hill, Que., June, (Curran).
Dolichopus luteipennis Loew. Orillia and Seabright, Ont., July, (Curran).
Dolichopus wheeleri Mel. & Br. Covey Hill, Que., June, (Curran).
Dolichopus compactus V.D. Oliver, B.C., June, (Garrett).
Dolichopus æratus V.D. Oliver, B.C., June, (Garrett).
Dolichopus amphericus Mel. & Br. Waterton, Alta., June, (McDunnough).
Dolichopus penicilatus V.D. Strathclair, Man., Aug., (Robertson).
Dolichopus chrysostoma Loew. Covey Hill, Que., June, (Curran).
Dolichopus harbecki V.D. Covey Hill, Que., June, (Curran).
Dolichopus versutus V.D. Hull, Que., June, (Curran).
Dolichopus sicarius V.D. Hemmingford and Hull, Que., June, July, (Curran).
Dolichopus scoparius Loew. Megantic, Hull, Covey Hill and Hemmingford, Que., June, July, (Curran).
Dolichopus plumosus Ald. Waterton, Alta., July, (McDunnough, Seamans).
305 *Gymnopternus humilis* Loew. Quebec, common, (Curran).
Gymnopternus phyllophorus Loew. Ontario, Quebec, June to August, (Curran).
Gymnopternus lunifer Loew. Hull, Que., June, (Curran).
Gymnopternus chalcochrus Loew. Ontario, Quebec, June to August, (Curran).
*306 *Hercostmus costalis* V.D. Toronto, Ont., July; Port Credit, Ont., Ridgway, Ont., (Van Duzee). Psyche, XXX, No. 2.
Hercostomus unicolor Loew. Waterton, Alta., July, (Seamans); Aweme, Man., July, (Robertson).
307 *Tachytrechus vorax* Loew. Hemmingford, Que., Orillia, Ont., June to August, (Curran).
Tachytrechus binodatus Loew. Hemmingford, Que., Orillia, Ont., June to August, (Curran).
Tachytrechus mœchus Loew. Hemmingford, Que., Orillia, Ont., June, July, (Curran).
Tachytrechus sanus O.S. Waterton, Alta., June, July, (McDunnough, Seamans).
Tachytrechus bipunctatus Greene. Waterton, Alta., July, (McDunnough).
308 *Pelastoneurus ramosus* V.D. Hull, Que., September, (Curran).

Platypezidæ
*340 *Agathomyia canadensis* Johnson. Norway Point, Lake of Bays, Ont., August, (J. McDunnough). Occ. Papers Boston Soc. Nat. Hist., Vol. V.

Syrphidæ
347 *Chrysotoxum coloradensis* Greene. Kelowna, B.C., July 29, (Buckell).
Chrysotoxum ventricosum Lw. Fort Wrigley, N.W.T., (C. H. Crickmay).

351 *Cartosyrphus canadensis* Shannon. (Ins. Insc. Mens., X, 133, 1922); B.C.; Waterton Lakes Park, Alta., June 12, (J. McDunnough); Hedley, B.C., Aug. 29, (Garrett) (See *Chilosia*).
Cartosyrphus townsendi Hunter. Hedley, B.C., August, (Garrett).
Chilosia hoodiana Bigot. (*petulca* Willist.) Hedley, B.C., August, (Garrett).
363 *Syrphus attenuatus* Hine. Mt. Revelstoke, B.C., Aug. 12, (Vroom, Buckell); Aspen Grove, B.C., Sept. 5, (Buckell).
363 *Epistrophe* (*Syrphus*) *grossulariæ melanis* Curran. Revelstoke Mt., B.C., Aug. 12, (Vroom); Aspen Grove, B.C., Sept. 5, (Buckell).
369 *Epistrophe* (*Xanthogramma*) *habilis* Snow. Revelstoke Mt., B.C., August, (Buckell). (Previously known only from the type which lacks the head, described from New Mexico. C.H.C.).
Epistrophe arctica Zett. Nain, Labr., June 15, 1922, (F. W. Waugh).
Phytomyptera (*Dichætoneura*) *leucoptera* Johns. Kentville, N.S., August 4, 1917, (Brittain); Ottawa, August 18, 1908, (Host for all specimens; *Cacœcia cerasivorana* Fitch.)

Tachinidæ
439 *Hyalomyodes dorsalis* Coq. Oliver, B.C., May 26, (Garrett).
444 *Heteropterina nasoni* Coq. Oliver, B.C., July, (Buckell, Vroom).
453 *Ernestia arcuata* Tothill. Macdiarmid, Ont., June 11, 1922, (N. K. Bigelow). (Panzeria of Aldrich Cat.)
Ernestia sulcocarina Tothill. Macdiarmid, Ont., June 17 to 27, 1922; Port Sydney, Ont., July, 1919.
467 *Acemyia tibialis* Coq. Douglas Lake, B.C., May 29, (Buckell).
472 *Arctophyto gillettii* Towns. Keremeos, B.C., June, (Garrett).
Arctophyto wickmani Towns. Banff, Alta., August, (Garrett).
(Note—A specimen in the Canadian National Collection, Ottawa, determined as *A. gilletti* by Coq. (Laggan, Alta.), is this species. C.H.C.)
475 *Metachæta atra* Coq. Oliver, B.C., May 10, (Buckell).
476 *Hilarella siphonina* Zett. Nicola, B.C., Aug. 1, (Buckell).

Sarcophagidæ
510 *Sarcophaga cooleyi* Parker. Oliver, B.C., Aug. 22, (Buckell); reared from *Melanoplus packardi.*
Sarcophaga hunteri Hgh. Lethbridge, Alta., July, (Seamans).

Anthomyidæ
540 *Phaonia deleta* Stein. Teulon, Man., (A. J. Hunter). (*Hyetodesia* of Aldrich Catalogue).
Phaonia basalis Mall. Winnipeg, Man., July, 1920, (A. J. Hunter).
Phaonia solitaria Stein. Teulon, Man., May, June, (Hunter).
Helina uniseta Stein. Hemmingford, Que., June, (Curran); Teulon, Man., May, (Hunter).
Helina nasoni Mall. Teulon, Man., June, July, (Hunter).
Helina tuberculata Mall. Hopedale, Labr., June, (Perrett); Nain, Labr., June, July, (Waugh).
Helina nigricans Stein. Oliver, B.C., May, (Buckell).
Helina linearis Mall. Teulon, August, (Hunter).
Myiospila meditabunda Mall. Nicola, B.C., (Buckell).

Lonchæidæ
*581 *Lonchæa atritarsis* Mall. Kaslo, B.C., (A. N. Caudell). Proc. Ent. Soc. Wash., Vol. XXV, No. 2, 1923.

Trypetidæ
* *Eurosta solidaginis fascipennis* Curr. Ottawa, Ont., June, (J. Fletcher). Ent. News, Vol. XXXIV, No. 10, 1923.
Eurosta solidaginis subfasciatus Curr. Vernon, B.C., March, (E. R. Buckell). Ent. News, XXXIV, No. 10.

Hymenoptera

Xyelidæ
* *Neoxyela alberta* Curran. Banff, Alta., May and June, (C.B.D. Garrett). Can. Ent., Vol. XLV, 20, 1923.

Tenthredinidæ
Empria cava MacG. Edmonton, Alta., (F. S. Carr).
* *Empria cadurca* MacG. Edmonton, Alta., (F. S. Carr).
* *Dolerus nuntius* MacG. Edmonton, Alta., (F. S. Carr).
* *Dolerus nutricus* MacG. Edmonton, Alta., (F. S. Carr).
* *Dolerus nummatus* MacG. Edmonton, Alta., (F. S. Carr).

* *Dolerus nudinus* MacG. Edmonton, Alta., (F. S. Carr).
* *Dolerus nummarius* MacG. Edmonton, Alta., (F. S. Carr).
* *Dolerus nicæus* MacG. Chilliwack, B.C., (A. L. Lovett).
Pachyprotasis rapæ L. MacG. Edmonton, Alta., (F. S. Carr).
* *Rhogogastera ruga* MacG. Edmonton, Alta., (F. S. Carr).
(*Tenthredopsis*) *Rhogogastera evansi* Harr. Edmonton, Alta., (F. S. Carr).
* *Tenthredo rutila* MacG. Edmonton, Alta., (F. S. Carr).
Tenthredo erythromera Prov. Edmonton, Alta., (F. S. Carr).
Tenthredo nigrisoma Harr. Edmonton, Alta., (F. S. Carr).
Tenthredo scævola Cress. Edmonton, Alta., (F. S. Carr).
* *Tenthredo rumina* MacG. Edmonton, Alta., (F. S. Carr).
Abia kennicotti Nort. Edmonton, Alta., (F. S. Carr).
* *Trichiosoma confundum* MacG. Edmonton, Alta., (F. S. Carr).
Cimbex violacea Le P. Edmonton, Alta., (F. S. Carr).
* *Pachynematus allegatus* MacG. Edmonton, Alta., (F.S. Carr).
* *Pteronidea egnatia* MacG. Edmonton, Alta., (F. S. Carr).
* *Pteronidea egeria* MacG. Edmonton, Alta., (F. S. Carr).
* *Pteronidea elelea* MacG. Edmonton, Alta., (F. S. Carr).
* *Blennocampa amara* MacG. Edmonton, Alta., (F. S. Carr).
The above Tenthredinidæ are treated in Can. Ent., Vol. XLV, 1923.

Vipionidæ

Apanteles (*Protapanteles*) *læviceps* Ashm. Alta., (E. H. Strickland).

Braconidæ

Meteorus communis Cress. Que., Ont., B.C., (C. F. W. Muesebeck).
Meteorus hyphantriæ Riley. Que., N.S., (C. F. W. Muesebeck).
Meteorus proximus Cress. Salines, Ont., Qaubamic, Ont., (H. S. Parish).
Meteorus vulgaris Cress. Ont., N.S., Alta., B.C., (C. F. W. Muesebeck).
Meteorus niveitarsis Cress. Ottawa, Ont., (C. F. W. Meusebeck).
* *Meteorus tibialis* Mues. Montreal, Que., May, 1902, (C. F. W. Muesebeck).
Meteorus versicolor Wesm. N.B., N.S., (C. F. W. Muesebeck).
* *Meteorus autographæ* Mues. Canada, (C. F. W. Muesebeck).
The above Braconidæ are treated in Proc. U.S. Nat. Mus., Vol. LXIII, 1923.

Halictidae

Halictus viridatus Lov. Smith Cove, N.S., May 8, 1916; Ottawa, Ont., June 27, 1921, (J. H. McDunnough); St. John, N.B., Aug. 11, 1901, (A. G. Leavitt).
Halictus hortensis Lov. Kazubazua, Aug. 4, 1914, (F. W. L. Sladen).
Halictus versans Lov. Kentville, N.S., July 30, 1914, (F. W. L. Sladen).
Halictus sparsus Rob. Aylmer, Que., July 10, 1922, (C. B. Hutchings); Ottawa, Ont., Sept. 16, 1913, (F. W. L. Sladen); Toronto, April, May, July, Aug., Sept.
Halictus vierecki Cwfd. Toronto, May, June, Aug., Sept.
Halictus cressoni Rob. Smith Cove, N.S., May; Ile de Montreal, June, (Beaulieu); Co. Hastings, Ont., July, Sept., (Evans).
Halictus atriventris Cwfd. Vernon, B.C., May, Mara, B.C., May, (R. C. Treherne); Brent, Alta., Aug., (E. H. Strickland).
Halictus nymphæarum Rob. Ottawa, Toronto, June, July, Sept., Oct.; Hemmingford, Que., Aug., (J. I. Beaulne); Co. Prince Edward, Ont., Oct., (Evans).
Halictus ovaliceps Ckll. Penticton, June, (E. R. Buckell); Vernon, B.C., June, (E. P. Venables).
Halictus pectoralis Sm. Lanoraie, Que., June, (Beaulne); Toronto, June, Aug.; Ottawa, Sept., (F. W. L. Sladen).
Halictus pectoraloides Ckll. Aweme, Man., Aug., (N. Criddle); Penticton, B.C., May, June, (E. R. Buckell).
Halictus cooleyi Cwfd. Lethbridge, Alta., June, (Sladen); Crescent, B.C., August, (Sladen); Victoria, B.C., July, (J. B. Wallis); Vancouver, B.C., August, (Sladen).
Halictus arcuatus Rob. Smith Cove, N.S., May; Ottawa, April, (Sladen); Ile de Montreal, May, June, (Beaulieu).
Halictus cordleyi Cwfd. Lethbridge, July, (J. B. Wallis); Banff, Sept., (C. B. Garrett); Cranbrook, B.C., (C. B. Garrett).
Halictus niger Vier. Aweme, Man., July, (Sladen); Chilcotin, B.C., June, (E. R. Buckell).
Halictus quadrimaculatus Rob. Smith Cove, N.S., July, (A. Gibson); Aylmer, Que., June, (Hutchings); Ile de Montreal, June, (Beaulieu); Trenton, Ont., June, (Evans).
Halictus foxii Rob. Sully, Que., June, Quebec City, Aug., (Sladen); Ottawa, June, (Sladen); Medicine Hat, May, (Sladen); Melfort, Sask., July, (Sladen); Aweme, Man., May, (N. Criddle); Kaslo, May, Lytton, April, (W. B. Anderson); Nelson, April, Vernon, May, (R. C. Treherne).
Halictus similis Sm. Weymouth, N.S., June, Aug.; Ottawa, June, Oct., (Sladen); Ile de Montreal, July, August, (Beaulieu); Cheticamp, C.B.I., Aug., (Johansen).

Halictus olympiæ Ckll. Royal Oak, B.C., June, (W. Downes); Victoria, B.C., May, June, (R. C. Treherne).
Halictus sisymbrii Ckll. Vernon, B.C., June, July, August, (N. L. Cutler); Penticton, May, (E. R. Buckell); Royal Oak, Aug., Sept., (W. Downes).
Halictus forbesi Rob. Kentville, N.S., June, (Sladen); Aylmer, Sept., (Hutchings); St. John, N.B., Sept., (A. G. Leavitt); Ottawa, Sept. and Oct., (Sladen).
Halictus pura Say. Aylmer, Que., May, July, (Hutchings); Grimsby, Ont., June.
Halictus viridissimus Vier. Toronto, Ont., June; Grimsby, Ont., Aug.
Halictus radiatus Say. Ottawa, Ont., July, (Sladen); Toronto, Ont., Aug.; Treesbank Sept., (C. G. Hewitt); Penticton, April, (E. R. Buckell).
Halictus splendens Le P. Caradoc, Aug., (H. F. Hudson); Aweme, Man., May, July, August, (N. Criddle); Medicine Hat, July, (Sladen).
Halictus virescens Fabr. Trenton, Ont., June, (Evans); Lethbridge, July, (Sladen); Okanagan, B.C., May, (E. R. Buckell).
Halictus ligatus Say. Trenton, Ont., Sept., (Evans); Chatham, Ont., August, (Sladen); Lethbridge, Alta., June, July, (Sladen); Jasper Park, Alta., Sept., (Johansen); Agassiz, B.C., August, (Glendenning).
Halictus farinosus Sm. Lillooet, B.C., July; Penticton, August, (Sladen).
Sphecodes persimilis Lov. & Ckll. Ottawa, Ont., May, June, (F. W. L. Sladen); Trenton, Ont., June, (Evans); Hull, Que., April, (F. W. L. Sladen); Toronto, Ont., June, (Harrington); Sandridge, Teulon, Man., June, July, (F. W. L. Sladen); Grimsby, Ont., May, (Harrington).
Sphecodes obscurans Lov. & Ckll. St. Stephens, N.B., July, (R. C. Treherne); Ottawa, Ont., June, (F. W. L. Sladen); Blenheim, Ont., May, (Harrington); Montreal, Que., May, (Beaulieu); Smith's Cove, N.S., July, (A. Gibson); June, (Evans); Teulon, Man., June, (F. W. L. Sladen).
Sphecodes lautus Lov. & Ckll. Ottawa, Can., September, (F. W. L. Sladen); Ft. Coulonge, Que., (J. I. Beaulne); Hastings, Ont., September, (Evans).

Andrenidæ

Andrena milwaukeensis Graen. Kentville, N.S., May, June, (Gorham); Chelsea, Que., May, June; Megantic, Que., June, (Curran); St. John, N.B., June; Toronto.
Andrena perarmata Ckll. Penticton, B.C., April, (E. R. Buckell); Summerland, B.C., April, (Sladen); Chilcotin, B.C., May, (Buckell).
Andrena pyrrhacita Ckll. Hanceville, April, Chilcotin, April, May, (E. R. Buckell); Kamloops, B.C., April, (W. B. Anderson).
Andrena clarkella Kby. (= *bicolor* Prov.). Chelsea, Que., April, Sudbury, Ont., Ottawa, April, (Sladen); Aweme, Man., May, (Criddle); Edmonton, Alta., June, July, (Carr).
Andrena dunningi Ckll. Grimsby, Ont., June; Ottawa, May, June, (Sladen); Ironsides, Que., April, (Sladen); Bird's Hill, Man., June, (Wallis).
Andrena transnigra Vier. Banff, Alta., May, June, (Sladen); Armstrong, Penticton, B.C., May, (E. R. Buckell); Cranbrook, May, (Garrett).
Andrena perindotata Vier. Crescent, B.C., August, (F. W. L. Sladen).
Andrena carliniformis Vier & Ckll. Okanagan Falls, B.C., June, (E. R. Buckell); Victoria, B.C., (G. W. Taylor); Agassiz, B.C., May, (F. W. L. Sladen); June, (R. Glendenning); Kamloops, B.C., May, (E. R. Buckell).
Andrena errans Sm. Aspen Grove, B.C., May, (Vroom); Chilcotin, B.C., May, (E. R. Buckell); Agassiz, May, (Sladen); Victoria.
Andrena saccata Vier. Royal Oak, B.C., May, (R. C. Treherne); Sidney, B.C., May, (F. W. L. Sladen).
Andrena regularis Mall. Annapolis, Royal N.S., April, (Sanders); Weymouth, N.S., May; Kingsmere, Que., May, (Sladen); White River, Ont., June, (Sladen).
Andrena vicina solidula Vier. Melita, Man., July, (N. Criddle); Lethbridge, Alta., July, (H. L. Seamans); Armstrong, B.C., June, (N. L. Luther); Sahtlam, B.C., May, (E. M. Anderson).
Andrena advarians Vier. Golden, B.C., May, (Sladen); Victoria, April, (Anderson).
Andrena washingtoni Ckll. Sidney, B.C., May, (Sladen).
Andrena pertarda Ckll. Meach Lake, Que., Sept., (Hewitt); Medicine Hat, August, (Sladen); Penticton, June, (Buckell).
Andrena azygos Vier. Lillooet, B.C., May, (W. B. Anderson).
Andrena frigida Sm. Ottawa, April, (Sladen); White River, June, (Sladen).
Andrena hitei Ckll. Teulon, Man., May and June, (A. J. Hunter), (F. W. L. Sladen); Sandridge, Man., June, (F. W. L. Sladen).
Andrena moesta Sm. Ottawa, Ont., April, May, (Sladen); Aweme, Man., May, (Criddle); Edmonton, April, (Carr); Banff, May; Penticton, April, (Treherne).
Andrena thaspii Graen. Ottawa, June, (Sladen); Spruce Bank, Nfld., July, (Walker); Kentville, N.S., July, (Sladen); Lethbridge, June, (Sladen); Rosthern, Sask., July, Sladen).
Andrena wilkella Kby. Fredericton, N.B., August, (Sladen); Fort Coulonge, Que., June, (Beaulne); Ottawa, June, (Sladen); Saanich, B.C., May, (J. Wilson).
Andrena perplexa Sm. Blenheim, Ont., May.

Andrena prunorum Ckll. Glenboro, June, (S. Criddle); Medicine Hat, May, July, Sladen); Lethbridge, July, (Sladen).
Andrena kincaidi Ckll. Penticton, B.C., April, (Buckell).
Andrena hilaris Sm. Trenton, Ont., May, (Evans).
Andrena commoda Sm. Kazubazua, Que., July, (Sladen); Ottawa, June, (Sladen).
Andrena cressoni Rob. Fort Coulonge, Que., June, (Beaulne); Trenton, Ont., May, (Evans); Agassiz, May, (Sladen).
Andrena trumani Vier. & Ckll. var. Agassiz, B.C., May, (Sladen).
Andrena lupinorum Ckll. Calgary, July, (Sladen).
Andrena pruni Rob. Ironsides, Que., April, 1915, (Sladen); Ile de Montreal, May, 1906, (Beaulieu).
Andrena erythrogaster Ashm. Toronto, April, June; Grimsby, Ont., June, (Brimley); Fort McMurray, May, (F. Harper); Aweme, May, (White); Stony Mountain, Man., June, (Wallis).
Andrena piperi Vier. Okanagan Falls, B.C., June, (Buckell).
Andrena subtilis Sm. Fairview, B.C., May, (Buckell); Cranbrook, B.C., May, (Garrett); Vernon, B.C., May, (Venables).
Andrena novæangliæ Vier. Co. Hastings, Ont., July, (Evans); Ironsides, Que., May, (L. M. Stohr).
Andrena peckhami Ckll. Toronto, June; Rosthern, Sask., July, (Sladen); Lethbridge, Alta., June, (Sladen).
Andrena atala Vier. Invermere, B.C., June, (Sladen).
Andrena geranii Rob. Toronto, June.
Andrena auricoma Sm. Kazubazua, Que., August, (Sladen); Medicine Hat, August, (Sladen); Victoria, B.C., April, May, (Treherne).
Andrena runcinatæ Ckll. Boucker, Sask., Medicine Hat, July, (Sladen); Lethbridge, July, August, (Sladen).
Andrena candida Sm. Royal Oak, B.C., April, (Treherne).
Andrena scurra Vier. Lethbridge, May, June, (H. L. Seamans); Invermere, May, (Sladen); Penticton, June, (Buckell).
Andrena salictaria Rob. Ottawa, April, May, (Sladen); Aweme, Man., April, May, (Criddle); Cranbrook, B.C., May, (Garrett).
Andrena nigrocærulea Ckll. Vernon, B.C., May, (Ruhmann); Lillooet, June, (Anderson); Royal Oak, April, (Treherne).
Andrena neurona Vier. Duncan, B.C., April, (W. B. Anderson); Penticton, B.C., May, (E. R. Buckell).
Andrena longihirtiscopa Vier. Royal Oak, B.C., April, May, (Treherne); Agassiz, May, (Sladen); Victoria, April, (Treherne).
Andrena colletina Ckll. Penticton, B.C., September, (Buckell); Cranbrook, B.C., September, (Garrett).
Andrena lata Vier. Ottawa, Ont., June, (Sladen); Aylmer, Que., July, on *Ceanothus americanus*, (R. Oxburn, H. L. Viereck); Trenton, Ont., May, (Evans); Toronto, Ont., June, (Harrington).
Andrena astragali V. & C. Penticton, June, (Buckell); Oliver, May, (Buckell).
Andrena tridens Rob. Ottawa.
Andrena mandibularis Rob. Strathroy, Ont., June, (H. G. Crawford).
Andrena accepta Rob. Medicine Hat, Alta., July, (F. W. L. Sladen).
Andrena erigeniæ Rob. Covey Hill, Que., May, (C. E. Petch); Toronto, Ont., May, (Harrington).
Andrena pallidifovea Vier. Penticton, B.C., May, (Buckell); Vernon, April.
Andrena erigenoides Vier. Victoria, B.C., April, May, June, (Treherne).
Andrena g. maculati Rob. Toronto, May, June.
Andrena asteris Rob. St. John, N.B., September, (A. G. Leavitt); Toronto, August, September; Grimsby, Ont., August, (Brimley).
Andrena haynesi V. & C. Medicine Hat, August, (Sladen).
Andrena aliciæ Rob. Toronto, August.
Andrena solidaginis Rob. Toronto, August; Aweme, September, (Criddle).
Andrena mendosa Vier. Penticton, B.C., May, (E. R. Buckell).
Andrena wellesleyana Rob. Aweme, Man., April, May, (Criddle).
Andrena nasoni Rob. Hull, Que., April, (Sladen); Ottawa, May, (Sladen); Toronto, June, (Sladen).
Andrena angustitarsata Vier. Victoria, May, (Treherne); Victoria, May, (A. E. Cameron); var. Lillooet, May, (E. M. Anderson).
Andrena fragilis Sm. St. John, N.B., June, (Leavitt); Ironside, Que., May, (Sladen); Toronto, June, (E. M. Walker); Aweme, Man., May, (Criddle).
Andrena barbarica Vier. Toronto, June, (E. M. Walker).
Andrena integra Sm. Hemmingford, Que., June, (Beaulne); Toronto, July, August; Ottawa, June, July, (Sladen).
Andrena bradleyi Vier. Kazubazua, Que., June, (Sladen); Aylmer, Que., May, (Sladen); Mer Bleue, Que., May, (A. W. Richardson).
Andrena carolina Vier. Halifax, N.S., June, (J. Perrin); St. John, N.B., May, (Leavitt); Aylmer, Que., May, (Sladen); Ottawa, June, (Sladen); White River, June, (Sladen).

Andrena wheeleri Graen. Fort William, Ont., June, (Sladen); Aweme, July, (Criddle); Toronto, June.
Andrena claytoniæ Rob. Kazubazuà, Que., July, (Sladen); Ottawa, April, (Sladen).
Andrena alleghaniensis Vier. Port Sydney, Ont., (N. K. Bigelow).
Andrena cratægi Rob. St. John, N.B., May, July, (Leavitt); Hemmingford, Que., June, (Petch); Ottawa, May, (Sladen); Vernon, May, (Treherne).
Andrena sigmundi Ckll. Aylmer, Que., May, (Sladen); Ottawa, May, (Sladen).
Andrena forbesi Rob. Toronto, June.
Andrena miranda Sm. (= *hippotes* Rob.) Charlottetown, P.E.I., July, (F. W. L. Sladen); Trenton, Ont., May, (Evans); Truro, N.S., (Brittain).
Andrena mariæ Rob. Toronto, June; Aweme, Man., May, April, (C. Criddle).
Andrena obscura Rob. Ottawa; Toronto, July.
Andrena striatifrons Ckll. Medicine Hat, April, (Sladen); Penticton, April, (Buckell); Victoria, March, (Sladen).
Andrena swenki Vier. Golden, B.C., May, (Sladen).
Andrena cleodora Vier. Penticton, June, (Buckell); Kaslo, June.
Andrena grandior Ckll. Port Sydney, Ont., July, (N. K. Bigelow).
Andrena grandior multiplicatiformis Vier. Ottawa, Ont., June, (J. I. Beaulne).

Dufoureidæ

Halictoides oryx Vier. Salmon Arm, B.C., June, (Sladen); Naramata, B.C., June, (Buckell).

Panurgidæ

Perdita perpallida Ckll. Medicine Hat, July, August, (Sladen).
Perdita stottleri flavida Swenk & Ckll. Lethbridge, July, (Sladen).
Perdita affinis Cress. Medicine Hat, August, (Sladen).
Perdita bruneri Ckll. Medicine Hat, August, (Sladen); Aweme, Man., (Criddle).
Perdita swenki Cwfd. Medicine Hat, August, (Sladen).

Nomadidæ

Nomada cuneata Rob. Toronto, May; Ottawa, May, (Sladen).
Nomada luteola Le P. Ottawa, May, (Sladen).
Nomada pascoensis Ckll. Vernon, B.C., July, (Cutler).
Nomada luteoloides Rob. Weymouth, N.S., May; Toronto, May, June.
Nomada citrina Cress. Saanich Dist., B.C., June, (Downes).
Nomada civilis Cress. Penticton, May, (Buckell); Okanagan Falls, April, (Buckell); Saanich Dist., June, (Downes).
Nomada nigrocincta Sm. Penticton, April, (Buckell); Aylmer, Que., May, (Sladen).
Nomada corvallisensis Ckll. Salmon Arm, B.C., April, (Buckell).
Nomada lewisi Ckll. Calgary, Alta., May, (Wolley-Dod).
Nomada vicina Cress. Kazubazua, Que., August, (Sladen); Port Sidney, August; Toronto, August, September; Lethbridge, August, (Sladen).
Nomada americana Kby. Woburn, Que., June, (Curran); Agassiz, May, (Sladen); Ottawa, April, May, (Sladen); Banff, Alta., April, May, (Sanson); Cranbrook, May, (Garrett).
Nomada cressoni Rob. Ft. Coulonge, Que., June (Beaulne); Ottawa, June, (Sladen).
Nomada illinoensis Rob. Cheticamp, C.B.I., June, July, (Johansen); Ottawa, June, (Sladen); Eastern Passage, N.S., July.
Nomada sayi Rob. Ottawa, May; Walhachin, Penticton, June, (E. R. Buckell).
Nomada articulata Sm. Bowmanville, Ont., Co. Hastings, Ont., (Evans); Toronto, Ont., May, June, (Harrington).
Nomada scita Ckll. Penticton, June, (Buckell); Walhachin, June, (Buckell).
Nomada superba Cress. Chilcotin, June, (Buckell); Victoria, May, (Downes).
Nomada obliterata Cress. Chelsea, May, (A. Gibson); Toronto, May, June; Ottawa, May 8, (Sladen).
Epeoloides pilosula Cress. Aylmer, Que., June, (Sladen); Aweme, Man,. July, (Sladen).
Bombomelecta pacifica Cress. Vaseaux Lake, B.C., May, (W. B. Anderson); Penticton, B.C., May, (Buckell).
Bombomelecta fulvida Cress. Medicine Hat, April, (Sladen); Penticton, April, (Buckell); Chilcotin, May, (Buckell).
Bombomelecta separata var. *maculata* Vier. Victoria, B.C., April, (Treherne); Royal Oak, B.C., May, (Treherne).
Epeolus bifasciatus Cress. Grimsby, Ont., July.
Epeolus lectoides Rob. Ottawa, Ont., July, (Sladen).
Epeolus autumnalis Rob. Sully, Que., June, (Sladen); Sudbury, Ont.
Triepeolus pectoralis Rob. Grimsby, Ont., August.
Triepeolus lestes Ckll. Medicine Hat, August, (Sladen); Vernon, B.C., August and July, (Sladen); Victoria, July, (Sladen).
Triepeolus donatus Sm. Toronto, August, September; Ottawa, August, (Sladen); Athabasca, Alta., Aug.
Triepeolus rectangularis Ckll. Summerland, B.C., July, (Sladen).

Triepeolus helianthi Rob. Medicine Hat, July, August, (Sladen); Lethbridge, July, (Sladen).
Triepeolus cressoni Rob. Ottawa, July, August, (Sladen).
Triepeolus occidentalis Cress. Medicine Hat, August, (Sladen); Vernon, B.C., July, (Sladen).
Holcopasites illinoensis Rob. Medicine Hat, July, August, (Sladen); Lethbridge, Alta., July, (Sladen); Prince Albert, July, (Sladen).

Euceridæ

Melissodes desponsa Sm. Ft. Coulonge, Que., August, (Beaulne); Quebec City, August, (Sladen); Ottawa, July, (Sladen); Toronto, July.
Melissodes illata L. & C. Kazubazua, Que., July, August, September, (Sladen); Fredericton, N.B., August, (Sladen); Hull, Que., August, (Beaulne); Aweme, August, (Criddle); Maryfield, Sask., August, (Criddle); Medicine Hat, July, (Sladen); Vernon, B.C., July, (Sladen).
Melissodes microsticta Ckll. Vernon, B.C., July, (Ruhmann); Royal Oak, August, (Downes).
Melissodes mysops Ckll. Medicine Hat, July, (Sladen); Vernon, B.C., July, August, (Ruhmann); Thompson River, August, (T. Wilson).
Tetralonia edwardsi Cress. Vernon, B.C., August, May, (Treherne); Fairview, B.C., May, (Buckell); Lillooet, B.C., May, (E. M. Anderson).
Tetralonia actuosa Cress. Vernon, B.C., May.
Tetralonia cordleyi Vier. Vaseaux Lake, B.C., June, (Buckell); Fairview, May, (Buckell); Penticton, B.C., July, (Buckell); Vernon, June, (Treherne); Lillooet, B.C., June, (Phair.)
Tetralonia fowleri Ckll. Vaseaux Lake, B.C., June, (Buckell); Fairview, May, (Buckell); Victoria, June, (Downes).

Anthophoridæ

Anthophora johnsoni Ckll. Penticton, April, (Buckell); Okanagan Falls, May, (E. M. Anderson).
Anthophora sodalis Cress. Aweme, Man., July, (Criddle); Lethbridge, Alta., May, June, (Sladen); Penticton, June, (Buckell).
Anthophora stanfordiana Ckll. Golden, B.C., May, (Sladen); Penticton, June, (Buckell); Kaslo, B.C., July, (Cockle).
Anthophora washingtoni Ckll. Summerland, B.C., July, (Sladen); Penticton, August, September, (Buckell).
Anthophora ignava Cress. Vaseaux Lake, June, (Sladen); Penticton, April, May, (Buckell); Lillooet, May, (E. M. Anderson).

Hylæidæ

(*Prosopis*) *Hylæus mesillæ* Ckll. Medicine Hat, Alta., May, (Sladen); Fairview, May, (Buckell); Summerland, August, (Sladen).
Hylæus verticalis Cress. Toronto, July; Ottawa, June.
Hylæus saniculæ Rob. Toronto, July.
Hylæus nevadensis Ckll. Kaslo, B.C., June, (J. W. Cockle).
Hylæus cooki Metz. Kaslo, B.C., June, (Cockle).
Hylæus tridentulus Ckll. Kaslo, June, (Cockle); Penticton, June, (Buckell).

Colletidæ

Colletes compactus Cress. St. John, N.B., September, (Leavitt); Truro, N.S., September; Bridgetown, N.S., September.
Colletes æstivalis Patt. Aweme, Man., July, (Sladen).
Colletes willistoni Rob. Point Pelee, Ont., June, (N. K. Bigelow); Kazubazua, Que., June, (Sladen).
Colletes nudus Rob. Point Pelee, Ont., July, (N. K. Bigelow).
Colletes tegularis Swenk. Vernon, B.C., September, (Buckell).
Colletes angelicus Ckll. Penticton, B.C., September, (Buckell); Walhachin, September, (Buckell).

Megachilidæ

Formicapis neomexicanum Ckll. (= *F. clypeata* Sla.) Aweme, Man., July, (Criddle); Waterhole, Alta., August, (E. H. Strickland).
Andronicus producta Cress. Hemmingford, Que., June, (Beaulne); Aylmer, Que., June, (Sladen); Toronto, June; Ottawa, May, June, July, (Sladen); Saskatoon, May, (Sladen); Lethbridge, June, (Sladen).
Monumetha argentifrons Cress. Ironsides, Que., June. (Sladen); Toronto, August; Teulon, Man., June; Ft. William, Ont., June, (Sladen); Banff, Alta., August, (Sanson); Penticton, June, (Buckell); Ft. Simpson, McKenzie River, June, (C. H. Crickmay); Nicola Lake, B.C., May, (Buckell); Shawinigan Lake, V. I., July, (Sladen).
Osmia odontogaster Ckll. Sidney, B.C., May, (Sladen); Victoria, B.C., May, (Downes).
Osmia georgica Cress. Toronto, June.

Osmia simillima Sm. Sudbury, Ont., July.
Osmia californica Cress. Okanagan Lake, B.C., April, (T. Wilson); Lytton, B.C., July, (T. Wilson).
Megachile relativa Cress. Regina, Sask., August, (T. N. Willing); Peachland, B.C., August, (J. B. Wallis).
Megachile pruina Sm. Medicine Hat, August, (Sladen); Swift Current, Sask., August, (Sladen); Lethbridge, June, August, (Sladen); Summerland, B.C., August, (Sladen).
Megachile optiva Cress. Toronto; Muskoka.
Megachile montivaga Cress. Ottawa, July, (Sladen).
Megachile subexilis Ckll. Aweme, Man., July, (Criddle); Saskatoon, July, (Sladen); Melfort, Sask., July, (Sladen); Calgary, July, (Sladen); Banff, July, (Sanson); Lethbridge, June, (Sladen); Penticton, June, (Buckell) Ft. Norman, McKenzie Rv., August, (Crickmay).
Dianthidium notatum Latr. Summerland, August, (Sladen).
Anthidium cognatum Cress. Western Canada, (Cockerell).
Anthidium porteræ Ckll. Calgary, (Cockerell).
Cœlioxys mœsta Cress. St. Anne de la Porcatiere, August, (Sladen); Trenton, Ont., September, (Evans); Toronto, August; Ottawa, June, July, (Sladen); Bear Lake, Alta., August, (E. H. Strickland); Peachland, August, (J. B. Wallis); Shawinigan, V.I., July, (Sladen).
Cœlioxys dubitata Sm. Kirk's Ferry, Que., July, (Sladen); Athabasca, Alta., August, (E. H. Strickland).
Cœlioxys deplanata Cress. Medicine Hat, August, (Sladen).
Cœlioxys banksi Cwfd. Toronto, September.
Cœlioxys comstocki Cress. Lake Simcoe, Ont., September, (E. M. W.); Ottawa, July, (Sladen).
Cœlioxys sodalis Cress. Toronto; Point Pelee, Ont., June, (N. K. Bigelow).

Stelididæ

Stelis tripetinum Rob. (=*Stelis ontariana* Sla.) Ottawa, August.
Stelis monticola Cress. Vernon, B.C., (E. P. Venables).
Stelis montana Cress. Okanagan Falls, B.C., July, (Sladen); Lethbridge, June, July, (Sladen); Banff, August, (Garrett); Ft. Steel, B.C., June, (W. B. Anderson).
Stelis elegans Cress. Penticton, June, (Buckell).

Ceratinidæ

Ceratina acantha Prov. Aweme, Man., July, (Sladen); Oliver, B.C., April, May, June, September, (Garrett); Gordon Hd., B.C., July, (Downes); Victoria, April, May, (Treherne).

Apidæ

Bremus affinis Cress. Grimsby, Ont., August, (Sladen); Grimsby, Ont., September, (Brimley).
Bremus strenuus Cress. Kutlan Glacier, Y. T., June, (Alf. Pattison).
Bremus arcticus Kby. Bernard Harbour, N.W.T., June, August, (C. E. A.); Cape Ross, N.W.T., June, (V. Stefansson); Herschell Is., July, (F. Johansen).
Bremus bifarius Cress. Victoria, B.C., (F. W. Taylor); Banff, Alta., (N. B. Sanson).
Bremus bifarius nearcticus Handlirsch. Clinton, B.C., May, (R. Phair); White Horse, Y.T., July, (A. P. Hawes); Banff, Alta., September, (C. B. D. Garrett).
Bremus americanorum Fabr. N.S.
This is the same species that was recorded in the 1907 Ent. Rec. from Ottawa under the name "*Bombus pennsylvanicus* D. G."

Hemiptera

(Arranged according to Van Duzee's Check List)

Cicadellidæ

* *Phlepsius marmor* S. & Del. Onah, Man., July, on *Juniperus horizontalis* (Criddle). Proc. Ent. Soc. Wash., Vol. 25, No. 7, 1923.

Miridæ

* *Lopidea lathyræ* Kt. Aweme, Man., on *Lathyrus* (Criddle); Saskatoon, Sask., (A. E. Cameron).
* *Lopidea dakota* Kt. Winnipeg, Man., (Mitchener and Cocks); Saskatoon, Sask., (Cameron).
These two species described in Ent. News, Vol. XXXIV, No. 3, 1923.

Notonectidæ

* *Notonecta borealis* Tor. B. & Hu. Bearfoot Mountains, B.C., Sept.
Bul. Brook. Ent. Soc., Vol. XVIII, No. 3, 1923.

Ephemeroptera

* *Tricorythus atrata* McD. Wakefield, Que., August, (McDunnough).
* *Baetis phœbus* McD. Ottawa, Ont., (McDunnough and Richardson).
* *Baetis dardanus* McD. Aweme, Man., June, (Criddle).
* *Baetis nanus* McD. Ottawa, Ont., August, (McDunnough).
* *Centroptilum fragile* McD. Ottawa, Ont., August, (McDunnough).
* *Centroptilum curiosum* McD. Ottawa, Ont., August, (McDunnough).
* *Cloeon ingens* McD. Nordegg, Alta., (McDunnough); Banff, Alta., Banff, Alta., August, (Garrett).
* *Cloeon rubropicta* McD. Ottawa, Ont., June, August, Norway Point, Lake of Bays, Ont., July, (McDunnough).
* *Cloeon punctiventris* McD. Ottawa, Ont., August, (McDunnough).
* *Cloeon chlorops* McD. Ottawa, Ont., August, (McDunnough).
* *Siphlonuroides crœsus* McD. Ottawa, Ont., May, (McDunnough).
* *Siphlonuroides midas* McD. Ottawa, Ont., May, (McDunnough).
* *Siphlonurus berenice* McD. Cascades, Que., June, (McDunnough).
* *Siphlonurus phyllis* McD. Banff, Alta., July, (Garrett).
* *Ameletus validus* McD. Banff, Alta., October, (Garrett).
All these species described in Can. Ent., Vol. LV., No. 2, 1923.

Plecoptera

Perlidæ

* *Nemoura cornuta* Claas. Nanaimo, B.C., June, (E. P. Van Duzee).
* *Nemoura columbiana* Claas. Laggan, Alta., (J. C. Bradley).
* *Nemoura trispinosa* Claas. Murray Bay, Que., July, (E. Corning).
* *Leuctra bradleyi* Claas. Emerald Lake, B.C., July, (Bradley).

Odonata

Agrionidæ

Agrion æqualis Say. Winnipeg, Man., (Wallis).
Agrion maculatum Beau. Waugh, Man., July, (Wallis).

Libellulidæ

* *Williamsonia fletcheri* Will. Mer Bleue, Ont., (Young, McDunnough and Richardson). Can. Ent., Vol. LV., No. 4, 1923.

Orthoptera

Acrididæ

Acrydium brunneri (Bolivar). Fredericton, N.B., 1918, (G. P. Walker). (New to Province).
Platybothrus brunneus (Thomas). Goodlands, Man., Aug., 1923, (N. Criddle). (New to Province).
Dissosteira spurcata Saussure. Oliver, B.C., Aug., 1922, (E. R. Buckell). (New to Canada).
Trimerotropis gracilis (Thomas). Chilcotin, B.C., July, 1921, (E. R. Buckell). (New to Canada).
Trimerotropis salina McNeill. Baldur and Ashdown, Man., July, 1920, (N. Criddle). (New to Canada).
Schistocerca alutacea (Harris). Medicine Hat, Alta., Aug., 1923, (L. H. Seamans). (New to Canada).
Hesperotettix pratensis Scudder. Oliver, B.C., July, 1922, (E. R. Buckell). (New to Canada).
Hypochlora alba (Dodge). Goodlands, Man., Sept., 1923, (N. Criddle).
Phœtaliotes nebrascensis (Thomas). Oliver, B.C., Aug., 1919, (E. R. Buckell). (New to Province).
Asemoplus somesi Hebard. Banff, Alta., July, 1922, (C. B. D. Garrett).
Melanoplus borealis junius (Dodge). Anahim Lake, B.C., Aug., 1921, (E. R. Buckell). (New to Province).

Tettigoniidæ

Peranabrus scabricollis (Thomas). Nicola, B.C., Aug., 1922, (E. R. Buckell). (New to Canada).

Gryllidæ

Nemobius fasciatus (DeGeer). Kelowna, B.C., Aug., 1922, (E. R. Buckell). (New to Province).

ARACHNIDÆ

Linyphiidæ

Ceratinella atriceps Comb. Cabot Lake, Labr.
Gongylidium armatus Banks. Cabot Lake, Labr.
Hilaira brunneus Em. Cabot Lake, Labr.
Linyphia limitanea Em. Cabot Lake, Labr.
Erigone longipalpis Sund. South Labr.

Epeiridæ

Epeira angulata Clk. Cabot Lake, Labr.

Lycosidæ

Pardosa forcifera Thor. Nain, Labr.

All the above spiders taken by F. W. Waugh and presented to the Canadian National Collection.

The following species were described in the Can. Ent., Vol. LV, No. 10, 1923.

Linyphiidæ

* *Gongylidium columbianum* Em. Terrace, B.C., (Mrs. Hippisley).
* *Areoncus pedalis* Em. Dauphin, Man., (Hippisley).
* *Grammonota spinimana* Em. Moose Island, James Bay, (F. Johansen).
* *Cornicularia pacifica* Em. Terrace, B.C., (Hippisley).
* *Delorrhipus bicornis* Em. Terrace, B.C., (Hippisley).
* *Lophocarenum minimum* Em. Terrace, B.C., (Hippisley).
* *Lophocarenum inflatum* Em. Terrace, B.C., (Hippisley).

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