Forty-Sixth Annual Report

OF THE

Entomological Society

OF ONTARIO

1915

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE)

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
1916

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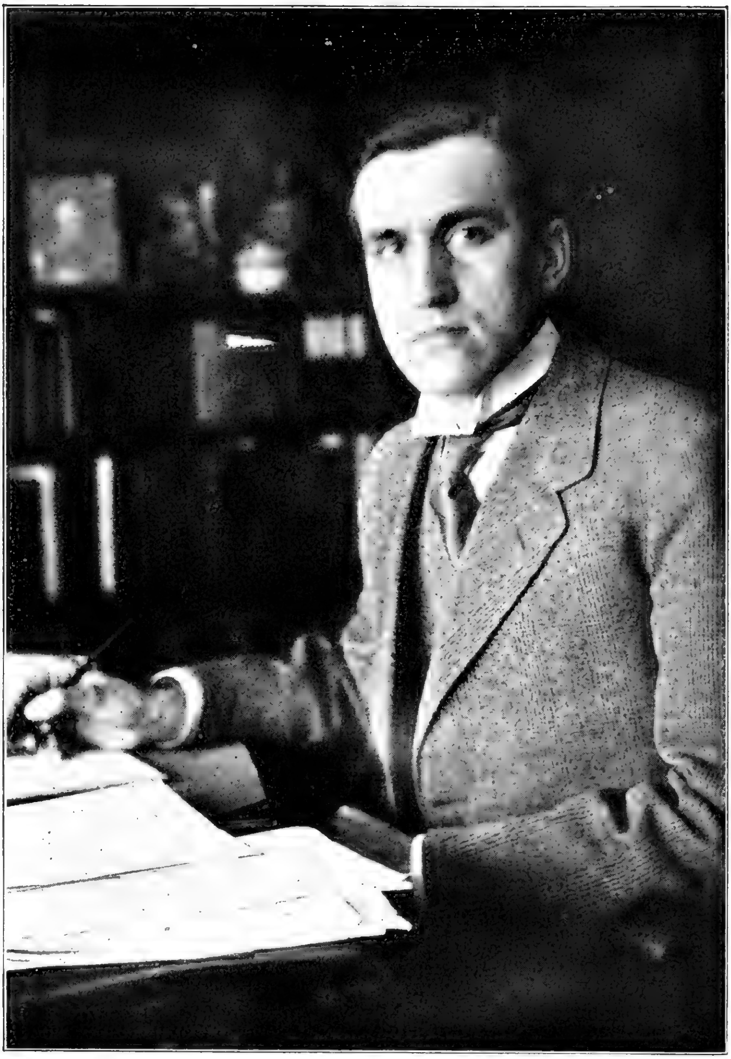

C. Gordon Hewitt, D.Sc., F.R.S.C.
President of the Entomological Society of Ontario, 1913-1915.

To His Honour SIR JOHN STRATHEARN HENDRIE, C.V.O., a Lieutenant-Colonel in the Militia of Canada, etc., etc., etc.,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned begs to present, for the consideration of your Honour, the Report of the Entomological Society of Ontario for 1915.

Respectfully submitted,

JAMES S. DUFF,

Minister of Agriculture.

Toronto, 1916.

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FORTY-SIXTH ANNUAL REPORT

OF THE

Entomological Society of Ontario

1915.

To the Honourable James S. Duff, Minister of Agriculture:

SIR,—I have the honour to present herewith the Forty-sixth Annual Report of the Entomological Society of Ontario, containing the proceedings of the Fifty-second Annual Meeting, which was held at Ottawa on November 4th and 5th, 1915. This meeting has been generally recognized as one of the most interesting and successful in the Society's history, and was attended by entomologists from nearly every province of the Dominion as well as from the United States and South Africa.

The reports of the various officers and branches of the Society, together with the papers and addresses presented at the meeting are embodied in the following pages.

The Canadian Entomologist, the Society's monthly journal, has been regularly issued and has now completed its forty-seventh volume. A special feature of this volume is the series of papers on Popular and Practical Entomology, which have appeared in each issue throughout the year.

I have the honour to be, Sir,

Your obedient servant,

EDMUND M. WALKER,

Editor.

Biological Department,
University of Toronto.

Entomological Society of Ontario

OFFICERS FOR 1915-1916

President—Mr. Albert F. Winn, Westmount, Que.

Vice-President—Prof. Lawson Caesar, Dept. of Entomology, Ontario Agricultural College, Guelph.

Secretary-Treasurer—Mr. A. W. Baker, B.S.A., Lecturer in Entomology, O. A. College, Guelph.

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

Librarian—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Professor of Entomology and Zoology, O. A. College, Guelph.

Directors—Division No. 1, Mr. Arthur Gibson, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, Mr. C. E. Grant, Orillia; Division No. 3, Dr. A. Cosens, Parkdale Collegiate Institute, Toronto; Division No. 4, Mr. C. W. Nash, Provincial Biologist, East Toronto; Division No. 5, Mr. F. J. A. Morris, Peterborough; Division No. 6, Mr. J. W. Noble, London, Ont.; Division No. 7, Mr. W. A. Ross, Vineland Station, Ont.

Directors (ex-Presidents of the Society)—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Guelph; W. Hague Harrington, F.R.S.C., Ottawa; Prof. John Dearness, Vice-Principal Normal School, London; Rev. Thomas W. Fyles, D.C.L., F.L.S., Ottawa; Prof. Wm. Lochhead, B.A., M.S., Macdonald College, Que.; John D. Evans, C.E., Chief Engineer, Central Ontario Railway, Trenton; Prof. Tennyson D. Jarvis, Grimsby Beach; 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.

Editor of "The Canadian Entomologist"—Prof. E. M. Walker, Toronto.

Delegate to the Royal Society of Canada—Mr. F. J. A. Morris, Peterborough, Ont.

FINANCIAL STATEMENT

For the Year Ending October 31st, 1915

Receipts.

Balance, 1913-14	$492 32
Dues	85 50
Subscriptions	439 30
Advertising	42 71
Government grant	500 00
Reports and back numbers	263 01
Cork and pins	157 99
Bank interest	9 68
	$1,990 51

Expenditures.

Cork and pins	$129 99
Printing	1,249 01
Expense	27 90
Salaries	250 00
Library	77 35
Annual meeting	86 60
Annual report	112 00
Insurance	26 00
Bank exchange	7 84
Balance on hand	23 82
	$1,990 51

Auditor: J. E. Howitt.

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

LIST OF MEMBERS

Ontario.

Addy, Paul H.	Jordan.
Astwood, J. C.	Port Arthur.
Auden, K. F.	Toronto.
Baker, A. W.	Guelph.
Bicknall, H. E.	Toronto.
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Burrows, A. R.	Guelph.
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Chrystal, R. Neil	Ottawa.
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Craigie, E. H.	"
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Dearness, Prof. J.	London.
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Dunlop, James	Woodstock.
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Fouse, C. M.	Toronto.
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Grant, L. J. M.	"
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Hannibal, J.	Toronto.
Harrington, W. H.	Ottawa.
Harrison, G. T.	Thorneloe.
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Hood, J. R.	Clifford.
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James, L. E.	St. Thomas.
Jarvis, T. D.	Grimsby East.
Johnson, G. S.	Whitby.
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Kitto, V.	Ottawa.
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Morris, F. J. A.	Peterborough.
Morse, A. E. W.	Grimsby.
Nash, C. W.	Toronto.
Noble, J. W.	Essex.
Petch, C. E.	Ottawa.
Prewett, F. J.	Toronto.
Ross, W. A.	Vineland.
Russell, J. M.	Woodstock.
Sanders, G. E.	Ottawa.
Saxby, J. W.	Toronto.
Sladen, F. W. L.	Ottawa.
Smith, Arthur	Toronto.
Snazelle, C.	"
Snazelle, Chas.	Thornloe.
Spencer, G. J.	Guelph.
Strickland, E. H.	Ottawa.
Thompson, W. R.	London.
Tothill, J. D.	Ottawa.
Walker, Prof. E. M.	Toronto.
Watson, Dr. A. H. R.	Port Hope.
White, James	Snelgrove.
Williams, J. B.	Toronto.
Wood, S. T.	"
Wright, W. H.	Guelph.

Quebec.

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Beaulne, J. J.	Ottawa.
Brainerd, Dwight	Montreal.
Burgess, Dr. T. J. W.	Verdun.
Chapais, J. C.	St. Denis.
Chagnon, G.	Montreal.
Clayson, G. H.	"
Corcoran, J. A.	"
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Dunlop, G. C.	Montreal.
Du Porte, E. M.	Macdonald College.
Germain, Bro.	Three Rivers.
Griffin, A.	Montreal.
Gooderham, C. B.	Macdonald College.
Huard, Rev. V. A.	Quebec.
Leopold, Rev. Father	La Trappe.
Letourneau, F.	Oka.
Lochhead, Prof. W.	Macdonald College.
Moore, G. A.	Montreal.
Simms, H. M.	"
Southee, G. A.	"
Winn, A. F.	Westmount.

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Bentley, Lettice	Lethbridge.
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Dod, F. H. Wolley	Midnapore.
Mackie, Donald	Edmonton.
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Whitehouse, F. C.	Red Deer.

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Hippesley, Mrs. W. W.	Winnipegosis.
Hunter, Dr. A. J.	Teulon.
Wallis, J. B.	Winnipeg.

Nova Scotia.

Abbot, Winona	Forbes Point.
Allan, E. Chesley	Yarmouth.
Baird, W. W.	Nappan.
Brittain, Prof. W. H.	Truro.
Cann, E. Mabel	Yarmouth N.
Conrad, Ethel M.	Halifax.
Craig, I. C.	Amherst.
Creighton, G.	Halifax.
De Wolfe, L. A.	Truro.
Dickey, C. M.	Kentville.
Distant, Mary S.	Halifax.
Dustan, A. G.	Bridgetown.
Gilliatt, F. C.	Granville Centre.
Good, C. A.	Truro.
Goodwin, Alberta	Stewiacke.
Henrion, Miss C.	Halifax.
Jennison, Mary	Truro.
Lindsay, Harriet E.	"
MacPherson, Dr. Hugh	Antigonish.
McGregor, Anna	South River Lake.

NOVA SCOTIA.—*Continued.*

McKay, Dr. A. H. .... Halifax.
Mitchell, Lillie J. .... "
Moses, Agnes .... Brooklyn.
Payne, H. G. .... Granville Ferry.
Payne, S. H. .... "
Perrin, Joseph .... Halifax.
Sanders, G. E. .... Bridgetown.
Scott, Prof. J. M. .... Truro.
Shaw, Prof. P. J. .... "
Shipton, J. W. .... Moschelle.
Sinclair, Nellie .... South River Lake.
Smith, M. Lois .... Truro.
Spittall, J. P. .... "
Trevoy, Nellie M. .... Brighton.
Wetmore, Ralph .... Yarmouth.
Whitehead, W. E. .... Kentville.
Whitman, C. F. U. .... Lawrencetown.
Williams, C. M. .... Nappan.
Young, Ermina .... Brighton.
Young, M. E. .... Middleton.

SASKATCHEWAN.

Androchowicz, E. .... Humboldt.
Hutchinson, H. .... Starblanket.
Johnson, G. S. .... Moose Jaw.
McCulloch, A. J. .... Regina.
Neville, S. J. .... Cottonwood.
Willing, Prof. T. N. ..... Saskatoon.

BRITISH COLUMBIA.

Abbs, A. W. .... Vancouver.
Abriel, T. .... Nakusp.
Anderson, E. M. .... Victoria.
Anderson, J. R. .... "
Bain, T. H. .... N. Vancouver.
Banks, W. W. .... Salmon Arm.
Bird, M. L. .... Vancouver.
Blackmore, C. H. .... Victoria.
Brand, James .... Vancouver.
Brealey, A. .... Hatzic.
Brett, W. F. .... Armstrong.
Breun, L. A. .... Victoria.
Bryant, T. .... Ladysmith.
Brydon, J. M. .... Victoria.
Bush, A. H. .... Vancouver.
Chapman, C. .... "
Cockle, J. W. .... Kaslo.
Collins, H. W. .... Grand Forks.
Cunningham, T. .... Vancouver.
Currie, H. B. .... Salmon Arm.
Davidson, J. T. .... Vancouver.
Day, G. O. .... Vancouver Island.
Evans, H. H. .... Okanagan Centre.
French, P. E. .... Salmon Arm.
Fulton, C. .... Kelowna.
Fulton, G. H. .... Port Haney.
Gavet, D. .... Vancouver.
Gemmel, M. .... Sechelt.
Getchell, F. H. .... Vancouver.
Hadwen, Dr. S. .... Agassiz.
Hanham, A. W. .... Duncan's Station.
Hill, Tom .... Vernon.
Hoy, B. .... "
Hugh, W. .... Victoria.
Hunt, E. C. .... Creator.
Jackson, W. .... Creston.
Kyte, R. J. .... Notch Hill.
Leach, D. H. .... Salmon Arm.
Lyne, W. H. .... Vancouver.
Matheson, J. B. .... Kelowna.
McCubbing, C. .... Salmon Arm.
McKenzie, K. .... Kelowna.
Middleton, M. .... Nelson.
Mitchell, D. .... Tappin.
Palmer, L. L. .... Vernon.
Palmer, R. M. .... S. Cowichan.
Parham, G. L. .... Invermere.
Reed, E. Baynes .... Victoria.
Robertson, W. H. .... "
Robinson, E. H. ....
Ross, A. H. .... Nelson.
Rowland, A. .... Vancouver.
Ruhman, M. .... Vernon.
Russell, D. .... Lavington.
Russel, M. W. .... Kelowna.
Scott, W. E. .... Victoria.
Skinner, E. M. .... "
Taylor, L. E. .... Kelowna.
Thornber, H. .... Kamloops.
Tomlinson, A. H. .... Prince Rupert.
Treherne, R. C. .... Agassiz.
Venables, E. P. .... Vernon.
Ward, W. E. .... Vancouver.
Whiting, H. H. .... Rock Creek.
Wilkerson, G. E. .... Victoria.
Wilson, Tom .... Vancouver.
Winslow, R. M. .... Victoria.
White, E. W. .... Sardis.

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Cockerell, Prof. T. D. A... Boulder, Col.
Comstock, Prof. J. H.... Ithaca, N.Y.
Cresson, Ezra T.......... Philadelphia, Pa.
Felt, Dr. E. P............ Albany, N.Y.
Howard, Dr. L. O........ Washington, D.C.
Webster, Prof. F. M...... "
Wickham, Prof. H. F..... Iowa City, Ia.

LIFE MEMBERS

Bethune, Rev. C. J. S..... Professor of Entomology, Ontario Agricultural College. Guelph.
Fyles, Rev. Dr. T. W..... Ottawa.
Reed, E. Baynes .... Director of the Meteorological Station. Victoria.

The Entomological Society of Ontario

ANNUAL MEETING

The Fifty-second Annual Meeting of the Entomological Society of Ontario was held at Ottawa on Thursday and Friday, November 4th and 5th, 1915. The President of the Society, Dr. C. Gordon Hewitt, occupied the chair. Among the members present were: Dr. H. T. Fernald, Amherst, Mass.; Mr. A. F. Burgess, Melrose Highlands, Mass.; Professor C. P. Lounsbury, Pretoria, South Africa; Dr. Hugh Glasgow, Geneva, N.Y.; Rev. T. W. Fyles, Ottawa; Dr. C. G. Hewitt and Messrs. Arthur Gibson and J. M. Swaine, Entomological Branch, Ottawa; Messrs. R. C. Treherne, G. E. Sanders, J. D. Tothill, E. H. Strickland, N. Criddle, G. Beaulieu, W. A. Ross, J. R. Gareau, C. E. Petch, R. N. Chrystal, and L. S. McLaine, Field Officers of the Entomological Branch; Prof. L. Caesar, Prof. E. J. Zavitz, and A. W. Baker, of Guelph; Prof. W. Lochhead, E. M. Duporte and T. Rankin, of Macdonald College; Prof. W. H. Brittain, Agricultural College, Truro, N.S.; Tom Wilson, Vancouver, B.C.; F. J. A. Morris, Port Hope, Ont.; A. F. Winn, Montreal; J. C. Chapais, St. Denis-en-bas, Que.; H. G. Payne, Kentville, N.S.; H. G. Crawford, Wilton Grove, Ont.; Rev. Father Leopold and Professor Letourneau, of La Trappe, Que.; Chas. MacNamara, Arnprior, Ont.; and Sir James Grant, Prof. E. E. Prince, Dr. T. Torrance, Dr. C. H. Higgins, Dr. F. T. Shutt, W. T. Macoun, R. H. Campbell, H. T. Gussow, W. Ide, D. Johnson, F. W. L. Sladen, V. Kitto, A. E. Kellett and J. I. Beaulne, Ottawa.

THURSDAY, NOVEMBER 4TH—MORNING SESSION.

The President: In opening our general session, I should like to welcome you all to Ottawa. This is an unusual meeting for a number of reasons. It is not the first meeting we have had in Ottawa—but it is an unusual meeting in that we have here for the first time all the officers of the Entomological Branch. Secondly, it is an unusual meeting as we have with us, and are honored by the presence of, Mr. C. P. Lounsbury, the Government Entomologist for the Union of South Africa. The surpreme nature of his visit prevented the appearance of his name on the programme, but that will not release him from taking part in our deliberations. He will probably have something to say later on. I, as President, did not prepare anything in the nature of an address for this meeting as we have a rather long programme. In the course of the proceedings I shall probably have a little to say regarding the progress of our work and of entomology in Canada generally. We have a certain amount of business to complete before our real session begins and I will now call upon the Secretary to read the Report of the Council.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1914-15.

The Fifty-first Annual Meeting of the Society was held in Toronto on Thursday and Friday, November 5th and 6th, 1914. The meeting of the Council was held in the Biological Building of the University of Toronto, and the general meetings were held at the Royal Canadian Institute. The President, Dr. C. Gordon Hewitt, occupied the chair during the sessions.

The annual meeting of the Council was held on Thursday morning. Numerous business matters were discussed and a recommendation was made to the Society that the next annual meeting be held in Ottawa.

On Thursday afternoon the Reports of the Directors on the insects of the year were read. Dr. Hewitt then delivered the Presidential address on "The Rise and Progress of Applied Entomology in Canada." Prof. Caesar then delivered a paper on the "Insects of the Season in Ontario."

On Thursday evening in the Biological Lecture-room of the University Prof. J. H. Comstock, of Cornell University, delivered the Public Lecture on the "Habits of Spiders." The lecture was extremely interesting and was extensively illustrated with magnificent lantern slides.

The business meeting of the Society was held on Friday morning at 9.30. The reports of the various officers and branches of the Society were read and adopted. The remaining time of the morning and afternoon meetings was occupied with the reading of the following papers:

"The Work of Fabre," Prof. Lochhead, Macdonald College, Que.

"Injurious Insects of Quebec in 1914," Prof. Lochhead. (Read by title.)

"Injurious Insects of Southern Quebec," Mr. C. E. Petch, Ottawa. (Read by title.)

"Outbreak of the Army-worm in Canada in 1914," Mr. Arthur Gibson, Ottawa.

"The Army-worm in Ontario in 1914," Mr. A. W. Baker, Guelph.

"Mountains and Hills," Dr. Fyles, Ottawa.

"Variation in colour in the bristles of the Hedgehog Caterpillar, Isia isabella," Mr. Arthur Gibson, Ottawa.

"Locust Control in Eastern Canada," Mr. Arthur Gibson, Ottawa.

"An Imported Red Spider attacking fruit-trees," Prof. Caesar, Guelph.

"The Entomological Record, 1914," Mr. Arthur Gibson, Ottawa.

"Forest and Shade-tree Insects of the Farm," Mr. J. M. Swaine, Ottawa.

"Cherry Fruit-flies," Prof. L. Caesar, Guelph.

The Canadian Entomologist, the official organ of the Society, has been published regularly each month. The forty-sixth volume of the magazine was completed in December, 1914. It consisted of 446 pages and was extensively illustrated. This is the largest volume to date.

The Annual Report of the Society contained the proceedings of the annual meeting and formed a valuable edition to our entomological literature.

The regular meetings of the Society were reduced in number owing to military activities at the Ontario Agricultural College. The meetings were chiefly of a business character, but during the year the following papers were read:

"Some interesting points in the Army-worm Outbreak of 1914," Mr. A. W. Baker.

"The Study of Entomology," Prof. L. Caesar.

"Laboratory Methods in Collecting, Preserving and Dissecting Insects," Mr. G. J. Spencer.

The records show that twenty-four new members have been added to the rolls of the Society during 1914-15. The reports of the branches of the Society for 1913-14 all showed a successful year. It is with much pleasure that the Council records the formation, due largely to the efforts of Prof. W. H. Brittain, of a large and flourishing branch of the Society in Nova Scotia.

REPORT OF THE CURATOR.

The collections of the Society have been examined from time to time during the past year and kept free from museum pests.

With a view to supplying in a small way the sad need of Diptera, Hemiptera and Hymenoptera, special collections were made this summer and, as soon as the material can be identified and labelled, it will be added to the collections.

Contributions of these orders to the Society collections from members will be greatly appreciated.

G. SPENCER, *Curator.*

REPORT OF THE LIBRARIAN.

During the year ending October 31st, 1915, seventeen bound volumes have been added to the library, making the number on the register 2,220. A large number of unbound pamphlets, bulletins, reports and periodicals have been received from authors and publishers and in exchange for *The Canadian Entomologist.* No binding has been done during the past year.

Among recent additions to the library may be mentioned the following: Packard's "Monograph of the Bombycine Moths of North America, Part 3"; Sir G. Hampson's "Catalogue of the Lepidoptera Phalænæ in the British Museum," Vol. 13 and supplementary vol. 1; Fletcher's "Some Indian Insects"; Slingerland and Crosby's "Manual of Fruit Insects"; Pierce's "Genitalia of British Geometridæ."

Reference to the library is constantly being made by the staff and students of the Biological Departments of the Ontario Agricultural College, and books are from time to time taken out by members of the Society at a distance.

Respectfully submitted,

CHARLES J. S. BETHUNE, *Librarian.*

REPORTS ON INSECTS OF THE YEAR.

DIVISION NO 1, OTTAWA DISTRICT—ARTHUR GIBSON, ENTOMOLOGICAL BRANCH, OTTAWA.

ATTACKING FIELD CROPS.

LOCUSTS. These insects were again very abundant in eastern Ontario. The young locusts began to appear towards the end of May, but owing to dull, cool weather conditions did not become active until the first and second weeks of June. The Lesser Migratory Locust (*Melanoplus atlanis*) was the chief destructive species. It was accompanied in noticeable numbers by the Pellucid Locust (*Camnula pellucida*). These two species are frequently found working together. Near Bowesville, Ont., where we continued our work on control with poisoned baits, the insects were present in countless thousands. The crops attacked were chiefly oats, barley, timothy, buckwheat, clover, tobacco, potatoes, and corn. In one instance near Ottawa about 6,000 celery plants were destroyed. On page 156 will be found a brief account of our 1915 work with poisoned baits.

Cutworms. The two species which in 1915 effected most damage in the Ottawa district are the Common Striped Cutworm (*Euxoa tessellata*), and the Dark-sided Cutworm (*Euxoa messoria*), both of which were very abundant the previous season. Vegetable and flowering garden plants were freely attacked. The former was the chief culprit and destroyed first sowings of beets, carrots, onions, etc. To a lesser extent the Red-backed Cutworm (*Euxoa ochrogaster*) was also present, being reported specially by vegetable growers. The Kansas grasshopper formula (Bran 20 lbs., Paris green 1 lb., molasses 2 quarts, oranges or lemons 3, water 2½ gallons*) this year gave excellent results at Ottawa for the control of cutworms. In one large field of onions the outbreak was stopped immediately. When scattered thinly the 20 lbs. may be used to treat about 3 acres, the application to be made after sundown. In one field of corn cutworms were plentiful and an application of the above mixture was made. Further injury was thus prevented and an examination made around 40 hills by Mr. Bryce, of Macdonald College, resulting in the finding of from 1 to 6 dead cutworms near each hill.

Root Maggots. The three species, viz., The Cabbage Maggot (*Phorbia brassicæ*), the Imported Onion Maggot (*Hylemyia antiqua*), and the Seed-corn Maggot (*Phorbia fusciceps*), were all present in the Ottawa district in 1915, the two former causing much loss. The latter was reported attacking beans in small gardens. The Cabbage Maggot was particularly destructive to cauliflowers, cabbages, turnips and radishes. One market gardener near Ottawa reported the loss of 3,500 early cauliflowers. In continuing our work on the control of this insect we again demonstrated the value of the one-ply tarred felt paper disc. In one experiment about 1,600 plants had the discs placed around their stems and practically the whole crop was protected from maggot attack. The control of these root maggots is discussed in full in a bulletin which we have just prepared and which we hope will be available for distribution in the spring of 1916.

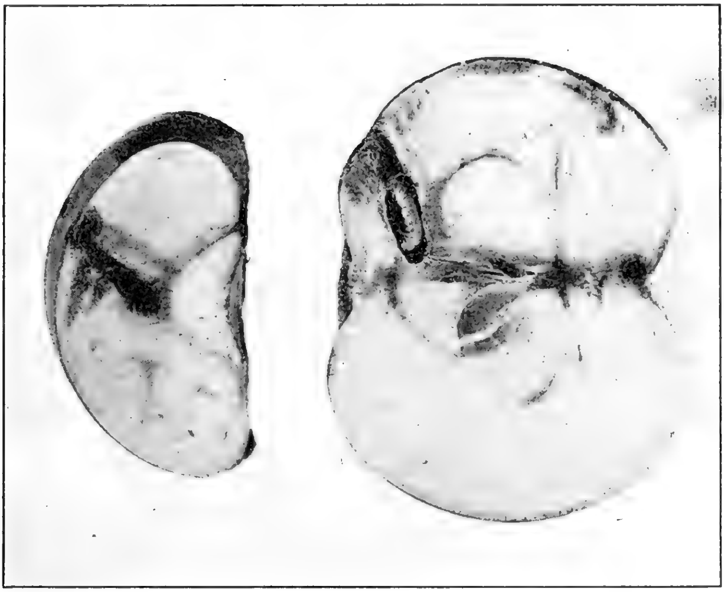
The Asparagus Beetles. In September 1906, we found at Ottawa the larvæ of the Common Asparagus Beetle (*Crioceris asparagi* L.). Until 1915, this was the only record we had for the district. During the past season, however, the insect was abundant and destructive, and it was accompanied by the Twelve-spotted Asparagus Beetle (*Crioceris 12-punctata* L.). The year 1915 is the first in which we have found this latter species at Ottawa. The adult beetles were commonly found in the latter half of August. The larvæ of the latter species were collected from the seeds of asparagus on September 23rd. Growers of asparagus in the Ottawa district should watch for the appearance of these beetles in spring and apply the well known remedies.

The Ash-gray Blister Beetle (*Macrobasis unicolor* Kirby). Large numbers of this insect were observed in eastern Canada, near Ottawa, and also in parts of Quebec Province, where locusts had been destructive. In one field of potatoes which I examined in the latter half of June the beetle was present in thousands and the vines were conspicuously defoliated. At Bowesville, near Ottawa, Mr. T. Rankin found the insect abundant in early July. In addition to potatoes this blister beetle attacks beans, peas, beets, tomato, clover, etc.

*In preparing the bran mash the bran and Paris green are mixed thoroughly while dry. The juice of the oranges or lemons is squeezed into the water, and to this is also added the pulp and peel after cutting into fine bits. The molasses should then be added, and when dissolved the mixture should be poured on to the dry bran and poison, stirring the whole constantly so as to dampen the bran thoroughly.

THE RED-HEADED FLEA BEETLE (*Systena frontalis*). In the middle of August this common black flea-beetle was seen at Ottawa to be attacking potatoes, and in flower gardens asters and chrysanthemums were injured. It was also found on carrot. It may be easily recognized by the conspicuous red patch on the top of the head; in length it is about three-sixteenths of an inch. Potato vines which are properly sprayed to protect them from the Colorado Potato Beetle would, of course, also be protected from the ravages of the Red-headed Flea Beetle.

PEA APHIS (*Macrosiphum pisi*). In eastern Ontario a rather serious outbreak of the pea aphis occurred, and from a few places reports of injury by the CARROT RUST FLY (*Psila rosæ*) were received.



Illustrating larva of Dock Sawfly, *Ametastegia glabrata* (*Taxonus nigrisoma*) and its habit of boring into apples in autumn in which to hibernate. (Original.)

ATTACKING FRUIT TREES.

APHIDES. These insects were present in large numbers during the season, many enquiries being received particularly with regard to the species occurring on plum and apple.

THE OYSTER-SHELL SCALE (*Lepidosaphes ulmi* L.) was frequently reported, but few instances of noticeable damage by the Codling Moth (*Cydia pomonella*), came to my notice.

THE DOCK SAWFLY (*Ametastegia glabrata* Fallen). During 1915 this insect, which in Canadian literature was previously known as *Taxonus nigrisoma* Nort., was abundant throughout eastern Canada, and its well-known habit of boring into apples in autumn was complained of. The same injury was noticed at Ottawa. In 1902, Fletcher* first recorded such injury to apples in Ontario, which was also in that year observed at Ottawa. The larva, which is known as the Dock False-worm, usually feeds on plants of the Dock family. Its habit of boring

*33rd Annual Report of the Ent. Soc. of Ontario.

into the soft flesh of apples in autumn to hibernate is shown in figure 1. In one apple examined in September last two larvæ were found. The holes where the larvæ had entered were conspicuous. Several apples were examined and, in one, three holes occurred close together. An examination of these indicated that the larva evidently has the habit of boring several holes before finally closing one up in which to pass the winter. In one case the cavity in the apple was five-eighths of an inch long by one-eighth of an inch wide. The end was closed up with the "chewings" made by the larva, no frass being present. In another instance the larva had entered to a distance of nine-sixteenths of an inch and in still another eleven-sixteenths of an inch. In every case the head of the larva was towards the skin or outside of the apple. The larva was one-half inch in length, dark green in colour, the sides and centre whitish green; head pale brown, darker brown at vertex, on either side a conspicuous dark brown spot. In the December, 1915, number of the Proceedings of the Entomological Society of Washington, Rohwer places the name we knew the insect by, viz., *Taxonus nigrisoma* Nort., as a synonym of the European species, *Ametastegia glabrata* (Fallen).

Greenhouse and Garden Plants.

Garden plants of many kinds suffered seriously from the attacks of plant lice, and in early spring newly set out annuals were cut off by cutworms, the Striped Cutworm being the most destructive of the species which occurred in 1915.

The Four-lined Leaf Bug (*Pœcilocapsus lineatus* Fab.) was abundant in the district, attacking freely such garden plants as asters, dahlias, etc.

The Red-headed Flea Beetle (*Systena frontalis*). As already mentioned, this common flea-beetle was found this year in August attacking asters and chrysanthemums.

The most interesting greenhouse insect of the year at Ottawa was the occurrence of the Chrysanthemum Midge, (*Diarthronomyia hypogæa* H.Lw.) in one of the large houses. This insect had doubtless been recently introduced with the plants from the United States, where it has become recently established. The Ottawa occurrence is the only record we have of the midge in Canada. Dr. Felt,* the New York State Entomologist, in writing of the species in April, 1915, recommends the destruction of badly infested plants by burning. Where the leaves only show slight infestation many of these may be removed. Fumigation with hydrocyanic acid gas would, of course, destroy the midges but would have little or no effect on the larvæ, which work within the leaf tissues.

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

So far as the writer is concerned, the Entomological season of 1915 opened April 7th with a trip to the Etobicoke, a small stream that enters Lake Ontario a few miles west of the city. The banks of this creek are still wooded in many places, and even yet the Indian significance of the name, "the place of the Alder," is peculiarly applicable. The locality was choice, but a delightfully warm sun and the lethargy incident to the first tramp of the year made energetic collecting almost an impossibility. This and the early date serve as an explanation of the confession that the only insects captured were specimens of *Aphodius femoralis* Say., many of which were on the wing.

The excessive rainfall and the low average temperature of the past summer do not appear to have reduced materially the production of the various forms

*Jour. Econ. Ent., Vol. 8, 267.

of insect life. Some orders were relatively poorly represented in the early part of the season, but later on became normally abundant. With the exception of the Cabbage-butterfly, other species were not so common as usual, until about the end of August, when several forms began to appear in larger numbers. At Mt. Dennis, Oct. 11th, many specimens of Milbert's Tortoise-shell, *Vanessa milberti* Godart, were flitting about or resting upon the heads of the large purple aster, the flower and insect combination adding a pleasing touch of color to the otherwise rather sombre tints of the frost-touched vegetation. After about the middle of July the Baltimore, *Melitaea phaeton* Drury, was fairly plentiful. As a general rule, both of these species are comparatively rare in this district.

The damage done this year by several injurious insects has been more pronounced than usual.

At the beginning of the season, the webs of the Tent caterpillars were frequently seen on the Choke Cherries and other native trees of the fence rows and thickets in the vicinity of the city. From complaints received from fruit growers, it would seem that this pest has lost none of its wonted energy, and is still an important issue from an economic standpoint.

The continuous wet weather is credited by many with the greatly increased activity of the Carrot Rust Fly, *Psila rosae*. A gardener of many years' experience, who had never noticed the pest before, had his crop completely ruined by its ravages. In some cases the larvae had so tunnelled the carrot that the entire cortex was destroyed; it was impossible to find a single plant that was not attacked. For the benefit of others who may have crops similarly affected, I take the liberty of quoting the directions, kindly sent by Mr. Gibson, for bringing the insect under control. "Protection against the attack of the insect may be obtained, early in the season, at the time the plants are thinned out, by spraying with the ordinary kerosene emulsion, diluted one part in nine of water. Where carrots are stored in sand for winter use, the larvae leave the roots and pupate in the soil. In spring, of course, such sand in which the puparia occur should be removed and buried in a deep hole or thrown into a pond. It is wise to use land next year in which the carrots were not grown during the present season."

Sawfly larvæ were received from Mr. Blakely, of the Parks Department, who reported that they were damaging the California poplars in the eastern part of the city. Several trees were attacked by them, and the leaves badly eaten. These larvæ have a ground colour of yellow, broken by two pairs of lateral rows of black spots. In the upper series, these are irregularly circular in outline; in the lower, while of nearly the same shape, they are much smaller. The vertex of the head is black, shading to a deep brown at the front and sides. All the mouth-parts are yellow, with the exception of the mandibles, which are black. A black spot covers the dorsal portion of the last segment. The whole body bears a covering of long light-yellow hairs. The larvæ are gregarious feeders. Mr. S. A. Rohwer, Washington, to whom specimens were sent, writing under date of Sept. 27th, replied as follows:

"Yours of the 25th instant reached me this morning. The sawfly larvæ that you sent cocooned en route, but I do not doubt in the least that it is *Trichiocampus viminalis* (Fallen), a species that is treated under the name of *Aulacomerus lutescens* by Lintner in the fourth report of the State Entomologist of New York, pages 44-46. As far as I am aware, this is the first report of this species being of economic importance. The larvæ cocoon in the leaves, or the cocoon is attached along the trunk of the tree. Lintner found two generations, and this is probably the last. The best control measures to be adopted would be the raking up and burning of the leaves."

The Lesser Bud-moth, *Recurvaria nanella*. Larvæ of this Europeon species were found in numbers at Toronto, on a pear tree; and an apple tree in an adjoining lot had all the leaves rolled up by the larvæ. The species was determined by Mr. August Busck. The insect is discussed at length in Bull. 113 of the United States Department of Agriculture.

A large percentage of the grasshoppers, examined during September, were found to be parasitized by "hair snakes" of either the genus *Gordius* or *Mermis*, the latter being more numerous. The Red-legged Grasshopper, *Melanoplus femur-rubrum* De G., was the favorite host in this district. It would seem a reasonable conjecture that the wet season has had, in this case, a deterring effect on the production of the grasshoppers by furnishing more suitable conditions for the development of this parasite, but the dexterity with which the infected specimens evaded a net has given me grave cause to doubt the efficiency of this check. At least it seemed impossible to distinguish parasitized from unparasitized forms by any lessened activity on the part of the former.

Throughout July, the unusually wet weather must have produced ideal conditions for the maturing of aphids, as these insects were forced upon the attention at all times. Many different species of plants were infested, the spiraeas and roses of the city gardens were often seriously injured by them, and even the burdocks and lamb's quarters, of the vacant lots, were not immume from their attacks. Masses of a small black species surrounded the stems and leaf petioles of the common nasturtium, in many cases killing the smaller plants. Another variety established colonies on the flower clusters of the honeysuckles, and destroyed the majority of the unopened buds. Especially in the case of infected roses, a number of different remedies were applied. Some growers apparently had implicit faith in the effectiveness of an "absent" treatment, and did nothing at all, to the detriment of their own and their neighbor's plants. Others were firmly convinced that spraying with cold water was all that was necessary, while a few substituted a solution of nicotine. This last method appeared to give universal satisfaction wherever it had been properly tried. One gardener did, however, assure me that his bushes had developed a particularly hardy variety of aphid that refused to succumb even to the nicotine application.

A very interesting root gall was collected early in the spring by Prof. J. H. Faull, University of Toronto. The galls, which are produced on the roots of the False Solomon's Seal, *Maianthemum canadense*, Desf., consist of elongated swellings, from 8-12 mm. in length, and 2-3 mm. in diameter. They are circular in cross-section, and fairly regular in shape, tapering gradually at each end to the size of the normal rootlet. As the specimens were immature when secured, it was necessary to keep them under moist conditions for several weeks. This may account for the fact that only four producers were secured from a dozen galls. The insects were sent to Dr. E. P. Felt, Albany, N. Y., who has pronounced them a new species, and is describing them under the name *Dasyneura torontoensis*. The only information that we possess, concerning the life histories of the adults, is that they emerge late in June. The light color of the insects would seem to indicate that the greater part of their existence is spent underground.

Division No. 5, Port Hope District—Francis J. A. Morris.

An active collector of Lepidoptera in Port Hope, Mr. H. L. Bowers, has now moved to Oshawa and reports an unprofitable season's work due to bad weather and unfamiliarity with his surroundings. He writes:

I collected pretty steadily until June 15th, but took few specimens, Oshawa being a poorer hunting ground than Port Hope. Extreme wet seemed to keep insect pests in the background. "*Pieris rapae,*" owing to spread of wild mustard, seems on the increase; in September the fields were white with them; milkweed butterflies were more numerous than last year; other butterflies were scarce; such scarcity has been remarkable the last two or three seasons. During 1912 I could have taken hundreds of *Vanessa J-album,* but have seen few since. Tent caterpillars, both American and forest, were more numerous this year than last. Many orchards around Oshawa were completely defoliated. I was interested to see how much these were parasitized, and out of 100 cocoons, I did not find one thus suffering. Pistol case-bearer of the apple was very plentiful. I noticed many apple trees badly infested with aphids. The tendency to allow wild apple, cherry and plum to grow unchecked has a great tendency to render means taken by progressive orchard-men to keep down insect pests, largely abortive. Practically all of the wild apple trees that I have seen around Oshawa have been heavily infested with the Oyster-shell scale. In September, I saw many cherry trees near Newtonville badly eaten by pear-tree slug (*Selandria cerasi*). The caterpillars of certain species of *Crambus* were very numerous in meadows. I noticed the maple trees in Oshawa badly infested with Pigeon Horn Tail, which oviposited continuously from August 3rd to September 15th; *Thalessa lunator* was also plentiful. Hemlocks on the main street were badly infested with *Tortrix funiferana.* Some horse-chestnuts were badly eaten by tussock caterpillars. The Promethea moth, found very scarce at Port Hope (one cocoon in six years), seems plentiful here. I took *Phigalia titea,* April 13th; *Orthofidonia vestaliata* were plentiful for several weeks; *Drepana arcuata,* May 30th; *Sphinx cerisyi,* June 13th; *Thecla liparops,* July 18th. I have identified some of the captures made last year, and the following is a list of those made at Port Hope, which have some interest. I believe they are all fairly scarce:—

Sphinx cerisyi.
Diphthera fallax.
Hyperaeschra georgica.
Fentonia marthesia.
Galgula hepara.
Catocala innubens.
Catocala vidua.
Raphia pater.
Semiophora opacifrons.
Semiophora tenebrifera.
Hydriomena ruberata (*birivata?*).
Thecla edwardsii.

Dr. Watson of Port Hope reports the cutworm locally troublesome on cabbage and cauliflower.

Mr. Duncan, of the Department of Agriculture in Port Hope, says the Potato Beetle was very prevalent and that he noticed in several places the Friendly Perillus at work destroying the larvæ. Aphids were not so abundant. He was called to look at an apple orchard near Orono that was overrun by Tent caterpillars. It was ten or twelve acres in extent, and most of the trees were denuded of foliage and bore no fruit, except in the one corner that he was able to save by spraying with arsenate of lead. Some idea of the numbers of these creatures could be gathered from a sack that he saw slung over a branch in the orchard: *ex pede Herculem*—in the folds of the sack he counted over fifty cocoons. His recollection is that both species of caterpillar were equally numerous. The orchard was a well-kept one and had not been attacked in 1914. This, again, points in the same direction as Mr. Bowers' note. There were doubtless rich breeding grounds along some nearby fences the year before, or even that same season, but the larvæ ran out of food and like many another young innocent crept into the apple orchard. The canker worm was also prevalent in the orchard.

The school collections of insects, Mr. Duncan says, were up to average and a few collections were extensive and well arranged. In the Peterborough Collegiate 30 or 40 of these come in annually and I often find specimens of great interest among them. This year the families of American Silk-worm moths and of Sphingidæ were remarkably well represented. Among the latter was a very beautiful specimen of the Nessus (*Amphion nessus*).

For the amateur collector the summer of 1915 was far from favourable. The bright days of May and June were nearly all marred by cold winds. This kept the sun-loving species inactive, and made your director's favourite field of collecting comparatively barren. This feature was specially noticeable in the second week of June and again after a spell of wet weather at the end of June. The early mornings were bright and promised well, but by noon quite a chill wind from the east had sprung up and the results of several all-day tramps were on the whole disappointing. In two years' residence in Peterborough it has been impossible for me to collect through the month of July, owing to work in Toronto. Next season this work will probably not be incumbent, and I have great hopes of watching more closely the insect visitors to blossoms during June and July in my new neighborhood. So far my observations have been chiefly confined to bark, sap, fungus and foliage.

Very early in May the tent caterpillars again made their appearance about Peterborough in large numbers. The city authorities set apart a small sum of money and had some men go round the residential streets within the limits, cutting off infected limbs and destroying some of the apple trees and wild plums on waste grounds and in hedges where the pest abounded. This work seemed fairly effective in saving shade trees about the city, but it did not strike at the root of the evil as Mr. Bowers points out. I had the curiosity one day to count the webs (very populous webs) beyond the limits on a stretch of lane about equal in length to two blocks of city street. They numbered over 100; choke-cherry, pin-cherry, wild plum, apple, and hawthorn, all affording food and shelter to myriads of both the forest and the apple tent caterpillar.

Early in May I paid a visit to the alder swamp between Peterborough and Best's where the varieties of Chrysomela reported last season had been found. These were all present once more, the differences from normal being apparently quite constant. In the middle of May where some cedar groves had been chopped down, I took several specimens of *Callidium aereum* on a cedar·trunk. At the end of May I captured some interesting beetles in hawthorn blossom; these included *Cyrtophorus verrucosus, Molorchus bimaculatus, Callimoxys sanguinolentus, Acmæops proteus, Leptura capitata,* and *L. sex-maculata; Orsodachna atra;* and *Malachius æneus.* This last was new to me, though a single specimen was taken near Port Hope this year by Dr. Watson. It is very abundant in the neighborhood of Peterborough. The collection made by pupils at our collegiate, I notice, are rarely without it. Last season I saw fifteen or twenty at the end of June on the blossoming heads of meadow grass; and this season I captured over a hundred from a single hawthorn on Aylmer Street without apparently reducing the number of guests at the banquet. This beetle is interesting to the systematist. It is described by Le Conte and Horn as introduced from the West coast and is, moreover, *sui generis* in Eastern America. The family occupies a space between the Lampyridæ and the Cleridæ. I think the only other member of the family known to me is a *Collops,* a very pretty little beetle (also frequenting blossoms) that I have captured occasionally—once at Guelph, when I was out with Mr. Caesar.

In the first week of June at Jubilee Point on the north shore of Rice Lake I captured two specimens of an Agrilus, steel-blue, with white marginal marks on the metasternum and abdomen, feeding on hazel leaves; and on Spook Island where I paddled over in the hopes of locating a colony of *Chrysomela scalaris,* var. *pnirsa,* I discovered nearly all the foliage on the island fretted into holes by millions of *Brachys ovata* on oak, *ærosa* on basswood and grapevine. About the middle of the month I spent a day at Hastings, and saw for the first time immense numbers of the larvæ of the Jumping Sumach beetle (*Blepharida rhois*); they were feeding on the fragrant or Canada Sumach. This shrub I have seen in three places only, on the north shore of the upper Rideau, in August, where the imago of this beetle was abundant; on the cliffs below the Whirlpool Rapids, Niagara, where no trace of either larva or imago could be seen; and here at last, June, 1915, where hibernated imagoes were occasional and larvæ in great abundance. The larva is one of the most disgusting sights in the insect world. It is covered with what appears to be liquid excrementitious matter. This is smeared so thickly over its surface as to give it a deformed lumpy appearance. The insect glistens with this slime much as the larva of the saw-fly, known as the Pear-tree Slug. Though the sumach grows, a low and upright shrub, in open pastures, and the insect feeds in broad daylight, exposed on the upper surface of the leaves, yet the fiercest rays of noontide sun seem to have no effect on its slimy coat; it neither evaporates nor cakes. Without imputing a fairly high aesthetic sense to insectivorous birds, we must suppose this creature to be just about as savoury a morsel as it looks; the soft, helpless, sluggish infant of a larva is just as immune as the hard-shelled, leaping and flying beetle.

On June 13th I captured a newly emerged specimen of the Elder-borer, *Desmocerus palliatus,* south-east of Peterborough. This is the earliest record I have made for the insect in our latitude; they became abundant in the last week of June. About the 10th of July I captured six in Niagara Glen and as late as the first week of August one in the neighborhood of Owen Sound. About the middle of June in some felled and decayed elms lying on the edge of a poplar swamp I found breeding several specimens of *Physocnemum brevilineum.* These were settling in the sunshine on the prostrate trunks, or sheltering from the east wind in crevices and under loose flakes of bark. It was there and then that I found the first specimen of the Elm Saperda (*Saperda tridentata*) I have ever taken on its food tree. As the net result of two visits to this collecting ground I will list the more interesting captures made:

Physocnemum brevilineum (elm)	25
Saperda tridentata (elm)	14
***Tetropium cinnamopterum* (white pine)	1
***Hoplosia nubila* (basswood)	1
Callidium antennatum (cedar)	1
Pachyta monticola (thimble-berry blossom)	6
Leptura proxima (thimble-berry blossom)	2
***L. chrysocoma* (thimble-berry blossom)	1
L. 6-maculata (thimble-berry blossom)	1
Rhagium lineatum (hemlock trunk)	1
Clerus thoracicus var. *rufiventris*	19
(wood piles)	abundant
Melanophila fulvoguttata (newly felled hemlock)	abundant
Anthaxia æneogaster (fleabane blossoms in hemlock swamp)	abundant
Xenorhipis brendeli (basswood stumps)	abundant

Besides these, seven or eight other species of Leptura were noted and ten other genera of cerambycid. In the latter part of June, larvæ, pupæ, and imagines of the very handsome Ladybird (*Anatis* 15-*punctata*) were found in great numbers on leaves of elder, ash, butternut, basswood and maple. About one-fifth of these were of the normal form, the rest were of the variety *mali*, in which the elytral spots are "eyed" with a narrow halo paler than the ground color. This mention of varieties recalls a point of interest in connection with an insect taken in 1914, but not identified by me till after our last meeting. The insect is the Staphylinid *Oxyporus*, but as my report is a long one I will omit the note, as I have done with similar notes on *Hoplosia nubila* and *Pogonochœrus mixtus*. The note is mainly of systematic interest.

At the end of June I went down to Port Hope a few days before reporting for duty in Toronto. While there I visited a hardwood four miles north of the town, where axe and saw had been busy in the winter. Again I will save space by listing the more interesting captures made:

Neoclytus erythrocephalus (dead twigs of hawthorn and maple)	3
Arrhopalus fulminans (under bark, stump of butternut)	1
**Calloides nobilis* (under chip of oak)	1
**Centrodera decolorata* (maple stump)	1
Elaphidion villosum (oak stump)	1
**Pogonochœrus mixtus* (pine trunk)	1
**Goes oculatus* (willow foliage)	1

The last beetle in this list was captured on the old home farm of Mr. John Hume. There is a swamp here just below a high ridge of land to the north, and where the willows are thick two streams flow out from the swamp, one about the size of a field drain, the other rather larger; the smaller flows south-east, the larger south-west. In the willows here I noticed a number of wasps flying to the stems. The stems proved to be covered with recent bore-holes, from which was exuding dark pulp. It was evidently the pungent smell of fermenting sap that had brought the wasps, and while I was investigating, several butterflies hovered or settled about the bores and two beetles (*Gaurotes cyanipennis*) were taken feeding at them. Presently I discovered a pair of weevils, with a large white patch near the apex of the elytra, resting on a stem a foot or two above the bores. It was *Cryptorhyncus lapathi* (as I have since learned from Mr. Caesar). I was unable to see any insect emerge from the tunnels, nor did I notice any ovipositing. Soon after, Dr. Watson came out with me and we captured over 20 of these curculios. Next day I had to go to Toronto as an associate examiner. This was about the 3rd of July. Dr. Watson visited the place about four times in the next five weeks and never failed to find several of these creatures on the willow. At Thanksgiving I visited the same place and also followed the larger stream for half a mile south-west. No insects were to be found on the trees, and though I took some infested stems home with me, I could find no trace of eggs. There were several larvæ, but I could not identify them for certain. One looked like the larva of *Saperda concolor*. The willow worst-bored appeared to be *Salix discolor*. Trees of *Salix nigra* seemed immune and also those of a species I could not identify—the leaves broad and not very long, rugose with veins on the upper side and downy beneath. The foliage was partly shrivelled in October and there seems to be much intergrading among the willows, which makes identification unsatisfactory except in the blossoming season. The boring was worst at the base and seldom extended further up than eight or nine feet. Stems less than 2½ inches in diameter were seldom, if ever, touched. Those of 5 inches in diameter seemed the favorite resort, and occasionally stems eight and nine inches in diameter were badly bored, but not trees of greater thickness than this. The damage was observed over more than a mile of country between south and north, and half a mile between east and west. In the west area the willows were riddled with holes, and trees that had five or six stems growing out from the roots had (nearly all) lost some of these, either snapped off above by the wind or broken down by their own weight at the base. More than once in crossing the stream I broke off a thick stem by simply bearing on it with my hand. On returning to Peterborough after Thanksgiving I went through twenty or thirty collections of insects made by pupils of the school, and in one located a single specimen of the beetle. So far I have not found any damage to willows in our neighborhood.

While I was in Toronto (between July 3 and July 24) Dr. Watson captured a large number of *Urographis fasciata* on a felled oak as well as on a neighboring woodpile of the same material. On the log he saw also, but failed to capture, some specimens of *Neoclytus erythrocephalus*. They are extremely quick in their movements, especially during hot sunshine. Two days snatched from the holocaust of July, I managed to spend at Queenston and made a number of interesting captures between there and Niagara Glen, mostly about blossoms of New Jersey Tea. I have a list of these but will not trespass further on your time and patience.

**Toxotus cylindricollis* (foliage of hazel)	1
Plagionotus speciosus (foliage)	1
Oberea bimaculata (raspberry)	1
***Strangalia luteicornis* (New Jersey Tea)	3
**Leptura subhamata* (New Jersey Tea, all male)	4
***Leptura cordifera* (New Jersey Tea)	6
***Leptura* (sp. ? *dehiscens* New Jersey Tea)	2
Trichius, 2 species (flowers)	abundant
Macrobasis unicolor (vetch)	abundant
3 species of *Cryptocephalus* (foliage)	abundant
Eupogonius subarmatus (basswood)	abundant

Early in August I took another specimen of *Eup. subarmatus*, always on basswood; and throughout August in the Algonquin Park found *Leptura canadensis* common—none of them males.

On returning to Peterborough in September, I found the climbing nasturtium on our verandah-railing badly infested with *larvæ* of *Pieris rapæ*. In a few minutes I picked about 100 off the leaves over a space of about six feet. On each of the two following days I gathered almost as many. I suspect they came from a vacant field, nearly opposite, in which charlock has been allowed to grow. They were succeeded in October by black aphids from a neighbor's dahlias. These multiplied so on a thick stem that had twined about the verandah post that it resembled a ship's mast coiled round with a spiral of tarred rope.

Division No. 7, Niagara District—William A. Ross.

As Mr. Caesar in his report on "Insects of the Season in Ontario" will no doubt refer to most of the common pests found in the Niagara district, I shall confine my attention to a few insects which were of special interest to me.

Apple Aphids. The three species, *Aphis sorbi, Aphis pomi,* and *Aphis avenæ,* were again abundant. Some young apple orchards were very heavily infested with *A. pomi,* but in bearing orchards *A. sorbi* was, as usual, the chief depredator.

In connection with the summer hosts of *A. sorbi* it was found that the migrant forms readily colonized three species of Plantago—*P. lanceolata, P. major* and *P. rugelii,* and that as many as eleven generations of the aphid may develop on these weeds. Both in the insectary and in the fields *P. lanceolata,* common rib grass, appeared to be the favorite host.

The Pear Psylla (*Psylla pyricola*). At the Vineland Experimental Farm gratifying results in the control of this insect were obtained. In one experiment infested trees were sprayed, after the cluster buds had burst, with lime sulphur wash, testing 1,030 specific gravity. In a second experiment, of course with different trees, lime sulphur diluted to summer strength in tobacco water (1 lb. tobacco refuse in 2 gallons of water) was used and the application was made just after the blossoms had fallen. The results given by these two treatments can best be stated by quoting from notes made on May 22nd: "Exp. No. 1. Results good—very few nymphs are present on the trees. Exp. No. 2. Results practically 100 per cent. effective—only one living nymph found. Check. Psyllas are numerous on unsprayed trees."

Lesser Peach Tree Borer (*Aegeria pictipes*). Early in the season many complaints were received from fruit growers regarding a "worm" which bored into the trunk and large branches of peach trees and produced gumming. On looking into this matter it was found that in practically all cases the gumming was primarily caused not by the "worm" but by the peach tree canker fungus. The "worm," the lesser peach borer, was, however, very much in evidence in the cankered areas and by its work aggravated and greatly increased the wounds. I should mention here that I found the borer in all old cankers which I examined, and that I took as many as six larvæ from one injured area.

The adults of the lesser peach borer commenced to emerge towards the end of May and the maximum emergence appeared to take place during mid-July, judging by the large number of empty pupal skins found protruding from the trees at that time.

Cherry Aphis (*Myzus cerasi*). Last spring there was a serious outbreak of this plant louse on sweet cherries in different parts of the Niagara district. In a Vineland orchard, which I had under observation, the young shoots were injured so severely that by the latter part of July most of the tender foliage was dead. The fruit in this same orchard was small, ripened irregularly and much of it was covered with honey dew and honey dew fungus. In fact so much damage was done to the fruit that most of the crop was left on the trees.

Mr. Howard Curran, my assistant, sprayed two infested trees with whale oil soap, 1 lb. to 4 gallons of water, and destroyed in the neighborhood of 99 per cent. of the aphids.

The Raspberry Byturus (*Byturus unicolor*). This insect is rarely troublesome in Ontario. However, during May it was present in a large raspberry plantation near Jordan in sufficiently large numbers to give a great deal of anxiety to the grower. The beetle destroyed many of the flower buds by eating into them. It also fed on and skeletonized the tender foliage, especially the foliage near the flower buds.

The owner of the raspberry bushes sprayed them with arsenate of lead and apparently got good results, because when I visited his place later on I found comparatively few beetles on the bushes.

THE RASPBERRY SAWFLY (*Monophadnoides rubi*). This pest was very troublesome last year, but I regret to say it was much more destructive this season. Two large raspberry plantations near Vineland were very badly infested and on many of the bushes all that was left of the foliage was the petioles and leaf ribs.

The raspberry sawfly is readily controlled by spraying with arsenate of lead, but as the insect is not regularly injurious the fruit grower seldom thinks of applying the remedy until it is too late.

THE PRIVET PLANT LOUSE (*Rhopalosiphum ligustri*). This greenish-yellow aphid was again very abundant on privet and as a result of its depredations several beautiful hedges were partially defoliated.

Last year I referred to this insect with some doubt as the European species *Rhopalosiphum ligustri*. However, there is no longer any question in regard to its identity, as my determination was confirmed by Prof. Theobald, of London University, England, who kindly examined some specimens which were sent to him.

Before coming to this meeting I had occasion to examine an infested privet hedge, and I was greatly interested to find three kinds of males present, viz.: winged, wingless and forms intermediate between alate and apterous. This would seem to suggest that the male of *R. ligustri* is in an unstable condition and that it is gradually changing from the primitive to the specialized form, i.e., from alate to apterous.

THE ASPARAGUS BEETLE PARASITE (*Tetrastichus asparagi*). Early in June this interesting chalcid, heretofore unrecorded in Canada, was found destroying the eggs of the asparagus beetle (*Crioceris asparagi* L.) at Vineland Station.

Tetrastichus has a very curious life history. The female by means of a sharp ovipositor pierces the egg of the asparagus beetle and deposits within it her own eggs (from three to nine in number according to dissections which I made). In due course, the beetle egg, its viability unaffected, hatches, and the grub grows to maturity. The chalcid eggs in the meantime hatch and the parasites apparently nourish themselves on the body fluids of their host without appreciably interfering with its development. The full-grown asparagus grub enters the soil and forms the pupal cell, but proceeds no further because at this stage it is wholly consumed by the chalcid larvæ. The parasites then pupate within their host's cell and later emerge as adults.

The adult *Tetrastichus* is a voracious feeder on the eggs of the asparagus beetle and in this capacity the insect is really of greater economic importance than in the role of a parasite. In support of this statement I may mention that early in June asparagus beetles and their eggs were exceedingly abundant on the asparagus plants at the Vineland Experimental Farm, but the hungry chalcids destroyed so many eggs that very few grubs hatched out—less than one per cent., I should say. Later on when the parasites were not so plentiful a larger percentage of the beetle eggs hatched.

In feeding the chalcid stands on the egg, plunges her ovipositor into it, and energetically works the ovipositor up and down usually for three or four minutes. She then steps back, applies her mouth parts to the puncture and feeds on the egg contents. If the first prodding does not render sufficient food available the operation may be repeated. In fact I noticed one chalcid attack an egg no less than four times.

There are apparently two broods of this insect in the Niagara district. Adults of what I took to be the first generation were very abundant during early June, but by June 28th they had all disappeared. Second brood "flies" emerged late in July and were found on the asparagus plants until the latter part of August. This generation was much smaller in number than the first.

REPORT OF THE BRITISH COLUMBIA ENTOMOLOGICAL SOCIETY.

MR. TREHERNE: As Secretary of the British Columbia Entomological Society, a branch of this Society, I may say that our membership stands at about seventy at the present time. About thirty of these can be considered active members, those that are engaged in recording insects from different parts of the province, and who are anxious to receive information of a more technical character, such as is recorded in *The Canadian Entomologist.* The remainder are mostly farmers and fruitgrowers of a better type who are interested in the control of insect pests. We have an interesting development that occurred during the past year in the formation of sub-branches, Victoria and Vancouver. The Vancouver sub-branch are holding monthly meetings during the winter, turning in their reports to what they call the parent Society, that is to say, the Entomological Society of British Columbia. The membership has been affected on account of the war, several of our men having gone overseas, and our Society has decided to continue their payments out of their own funds. We have published up to date seven bulletins during the past three and one-half years. At the present time many recent members, members that are not particularly interested in the Society, are dropping out, and the result is that with those that are members we are getting on a more level basis in that we have men that are more keenly interested in the Society, and I think that in a year or two the Entomological Society of Ontario will find a very active, strong Society in the West.

DR. HEWITT: The Society has listened with much interest to Mr. Treherne. We all know that the formation of the Branch out there is entirely due to Mr. Treherne's personal efforts and the support he has received from men like Mr. Wilson, who is with us to-day, Mr. Day, and others, and it is very satisfactory to think of the strong branch the Society has out there. We will now have the report of the Montreal Branch.

REPORT OF THE MONTREAL BRANCH.

The 42nd annual meeting of the Montreal Branch was held at 32 Springfield Ave., Westmount, on Saturday evening, May 15th, 1915.

The Secretary read the report of the Council as follows:

The Branch has held, during the season of 1914-15, nine monthly meetings, the average attendance being over six.

We record, with deep regret, the death of our late member Mr. Henry H. Lyman, who had been an active member since 1875, and had occupied all the executive offices of our Society at one time or another. By his will, his large and valuable collection of Lepidoptera and other insects, and his fine entomological library, are now housed in the Redpath Museum of McGill University. This is now being carefully put into order and when funds become available it should rapidly become one of the most important insect collections in Canada, and of great assistance to students of insect life. By the terms of Mr. Lyman's will the President and Secretary of this Branch are desired to be associated with the Professor of Zoology of McGill University, as members of a committee to manage the bequest.

The papers read at the meetings during the year were as follows:

1. Annual Address of the President .... A. F. Winn.
2. Electrical Fuses Attacked by Larvæ of *Dermestes lardarius* Geo. A. Moore.
3. The American Tortoise Shell Butterfly, *Vanessa milberti* Godard .... A. F. Winn.
4. *Saldidae*, or Shore Bugs .... Geo. A. Moore.
5. Studies in the Genus *Phaeocyma* .... G. Chagnon.
6. The Geometrid Genus *Nyctobia* Hulst .... A. F. Winn.
7. The Coloration of Insects .... A. F. Winn.
8. The Coloration of Exotic Butterflies .... G. C. Clayson.
9. The Colors Seen in Hemiptera .... Geo. A. Moore.
10. Address on Annual Meeting .... Prof. Lochhead.
11. Illustrated Talk on "Work of Entomological Division .... A. Gibson.
12. Notes on the Cause of the Blue Coloration of the Blue Lycænids .... H. M. Simms.
13. Report of the Annual Meeting of the Quebec Society for the Protection of Plants .... Geo. A. Moore.

Besides the regular papers read Mr. Winn exhibited the list of Quebec Diptera which had been compiled with the assistance of Mr. Beaulieu, and had been edited by Mr. Johnson of Boston.

Our January meeting was honored by a visit from Prof. Lochhead, of Macdonald College, with three students.

We also had a visit from Mr. Arthur Gibson, Assistant Dominion Entomologist, at our February meeting. He gave a lantern-illustrated talk upon the work being done at the different entomological laboratories in Canada.

At this latter meeting Mr. Simms illustrated the blue coloration of the Lycænids, by means of a spectroscope.

Our March meeting was made more interesting by a series of microscope slides being shown.

The report of the Treasurer showed a balance of $82.34 on hand.

Mr. H. M. Simms, one of our members, has enlisted for Overseas service in the great European war.

The following officers were elected for the ensuing year:

President .... A. F. WINN.
Vice-President .... G. CHAGNON.
Secretary-Treasurer .... GEO. A. MOORE.
Librarian .... G. CHAGNON.
Council .... MESSRS. G. A. SOUTHEE, G. H. CLAYSON, E. C. BARWICK, H. M. SIMMS.

GEO. A. MOORE,

Sec.-Treas.

REPORT OF THE TORONTO BRANCH.

The nineteenth annual meeting of the Toronto Branch was held in the Biological Building on Thursday, October 14th, 1915, the chair being occupied by the President, Dr. Cosens.

The minutes of the previous meeting having been read and approved, the report of the Council and financial report were presented and adopted.

Eight regular meetings, not including the annual meeting, were held during the season 1914-15, at which the average attendance remained about the same as in past years.

The following list comprises the papers read during the season:

Oct. 9. "Insect Aliens, Desirable and Otherwise," illustrated with specimens. Dr. A. Cosens.
Nov. 19. "A Trip to Point Pelee." Mr. C. W. Nash, Provincial Biologist.
Dec. 10. "Crickets," illustrated by specimens. Dr. E. M. Walker.
Jan. 14. "Some Entomological Notes in North Dakota," illustrated by specimens. Mr. F. J. Prewett.
Feb. 10. "Two Months in New Brunswick," with lantern illustrations. Mr. E. Horne Craigie.
Mar. 25. "Types of Neuroptera," illustrated by specimens. Dr. A. Cosens.
April 29. "Blood-sucking Flies," with lantern illustrations. Dr. E. M. Walker.

At the meeting held May 20th, Dr. Walker exhibited a collection of beetles intended for the Royal Ontario Museum; Mr. Hanniball, a living horned toad from Texas, and Dr. Cosens, galls and producers of the genus Rhodites.

A successful field meeting was held at Mount Dennis on May 29th.

During the season four new members had been elected, two had gone to the front, and one had resigned.

The financial report showed a balance on hand of $13.90.

A paper was read by Dr. Cosens upon "The Founding of the Science of Cecidology," after which the election of officers for the coming season took place.

The election resulted as follows:

President .... Dr. E. M. Walker.
Vice-President .... E. Horne Craigie.
Secretary-Treasurer .... S. Logier, 1244 St. Clair Ave., Toronto.
Librarian .... H. E. Bicknell.
Council .... Dr. A. Cosens, C. A. Snazelle, C. W. Nash, J. Hanniball.

Respectfully submitted,

E. Horne Craigie,

Secretary.

THE NOVA SCOTIA BRANCH.

The President: We are very pleased to learn, as announced in the report of the Council, of the formation in Nova Scotia of an Entomological Society, which has become affiliated as a branch of the Ontario Entomological Society, and I should like to take this opportunity of congratulating Prof. Brittain and his associates in the energetic way in which he has collected together the scattered units who have entomological leanings in that Province. We shall be glad to hear from Prof. Brittain, if he has not a formal report, a few words in regard to the Society.

Prof. Brittain: Though I did not prepare any formal report, I am pleased to be able to say that in July last we held an organization meeting and succeeded in forming a very flourishing branch of the Ontario Entomological Society.

We were fortunate enough to have the support of Dr. A. H. MacKay, Superintendent of Education; Mr. L. A. DeWolfe, Director of Rural Education; several of the provincial school inspectors and others. All of these men have shown the deepest interest in the work of the Society, and with their help we have been able to enlist the support of a large number of teachers throughout the Province, many of whom have already done some collecting and otherwise shown an interest in entomological work.

I have also had the heartiest assistance and encouragement from Mr. George E. Sanders, Field Officer of the Dominion Entomological Branch. In all these, together with the inspectors and ex-inspectors of the Dominion and Provincial Entomological Branches, we have a very good nucleus for the establishment of a strong and vigorous society.

At the present time we have a paid-up membership of forty-one members, and I confidently hope and expect that before the winter has passed, we will have doubled that number.

The President: I am sure the members have listened to this extempore report with very great pleasure. It is a matter of regret that while there used to be a branch in the City of Quebec, we have not had a branch there for many years, at least as long as I have been in this country, although we now have in the Province of Quebec the Society for the Protection of Plants from Insect Pests and Plant Diseases, which, in a way, takes the place of a Provincial Entomological Society. At the same time, I think there is room for greater activity in the Province of Quebec in the matter of entomology. We have a faithful friend in Mr. Chapais, who, I think, should try and work up the interest of the Entomological Society in the Province of Quebec. Before proceeding further I should mention that letters of regret have been received from the following people on account of their inability to attend the meeting: Mr. Grodge Davidson, Provincial Botanist of British Columbia; The Rev. Abbé Huard, Provincial Entomologist of Quebec; Prof. J. M. Aldrich; Prof. G. A. Dean; Dr. W. E. Britton, State Entomologist of Connecticut; and then, in addition, we had promises to be present from the following members of the Society and gentlemen who intended to be present: Dr. Felt, but he has had an urgent call to Long Island; Dr. Walker, who has been unable to come on account of his academic duties, and Dr. Bethune, who was not able to make the trip and who had lectures to attend to. Dr. Howard was to give our public address, but he is unable to come owing to the fact that he met with an accident. We also should have had with us Prof. Willing, Assistant Professor of Natural History at the University of Saskatchewan, but illness has prevented him from coming.

REPORT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

I have the honor of presenting the following report of the work of the Ontario Entomological Society for the year 1914-15.

The past year was a very successful one. The active membership continues to increase, and the Society has now a relatively large number of trained workers engaged in the investigation of the many insect problems that arise yearly in every province. The presence of these new members has a stimulating influence on the general work of the Society. They are young men, mostly graduates of the agricultural colleges, and filled with the enthusiasm of youth and eager to advance the interests of their profession. As a matter of fact the entomological interests of the Dominion are now, to a large extent, in their keeping.

Another feature of recent entomological work is the appearance of an increasing amount of investigation that might fairly be classed as high grade. This result may be attributed to the fact that our younger entomologists have the advantages of a scientific training and are thus able to undertake problems beyond the power of their predecessors.

Much of the credit for the vigorous condition of the Society must be assigned to its active President, Dr. C. G. Hewitt, Dominion Entomologist, who presided most worthily at the fifty-first annual meeting held in Toronto on the 5th and 6th of November last. This meeting was well attended, and many valuable papers were presented. Considerable discussion took place on various subjects of importance, particularly on the outbreak of the Army-worm in Canada in 1914.

Following is a list of the chief papers and addresses:

"Applied Entomology in Canada: Its Rise and Progress," the address of the President, Dr. C. G. Hewitt.
"The Habits of Spiders" (illustrated), by Prof. J. H. Comstock, Cornell University.
"Jean Henri Fabre, the French Entomologist," by Prof. W. Lochhead, Macdonald College, P.Q.
"Insects of the Season," by Prof. L. Cæsar, A. Gibson, W. Lochhead, A, Cosens, J. A. Morris, W. A. Ross, C. E. Grant, and C. E. Petch.
"The 1914 Outbreak of the Army Worm in Canada," by A. Gibson.
"The Army Worm in Ontario in 1914," by A. W. Baker, O.A.C.
"Mountains and Hills," by Dr. T. W. Fyles, Ottawa.
"Experiments with Poisoned Bran Baits for Locust Control," by A. Gibson, Ottawa.
"An Imported Red Spider Attacking Fruit Trees," by Prof. L. Caesar.
"Cherry Fruit Flies," by Prof. L. Caesar.
"Control of Forest and Shade Tree Insects of the Farm," by J. M. Swaine, Ottawa.
"Variation in the Hedgehog Caterpillar," by A. Gibson.

The Canadian Entomologist, the monthly journal of the Society, continues to maintain its high reputation and its wide circulation in spite of the increased subscription price. The 46th volume, completed in December last, is the largest and most fully illustrated that has yet been published.

During the year 1914 and since the last meeting of the Royal Society, the Ontario Entomological Society lost two of its best known members. Mr. H. H. Lyman perished in the disaster to the "Empress of Ireland" on the 29th of May—a few days after he had presented his report as delegate of this Society. Dr. William Saunders, ex-Director of the Dominion Experimental Farms and one of the charter members of this Society, died at his home in London on Sept. 13th. In his Presidential Address at the Annual Meeting in Toronto, Dr. Hewitt spoke very feelingly of the loss of these two highly esteemed members and ex-presidents of our Society, and paid a high tribute to their memories. Besides, our worthy and revered member, Rev. Dr. Bethune, who knew both very intimately for many years, has written notes of high appreciation in the 45th Annual Report.

W. Lochhead, *Delegate.*

INSECTS OF THE SEASON IN ONTARIO.

L. Caesar, Ontario Agricultural College, Guelph.

The past season with its abnormal amount of rainfall has been much more favorable for the development of plant diseases, both fungous and bacterial, than of insect pests.

Codling Moth (*Carpocapsa pomonella*). The most interesting thing about the Codling Moth was that in the Niagara district, where the amount of injury done by the second brood is usually very much greater than by the first, this year for the first time in my experience things were just reversed, the second brood being remarkably small, though the first brood was about as abundant as usual. Probably the excessive moisture was the chief reason for this, though other factors may also have been at work.

Plum Curculio (*Conotrachelus nenuphar*). This insect also was apparently less abundant than usual, although the fruit in neglected apple orchards suffered a great deal of injury both from spring and fall attacks. On some trees nearly every apple was deformed.

San José Scale (*Aspidiotus perniciosus*). The season of 1914 with its dry summer and long open fall was remarkably favorable for the increase of San José Scale. This was not true in 1915, for this year, so far as my observation enables me to judge, the increase has been less rapid than usual. This spring was also favorable for good results from careful spraying. With a single application we were able to destroy almost every scale in an old orchard that would otherwise have been nearly all dead by now. Lime-sulphur, strength 1.035, was used on one part of the orchard; Soluble sulphur, strength 12½ lbs. to 40 imperial gallons, on another part, and Scalecide 1 to 15 on a third. All were about equally satisfactory this year.

Blister Mite (*Eriophyes pyri*). For some unexplained reason the increase of Blister Mite, even in unsprayed orchards, the last two or three years has been very slight; in fact some trees seem to have fewer leaves infested than three years ago.

Leaf-Rollers [*Tortrix* (*Cacœcia*) *rosaceana*, *T. argyrospila* and *T. semiferana*]. (See p. 163.)

Capsids Attacking Apples (*Neurocolpus nubilus, Paracalocoris colon, Lygidea mendax and Heterocordylus malinus*). All four of these Capsids were found on apple trees but not all in any one orchard. *Lygidea mendax* was found in the greatest number of orchards, but *Neurocolpus nubilus* has apparently been the most destructive. It was sometimes found with *Lygidea mendax*, but in other orchards was the only species present. *Heterocordylus malinus* apparently did almost no harm and was much more common on hawthorns than on apples. *Paracalocoris colon* was also scarce. *Lygus invitus* is abundant in the Province but has not yet been found attacking apples or pears. Mr. Crawford's paper gives an account of our work on *Neurocolpus nubilus*.

Tent-Caterpillars (*Malacosoma americana* and *M. disstria*). These caterpillars still destructive in the eastern half of the Province, though Mr. E. P. Bradt, the district representative at Morrisburg, informs me that a large percentage, apparently 50 per cent., of the eggs failed to hatch and fully 50 per cent. of the caterpillars died before reaching maturity. There has been a gradual decrease the last two years in the numbers of both species down east, but this is not true of the western part of the Province, into which they are gradually spreading.

M. americana is now very abundant, at least as far west as St. Thomas. It has not yet, however, so far as I could see, become numerous in the extreme western counties. Around Guelph there are many egg masses this year, and, therefore, prospects for a severe infestation next year. *M. disstria* west of Toronto does not seem to be nearly so abundant as *M. americana.*

FALL CANKER-WORM (*Alsophila pometaria*). Throughout a considerable stretch of territory from Grimsby west, including Hamilton and Dundas, the Fall Canker-worm is very numerous and destructive. It is also very abundant in some forests in Norfolk County where the American elms, basswood, wild cherry, blue beech, birch and oaks were either partly or entirely defoliated. Elms suffered most. Maples were not so severely attacked as the other trees mentioned. Several other kinds of loopers were also prevalent on these trees, but not in nearly so large numbers as the Fall Canker-worm.

PEAR PSYLLA (*Psylla pyricola*). Early in the season it looked as if pears were going to be much infested by this insect, as adults and eggs were abundant. However, the cold weather of May destroyed all but a very few. By autumn a few orchards were again badly infested.

APHIDS. On apple trees there were many aphids this spring up to a few days before the blossoms were ready to burst. They then almost completely disappeared in all the orchards that I had an opportunity to examine, so that apple trees suffered very little from any of the leaf and fruit infesting aphids.

The Woolly Aphis (*Schizoneura lanigera*) in some districts was abundant, especially on young shoots in late summer and autumn. On cherry trees at Guelph the Black Aphis (*Myzus cerasi*) was very conspicuous and much more numerous than for many years past. It was also very troublesome in the Niagara district.

When moderately early peas were just beginning to bloom in Norfolk County hundreds of acres of them grown for the canning factories were threatened with destruction through the abundance of the Pea Aphis (*Macrosiphum pisi*) on the blossoms and new growth. Fortunately there came several days of very hot weather with occasional heavy downpours of rain and almost all the aphids disappeared. Sufficient damage, however, had been done to lessen the yield considerably and in some fields almost to destroy the crop. The Pea Aphis has done more damage the last few years in Ontario than it formerly did.

PEACH BORER (*Sanninoidea exitiosa*). Many complaints have been coming in of injuries from this borer, particularly from those districts where peaches have only recently been grown to any appreciable extent. I suspected at first that the gum oozing out of the trunks of the trees as the result of winter injury was being mistaken for the work of the borer, but my observations this year in Norfolk County showed that such was not necessarily the case, as nearly every tree in some orchards was attacked by from 1 to 20 or more borers. We have done some preliminary work on the control of this pest, and in this connection have also worked out fairly well its life history for this Province. It will be interesting to some to learn that adults appeared in Norfolk County as early as July 15th and continued up into September. One female in Niagara was seen on September 11th.

LESSER PEACH BORER (*Aegeria pictipes*). The numerous cankers on peach trees in many orchards in the Niagara district have given ideal conditions for the increase of this insect, so that it is to-day very prevalent in that district. Control measures under the circumstances are not easy.

ROSE CHAFER (*Macrodactylus subspinosus*). Near Fonthill several vineyards had almost every grape cluster destroyed by this pest. I visited the district as soon as informed of the trouble, but it was then too late to do anything as the beetles had already begun to disappear. Several acres of waste sandy land lying alongside the infested vineyards showed ideal conditions for bringing about just such an outbreak.

IMPORTED RED SPIDER (*Tetranychus pilosus*). This spider was found as far east this year as Trenton. It continues to do considerable injury, especially to European plums. Some trees, however, that were badly infested last year were only lightly attacked this year. Moreover, in some apple orchards trees heavily infested just before bloom were comparatively lightly infested a couple of weeks later. It is very probable that weather conditions have a very important part in the control of this pest as of so many others.

GRAPE-VINE FLEA-BEETLE (*Haltica chalybea*). There were again many complaints of injury from this beetle, especially in the Niagara district.

GRAPE LEAF-HOPPER (*Typhlocyba comes*). This insect was very abundant in the Niagara district. Red grapes were, so far as I observed, much worse attacked than blue. The foliage on many of the former in September was so brown from injuries that one would expect the fruit at picking time to be inferior in quality. I have had no opportunity to test whether this was so.

RASPBERRY SAW-FLY (*Monophadnus rubi*). This raspberry pest is very widespread in the Province and has the last few years been doing more damage than usual. One large raspberry plantation near Vineland was almost completely defoliated by it this year.

IMPORTED CURRANT-BORER (*Aegeria tipuliformis*). Almost every currant plantation is infested by this borer. In some cases a very large number of the canes are found to be attacked.

GLASSY CUTWORM (*Hadena devastatrix*). Last autumn at our annual meeting I reported that some fields of wheat had been badly injured by this cutworm. The caterpillars in November last varied in length from about ½ to 1 inch; hence we expected these over-wintering caterpillars, where numerous, to do much damage. As soon as growth began in spring reports started to come in of fields of wheat and barley being attacked. Several fields of wheat were almost ruined by the severity of the attacks. A few Army-worms, but only a very few, were found among the cutworms. As the Glassy Cutworm works under the surface of the soil farmers were advised to use the poisoned bran, harrowing it into the soil in the evening. I did not receive any reliable accounts of the degree of success obtained. About the usual number of reports of damage by other kinds of cutworms here and there throughout the Province were received.

STRAWBERRY WEEVIL (*Anthonomus signatus*). A few more complaints than usual were sent in of injuries from these insects.

IMPORTED ONION MAGGOT (*Pegomyia ceparum*). It is worth recording that in the great onion marshes of Kent County I could scarcely find a root maggot when visiting the district this summer. Growers tell me they are never troubled by it. This is strange, because onions have been grown on these marshes for at least fifteen years, and, as the Onion Maggot is a very troublesome pest in many parts of the Province, one would expect it to do even more damage in the marshes where onions are grown on a larger scale than anywhere else in Ontario.

SLUGS. In Oxford County the district representative stated that Slugs were so abundant this spring that some farmers claimed they were destroying the corn just as it was coming or had come through the ground.

MILLIPEDES. Last year, but more especially this year, Millipedes were very abundant and several correspondents asked for methods of destroying them. Some work was done in testing different substances. Of these tobacco seemed the most satisfactory, although it was not a complete success. The Millipedes are repelled by it and, where they come into close contact with a moderately strong solution, are slowly killed. Dusting tobacco refuse thickly over the garden where they are troublesome and then watering it well with the hose once or twice a day for a few days seems about the best method, and the least dangerous to the plants. It is probable that placing decaying fruits or other decaying vegetable matter here and there in little heaps among infested plants and then pouring scalding water over such traps daily would gradually do a great deal to free the garden of the Millipedes. They are very fond of collecting under such decaying refuse and roam around in the dark so freely that they would be very likely to find the baits.

SPITTLE BUGS (*Cercopidæ*). This seems to have been a remarkably favorable year for the multiplication of Spittle Bugs. Complaints of the great numbers of froth masses on the grass came in from Clarksburg, Mount Forest, Ridgeway, Thornton, Oakville and several other districts. A few pasture fields near Oakville were so badly infested that the farmers, fearing injury to stock if they fed on the infested grass, mowed the pastures and destroyed the cut grass.

A SARCOPHAGID ATTACKING THE FOREST TENT-CATERPILLAR (*Sarcophaga aldrichia* Parker). In 1914, while engaged in some investigation work in the County of Dundas, I observed that many of the pupæ of the Forest Tent Caterpillar were parasitized by what I considered to be the larvæ of a Tachinid Fly. On further examination at Mountain, Kempton and Morrisburg I estimated that close to 90 per cent. of all the pupæ contained what seemed to be this same larva. About 30 of the cocoons were gathered and brought to Guelph, though it was nearly two weeks before I reached there. On my arrival the cocoons were all transferred to a pint jar, in the bottom of which an inch or so of sand was first placed. The jar then was covered with cheesecloth. In May, 1915, I happened to glance at the jar and to my surprise found seven dead and one living Sarcophagid. These Dr. J. M. Aldrich kindly identified for me. He states "The species is one which Mr. R. R. Parker now has in manuscript as *Sarcophaga aldrichia,* n.sp. His article is completed and, I think, is deposited with the Boston Society of Natural History for publication, but I am not quite sure on that point. I will send him a quotation from your letter if you do not mind, as it indicates a considerable economic importance for the species which is widespread, occurring in the Puget Sound region."

If I am correct in my opinion that the death of the pupæ was due to the larva of this insect and not to disease, we have here a very good example of what seems to have been only comparatively recently fully admitted, namely, the true parasitic habits of some Sarcophagids.

PHOROCERA DORYPHORÆ. In June Prof. T. D. Jarvis called the attention of my assistant, Mr. A. H. Cowan, to the white eggs on the back of Colorado potato beetles at Grimsby. Mr. Cowan reported to me and on my suggestion reared a few adults and captured a few more that were attempting to lay eggs. Dr. Aldrich identified all these as *Phorocera doryphoræ,* a parasite that, as he says, has been bred repeatedly from this host.

Mr. Cowan made the following observations: "Eggs begin to be laid in June. At first they seem to be laid only on adult beetles, but later to some extent on the slugs. From June 18th to July 13th eggs were found mostly on the beetles, 1/3 to 1/2 of the beetles being affected. Early in July some were found on larvæ also, but always on nearly full-grown larvæ. The total time from egg to adult fly would appear to be about one month. On September 15th the eggs and adult flies were again found at Vineland."

At Simcoe I observed on several occasions what was probably this same Tachinid attempting to lay eggs on full-grown larvæ of Colorado potato beetle.

POPLAR SAWFLY (*Trichiocampus viminalis,* Fallen (?)). On September 28th the Parks Commissioner of Toronto sent me a few Sawfly larvæ that were attacking the foliage of Carolina poplar in the City and asked for the name of the insect and the method of control. On looking over the list of insects given by Dr. Felt in the New York Museum Memoir 8 as attacking poplars I found that the description given there of the larvæ of *Trichiocampus viminalis,* Fallen, agreed very closely with the larvæ I had received. The latter were, when full grown, nearly one inch in length, orange-yellow in color, though some had a decided greenish tint. The head and caudal plates were black, and on each side of the body were two rows of distinct black spots, the spots in the upper or subdorsal row being three or four times as large as those in the lower or stigmatal row. On the back and sides were numerous white hairs arising in thin tufts from numerous tubercular-like areas on each segment. These hairs were not more than 1/4 as long as the width of the body.

I wrote to the owner of the infested trees for further information on the habits of the insect. The following extract is taken from his reply:

"The caterpillars were green at first, changing to yellow as they grew larger, apparently being full grown by the time they had eaten a full sized leaf. They were all side by side on the under side of the leaf tight together, eating from the edge away from the stalk towards it. That is to say, their heads were away from the stalk and they kept getting towards the stalk as the leaf was eaten away. Some of them grew faster than others, or seemed to, and as the leaf narrowed down they dropped off, thus leaving the smaller ones to finish the leaf. When I first noticed them they were small and green, and I should say there were about twenty on a leaf. It was full on the outside edge with all lying the same way, heads from the stalk of the leaf, the middle ones parallel with the thick membrane of the leaf, that is the continuation of the stalk. After dropping off the leaf they crawled all over the board fence and up the side of the house everywhere off the ground looking for holes in the fence. They went into every hole or crack they could find. The fence was covered with them. Into some overalls that were hanging on the line they got and when found were in a cocoon. Every leaf that they were on was completely eaten except the stalk, and the continuation of it right to the point. I notice that it is not a leaf here and there, as all the leaves on some branches are eaten and others not touched. I should say they have been on about 1-20th of the branches of the trees and eaten them. As there are six trees about 35 feet high, you may guess the number of them. I can only say there were thousands. I killed thousands myself with a broom on the fence."

THE IMPORTED WILLOW AND POPLAR BORER OR CURCULIO.

(*Cryptorhynchus lapathi* L.).

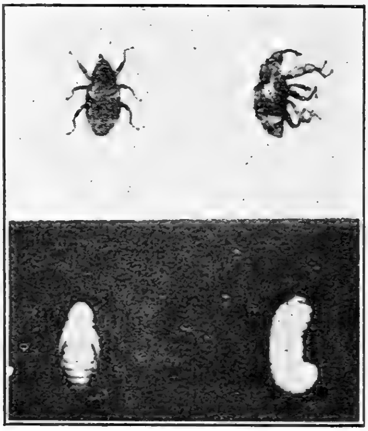
L. CAESAR, ONTARIO AGRICULTURAL COLLEGE, GUELPH.

About the middle of August I was requested to investigate the injury done by a borer to willows and poplars in the eastern part of Toronto Island. I visited the district on August 21st and again September 8th. On the latter occasion

J. E. Howitt, Professor of Botany, kindly accompanied me to assist in the identification of the species of willows and poplars that were attacked and also of those that were immune.

The insect in question was, as suspected, the Imported Willow and Poplar Borer or Curculio. The total damage done on the island was not large but was sufficient to convince the Superintendent of Parks that if the insect were to spread throughout the island and attack all kinds of willows and poplars, it would destroy the beauty and attractiveness of Toronto's favorite summer resort. One can easily understand why he should feel alarmed when we consider that about 90 per cent. of the trees on this island consist of willows and poplars, because these are the chief kinds that will thrive in its light, sandy, moist soil.

My observations showed me that before I could suggest the right means of control it would be necessary to know two things: first, at what time infested trees should be cut down and burned to destroy the maximum number of the



Willow Curculio: two adults, a pupa and full-grown larva.
(All about natural size.)

insects; second, what species or varieties of willow and poplar, if any, were exempt from attack. If the latter species were known they could henceforth be substituted for the kinds subject to attack.

On looking over the literature on this insect I found that to satisfy myself on these points I should have to devote whatever time could be spared this autumn to finding out whether the borer differed in Ontario in any important respects from the accounts given by Kirkland, Jack, Webster, Chittenden, Felt and others. The following are the results of my investigations:

Length of Time the Beetle has been in the Province and Present Distribution.

This beetle, which is known to be a native of Europe and of parts of Asia, and which is supposed to have been imported into the United States about the year 1880, was not, so far as I have been able to discover, found in Ontario until the year 1906. That year Mr. Cosens took it at High Park, Toronto, and Prof. E. J. Zavitz at Ridgeway and Beamsville. These discoveries in three widely separated localities lead me to believe that it must have been in the Province several years earlier. Up to the present time I have records of its presence at the following additional places: St. Catharines, Grimsby Beach, Grimsby, Winona, Fruitland, Guelph, Elmira, Willow Grove near London, Toronto Island, Port Hope, Trenton, Hillier (Prince Edward County) and Montreal (Quebec).

There has been very little opportunity to examine other parts of the Province, but the above localities show a very wide distribution throughout the Province, especially along the great waterway on the south. It is apparently, however, not yet all over the Province, because I have been in several localities where there seemed to be no evidence of its work, and Dr. E. M. Walker tells me that he has not seen any evidence of injury from it at Lake Simcoe. Montreal, near which Mr. Swaine reports its presence, seems to be the only place it has been seen in Canada east of the Province of Ontario, though very likely it is present in several localities but has not been noticed.

Host Plants.

In Europe this insect attacks several species of willows and poplars and also a few species of birches and alders, including our common alder (*Alnus incana*).

In the United States a perusal of the writings of Jack, Kirkland, Webster, Chittenden, and Felt, show that scarcely any species or variety of poplar or willow, whether native or imported, is entirely exempt and that the birches (*Betula pumila* and *B. nigra*) are also occasionally attacked. I do not remember seeing any definite record of its having been found in alders.

In Ontario I have devoted every opportunity I could get to discovering the host plants and the degree of infestation of each. Prof. Howitt has assisted me greatly in determining the species whenever I was in doubt. I find that the insect prefers Balm of Gilead (*Populus candicans*) and Balsam Poplar (*Populus balsamifera*) to any other variety of poplar, but that it is sometimes quite abundant in Carolina Poplars, especially where the above species are not present. At Guelph the Balm of Gilead is severely infested in a small clump of poplars on the College grounds, but the other poplars in this clump, consisting of the Carolina, White, Large-toothed and Lombardy species, are untouched. By the edges of a woods not far away from the College the Balsam Poplars are much injured by the pest, but the American Aspens alongside them are uninjured. The same was true of the aspens near infested Scrub Willows in the swamps.

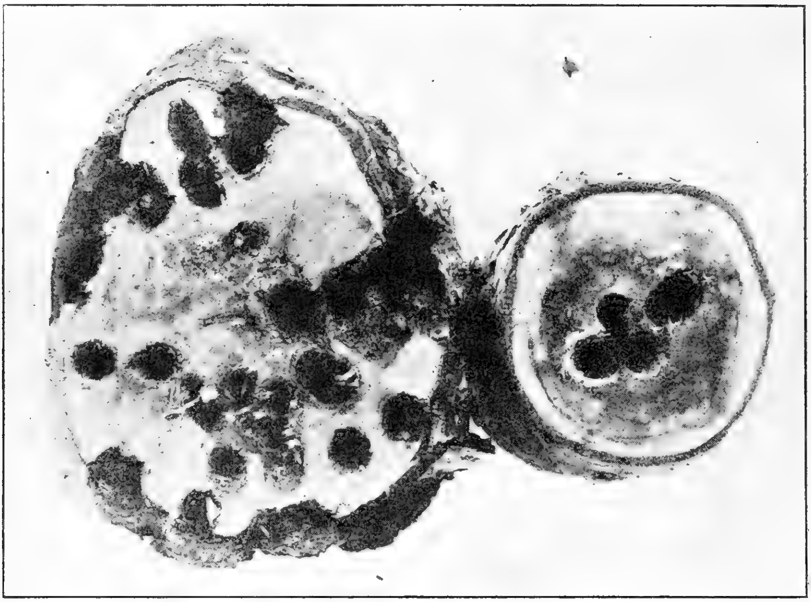
Of the willows the worst infested are our native Scrub Willows found so abundantly along streams. A tree willow, whose species could not be determined at this season of the year, was also severely attacked. This willow grows 25 feet or more in height, has not so large spreading branches as the Golden or White Willow (*Salix alba*) or the Crack Willow (*Salix fragilis*) but has much more slender and drooping branchlets and smaller, more delicate leaves. It is evidently a native species. One ornamental Weeping Willow in a lawn at Winona was killed by this borer last year. It was the dark-bark type of Weeping Willow, apparently an imported tree. Of the other willows we have not seen more than a very light infestation on the Crack Willow, and the White Willow has been entirely uninjured, as also the Glossy Willow (*Salix lucida*). There are not many Babylonian Willows to be found, but so far they too have been uninjured wherever examined.

Comparing what we have observed in Ontario with what has been written of the host plants in the United States, it seems quite clear that Balm of Gilead, Balsam Poplar, and our native Scrub Willows, along with one or two native tree willows, are the favorite food plants. Next to these would appear to be the Carolina Poplar (*Populus deltoides*).

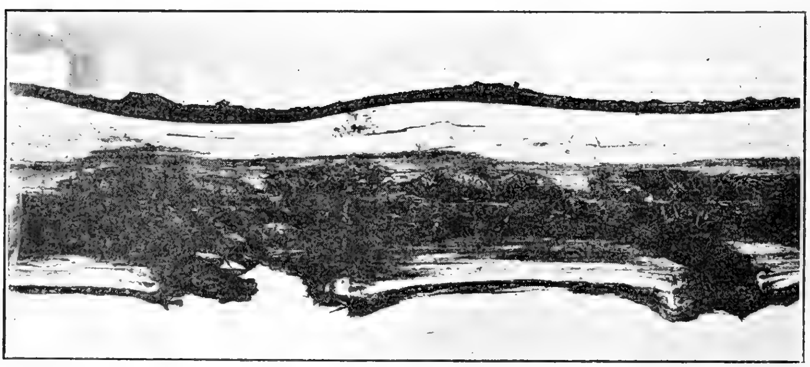
No alders were found infested even when in the midst of infested scrub willows. Birches have also appeared to be exempt in Ontario.

Nature of the Injury.

The photographs show sufficiently well the sort of injury done. It is all caused by the larvæ. These work both in the sapwood and heartwood in older trees and in the heartwood of very small trees. The borers seem to prefer the base of the smaller trees, but they are found on larger trees as high as 15 feet or



Cross section of a young poplar and of a larger willow tree, near the base, showing the work of the borers. (About natural size.)



Longitudinal section of a poplar tree, showing tunnels made by the larvae. (Slightly reduced.)

more. In old trees with rough bark they usually work in the lower branches instead of in the base of the trunk. Often there are so many tunnels, especially towards the base of the tree, that it is weakened and easily broken down by a strong wind. It is quite common to see Scrub Willows killed and also small poplars. The swellings on the bark of poplars where the larvæ have entered, and also the exit holes, cause the trees to look unsightly, and these, along with the castings around them composed of small tissues of wood from the tunnels, dust and fæces, easily reveal the presence of the insects. The total number of trees destroyed in the Province must be large, but the Scrub Willows are of very little value and, though the Balm of Gilead and Balsam Poplars are of much more importance, they can scarcely rank among our valuable trees. Fortunately not many Carolina Poplars seem to have been killed yet. These are good shade and landscape trees and their loss would be deplorable.

Life History.

Adults.—The adult is a snout beetle, stout, about one-quarter inch long, black, with the body and legs mottled with light pinkish or grayish white scales. These scales are so abundant on the sides of the prothorax and also on the anal third of the wings as to cause these parts to be pale pink or white. The upper surface of the body is rough, being coarsely and deeply punctured, and having longitudinal furrows on the elytra. The rough appearance is increased by the presence of a few tufts of black scales scattered here and there over the thorax and elytra.

I do not know how early the adults begin to appear. In willows at St. Catharines examined about June 20th, 1914, the larvæ seemed full grown but no pupæ were seen. As Kirkland estimates the pupal stage at about 18 days, it is probable that adults would have been found last year on these trees early in July. Mr. F. Morris found many adults on willows near Port Hope the first week in July, 1915. I have captured a few in August in previous years. By September 8th, 1915, by far the majority seemed to have emerged at Toronto Island but they still continued to appear this year all the first half of October, the weather being warm. An examination on October 23rd showed a few live adults still in their burrows in poplars, also some pupæ that looked healthy and four larvæ, but three of the latter were dead. The fourth looked healthy but, when handled, did not move, so may also have been dead. In all the accounts I have read it seems to be assumed that very few adults are to be seen in the spring. Kirkland found one which he remarked was "probably an overwintered specimen." But the adults in May are not nearly so few in number in Ontario as one would expect from the different accounts of the insect given. Three of my nursery inspectors each captured several specimens and saw others this last May on poplars and willows in the nursery rows. There were a few also on apple trees in adjoining rows. It is not known whether these passed the winter in the trees as adults, pupæ or larvæ, or whether they emerged in autumn and wintered over under shelter. The important point is that there was a considerable number of adults found at that time of the year, indicating that many others also were probably present. The adults in autumn hide on cold days but appear on the trees when the weather is warm. They feed on the juices exuding from injuries at the points of exit, also upon the young twigs, where they seem to prefer the neighborhood of leaf scars, in which the small feeding punctures are often seen. These punctures, however, may also be found in various other parts of the tree and sometimes even on the bark of dead fallen branches. In breeding cages I fed them on pieces of ripe apples and peaches, both of which they relished greatly. I do not know the length of life of these autumn adults, but five specimens caught in September were still alive almost a month later when I removed them from the cages. The last adults were seen in the open on October 11th. One found then was ovipositing.

Eggs.—Oviposition probably begins early in August, but with the very limited time at my disposal the first adult I could find doing this was on September 29th. After that date I saw several both in the cages and outside. It is very probable the beetles found in May oviposit in spring, as in Europe, eggs are laid both in autumn and in spring. The eggs are laid, as one would expect, at such places on the tree as we find the injuries later. Sometimes this may be at the base of a bud or small branch, but on the Balm of Gilead trees under observation and also in the cages it was just as commonly on the internodes, sometimes where there was a small rupture in the bark, sometimes where there was no rupture. About one hundred egg punctures in all were observed and several ovipositions. Before laying the egg the female eats a small hole, usually easily visible to the eye, through the bark to the full depth of her proboscis; at the bottom of this she makes one, two or three cavities. Where there are more than one they are a little distance apart from each other. Then she turns around, inserts her protruded ovipositor into the hole and lays an egg in each cavity. The making of the hole and laying of the egg is a slow process. I observed one which had already been at work some time when noticed and from the time she was first seen until the eggs were laid was a little over thirty minutes. One female was observed after laying the egg to turn around and insert her beak into the hole many times as if putting in small particles of bark. The eggs are pale translucent whitish, oval, about 1.5 mm. long and a little more than half as wide as long. Each female probably lays many eggs. One about to oviposit was dissected and only three mature eggs were found in the ovaries, all the others being much smaller.

It is hard to say how long it takes the eggs to hatch. As stated the first oviposition was observed on September 29th, but an examination from time to time of egg punctures at Guelph revealed no larva until October 7th. On October 25th, fourteen egg punctures on a Balm of Gilead were examined and in five of these sound unhatched eggs were seen, in five others tiny living larvæ, and in the remaining four hatched eggs but no larvæ. All previous examinations showed more unhatched eggs than larvæ on all trees.

Larvæ.—The freshly hatched larva is white, curved, and has a brown head. Full-grown larvæ are, as shown in the photograph, stout, about half an inch long, white, curved and have a brown head and no legs.

The young larvæ found were in every case very near where the eggs had been deposited, and had not eaten their way through the bark. They appeared to be settled down comfortably for the winter. Only in one case was there any evidence of a larva having reached the cambium, and that one was doubtful.

The discovery of so large a percentage of healthy eggs along with these tiny larvæ would suggest that the winter is probably passed in the egg stage as well as the larval. We saw above that it is apparently passed also either in the adult or pupal stage or both, with a slight possibility of there being some full-grown larvæ too remaining over in the burrows.

A study of the burrows shows that in spring the larvæ work obliquely into the sapwood, throwing out many castings at first as they do so. When they have gone in some depth the entrance appears to become closed, at least in poplars, by a callous growth, referred to above. Once in the wood the burrows run nearly straight. The total length of a burrow is from 2½ to 4 inches. In spring the larvæ clearly grow very rapidly, as by the end of June they are about full grown in many cases. When this stage is reached they evidently turn back in their tunnels and enlarge them either to the place of entrance or else to some more convenient exit. They then return to the far end of the burrow, make a little chamber for pupating, then with head toward the exit change into a white pupa. The adult works its way out through the tunnel enlarged by the larva.

Means of Distribution.

The insects have been widely distributed by shipping out poplars and willows from infested nurseries. The tiny larvæ or eggs in these in the spring would easily escape notice. In addition to this means there seems no doubt that the adults fly about from place to place. They have large under wings well adapted for this purpose. Flight is probably late in the evening or at night, as I have never seen an adult fly when observing them during the day.

Methods of Control.

In most cases no effort will be made to control or prevent injury from the pest, but in parks like Toronto Island, control measures are very necessary. It was my intention to suggest that all infested trees be cut down in the winter and burned early in spring, but since learning from my inspectors of the discovery of a considerable number of adults in May which very probably lays eggs, I have thought it wise to suggest that the cutting down and burning should not be done until the first or second week in June, so that all the insects might then be caught in the larval stage. This should lessen the numbers of the insect greatly. Then to avoid future loss in these places I think that the willows most exempt from attack, viz.: the White Willow (*Salix alba*), one of our largest and best willows, and possibly the Glossy Willow (*Salix lucida*) should be planted instead of those removed. Also White Poplar and Aspen Poplar might be substituted for the Balm of Gilead, Balsam Poplar, and even for Carolina Poplar. Of course if Soft Maples, Dogwoods or other suitable trees or shrubs will thrive in these places, they would be preferable to any of the above. I should be very pleased to have further suggestions from anyone present.

The President: I am sure we have all listened with much pleasure to Mr. Caesar's two excellent papers. They are now open for discussion. We are pleased to see with us to-day Professor Zavitz, the Provincial Forester of Ontario, and he has no doubt something interesting to say regarding the papers just read.

Prof. E. J. Zavitz: Mr. Chairman, I came here to obtain information, and this beetle to which Professor Caesar has been referring is naturally of interest to foresters. I first saw it in the Niagara District near Ridgeway, working in the scrub willows. This season, in visiting that district early in the summer (it is a favorite collecting ground) I found that these willows had been entirely killed.

I think the chief danger from this insect is to our Carolina Poplar (*Populus deltoides* Marsh) which, to my mind, is the most important poplar from the foresters' standpoint. We were beginning to think that the Carolina poplar would be a very important tree in sand planting and in fact we are using considerable numbers in Norfolk County. I regret to find that this insect is working in that tree. Apart from the willow holts or basket willows, the damage to willows will be small. We use the other willows to a very small extent in forest planting.

The chief injury from the standpoint of the forester will likely be to the poplars and especially the Carolina Poplar.

The President: Perhaps Mr. Swaine would like to make a few remarks in this connection.

Mr. Swaine: Mr. Chairman, I have had very little opportunity to study this beetle in Canada. Some years ago in Ithaca it was very common in the basket willow in the plantations there and did considerable damage. In Canada I have found it only near Ste. Anne's and it was there in the common scrub willows and not very abundant. I have not had it sent in in the last three or four years in any numbers from any part of Canada except Ontario and southern Quebec, and very few reports have been received. Mr. Caesar's account was very interesting, indeed; the life-history is just as I remember it on the different occasions I have studied it, and the control measures usually given are not very effective; it is a very difficult matter to control this beetle. On the smaller willows no special effort to save any particular tree is worth while and the destruction of the infested trees is perhaps the only effective method. Only a few of the willows that are affected are worth saving.

Mr. Winn: Professor Caesar mentions the keeping of the beetle alive on apple or peach. I may say he very kindly sent me ten specimens of the beetle to show what it looked like in order that I might recognize it if I ever found it alive. After a couple of days I turned the specimens out on a blotting pad and pinned two or three, then noticed that instead of there being ten there were only nine. The tenth was still alive and had crawled away. This I secured and placed in a tin box and after again taking it out three weeks later, apparently dead, it recovered. This shows how long the insect can live without food being given it, and how dangerous the insect might be when capable of living through a like shortage under natural conditions.

Prof. Caesar: One of the points that I would like very much to get information on is whether any person has found the adults of this beetle in the spring. It seems to be taken for granted in the U. S. literature on this pest that it does not pass the winter as an adult, and that there are no eggs laid in the spring, but the fact that we could find a considerable number of them in nurseries suggests that egg-laying in the spring is very probable.

Mr. Swaine: The specimens that I took at Ste. Anne's were, I think, all taken in the fall. This is some years ago, so I am not quite certain on this point, but believe that they were taken in the fall.

The President: I have no doubt that if any of the members get further information in regard to this beetle hibernating in the adult form they will advise Professor Caesar of the fact, and we will now proceed to the next paper.

Dr. Felt's paper was read by Mr. Gibson.

SIDE INJURY AND CODLING MOTH.

E. P. Felt, Albany, N.Y.

This type of injury has been unusually abundant in the western part of New York State for the past four years. It appears to have been figured and described first by John W. Lloyd in 1907 (Bul. 114, Ill. Agr. Exp't Sta.). He, however, attributed the damage to the work of the second brood.

Investigations the past season established the connection between late-hatching first brood larvæ and this type of injury. Many codling moth eggs are laid in the lake region the latter part of June and early in July on the fruit. The young larvæ hatching from these eggs enter the exposed, smooth surface of the developing apple and excavate a shallow gallery having a radius of approximately 1/16 of an inch. This is probably a manifestation of the leaf-mining habit of the young larvæ, recorded by a number of observers, in relation to those hatching from eggs deposited upon the foliage. A few days after entering the fruit many of the larvæ desert the initial point of injury and make their way to the blossom end. The impulse to desert a perfectly satisfactory shelter and brave the dangers of migration to the blossom end can hardly be explained as other than inherited and an outcome of the same unrest which, under other conditions, leads the larva to forsake the leaf mines and search for fruit. The attempt to enter the apple once more is frequently a failure on sprayed trees, owing to the poison deposited in the calyx cup in the after blossoming treatment. Unfortunately, so far as the apple grower is concerned, the young codling moth larva does not perish until the characteristic mark has been made on what should be an unblemished surface.

Records made during the past four years by Mr. L. F. Strickland, Horticultural Inspector of the New York State Department of Agriculture, show that as much as 20 per cent. of the fruit may be affected in this manner. Investigations by the speaker last summer indicate a somewhat general prevalence of such conditions along the south shore of Lake Ontario. In one orchard at Newfane, 9 to 12 per cent. of the total crop on three sprayed plots bore this side blemish, while in an Orleans county orchard similar plots showed from 25 to 35 per cent. side injury. The unsprayed or check plots in these two orchards had from 30 to 37 per cent. respectively, of the apples thus affected. It should be stated in this connection that very little "side injury" is to be found in Hudson Valley orchards.

The somewhat general limitation of this type of work to the vicinity of a large body of water leads us to believe that this variation in habit may be caused by local climatic modifications. There is on record a statement by Cordley to the effect that eggs are not deposited when the evening temperature falls much below 60° F. In this connection some interesting data has been published by Sanderson (N. H. Agr. Exp't. Sta., 19th-20th Rep'ts., 1908, p. 406). He finds that if evenings be cool, egg laying will sometimes be deferred for several days, and states that from June 9th to 15th, 1906, he was able to secure eggs but after that the evenings were cool until the latter part of the month and no eggs were obtained until June 28th. Again, in 1907, "no eggs were found until June 22nd * * * * though moths had been emerging since the 10th." An examination of records made the past four years by Mr. Strickland shows a fairly close connection between this type of injury and the rise of daily minimum temperatures above 60° F. The damage referred to above occurs mostly the last of June and the first half of July, and so far as records go, is preceded by a period of low temperatures which probably inhibit the crepuscular or nocturnal activities of the moth, and then with the rise of minimum temperatures above 60° F. we have the deposition of eggs and the development of side injury.

The low minimum temperatures from about the time the moths begin to emerge till the latter part of June, do not materially hinder the development of the apple and, as a consequence, when oviposition is possible the fruit is some size, smooth, and from observations in the orchard, appears to be more attractive to the moths as a place of oviposition than the foliage. Two, three and even four eggs were to be found upon apples here and there, though this would hardly be an average, and more than three-fourths of the eggs found were upon the fruit. This is the reverse of conditions recorded earlier by Messrs. Ball, Card, Pettit and Sanderson.

It will perhaps suffice to state in this connection that in the Hudson Valley, where "side injury" is comparatively rare, temperature records show no such prolonged periods after emergence of the moths begins where daily minimum temperatures fall below 60° F.

The "side injury" phase of the codling moth problem has a very practical bearing, since experiments conducted the past season show it to be extremely difficult, if not impracticable, to reduce damage of this character to a negligible quantity by one season's work. It happened that two of the experimental orchards mentioned above were very badly infested and in one, although the spraying was distinctly above the average, 25 to 33 per cent. of the fruit in certain plots showed the familiar side blemish. This was due largely to the fact that the injury was caused by newly hatched larvæ attacking the poorly, necessarily so, protected surface of the rapidly growing apple. These eggs, it is evident, were deposited by moths developing from hibernating larvæ, consequently this serious "side injury" was the logical development in a badly infested orchard when climatic conditions compel a late deposition of eggs, many of which may be placed on the fruit. This danger, in our estimation, is ample justification for urging thorough and annual sprayings of bearing orchards whether the trees happen to be fruiting or not. There are in most orchards, even if there is no crop, enough scattering apples to carry to maturity a number of codling moths, ignoring, if you please, the fact that Headlee and Jackson observed larvæ which developed to full size in water sprouts.

It is noteworthy in this connection that the experimental orchard of last season, not badly affected by "side injury," was sprayed annually and presumably thoroughly, even when not in fruit. The same was true of some other orchards where there was very little codling moth injury. That this comparative immunity could not be attributed entirely to accident was evidenced by the fact that just across a roadway from the orchard showing almost no injury, trees were found with 75 per cent. of the apples on the ground wormy.

The President: This paper of Dr. Felt's is of great interest to those who are engaged in fruit insect investigations, particularly insects affecting the apple. The Codling Moth damage, of course, is usually internal and quite serious, but on the other hand it is a kind of damage which, even if slight, may produce a blemish on the outside of the apple, which is very serious from the fruit grower's point of view, in view of the fact that it degrades his fruit. You may have a very fine apple, which ordinarily would rank as No. 1, but through some blemish produced in this way by the Codling Moth it is degraded to No. 3. This proves to be very serious in the case of the large fruit grower. In Nova Scotia, Mr. Sanders is making a study of a somewhat similar injury caused by the Budmoth, which also reduces the quality of the apple by a blemish of much the same nature as the one caused by the Codling Moth. I think it might be well to mention here that in his investigations Mr. Sanders found that there was injury being caused by another insect imported from Europe, and he sent me the other day a photograph of the injury caused by this insect, the Lesser Budmoth, *Recurvaria nanella*. As a number of men here have been working on insects affecting apples and fruit generally I have no doubt that they will have something to say in regard to Dr. Felt's paper.

PROF. CAESAR: In regard to the matter of side-worms, I may say that every persons who endeavors to spray thoroughly for Codling Moth finds that far the greatest trouble is to prevent the worms from entering the side of the apple, especially if there are two broods and if it is the first season the orchard has been sprayed.. I do not know anything about the influence of temperature on this questions of side-worms, but I do know that in Ontario side-worm injury is abundant both on high land and on low land.

MR. GIBSON: Mr. Chairman, I should like to remark that in Dr. Cosens' report which he sent as Director, he makes a brief mention of the occurrence of the Lesser Budmoth on pear trees in Toronto, and he also mentions that it was quite abundant on an apple tree. This insect is treated of in a bulletin published by the U. S. Bureau of Entomology.

THE PRESIDENT: If there is no further discussion on this paper we will proceed to the next by Mr. Winn.

THE HOME OF GORTYNA STRAMENTOSA.

ALBERT F. WINN, WESTMOUNT, QUE.

This moth is one to which but little space has been devoted in our literature, but being a typically Canadian insect, perhaps you will pardon a longer and more rambling paper than intended for the meeting.

In Vol. XXXII, pp. 61-63 of the Canadian Entomologist, Mr. J. A. Moffat, late curator of our Society, published a copy of Guenée's description of the moth, an enlarged half-tone cut of it and some remarks on its occurrence. This was followed in the same volume by a note on p. 119 by Mr. Grote, and a reply on p. 133 by Mr. Moffat. The species has again been figured by Sir George Hampson in Vol. IX of the Phalænidæ of the British Museum, plate 138, to which we will refer elsewhere. From Mr. Moffat's article we quote the following: "*Stramentosa* has been taken regularly at Montreal for years past by collectors connected with the Branch of the Entomological Society of Ontario there, apparently none knowing of its existence there except themselves. Mr. Brainerd intends to make a vigorous effort to discover its foodplant next season."

Although over fifteen years have elapsed since this was written and we had already been hunting over ten years, the search for its foodplant and consequent laying bare of the life history has been carried on faithfully and well by various members of our Branch, and at last it has fallen to my lot to have the pleasure of entirely solving the mystery of its hiding-place. It is not necessary to particularize the members who have tried to locate it and failed; practically all of us interested in Lepidoptera have searched our Mountain for infested plants possibly tenanted by *stramentosa*, and we had a few years ago the aid of Mr. Henry Bird for a couple of days; but although we were actually within a few feet of scores of larvæ, they were not detected. It is doubtful if any other Canadian insect has had so much time and thought expended on its habits and life history, and as successive seasons closed with the flight of the moths around our street lamps in the fall, and occasional captives on flower heads, we began to feel certain that no visible clue could be hoped for in the plant and that nothing but sheer luck would ever disclose the secret, but we kept on pulling up and splitting down all sorts of possible and some impossible plants.

On the afternoon of September 13th, 1914, while walking along a path on our Western Mountain, near the ski-grounds, looking for edible fungi rather than for insects, I found a *stramentosa,* resting on a leaf of the rattle-snake root (*Nabalus racemosus*) and a minute later disturbed another on a plant of the same species. This plant was given a tug and it broke off short, but the root was easily dug up and was evidently bored. On going back to the first plant, it was also found to have been attacked. Things began to look interesting and mushrooms were put aside for another day. By tramping among the plants and beating them with a stick, a number of the moths were disturbed, either dropping to the ground or flying a short distance and hiding. Among the hundreds of plants in the neighborhood a plant here and there was pulled up and most of them showed they had been bored, and we felt so sure that the long-sought for plant had been stumbled across that a supply of seeds was sent to Mr. Bird so that he might have a supply of plants in his "garden of borers" at Rye, N.Y., ready for the larvæ that would follow another season.

Early this June, when the larvæ of the borers were beginning their work in burdock, thistle, cicuta, iris, etc., the same locality was visited, but the Nabalus plants were hardly visible above ground and those dug up showed no sign of attack. We concluded that we were too early, for the moth being later in appearing than most of the borers, it seemed possible that the egg was also later in hatching. The next visit was three weeks later and the plants were about two feet high, but the most careful search failed to find any trouble. Something had evidently gone wrong with our discovery of the previous fall and *stramentosa* was still surrounded by a mystery. One thing was very certain, however, namely, that if I had disturbed a dozen or so of the moths there must have been in the neighborhood scores or hundreds that were not seen, and as the number of examples seen about the lights each year was about uniform, there *must* be a lot of larvæ close at hand. If they were not in Nabalus, they must be in something else growing commonly there. Fortunately I was in a clear patch on a hillside and could get a sort of bird's-eye view of the tangle of weeds and undergrowth. A plant was noticed that we had seen in many places on Mount Royal Park and an isolated clump was selected. There was no wilted top nor brown leaf to indicate attack, but on splitting the longest stem down from the top, a boring was struck about a foot from the ground and a section containing the little larva was quickly boxed. Other plants were similarly treated but nothing was found, and it looked as if our day's take was going to be only one larva. Something suggested that we were again off the track, so we opened our box, removed the larva from its boring and had a good look at it. It was seen to belong to a different genus—*Papaipema,* probably *P. cataphracta,* and such it proved to be. This in itself was rather a discovery, as the insect, though common enough in Ottawa and elsewhere, is seldom found with us, and it seemed remarkable that the very first stem selected to be split open should have contained a larva, which prevented my continuing the process down to the ground, which is the simplest way of locating boring larvæ in their earlier stages. We could not recollect ever having pulled up a clump of this plant on any previous occasion and as we looked at the erect stems with their perfect foliage surmounted by the forming seed pods, which later on rattle merrily when touched, it seemed incredible that they should be bored; and yet, that little cataphracta had been in one stem, equally perfect externally. A cluster of stems coming from one root was grasped and given a tug. Up it came, and after giving it a shake, a fine fat larva about 1¼ inches long was seen shuffling back into its burrow. As we were extricating him, another dropped to the ground and was secured. This surely was our quarry at last. Another clump was pulled up, two more larvæ and so on, as many as eight being taken in one clump and no blanks, every clump seemed to be attacked. Other plants noticed here and there on the way home were examined and proved to harbour larvæ in their roots. There was, henceforth, no shadow of doubt as to the home of the *stramentosa.* But what was the plant's name? I tried to determine it by Gray's Manual of Botany, but was misled by the square stem in trying to locate it among the members of the Mint family. A specimen was sent to the Dominion Botanist and Mr. Adams kindly determined it as belonging to the genus *Scrophularia,* but did not like to state the species owing to the absence of flowers. On referring to Britton and Brown's Botany, our plant was easily recognized by the cut and description as being *S. leporella*—the hare figwort—but to make doubly sure, the original description was turned up in Vol. 33, p. 317, Bulletin of Torrey Botanical Club (1896)—so *stramentosa* may be given the common name of the "Fig-wort borer."

As I was leaving town for my holidays within a few days, the bulk of the larvæ and roots were packed up and sent to Mr. Bird, only a few being kept as I felt sure that on my return any desired quantity of full-grown larvæ could be secured and that the pupæ would be likewise found in due season. Mr. Bird was away on a *Papaipema* hunt in Illinois when the package arrived, but his son looked after it and was successful in obtaining the imagos and so quickly that we might almost suspect that he used an incubator in his anxiety to get the first bred *stramentosa.* On my return I found several larvæ had pupated, while the rest died of starvation owing to the drying up of the roots. A series of wet days and other contingencies prevented my getting any time to visit my hunting-ground till Saturday, August 20th, by which time it was supposed all would be in pupa. In the first clump selected a larva was found and evidence that there had been another, so I proceeded to get out my entrenching tool and began scraping away the earth carefully. At a depth of about two inches a fine yellowish-brown pupa lay exposed, wriggling about in a very lively fashion as if not at all appreciating being disturbed. Proceeding to a nearby clump resulted in two more—then six, which is the most found under one plant, and in the course of three-quarters of an hour, thirty had been boxed. Reluctantly we were compelled to stop, as the drizzling rain which had been falling was becoming heavier and the vegetation was decidedly moist to work among. The pupæ were all found in the same situation as the first, namely not over two inches below the surface, invariably on their sides, without any cocoon or cell and wriggling much when disturbed. All were within a foot's radius from middle of root. The question occurred: how would the moths emerge from those earthy homes? Would they force their way through the soil or would instinct tell the pupæ to come to the surface? Having brought home a supply of soil from the woods a layer was put in two breeding cages, 18 pupæ were placed in one cage and 12 in the other, all in a horizontal position, and were covered with about two inches of soil and on top was an inch or more of the *prepared fibre,* sold by the florist for growing bulbs. This I find an excellent material for keeping burying pupæ moist enough without inducing mold. Two days later the question was answered. Seventeen of the pupæ were visible, some were on their sides, but most of them were nearly vertical, tail up. To what extent the cremaster aids the tunneling process was not ascertained, but its structure is suggestive that it might be useful.

On August 30th my first moth appeared. The following evening I went straight from the office to the woods but it was nearly 6.30 when the ground was reached and four pupæ were all that were secured in what remained of the daylight. The next Saturday afternoon, September 4th, was warm and bright, rather too warm in fact for digging operations. Pupæ were found nearer the surface and two sticking up on end, cremaster up, as in the cages. Collecting at this date, though successful, is difficult, for the digging implement is almost sure to injure about as many pupæ as it unearths sound ones, so after cutting in two or dinting over twenty a piece of wood was substituted. It was not much improvement as the extra force required to use it bruised the pupæ instead of cutting them in two. On returning home it was found that twenty-six sound pupæ was the result of the outing. But this was not all, for two larvæ were found, one evidently sickly, the other full-grown and well below the ground ready to pupate. One empty pupa shell was also picked up and the plant above searched for the moth. Whether it was this one or another I disturbed during my search cannot be said, but happening to look down a moth was seen running along among the leaves on the ground and took refuge under one of them. When disturbed, she ran off and finally hid under another leaf—the performance exactly resembling that of *Amphipyra tragopogonis* which in England has earned for itself the common name of *The Mouse.* Several other moths had by now emerged in the cages and many pupæ were darkening up in color, betokening early emergence. In doing this one escaped and fell to the floor, without attempting to use its wings, and immediately scurried about on the floor in search of a hiding place. It was noticed that the moths in the cages all appeared to try to squeeze themselves as close into the dark corners as possible, often remaining two or three days without altering their relative positions. It is, of course, possible that during the night they may have flown or moved about and returned to their post before morning, but the habit of secreting themselves by day is evident.

Having a supply of living moths the next point was to secure eggs, and not having any experience in getting bred specimens of Noctuids to mate in captivity, I tried every plan I have ever used in the case of moths belonging to other families, but was unable to get a pairing among themselves, and freshly emerged females placed on the inside of screen doors and taken into the woods failed to "assemble" any flown males. Finally a large skeleton box, about thirty inches each way, covered with netting, was put in the garden, with stems of several figwort plants stuck vertically in the ground, as well as the cuttings of such perennials as were in flowers and some twigs and leaves smeared with sugaring mixture. After feeding all the moths forcibly, they were turned into the moth paradise. Two days later, success was attained, one moth having selected a blue-bell, and in the axil of the leaf deposited a cluster of eight eggs, irregularly placed, while lower down on the same stem were about ten eggs in a crooked line, the lowest barely an inch from the ground, and the moth was hiding under the lowest leaf which was drooping and provided a suitable shelter. The moth was brought indoors and placed in a breeding cage with cuttings of figwort and blue-bell stems, but evidently they were not attractive-looking, for the moth would not use them, but placed eggs in all sorts of places in corners, on the glass door, loose on the bottom and most curiously on and in the empty pupa cases of its own kind. It was hoped, by observing where eggs were laid in confinement, that the habits in nature would be indicated, but the results were unsatisfactory. In no case did it seem as if the eggs were placed otherwise than as a sort of makeshift, although the use of the axil of leaf and inside of pupa cases hinted that they would probably be concealed, that is thrust in somewhere; which might have been presupposed. However, knowing what the eggs looked like, and armed with a reading glass, we proceeded to the hillside the next Saturday afternoon and looked over the plants from the ground to the top seed-vessels. The inside of the latter were very carefully examined, as well as the little cluster of leaves closely pressed together at the foot of the plants ready for next year's growth. Nothing was found, and it looked as if the old saying about looking for a needle in a hay-stack might be revised to cover looking for a moth's egg on a mountain. Next day I was in a different place, but seeing some of the figwort, pulled up a clump just to see whether it had been attacked. It had—very much so. All of a sudden it occured to me that the natural place for eggs to be deposited to secure a ready access to food supply in spring had been overlooked, and that the habit of the female running on the ground should have been a sufficient clue. As is the case with many tall perennials that are bored, there remains of the previous year's stem a little tube extending a few inches above ground and forming a natural tunnel straight to the roots. Hastily, but carefully, with a penknife this was split open and four eggs were revealed. Others were found, as many as twelve in one case, and some of them were so slightly attached that many others may have dropped down the hole. This, of course, may not be the only place the female selects, but it satisfied me that in 1915 a good deal had been found out about the home of *stramentosa*. There is one brood per annum, the egg hibernates, the larva feeds wholly in the roots of the figwort, matures about the middle of July to August 10th, the pupa lies beneath the plant about two inches below the surface, bores its way to the surface tail first, the moth, emerging, tumbles the pupa over, and climbs very rapidly up the plant's stem, stops, holds its soft wings by its sides for eight to ten minutes, then when about half expanded, suddenly flaps them together over the back like a butterfly at rest, and remains in that position till the wings are fully developed, or about half an hour. The wings are then lowered, and the moth crawls into a corner and stays there. How long it takes for the wings to become dry enough for flight was not ascertained. Most of the moths emerged between five p.m. and eight p.m. No parasites were observed, but indoors the wriggling pupæ proved enticing to a pair of mice, and one of my small cages having a cotton netting in front was entered, with the result that there was a round hole in the net and the chrysalids went away inside the mice. They were evidently relished, for next night a trap caught one mouse and the following night the other. This suggests that field mice may greatly reduce the number of pupæ after they come up and wriggle about on the surface of the ground. The moth most closely allied to the figwort borer—*G. immanis,* the hop-vine borer—is said to be considered as a particularly choice delicacy by skunks (Can. Ent., XIV, 93-95), one hop-grower stating that he had seen ten acres where not a dozen hills had escaped their little noses. It may be that the absence of this odoriferous mammal from the neighborhood of Montreal has given *stramentosa* a chance to increase in the land.

Detailed descriptions of the various stages will be published shortly by my good friend, Mr. Bird, as in view of his wonderful knowledge of the life histories of the boring Noctuids, it seemed more in the interests of science that the making of descriptions and comparisons should come from his pen than from mine.

THE PRESIDENT: We are very pleased to have Mr. Winn's paper, and I should like to thank him for the specimens of this interesting moth which he has placed in our National Collection here. It has been said to me by a keen external observer of the activities of this Society for many years that there is a preponderance of economic papers in our programme, and that this is not as it used to be, that in the old days there were more papers of a purely scientific character by such men as Mr. Winn, who are not professional entomologists but who follow entomology as their chief hobby. For that reason we are especially pleased to have Mr. Winn's paper. It would be a very bad day for the Society when papers of such a nature cease to appear in our proceedings, and for that reason also we shall look forward to hearing a number of other papers by our old friends who are not professional entomologists, such as Dr. Fyles' paper this afternoon and Mr. Morris' paper to-morrow. The paper is now open for discussion.

Mr. Gibson: The study of these Lepidopterous boring larvæ such as Mr. Winn has told us about is one which has always given great pleasure to those who are interested in rearing the larvæ of our moths. We have not, as yet, found this insect at Ottawa, but now that we know more about the larvæ and what they feed upon we hope that we may be able to find the species. The chief boring larva of this family which occurs in the Ottawa district is called the Burdock Borer, *Papaipema cataphracta.* This is quite a pest, some years attacking soft-stemmed flowering plants, such as dahlia, lily, etc., and in addition, of course, it occurs in burdock and thistle. I am very glad to know that Mr. Winn has donated specimens for the collections here.

Sir James Grant: Mr. President, I should like to make a few observations. I am happy to inform you that after a very careful survey of the Dominion of Canada, from Victoria on the Pacific to Halifax on the Atlantic, through the whole of Central Canada and New Ontario, that the work of this Entomological Society has proved of great practical value to Canada in the Department of Public Health. The information that you have given to our people on the part played by the house-fly as carriers of disease has conserved very materially the life of the people of Canada. Those house-flies play, as you know, a very important part in the dissemination of tuberculosis from sputum. There is now, I am happy to inform you, as you will find in my report recently presented to the Canadian Public Health Association at Toronto, a reduction in the past fifteen years of fully twenty-five per cent. in the number of cases of tuberculosis. I have lately gone through whole sections of Central Canada where fifteen years ago the disease was very common, indeed, hundreds of cases in nearly every direction. To-day, with difficulty, in those sections can you discover a solitary case of tuberculosis, and I am happy to inform this Association that if they continue the good work they have done in the past in the preservation of health by similar measures, and by the destruction of the house-fly, I am confident that the next ten or fifteen years will bring about a reduction of this disease of fully fifty per cent. The head of the Pasteur Institute, Paris, France, has recently announced that throughout the whole of Europe there is now a reduction of fully twenty-five per cent., and I am very glad, indeed, to have accepted your kind invitation to attend this meeting to thank you and the members of this Association, for the active part taken in instructing our people, as to the vast importance of the destruction of this house-fly, which is undoubtedly very instrumental in the production of the death rate from tuberculosis.

Dr. Hewitt: We are very pleased to have Sir James Grant with us and I hope that he will attend as many sessions as he can and hear other papers of interest.

INSECTS OF STE. ANNE'S, QUE., SEASON OF 1915.

E. Melville DuPorte, Macdonald College, Que.

During the past season there were outbreaks of several injurious insects at Ste. Anne's and the surrounding country, the most important of which are discussed below.

Grains and Clovers.

The Frit Fly (*Oscinis carbonaria*) along with the Wheat Stem Maggot (*Meromyza americana*) caused appreciable injury to small grains. These insects which have not, at least within recent years, been destructive in this region were more plentiful than usual.

Hessian Fly injury was observed by Mr. P. I. Bryce in the experimental plots at Macdonald College. Hitherto these plots have been free from this pest. As the plots worst affected were in the neighborhood of a manure pile it is practically certain that the insects were brought in with the manure.

The more important insects of the clover during the season were the Clover Seed Chalcid (*Bruchophagus funebris*), The Lesser Leaf Weevil (*Phytonomus nigirostris*), The Clover Mite (*Bryobia pratensis*), The Pea Aphis (*Macrosiphum pisi*), and *Tychius picirostris*. The Seed Chalcid was quite destructive during the seasons of 1913 and 1914. The injury due to it was not so marked during the season under discussion, but its work was supplemented by that of the Lesser Clover-leaf Weevil, the larvæ of which destroyed a fair proportion of the red clover seed. The Clover Mite was quite abundant in the latter part of the season.

Locusts. The locust outbreak was very severe in the Province of Quebec during the past season. Not only forage and field crops, but some garden crops were severely injured. The species most numerous and causing most injury at Ste. Anne's was the red-legged locust (*Melanoplus femur-rubrum*). *M. bivittatus* was also quite numerous. At Macdonald College the poisoned bran mash, Kansas formula, was used to protect the experimental plots. For some reason the mortality among the locusts was not as high as expected. The incursion of locusts from neighboring untreated fields increased the difficulty of controlling the pest and for this reason strong emphasis should be laid on co-operation among farmers in combatting these insects.

Field and Garden Crops.

Cutworms. Another very serious outbreak of cutworms occurred in parts of the Province, causing considerable injury to garden and field crops. At Ste. Anne's the species responsible for most of the injury was the striped cutworm (*Euxoa tessellata*), but a few white cutworms and red-backed cutworms were also found. Several parasites of these insects were actively at work, and the relatively small number of moths observed holds out some hope that the cutworms will be less destructive next year.

Root Maggots. Both the cabbage root maggot (*Chortophila brassicæ*) and the seed corn maggot (*Chortophila fusciceps*) were the cause of much injury to cruciferous crops. In some turnip fields a large proportion of the plants was destroyed by the seed corn maggot even after the tops were practically full grown and the roots had attained a fair size. The carrot rust fly (*Psila rosæ*) was more injurious than usual this year, causing considerable loss in small kitchen gardens.

The Beet-Leaf Miner (*Chortophila vicina*) was injurious at Ste. Annes to mangels, beets and spinach. Complaints were received also from other parts of the Province.

The Hop Flea-Beetle (*Psylliodes punctulata*). Beets and mangels were badly attacked by this insect in the early part of the season. It was the only flea-beetle which occurred in very large numbers at Ste. Anne's.

The growing of parsnip seed for the first time at Macdonald College introduced there a new pest, the Parsnip Web-Worm (*Depressaria heracliana*), which greatly reduced the yield of seed. This insect is always present in the wild carrot at Ste. Anne's but has not before given us any trouble.

Orchard and Small Fruits.

The Plum Slug (*Eriocampoides limacina*) was very destructive during 1913 and 1914, and judging by the number of adults which emerged last spring and the number of eggs laid, I expected a severe outbreak this season. The eggs, however, were so effectively parasitized by the chalcid *Pentarthron minutum* that it was not even necessary to spray for the slug.

The Budmoth (*Tmetocera ocellana*) continues to be injurious in various parts of the Province, especially in poorly kept orchards. Its parasites were at work, *Pentarthron minutum* being most active. Experiments on the control of the budmoth larvæ indicated that they could be kept in check by the application of two sprays, one three days before the blossoms open, the other shortly after the petals fall. It was also found that lead arsenate at the rate of 2½ lbs. per 100 gallons of spray, applied at the end of June while the eggs are on the leaf, will destroy a very large proportion of the newly hatched larvæ.

The Cigar Case Bearer (*Coleophora fletcherella*) was present on unsprayed trees but gave no trouble in well kept orchards.

The work of the Buffalo Tree-Hopper was very evident in some orchards. In a young orchard of about 4,000 trees, not far from Ste. Anne's, this insect has dwarfed and deformed several of the trees to such an extent that they are practically valueless.

Among the insects injurious to small fruits the more important were the Currant Saw Fly, the Raspberry Saw Fly, and the imported Currant Borer.

THE OCCURRENCE OF TYCHIUS PICIROSTRIS ON CLOVER AT STE. ANNE'S, QUE.

E. Melville DuPorte, Macdonald College, Que.

Last May I noticed that the leaves of red clover which forms a cover crop in an orchard at Ste. Anne's were being destroyed by a small snout beetle. This insect was present in large numbers feeding gregariously on the leaves, in many cases upwards of twenty being found on a single leaf. On being disturbed the weevils readily "feigned death" and fell to the ground. Specimens sent to the United States Bureau of Entomology were identified as *Tychius picirostris* by Mr. E. A. Schwarz.

Later in the season, as soon as the clover came into bloom, the insects deserted the leaves and attacked the flower heads in which they remained throughout the season. My latest record is dated September 28th.

The weevil was found in practically all fields of common red and mammoth red clover in the neighborhood of Ste. Anne's, but did not seem to attack other varieties.

The adult beetle is a small curculio about 2.25 mm. long and 1 mm. broad. The interspaces of the elytra are thickly clothed with narrow, hair-like, procumbent scales, the elytral striæ are naked. The ventral side of the body bears somewhat broader scales. Pronotum punctate; not much narrower than the elytra; its length about equal to its greatest breadth; narrowed in front; the scales on the pronotum and also on the legs are similar to those on the elytra. The head is sparsely clothed with fine hairs; the beak is about as long again as the head and clothed at its basal end with scales like those of the elytra.

The scales of the elytra and prothorax give the weevil a pale olive green colour, but they are rubbed off as the insect gets older, leaving the elytra and pronotum bare so that the insect gradually assumes a dark brown colour.

Tychius picirostris is not an indigenous form, but has been introduced from Europe where it attacks the flower heads of red clover, plantain and *Genista.* It has not before been recorded as injurious in North America though I learn from

Tychius picirostris on clover leaf. (Original.)

Professor F. M. Webster that it has been collected at Ithaca and Oswego, N. Y., and at Framingham, Mass. I have observed it at Ste. Anne's for several years, but not before in sufficiently large numbers to be regarded as injurious.

THE PRESIDENT: Mr. DuPorte is to be congratulated on his account of his season's work, which indicates how very active he has been and to what good purpose he has directed his attention. We here have been particularly interested in his observations on *Tychius picirostris,* this new pest of clover, and probably Mr. Gibson has some remarks to make about this.

Mr. Gibson: We have a specimen in the collection which may possibly be this species and which is from Brockville. We have not, however, examined it carefully enough to be certain. I was glad to hear of the eastern occurrence of the Hop Flea-beetle, which Mr. DuPorte referred to.

Prof. Lochhead: I would like to remark in regard to Mr. DuPorte's papers that I had not much time to give to the work done by Mr. DuPorte, who is a member of the Biology staff of Macdonald College as investigator under the Dominion Federal Agricultural Institution Act. He has done a great deal of work of which this is a small fraction, and he has other more elaborate work at hand. It is especially in the line of anatomical work that his investigations are valuable. I know of no person in Canada who is more adept or more patient in the unravelling of minute anatomy than Mr. DuPorte, and we may expect to hear of some of his investigations a little later. He had the honour of presenting a paper to the Royal Society last year, and I feel sure that Mr. DuPorte will favor us year after year with his attendance and give an account of his work.

The President: If there is no further discussion I think we will conclude this morning's session.

THURSDAY, NOVEMBER 4th—AFTERNOON SESSION.

The President: We are to begin the afternoon session with a paper by Dr. Fyles. Dr. Fyles needs no introduction to the Entomological Society. He is the oldest member among us, and when he said last year that the paper he presented would be probably the last I well remember disputing the fact with him, and apparently my own prophecy has proved correct in that we are to enjoy another paper by Dr. Fyles entitled "Observations Upon Some of the Predaceous and Parasitic Hymenoptera."

OBSERVATIONS UPON SOME OF THE PREDACEOUS AND PARASITIC HYMENOPTERA.

Rev. Dr. Fyles, Ottawa.

One day in summer, I was sitting under the verandah of a friend's house, at Hull, when I noticed a specimen of *Pelopœus cementarius* Drury, exploring some webs that had escaped the notice of the mistress of the dwelling. The creature was in search of spiders, wherewith to provision the mud castles that it was building for its young. This incident suggested the subject of my paper.

The question entered my mind, How can I obtain a supply of the mud structures for use in the preparation of the article? I bethought me that boys are privileged, and can go where older persons cannot, without being regarded as intruders, so I asked the aid of one of Baden Powell's boy scouts, and not in vain; for next day he obtained for me an ample supply of the castles, from an unused attic of a neighboring house.

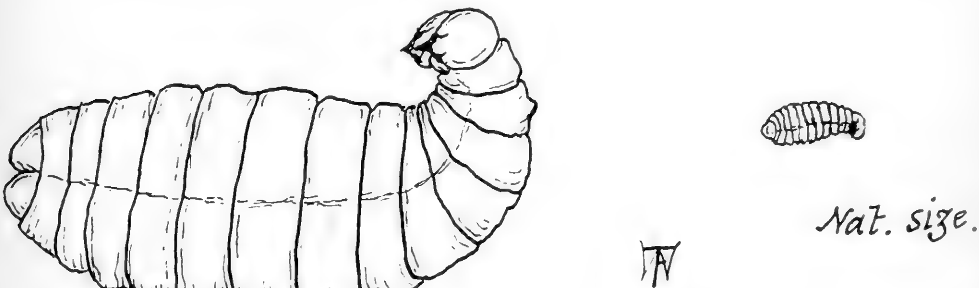
Pelopœus cementarius has practised the business of pottery from the creation of the world that now is. Its instinct impels and guides it, and its work is accurately done, according to its need.

I have watched the insect preparing material for its building.

In the grounds of the late Mr. Quartus Bliss, at Compton, in the eastern townships, there was a horse-trough hewn out of a huge basswood log. The water was supplied by a spring, and its overflow escaped at one end of the trough, through a circular cut, and formed a puddle in the clay ground. One day, when on a visit to Mr. Bliss, I saw a number of mud-wasps at this puddle gathering soil, tempering it with their mandibles, and then flying away with pellets of the cement.

The cells brought to me were in masses, and probably numbered two hundred. They reminded me of dirty peanuts jammed together. Within each was a long oval chamber, at one end of which were the remains of the spiders on which the inmate had fed. Next to these was a hard cap, rough and rounded on the outside, and concave and polished on the inside. Attached to this was a case, yielding to the touch, and somewhat brittle, but strengthened by a fine silken covering, which I found could be peeled off.

The case was semi-transparent. The form of the waxen larva, free and unattached, could be seen through it. Examined through a glass it appeared to be formed of a like silken texture as its covering, but smoothed and compacted by a vehicle that resembled glue or varnish.



Grub of *Pelopæus cementarius* (Drury) in the month of November.

As the case was complete, and the remains of the spiders on the outside of it, its occupant must have ceased to feed.

The perfect Pelopæus is a grim object, very active, very forbidding. Its "frightfulness" is its protection. It seems to say, "You let me alone, and I'll let you alone." In reality it is one of our insect friends.

I think three spiders for each would be a low estimate for the provision made in the cells brought to me. That would give 600 spiders collected in the immediate vicinity of the house in which the cells were found. Now, when you call to mind how prolific the female spider is, you will be able to form a faint idea of the terrible and disgusting plague from which the mud-wasps preserve us.

But the spiders have their use in the economy of nature. Are there no counter checks against the undue increase of the mud-wasps? Yes, several ichneumon-flies have been recorded as preying upon them: for instance, *Cryptus junceus* Cresson (Am. Ent., Vol. I, p. 137).

Some years ago, I had a batch of Pelopæus cells in my study window. One day, when the wasps were breaking from their domiciles, I found a specimen of *Sarcophaga prædator* Zabriski in the window. I can only account for its presence by supposing that it came from one of the mud cells. If my surmise is right, how can we account for the presence of intruders such as this in the mud castles of the wasp? I think that Prof. W. S. Blatchley, in "Woodland Idyls," pages 206-9, has supplied an answer. He tells that he saw an ichneumon light upon a spider, *that a wasp was carrying off,* and deposit an egg in it.

Zabriski found *S. prædator* in the nests of *Vespa maculata* Linn., and *Vespa germanica* Fabr., insects of widely different nesting habits. Has it a wider choice of domiciles? It may have.

The Digger Wasps should be numbered among our insect friends.

One summer day, a few years ago, I was walking in the beautiful cemetery at St. Joseph de Levis when I came to a bare and unused portion of ground. The soil was light yet not friable. It seemed to be just suitable for the operations of *Bembex fasciatus* Fab. About a score of these insects were in sight, some of them sinking shafts in the ground; others storing their shafts already completed with Blue-bottle flies.

It must be told here that a considerable tract of Government land lies near the burial ground which I have spoken of; and that some of the dwellers in the vicinity were guilty of the reprehensible practice of carting their garbage out to this waste land, and leaving it there uncovered. It was not surprising that Blow-flies were plentiful in the neighborhood, and that Digger Wasps and Carrion Bettles were plentiful there, too.

I once saw *Ammophila communis* Cresson, staggering along with a caterpillar larger than itself, and then burying it in a hole previously prepared.

The monarch of our Canadian ichneumons is undoubtedly *Thalessa atrata* Fab.

On the 17th of June, 1899, the Quebec Branch of the Entomological Society, which was then in a flourishing condition, held a field day in the grounds of Mr. Harper Wade, of New Liverpool, Quebec. Mr. Wade's house is on a bluff overlooking the St. Lawrence. Behind it is an extensive lawn bordered by ornamental trees and shrubs. At the time of our visit a huge maple log had been sawn into blocks of stove length, ready for the splitting; but the owner had placed them here and there, under the trees, for rustic seats. On approaching one of these I found several female specimens of *atrata* in the act of depositing their eggs, while others of the species were darting about in the vicinity. Each block had its visitors of the kind attracted by the larvæ of *Tremex columba* Linn., which were tunneling in the wood. But how were the ichneumons attracted? Was it by some subtile emanation from their victims? Who can say?

There are trees on each side of the street on which I live. A Red Maple (*Acer rubrum*) is growing a few yards from my door. On the 16th of June, 1912, looking from the portico over this door, I saw an assembly of ten or a dozen males of *Thalessa lunator* Fabr. The insects were clustered on a spot where a limb of the tree had been lopt some years before.

There was apparently much agitation amongst them. Before night two females made their appearance from the wood; and then the males dwindled in number. Only the two females remained next day.

What attracted the male insects to the spot where the females were about to show themselves? Was it scent, or sound, or some influence we know not of?

While speaking of the Longtails let me say that some years ago, I took on the Heights of Levis a Thalessa of great rarity. It is about the size, and of the same rich sienna-colour as *Thalessa lunator* Fabr., but very different in its markings. Instead of the lunettes which are seen on the abdomen of *lunator,* there are, on each side of the 3rd, 4th and 5th abdominal segments of the insect I am speaking of, a bright crome-yellow circle upon a black fascia which passes round the segment. I presume that this insect is *Thalessa nortoni* Cresson.

Epialthes gigas Walsh, which closely follows the above in our lists, has a forbidding appearance. Epialthes (Gr.) means a *nightmare, one that leaps upon you.* Not a bad name! Decidedly it is better to have the insect preserved in the cabinet than alive in the bed-chamber.

I have in my collection, amongst many other useful insects, representatives of twenty-two species of the genus *Ichneumon.* They attack the Noctuids. I have seen *Ichneumon lætus* Brullé break from the emptied skin of a cut-worm.

The micro-hymenoptera are valuable friends to man. I have here a family of 103 specimens of *Apanteles longicornis* Provancher, which fed in one Tussock caterpillar, and then spun their cocoons around the remainder of their victim.

To show how thoroughly the work of the micro-hymenopterous parasites is done, and how important it is, in sometimes un-noted directions:

Those who have stood on a Quebec wharf in the blueberry season, and seen the Saguenay steamboats discharging their freight, will have noticed the stacks of rude boxes, made of slabs from the sawmills, and filled with blueberries, landed there; and they will have witnessed the eagerness with which dealers have made bids for them. The reflection will have come into their minds, what an important source of revenue—what a provision of food—the blueberry crop must prove, to the poor inhabitants of the Chicoutimi and Saguenay wilds, and how serious a loss to them its failure would be.

In May, 1895, I sent to Mr. Wm. H. Ashmead, a number of galls that I had found on the blueberry bushes at Levis, and specimens of the flies that I had raised from them. Mr. Ashmead replied:

"The gall on Vaccinium is my *Solenozopheria vaccinii* described in 1887 (Trans. Am. Ent. Soc. XIV, p. 149).

"The parasite reared from it is my *Megorismus nubilipennis.* The gall occurs abundantly on various species of Vaccinium, in all parts of the country, but the maker is extremely rare; and the only one known, so far as I know, is my single type specimen. I took the gall by the hundreds, and have never reared but one specimen of the gall-maker; all other things reared from it being parasites. I have reared several distinct species of micro-hymenoptera from it, although of these the *M. nubilipennis* was the most common."

One of the most brilliant little micro-hymenoptera came under my notice in peculiar circumstances, and has remained a memory and a mystery to me to this day. The late Mr. Joshua Thompson, of D'Aubigny Villa, Levis, sent to me one day in July, begging me to come and see his plum trees. The trees were loaded with half-grown fruit; and a most remarkable invasion of the trees had occurred. I never witnessed anything like it. There were myriads of tiny hymenopterons upon them. I counted as many as thirty on one plum. The females of the species had their ovipositors thrust deep into the fruit.

I submitted specimens of the insects to Mr. Ashmead and he declared them to belong to a new species. I named them *Torymus thompsoni,* and I published a full description of them in the Thirty-fourth Ann. Rep. of the Ent. Soc. of Ont., page 10. The type of the species is in my collection in Ottawa.

I had previously raised specimens of *Torymus sackenii* Ashmead, from blisters on the leaves of Golden Rod.

In the valuable series of Farmers' Bulletins issued by the Bureau of Entomology, at Washington, there appeared lately an article by Mr. F. M. Webster, which reminded us of a time when the hearts of men began to fail them for fear because of the devastations wrought in their grain fields by the Hessian Fly. Where this insect comes in its strength—to use the words of Mr. Webster—

"hundreds of thousands of acres of wheat may be either totally, or so badly injured as to reduce the yield 50 to 75 per cent., and the monetary losses expressed in dollars would run far up into the millions."

Agriculturists, at the time I have alluded to, were at their wits' end to discover checks upon the destroyers. The checks came, but they were not of man's devising. Doubtless, in the beginning of the world that now is, such interruptions and disturbances in the order of nature, as the Hessian Fly plague—

"Deep in God's foreknowledge lay."

And it was He who brought to bear the minute antagonists of the fly, that are so well figured in the bulletin I have mentioned, viz.: *Polignotus hiemalis, Merisus destructor, Platygaster herrickii, Bœotomus subapterus.*

A bulletin on the Hessian Fly has also been written by Mr. Norman Criddle, and published by direction of the Minister of Agriculture, Ottawa. In it a full description of the pest, its life-history, and its operations are given. A reference to its hymenopterous parasites is also made.

Such investigations as Mr. Webster and Mr. Criddle, and others of our practical Entomologists, are carrying on, dignify our favorite study, and raise it far above trivialities and hobbies. In following out the life-histories of our insect friends and insect foes, and showing how wonderfully they work for the general good, they—

"Justify the ways of God to man."

In pointing out the best methods of operating under the vicissitudes of nature, of remedying evils, and advancing benefits, their work is ennobled, for the are "workers together with God."

HYMENOPTERA PARASITICA—ICHNEUMONIDÆ TAKEN IN THE PROVINCE OF QUEBEC BY THE REV. DR. FYLES.

ICHNEUMONIDÆ.

Ichneumon annulipes Cresson. Levis, rare.
Ichneumon canadensis Cresson. Levis, common.
Ichneumon cincticornis Cresson. Levis, common.
Ichneumon comes Cresson. Levis, common.
Ichneumon creperus Cresson. Levis, common.
Ichneumon extrematus Cresson. Levis, rare.
Ichneumon flavicornis Cresson. Levis, common.
Ichneumon flavizonatus Cresson. Levis, common.
Ichneumon grandis Brullé. Levis.
Ichneumon insolens Cresson. Levis.
Ichneumon jucundus Brullé. Levis, rare.
Ichneumon lœtus Brullé. Levis, common.
Ichneumon malacus Say. Levis, rare.
Ichneumon paratus Say. Levis, rare.
Ichneumon pictifrons Cresson. Levis.
Ichneumon promptus Cresson. Levis, rare.
Ichneumon rufiventris Brullé. Levis, rare.
Ichneumon sublatus Cresson. Levis, common.
Ichneumon unifasciatorius Say. Levis, common.
Ichneumon versabilis Cresson. Levis, common.
Ichneumon wilsoni Cresson. Levis, rare.
Ichneumon xanthropus Ashmead. Levis, rare.
Amblyteles indistinctus Provancher. Levis, rare.
Amblyteles quebecensis Provancher. Levis, rare.
Amblyteles rufizonatus Cresson. Levis, rare.
Amblyteles subrufus Cresson. Levis, common.
Amblyteles saturalis Say. Levis, rare.
Trogus brullei Cresson. Levis, common.

Trogus copei Cresson. Levis, common.
Trogus excesorius Brullé. Levis, common.
Trogus fulvipes Cresson. Levis.
Herpestomus hebrus Cresson. Levis, rare.
Trychosis tunicula-rubra Fyles. Levis.
Cryptus americanus Cresson. Levis, rare.
Cryptus extrematis Cresson. Levis, parasitic in *Samia cecropia.*
Cryptus robustus Cresson. Levis, rare.
Hemiteles mucronatus Provancher. Levis, parasite of *Tricotaphe levisella* Fyles.
Hemiteles utilis Norton. Levis, secondary parasite in Acronycta larvæ.
Ophion macrurum Linneus. Levis, parasitic in the Saturnians.
Ophion purgatum Say. Levis, common.
Exochilum fuscipenne Norton. Levis, common.
Exochilum mundum Say. Levis, common.
Heteropelma flavicornis Brullé. Levis, common.
Opheltes glaucopterus Linneus. Levis, parasitic in *Cimbex americana.*
Paniscus geminatus Say. Levis, common.
Campoplex glaucus Norton. Levis, rare.
Campoplex laticinctus Cresson. Levis, rare.
Exetastes rufofemoratus Provancher. Levis, common.
Exetastes suaveolens Walsh. Levis, rare.
Sphecophorus prædator Zabriskie. Hull parasitic in nests of Vespa.
Polyblastus quebecensis Provancher. Levis.
Exyston humeralis Davis. Levis, rare.
Bassus tripicticrus Walsh. Levis, rare.
Arotes amœnus Cresson. Levis.
Arotes vicinus Cresson. Iron Hill.
Thalessa atrata Fabricius. New Liverpool.
Thalessa lunator Fabricius. Sherbrooke, common.
Thalessa nortoni Cresson. Levis, very rare.
Ephialtes gigas Walsh. Levis.
Pimpla annulicornis Cresson. Levis, rare.
Pimpla conquisitor Say. Levis, common.
Pimpla inquisitor Say. Levis, parasitic on *Hylotoma pectoralis.*
Pimpla pedalis Cresson. Levis, common.
Pimpla pterelas Say. Levis.
Pimpla tenuicornis Cresson. Levis, rare.
Lampronota americana Cresson. Levis, common.
Lampronota punctulata Cresson. Levis, rare.
Lampronota varia Cresson. Levis, rare.
Xytonomus stigmapterus Say. Levis.
Echthrus abdominalis Cresson. Levis.

THE PRESIDENT: Dr. Fyles, I should like to express on my own behalf and on behalf of the members here our great appreciation of your address, especially your peroration and your tribute to those practical entomologists who, in their work, are rather apt to forget that aesthetic and beautiful side of entomology which you so well express, not only in this but in your previous papers. Your reference from time to time of discoveries you made fifty years ago make so many of us here feel how really very young we are, and how much we have to learn from our predecessors in entomological investigation and study. I have always felt, sir, that the papers and addresses which you have given from time to time are most valuable to us particularly as exponents of good English. I feel that in the hurried life we lead and the desire that some workers have to get their information quickly into print, there is a tendency to neglect the form and style of our English, which, of course, as English-speaking people, we should do everything we can to prevent, and, therefore, for an additional reason your addresses are more valuable and of practical use to us as examples of the use to which English can be put. I will not detain the meeting any longer, because there may be other members who would like to say a few words of appreciation.

PROF. LOCHHEAD: Mr. President, may I say a few words in addition to what our Chairman has said regarding the long services of Dr. Fyles in connection with work in entomology? I have known Dr. Fyles for over twenty years; I am sorry I have not known him longer, for I might have been a better man. About twenty years ago I came into contact with a small number of men older than myself, I might say a generation older—Dr. Fyles, Dr. Bethune and Dr. Fletcher, a little younger than these two. I met them all at the Annual Meeting in London, in 1895 or 1896. These men, I think you will all have observed, have given great attention to the literary form in which they express themselves. I have said very frequently in reading over their papers (take the old Entomological Society Reports of Dr. Bethune or Dr. Fletcher, for example) that they were masters

Megarhyssa atrata ovipositing on maple, approximately natural size. Photograph by Charles Macnamara, Arnprior, Ont.

of English, and we are not keeping up to the standard they set in this respect. I agree with our Chairman that more attention should be given to the form in which our reports and papers are prepared. This is not the first paper I have heard from Dr. Fyles during all that time, for he has seldom been absent from the meetings. Then in addition, we have had him several times in attendance at our meetings of the Quebec Society for the Protection of Plants at Macdonald College. While Dr. Fyles is a strong member of the Ontario Entomolgical Society, yet I think his heart is in Quebec, where he has laboured so long. While he cannot come down to our meetings as he used to, yet we always feel that his heart is with us, and his mind and thoughts are with us at our Annual Meetings. I hope he will be able to come down for the next meeting. I rise simply to show my appreciation of the valuable work that Dr. Fyles has done in connection with the Society.

THE PRESIDENT: I wish to make a slight alteration in the programme because of the circumstances. We have with us a gentleman from Arnprior, Mr. Macnamara, who is rapidly becoming an entomologist—in fact I think he is already an entomologist. He has been making some very interesting observations on certain insects to which Dr. Fyles referred, namely, those extraordinary hymenopterous parasites of the genus *Thalessa*. Mr. Macnamara, in addition to being an entomologist, is also a photographer of considerable skill, and has been able to apply his photographic knowledge to the recording of the oviposition of those extraordinary parasites, some of the most extraordinary parasites we have, and, therefore, I think it is rather fitting that, although I took upon myself to ask Mr. Macnamara to read this paper and it is, therefore, not in the programme as the latter had already been prepared, Mr. Macnamara should give us a brief discussion on his observations of which he has some photographs.

MR. MACNAMARA: You have taken me entirely by surprise, Dr. Hewitt, and I do not think I have much of interest to say, but I have a few photographs of one of the ichneumons that the members may care to see. The prints show the male and female *Thalessa,* or as the genus is now called, *"Megarhyssa" atrata;* and the female alone with her extraordinary ovipositor separated to show the two sheathes and the drill. Other prints show the tree infested with Tremex which the *M. atrata* frequented, and magnified views of the ovipositor, foot and other parts are given. Perhaps the most interesting views are those of the insect in the act of ovipositing, with the flexible sheathes curved over her back.

I first observed these insects ovipositing on a maple tree in a small hardwood grove about the middle of June. They were in considerable numbers, some days twenty to twenty-five, and continued egg-laying until the middle of September when they disappeared. As their victim, the Tremex never seems to attack perfectly sound wood, *Megarhyssa* generally bores into somewhat decayed material, but it is wonderful that she should be able to drive her ovipositor as she does, to a depth of five or six inches into wood that we find hard enough to cut with a chisel or a knife.

Dr. Fyles spoke of the instinct which enables them to discover the tree tunnelled by the Tremex. Their instinct in this respect is remarkable, but by no means infallible. The *Megarhyssa* I observed frequently only on one tree in a grove of five or six acres, and frequent and careful search failed to discover them on any other tree in the wood. But in October a large maple nearby, broken off by a gale, was found to be riddled by Tremex and no *Megarhyssa* had ever discovered them.

As Dr. Hewitt has taken me entirely by surprise I hope you will excuse the crudeness of my remarks, as I have not had time to prepare anything, but probably the photographs will prove interesting to some of you.

THE PRESIDENT: I think the photographs which are going around will prove my statement that we have with us a photographer-turned entomologist, and those of you who remember Mr. Macnamara's previous contributions to entomology in the shape of his account of the habits and some notes on the biology of those very small, little-studied creatures, *Achorutes,* will agree with me that we have a very ardent entomologist in Mr. Macnamara, and I do not think that he will need any further introduction or words to back up his election for membership when his name comes forward, as it will to-morrow.

PROF. CAESAR: This photograph of Mr. Macnamara's, showing ovipositing is extremely good. It is a most wonderful thing to look at this insect ovipositing.

Time after time I have watched it and tried to get a photograph, but failed at the last moment. Might I ask that this photograph be published?

THE PRESIDENT: I agree with Professor Caesar that the publication of that photograph would be most useful.

We will now proceed to the programme. The next paper is that by Mr. Parrott and Dr. Glasgow on "The Leaf Weevil (*Polydrosus impressifrons* Gyll.) in New York."

THE LEAF-WEEVIL (*Polydrusus** *impressifrons* Gyll.) IN NEW YORK.

P. J. PARROTT AND HUGH GLASGOW.

The leaf-weevil which is discussed in this paper is a new and, until the inception of this study, an unrecorded enemy of shade and fruit trees in the United States. In view of the losses sustained by farming interests in America by introduced insects a newly-discovered species of foreign origin, however unimportant it is in its original home, is the subject of considerable speculation as well as of some apprehension until its status as a pest is definitely determined. The following notes represent a preliminary account of our studies upon the weevil, which are perhaps not without interest to those who are especially concerned in matters dealing with the introduction and spread of noxious insects.

DISCOVERY AND IDENTIFICATION OF SPECIES.

Our attention was first attracted to this species during the summer of 1906 when large numbers of the beetles were observed in young plantings of willows and poplars in the vicinity of Geneva. They were present on nearly every tree and were feeding on the margins of the more succulent leaves. Some days later specimens of the insect were sent to us by the foreman of a nursery in another part of Ontario County, N.Y., who reported that the beetles were injuring roses and apples. As the species was apparently not represented in entomological collections in this country and it was difficult to secure positive identification, specimens of the insects were forwarded to Professor Alfred Giard, The Sorbonne, Paris, and to Doctor G. Horvath, The Hungarian National Museum, Budapest, both of whom independently classified the beetle as *Polydrusus impressifrons* Gyll.

STATUS OF THE SPECIES IN EUROPE.

In view of the great numbers of the beetle in certain sections of New York, a perusal of European literature impresses strongly two points on the mind of the reader: (1) The weevil belongs to a group of insects which contain some species that are destructive, and (2) the species *impressifrons* is of little significance; and there apparently very little knowledge, if any, as regards its life history and habits—deficiencies which hold equally for some associated species that are of considerable importance, and therefore better known, at least by name. Notwithstanding the seeming lack of detailed data on life histories and habits, the weevils attacking buds and tender foliage of fruit and shade trees appear to be more injurious and varied as regards number of species in Europe than is

*This genus is also designated *Polydrosus*, but W. D. Pierce of the U. S. Bureau of Entomology has kindly informed us that the foregoing designation is, according to the rules of nomenclature, to be preferred.

the case in this country. From the standpoint of economic status, two Otiorhynchid genera are at this time of special interest—*Phyllobius* and *Polydrusus,* which comprise a number of species of weevils that range from various shades of brown to bluish-green or golden yellow in colour. Several of these are listed as noxious insects because of their habit of nibbling young opening buds and then later attacking the foliage. With plants of horticultural importance as hosts some species also do considerable harm by gnawing the parts of the blossoms and thus preventing fructification. According to Zimmerman[1] the species of these genera are very similar in appearance and the two groups are distinguished by the character of the antennal groove. In his discussion he, however, treats the different species as a whole, considering in the following order *Phyllobius argentatus* L., *Phyl. maculicornis, Polydrusus sericeus* Schall, *Phyl. pyri,* L., *Poly. mollis* Stroem., *Phyl. oblongus* L., and *Phyl. viridicollis* Fabr. Aside from merely mentioning the names of the foregoing species and calling attention to errors in the writings of other authors, very little information is given as to the life histories and bionomics of the insects. It is to be noted also that *impressifrons* is not listed, an omission which would indicate that it was not of sufficient importance to be considered in an economic treatise. Judeich[2] and Nitsche mention nine species of the genus *Phyllobius* and two species of the genus *Polydrusus,* and make no reference to *impressifrons.* The also call attention to the lack of knowledge upon the different insects of the two groups. Die[3] Tierischen Feinde by Reh, which is one of the latest economic works on European insects, contains a brief account of a number of species in the genus *Phyllobius,* and states that of the numerous species in the genus *Polydrusus* only a few are so abundant as to be destructive. Four species are mentioned, but there is no reference to *impressifrons.* While Nördlinger,[4] Kaltenbach[5] and Hess[6] discuss other species in either of the two genera, none of these authors refer to the insect under discussion. In Fauna Austrica, Redtenbacher[7] gives a brief description of *impressifrons,* and states its habitat is North Germany. Jäger[8] gives its distribution as Germany and France. In 1888[9] Schilsky listed the species and states that it is plentiful throughout Germany. Turning now to England, Rye[10] in his work on Brtish Beetles lists a good number of species of the genera *Phyllobius* and *Polydrusus,* in which *impressifrons* is not definitely included. Theobald[11] in his Insect Pests of Fruit makes no reference to any species of *Polydrusus,* but discusses with some detail several Phyllobius species as *Phyl. calcaratus, maculicornis, oblongus* and *uniformis.* He states that various leaf weevils are found on all kinds of vegetation and that several species are common to not only many kinds of fruit but also to various forest trees and shrubs. Two species more prominent than others on fruit trees and bushes are the Green Leaf Weevil (*Phyl. maculicornis*) and the Oblong Leaf Weevil (*Phyl. oblongus*). The Glaucous Leaf Weevil (*Phyl. calcaratus*) is also mentioned as doing serious damage to black currant bushes. It usually occurs on alders and various low bushes and hedges. With respect to *impressifrons* Professor Theobald

[1] Zimmerman, Hugo, Die Obstbauschädlinge aus der Familie der Rüsselkäfer.
[2] Judeich, J. F., and Nitsche, H., Forstinsektenkunde, Bd. I, pp. 407-411.
[3] Reh, L., Handbuch der Pflanzenkrankheiten, Bd. 3, p. 539, 1913.
[4] Nördlinger, H., Die kleinen Feinde der Landwirthschaft, 1855.
[5] Kaltenbach, J. H., Die Pflanzenfeinde, 1874.
[6] Hess, W., Die Feinde des Obstbaues, 1892.
[7] Redtenbacher, Ludwig, Fauna Austrica, Die Käfer, Wien, 1858.
[8] Jäger, G., Käferbuch (C. G. Calwer), p. 420.
[9] Schilsky, J., Systematisches Verzeichnis der Käfer Deutschlands, 1888.
[10] Rye, Edward C., British Beetles, 1886.
[11] Theobald, F. V., Insect Pests of Fruit, 1909.

informed the senior author in 1914 that he was not familiar with it and no specimens were contained in his museum collections. As the species seemed to be more numerous in France, Austria and Germany, and desiring to know more of its present status as an injurious insect, a circular letter soliciting information on the creature was sent to a goodly number of European entomologists. The importance of the species can be judged from excerpts from two letters, one from France and one from Austria. A. Giard[12] writes that while *impressifrons* is by no means rare in the spring upon willow and alder, it is not an important species, and little is known regarding its ethology. Zimmerman[13] states that the insect is not very common in Austria or Germany and occurs on willow and alder. Injuries to the foliage of fruit trees have not so far been recorded. Little knowledge exists as to its life history and habits.

Distribution in New York.

The actual range of distribution of the beetle in the State of New York has not been determined. The insect has become established in Ontario, Monroe and Wayne counties, and scattering numbers of the species have been captured as far west as Albion, in Orleans county. It is not improbable that the species occurs over a larger territory than has been indicated.

Food Plants.

The beetle is apparently an omnivorous feeder, subsisting on the foliage of a large number of plants, among which there may be listed birch, willow, poplar, apple and pear as its favorite plants. Scattering individuals have been collected at various times on elm, rose, linden and black locust, which seemingly were feeding on these plants, although their presence on them may have been accidental and due to the close proximity of more attractive plants. While specimens of the beetles, either actively engaged in feeding or in copulation have been observed on all of the above plants, it should be noted that none or very few of the insects have been seen on maple, box elder, horse chestnut, lilac, syringa or elderberry, although these were growing in considerable numbers near the preferred hosts.

To determine more closely the preferences of *impressifrons,* beatings were made of different plants, and from the collections obtained it appears that the insects seek birches, willows and poplars in the greatest numbers, and, if the beetle manifests any choice among these, preference is given to birches. In feeding tests in breeding cages the creatures subsisted on the foliage of these plants as well as of pear with no apparent choice, and selected the foliage of the foregoing trees in preference to that of the apple.

Siftings of earth showed that the insect breeds in large numbers on such varieties as the Pussy Willow (*Salix discolor*), the Kilmarnock Willow (*Salix pendula*), the Laurel-Leaf Willow (*Salix petandra*), the Weeping Willow (*Salix babylonica*), the Wisconsin Willow (*Salix dolorosa*), and the White Willow (*Salix alba*). Larvæ in great abundance were similarly obtained in soil about two species of birch (*Betula populifolia* and *alba*) and the Carolina and Lombardy poplars (*Populus deltoides,* var. *carolinensis* and *P. nigra,* var. *italica*).

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[12] Giard, A., Letter of July 7, 1906.
[13] Zimmerman, W., Letter of Aug. 7, 1910.

Character of Injury.

As is the case with many associated species in Europe, the damage that *impressifrons* causes is two-fold: First, it nibbles the unfolding buds and then it attacks the foliage, preferring the margins of the leaves. The beetles, while small in size, are voracious eaters, and the extent of their injury is, broadly speaking, in proportion to their abundance. Many of them confined to a relatively small feeding area may cause much harm. The numbers of the insect that one may sometimes observe would suggest at once that they must be doing appreciable damage. However, it should be recorded that generally the extent of injury seems to be greatly disproportionate to the numbers of the creatures. The most conspicuous example of their destructive capacity was observed in 1912 in a large block of willows in a nursery plantation. This was largely composed of the goat willow (*Salix caprea*) grafted to such sorts as New American, Rosemary and Kilmarnock. The latter variety particularly suffered severely as a great many of the insects attacked the opening buds, so that a goodly percentage of them were killed while those partially injured produced imperfect clusters of leaves. The initial injuries were later aggravated by the feeding of the beetles on the margins of the leaves. The effect of this latter attack is to cause the leaves to have an uneven outline, and in instances of extreme injury to present a ragged appearance. So abundant has the insect become in the certain nurseries that the owners have found it necessary to resort to spraying in order to protect their willow plantings. So far we have observed no injuries by the beetle to buds of poplar, birch, apple or pear, and while feeding to an important extent has not been detected on these trees, an examination of them during June will seldom fail to find the work of the insect on the margins of the leaves. At present *impressifrons* derives it importance as a pest from its destructive work in nurseries. In some plantings where it has become established it is very numerous and will hardly fail to attract the attention of an ordinary observer. There is no other species of snout-beetle that, during its active period, so frequently brings itself to your notice. It is not an uncommon experience to carry the beetles on one's clothes into the home or to observe them on the window screens of buildings. The foreman of one well-known nursery has informed us that aside from the damage sustained the beetles have become so abundant in plantings of poplar, birch and willow that they are a source of great annoyance to laborers by flying in their faces. The abundance of the insect is indicated by the following counts: From a sample of earth about osier willow two feet square and to the depth of the spade, ninety-two larvæ were collected. From three spadefuls of earth taken near the base of different kinds of nursery trees the following numbers of larvæ respectively were found: Carolina poplar, 27 specimens; Lombardy poplar, 12 specimens; silver-leaf poplar, 12 specimens; birch, 25 specimens; willow, 19 specimens; American mountain-ash, 17 specimens; European mountain-ash, 1 specimen; apple, old tree in sod, 1 specimen. A similar quantity of earth, three spadefuls, taken about five-year-old fruit trees in a mixed planting yielded the following numbers of insects respectively: apple, 65 specimens; pear, 51 specimens; peach, 35 specimens, and plum 62 specimens. One corner of this orchard was only a little removed from a row of osier willow. The fact that *impressifrons* is apparently of little significance abroad certainly does not warrant the conclusion that it will prove of no importance in this country. The conditions described justify the inference that the species is already more abundant and injurious here than in Europe or more attention would surely have been devoted to it there.

Life History and Habits.

The beetles emerge from the ground during the latter part of May and early June. In 1914, they were first detected on May 26, and during the next few days they were mating freely on the foliage. By May 30, eggs were being deposited. For the reception of the eggs the insect seeks cracks or crevices in the bark, such as spaces that occur when the bark is loose at stubbed ends of twigs or branches. Loosened bud scales on twigs or wood, which have been removed by pruning and allowed to remain on the ground, are also sought by the creatures for the deposition of eggs. They appear to select any dry cavity in which the eggs may be inserted, and which occupy positions that are exposed to the sunlight. Eggs have been observed in situations on trees that were ten feet from the ground, and doubtless they will be found in higher positions. The egg measures about .2 mm. in width and .5 mm. in length. It is white, cylindrical and gently rounded at the ends. Its shape seems to be influenced by the accommodation of the egg to surrounding surfaces. Eggs occur singly or in masses, but usually in groups containing from twenty to eighty-five of them. Oviposition is most active during early June. The period of incubation averaged between twelve and thirteen days with little variation under ordinary conditions. Upon hatching the young larva wriggles out of its position of concealment in the bark and falls to the ground. It then seeks a crack in the earth, when it quickly disappears. The larvæ apparently feed on tender roots, and our observations indicate that they can live exclusively on the roots of willow, poplar and birch. Doubtless they find subsistence on the root systems of other trees. It has not been determined that they can live on the subterranean parts of grasses or weeds which may be growing about the foregoing plants. The larvæ transform to pupæ during the latter part of April and early May. The pupal cells are considerably larger than the larvæ and are at an average depth of about two inches, although some of them may be three inches in the soil.

Methods of Control.

The beetles are quite susceptible to arsenical poisons, and should it become necessary to combat them little or no modification will probably be required in existing spraying practices. Cultivation, if done with care and at the proper time, would doubtless prove very destructive to both larvæ and pupæ in the soil.

The President: The State of New York certainly is a general stamping ground for new pests. We have the *Hyponomeuta,* and now we have this other *Polydrusus* which evidently by its abundance seems to be firmly established in that State. I do not remember whether you mentioned in the paper any suggestion as to how it came in.

Dr. Glasgow: We cannot say with certainty, but probably in earth about the roots of nursery stock. This is the only way apparently that it could get in.

Mr. Burgess: I would like to ask Dr. Glasgow what success he has had in its control.

Dr. Glasgow: It is very readily controlled by arsenical poisons.

Mr. Burgess: Do you use arsenate of lead?

Dr. Glasgow: Yes.

Mr. Burgess: At what strength do you use it?

Dr. Glasgow: Commonly at the rate of three or four pounds of the poison to fifty gallons of water.

Father Leopold: At what time of the year do you use arsenate of lead?

Dr. Glasgow: About the last of May or early in June, or whenever the beetle becomes abundant to warrant treatment.

The President: If there is no further discussion we will proceed to the next paper, which is of great interest, by Professor Brittain, on "*Lygus invitus* and its control in 1915."

THE GREEN APPLE BUG (*Lygus invitus* Say.) IN NOVA SCOTIA.

W. H. Brittain, Provincial Entomologist for Nova Scotia.

History.

For a number of years past certain fruit-growers in the Annapolis Valley have complained of the non-bearing of their Nonpareil trees. These trees would bloom heavily each year, but would never bear anything like a full crop, yielding only a few gnarled apples; or, in many cases, none at all. This trouble was not entirely confined to Nonpareils, but was more pronounced and by far the most common in this variety. Others complained that their pears "grew woody" and were covered with corky, disfiguring scars. This latter trouble was commonly ascribed to lack of iron in the soil, and liberal applications of iron filings were frequently applied to correct this condition. Driving nails or spikes into trees was also practised.

No one appears to have suspected that there was any connection between the apple and pear trouble, or that either was caused by an insect. In June, 1914, the writer visited an orchard consisting of mature Nonpareils, Ribstons, Gravensteins, Golden Russets and several varieties of pears. The owner stated that the Nonpareils had not had a crop for at least six years, and that the trouble was gradually spreading to the other varieties. Furthermore, the pears were so badly affected that a number of them had been cut down. The affected trees were swarming with the green nymphs of *Lygus invitus,* and it took very little observation to show that they were the culprits. Following this, many reports of similar damage to apples and pears were followed up with a like result, and further investigations have only tended to confirm our early observations.

Distribution and Spread.

The pest seems to be well distributed throughout the fruit-growing centres of Nova Scotia, including the counties of Hants, Kings, Annapolis and Digby. It seems to be more widely distributed on the pears than on the apples, the phrase "injury to pears only" occurring with considerable frequency in the reports of the entomological inspectors.

Though experiment has shown that the adults are capable of flying considerable distances, as a matter of fact, the pest spreads only slowly from orchard to orchard. One orchard immediately across the road from a very heavily infested one, showed few signs of injury. The amount of damage to pears does not seem to vary much from year to year, but the injury to apples appears to be on the increase in many localities and spreading from the more susceptible to the less susceptible varieties.

Seriousness of the Pest.

Sufficient has already been written to indicate that this insect is a very serious pest of both the apple and pear, but any estimate of the actual damage done would, of course, be out of the question. However, it is safe to say that it is one of the most serious insect pests of our orchards. In fact, there can be no doubt that in orchards where it has become established, we have no pest to compare with it, either in amount of damage done or in the difficulty of eradication. The pears in certain orchards have for years been so scarred as to be scarcely merchantable, and, in not a few apple orchards, the crop of fruit from susceptible varieties has been greatly reduced or even destroyed. In one orchard visited, only one apple could be found among ten large Nonpareil trees, due entirely to the work of the Green Apple Bug.

Host Plants.

As far as we have determined, the insect only breeds in the apple and pear. It has been found feeding in the adult stage on plums, but has not been known to oviposit in that plant. When shaken from the trees the nymphs have been observed to feed upon couch grass, timothy, red clover, dandelions and other plants growing beneath the tree, but on reaching the adult stage they again seek the apple and pear trees for the purpose of feeding and depositing their eggs.

The Insects.

When the insect first appears it is light yellow in color, but as it develops it becomes green. It somewhat resembles an aphis in appearance and was once described by a farmer as a "new kind of long-legged aphis." Others speak of it as the "horned aphis" on account of its long antennæ. The adult is a small, delicate insect, one quarter of an inch long. It is very pale on first emerging, but later becomes a combination of light and dark brown. In appearance it resembles quite closely the Tarnished Plant Bug (*Lygus pratensis*).

Life History.

The maximum emergence of the nymphs from the egg state coincides with the opening of the blossoms of the Gravenstein apple, but the beginning of the emergence is about five or six days earlier. They continue to hatch until the time the blossom petals fall, when emergence is practically finished. In the season of 1915 the first nymph to emerge was taken on May 24th and the last on June 10, the period of maximum emergence being from June 1st to June 5th. The duration of the first nymphal instar is 5.22 days (average of 52 individuals); of second, 5.43 days (average of 34 individuals); of the third, 6.66 days (average of 34 individuals); of the fourth, 6.77 days (average of 24 individuals); and of the fifth, 6.83 days (average of 12 individuals).

No nymphs were observed during the past summer after July 7th, all having completed their transformations by that date. The length of the adult stage varies greatly, single individuals having been taken in the orchard as late as the first week in October.

The following table gives the details of the life history of twelve individuals, which were reared from the egg to the adult stage:—

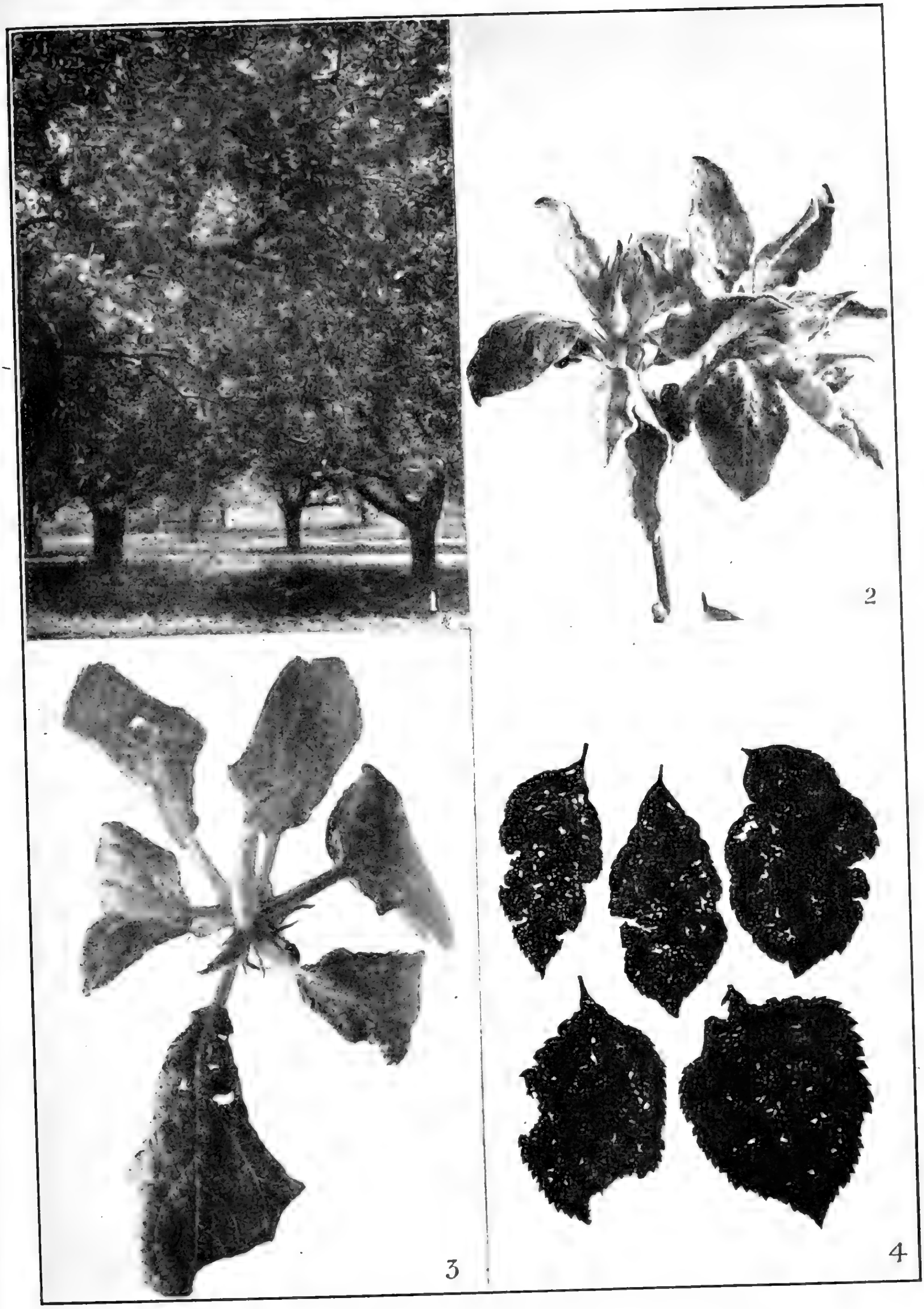


Plate I.—*Lygus invitus.*

Fig. 1.—Orchard heavily infested with Lygus. Note thickness of the trees.

Fig. 2.—State of buds when first bug was found in the spring.

Fig. 3.—Injury to young leaves.

Fig. 4.—Appearance of mature leaves, that have been punctured while young, when held to the light.

LIFE HISTORY OF LYGUS INVITUS IN 1915.

No. of insect.	Date of hatch-ing.	Date of 1st moult.	Date of 2nd moult.	Date of 3rd moult.	Date of 4th moult.	Date of 5th moult.	Date of death.	Number of days spent in each Nymphal instar.						Duration of adult stage.	Total length of life.
								1st instar.	2nd instar.	3rd instar.	4th instar.	5th instar.	Duration of nymphal stage.		
													Days.	Days.	Days.
1......	June 1	June 6	June 13	June 20	June 27	July 4	July 8	5	7	7	7	7	33	4	38
2......	" 2	" 7	" 11	" 18	" 26	" 3	" 4	5	4	7	8	7	31	1	33
5......	" 4	" 8	" 15	" 22	" 29	" 6	" 10	4	7	7	7	7	32	4	36
11......	" 4	" 10	" 16	" 22	" 29	" 6	" 13	6	6	6	7	7	32	7	39
17......	" 2	" 6	" 13	" 20	" 28	" 5	" 10	4	7	7	8	7	31	5	38
19......	" 3	" 8	" 15	" 23	" 30	" 7	" 11	5	7	8	7	7	34	4	38
22......	May 31	" 4	" 10	" 17	" 25	" 2	" 9	4	6	7	8	7	32	7	39
23......	June 2	" 7	" 13	" 20	" 26	" 2	" 8	5	6	7	6	6	30	6	36
27......	" 2	" 7	" 12	" 19	" 26	" 4	" 9	5	5	7	7	8	32	5	37
31......	" 3	" 9	" 16	" 22	" 28	" 5	" 14	6	7	6	6	7	32	9	41
33......	" 1	" 7	" 15	" 21	" 29	" 4	" 12	6	8	6	8	5	33	8	41
34......	" 3	" 9	" 16	" 21	" 28	" 5	" 10	6	7	5	7	7	32	5	37
						Averages		5.08	6.41	6.66	7.16	6.83	32	5.41	37.75

The duration of the nymphal stage in our open air insectary corresponds closely with that in the orchard, as proved by extensive observations, but the life of the adult insect under natural conditions is much longer than the insectary records would seem to indicate. Repeated experiments show that the adults will not thrive in confinement, but keep flying restlessly about, until they die of exhaustion. For the first week or ten days after emerging the adults were abundant in the orchard, but after that they began to die off quite rapidly. It was an easy matter during this time to find a number of dead bugs fastened along the midrib of a single apple leaf. The bugs have a habit, when about to die, of extruding the caudal extremity of the alimentary canal, which is covered by a viscid secretion, by means of which they attach themselves to the leaf.

Though large numbers of bugs died during the latter part of July, there was no difficulty in finding specimens through the month of August and early September. After that individual specimens could only be located with difficulty. On August 27th 50 adults were collected, 46 being females and four males; on August 30th, 50 more were collected, 45 females and five males; on September 3rd, collected 31 specimens, 27 females and four males; September 9th, 10 insects collected, all females, September 13th, 10 more specimens, all females, and on September 17th only two adult females could be found. From that date until October 7th scattering female specimens have been taken.

Oviposition.

The eggs are laid beneath the tender bark of pears and apples, principally the latter. All attempts to catch the female in the act of oviposition were fruitless, though many hundreds of females were brought into the laboratory and placed on apple and pear limbs, or upon apple seedlings beneath jars or wire frames. In no case was the female observed to oviposit, but after flying around for a few days dropped to the ground and died. Neither were we able to make any observations on this point in the orchard, owing to the extreme shyness of the adult insect, and to the almost continuous wet weather that prevailed at that time. Eggs were found beneath the bark on July 20th and several times subsequent to that date, which agreed in every respect with those dissected from the female insect.

H. H. Knight,* who observed one female of *Lygus invitus* in the act of oviposition, writes of it in these words:—

> The female observed to oviposit was first discovered when the ovipositor was inserted nearly to its base in a fresh pear shoot of the present year's growth. After two minutes the ovipositor was withdrawn. The female turned, inspected the hole, then moved along the branch about two inches. After five minutes she became very active and proceeded along the branch feeling with antennae and beak. She soon returned to the spot where eggs had been placed before, and, with proboscis to mark the opening, she raised up, unsheathed the ovipositor, and made the insertion much in the same manner as observed in the case of apple red bugs. A period of two minutes elapsed before the ovipositor was withdrawn. Upon examining the branch, it was found that six eggs had been laid in a space 1 mm. long. The eggs were closely packed in a double row lying flat just within the cambium layer. Of two eggs measured, the length is 1.05 mm. by 26 mm. wide.

Habits of Nymphs.

The nymphs of this insect are extremely elusive in their habits, which probably explains the fact that, though their injury has been known for many years, they themselves have never been connected with it until the present time. When

*Jour. of Economic Entomology, Vol. 8, No. 2, pp. 296-297.

disturbed they run rapidly, hiding in the axils of the leaves or any place that affords concealment. When disturbed suddenly, they often drop, but usually alight on another branch before reaching the ground. In cases where nymphs fallen to the ground have been prevented from reascending the tree, by means of tanglefoot bands, beneath which they cluster, it has been observed that when a person suddenly approaches the tree, a number of them will drop to the ground. Others have been observed to drop in this way when approached by an enemy or harvestman.

The young nymphs seem to prefer the young foliage of apple and pear, but will also puncture the tender shoots. Later they freely attack the blossoms, but they forsake all other food for the fruit once it has set. Though we have reared through these insects exclusively on leaves, there is no doubt that the later nymphal stages prefer fruit, and they can only with difficulty be induced to feed on mature leaves. A favorite place to feed is a cluster of fruit growing closely together and not having reached the size when their own weight pulls the separate fruits apart. In feeding, the nymphs range quite widely over the tree, especially when not numerous. Every fruit on a very lightly infested pear tree was pierced several times, showing that several must have been punctured by one insect. This observation was further confirmed by liberating a number of nymphs beneath a non-infested tree. The next day the typical injury was present all over the tree. The nymphs were observed to exhibit predaceous habits on several occasions. At one time a number of bugs were observed repeatedly thrusting their beaks into three larvæ of the green fruit worm (*Xylina* sp.) that had become caught in a tanglefoot band, and continued to do so until the caterpillars had been sucked completely dry. They will also on occasions attack man. The writer has been stung in the neck and hand more than once. If left alone the insect will pierce the skin of the hand as many as three times and remain feeding until gorged with blood.

Habits of Adults.

The adults, like the nymphs, are very active. On bright, sunny days they usually take to flight very readily when disturbed. On dull, cold days they are more sluggish and sometimes drop to the ground, though often they take to flight after having dropped a short distance. On really hot days the adults fly about considerably, and, standing in a heavily infested orchard, they can be readily observed flying about in the sunlight.

Since the prevailing opinion is that the pest spreads but slowly in an orchard, experiments were tried to determine the length of flight of the adults. When liberated the insects fly straight up in the air for a considerable distance, after which they can be followed by the eye for several yards, as they fly straight off in one direction. Just how far they fly at any one time it would be difficult to determine, but individuals have been taken one quarter of a mile from the point of liberation, a few days later.

Like the nymph, the adult may also become predaceous in habit. The writer observed one with beak inserted full length in a tussock moth larva, and it relinquished its hold very reluctantly. It will also pierce the skin of man quite as readily as the nymph.

The adult Lygus will not feed upon foliage at all readily, preferring a diet of fruit, and, unlike the nymph, which seems to prefer the apple, the adult seems to have a preference for the fruit of pears. One case was observed in which a row of pear trees had been freed of nymphs by spraying. Adjoining this row was a number of infested apple trees, and as soon as the bugs developed wings, they flew over

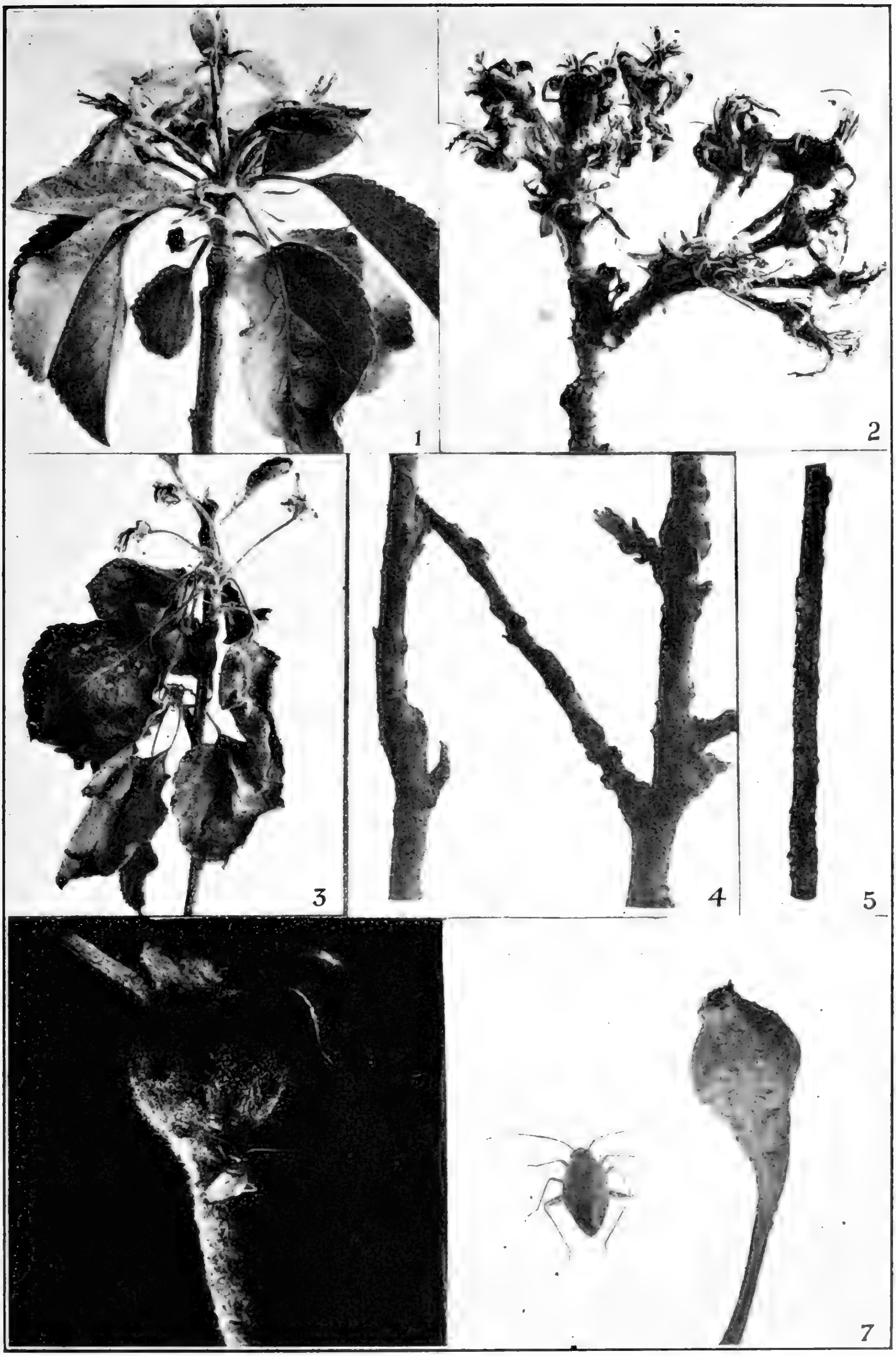


PLATE II.—*Lygus invitus.*

Fig. 1.—Injury to blossoms.

Fig. 2.—Final condition of injured blossoms.

Fig. 3.—Blossoms and twigs killed by repeated punctures.

Figs. 4 and 5.—Twig punctures.

Fig. 6.—Nymph at work on a young apple.

Fig. 7.—Fifth stage nymph and young pear, showing effect of punctures.

and pierced the pears till they were bathed in the sap that oozed from the punctures. In the laboratory, adults have left a fairly ripe, soft apple to feed upon a hard green pear. All through the season a favorite place for the bugs to feed is about clusters of apples that have been dwarfed by the Rosy Aphis, and here the adults can be found, when nowhere else, late in the season. These belated individuals also show a preference for over-ripe or even decaying fruit.

Character and Extent of Injury.

1. Injury to the Apple.—The first evidence of injury is to the tender foliage in the form of purplish spots upon the surface of the leaf, accompanied, in severe cases, by a slight tendency to curl. To one who is familiar with the work of this insect, this symptom is most characteristic and makes it possible to detect the presence of the nymphs at a very early stage, and even when they are present in small numbers. Six newly hatched nymphs were placed on an apple seedling in the laboratory, and twenty-four hours later every leaf was spotted with the typical purplish markings. As the leaves unfold and later reach full size, the discoloration disappears, but if affected leaves are held up to the light they will appear to be pierced through and through with tiny holes. Very severe attacks result in a ragged, frayed appearance of the leaf. By these symptoms, the former presence of the bugs on any tree can be detected long after they have completed their transformation and disappeared.

The tender, succulent twigs are also subject to attack, and as the insect withdraws its beak a drop of clear or amber sap oozes through the bark, marking the puncture. Later, as the twig increases in size, quite a decided lump may develop at the point of puncture, accompanied in severe cases by a longitudinal crack.

In heavily infested orchards, where the insect may be present in tens of thousands, the repeated puncturing and withdrawing of the sap goes so far that affected twigs wilt, the leaves become brown and dry, and finally the whole shoot dies. Cases where many of the twigs were literally stung to death in this way were quite common early in the summer. Later the dead twigs dropped off and were replaced by a strong new growth, which covered up the injury done by the bugs.

As the blossom petals appear and begin to unfold they are quickly attacked by the young nymphs, which have been frequently observed right inside a blossom with beak inserted in the pistil. In fact, so numerous were the insects and so persistent their attacks that the blossoms and the blossom pedicels wither and die, having been sucked quite dry by the nymphs. These dead and dry blossoms remain on the tree for some time, but break off and fall to the ground before the end of the season. These facts explain why susceptible varieties may come into bloom year after year but never set a crop of fruit.

As soon as the young fruit is formed, drops of gum oozing through the skin show that it also has been punctured by the insect. Later, slightly raised, discolored spots mark the injury, and a large proportion of fruit so injured drops to the ground in the course of a few days. Apples that are able to cling to the tree or that remain uninjured until later on in their life, are badly gnarled and misshapen as a result of the insect's attack. The tissue above the puncture fails to develop and, as a result of the uneven growth, the apple will be one-sided with a pronounced depression about the point of puncture, which itself is marked by a brown, corky scar with ruptured epidermis.

2. Injury to Pears.—Injury to the leaves, stems and blossoms of the pear resembles that of apple, except that in this case the tissue about the puncture

turns black. Stinging of the young pears does not often result in dropping, as in the case of apples. The effect of the punctures on the fruit is, however, very conspicuous, it being covered with hard, granular, corky scars, which are often split open as in the case of those on the apple. Hard, flinty areas extend into the pulp, making the fruit useless for any purpose whatever.

3. Injury to Plum.—Injury to the fruit of plums is not uncommon, where these trees border on affected apples or pears. Plums injured by the bugs do not usually become scarred and twisted, as in the case of apples and pears, though they may sometimes grow somewhat one-sided. The seat of the injury is usually at the extremity of the fruit furthest from the stem. As usual in the case of stone fruits this injury is marked by the exudation of colorless gum which flows through the small puncture, sometimes forming a globule and sometimes a coil of gum which finally hardens in the air.

Feeding Experiments.

In affected orchards large numbers of nymphs are frequently shaken to the ground by sprays, heavy rains, winds, etc., and in numerous instances these were observed feeding upon dandelions, couch grass, red clover, and other plants at the base of the tree. Even when forced to feed on these plants early in the nymphal life the insects seemed to be able to complete their transformations, but once they had obtained their wings, they invariably sought the fruit of the apple or pear.

A number of nymphs in their second or third instars were divided into lots of ten and confined upon a number of plants under cheesecloth bags. The following observations were made:—

Grape (*Vitis* sp.).—The nymphs feed readily upon grape, puncturing leaves and blossom clusters. The tissue surrounding the punctures turns black.

Elm (*Ulmus americana*).—The injury to the foliage of the elm was quite noticeable in dark colored spots, but there was no apparent puncturing of the twigs.

Maple (*Acer saccharum*).—The injury to maple leaves was slight. The injury was characterized by small translucent spots.

Sweet Cherry (*Prunus avium*).—Slight puncturing of leaves and blossoms, but little apparent injury.

Peach (*Prunus persica*).—The leaves showed visible punctures and were slightly curled. Small globules of transparent gum showed where the fruit had been punctured.

Red Clover (*Trifolium repens*).—Transparent areas on the leaf accompanied by a gradual fading and wilting of the plant, characterized the injury to red clover.

Strawberry (*Fragaria chiloensis*).—Strawberries showed evidence of more serious injury than any of the plants experimented with. Blossoms and leaves were so badly punctured that they finally withered and died.

Couch Grass (*Agropyron repens*).—The blades of couch grass were punctured quite severely, fading in color and showing other evidence of wilting.

Susceptibility of Varieties.

Extensive observations regarding the susceptibility of varieties reveals the fact that of all varieties of apples the Nonpareil is by far the most liable to attack. In many orchards it is only the trees of this variety that appear to suffer at all. Cases have been observed in which badly attacked Nonpareil trees were surrounded by trees of other varieties apparently untouched. Nevertheless, it seems to be true that in most cases the bug will gradually enlarge its field of operation from the more to the less susceptible sorts. Fruit-growers tell of numberless instances where the trouble began in their Nonpareil and gradually spread to their other trees. The following varieties show susceptibility in the order named:—Ribston, Gravenstein, Golden Russet, Blenheim, Baldwin and Greening.

Among the varieties of pears attacked the Bartlett shows the highest degree of susceptibility. So much is this the case, that some have regarded the trouble as a disease of this variety. Other susceptible varieties are Clapps' Favorite, Burbridge, Maria and Flemish Beauty. Varieties not so susceptible are Louis Bonne, Bosc, Lawrence, Duchess and D'Anjou.

Conditions Favoring Increase.

It is difficult to state definitely under what condition this insect flourishes best, since it is found in orchards treated in every conceivable way. Sprayed and unsprayed, clean cultivated and sod, well cared for and neglected orchards are all attacked. It is a notable fact that some of the very worst infestations are in orchards that have received the best of treatment in the way of spraying, fertilization and tilth. In most cases, however, such orchards were unduly shaded, insufficiently pruned, or too thickly planted. In two very bad cases the orchard was cultivated on the strip system, i.e., a strip of clover sod alternated with a clean cultivated strip. In another case the orchard was part cultivated, part in sod. Here the trees in sod seemed to show the greatest evidence of injury, but the difference was not readily detected. On the whole orchards with a thrifty, succulent growth seemed to suffer most.

As a result of all our observations throughout the infested area, it appears that the most suitable conditions for the undue increase of this pest are shady orchards with closely planted, thick growing trees, with a certain amount of herbage at their base, but for the most part thrifty and vigorous in other respects. Nevertheless, these factors are not essential, as the insect is capable of doing injury under a wide range of conditions.

Natural Enemies.

Ants seem to be the only natural enemies that exert any appreciable influence on the control of this pest. These have been frequently noticed carrying away nymphs on their jaws. On one occasion, when a number of nymphs were liberated at the base of the tree, four of them were seized by as many ants and carried off through the grass to the ant hill, which was distant fifteen feet from the tree. Spiders also destroy a certain number of nymphs, but it is questionable whether ants or spiders ever kill enough nymphs to noticeably reduce their numbers. The ant responsible for this work was determined by Dr. Wheeler as *Formica fusca.*

Control Experiments.

Control experiments were carried on under most unfavorable conditions this spring, the weather being almost continuously wet. This made it very difficult to apply the spray at the proper time or to observe its effect upon the insect. Two orchards were chosen, containing a large number of mature apple and pear trees of the susceptible varieties.

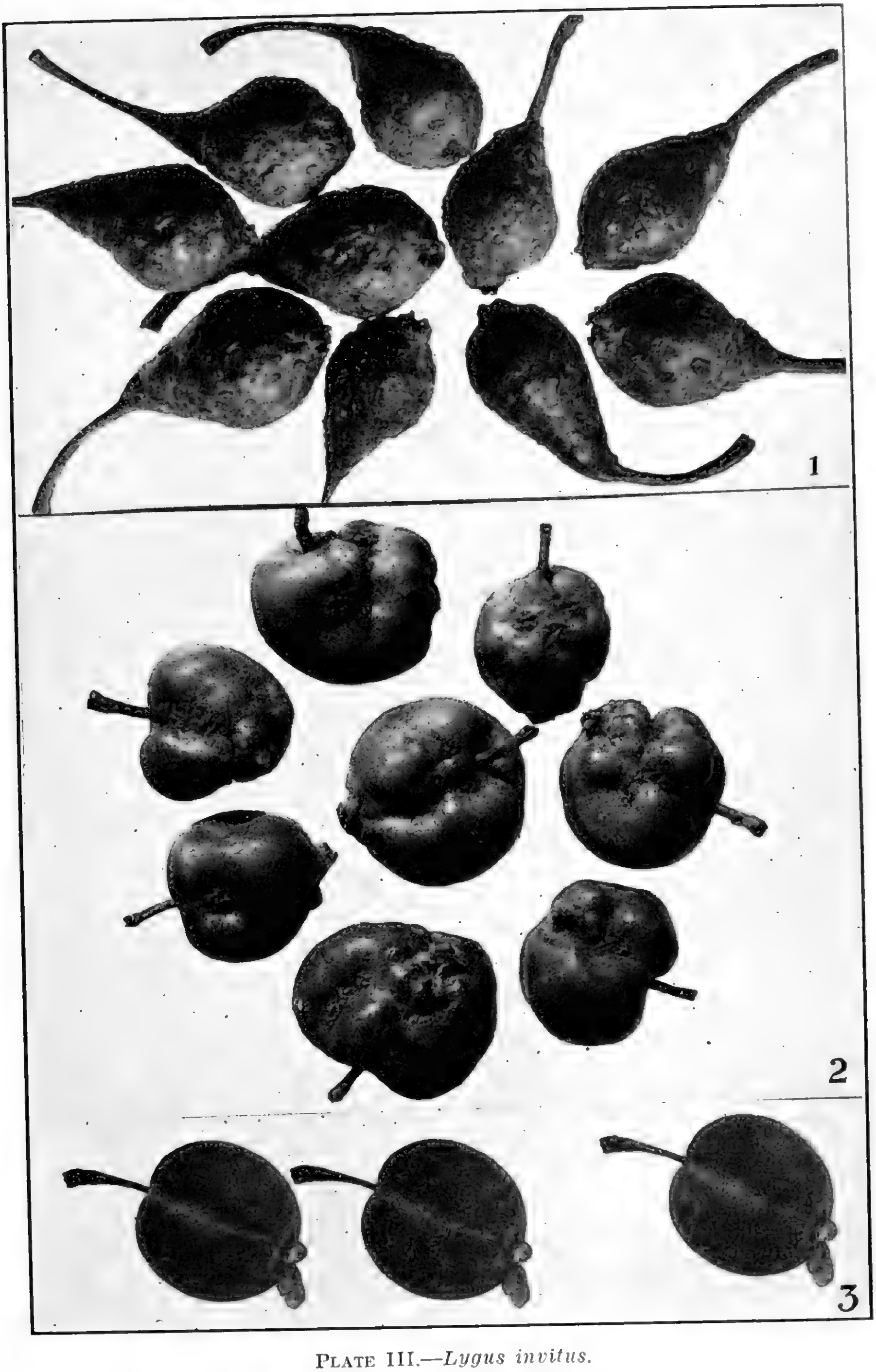


Plate III.—*Lygus invitus.*

Fig. 1.—Injured pears.
Fig. 2.—Injured apples.
Fig. 3.—Injured plums.

Blackleaf 40, 1 pint, 1½ or 2 pints to 100 gallons was used both alone and with soap, and also in combination with lime-sulphur. One spray was put on just before the blossoms opened, with another just after the blossoms fell, for the apples. Another block was sprayed in full bloom. Pears were sprayed just after their blossoms fell and again five days later.

Examination of trees directly after spraying showed them to be apparently free from insects, and large numbers of dead nymphs would be found stuck to the leaves by their caudal extremities in the characteristic fashion. Examined two days later, though the block sprayed in full bloom seemed to show best results, all the trees were found to be covered with bugs. As laboratory experiments had shown that the material used was quite effective in killing the insect when hit by the spray, even when the weakest strength was used, we knew that the trouble was not in the strength of the spray, or in the manner of its application.

Observations taken in the sprayed orchards showed large numbers of nymphs ascending the tree trunks. Even in unsprayed orchards it would appear that large numbers of nymphs fall to the ground, shaken off by the high wind or washed off by the heavy rains. Insects were found in abundance beneath the trees in such orchards or climbing up the trunks.

In order to determine to what extent nymphs were washed off during spraying and whether any considerable proportion of these succeeded in reascending the tree, one large tree was sprayed thoroughly with Blackleaf 40 and soap, after having been banded with tree tanglefoot 3 feet from the ground. Shortly after spraying the trunk of the tree beneath the band was green with nymphs. These were counted and removed each day for seven days, and at the end of that time the total number of insects captured beneath the band reached the total of 1,389. Large numbers, of course, went up adjacent trees, 538 being taken from one of these. It should be noted here, that this number represents but a very small proportion of the insects originally on the tree. By far the greater number were killed and their dead bodies could be found in abundance sticking to the leaves or on the ground. Nevertheless, where so many thousands were present they were sufficient in number to sting every fruit on the tree and so destroy the crop.

To determine whether the effect of the spray was merely mechanical or whether the insects that fell were partially overcome by the spray material, another tree was given a strong spray of water with a drive nozzle and at a pressure of 200 pounds. In this case the total for seven days was 308. This shows that there was something beside the mechanical effect responsible for the large drop from the sprayed tree. This may be due to the insects being hit by the spray, but not sufficiently covered to cause death. Again, it may be that the effect of the nicotine fumes is to make the nymphs relax their hold and drop to the ground. Laboratory experiments have shown that the fumes of the spray material alone are sufficient to cause death. Nymphs were placed on apple seedlings in cages and at the base was placed cotton wool soaked in Blackleaf 40 at the regular strength. The next day the nymphs were dead.

Experiments were made to determine the distance the nymphs were able to travel and reascend the tree. In an orchard that had not been cultivated for several days, four trees 30 ft. apart each way were banded and 300 nymphs liberated midway between them. The next day 17 insects were taken from beneath the tanglefoot band. A similar experiment was tried with 150 bugs in an orchard that had just been thoroughly cultivated. In this case 19 insects reached the trees. The same experiment was repeated in an orchard that was in sod and 300 nymphs liberated. In this case none reached the tree, but could be seen feeding freely upon the grass and clover. That the nymphs do travel through a sod orchard, however, is shown by the fact that a number were taken from a young tree of the current season's planting, placed midway between two trees thirty-five feet apart.

It was evident from the foregoing experiments that, in addition to spraying, some method must be devised to prevent the nymphs that fall to the ground from reascending the tree, and continuing their injury. Accordingly, another block of trees was sprayed, some of which were banded with the tanglefoot and others not. Subsequent examination showed that the unbanded trees showed insects in abundance, while on the banded ones it was almost impossible to find a single nymph. Experiments showed also that a thorough harrowing after spraying had the same effect as banding. Of all the unbanded trees, those sprayed in full bloom showed the least injury, but even on these trees the fruit was so badly scarred as to be practically worthless.

Another difficulty arose in this connection, viz., that the nymphs are capable of feeding and coming to maturity on grass or weeds growing beneath the trees. Cases occurred in which fruit which had been kept clean by spraying was rendered worthless by adults flying in from outside. For this reason, if this pest is to be controlled, the orchard must be kept under a system of clean cultivation until the end of the first week in July.

The control of the Green Apple Bug in Nova Scotia sets a new precedent in heavy spraying in that Province. Furthermore, the method of planting and heading frequently does not lend itself to the kind of spraying required. The trees are frequently very large, headed very high and planted very thickly, so that it is impossible to get through the rows with a tower on the machine, which is the only way that the tops can be reached. Furthermore, the trees are often very thick-headed, so that even with other conditions favorable, it is a matter of very great difficulty to hit every insect with the spray, and attempts to control the pest in such trees is certain to result in failure. All the foregoing facts must be kept in mind if this pest is to be eradicated from the orchard.

Summary.

The observations and experiments of the past season may therefore be summarized as follows:—

1. The Green Apple Bug is one of the most serious pests of apples and pears in Nova Scotia, though hitherto, owing to its elusive habits, it has not been recognized as such.

2. It is the cause of "woody pears" and one of the causes of gnarled, twisted apples. It is the most common cause of the continued failure to bear of Nonpareil and certain other varieties of apple. It attacks not only the fruit but also the foliage, stems, and blossoms of apples and pears, and in the adult state has been known to attack plums.

3. The nymphs are frequently caused to drop from the trees by high winds, heavy rains, sprays, etc., and may then either reascend the tree or feed upon the weeds, grass or clover at its base.

4. Though capable of coming to maturity on the foregoing plants, in the adult state they invariably seek the apple and pear to deposit their eggs.

5. In control, not only must the tree be thoroughly sprayed to kill as many bugs as possible, but those which have fallen to the ground must be kept there without food until they starve. If the orchard is in sod, or weeds are abundant, the insects on reaching the adult state, will fly to the trees and continue their work.

6. The orchard must, therefore, be kept in a state of clean cultivation, until all the insects have reached the adult state, which will be at the end of the first week in July.

7. The trees must be banded with tree tanglefoot to prevent the reascent of the insects that have fallen to the ground.

8. The trees must be properly pruned, so that all parts can be readily reached by the spray.

9. Apple trees should be sprayed with Blackleaf 40 in the strength of 1 pint to 100 gallons, just before the blossoms open and again after they fall; pear trees just after the blossom petals fall and again five days later.

10. A very heavy, drenching spray must be applied.

11. The insects are much more easily controlled on pears than on apples so that with light infestations in this tree, spraying alone should be sufficient to control the pest.

Conclusion.

The foregoing is only a summary of a single season's work. New facts will doubtless be revealed by subsequent study. The work was carried on under considerable difficulties, the pest being a new one and little known regarding its habits. The methods of control which have been given require considerable care in their application, but once the pest is eradicated it should not be so troublesome to prevent further serious infestations. The great need at the present time is an insecticide cheaper than Blackleaf 40, that will do the work as effectively. However, even under present conditions, growers who have lost entire crops from the work of this pest will not hesitate to take the measures recommended.

The President: Professor Brittain is to be congratulated on the amount of work he has accomplished in a single season, and also the extent of his work. I myself have noticed the corky pears in Nova Scotia, but I never performed the crucial experiments which induced Professor Brittain to undertake the eradication of the pest. I can personally testify to the extraordinary damage which is now being caused by this insect throughout Nova Scotia. I was down there about three weeks ago and was able to see the results of the damage. I was also able to appreciate the extent to which the fruit-growers in the Annapolis Valley are grateful to Prof. Brittain for discovering the cause of these corky pears and the cause of the injuries on the Nonpareil trees. I know there are a number of members here who wish to ask Professor Brittain questions, and the paper is now open for discussion.

Prof. Caesar: On account of the similarity of this paper to the next I think the discussion of this paper should be postponed until after the next.

The President: You move that the discussion of this paper be left over until after the next?

Mr. Treherne: I second the motion. Carried.

A CAPSID ATTACKING APPLES.

(*Neurocolpus nubilus Say.*)

H. G. Crawford, Wilton Grove, Ont.

In the Province of Ontario four Capsids, or Plant-bugs have been found attacking apples, namely: *Neurocolpus nubilus, Lygidea mendax, Heterocordylus malinus* and *Paracalocoris colon.* The nymphs of the second and third are the so called "Red-bugs" described by Crosby of Cornell. *Lygus invitus,* the False Tarnished Plant-bug, occurs in abundance in the Province, but, strange to say, has not been observed doing any damage either to apples or pears, though a great pest in Nova Scotia and causing considerable damage to pears in New York State.

Of the above four injurious Ontario species the only ones of much importance so far as known at present are *Neurocolpus nubilus* and *Lygidea mendax.* Crosby in Bulletin 219 of Cornell University described the life history, habits and means of control of the latter; but very little was known about the former, and as this was the more common and troublesome Capsid in Ontario and, as requests for information on the means of control had begun to be made, Prof. Caesar decided to attempt to work out its life-history this year, being influenced also by the fact that this species was very common in the same orchard where he had planned to study the Leaf-rollers of the Apple. It was my good fortune to be chosen to do this work under Prof. Caesar's guidance and with his personal co-operation so far as his other duties permitted. The following is a brief account of the knowledge gained.

History of the Insect in the Province.

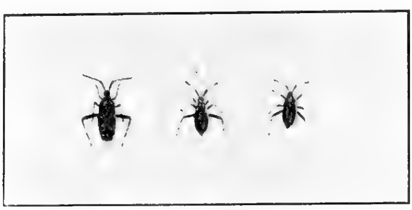
There is no doubt whatever that this Capsid has been present for many years in Ontario, in fact it is apparently a native species. It is only very recently, however, that it has been discovered to be an apple pest. In 1909 Prof. Caesar was shown by Mr. Jos. Tweddle some deformed apples that caused him to suspect that a Capsid might be to blame. In 1910 he accordingly visited Mr. Tweddle's orchard at Woodburn when the apples were about the size of small marbles, and saw the nymphs at work, though at the time he was not sure of the species. In 1911 he again visited the same orchard, saw both these nymphs and those of *Lygidea mendax* feeding on the fruit, and from specimens brought to Guelph reared adults of three species: *Neurocolpus nubilus, Lygidea mendax,* and *Paracalocoris colon.* In 1914 he found the former two species were in a large orchard at Hamilton, and in 1914 found nymphs of *Neurocolpus nubilus* alone in abundance in the orchard of Johnson Bros. at Simcoe. This is the orchard in which the investigation was carried out. There has been no opportunity to examine many orchards to see just how important the pest is in the Province. We suspect that it occurs in a good many orchards but know that the great majority of them are free or almost free from the pest.

Distribution.

This insect has a very wide American distribution. From literature at our disposal, records were obtained of its presence in a collection of Capsids made in Panama and Guatemala, in the States of Florida, New Mexico, California, Colorado, New Jersey, Maine and New York, as well as in the Provinces of Quebec

Eggs of *Neurocolpus nubilus in situ* on first-year Spy twigs, all, with the exception of (2) having had the leaves and buds removed. Enlarged about 5 times.

(1) Egg just as it was after the leaf and bud had been removed, half its length being buried in tissues of the twig;
(2) Egg, with leaf only removed, position at side of bud not normal, but curve of egg well shown;
(3) Two eggs close together, thrust very far down into tissue, and being completely hidden by bud and leaf;
(4) Eggs with tissue cut away from front, showing rounded lower end.



Adult *Neurocolpus nubilus*, and two nymphs.
(Natural size.)

and Ontario. In Ontario E. P. Van Duzee reported it as "common and highly colored" in Muskoka during July and August, 1888; he also saw a specimen that had been captured at Temagami in 1908. It has also been observed by Prof. Caesar, Mr. G. J. Spencer or the writer in the following additional places in Ontario: Woodburn, Hamilton, Fonthill, St. Catharines, Wilton Grove (Middlesex County), and in Norfolk County at Simcoe, Walsh and Tyrill.

Life History.

Eggs. Although we could never find a female ovipositing either in cages or in the orchard there seems no doubt that egg-laying extends over a long period, which this year would be from about July 15th to September 1st, most of it being over by August 15th, from which time the adults gradually decreased in number, completely disappearing by September 7th. The majority of the eggs are laid singly, but not infrequently two are found so very close together as to suggest that they might have been laid at the same time. They are invariably found behind

Adult *Neurocolpus nubilus* and nymph. (Enlarged.) Note the clavate hairs on antennae of nymph.

the buds which are situated in the axils of the leaves on the new growth. In addition to the Apple, eggs were found also on Sumachs. They were inserted into the tissues of the new growth. We suspect they are also laid in Elder though we are not sure. No eggs could be discovered on any kind of weed in the orchard. On apple trees they are so deeply pushed under the bud into the tissue that even the white tips are hidden from view. If the bud is removed the egg will be seen to be sticking out of the spongy tissue for from one-quarter in extreme cases to one-half its length, the average being about one-third of the length (see fig.). There is absolutely no external evidence of the presence of the egg when the bud and leaf are on the twig.

This year the eggs began to hatch on May 27th; the maximum hatching taking place between June 5th and June 9th. Freshly hatched nymphs, however, continued to be found up to July 13th.

In this connection it will be interesting to note the relationship existing between the maximum hatching of the various kinds of apple-attacking Capsids and the stages of the apple trees in each case. Thus this season at least (1915) the majority of the eggs of *N. nubilus* in Ontario hatched from *just after the* *calyces had closed up to the time when the fruit of the Spy trees was one-quarter inch in diameter. Lygidea mendax* in Ontario and in New York hatches most freely *just as the blossoms are opening out well.* Of *Lygus invitus* in Nova Scotia the maximum hatching takes place *during the period of maximum bloom,* and of *Heterocordylus malinus* in Ontario during the period from the time the Spy blossoms are *opening up to full bloom.* Of *Paracalocoris colon* in Ontario the records are not definite, but nymphs gathered at Woodburn in 1912 with *N. nubilus* were in the same instar, suggesting that they may have hatched about the same time. However, in 1912 *N. nubilus* seemed to hatch somewhat earlier than in 1915; thus making impossible the assignment of a date of hatching for *Paracalocoris colon.* From this comparison it can be seen that a spray designed to control the other Capsids and which could be applied at the time of the spray for the Codling Moth would fail to control *N. nubilus,* at least during the season of 1915, because it would be too early for this species.

NYMPHS. The nymphs, which appeared first on May 27th, at first grew rather slowly but later seemed to grow more rapidly. By June 11th the largest were about 3 mm. long, and by June 20th many were found 5 mm. long, exclusive of antennæ. About June 22nd the largest were slightly over one-quarter of an inch in length and wing pads were then present on quite a number. The first adult was seen on June 30th. Thus we suppose the nymph stage requires in the neighborhood of a month in a cold season like that of 1915. In a warm season, however, it is quite probable that less time would be required.

ADULTS. From June 30th the adults increased in number until by July 15th they outnumbered the nymphs present. Many of the females at this date were distinctly swollen with eggs, which upon being examined seemed to be perfectly formed and, though as mentioned above, no egg-laying was ever witnessed, there is no doubt that oviposition began about the middle of July. It is perhaps worth recording that we never saw any mating of the sexes. Males do not live so long as females. Several of the latter which were in the adult stage when put in a cage on July 9th were still alive on August 12th, having lived at least 33 days. From July 15th for two weeks the number of adults seemed to be constant, then began slowly to decrease till by August 24th very few were observed, and these had disappeared entirely by September 7th.

DESCRIPTION OF LIFE STAGES.

EGGS. The egg is 1.5 mm. long by .3 mm. in average diameter, quite strongly curved, slightly club-shaped, nearly colourless, with a glistening white cap. The end which is thrust into the twig is slightly larger than the other, is rounded, and circular in cross-section. Towards the other end the egg gradually flattens, is oval in section and is surmounted by a definite, glistening, white, cylindrical hollow cap, which makes up about one-sixth the total length of the egg (see fig.). The cap appears as though it had been slipped on over the end and is deeply notched on the flattened sides. The tips of the projections so formed, draw more or less together after the eggs are laid, suggesting somewhat a minute lobster claw.

NYMPHS. The nymphs, when freshly hatched, are about 1.5 mm. long, almost colorless, with large triangular head, large dull red eyes and with long stout antennæ and legs marked with faint reddish bands. They are quite sluggish and were mistaken by one of Ontario's best apple growers for aphids.

All the later stages of the nymphs have green bodies with dull reddish mottlings upon the back and sides; the second abdominal segment has a small circular black spot which persists in the adult though hidden by the wings. The antennæ are long and conspicuous, the first and second joints bearing a broad band of close-set, prominent, dark-brown, *clavate* hairs (see fig.). The legs are slender and distinctly marked with red bands. The nymphs, when in the last instar, attain a length of a quarter of an inch, and bear a pair of conspicuous wing pads. Nymphs in all stages after the first moult are very much alike, though the reddish mottling becomes more pronounced and darker as they grow older and increase in size.

ADULT. The adult is slightly more than a quarter of an inch in length being distinctly longer and narrower than the Tarnished Plant-bug (*Lygus pratensis*). (See fig.). The general colour varies greatly both in the case of those living on different hosts, where it is very marked, and also to a lesser extent among those living upon the same host. The dorsal aspect of those living upon the apple varies from a dull cinnamon brown with dark areas to a reddish black with light areas. It has a dull felty appearance due to the presence of numerous fine light to dark cinnamon hairs upon the thorax and thickened part of the wings. The sides are mottled with a dull, dirty red, and ventrally the colour is a light green. The antennæ are longer than those of the Tarnished Plant-bug. The basal joint is stout, dark in colour and densely clothed with dark brown hair, many of which in fresh specimens are distinctly clavate. The second segment is slender, elongate and slightly club-shaped, the distal half being dark brown and clothed with very short, dark brown hairs. The legs are slender and have the same reddish banding as those of the nymphs. Referring to this species Prof. E. P. Van Duzee states: "No other Capsid known to me has thickened, clubbed hairs on an incrassate first joint."

HABITS OF NYMPHS.

The nymphs, when they first appear, are rather sluggish in their movements and are found on the lower sides of the opened leaves, also in the unopened leaves, and in those leaves which had been rolled up by the Leaf-rollers. In these rolled leaves they remain at night and on cool or rainy days and in the cool part of the mornings, coming out and moving around somewhat during the heat of the day and feeding on the tender leaves. When the apples were about a quarter-inch in diameter these were attacked, the attack continuing for about ten days till the apples were a half-inch in diameter. Then the fruit was deserted and the great bulk of the insects made their way to the ground and soon were found feeding upon practically every plant growing in the orchard. The suckers at the base of the trees, red clover and curled dock were the favorite food plants. They fed also upon alsike clover, Canada blue grass, rye, evening primrose, peach trees, hairy vetch and timothy.

HABITS OF THE ADULTS.

When the adults began to appear the great majority of them were found upon the weeds and suckers, where they remained for about a week. At the end of this time a small proportion of them appeared on the trees where they moved slowly about constantly feeding upon the buds in the axils of the leaves on new growth. The proportion of those on the trees to those on the weeds seemed to remain nearly constant throughout the season, there always being some on the trees but never very many. On and about July 19th an attack upon the aphid-stunted apples took place and even a few sound Spys one and three-quarters of an inch in diameter were punctured, but this attack did not become at all general. However, at this time an attack of great severity was made upon the fruit of three trees of an unknown variety and lasted for a week. The adults feeding on the suckers, as before mentioned, confined their attention largely to the newly formed buds and the tender twigs, while those on the weeds showed a marked preference for the horseweed (*Erigeron canadensis*), which was abundant at this time. They seemed to be particularly fond of plants of this species infested by aphids. Other species of plants, however, were also fed upon, such as mullein, ragweed, pigweed, catnip, stinking mayweed, round-leaved mallow, burdock, golden rod, Hungarian millet, old witch grass, sumach, elder, orange milkweed (*Asclepias tuberosa*) and all the plants mentioned above as food plants of nymphs except where these had become too dry to attract them.

The adults, as a rule, were not very active and were quite easily captured, dropping from leaf to leaf when disturbed and only flying as a last resort.

Injury.

Fruit. The chief injury is due to the feeding of the nymphs upon the apples. It is done when the fruit is from one-quarter to one-half of an inch in diameter, and when the nymphs are still small. The first evidence of the attack is the

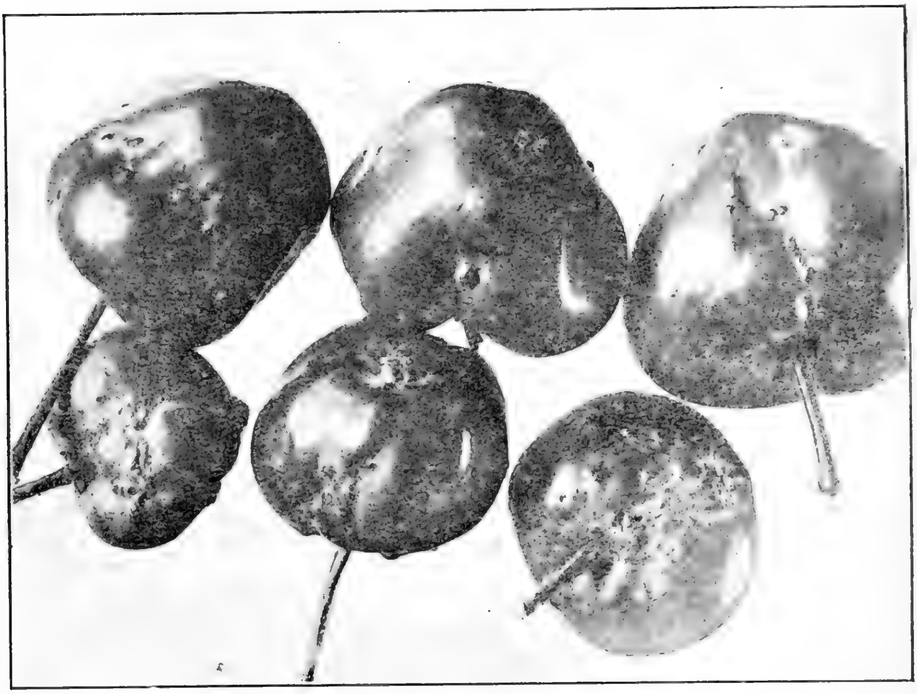
Injury due to the feeding of *Neurocolpus nubilus* nymphs upon young fruit very shortly after the attack. (Natural size.)

oozing of droplets of juice from the punctures which are made at any point upon the surface of the apple. These punctures in three or four days are evidenced by small, conical to rounded pimples, varying in height and diameter from 2 to 3 mm. In their apices are small, very dark green spots of tissue, beneath which is a very slight streak about 3 mm. deep. These pimples vary in number from one to twenty-five or twenty-six per fruit, and where abundant on a very small apple cause it to wither and fall; on a larger one they very severely stunt its growth, and if the pimples are massed on one side, they cause the growth on that side to be checked, and the apple to be much deformed when mature. Where the pimples are few or scattered the apple may grow to normal size and nearly normal shape, the pimples becoming gradually less distinct or forming small raised, brownish, corky areas or convex russet spots from 3-4 mm. in diameter.

The orchard in which the observations were made had almost no crop, so no proper estimate of the damage done by these insects was possible. One tree, however, which had quite a few apples, had about 40 per cent. attacked, but only about 10 per cent. rendered culls, the rest being quite saleable as second-class fruit.

About July 19th a few of the Spys were attacked by the adults, but the feeding was very slight and of no importance. At the same time a very severe attack indeed was made upon three trees of an unknown large, yellow, seedling variety. The attacked fruit soon rotted and fell, due possibly to inoculations of Twig Blight (*Bacillus amylovorus*) with which the trees were badly attacked, and to which they seemed particularly susceptible. It is probable that this Capsid was the chief factor in carrying this disease from limb to limb and from fruit to fruit.

LEAVES AND TWIGS. No injury of any description was observed on the leaves



Injury due to the feeding of nymphs upon the apples when very small, about six weeks after the attack. Note the corky scars and pimples. (Natural size.)

themselves, but the tender buds in axils of the leaves of the young growth were punctured by both nymphs and adults, many of them being killed. The young twig itself was also punctured and, when badly attacked, the puncturing was followed by a small, very convex gall, which later in many cases split and became corky upon the top (see fig.). Both of these kinds of injury were confined largely to the suckers which became bushy and stunted with the tips of the twigs frequently dying. The new growth on the trees themselves was very seldom more than slightly injured.

SUMMARY OF CONTROL EXPERIMENTS.

In our control experiments kerosene emulsion and carbolic emulsion were both found to be almost useless for, even when applied with great thoroughness they failed to kill more than a small percentage of the nymphs.

Black-Leaf-40 was used alone with water in the proportions of one part of the solution to 1,066, 800, 400 and 250 parts of water respectively, but in no case was it at all satisfactory as it only killed a small proportion of the nymphs, even of the small ones. At first we thought that this spray would kill at 1 to 800 both by contact and by the fumes, but experiments showed that the nymphs were not dead but only stupefied and that they soon revived and appeared to be none the worse for the treatment.

Severe case of injury due to feeding of both adults and nymphs of *Neurocolpus nubilus* upon suckers at the base of the apple trees. (Natural size.)

The Black-Leaf-40, however, when used with soap—1 part of the solution to 800 parts of water, with 4 lbs. *Sunlight Soap* per 100 gals. of mixture—produced a spray which killed 96 per cent. of nymphs of all sizes, most of them being large. The tree was, of course, thoroughly covered with the mixture. Soap alone gave almost as good results but, owing to scarcity of nymphs at the time it was tried, was not given so many or quite so good tests. The results, however, were very gratifying. The efficiency of the soap spray was seen to depend chiefly upon its stickiness and power to glue the nymphs to the leaves and twigs. For this purpose Sunlight Soap was found the most satisfactory of any soap tested.

It should be mentioned that owing to the large number of rolled leaves due to the work of the three species of Leaf-rollers that were very abundant in this orchard, it was found impossible to get good results from spraying large apple trees because there was always a large proportion of the Capsid nymphs hidden in these rolled leaves where no spray could reach them. Consequently all experiments were performed on trees 4 to 5 years of age. Any rolled leaves on these were first removed, then large numbers of nymphs were placed on the trees and given plenty of time to settle down before the spraying was done.

We found also that the time of hatching of the eggs of this Capsid compared with those of the Red-bugs and of the False Tarnished Plant-bug was as mentioned above, so much later that the spraying just after the blossoms fell, recommended for them, would be useless for this pest, because only a very few eggs would be hatched at this date.

Suggestions for Control.

1. Practise a system of clean cultivation of the orchard, keeping down all weeds until the end of June or as late as safe for the trees in that district. This will destroy large numbers of the nymphs which drop to the ground and which, unlike some species of Capsids, have no instinct to lead them back to the trunk and so must perish if there are no weeds to feed upon.

2. Watch the trees closely from the time the blossoms fall to see when the nymphs hatch and are abundant enough to justify spraying. Then apply with great thoroughness both to the upper and lower side of the foliage either (*a*) 2 lbs. of Sunlight Soap to 40 gals. of water containing Black-Leaf-40 at the strength of 1 part to 800 of water, or (*b*) 3 to 4 lbs. of Sunlight Soap to 40 gals, of water, preferably rain water if available. Dissolve the soap first by slicing and boiling in soft water.

In exceptional cases it may be necessary to repeat the spraying in a couple of weeks.

It is of course well to test the mixture on a few trees and observe results before spraying the whole orchard.

The President: These two papers should provide a very interesting discussion as I know there are a number of workers here who are particularly interested in the injuries caused by these insects.

Prof. Brittain: In regard to Mr. Crawford's statement that he was able to destroy 96 per cent. of the insects with Black-Leaf-40 and soap, I may say that our results were about the same. Unfortunately, the insects were so numerous that the remaining 4 per cent. left many thousands to infest the trees and ruin the crop.

Mr. Treherne: The subject of Capsids affecting apples is a very important question in British Columbia. Blossoms in orchards, miles in extent, have been destroyed by Capsids and I am interested in the two papers that have been read.

Prof. Caesar: Do you remember by what species?

Mr. Treherne: As far as I know it was *L. pratensis,* but we have not given the matter much attention as yet.

Prof. Brittain: I am well acquainted with the injury referred to by Mr. Treherne. During my stay in British Columbia a good deal of this Capsid injury came under my notice and considerable material was sent in to the office. I looked into the matter and succeeded in finding the insect responsible, but was not able to get it determined. If my memory serves me rightly, it was neither *pratensis* nor *invitus*. One of its favorable food plants is the mullein.

Prof. Caesar: There are a number of interesting points of comparison between *Lygus invitus* and *Neurocolpus nubilus;* (1) The damage done by the latter is not nearly so great as that done by the former as described by Prof. Brittain, and there is none of that corky growth or rough brown surface mentioned by him. (2) *Neurocolpus nubilus* seems, unlike the other species, to have no instinct to cause it, if it drops to the ground, to find its way back to the trunk, but instead wanders aimlessly around. *Neurocolpus nubilus* will feed on a great number of plants. It is probable its native host plant is sumac.

It is strange that while *Lygus invitus* is to be found all over Ontario in just as great abundance apparently as the other species, it does not, so far as I can see, do any harm to apples or pears. As for the difficulty of seeing the insects laying eggs, both species must be much alike for we could never find *Neurocolpus nubilus* ovipositing or even copulating.

Mr. Petch: This year we had a frost in the blossoming period, and I think the injury was caused by frost to the blossoms. However, as the injury occurred on only one tree I cannot see how that can be the cause, and I do not know what the injury to blossoms by this insect is like. Does it give the appearance of having been frozen?

Prof. Brittain: Yes, it looks very much like fire blight. The blossoms are brown and dead and I attribute a great deal of the so-called frost trouble to *Lygus invitus.*

Mr. Petch: With the use of Black-Leaf-40 in the ordinary strength do you find it injurious to the foliage of apples?

Prof. Caesar: We found that where Black-Leaf-40 was put on very heavy along with lime surphur it did seem to injure the apple foliage to some extent.

Mr. Tothill: The two accounts we have had of *Lygus invitus* in Ontario and Nova Scotia suggest the possibility that there may be two species concerned. The species of American Capsidæ are, of course, based on a study of museum specimens only. They are not based on habits and as the group is an extremely difficult one to do anything with, and as no breeding work of any kind has been done, it seems to me from the great differences in the habits of the so-called species that it is just possible there are two species concerned.

Prof. Brittain: Mr. H. H. Knight writes me that he is convinced that the species in Nova Scotia is a new variety. He intended to describe it as such in the near future.

Mr. Tothill: That would seem to bear out this contention.

The President: If there is no further discussion on these two papers we will proceed to the next, which is a paper by Dr. Cosens entitled, "The Founding of the Science of Cecidology."

THE FOUNDING OF THE SCIENCE OF CECIDOLOGY.

A. Cosens, Toronto.

At a time when the problem of gall formation is exciting deep and increasing interest, it seems opportune to consider for a few minutes those investigators, who, lured by the fascination of the subject, laid the foundation for its scientific treatment.

Centuries before any serious attempts had been made either to describe the structure of galls or to explain their origin, these abnormal vegetable growths had been noted and commented upon. The early ideas concerning them were fanciful in the extreme; such terms as "thunder bushes," and "witches' brooms," still popularly used, have crystallized in them the superstitions that enshrouded the origin of these structures. Some of the primitive, whimsical notions concerning them have been adhered to with surprising persistency. Even as late as the 18th century, Reaumur states that a number of German savants still attributed the production of *Neuroterus baccarum* Linn. to Satanic agencies. At the far-off time when galls first began to have a prominent place in the ancient botanical writings, ignorance frequently ascribed supernatural attributes to anything at all unwonted, or even occasional, and events of outstanding importance were often supposed to have been portended by perfectly natural trivial occurrences. It is not surprising, then, that the earliest naturalists should have seen, in the unusual structure of galls, signs that forboded the future. If an uninjured gall, opened in January or February, contained a fly, war must inevitably occur; if a worm, famine was foreshadowed; while a spider betokened pestilence. "Always for ill, and never for good," were the auspices. That the data, presented by galls, could be interpreted as a representation of the future, was proposed first by Magnus, in the 13th century, but the omen was still accepted by Lonicer and Mattioli, in the 17th.

When the old writers first refer to galls, they are sufficiently well-known to constitute an important part of the list of prescriptions formulated by the physicians of that age. A solution of the gall substance in water, or wine, was the common form in which these remedies were applied. Their marked astringent properties were familiar to the ancients, and, in this connection, it is interesting to note that gall products are still found in the British pharmacopoeia as astringent ointments. Two eminent writers, before the Christian era, who have made somewhat detailed reference to galls, are Hippokrates (406 B.C.-377 B.C.) and Theophrastus (371 B.C.-286 B.C.). The former, a famous Greek physician, dealt with the subject almost exclusively from a medical viewpoint. At various places in his writings he makes detailed reference to the efficacy of galls as remedies in cases where an astringent action is desirable. The latter's work indicates more of the qualities of the naturalist in its author, who must have observed the specimens rather closely, as, in general, he refers to their many sizes and colors, and to the various shapes of particular forms. He especially mentions a gall covered with weak hairs, that would serve as a wick, and a particularly hairy specimen that exuded a honey-like juice. One of the most striking observations which he has recorded is that the elm galls of *Tetraneura ulmi* were suitable for caprification, since they contained animals. Although it is apparent that he must have observed the insect producers, he did not, however, appreciate the relation between their presence and the origin of the gall. Also, the galls on the ash and pistachia were familiar to him, and with them he compares those on the elm. Theophrastus may have been taught the importance of observational work by Aristotle, whose favorite pupil he was.

While the work on galls of Pliny the Elder, who died in the eruption of Vesuvius, A.D. 79, is better known than that of any other writer of antiquity, yet he contributed very little really new material to the knowledge of the subject. He treats chiefly of the oak gall of commerce, *Cynips tinctoria* L., produced on *Quercus infectoria*. He distinguishes several forms of it, and names the variety of oak upon which each is found. He mentions in this classification the green gall-nut on the "hemeris" oak as the one best adapted for the preparation of leather,

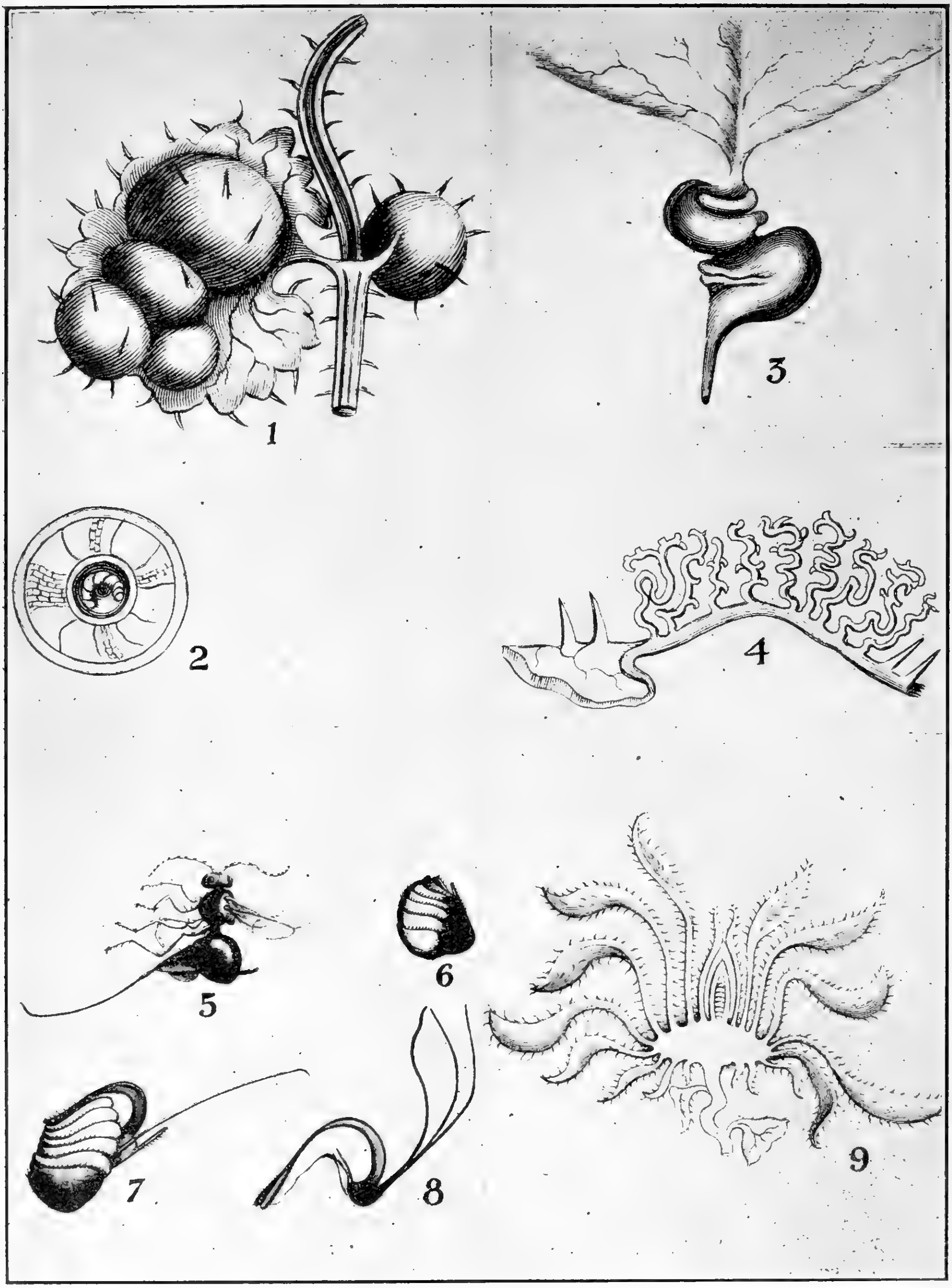


PLATE IV.—REPRODUCED FROM MALPIGHI'S "DE GALLIS."

Fig. 1.—Gall produced by *Aylax glechomae* Linné, on ground ivy. Fig. 2.—Section showing the larval chamber and the enclosed larva.

Fig. 3.—Aphid gall on the leaf of poplar.

Fig. 4.—Mite gall; the producer was unknown to Malpighi.

Fig. 5.—Cynipid producer; 6.—Abdomen of producer, with ovipositor retracted; 7.—The same with ovipositor protruded; 8.—Ovipositor.

Fig. 9.—Section of a willow gall, produced by a midge.

and the white gall-nut parasitic on "latifolia" as similar to the preceding, but lighter in color, and slightly inferior in quality. He includes, as well, the black gall-nut that grows on both the "latifolia" and the "robur" varieties of oaks. He states that the black gall-nut, when on the latter host, has holes in it, and is, in consequence, of much less value. The holes, that he notices apparently only in this form, were without doubt the exit channels of the producers. But, unfortunately for the progress of the science, this point escaped him entirely, and he saw in them nothing but a proof of the inferior character of the galls.

In common with his predecessors, Pliny shows the most perfect confidence, real or assumed, in the value of the medicinal properties of gall extracts. He recommends their use in the treatment of twenty-three different ailments, ulceration of the mouth, affections of the gums and uvula, burns, etc. Toothache may be allayed by merely chewing a little of the gall, but, to secure the best results in more serious disorders, the gall substance should be burned and quenched in wine, or in a mixture of water and vinegar. Pliny no doubt owed much that he has stated concerning the healing properties of galls to his contemporary, Dioscorides. This author named and described five or six hundred plants supposed to be medicinal, and included oak-galls in this primitive materia medica.

In addition to the oak-gall of commerce, the writings of Pliny contain references to other galls. He states that the "robur" oak produces one that can be used for illuminating purposes, and another that contains a sweet juice. These are clearly the same species mentioned by Theophrastus. In the axils of the branches of this same oak, Pliny has observed galls. Following his description of the species, it adheres to the bark without the medium of a stalk; at the point of junction with the host the gall is white, but is spotted elsewhere with black; the inner substance is scarlet in color, and has a bitter taste. Quite a concise and detailed description, considering the early developmental stage of the subject. It has been inferred that Pliny had seen Cynipid producers, since he speaks of a sort of gnat in watery pustules on the leaves of the "robur" oak. Clearly the correlation between the life-history of the insect and that of the gall was not noticed by him, and indeed it is not perfectly conclusive that he recognized the nature of the oak pustule as the same as that of the gall-nut, although he states that the two species mature in about the same way.

Many of the statements of Pliny incline us to the belief that he was influenced to a greater degree by tradition than by observation. Only some such charitable conclusion can explain his assumption that gall-nuts are a fruit of the oak, produced in alternate years with the acorns; or that the gall-nut develops in a single day, but shrivels up immediately if the heat strikes it.

The writers already considered may be regarded as representative of the ancient period of the literature dealing with galls. That era, in reality, contributed very little to our knowledge of the subject. Swellings on certain plants had been noted, and, in some instances, described, but, apart from that, nothing of scientific value had been accomplished. At that time, different hosts, such as the oak, beech, rose, and ash, were known to bear galls. They were supposed to be a fruit-like product of these trees, and it is extremely doubtful that the deformities on the various hosts were known to be of the same fundamental character. It is almost impossible that they could be so regarded, since the common and unifying element, their production by an insect, was unknown. The consideration of galls as fruits caused them to be looked upon as natural products, and made any attempt to explain their origin quite superfluous. During this period, confidence in the medical properties reached its maximum, and their extracts were recommended as infallible remedies for a long list of diseases.

For 1,600 years after the time of Pliny the scientific world slept, and, as a consequence, at the beginning of the 17th century the work on galls had been advanced very little beyond where the ancient naturalists had left it. During the time elapsed, while no appreciable progress was made, several writers had incidentally mentioned galls. Magnus (1193-1280), and Konrad von Megenberg (1309-1337), in particular, have referred to them in their general discussion of the oaks. The latter author introduced the term "oak-apple" as a synonym for the older name "gall-nut." Mattioli and Lonicer, about the year 1600, wrote on the subject, and, in imitation of the early physicians, recommended the gall extracts as a panacea for many ailments. Galls, acorns, and mistletoe were regarded as three varieties of oak fruit by these authors. Their belief in the oracular powers of galls has already been considered.

These desultory references to galls, however, do not indicate any special interest, and we may say that the subject had never been approached in a serious scientific manner until its importance attracted the attention of the Italian physiologist, Marcello Malpighi (1628-1694). This investigator was the outstanding figure of his age in medical science. He was physician to Innocent XII, and professor of medicine at Bologna, and afterwards at Messina. In his methods, he isolated himself entirely from the dogma of tradition, and based his conclusions upon his own observations. In his research work, he investigated the anatomy of the brain and lungs, and made a beginning in embryology by tracing the various stages in the development of the germ in the hen's egg. While his work along zoological lines has placed him in the front rank of the scientists of his own era, that on the botanical side has marked him out as one of the leading naturalists of all times. When a biologist of such ability penetrates into a practically unexplored region as that presented by the subject of galls, it is to be expected that the progress made will be quite phenomenal, and this has proven to be the case. The science of cecidology, with the founding of which Malpighi must be credited, was based by him upon taxonomic knowledge. His catalogue, "De Gallis," published in 1686, contains descriptions of a large number of Italian and Sicilian galls, and shows the intimate familiarity of the author with the included types. Prior to this work, the galls that appeared in the literature were, with few exceptions, confined to the rose, beech, and oak. But, in addition to such well-known forms as *Rhodites rosæ, Andricus fecundatrix, Cynips Kollari, etc.,* he has described others that are less common and more restricted in their distribution. For example, he collected *Aylax glechomæ* Linn. parasitic on *Nepeta hederacea*, a gall that has been widely introduced into America, and is almost certain to be found wherever the Ground Ivy is established. He was also the first to observe the beneficial gall nodules on the roots of Leguminous plants, and had noticed, as well, Erineum galls without being familiar with their production by mites. The deformities of this nature he has mentioned are those produced on Vitis and Populus. Malpighi did not concern himself only with the characteristics of the external form of galls, but applied his knowledge of plant anatomy to the investigation of their internal structure. By this means he became familiar with the course of development of several galls, and the typical stages of individual species.

Valuable as was the contribution thus made by Malpighi to our botanical knowledge of galls, it was overshadowed by the importance of his work along entomological lines. Indeed, the complexity and importance of the problem presented by the production of galls was never fully appreciated until he discovered their insect origin. Only then was the question seen clearly in its dual character, involving a stimulation by the producer, and a reaction by the host.

That he understood the nature of this reaction may be deduced from his statement that the plant is compelled to furnish a deformity that serves to nourish the deposited eggs of the insect. He must have observed the producers very closely, as he gives a detailed account of the curious ovipositor of the Cynipidæ, and mentions, also, the stalked character of their eggs. He further discovered that the galls are not left to the undisputed possession of the producers, but are inhabited by other insects. He seems to have grasped fully the importance, not only of a close study of the host plant, but also of the habits and structure of the insect parasite.

Malpighi has recorded a number of reflections concerning the biological relation between plant and insect in gall formation. His theory summarized in brief is that a poison, introduced at the time of oviposition, breaks down the substances of the cell sap, and diverts the currents of its transference into wrong channels, thus producing malformation by causing the growth energies of the plant to be wrongly directed.

Particularly interesting to us, as students of insect life, is the fact that the founder of the science of cecidology, realized the importance of the entomological viewpoint of the subject.

The President: As the writer of this paper is not present and as its historical nature rather frees it from any discussion, we will proceed to the next paper by Mr. Strickland on "The Army Cutworm in Southern Alberta."

THE ARMY CUTWORM IN SOUTHERN ALBERTA.

E. H. Strickland, Entomological Branch, Department of Agriculture, Ottawa.

The Army Cutworm (*Euxoa auxiliaris*) is new to Canada as a field pest, though it is a native species of the Western Provinces. Fletcher recorded it in 1903 as injurious to gardens in Regina and Calgary, but apart from this report the insect has not been described as one of any economic importance in Canada. Since 1898 it has been a frequently recurring field pest in Montana, where it was given its popular name.

In 1915 an extensive outbreak of this insect occurred in Alberta, and covered a territory of about 3,000 square miles. The resulting study of the insect from an economic standpoint brought to light several interesting features in its life-history and habits.

The eggs are laid in September and October, mainly upon weedy fields. We were unable to find eggs in the field, but in all the experiments in which we reproduced natural conditions in so far as we were able the eggs were laid in the soil—near, but never actually upon, vegetation. This suggests, therefore, that even though the eggs of this species may be found on vegetation the majority of them are laid in the soil. We believe that this will be found to be true of several other cutworms which are described as laying their eggs exclusively on vegetation.

The eggs hatch in the autumn, and the young larvæ hibernate in the soil. Soon after the frost is out of the ground in the spring they come to the surface and feed upon the weeds. When the cutworms are numerous they soon destroy all of the weeds upon the fields where they hatched and have passed the winter. Then, like the Army-worm, they move off more or less in a body in search of more food.

Their general trend of migration, in all cases observed, has been towards the northwest. We believe that they are oriented by light. As in the adult stage these cutworms display a positive phototropism to artificial light, and also to subdued daylight, such as is experienced soon after sunset. Also, like the adults, they avoid strong daylight. The latter tendency causes them to remain below ground on bright, sunny days. It happens, however, that when the cutworms are sufficiently numerous to assume the migratory habit, they have been unable to obtain enough food to appease their hunger. Hunger causes them to migrate, and it may become so intense that it overcomes their aversion to exposing themselves to direct sunlight, so that they come above ground by day, and crawl rapidly in search of food. This search is haphazard. They are not making for any definite feeding ground, of which they have some knowledge. They crawl, therefore, in the line of least resistance—that is, away from the sun, or in a more or less northerly direction. We have disturbed adults hiding under clods at noon time, and they too, in nearly every case, flew more or less due north. In the evening, when the sun is low, its weakened light seems to attract, as does that of an artificial light, and the cutworms crawl towards it. It is at this time of the day that migration usually begins. Once more this agrees with the adult habits; for the moths begin to fly at dusk, and an examination, soon after sunset, of the windows of a barn shows that most of the moths of this species are congregated on the western windows.

The food plants include practically all weeds, field, and garden crops. Larvæ even ascended young Manitoba maples and ate the bark off the twigs, thus killing the trees. They are entirely superficial feeders, and never cut off plants below ground as do the common cutworms.

The pupæ are found in the usual earthern cells made by the Agrotine species.

The moths fly from the middle of June till the end of September or early October. They may æstivate during the hottest part of the summer, and so appear to be double brooded. There is, however, one brood only. During the first flight the ova remain undeveloped, but the moths feed freely and accumulate fat body. After the period of æstivation the eggs have begun to develop, and they are laid during the autumn.

The moths are a serious domestic pest, and gain access to well screened houses. Contrary to general belief, very few of them are attracted into houses by the lights. A lighted lamp merely attracts around it the moths already in the house. The majority of moths enter houses between the shingles or through cracks around doors and windows. They enter these crevices in the early morning for protection from the daylight, working so far in that many of them are unable to find their way out again. Many of these crevices communicate, by however devious a course, with the interior of the building and the result is that a number of the moths gain admission to houses from which the smaller house flies, which avoid dark chinks and crannies, are effectively excluded. The moths are attracted only from a short distance by light, and in this connection it may be mentioned that light traps in the fields proved to be an absolute failure. The majority of moths migrate to buildings soon after they emerge, and remain there until they are mature.

The destruction of the larvæ by poison can be accomplished with comparative ease. This is done most economically by the use of a poisoned bait applied to specially prepared furrows. In wet seasons a vertically sided furrow can be used but under the conditions prevailing in southern Alberta the soil is usually too dry for its construction without expensive hand labor. Under such circumstances it can be replaced by a dusty sided furrow, made by drawing a heavy log through a deep plough furrow. For bait we used either sweetened shorts, which proved to be far superior to bran, or some green vegetation, such as Stinkweed (*Thlaspi arvense*), or alfalfa, poisoned with Paris green. The cannibalistic tendency of these larvæ proved to be of great benefit, since the poisoned larvæ, which soon lined the treated furrow, were eaten readily by subsequent arrivals, and definite experiments proved that under these circumstances they themselves furnished a very effective poisoned bait.

The cutworms appear early in the season, before the spring grain is sown. If they are observed in large numbers in a field which is being prepared for seeding, extra care is taken to remove all traces of green growth, a poisoned furrow is prepared right round the field, and seeding is proceeded with as usual. The lack of food results in a rapid migration of the larvæ already on the field, and by the end of the week necessary for the germination and appearance of the crop, the majority of them will have entered a furrow and have been poisoned, while others attempting to enter the field from the outside also will be trapped. Sometimes it is advisable to make more than one furrow along the menaced side of the field, and if the season is so advanced that germination is rapid, it may be necessary to plough subsidiary furrows at intervals through large fields.

Fortunately, we have no evidence which would lead us to anticipate a frequent recurrence of the pest, and we feel that similar outbreaks to that experienced this year can be held in check by the control measures advocated above.

The President: I think all will agree as to the very practical nature of Mr. Strickland's paper and at the same time its value on account of the very interesting points he brings up regarding certain biological questions. Mr. Strickland certainly won two victories in the West this past season. He won a victory over the Cutworms, and he won a more important one than that, the obstinacy of the farmer, who is always very chary about adopting any remedial measures from experts unless you can convince him by demonstration. The way he was able to break through that obstinacy on the part of those farmers who were not willing to accept advice unless they were shown is really one of the valuable lessons we learn from the method we now have of carrying out our work through the field stations. Secondly, the fact that Mr. Strickland had to begin the study right from the very beginning, and leave behind him all the previous historical matter regarding the treatment of Cutworms under other conditions and in other parts of Canada, shows what a difficult task he had. There are a number of points in his paper which might be the subject of a very interesting discussion; for example, the behaviour of the larva as compared with the behaviour of the moth. They behave practically the same both towards artificial light and towards the natural light of the sun. Apart from its practical interest, of course, this paper does bring forward very emphatically the necessity of studying the behaviour of insects, and I believe that in our practical work we are coming more and more to realize that we shall have to go in for behaviour studies in addition to the study upon which so much of our advice has been based in the past, that is, studies of the life-history. We have many instances of that, such as the recent work in regard to the Fruit Flies of various species and work in connection with the relation of the ants to the Corn Root Aphis, all of which tends to prove that life-history study only leads so far in many instances. That is one of the most important things that Mr. Strickland's paper brings out. The paper is now open for discussion, and I have no doubt that a number of the members would like to take up certain matters.

Prof. Lochhead: Did Mr. Strickland say what effect the juice of lemon has upon the mixture as an attractant?

Mr. Strickland: We tried using the juice of both oranges and lemons when poisoning in the trench, but found that since the bait was not in competition with a growing crop there was no necessity to use it; and as a general rule we found that the fruit juices made very little difference. We have been using a series of cages sunk into the ground over a growing crop, 9 feet square, so that we can put in each a certain number of cutworms, apply poisoned baits, and tell exactly what our poisons are doing. We did some forty or fifty experiments in them this year with various poisoned baits, and generally about three days afterwards we would recover all of the larvæ, living or dead, from the soil, and in that way we were able to tell the relative values of the baits used. Here also we find that fruit juice has very little beneficial effect, and that cane molasses is very much inferior to beet molasses.

Mr. Winn: I would like to ask Mr. Strickland about the first stage of the insect, namely, the egg-stage. When the eggs were found were they attached in any way?

Mr. Strickland: We never found more than three together.

Mr. Winn: Did you notice where they were laid?

Mr. Strickland: Of course we disturbed them when we examined them, but we found that particles of earth were attached all around them, and therefore we concluded that they were laid in the soil rather than on the soil.

Mr. Winn: I have examined several of the eggs and it was very peculiar the way they were laid.

Mr. Strickland: Our examination of vegetable matter has been naturally far more thorough than that of the soil, and we have never found them on vegetation, so that we are rather forced to the conclusion that they are laid in the soil.

The President: Perhaps Mr. Gibson would have some remarks to make on this subject.

Mr. Gibson: I am afraid I can add very little to what Mr. Strickland has already said. He seems to be working under conditions peculiar to Southern Alberta. In the East, here, we frequently find the eggs of Cutworm moths laid on leaves, and even on the stems of trees, but we have not ourselves, as Mr. Strickland has, located any eggs in the soil in eastern Canada. In the case of the Variegated Cutworm, which was so abundant in British Columbia in 1900, the eggs were laid on the leaves and stems of trees, windows, verandahs, and even on clothes hanging out to dry. In regard to the control of cutworms in the East, we this year used the locust poisoned bran formula with good results. Twenty pounds of this, if spread properly, is sufficient for two or three acres.

Mr. Criddle: I would like to say that I have also been carrying on a few investigations in Cutworms during the past season, and I found that market gardeners near Winnipeg had very little faith in oranges or lemons. They had remarkable success by using both bran and shorts (the majority were in favour of shorts) and just molasses in addition, and my results seemed to bear out what they said.

Mr. Tothill: I would like to ask Mr. Strickland if in connection with the Noctuids there is any special machinery in connection with any of the ovipositors for laying eggs beneath the soil?

Mr. Strickland: Whenever we disturbed moths in the day time they were always beneath clods and so beneath the soil.

Mr. Wilson: I would like to ask Mr. Strickland about what time the Cutworms appeared in Alberta this summer?

Mr. Strickland: They appeared as soon as the frost was out of the ground, the very first record being of larvæ attracted to light at the Provincial Jail on April

7th, and on about April 10th we had an account from the country where we found them plentifully.

Mr. Wilson: In 1900, about the 15th June, I received a report of damage by potato beetles up North and I proceeded there, but could find no potato beetles of any kind, and I had good evidence that cutworms were present.

The President: If there is no further discussion on this paper we shall now bring this session to a conclusion.

Mr. Gibson: Several of the members undoubtedly would like to spend some time looking over our collections here, and as I think we have plenty of time for all the papers on the programme to-morrow morning, I would move that the session begin at 9.30 instead of 9.00 o'clock.

Mr. Tothill: I second that motion.

The President: To-night we are to have the privilege of hearing a public lecture from Dr. H. T. Fernald, State Entomologist of Massachusetts. Dr. Fernald has been most kind in stepping into a breach which was made by the unfortunate accident to Dr. Howard, who would otherwise have delivered this lecture, and I take it for granted that everybody here will be there to-night as we ought to give Dr. Fernald a good audience, and I hope the members here will do their best in bringing their friends to hear Dr. Fernald. The lecture starts at 8.00 p.m.

The meeting is now adjourned.

Thursday, Nov. 4th.

EVENING SESSION.

LIFE ZONES IN ENTOMOLOGY AND THEIR RELATION TO CROPS.

H. T. Fernald, Amherst, Mass.

From the time when the late Alfred Russel Wallace published his epoch-making volumes on "The Geographical Distribution of Animals," this subject has been one of extreme interest. Wallace used his discoveries in this line as evidences of evolution, and provided many able arguments to support the theory from that source. The possibility of a practical application of distribution to agriculture, however, seems not to have received consideration by him, and it was apparently left for Dr. C. Hart Merriam to present this phase of the subject, though in a somewhat general way, in his paper on "Life Zones and Crop Zones in the United States," about a quarter of a century later.

Two years ago, Dr. E. M. Walker, in his presidential address before this society, discussed at some length the life zones as they are found in northern North America, and therefore only a brief reference to this phase of the subject is necessary at this time. Studies of the distribution of plants and animals all show that on any continental area, belts running from east to west across the country are inhabited largely by the same forms, while as we go north or south to the limits of these belts, we find other species beginning to present themselves, and these increase until finally we are surrounded by a fauna and flora almost entirely different, and belonging to a different belt.

Such belts constitute the so-called life zones and these are grouped into regions, that covering the tropical portion of the continent being called the Tropical Region, that next the north the Austral Region, and the northernmost, the Boreal Region. Naturally we are interested mainly in the last two of these areas.

Canada is, of course, largely within the Boreal Region, but the differences within her territory are such that three sub-belts, called zones, are easily recognizable. On the north, beyond the limit of the growth of trees, we find corresponding changes in plant and animal life, establishing the Arctic Zone of the region. Here are typically Arctic plants and such animals as the Arctic fox, polar bear, musk ox, and ptarmigan. South of this, stretching across the continent from Labrador to Alaska, and southward along the tops of the Rocky Mountains is the so-called Hudsonian Zone. Its southern limit extends from near the mouth of the St. Lawrence River to the southern end of Hudson Bay, thence passes northwest to near Great Slave Lake, then down the Mackenzie River to about 65 deg. latitude, after which, influenced by the mountainous heights, it extends again to the south to about latitude 55 deg., sending narrow tongues farther south along the mountain tops. As it approaches the western ocean, however, the moderation of climate due to the Kuro sivo, or Japanese Gulf Stream, makes its influence felt, and the southern edge of the zone is driven north and is only able to reach the western shore of the continent about five degrees farther north than it was when the effects of the ocean came within reach. As neither the Arctic nor Hudsonian zones of the Boreal Region has great agricultural value, we now turn to the third zone of this region—the Canadian—which with certain exceptions occupies the rest of the Dominion of Canada and a portion of the United States. Here we must look for the greatest agricultural returns and one of the best opportunities for the utilization of crops not as yet grown.

The Austral Region occupies but a small portion of Canadian territory, but what it does occupy is of great value, for here it should be possible to produce crops not raised elsewhere in the Dominion, and to produce to perfection crops only partially successful in the Canadian Zone. Like the Boreal, the Austral Region is divided into three zones, the northern one being known as the Transition Zone. How accurate our knowledge of the area occupied by this zone as shown on the map is, may be questioned, but a strip around the Bay of Fundy and along the shore of Lake Ontario, and the Southern parts of Manitoba, Saskatchewan, and Alberta, besides the shore belt in the region of Vancouver Island, are believed to belong to this section.

Next south comes the Upper Austral, and this appears to be present in Canada only as a narrow strip along the shore of Lake Erie. How correct this is must be determined by future investigation.

It is a safe statement that Life Regions and Zones are always limited by barriers, though these may be of many kinds. Every kind of animal and plant has an optimum temperature at which it thrives best. As we depart from localities where this is true, and pass to the north, we will reach a latitude where it can no longer exist, while if we pass to the south the same will hold. Sometimes the limits will be established, not by temperature but by absence of food or by a change from a moist to an arid climate or the reverse. A mountain chain of considerable height may so affect temperature that forms reaching it are unable to cross and enter a continuation of the same zone beyond. Near the shores of our continent the influence of the ocean is a modifying factor, and others might also be enumerated, all affecting the arrangement of the regions.

Evidence indicating the limits of these zones is gathered by a study of the plants and animals present. Many plants found only a short distance south of the international boundary disappear as we pass northward, and with them disappear animals feeding on those plants, unless satisfactory substitutes can be found. The cold of winter holds many forms in close agreement for their northern limit with certain isothermal lines, and by a study of these and other factors, a general understanding of the zonal areas can be obtained.

At the present time investigations on this subject are mainly by preparing faunal and floral lists for different localities, particularly from places presumed to be near the borders of the zones, and as a whole the latest results seem to indicate that the Upper Austral Zone extends farther north than was formerly supposed to be the case. It is, of course, recognized that no absolute line separates the zones, but that they overlap somewhat along their edges, leaving more or less of a "debatable ground," but despite this, approximate limits have a significance when it comes to the selection of the most successful crops to raise in any locality, and even local modifications are worthy of consideration.

The speaker regrets a lack of knowledge of local conditions of Canada as bearing on this point. Certain examples from cases with which he is familiar, however, may be suggestive and be possible of application here.

The State of Massachusetts is mountainous at its western end, numerous peaks reaching a height of more than 2,500 feet, and that whole portion of the state is more than a thousand feet high. East of this the state is crossed by the broad Connecticut River Valley, where, except for a few hills, the elevation is everywhere less than 500 feet. The central part of the state is higher again, the general elevation of the land except for narrow grooves cut by streams, being over a thousand feet. The eastern third of the state, however, is all less than 500 feet above sea level.

So far as elevation goes, therefore, the eastern part of the state and the Connecticut Valley should have much in common. Such differences in elevation in the state as have been indicated should not be of such importance as to affect apple raising, for instance, but they do result in the appearance of minor differences which all have their effect.

But even two such similar areas as the eastern end of the state and the Connecticut Valley have their differences. Nearness to the ocean has its effect in the former case, moderating the temperature somewhat in winter, and slightly checking excessive heat over extended periods in summer. But when southeastern Massachusetts is considered, yet another difference is found. Here the influence of the Gulf Stream as it sweeps northward modifies the winter and lengthens the fall, preventing frosts until much later than only a few miles farther inland.

The Gulf Stream is itself a somewhat variable factor. From time to time its course changes, sometimes swinging in quite close to the land, while at others it turns more out to sea, thus having less effect. In general, however, the result is that crops normally grown only much farther south can be successfully raised on Cape Cod and along the shore towns of the southern part of the state, besides insuring safety to late planted crops coming onto the market after the regular season has ended.

Small factors sometimes prove to be of considerable importance in establishing the limits of life zones, and this is illustrated by the Holyoke range of mountains in the Connecticut Valley. This range is by no means a continuous one, but its general trend is across the valley with an average height of perhaps a thousand feet. In spite of its numerous breaks which would seem to render it of no importance as a line of separation, we find many forms of life extending from the south as far as this range but no farther, and the season on the northern side of the range is about ten days later in spring than on the southern side. The steep northern slopes of the mountains are well covered by snow during the winter, and this is not quickly reached and melted by the sun in the spring, thus delaying the season north of the range. During the winter, too, increased cold results, and it is probably this which prevents a farther northward spread of the forms which reach the southern slopes, by establishing a winter temperature which they are unable to withstand. During the summer, northward migrations can and sometimes do occur, but the cold of the winter following is always sufficient to destroy these marginal settlements, leaving the northern limit of occurrence of these forms where it was before.

Closely related to the questions of distribution of our native animals and plants, are those of introduced forms of life. The Elmleaf Beetle, which reached this country nearly three-quarters of a century ago at Baltimore, has now spread far to the northward, and how much farther it can go is a question of considerable importance. It thrives in the Upper Austral Zone, but is noticeably absent in the highlands of the Pennsylvania mountain region, though it is present again west of them. To the north it has caused serious loss to the elms of New England, resulting in the appropriation of large sums for spraying of the trees to protect them from its ravages. Careful studies of this pest in Massachusetts show that while a serious menace to the life of the elms in the southern part of the state and in the river valleys, it becomes of little importance in the higher and northern parts, and many towns which formerly appropriated money for the protection of their elms from this insect have now learned that this was unnecessary, as the trees would suffer but little at most, in any case.

With the San José Scale similar facts are now coming to light. This pest finds the best conditions for its life in the Lower and Upper Austral Zones, where it has caused the loss of many millions of dollars. Even in the Upper Austral territory of Massachusettes, it is one of the most destructive enemies of the fruit-grower. As we pass into the Transition Zone, however, its ravages become less severe, and by the time the centre of this zone has been reached, it is of only medium importance. In this case, it has seemed to those studying this problem that this insect was originally limited by the Upper Austral, but has gradually acquired some degree of resistance to lower temperatures and has thus been able to extend into the Transition Zone. Whether this resistance of cold will continue to develop until it becomes a serious insect in this entire zone is a question which cannot now be answered. At least, it points out the possibility of the acquirement of resistant qualities as a factor which must be taken into consideration. The speaker has watched with much interest a small colony of these insects which about fifteen years ago was brought on nursery stock to a point near where the Transition Zone meets the Canadian. Here from year to year the insect has reproduced just sufficiently to maintain itself, doing no injury, and "eking out a miserable existence" and nothing more.

The Asparagus Beetle and numerous other examples might here be considered as illustrating the significance of life zones in their relation to the limits of spread of our insect foes, but time for their consideration is inadequate.

With life zones divided by mountain ranges we find that it is not usually the case that the same forms occur on both sides of the barrier. When this does happen, two explanations offer themselves. The barrier may be a recent one, at least geologically speaking, having arisen after the zone had been occupied by the forms concerned. Or the barrier may be a less complete one than it was supposed, and these forms have in some way succeeded in crossing it. More often the animals on the two sides are not the same, though they may play similar parts in Nature's economy, and again two explanations are possible. Where two similar but different forms occur, one on each side of a barrier, it has been suggested that a common ancestor of the two had established itself over the entire zone before the barrier was formed, and that development on the two sides since has been along sufficiently different lines to produce different species. The Peach Borer east of the Rocky Mountains, and its close relative, the Pacific Coast Peach Borer, on the western coast, are considered an example of this. Many forms, however, show little close relationship but much similarity to Old World forms, and here geology steps in to provide an explanation.

There is much evidence that in past ages the northern part of the world's surface was much warmer than it now is, and also that there were more or less complete land connections between Europe and North America on the east, and Asia and Alaska on the west. It is noticeable that many forms of life in the northeastern part of this country find their closest relatives among European forms, and similarly that many of our western forms closely resemble those of North-Eastern Asia. From these facts it seems at least probable that differences in the life of the same zone found on two sides of a north and south barrier may be accounted for as being the results of migration from the two opposite ends of the Eurasian continent.

Life zones then mean, not the areas continuously inhabited by a certain list of forms, but territory having fixed standards, which meeting the needs of animals and plants, able to live under such standards, can be populated by them if means of access is provided.

It has been said that certain places in Africa are perfectly fitted for some American forms of life. If this be correct, such American forms once placed there would establish themselves and thrive in their new home, the only difficulty being that of getting them across the ocean in the first place. This may remain a difficulty for years, but, so far as North America is concerned, the arrival of new forms from other countries is not only possible, but is actually occurring, and if favorable conditions are found on arrival, or, in other words, if proper life zone conditions and proper food are at hand, the establishment of new animals and plants in our land is certain.

Some of these arrivals in the past have been desirable, but certain it is that many have proved veritable pests. It is stated that about seventy-five of our one hundred worst insect pests are of foreign origin, and, in spite of all systems of inspection and care, new ones somehow creep in and establish themselves before we are aware of their presence.

To prevent this seems hopeless under our present methods, and the recent development of the nursery business, bringing in millions of all kinds of plants from all parts of the world, harboring insects many of which it may be difficult or impossible to find by any inspection, raises the question whether it would not be wise to absolutely prevent the importation of all plants from foreign countries, in order to protect ourselves from the pests of other lands which otherwise might join forces with those already here, in the destruction of our crops.

MORNING SESSION

FRIDAY, November 5th.

THE PRESIDENT: The meeting is now called to order and I intend to postpone the first item on the programme, that is, "Election of officers, etc.," and instead to ask Mr. Morris to read his paper on "Fresh Woods and Pastures New."*

Mr. Morris's paper was read.

DR. HEWITT: I am sure I am voicing the sentiments of the whole meeting when I say how pleased we are that Mr. Morris was able to come to this meeting and deliver one of his charming papers. It occurred to me, as Mr. Morris was reading his paper, what a pity that he could not be given charge of an expedition such as Bates had in South America, what charming accounts of those entomological journeys we should have when Mr. Morris returned. This paper is now open for discussion, if any of the members care to ask Mr. Morris any questions regarding his captures.

I hope, Mr. Morris, that you will take this silence as indicating that your paper was so fully detailed by you that no one wishes to discuss it. We will now pass on to the next paper, by Professor Lochhead, on "Some Notes on Nose and Other Bot Flies."

SOME NOTES REGARDING NOSE AND OTHER BOT FLIES.

PROF. W. LOCHHEAD, MACDONALD COLLEGE, QUE.

1. NOSE FLIES.

In connection with the "Farmer's Friends and Foes" department in the *Family Herald* and *Weekly Star* several interesting letters were received by me from the West regarding *Nose Flies.* I consider the information obtained of sufficient importance to bring before this meeting, for it became evident when I looked up the literature available that entomologists as a rule have much to learn regarding this group of flies.

The correspondence referred to began innocently enough through a question asked by a Saskatchewan subscriber; "Does the Nose fly that torments horses in summer time sting or bite the horse, or what makes them so afraid of the flies?" I replied as follows:—

> Nose flies are a species of horse bot flies and have a peculiar habit of laying their eggs round the lips of horses, and the nostrils. For this reason they have been termed "Nose Flies." We all know that horses have an instinctive dread of this fly, and seem to recognize its presence. While these flies may appear to sting, they cannot do so, for they have no sting. Their mouth parts are aborted. However, this fear of the bot fly has been bred into the bone of thousands of generations of horses, who have suffered the effects of the bots in the stomach. There may be something in the fact that the bot fly resembles a wasp or a small bee and that the horse cannot very well distinguish between these insects which sting and the bot fly which does not sting. Personally, I am of the opinion that horses know instinctively that this insect is harmful to them. There are many things that we cannot explain, and this instinctive dread of nose bot flies is one of them.

*This paper will appear in the *Canadian Entomologist*, Vol. XLVIII, No. 5, May, 1916.

My reply led another Western reader to make a spirited reply to my statement that the bot flies cannot sting either with its mouth-parts or with its ovipositor. He says:—

My experience with "nose flies" that annoy horses dates back eight years. Previous to that time they were unknown in the district. A bunch of horses were brought in from the United States the year before and from them I think we obtained this pest. Of course we always had the long-tailed bot-fly, but this bob-tail is a curse both to horses at work and in pasture. Work horses can be given some protection in the shape of nose covering, but the poor horses outside cannot even feed in the day-time for them. If you could see the poor beasts huddled up together stamping, rubbing, etc., I am sure you would not think the laying of an egg by these pests so simple a matter. Come and hitch up a six-horse outfit without any protection sometime this coming summer and you will change your mind. Anyone who will take the trouble to examine these bob-tail bot flies will notice on the tail end a pair of tweezers when pressed slightly. It is from these tweezers the trouble arises.

In my reply to correspondent No. 2 I suggested that perhaps the real culprit was a Tabanid for these insects are known as Gad-flies, Breeze-flies, Greenheads and Ear-flies, but asked for specimens. Correspondent No. 2 was good enough later to send a few specimens of the Nose flies and made further observations regarding their habits:—

These pests have been some weeks later making their appearance this year, owing I presume to the late frosts. I think the description you once gave, namely, red-tailed bot-fly, was fairly accurate, but strange to say I have looked very closely for their eggs but have failed to find any—so different from the ordinary long-tailed bot, which distributes its eggs promiscuously. On squashing an ordinary bot fly one finds numberless eggs, but in these I have failed to see any. The habits of these nose flies are to hover around a foot or so above the earth, when they make a dart upwards and try to hit the horse on the lips or nostrils; it also seems to dig its hind part similar to a bee or wasp when stinging an object. It rarely hits but once at a time, when it seems to disappear for a few seconds, then comes again. I have examined its rear end for stinging apparatus, but can only see what to me appears a pair of tweezers. We have all the other kinds of horse flies you mentioned, but a horse will calmly endure being chewed up with the spotted winged horse flies, bull dogs and the rest of that family, but let one of these nose flies strike and he is up in the air at once and has to rub his nose on something or other. As I mentioned in my previous letters it is only a few years since they made their appearance in this district and I have heard that there are parts of this province where they have not yet made their appearance. They are the greatest pest we have got on horses. I think the Royal Humane Society should get busy and make all owners provide some building in which any stock in pasture could go in for protection. I have a pole and straw shed which I put up for winter and the straw has settled down a little, which leaves an air current at the top of walls. My stock appreciate it and it is also a protection from the bull dog flies, too, which are a great annoyance to cattle as well as horses. These nose flies don't touch cattle.

My reply was as follows:—

We were very glad to get four specimens of nose flies from Saskatchewan, for their arrival sets at rest the question of the identity of the flies that bother the horses so much in the western provinces. They are nose flies (*Gastrophilus nasalis*), and are one of the species of horse bot-flies. Now our friend S. H. differs from us on the power of stinging these nose flies possess. We maintain that these flies do not and cannot sting, for they have no stinging appliance. In all kinds of flies that sting the mouth-parts are modified to form a stinging or piercing apparatus; on the other hand, in all the kinds of bees and wasps that sting the egg-depositor at one hind end of the body is modified for piercing purposes. Now, as bot-flies are true flies we would naturally expect their mouth-parts to show piercing appliances if they can really sting, but examination reveals no such appliances. Moreover, the egg-depositor at the hind end of the body is rather long, but it is too soft and flexible to serve as a stinging instrument.

If these bot or nose flies cannot sting, why do they cause such panic among horses? The answer is, we believe, the persistent efforts of the flies to deposit their eggs on the hairs of the front legs. They resemble a bee or a wasp to a considerable extent, even to the humming noise, and their sudden darts coming continuously and persistently get on the horses' nerves and set up a panicky state of mind. The cattle or warble or bot fly is another instance where a fly that cannot sting causes cattle to go careering through the fields in a panicky condition. The real biting flies like the horse fly do not seem to produce the same effect, for the reason we suppose that once the horses get rid of it they have rest for a while. There is no doubt as to the name of the flies sent, and it is also certain that they do not sting. Three of the specimens submitted were males, hence would not have eggs.

Later still, a third correspondent from Saskatchewan writes me regarding Nose flies and gives further particulars as to the differences between the Nose fly and the Bot fly. He says:—

I have been reading in the issue of July 28 an article on nose flies. As the nose flies are a very troublesome pest among horses, I would like to add my mite of knowledge concerning them. Now they cannot be the same flies that deposit their eggs on the legs because they are much smaller and darker in color, and the mode of laying the egg is different; the ordinary bot-fly keeps buzzing and depositing her eggs (which are yellow) continuously; whereas in the nose fly it strikes upward swift and wickedly and then disappears, to return again possibly in half a minute; the egg is black. One fellow struck me on the back of the hand last summer and left an egg which attached to a hair; there was no pain, though the wicked way it does the trick is quite enough to scare a person or a horse either. When there is protection on the nose of the horses (rags are commonly used and wire screens are sold to cover the nose), they will strike at the person; often I have had them hit the underside of the brim of the hat.

My reply was as follows:—

The correspondence regarding nose flies has brought out much important information regarding these pests. Our friend (W. B.) tells us something really important in the way of distinguishing two kinds of bot flies of horses. It is likely, however, that there are at least three kinds of bot flies in the West, and this fact will account for the difference noted by the various observers. There is first of all the "common bot fly," which deposits its yellowish eggs on the legs and is of a general reddish brown color. The eggs may be deposited on the fore legs, knees and shanks. A second form is what is known as the "nasal fly," specimens of which we identified in our last note on nose flies in these columns. We beg to note a clerical mistake which we made in stating that they deposit their eggs on the hairs of the front legs; this should have been "on the hairs of the lips and the margins of the nostrils." This insect is smaller than the first, has white eggs and is of a darker color, but still with a considerable number of brownish hairs. The third form of bot fly is the "red-tailed bot fly." This has about the same general color as the nasal fly, but is not so large and deposits its eggs on the lips of the horses. The eggs are darker than those of the first or second. It must not be supposed, however, that the "red-tailed bot fly" is the only red-tailed bot fly. A confusion may arise here; there are different bands of color on the abdomen of both the nasal and the red-tailed bot fly, the bands being very much alike in both—a yellow band in front, black in the middle and orange on the last. The term "red-tailed bot fly" is, therefore, not a good one to use, because the nasal bot fly is also red-tailed. These facts regarding the three forms of bot flies may account for the differences observed by our correspondent, as we have already stated. There are other differences, of course, which are revealed on close examination under a magnifying glass or a microscope, but the foregoing are sufficient to identify them. We should be very much indebted to our readers in the West if they could send specimens of bot flies to us so that we may be able to give further information when questions are answered.

A fourth correspondent at this time contributes his mite as to the best treatment against nose flies:—

There is an objection to the use of rags tied over the horse's nose on account of difficulty in breathing. I have tried the following remedy with much success: Mix about 10 cents worth of oil of tar in machine oil (but other oils would be better), and wipe lightly around the muzzle of the horse—but use it very sparingly—whenever flies make an attack. I keep a bottle among the implements and flies never come near the horses. Mosquitoes dislike this substance also.

A fifth Saskatchewan correspondent writes as follows:—

I would like to add the following information, which I will vouch for being correct. The nose fly appeared in this district some ten years or more ago, brought I expect from the States or Mexico. In size, shape and color it closely resembles the bot fly, and is often mistaken for it, but it is a trifle smaller and more grey. The principal difference, however, to the horse and stockman lies in its method of depositing its eggs. The bot fly buzzes incessantly up and down the animal's legs, sticking a yellow-white egg on the hair every other moment, mostly below the hock or knee. In distinction from the bot fly, the nose fly uses its ovipositor like a hypodermic needle. It flies very swiftly back and forth, poises itself for a moment as though to judge place and distance, and then, darting upward, stabs a *black* egg into the lip or chin of the horse and retreats as swiftly, only to return at the next suitable moment. The horse can hear it and awaits the attack with nervous apprehension. On feeling the needle-like thrust it starts violently and rubs its lips or nose on the grass or against another horse. Often horses on the range will be seen standing with their noses buried in each other's manes or resting on another's back. I never saw a nose fly draw blood, and I think the "ear fly" referred to in the article is a very small grey-black fly that bites principally in the ears, across the chest and around the sheath. These are distinct from the flies, like very diminutive house flies, which congregate around animals' eyes. There is also the "deer fly," about the size of the house fly, but having a speckled or mottled appearance, whose wings when at rest stand out, giving it a triangular shape. Also the huge fly as big as a wasp, locally known as the "bulldog." The latter flies bite with nippers and generally draw blood. There is also another pest called the heel fly which I have not studied yet. Some people claim it is identical with the nose fly. It attacks the heels of cattle, which take refuge in water when possible. It is a common sight to see one or more individual animals break from a bunch or off the feeding ground and stampede for water, brush or, when neither is handy, a buffalo wallow or washout. Animals will be found thus upwards of a mile from any other cattle. In a country so large, individual attempts to destroy any of these vermin seem hopeless; but if any means could be devised to co-operate for their destruction, the relief would be tremendous both to man and beast. Of all the flies the "nose fly" is perhaps the worst, and we have to use some kind of porous net over our horses' noses, as referred to in the quoted article.

A reader from Alberta (Correspondent No. 6) writes as follows:—

I have been very much amused and interested at your articles on nose flies and bot flies. I imagined that every farm boy of an inquiring nature and over ten years of age knew all there was to know about those little pests. I have been a neighbor of theirs for the past thirty years and consider I am about as well acquainted with their habits as the ordinary man. I was a boy of thirteen when I first made the nose flies' acquaintance. I used to lead an old blind horse to the cultivator; on calm, hot days the horse would suddenly stand on his hind legs and start pawing the air with his front feet, sometimes bruising me in his flurry, so I naturally started in to investigate with a boy's curiosity, and the only thing I could notice for a while was a dark object about the size of a buckshot come from somewhere near the ground, strike the horse on the lip and immediately fall to the ground. One thing I noticed in particular was that when they struck the horse they were upside down and their tail struck in advance. My idea was that they were a variety of bee. The first one I caught I examined very closely for a sting but could not find any; then I started to squeeze the rear end to see if there were any eggs in the oviduct and did not find any eggs, but to my surprise I squeezed out two stings just below the oviduct shaped exactly like the mandibles of an ant, but considerably stronger and sharp as needles. So I came to the conclusion that was the cause of the horse's antics. The nose flies that I was acquainted with in the East were about the size of a house fly but shaped like a bee. You say that only bees have stings in the tail, and I believe you are right; but when you claim that a nose fly is a bot fly I think you are off. The nose fly is one branch of a large family of stock bees, and the bot fly may also be a branch of the same family, but it is the only one that lays the yellow egg which hatches into the bot inside the horse's stomach, and it will lay eggs on a horse from heels to ears and sometimes on cattle. It appears to be the strongest flier of any of the family and also the best known. Since coming to Alberta I have made the acquaintance of several other members of the stock bee family. First I will mention the brown-tailed light yellow nose fly; it is about the size of a blue-bottle fly but shaped like a honey bee. It also carried heavy mandibles just below the oviduct; they are sheathed in the body and cannot be seen unless the body is pressed between the thumb and finger, when they expose themselves.

Then there is another with a light yellow body, about the size of the female bot, which I imagined was the male bot; it also has a pair of mandibles, but they are frailer than those on the nose fly.

Now we get to the heel fly, which belongs to the same family and is the largest of the family that I know. It is about the size and shape of a small honey bee and carries the heaviest set of mandibles of any of the stock bee family; it is also the poorest flier; it hovers around in the grass or near the ground on calm, hot days, and darts up, striking the cattle on the first place it reaches, generally from the heels up to the hocks and sometimes on the rump; then up goes the animal's tail and it bolts. If there is a four wire fence in front of the animal it goes right on through, while the fly calmly drops to the grass and sails along until it comes to the next cow or steer, which also throws up its tail and has business elsewhere. By that time all the cattle have taken the hint and disappeared.

Another one I captured near the horses one day about as large as the heel fly and the same color; the only difference I noted was that its mandibles were jet black and very strong, while all the rest were brown. One thing I noticed with all of these insects is that they are always worse on hot, calm days and are very weak fliers, never appearing when there is any wind, excepting the bot which is with us all summer.

A correspondent (No. 7) from Chatham, Ont., writes:—

I think your correspondents of July 28th and September 1st are in error about what they call nose flies, as the flies do not strike on the horse's nose but underneath, just back of the opening of the jawbone. I have caught scores of them by placing my hand beneath the horse's chin. They do not deposit eggs, as they are males of the common bot fly. The eggs that are on the lips were not deposited there, but adhered when the horse was rubbing his legs, as the horse does not use the tongue for that purpose. The difference in colour of eggs can be accounted for in this way. When first deposited they are yellow, but turn darker until hatched; then the shells which still adhere to the hairs get quite light.

2. Warble Flies.

For the last two or three years reports have reached us from Chateauguay and Huntingdon Counties that certain flies were very troublesome on the dairy herds in pasture during June and early July. It was asserted that they stung the cattle and chased them about the fields. This summer a specimen of the pest was sent me, and on comparing it with type specimens of Warble flies sent me by Dr. Hadwen, of British Columbia, I identified it as *Hypoderma bovis*. Dr. Hewitt, to whom I submitted the specimen, corroborated my identification.

The explanation of this outbreak of *bovis* in the Chateauguay-Huntingdon district is clear when it is known that a large importation of cattle from Scotland has occurred annually for many years. The breeders of this district admit that warbles on the backs of the cattle are more common now than they were a few years ago.

Following is a table which may be of service in identifying the common genera and species of the Oestridæ.

Oestridae.

(Bot Flies.)

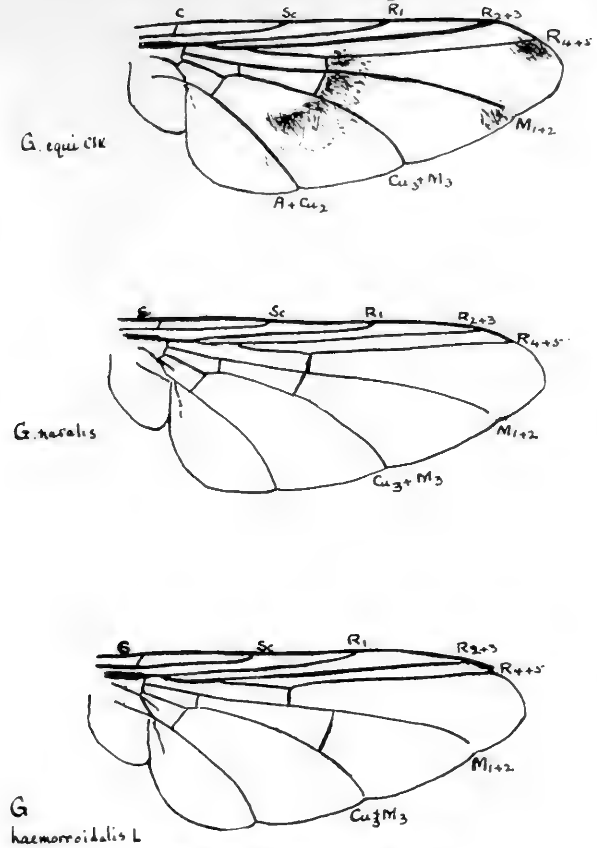
Common genera and species:

a. Costal vein ends at tip of R4+5; M1+2 is straight, not reaching the margin, and cell R5 wide open; squamae small, arista bare; ovipositor elongate. *Gastrophilus.*

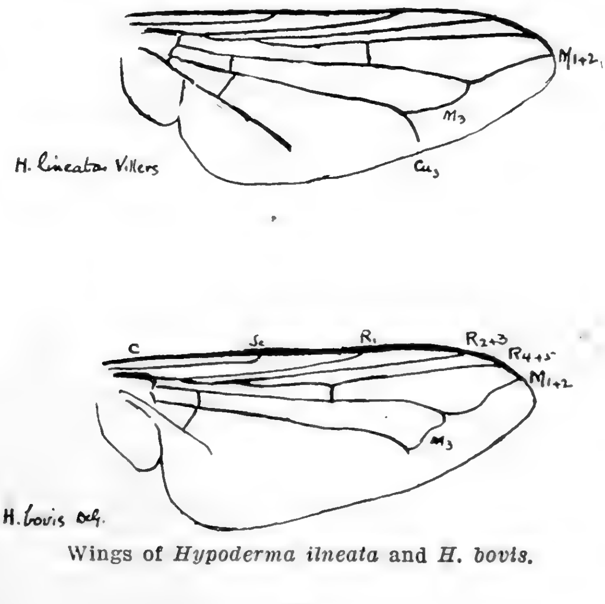
b. Wings with spots and smoky median cross band. *G. equi* (horse bot fly).

bb. Wings without spots.

c. Posterior cross-veins (M-Cu) beyond the anterior cross-vein (R-M); legs blackish brown. *G. hæmorrhoidalis* (red-tailed bot fly).



Wings of *Gasterophilus.*



Wings of *Hypoderma ilneata* and *H. bovis.*

cc. Posterior cross-vein opposite and nearer than the anterior cross-vein. *G. nasalis* (nose fly).
aa. Costal vein ends at tip of M1+2; M1+2 with a bend; cell R5 much narrowed or closed.
b. Facial grooves approximated below; cell R5 closed and petiolate. *Oestrus.*
bb. Facial grooves far apart; squamae large, ovipositor elongate. *Hypoderma.*
c. Prothoracic band of yellow hairs, mesothoracic band of brownish black hairs; media 3 sinuate; legs black with black hair; tips of hind tibiæ and tarsi yellowish brown. *H. bovis.*
cc. Thoracic band of hairs brownish; media 3 rounded; tibiæ and tarsi yellow; femora black. *H. lineata.*

The President: We are pleased to have Professor Lochhead's paper in our Proceedings, because this is a group of insects which is gradually coming to the front more and more. It is very apparent that, both in the case of the Nose Flies attacking horses and in the case of the Warble Flies attacking cattle, these insects are becoming far more frequent. Our own correspondence files would display a somewhat similar series of letters as Professor Lochhead has read here, and the farmers who write to us about these things are very confident about their own observations and their own knowledge, as a rule. In regard to a brief note that Professor Lochhead mentioned about warble flies, I believe what he says is quite true, that we can trace the increasing prevalence of *Hypoderma bovis* in this country to the importation of cattle. In the old days the only species recognized in this country was *Hypoderma lineata,* which was considered to be a truly native species, but more recently, owing to the investigations of Dr. Hadwen in British Columbia and my own enquiries from the Branch here, we were able to show that *bovis* occurred in this country in addition to *lineata,* and further that *bovis* was pretty widely distributed, particularly in the Province of Quebec, and it is on this suspicion that Dr. Hadwen has based most of his very valuable investigations, but before passing on to this paper I think there are a number of points in Professor Lochhead's paper which might be discussed. We might discuss the two papers together.

Prof. Lochhead: Since the two papers deal with almost the same subject, I think it would be preferable to have the discussion on the two papers at the same time.

Dr. Hewitt: We shall now have Dr. Hadwen's paper entitled "Further Notes on the Warble Fly, *Hypoderma bovis.*"

Read by Mr. Treherne.

THE SEASONAL PREVALENCE OF *HYPODERMA BOVIS IN* 1915, TOGETHER WITH OBSERVATIONS ON THE TERRIFYING EFFECT *H. BOVIS* HAS UPON CATTLE, AND LESIONS PRODUCED BY THE LARVA.

Seymour Hadwen, D.V.Sci., Agassiz, B.C.

The observations and experiments on *H. bovis* which were conducted at Agassiz this year, are all preparatory to the work which is contemplated for next year, on the prevention of egg laying and destruction of larvæ.

A previous paper has been written on the seasoned prevalence of *H. lineatum.* It is remarkable that so little is known about the seasonal activity of these flies, and if any treatment is to be undertaken it is absolutely necessary to know when they come and go. As I have already pointed out, the statements made by the European writers about the length of the season, especially for *H. lineatum*, are very vague.

The following table gives a complete record of the observations. The cattle, ten in number, were kept in a field directly in front of my laboratory. The animals were under almost constant observation. Whenever they were seen running, either myself or assistant went out to look for flies. If flies were noticed in the morning, then no further trouble was taken for that day. It is of course possible that we may have failed to observe them on some occasion or other, but this seems hardly likely, seeing that *H. bovis* invariably causes alarm among cattle.

The most likely error made was in the catching of flies, but these were mainly caught when they were abundant. It may be that on one or two occasions the flies which were taken would have lived over night and attacked the cattle on the following day. The only dates on which this may have occurred was on June 15th and 22nd. The meteorological records were kindly supplied by Mr. Moore, Superintendent of the Experimental Farm. In comparing them with my records, I was delighted to find that the changes of temperature coincide almost perfectly with the appearance and disappearance of the flies.

THE SEASONAL PREVALENCE OF HYPODERMA BOVIS IN 1915.

June.	—	Sunshine. Hrs.	Sunshine. Min.	Rain. Inch.	Temperature, °F. Max.	Temperature, °F. Min.
1....	Cattle quiet, no flies................	5	42	.47	64	48
2....	" "	1	48	......	62	49
3....	" "	2	54	......	72	42
4....	" "	11	06	......	78	43
5....	Flies seen, cattle running............	11	54	......	82	50
6....	1 *H. bovis* taken.....................	7	24	......	81	52
7....	Cattle quiet, no flies................	2	00	......	65	47
8....	" "	Dull		0.8	64	46
9....	" "	1	18	......	64	51
10....	" "	5	30	......	59	45
11....	" "	......	18	.6	58	46
12....	" "	1	00	.35	64	51
13....	Flies seen, cattle running............	......	18	......	67	50
14....	1 *H. bovis* taken.....................	4	30	......	70	53
15....	Cattle quiet, no flies................	8	36	......	78	55
16....	" "	2	42	......	67	51
17....	" "	Dull		.65	64	50
18....	" "	......	54	.06	62	46
19....	" "	Dull		.05	64	47
20....	1 *H. bovis* taken.....................	5	54	......	67	45
21....	5 *H. bovis* taken.....................	11	48	......	81	43
22....	2 *H. bovis* taken.....................	11	42	......	82	43
23....	Cattle quiet, no flies................	1	06	.02	74	46
24....	Flies seen, cattle running............	3	24	.03	78	46
25....	" "	2	12	......	76	45
26....	Cattle quiet, no flies................	Dull		.05	70	47
27....	1 *H. bovis* taken.....................	3	42	......	76	46
28....	6 *H. bovis* taken.....................	9	24	......	80	43
29....	Flies seen, cattle running............	11	36	......	84	48
30....	2 *H. bovis* taken.....................	10	48	......	91	49
July.						
1....	Flies seen, cattle running............	11	36	......	93	56
2....	" "	11	42	......	89	55
3....	Cattle quiet, no flies................	11	18	......	84	56

THE SEASONAL PREVALENCE OF HYPODERMA BOVIS IN 1915.—*Continued.*

July.	—	Sunshine.		Rain.	Temperature, °F.	
		Hrs.	Min.	Inch.	Max.	Min.
4....	Flies seen, cattle running............	10	48	......	82	59
5....	" "	4	42	.03	77	52
6....	Cattle quiet, no flies................	1	42	.18	76	55
7....	Flies seen, cattle running............	9	18	.02	84	43
8....	Cattle quiet, no flies................	6	6	.25	70	44
9....	1 *H. bovis* taken....................	5	48	......	69	44
10....	Flies seen, cattle running............	6	00	......	71	42
11....	" "	......	36	.04	68	40
12....	Cattle quiet, no flies................	2	30	.16	70	43
13....	" "	Dull		.08	69	41
14....	" "	Dull		.02	68	42
15....	" "	Dull		.58	64	40
16....	Flies seen, cattle running............	2	12	......	66	47
17....	" "	5	18	......	70	46
18....	Cattle quiet, no flies................	6	00	......	79	34
19....	" "	11	06	......	88	42
20....	Flies seen, cattle running............	11	54	......	95	56
21....	Cattle quiet, no flies................	11	36	......	84	50
22....	Flies seen, cattle running............	11	30	......	78	49
23....	Cattle quiet, no flies................	11	10	......	81	46
24....	" "	10	54	......	86	48
25....	1 *H. bovis* taken....................	10	06	......	76	49
26....	Cattle quiet, no flies................	Dull		......	70	49
27....	" "	......	36	.05	71	56
28....	" "	......	30	.02	72	58
29....	Flies seen, cattle running............	2	42	......	77	58
30....	" "	5	30	.08	75	56
31....	Cattle quiet, no flies................	5	00	......	72	55
Aug.						
1....	Cattle quiet, no flies................	7	08	......	78	52
2....	" "	6	08	......	76	50

No more flies seen for the rest of the season, nor were the cattle seen running.

SEASONAL ACTIVITY OF H. BOVIS AT AGASSIZ.

In 1912, *H. bovis* was first noticed on June 8th, and the last appearance was on Aug. 2nd, a total of 55 days.

In 1914, *H. bovis* appeared on May 31st, and none were recorded after July 27th. On this latter date, the flies were seen attacking the cattle at 6.30 p.m. Total 57 days.

In 1915, the flies were either seen or caught on 28 days, from June 5th to July 30th, a total of 55 days. The height of the season was from June 20th to July 11th.

These observations coincide closely with the pupal period and with the time the last larvæ emerge from the backs of cattle; both at Agassiz and in Europe.

EMERGENCE OF LARVÆ.

Carpenter (1915) says that most of the maggots emerged from May 27th to June 17th, "while a belated one occurred several weeks afterwards on July 3rd."

In my own article (1912) I recorded the last larvæ of the season on July 2nd.

Lucet (1914) says, "Sur 79 que j'ai recueillies, 24 l'ont été du 16 au 31 mai; 53 du 1er au 30 juin; 2 au début de juillet, époque a laquelle mes sujets d'experience en furent débarrassés."

Pupal Period for H. bovis.

Miss Ormerod (1900) puts the pupal period at 25-36 days = 32.5 days.

Carpenter (1908) at 31-32 days. (1914, about 8 weeks. Not included in average).

Hadwen (1912) at 34.7 days.

Glaser (1913) gives an average of 44 days.

Lucet (1914) records an average of 32.5 days.

Averaging all these records gives a result of 35 days.

If then, the last larvæ emerge about the first of July, the season for flies cannot extend far into August, and my records show this to be the case.

The Effect of Temperature on the Pupal Period.

I have already shown (1914) that if the pupæ of *H. lineatum* are placed in an incubator that the fly will emerge in as short a period as 13 days. This year I placed several larvæ of *H. bovis* in an incubator kept at 80°F. The pupal period was shortened to 17.4 days.

Pupæ Kept in Incubator at 80°F.

							Period.
2 larvae pupated	May 1st......	Emerged	1*	1†	May	19th........	19 days.
3 "	"	3rd	"	3	"	20th........	17 "
1 "	"	4th	"	1	"	20th........	16 "
1 "	"	5th	"	1	"	21st........	16 "
2 "	"	6th	"	1	"	22nd........	18

As the temperature at which the pupa is kept causes early or late emergence, the situation in which the larva finds itself on leaving its host will make some difference also. An experiment I hope to carry out next spring is to place some pupæ in a situation such as the edge of a manure-pile; here the larvæ would derive heat much in the same way as if placed in an incubator. Others must find crevices in the floors of stables, etc., where they would be warmer than out of doors. These warm situations would mainly favor *H. lineatum* and the early larvæ of *H. bovis*. Later in the season, when the sun is stronger in June and July, I do not think the places the larvæ choose to pupate in can matter so much. But early in the year it is quite possible that some of the early appearances of *H. lineatum* may be accounted for in this way.

An Experiment made to prove how *H. bovis* engenders Fear in Cattle.

July 1st, 3 p.m. Two calves which had been kept inside since they were born, were turned out into a small paddock. The cattle which had previously occupied the paddock, had just been put into the stable, and the flies had been chasing them a few minutes before. The two calves on being liberated at once began to caper about and run as calves will after they have been confined. Finally they came to a halt just in front of me. They stood there panting. A moment or two later I saw a single *H. bovis* attack one of the calves. It struck several times before it was noticed. Finally I saw the calf give a kick or two, then it turned its head round to see what was annoying it. There were some more kicks and stamps, then the calf began to move away, its tail went up and it began to run and finally to gallop. The other calf remained standing for a short time

* Male. † Female.

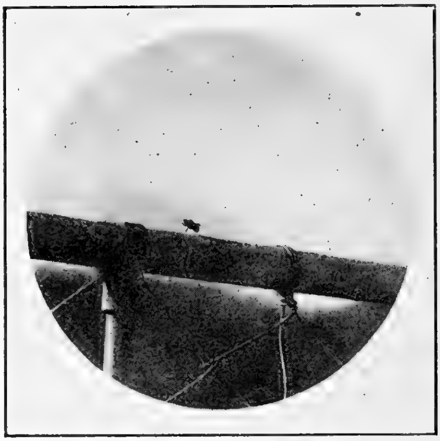
after the first one left, but soon went through the same antics as the first. Both calves ran erratically about the paddock; they finally discovered a barrel used for watering the cattle; they both tried to get into it at once, and I was fortunate in securing a photograph of them in this position.

The flies (there were, I should judge, three or four in the field) kept on striking even when they were in the barrel. Later the calves found a corner behind some boards, there they lay perfectly quiet with their noses stretched out straight in front of them on the ground. Occasionally a fly would find them, they could stand the fly striking perhaps half a dozen times, but then, suddenly, they would get up and run as if possessed.

I have noticed the cows endeavoring to hide from the flies just in the same way. If they could find the least bit of shade along a fence or building, they would lie there quite motionless, until roused by the repeated attacks of the fly. In some cases cattle lie down also from exhaustion.

This experiment was also witnessed by Mr. Moore.

Calves attacked by *Hypoderma bovis* trying to get into a barrel of water.



***Hypoderma bovis* sitting on fence, waiting to attack cattle.**

In my first paper of 1912, I gave my reasons for cattle being afraid of *H. bovis*. I quote the following: "It is this clumsy, persistent attack which I believe frightens cattle, and I would suggest that probably it is this cause which makes cattle stampede or 'gad.' When the *Tabanidæ* (or other flies) attack an animal and cause annoyance, the cow simply flicks her tail or brushes off the fly with her tongue, and feels that she has control or can get away from the insect. But a Warble fly comes buzzing along, strikes a time or two, and when the animal it is attacking kicks or stamps, it comes back just the same. Then the animal begins to lose its head and runs away, and when it still finds itself followed becomes wild with terror."

There have been so many false theories advanced for the fear which these flies engender, that I feel licensed to go fully into this question.

The commonest theory is that cattle are afraid of the fly because of its resemblance to a bee. The experiment just quoted refutes this entirely, because the calves had never seen a bee. Another idea is that cattle fear the fly because they are aware that it will cause them future trouble. This idea must have come from someone who thought that cattle were endowed with especial intelligence.

The only theory which all entomologists now agree upon is that the old idea of the fly causing pain is wrong, seeing that it has no organs capable of piercing the skin. Some authors claim that other insects as well as Warble flies cause cattle to "gad."

This is also entirely wrong, and can be refuted in several ways. For instance, I saw *Tabanidæ* and other flies worrying the cattle this year long after the last Warble fly had left, and did not see any of them stampeding. Besides as I have pointed out cattle only run one or two at a time from other insects. They merely show anger and not fear, when they run into the bushes or dust themselves. With *H. bovis* the fear is undoubtedly contagious. The only time I think it is permissible to make a mistake, is when cattle are at play, when they often run with their tails up. Or when, for instance, a steer has been roughly handled and dashes wildly into the middle of a herd of cattle, then one sometimes sees a stampede. In other words if a cow gets really frightened from any cause and runs, then those near her will often follow, and the fear spreads. This is exactly what takes place when an animal is chased by *H. bovis*.

The great difference between *H. bovis* and *H. lineatum* is in their effect upon cattle and in their methods of oviposition. I have shown that *H. lineatum* may not even be felt when it lays its eggs while resting on an animal's foot or on the ground. When it does grasp the hairs to lay eggs for instance on the hock, it does so gently, otherwise it would be brushed off before it had time to lay several eggs on the same hair.

H. bovis is rougher and clumsier in its attack and as it only lays one egg at a time, it can do so regardless of the fact that the animal may be kicking or running.

THE PENETRATION OF THE SKIN, AND THE LESIONS PRODUCED BY THE LARVA OF *Hypoderma bovis*.

Hewitt (1914) saw three larvæ of *H. bovis* work their way into the skin of a calf. I have not been fortunate in seeing the penetration of the skin by these larvæ, but can confirm Hewitt's observation in another way, by showing lesions on the skin of cattle, over which were found the eggs of *H. bovis*.

I have already described the skin lesions produced by the larvæ of *H. lineatum*, and of the disease caused by them, for which the name of *hypodermal rash* was proposed. The penetration of the larvæ was proved in three different ways—by removing bits of skin from cattle and placing larvæ upon them, by finding a larva in the act of passing into the skin of a cow, and finally by expressing two larvæ from the skin of an animal which I had under observation. The passage of the larva in *H. bovis* was proved by cutting circles in the hair round new laid eggs, and later, after the eggs had hatched finding the swellings underneath.

The swellings are somewhat different from those caused by *H. lineatum*. There is not so much exudation of serum, and they seem rounder and more raised. They are usually about half an inch across, but if several eggs are laid close together the swellings may merge. The explanation of the difference in the character of these lesions, is because in *H. bovis* the eggs are laid singly. In *H. lineatum* it is most likely that several larvæ choose the same follicle for entrance, seeing that a number of eggs are attached to the same hair. In my experiments I also noted that the eggs nearest the skin hatched first, due no doubt to the animal heat and to their having been laid first, and it would appear probable that the larvæ follow one another through the same opening. The result would be a larger opening than the single larva of *H. bovis* could make, consequently a bigger flow of serum. The swellings in the case of *H. bovis* are sometimes quite large, but there is not so much dermatitis or exfoliation of the skin.

It is clear that the amount of damage done would depend on the variety of bacteria introduced beneath the skin, and to the resistance of the animal against the particular organism.

One remarkable fact I have noted which applies to both species of larvæ, is that the swellings and skin lesions are confined almost entirely to the older animals, the calves only show slight effects. This peculiarity can be observed in several

Lesions on outside of cow's leg.

Lesions on hindquarters; note large swelling on left leg behind the udder.

microbial diseases. It is a sort of natural immunity which breaks down as they grow older, and is all the more interesting because young cattle are more parasitized than the old by Warble flies.

No appreciable lesions have been noticed below the knee or hock. The skin while it is very thick on the legs, is quite porous and open; perhaps owing to its tightness and thickness the swellings are not so evident. *H. bovis* does not lay as many eggs round the hoof as *H. lineatum.* This is an important difference, for it is probable that many of the lamenesses resulting from swollen feet are due to the larval penetration. For three years in succession, lamenesses among the cattle have occurred here during the season for *H. lineatum.*

Situations in Which Eggs are Laid.

There is little to add to my previous descriptions, except to emphasize the irregular distribution of eggs as compared to *H. lineatum.* The photographs show the scattered lesions. The irregularity must be due to the fact that cattle are running when the fly is laying, so that the eggs are deposited at random. On a number of occasions *H. bovis* was seen flying beside the animals just about level with the stifle joint, striking repeatedly at the outside of the leg. This is, I find, the most common manner of ovipositing during rapid flight. Another favorite way is to follow a foot or two behind, then catching up and striking just below the pin bones. But the first few strikes prior to the animals getting away are almost invariably on the legs, lower down.

Summary.

The seasonal activity of *H. bovis* at Agassiz is from the beginning of June to the beginning of August.

The last larvæ to emerge from the backs of cattle, leave during the first days of July.

In *H. bovis* the pupal period averages thirty-five days.

High temperatures shorten the pupal period.

The fear cattle have for *H. bovis* is due to the insect's persistence and manner of egg-laying.

Hewitt's observations on the penetration of the skin by the larvæ of *H. bovis* are confirmed.

The lesions caused by the larvæ, differ from those of *H. lineatum.* Older animals show more lesions than the young.

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Note.—I am indebted to Dr. F. Torrance, Veterinary Director-General, for permission to publish this article.

The President: Mr. Treherne is to be congratulated on the excellent manner in which he has presented another man's piece of work. It is very difficult to present in so intimate a manner the work which another man has been responsible for, but it shows how closely Mr. Treherne has watched and been interested in the work of Dr. Hadwen. I think it is one of the most important papers that has been discussed at this meeting. The question of the method of entrance of *Hypoderma bovis* has been a disputed point for many years and we have had observations and evidence supporting now one view and now another, but in view of Dr. Hadwen's conclusive experiments, which have been supported by photographs, I think he has cleared up this question. We are pleased to have with us this morning Dr. T. Torrance, the Veterinary Director General of the Health of Animals Branch, Department of Agriculture, and perhaps he would have something to say in connection with these two papers.

Dr. Torrance: Mr. President, ladies and gentlemen, it affords me very great pleasure to be with you to-day, especially as one of our men has contributed something towards the programme. The work which Dr. Hadwen has done is very much appreciated by his chief, and I think, will be appreciated by all when it is better known. He has proved a very diligent and careful investigator, and I think the facts which he has brought out will bear the closest scrutiny. He has succeeded in throwing light upon a very difficult problem, the problem of the migration of newly hatched warble larvæ to their final resting place beneath the skin of the back. The importance of this work will be realized when I tell you that in Canada the leather produced is damaged to the extent of perhaps 70 per cent. by the presence of this larva. After the larva has escaped from the back the scar tissue which repairs the damage causes that portion of the leather to be unsuitable for the manufacture of the better grades of harness. You are, perhaps, aware that in making harness, especially traces, it is necessary to take long strips of the thickest leather from along the back. This is the part that is chiefly damaged by the warble flies, so that the best portion of these hides is unsuitable for the manufacture of harness. In correspondence with practically all the tanners of Canada referring to the damage done by this parasite, the opinion was expressed that it was the greatest source of injury to the leather that they knew of. There were not many other things that caused the same amount of damage. The injury caused by barbed wire fences, warts, etc., was trivial when compared with the damage caused by this warble fly. It is only by the close study of the life-habits of a parasite that we can arrive at the best possible means of combating it and we hope that the result of this work of Dr. Hadwen's will be some practical method whereby the damage caused by this insect can be avoided. I was greatly interested, too, in the paper read by Professor Lochhead, in the damage he describes in horses, as we have had practical experience with the effects of these parasites on horses. The more common is the one to which he did not refer, the *Gastrophilus equi*, an extremely common parasite of horses. In my experience covering thirty years of active practice I may say that I have seldom found a horse not infested. Every horse that passes a portion of its life in the open is sure to contain these parasites. In cities horses may possibly avoid them but it is very common to find them in a horse's stomach. Among farmers the presence of bot larvæ in a horse's stomach is looked upon as the cause of the horse's death in very many cases, but when we find them in horses that have died from any cause we may realize that the presence of a moderate number of these parasites may be tolerated without injury to the animal's health. On the other hand, we know that where they are present in very large numbers they affect the function of the stomach to such an extent that many derangements may take place, such as ulceration of the walls of the organ. These larvæ are harmless when in small numbers but in large numbers cause much trouble and sometimes death. The Nose Bot Fly, which give so much trouble to the farmer in the North-west when he is hitching up his horses, does not cause so much trouble; it is not nearly so harmful to the horses and we have very few examples of its doing much injury, the annoyance it gives is about all the harm it does. Why the ovipositing of these two flies, the Bot Fly of the horse and the Bot Fly of the cow, should occasion such intense fear in the victim I do not know. We are assured by scientists that neither of these flies have any stinging apparatus and yet the animal affected shows every evidence that the fly must inflict much pain. I cannot imagine that the depositing of the eggs upon a hair would give so much discomfort to the animal. I think we will have to search a little further, probably, and gain more experience before we learn the actual cause of the terror in cattle and horses caused by the Bot and Nose Flies. The contributions that have been made on this subject to-day are of great importance and I wish to express the feeling of pleasure that I have in meeting you all to-day and to assure you that my Branch will assist Dr. Hadwen in carrying on the work he is now engaged in.

THE PRESIDENT: The Society is very much indebted to Dr. Torrance for his valuable contribution and for the information which he has given from the veterinary side.

DR. TORRANCE: Mr. President, I have brought up with me some specimens and pictures which Dr. Hadwen sent me.

THE PRESIDENT: The question of the effects of internal parasites which Dr. Torrance brought up is one which has been always of great interest to me, and it becoming more generally realized that the importance of these parasites is not so much because they are present but owing to the fact that their presence may be responsible for the penetration of the mucous membrane of the alimentary tract. Now these two papers have a number of important points and I have no doubt there are other members who would wish to discuss them.

MR. TOTHILL: Mr. Chairman, this paper to me is one of the most interesting that has been presented for some years on account of its extremely interesting biological points and on account of its significance. It may be interesting to recall that the origin of the Oestridæ is quite uncertain, but at the same time they are undoubtedly related to the parasitic dipterous families Tachinidæ and Dexiidæ. In my studies on life-histories of the Tachinidæ some years ago it became evident that there was something the matter with the supposed life-history of the Bot Fly. In the Tachinidæ there are flies which deposit eggs which are taken into the alimentary canal. The larvæ migrate from the alimentary canal to various tissues of the host. In every known case in which this habit obtains the egg is modified for passing down the alimentary canal without injury. In the eggs of these warble flies it is evident that there is no such modification for such a habit and this work of Dr. Hadwen's clearly shows that the larvæ do not pass through the alimentary canal, is very interesting.

MR. SANDERS: In regard to the date of introduction of *Hypoderma bovis* into Canada, we have a pretty fair idea as to when it first became common in Nova Scotia owing to the fact that oxen are worked so much more down there than in the rest of Canada. Farmers will tell you that the Gad Fly became a nuisance in Nova Scotia about fifteen years ago. It causes a little damage that has not been mentioned in these papers, that is, the damage that the oxen do when they are attacked by these insects. It drives the oxen almost frantic; appearing about the 10th July and attacking the oxen all through haying time. Sometimes they will be driven so wild as to run away with the loaded hay waggons, and often will break wheels, axles, tongues or yokes in their efforts to get away from the insects. We find that cattle are mostly attacked in the open, and when a Gad Fly appears in a herd of cattle they will at once take to the bush where they seem to be free from attack. From Dr. Hadwen's work, can Mr. Treherne suggest any method of control?

MR. TREHERNE: I don't think it would be letting Dr. Hadwen's secrets out if I told you that he is pretty well satisfied he can effectively control these flies. Now that the penetration takes place through the skin, he thinks he can dip every ten days or so and give the larvæ a dose of arsenic.

Dr. Torrance: Might I be allowed to say another word in connection with the last fact brought out by Mr. Treherne. There is a portion of the North-west territories in which the disease known as Mange of cattle has been in existence for some time. This is known as the "Mange Quarantine Area," in which we require the dipping of all cattle. It has been found that in this area it has also had the effect of lessening the ravages of the warbles. The skins of the cattle in this district are more free from warbles than they are anywhere else.

Dr. Fernald: It certainly seems that the two papers here this morning have contributed much of interest to this subject. I am very glad, indeed, that I can now change a statement made to my junior students that the eggs of the warble fly are licked off into the mouth, and give something that is more accurate. I have thought for many years that there was room for more work on this subject, but certainly in the regions where I am now living these flies are not abundant enough to cause much attention and the opportunities for their study have been few. In connection with Professor Lochhead's paper, the attitude some of his correspondents have taken has been paralleled by an experience of my own. A case was recorded this fall of a house having been so infested by fleas that it was impossible to live in it. The members of the family were very anxious to know what could be done. I naturally, under the circumstances, gave out the remedy for fleas. When the specimens came in accompanied by the statement that it was unbearable to live in the house on account of the bites of these fleas, the specimens were those of the Pomace Fly.

Mr. Payne: I understand, Mr. Treherne, that Dr. Hadwen has found in the migration of the second stage larvæ that they pass down the spinal cord, is there anything in that?

Mr. Treherne: As far as I understand, Mr. Payne, the eggs, if laid on the knee, for instance, hatch and the larva passes up by the fibrous tissue route until it reaches the stomach, and after stopping there for some time it proceeds in a direct line to the back of the animal, emerging, however, horizontally in the last stage.

Mr. Petch: *Hypoderma bovis* in the counties of Huntingdon and Chateauguay has proven to be a very injurious insect, and as these two counties are practically a dairying district, I would like to know if Dr. Hadwen has found any appreciable effect on the milk supply.

Mr. Treherne: The irritation produced by larvæ within the bodies of cattle does not seem to affect the milk supply to any great degree, but the presence of the fly in the pasture field and its terrifying effect, may easily be understood to affect milk yields.

The President: The only damage caused, Mr. Petch, seems to be that the cattle are bothered while feeding.

Prof. Lochhead: There is a suggestion in connection with one of the letters which I received and which, I think, this Society could take up, that is, the removal of the warbles before spring from the backs of the cattle. If all the farmers co-operated and removed the warbles before the first of April I think it would soon control this warble fly and, at any rate, it would be worth while trying. I would like to hear what the Society thinks of such a move.

The President: As Professor Lochhead no doubt knows, that system has been followed in Europe, especially Germany and Denmark. It is customary to appoint a man to go around extracting the warbles, making a small charge per head and it certainly accomplishes much good, and I recommended in my annual report a few years ago the importance of such co-operation. This could be helped along very much by the use of the press.

If there is no more discussion on these two papers we will pass on to the next paper on "Forest Insect Investigations in Canada." I regret to say that Mr. Swaine, who was to have read this paper, has been suffering very severely from grippe during the past week or so, and while he hopes to be at the meeting this afternoon he did not feel sufficiently well to give his address this morning, so we will postpone the paper until this afternoon. Therefore, I will take this opportunity of making a few brief remarks in regard to the progress of our work.

PROGRESS OF ENTOMOLOGY IN CANADA DURING 1915.

C. Gordon Hewitt, Dominion Entomologist, Ottawa.

As I remarked in opening our meetings yesterday I do not consider that it is necessary or even desirable for the President to give a presidential address on re-election, apart from the fact that we have a very full programme. Nevertheless, it may be of interest to review the progress of our work in Canada during the past year, especially as we have a number of visitors from other countries. As you may remember, the Minister of Agriculture arranged for a campaign to be carried out shortly after the outbreak of war for the purpose of securing greater production and in this work the Provincial Governments co-operated fully. That this campaign has proved successful is shown by the fact that the other day the Minister of Finance, in Montreal, said that on a conservative estimate our agricultural products would exceed those of last year by three hundred million dollars; such a result at the present time when the question of food supply is a vital one is very encouraging. As entomologists we have played our part in this successful effort to increase our production. Everyone realizes that increased agricultural production is dependent very frequently on the control of insect pests. One of the most important steps to be taken in order to secure production is to reduce or eliminate those factors which check or reduce production; of these factors insect pests are one of the most important. For this reason we have all endeavoured to exert ourselves harder than ever during the past year with a view to persuading the farmers and fruit growers to take steps in an increasing measure to control those factors which are responsible for loss of production.

I feel sure that those of our officers who have been working at the Branch Laboratories in the various provinces will feel that their work has been very successful in this direction. In Nova Scotia, the energetic work that has been carried on so successfully by Mr. Sanders has done more than anything else, so I am informed by the fruit growers of that province, to increase spraying and spraying along successful lines in the Annapolis Valley. This means more fruit and fruit of a better grade.

Mr. Petch has been carrying out similar educational work in Hemmingford County in Quebec, with good results, and has shown the value of insect control in the production of more fruit and fruit of a higher grade.

Our work on Locust Control in the Province of Quebec will be described by Mr. Gibson this afternoon. The depredations of locusts in certain parts of the Province of Quebec have been serious and extreme during the last few years. In some sections farmers had to abandon their farms on account of the repeated total destruction of their crops by locusts, and the number of abandoned farms in some parishes caused serious apprehension. We have been carrying on experiments in the control of locusts by means of poisoned baits and decided to carry on the work on a larger scale during the past season. In certain parishes we were fortunate in having the co-operation of the parish priests, who were of great assistance in bringing about co-operative effort on the part of the farmers. We have been able to demonstrate to those farmers the value of poisoned baits and the change that has been wrought is most satisfactory. Serious losses year after year had disheartened these farmers to the extent in many cases of compelling them to abandon their farms as I have remarked. Now they have found the means of controlling the locusts at a comparatively low cost and of saving their crops, and the saving in the aggregate has been very great during the past season. The farmers have not only returned to their farms, but those who had remained, although disheartened, now see a brighter prospect and will improve their farms on account of the possibility of removing the cause of the depression.

Mr. Strickland described to us yesterday his work on the control of Cutworms in Alberta, and I do not think that this subject requires further discussion on my part. He described very clearly how by his investigations and demonstrations to the farmers he was able to prevent serious losses which otherwise would have occurred in Southern Alberta.

I have only mentioned a few cases. In such manner our work has been of direct assistance in the movement for increased production. Similar work has been carried out at all our field laboratories and from headquarters, and each of the Provincial Departments of Agriculture who maintain an entomological staff has been increasing the activity in their efforts.

This increased assistance has created a greater demand for such assistance and we are now finding that as the farmers and fruit-growers realize that this work has been done for their direct benefit there is an increased call for assistance. It is the creation of that demand which will enable us to carry out to a greater degree the objects we are striving to obtain, namely: to bring ourselves in touch with a larger number of people whom we are able to assist by the information we are securing. All must feel that we are making the best use of our abilities in this time of great crisis.

During the past year we have discovered several new pests in Canada. Probably the most important of these is the Pear Thrips, *Tæniothrips pyri,* which Mr. Treherne reported from the Victoria district on Vancouver Island, British Columbia. The serious nature of this pest will be realized from the fact that in California it is estimated to cause an annual loss of about ten million dollars on prunes alone. At present it appears to be confined to a very small territory near Victoria, but we fear its spread to other sections. Mr. Treherne also reported the occurrence of the Currant Bud Moth, *Eriophyes ribis,* at Duncans on Vancouver Island in British Columbia. This pest has evidently been imported from Great Britain, where it is one of the worst pests of black currants occurring there, as I know from personal experience. Every step will be taken to prevent the spread of these two new and serious fruit pests.

We referred, in our session yesterday morning, to the increased organization of entomology which had taken place in Canada and I spoke of the formation of the Entomological Society of Nova Scotia, for the organization of which great credit is due to Professor Brittain. Before the outbreak of war the Council of your Society had under consideration the improvement of the organization of

Entomological Societies throughout Canada. We hoped to develop other branches and bring together a large number of people interested in entomology who are at present unattached to any society and in turn to bring them into touch with the active workers; but as this question involves financial consideration it must necessarily be postponed. Nevertheless, the Society has every reason to be proud of the manner in which entomology is now organized throughout the Dominion and the increased attention that is being paid to this study. Throughout the country we are finding more and more people who are becoming interested in the subject and in time we will endeavor to create a sentiment which will be productive of pleasure to themselves and of value to us in our practical work.

You will be pleased to learn that increased facilities have been provided for the work of the Entomological Branch during the past year and I think it will be of interest to all the members of the Society if I describe the new laboratories that have been erected during the past year.

The pressing need for increased accommodation for the entomological work that is being carried on in various provinces by the Field Officers of the Entomological Branch, and a demand on the part of farmers and fruit-growers for further assistance in controlling insect pests, have been responsible for a decision on the part of the Minister of Agriculture, to have entomological laboratories erected where they were most necessary. Accordingly four new laboratories have been built during the past summer at the following places: Annapolis Royal, N.S.; Fredericton, N.B.; Treesbank, Man.; and Lethbridge, Alta. These laboratories I will briefly describe.

Entomological Laboratory, Annapolis Royal, N.S.

Since 1912 a small laboratory at Bridgetown, N.S., served as headquarters for the entomological work of the Branch in Nova Scotia. The increase of the work and of the staff employed necessitated increased accommodation. Annapolis Royal was selected as the place for the new laboratory on account of its situation in reference to the area of the Brown-tail Moth infestation, convenient railroad facilities and the presence of a promising fruit-growing district in which the orchards were not at present properly cared for. The laboratory is erected on an excellent site on the County School Grounds which the School Board of Annapolis Royal have kindly provided.

The building measures twenty-six feet square and consists of basement, ground floor and attic. In the roomy basement accommodation is provided for field and spraying equipment; it also contains a dark-room and laboratory. The ground floor is divided into three rooms, namely, an office for the Field Officer in charge, a large laboratory and a general work room. The commodious attic is specially well-lighted to serve as a photographic room and work room. Steam heating is installed.

From this laboratory the campaign in Nova Scotia against the Brown-tail Moth is directed. In addition, investigations are being carried out by Mr. G. E. Sanders, Field Officer in charge, on the more important insects affecting fruit* such as the bud-moth and fruit-worms of apples. Experimental work in spraying and the investigation of insecticides has already rendered very valuable assistance to the fruit-growers of the province. The former entomological station at Bridgetown will be used as a sub-station whenever it may be most needed.

*To prevent duplication of work and to secure the best co-operation, the Dominion Field Officer confines his attention to the biting insects and the Provincial Entomologist, Prof. Brittain, studies the sucking insects (aphides and bugs).

Entomological Laboratory at Fredericton, N.B.

In 1912, a small laboratory was established at Fredericton, N.B., in connection with the Brown-tail Moth and other work in New Brunswick. The University of New Brunswick provided a site on the University campus. The increase in the infested area, and the large amount of work consequent upon our efforts to establish the parasites of the Gipsy and Brown-tail Moths imported from the New England States and the carrying on of an extensive study of the natural control of certain native insects such as the Tent Caterpillars, the Spruce Bud-worm and Fall Web-worm, rendered an increase in the laboratory accommodation immediately necessary; the University had kindly permitted us to use one of their large laboratories during the summer.

The building is of solid brick construction and measures twenty-four feet by thirty feet. It consists of basement, ground floor, first floor and attic. The basement contains the water supply for the building, comprising a well, tank, and electrically driven pump, and provides storage room for field equipment and supplies. The ground floor contains at the front offices for the two officers in charge of the work; Mr. J. D. Tothill has charge of the colonization and study of the parasitic insects and Mr. L. S. McLaine has charge of the field work against the Brown-tail Moth and the collection of parasites in the New England States; at the back is a work room. On the first floor a large laboratory occupies the front half of the building and behind a specially lighted room is provided for photographic and other work; a dark room and bath room are also provided on this floor. The high pitched roof furnishes a roomy attic for storage purposes. Steam-heating and electric light have been installed. The building is well situated on the University campus on a site which the University authorities have generously provided.

The work that is carried on at this laboratory comprises some of the most important investigations that the Branch is prosecuting on the natural control of insect pests. The thoroughness with which the Brown-tail Moth campaign is carried on is evidenced by the fact that by taking the necessary measures from the time of the discovery of the first infestation, it has been possible in New Brunswick to prevent this insect from becoming established in the Province; whereas it is established in Nova Scotia owing to a lapse of some time before the infestation was discovered in 1907 and eradicative measures were begun.

The small laboratory will be used as a sub-station in another part of the Province.

Entomological Laboratory at Treesbank, Man.

Mr. Norman Criddle was appointed in 1913 to carry on investigations on White Grubs (*Lachnosterna*) and other cereal pests in Manitoba and adjoining territory. As the temporary quarters he occupied did not afford adequate accommodation for his work a small wooden laboratory measuring twelve feet by sixteen feet has been erected during the past summer on a site kindly provided by Mr. Percy Criddle on his farm where excellent facilities occur for field and experimental work.

Entomological Laboratory at Lethbridge, Alta.

Investigations on insect and other pests in Southern Alberta were commenced in 1913 by Mr. E. H. Strickland, Field Officer for Alberta, who was provided with temporary laboratory accommodation at the Dominion Experimental Farm at Lethbridge, Alta. During the past summer a permanent laboratory was built on the Experimental Farm.

The building measures twenty-three feet by twenty feet and contains four rooms, namely: office, laboratory, spare room and dark room. By arrangement the Director of the Experimental Farms and the Superintendent of the Farm have kindly furnished for experimental purposes a small plot of ground adjoining the laboratory.

I will not take up more of your time with any rambling remarks of mine; but before closing I should like again to express to our visitors our gratitude to them for coming so far to take part in our proceedings, their presence and contributions to the programme and the discussions are a source of great encouragement to us and I think they will admit that though our numbers are not large the character of the work that has been described is of the highest nature judged by any standard, and that our enthusiasm could not be excelled.

THE LIFE HISTORY OF *CHERMES COOLEYI* GILLETTE IN STANLEY PARK, VANCOUVER, B.C.

R. N. Chrystal, Field Officer for Forest Insects, Entomological Branch, Department of Agriculture, Ottawa.

As a result of an enquiry into the serious injury done to the Sitka Spruce in Stanley Park, Vancouver, B.C., by the attacks of the above species of gall-making insects of the Genus Chermes, the following notes of its life history and habits in that region are presented. This species was named and described by Professor Gillette, Fort Collins, Colorado, in his paper, "Chermes of Colorado Conifers," Proc. Acad. Nat. Sci. Philadelphia, Jan., 1907; its life cycle also being discussed. The following account in a large measure confirms the results given in the above paper, differing only in the species of spruce attacked, and some minor details.

The hibernating stem mother on the Spruce, is oval in outline, flat, .5 to .7 mm. in length, .3 mm. in width, dark brown to black in colour, with a slight fringe of white waxy threads along the edges of the body, and down the middle of the back. The body of the louse is closely appressed to the twig, and the setæ are deeply sunk in the crevices of the bark. The location on the twig varies, from immediately below the terminal bud to 3 inches down the stem.

During the first week of April, 1915, the stem mothers, having cast their winter coat, began oviposition on the spruce, the waxy secretion increasing to such an extent by this time, as to hide the dark coloured, and now much swollen body of the insect from view. Several hundred eggs may be laid by this Chermes, as many as 500 being counted in one egg mass; in cases where several stem mothers are located in close proximity to each other on the twig, the egg masses come together, and the waxy secretion becomes very conspicuous. The eggs are light brown in colour, lightly dusted with a whitish powder, each attached to the stem by a fine thread. They hatch in about 5 or 6 days, and the young, which are light reddish in colour, locate themselves at the inner bases of the young needles, then just breaking from the bud scales. A gall begins to form, and develops with great rapidity, the complete formation taking only a few days in some cases.

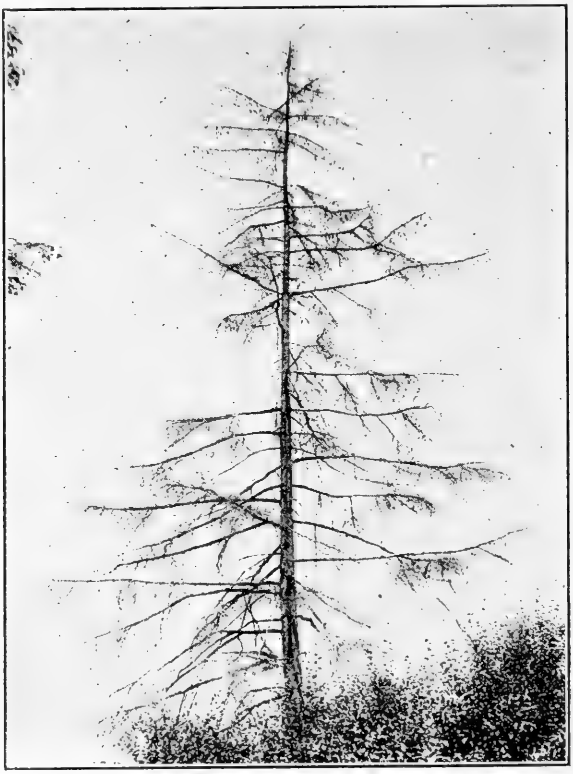
The Galls: The galls vary in length from ½ inch to 3 inches, the size apparently depending on the strength of the twig attacked. The following conditions may prevail:

(*a*) The whole twig may be completely galled.

(*b*) The twig may be galled on one side only, causing twisting and bending of the stem.

(*c*) Rarely, the upper part of the twig may be galled all round, and the lower part only half way round.

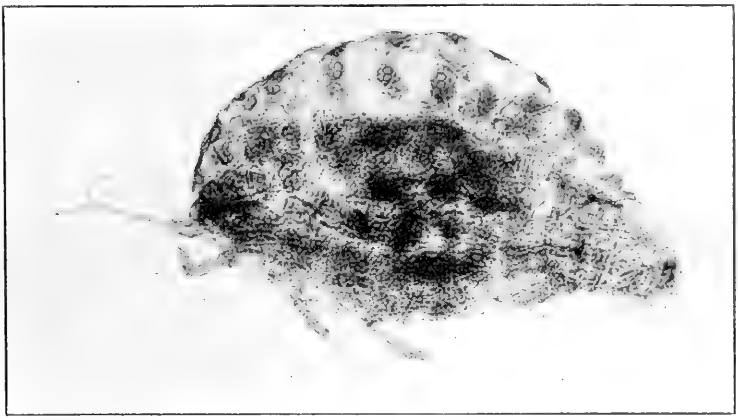
In Stanley Park the first condition was by far the most common, but it may be said, that even in cases where the twig was not completely galled, its ultimate destruction through weakness was, in nearly every case, assured. The number of



A Sitka spruce killed by chermes galls.

chambers varies from 40 to 200, the number of young in each chamber varying from 1 to 15, with an average of 5. The young are seen to be covered with a waxy coat, which, as Professor Gillette indicates, provides them with a very efficient protection against the superabundance of liquid excretion which they exude. If galls, which are nearly mature, be opened, cast skins of the young may be found filled with this liquid. These very remarkable objects are also mentioned by Professor Gillette in this connection. A few days before the galls begin to open the young inside change to pupæ, the rudiments of wings being readily seen. The earliest date recorded for the opening of the galls in Stanley Park during the summer of 1915, was June 25th. This is the earliest record for this locality so far, and doubtless a direct result of the unusual earliness of the past season, the previous year's (1914) date being about two weeks later.

When about to moult for the last time the pupæ crawl out of the gall chambers, and settle on a needle, the head facing the point of the needle. The pupa is reddish in colour with an outer coat of wax. This outer covering begins to split from the head down the middle of the back, the complete operation of moulting lasting some ten minutes. When the moult is completed the cast skin, a ghostly replica of its former occupant, is left hanging to the needle.



Details of wax glands, var. *coweni*.

Winged migrant to Douglas fir.

The newly emerged winged form has the antennæ and legs very light yellow, almost transparent; the eyes dark red and very conspicuous, the head, prothorax and abdomen rufous red, the mesothorax yellowish, streaked with red. The wings are crumpled up at first and dark green in colour, with the exception of the costal nerve, which is yellow. The green colour remains for some time after the wings are finally resting roofwise over the back of the insect.

The waxy excretion does not make its appearance in any quantity until some twenty-four hours after the winged form has emerged from its pupal covering.

MIGRATION. Experiments were carried out in Stanley Park two years ago with the object of confirming the former observations on the secondary host tree. Opening galls were placed in cages along with fresh branches of Sitka Spruce

Stem mother on Sitka spruce.

Experimental cage in Stanley Park.

(*P. sitchensis*), Douglas Fir (*Pseudotsuga mucronata*) and Western Hemlock (*Tsuga heterophylla*), these three trees being the only conifers within the precincts of the Park. The experiments showed beyond all doubt that the secondary host tree was the Douglas Fir; only a few lice locating on the spruce and hemlock, on which they apparently do not thrive; whereas they were found settling freely on the needles of the fir, as many as 7 being found on the same needle, 2 or 3 being a common number. A few figures of the cage experiments are given below:

	Nos. of Lice Settling on Each Tree.		
Cage.	Spruce.	Douglas Fir.	Hemlock.
1	0	221	0
2	1	672	5
3	15	216	0
4	0	275	2

No success attended the attempts to breed the specimens through on spruce and hemlock at this time. In the open, winged migrants were found locating on the Douglas fir, confirming the experimental results, but in no case was any winged migrant found on a spruce or hemlock in the open. Within a very short time of settling on the needle of the Douglas fir the winged migrant commences to oviposit, about 100-150 eggs being laid. These hatch in 6 to 7 days, and the young, which are elongate oval in shape, and almost black in colour, with only a trace of wax present, settle on the needles of the Douglas fir. There they remain motionless, without any apparent increase in size, through the rest of the summer, fall and winter of the year, until the following spring; when having moulted once, they commence oviposition as stem mothers on the needles of the Douglas fir, laying from 30 to 40 eggs, which hatch in numbers about the end of May and the beginning of June.

This life cycle was traced out for Stanley Park by observations on marked twigs of Douglas fir, through the summer, fall and winter of 1914-15. During

Stem mother on the Douglas fir.

the first half of May, 1915, this generation on the Douglas fir was observed to be dimorphic, about 50 per cent. of the lice developing wings and migrating back on to the Sitka spruce, while the rest remained like the parent on the fir.

The migration back to the Sitka spruce began about June 6. Experiments were started in this case as well as in the case of the former migration to the fir. to endeavour to determine for certain that the Sitka spruce was the return host. Young trees, of the three coniferous species, spruce, Douglas fir, and hemlock, were used, being enclosed in a cheesecloth cage. The fir was heavily infested with the Chermes and gave promise of good results. The numbers of migrants located was disappointing, but gave clear indications that the Sitka spruce was the chosen tree, the migrants found settling on the Sitka spruce in the cages were compared with winged migrants found settling on the spruce in the open and proved identical.

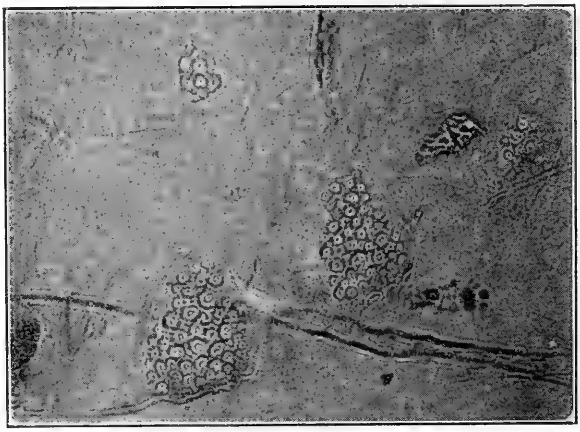
This form on the fir is Professor Gillette's *Chermes cooleyi* var. *coweni*. The apterous forms left behind on the needles of the fir, increase in size, and amount of wax secreted; lay a small number (30-40) of eggs, and the young on hatching take up their location on the needles of the spruce, there to remain until the following spring when they become stem mothers. The winged migrant to the spruce lays 30-40 eggs, and then dies, the eggs hatch in about a week and the young, which were kept under observation until the winter, remain on the needles, and probably, although this fact has not yet been actually followed in the case of Stanley Park, remain stationary until the following spring, when they become stem mothers for the new broods on the Sitka spruce.

Full descriptions of the various forms of this species and its variety *coweni* have already been published by Professor Gillette in the paper already cited; the writer would like to take this opportunity of acknowledging the assistance rendered by Professor Gillette in the identification of the material submitted to him.

A careful study has been made of the various forms, using Professor Gillette's published descriptions, and these have agreed in every case.

Mention may be made here of the principal differences between the various corresponding stages of the two forms on the fir and the spruce.

Chermes cooleyi Gillette.	*Chermes cooleyi* var. *coweni* Gillette.
Winged Migrant to Douglas Fir.	*Winged Migrant to Sitka Spruce.*
Antennal joints slender.	Antennal joints robust.
Antennal sensoria larger.	Antennal sensoria smaller.
Pores of wax glands small.	Pores of wax glands large.
Stem Mother on Spruce.	*Stem Mother on Douglas Fir.*
Wax glands large, with small pores.	Wax glands small, with large pores.
Beak long and slender.	Beak short and stout.



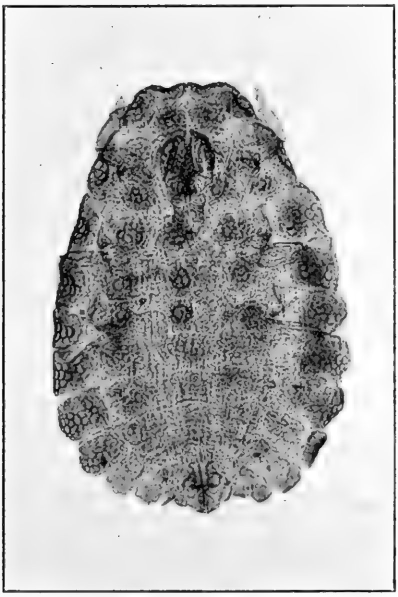
Winged migrant to spruce; details of wax glands.

DAMAGE TO THE SPRUCE. The damage done to the Sitka spruce in Stanley Park by this form has been very considerable, a large number of trees have been killed, whilst many others are in a dying condition and beyond hope of recovery. The fact that in most cases the whole of the young twig is destroyed makes the injury very much more serious.

THE DOUGLAS FIR. The damage done by the form *coweni* on the Douglas fir has never been particularly noticeable, no deleterious effect on the health of the fir in the Park having been noticed. Only in one case outside Stanley Park, in a garden where a Douglas fir and Sitka spruce were growing alongside each other, the spruce being very heavily galled, did the needles of the fir show effects of heavy infestation later on in the summer. The nature of the damage on the fir is to cause the needles to curl and bend at the points of attack.

NATURAL ENEMIES. Syrphus fly larvæ and coccinellid larvæ have been observed feeding upon the pupæ in the galls, but not in sufficiently large numbers to produce any appreciable effects.

THE PRESIDENT: We are very pleased to have this account of Mr. Chrystal's work from himself for the benefit of those who are here and who may know when I say that Stanley Park, in which Mr Chrystal is working, is one of our finest pieces of natural woodland in the whole Dominion, and is known to all foresters in Canada; but unfortunately, owing chiefly to the depredations of certain species of insects, its beauty is fast passing away. When I visited the Park last summer I was abhorred to find the enormous destruction which has been caused in a few years by various species upon which Mr. Chrystal has been working. They really are the reason of Mr. Chrystal's presence in Stanley Park. There are whole areas



Stem mother from Douglas fir.

Stem mother, from spruce.

of hemlock there which are absolutely dead, places which Mr. Chrystal has named "the graveyard." I had with me Mr. James White, the Assistant Chairman of the Commission of Conservation, and we were able to demonstrate to him the enormous destruction of these trees by insect pests. I fear the time has nearly come when Stanley Park may no longer be considered Canada's most beautiful natural park. This paper is now open for discussion and perhaps Mr. Macoun, the Dominion Horticulturist, who is with us this morning, might have some remarks to make in regard to this paper.

MR. MACOUN: I am afraid I have not much to add to what you have said, Dr. Hewitt. Stanley Park is one of the sights of Canada and certainly everything possible should be done to preserve it.

PROF. CAESAR: I would like to ask if this species is native to North America and also whether Mr. Chrystal has yet in mind any plan of a practical means of control.

Mr. Chrystal: Prof. Gillette states in his paper that on seeing the species of *cooleyi* he described it as a new species and said that this species was confined to the Rocky Mountain region. The state of the spruce in the Park was very bad; on careful examination about 60 per cent. were found to be beyond hope of control, but the rest could be sprayed, even to a considerable height.

Prof. Caesar: It is quite an interesting matter of observation at Guelph to note that *Chermes abietis* and *Chermes similis* have, the last few years, been almost totally controlled by some natural enemy. Since this western species is a native insect one would expect that sooner or later we should have natural means of control of it too.

Mr. Tothill: There has been an outbreak of presumably *Chermes* in New Brunswick. This outbreak was exceedingly conspicuous about three years ago and Professor Caesar will know fully well, the outbreak has been brought under complete control.

The President: If there is no further discussion on this paper we will pass on to the next and last of this session. There are really two papers but they will be taken as one and read consecutively.

THE CABBAGE MAGGOT—AUTUMN DEVELOPMENT IN BRITISH COLUMBIA.

(*Phorbia brassicæ.*)

R. C. Treherne, Field Officer, Dominion Entomological Laboratory, Agassiz, B.C.

The matter of autumn development in the life-history of the Cabbage Maggot is obviously of great importance in the control of this fly. On the basis of the knowledge obtainable in the autumn rests the question of autumn cultivation and the destruction of the refuse and debris resultant from the summer's crop. Still further great bearing will be obtained on the early spring development, inasmuch as little change is undergone by the spring by these forms entering upon the winter.

I do not propose, at this moment, to present all the information that has been obtained during the past few years in British Columbia on the life history and characteristics of this important pest, but merely to confine myself, in the time allotted, to a consideration of the developments that occur in the autumn.

Inasmuch as climate may offer changes and locality present differences, I shall confine myself strictly to conditions that prevail at Agassiz, B.C. (Lat. 49.15, Long. 121.40, 52 feet above sea level), which in themselves are comparable to the entire Lower Fraser Valley or what is known as the "Lower Mainland" of the Province.

It is my belief that opinions generally consider that the Cabbage Maggot Fly passes the dormant winter season mainly in the pupal state in the soil surrounding cruciferous roots or imbedded in the root itself. There are also opinions expressed from various quarters that there is a "possibility" that the fly may pass the winter in the adult condition. It is not my intention to enlarge on these expressions, but inasmuch as it is our duty to take careful observations in each locality where this fly is a pest and the growing of vegetable crops is a leading industry, I merely wish to offer a contribution on the life characteristics of the fly in the locality above mentioned.

Further I may say that up to the present we have little information in this Province on the habits of this fly and little knowledge, other than the generally accepted conceptions, on which to base the more approved remedial measures.

Without entering upon a detailed study of the complete life history of the fly, I wish to say that usually there are three complete and overlapping generations of this fly at Agassiz. It is possible for forms of the third generation to appear on the plants as early as July 18th, developing from the first eggs of each generation, while the second generation would ordinarily cease approximately about September 1st.

I will commence the discussion on the autumn development of this fly from this date, September 1st, and, in doing so, consequently, we will be dealing in all probability with third generation forms with a possibility that certain of the younger stages may belong to the fourth generation.

Autumn Fly Emergence.

Cabbages and cauliflowers are harvested mainly in the months of August and September. During the past three years larvæ have been observed at times during each of the months of October, November and December working on roots of cruciferous plants. This year particularly an attempt was made to account for these larvæ and to solve the question of the hibernating form.

In the process of harvesting, therefore, collection was made of all pupæ seen and these were placed under observation in a sheltered place, but under supposedly equal atmospheric conditions as would prevail in the open field. One was struck during the course of the field observations with the preponderance of pupal forms over the larval, and one might easily suppose that given a cold wet autumn with low maximum and minimum temperatures that pupal forms would continue as such for the winter and larvæ would complete their growth and pass the winter as pupæ also. Detailed observations in an autumn of such a nature are lacking up till the present. As it happened, the past two years, 1914, 1915, when the notes herein presented were recorded, have been open and mild, during September and October. Such a condition is not out of the ordinary in this part of the world, thus the facts recorded are of interest.

From puparia collected, therefore, the following emergence of flies is recorded. It will be seen that the number of puparia under observation is increased on certain days. This is explained by the fact that harvesting operations were continuing and more pupæ were being collected and added to the number under observation.

TABLE 1.—AUTUMN FLY EMERGENCE.

Date	Number pupæ under observation.	Number of flies emerging.	Sex.		%
			Male.	Female.	
September 1st........	137	1	1	....	.8
" 2nd	136	2	1	1	1.5
" 3rd	134	3	1	2	2.2
" 4th	131	0	....	....	0
" 5th	131	8	6	2	6.1
" 6th	123	0	....	....	0
" 7th	123	1	1	....	.8
" 8th	122	2	1	1	1.6
" 9th	120	1	1	....	.8
" 10th	119	7	5	2	5.8
" 11th	112	11	2	9	9.8
" 12th	101	0	....	....	0
" 13th	101	8	3	5	7.9
" 14th	93	5	1	4	5.3
" 15th	90 (2)	4	1	3	4.4
" 16th	96 (10)	6	4	2	6.2
" 17th	102 (12)	4	4	....	3.9
" 18th	108 (10)	2	1	1	1.8
" 19th	111 (5)	0	....	....	0
" 20th	111	9	3	6	8.1
" 21st	105 (3)	0	....	....	0
" 22nd	105	4	....	4	3.7
" 23rd	113 (12)	2	....	2	1.7
" 24th	117 (6)	5	3	2	4.2
" 25th	117 (5)	3	1	2	2.6
" 26th	114	5	3	2	4.2
" 27th	109	1	....	1	.9
" 28th	121 (12)	0	....	....	0
" 29th	121	0	....	....	0
" 30th	193 (72)	0	....	....	0

FLY EMERGENCE IN THE FIELD.

Inasmuch as the records given in Table 1 might have been influenced by unnatural conditions resulting from laboratory arrangements, the important point was to determine whether or not the same conditions were occurring in the field under strictly natural conditions. It was clearly proved that flies will emerge from September puparia under laboratory conditions, and, as will be seen later, eggs were being taken freely in the field. Hence it was probable that flies were emerging freely from the soil in the field. In order to determine this point careful examination of the roots of old cabbage plants was made. The roots were cut and the soil worked over to the depth of 6 inches. This was done on September 28th, 29th, 30th, and it was found that out of 78 plants examined, 48 plants were or had been infested. 30 plants did not show any sign of attack, and no puparia were taken. From the 48 plants, however, were found:

124 empty puparium cases from which flies had emerged.
96 sound and apparently healthy puparia.
14 large maggots more than 3 mm. long.
4 small maggots less than 3 mm. long.

Close examination for minute forms was not made, the important point being indicated that many flies were emerging in the field. It is hardly fair to claim a ratio between the empty puparium cases taken in the field with those under observation in the laboratory, because we could not be sure when the flies did emerge. However, the fresh nature of the puparium cases leaves no room for doubt that flies emerge freely from the soil during September.

Hence it is probable that Table 1 closely approximates the actual field conditions.

Adult Fly Mortality.

Having satisfied ourselves that many flies emerge from the soil in September, several important considerations open up, viz., length of life of the fly, mortality, whether copulation occurs in autumn and eggs are laid, whether these eggs are fertile, and if so what happens to the young maggots, and lastly what proportion, if any, of the adults winter as adults.

The question of the length of life of the fly and the mortality is represented by the following table 2. The flies as they emerged, as indicated in table 1, were placed in 6-inch tubes and kept under observation in a shaded box under outside temperature conditions. Periodically they were examined for mortality and the live ones fed a little syrup and water solution. This table 2, therefore, has direct reference to the "sex" column on fly emergence as indicated in table 1. To interpret this table read horizontally for fly emergence and perpendicularly for date of death.

TABLE II.—Male Mortality.

Date.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
September 1.....	1																			
" 2.....		1																		
" 3.....			1																	
" 4.....				0																
" 5.....					6															
" 6.....						0														
" 7.....							1													
" 8.....								1												
" 9.....									1											
" 10.....										5										
" 11.....											2									
" 12.....												0								
" 13.....		x			5x			x					3							
" 14.....			x		x									1						
" 15.....															1					
" 16.....																4				
" 17.....																	4			
" 18.....										x								1		
" 19.....																			0	
" 20.....	x						x			x			2x	x						3
" 21.....																				
" 22.....									x							x				
" 23.....																				
" 24.....																				
" 25.....										x			x		x	2x				
" 26.....																				
" 27.....											x									
" 28.....																x	x			
" 29.....										x										
" 30.....																	3x	x		2x
October 1.....																				x
" 2.....																				
" 3.....																				
" 4.....										x		(1 fly escaped)								

FEMALE MORTALITY.

Date.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
September 1.....	0																			
" 2.....		1																		
" 3.....			2																	
" 4.....				0																
" 5.....					2															
" 6.....						0														
" 7.....							0													
" 8.....								1												
" 9.....									0											
" 10.....										2										
" 11.....											9									
" 12.....												0								
" 13.....					2x								5							
" 14.....														4						
" 15.....															3					
" 16.....																2				
" 17.....																	0			
" 18.....																		1		
" 19.....																			0	
" 20.....		x	x								2x		2x	x						6
" 21.....																				
" 22.....											2x			x						
" 23.....																				
" 24.....																				
" 25.....			x								x		x	x	3x	x				
" 26.....																				
" 27.....											2x									
" 28.....								x		x	x									
" 29.....													x							
" 30.....													x					x		2x
October 1.....														x						
" 2.....																x				3x
" 3.....					escaped															x

From these records it will be seen that the length of life varies from 7-25 days in the autumn. This is of interest as the average life of an adult during the summer is approximately only 4.5 days.

It will be seen that all the flies in the above table 2, which emerged from puparia up till September 20th, died.

Those flies that emerged after September 20th (table 1 indicating that emergence continued until September 27th), were treated in a different manner. It was felt that 6-inch tubes hardly gave a fair test of longevity, hence a large wire mesh cage was arranged to give the flies more liberty of flight. The records follow on this experiment.

Hibernation of the Adult.

As has just been seen a certain number of the flies that emerge as adults in the autumn live as long as twenty-five days, this period being passed in a six-inch vial. It was thought possible that the stage might be prolonged still more if the flies were allowed more room for flight and if this occurred we might persuade some of the flies to pass the winter in the adult condition. Accordingly a large cage was arranged consisting of wire mesh and suspended within was a large piece of rough fir bark, with many crevices into which flies might crawl should they desire to. This cage was suspended to the outside wall of the building. A small amount of sweetened water was placed on the floor of the cage, upon which, later, it was observed, the flies fed readily. No cabbage plant was introduced into the cage for fear the flies would be tempted to deposit eggs, and if they did so, their life functions would be over and they would probably die. Into this cage twenty-two flies of both sexes were liberated between September 22nd and 27th. Examination of the cage was difficult for fear of allowing the flies to escape. However, flies were observed dead on the floor of the cage on September 25th and finally on October 8th all the flies had died. On October 5th only six flies were observed dead on the floor of the cage, hence a rapid mortality must have occurred between the 6th and the 7th. The night of the 7th was the coldest night thus far experienced during the autumn, being 33 degrees F. This temperature may have killed the adults. At any rate we have nothing to offer which proves that flies winter over as adults although indications that such might occur were propitious. It might be noted again that no flies emerged from puparia after September 27th, despite the fact that 193 puparia were still confined on soil in boxes on that date.

I can only say that the number of flies experimented with in this instance was far too small to record an invariable and established fact I can merely say that those flies used did not survive the first touch of cold weather and hence did not pass the winter as adults. It might, however, be said with reason that it is highly probable that a small percentage of adults will winter as adults in a favorable season, although such has not been shown in our experiments thus far.

Egg Deposition in Field.

Not only do adult flies emerge freely from the puparia during September and probably part of October, but we find also that eggs are deposited equally freely during these months. These notes, recorded now, are a part of a long series of notes obtained throughout the summer on the question of egg deposition hence I shall not give the full details at this juncture. We are only interested now in the autumn development. To obtain this record 12 cabbages and 6 cauliflowers were examined daily between 4 p.m. and 6 p.m. and all eggs laid during the twenty-four hours removed by means of a knife blade and counted. By this method we would obtain an absolutely accurate record of the daily deposition. Further useful information may be deduced in reference to effects of temperature, sunshine, rain, wind, on egg deposition and the size and shape of the plant chosen for deposition.

The record follows in table 3. (For the sake of comparison the record of 12 cabbages is reduced to read for 6.)

TABLE III.—EGG DEPOSITION RECORD.

September.	No. of eggs on 6 cabbages.	No. eggs on 6 cauliflowers	Weather Notes.
1st	10	42	Morning, cloudy .... Afternoon, showers.
2nd	16.5	96	" fine .... " cloudy.
3rd	1	73	" fine .... " cloudy.
4th	15	116	" fine .... " fine.
5th	1	13	" foggy .... " dull.
6th	2.5	25	" cloudy .... " showers.
7th	3	24	" dull .... " showers.
8th	0	1	" rain .... " heavy rain.
9th	2.5	11	" fine .... " heavy rain and some sunshine.
10th	0	66	" fine and strong wind .... " fine.
11th	1	17	" fine .... " fine.
12th	7	15	Bright and sunny all day, night wet.
13th	0	0	All day cold and stormy.
14th	0	0	Warmer, but cool and cloudy.
15th	(no record taken)		
16th	0	10	Day fine, warm and sunny.
17th	0	49	Day fine, warm and sunny.
18th	0	21	Day fine, warm and sunny.
19th	0	32	Day fine, warm and sunny.
20th	9	61	Day fine, warm and sunny.
21st	10	38	Day fine, but smoky.
22nd	0	78	Day fine, warm, but dull.
23rd	(no record taken)		Showers fell throughout day.
24th	8	147	Day fine, warm and sunny.
25th	0	137	Day fine, warm and sunny.
26th	0	18	Day dull, but fairly warm; rain fell during the night.
27th	3	17	Morning dull; afternoon fair.
28th	6	80	Day fine and fairly warm.
29th	0	102	Day fine and warm.
30th	0	22	Morning dull, afternoon rain fell.
October.			
1st	(no record taken)		
2nd	(no record taken)		
3rd	0	99 (33 eggs per day)	Day dull with some rain.
4th	No further records taken on the cabbages	35	Day dull with slight sun, rain at night.
5th		15	Morning, fine; afternoon, bright and sunny.
6th		100	Windy, but fine and sunny.
7th		5	Day fine, warm, sunny; night coldest yet, 33° F.
8th		86	Morning sunny, afternoon dull and cloudy, night warm.
9th	....	1	Fine all day and sunny.
10th	....	48	Day fine and sunny.
11th	....	0	Rained.
12th	....	0	Rained.
13th	....	0	Heavy rain.
14th	....	13	Fine autumn day, cool but sunny.
15th	....	11	Fine autumn day, sunny, cool at night.
16th	....	11	Day fine, comparatively warm.
17th	....	0	Day mild but no sun.
18th	(no record taken)		
19th	(no record taken)		
20th	....	0	Dull and wet on past three days.
21st	(no record taken)		
22nd	....	4	Dull but mostly fine, rain in evening.
23rd	....	0	Rain.
24th	....	0	Showery.
25th	....	0	Dull with showers.

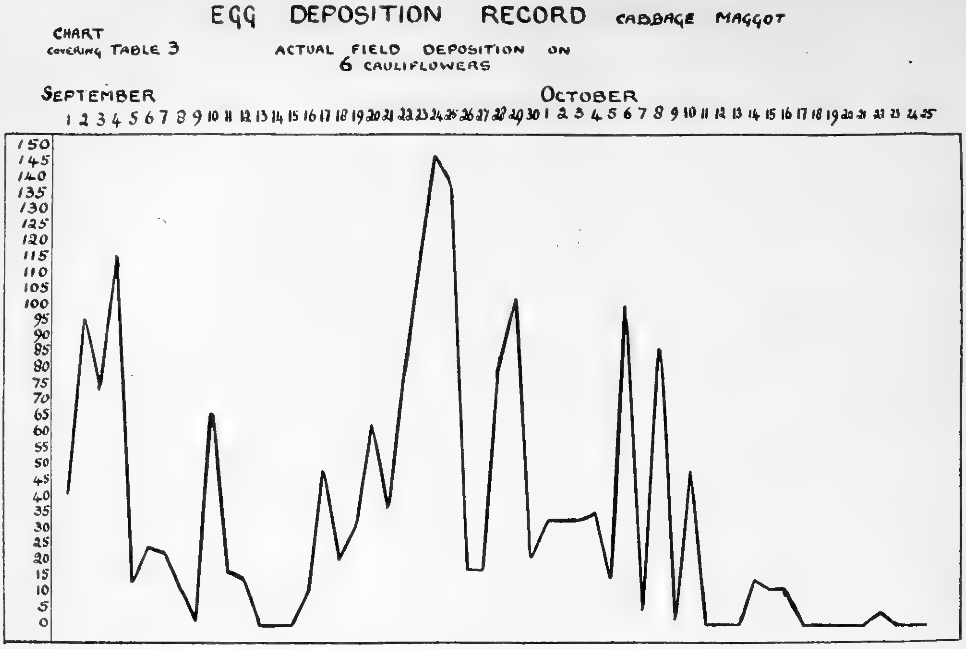
From this table 3, we find that flies were active up till as late as October 22nd; having since September 1st deposited 1,739 eggs on six cauliflower plants. The egg deposition on six cabbages for the month of September was 95.5, while the deposition on a like number of cauliflowers over the same period was 1,311. This indicates the importance of pursuing the life history on more kinds of plants than one. The records from cabbages alone would incline towards an entirely different rendering of the actual situation.

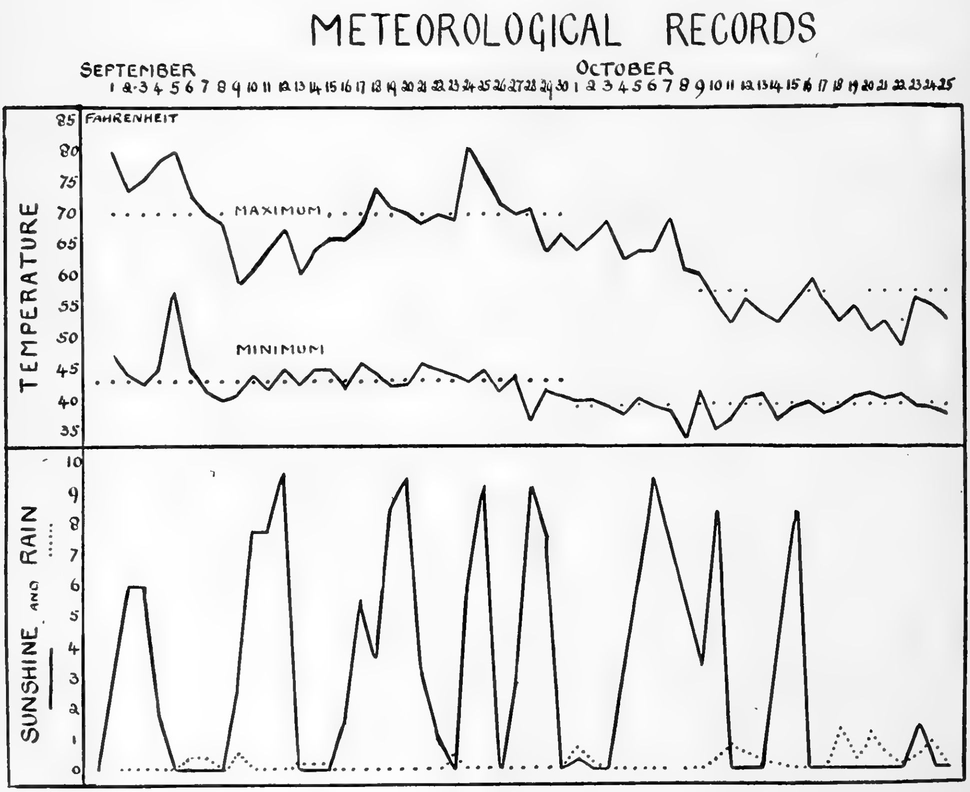
(See chart covering egg deposition on six cauliflowers.)

Autumn Larval Notes.

We are now satisfied, in the first place, that flies freely emerge from the soil in September, and in the second place that quantities of eggs are laid around plants until late into October. The high egg fertility percentage is maintained throughout the entire year, consequently we are justified in assuming that larval forms may be found working on the roots of plants during November and December. This assumption is supported by fact inasmuch as larvæ, freshly hatched, from late September eggs, having been placed on plants in pots, developed to 2 mm., 3 mm., and 4 mm. in length by the commencement of November. Inasmuch as these pots were sunk in the soil out of doors, we claim with assurance that the conditions were precisely natural.

Eggs taken from plants in the field between September 13th-26th, were hatched in the laboratory and placed on the soil around a potted plant (which was in turn sunk in the open soil), developed maggots 3 mm.-4 mm. long by October 25th. Larvæ hatching after September 26th and before 30th, treated in the same way developed maggots 2 mm. long by the close of October. There is no question of doubt that the larvæ found in both these instances would mature, pupate and pass the winter. It is true that no further notes were taken on them after this date, but their general thrifty appearance does not allow of much doubt that they will survive. Eggs hatching in October were also placed around the stems of plants and they developed slowly during the early days of November. Frost, it would seem, might affect them, especially the very small larvæ. Given no severe weather in November and December, there is, again, little doubt that October eggs will persevere also to puparia by the approach of winter. Real winter weather seldom sets in with any degree of permanence in this locality until the New Year.


EGG DEPOSITION RECORD CABBAGE MAGGOT
CHART COVERING TABLE 3
ACTUAL FIELD DEPOSITION ON 6 CAULIFLOWERS
SEPTEMBER
OCTOBER


METEOROLOGICAL RECORDS
SEPTEMBER
OCTOBER
FAHRENHEIT
TEMPERATURE
MAXIMUM
MINIMUM
SUNSHINE AND RAIN

The Meteorological Records.

The Meteorological records covering the notes given in this paper are as follows:—

	Temperature Degrees Fahr.		Sunshine in hours	Rain in inches
	Maximum	Minimum		
September 1st	80	47	....	....
" 2nd	74	44	6.2	....
" 3rd	76	43	6.4	....
" 4th	78	45	1.8	....
" 5th	80	58	....	....
" 6th	73	45	....	.04
" 7th	70	42	....	.03
" 8th	68	40	....	....
" 9th	59	41	2.5	.45
" 10th	61	44	7.8	....
" 11th	64	42	7.8	....
" 12th	67	45	9.7	....
" 13th	61	43	....	.08
" 14th	64	45	....	.05
" 15th	66	45	....	.14
" 16th	66	42	1.5	....
" 17th	68	46	5.5	....
" 18th	74	44	3.6	....
" 19th	71	43	8.5	....
" 20th	70	43	9.5	....
" 21st	68	46	3.1	....
" 22nd	70	45	1.0	....
" 23rd	69	44	....	.48
" 24th	81	43	5.9	....
" 25th	76	45	9.2	....
" 26th	72	42	....	....
" 27th	70	44	2.9	....
" 28th	71	37	9.2	....
" 29th	64	42	7.5	....
" 30th	67	41	....	....
October 1st	64	40	.48	.61
" 2nd	67	40	....	.12
" 3rd	68	39	....	....
" 4th	63	37	3.24	....
" 5th	64	40	6.24	....
" 6th	64	39	9.6	....
" 7th	68	38	7.18	....
" 8th	61	33	5.18	....
" 9th	60	43	3.42	....
" 10th	56	35	8.48	.12
" 11th	53	37	....	.63
" 12th	56	40	....	.57
" 13th	54	41	....	.49
" 14th	53	37	4.50	.12
" 15th	55	38	8.48	....
" 16th	58	39	....	....
" 17th	56	37	....	....
" 18th	53	38	....	1.22
" 19th	55	40	....	.39
" 20th	51	41	....	1.19
" 21st	53	40	....	.52
" 22nd	48	41	....	.15
" 23rd	54	38	1.42	.36
" 24th	55	38	....	.95

THE CABBAGE MAGGOT IN BRITISH COLUMBIA (*Phorbia brassicæ*).

THE NATURAL CONTROL BY PARASITES AND PREDACIOUS INSECTS.

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The Cabbage Maggot fly is a very serious pest in the Lower Fraser Valley of British Columbia. Variations in prevalence occur one year with another, and certain locality differences are observed in any given season. These changes are not accounted for with any degree of satisfaction, but it is certain that autumn temperatures and precipitation play an important part in the conditions that arise the following spring.

The importance of this insect may be gauged by its long period of activity. Eggs may be frequently observed deposited on the stems of plants during the first week of April, and oviposition may continue intermittently but continuously until well in October. Nearly full-grown larvæ have been taken from roots in the closing days of April, and they may be found at all times until November and sometimes as late as December. These records were taken in the Lower Fraser Valley of British Columbia and apply only to that district, which ranges about 100 miles east of Vancouver. They are, further, notes gathered from three years' work with the fly, and are only given in this connection to indicate the serious possibilities that may follow an attack by the pest.

During the past summer an attempt was made to estimate the egg-laying proclivities of the fly. A number of plants, as indicated below, were examined every day, at the same time, from April 17th until October 26th. At each examination all eggs were removed and counted, so that as a result we find we have an accurate record of the total number of eggs laid per day throughout the summer. As an indication of the seasonal prevalence during the past summer, I may say that in a large experiment on control measures, out of 215 cabbages, untreated and used as checks, only 26 died strictly by reason of maggot attack (12.1 per cent.), and out of 210 cauliflowers, of the same nature, only 24 died (11.4 per cent.). Of course many plants were attacked and a diminution of weight was noticed at harvesting, but they survived the ordeal of the attack and a certain weight was recorded to their credit at the close of the season.

The fertility of these eggs, of which at least 2,500 were tested over the whole of the above period of time, was shown to be well over 80 per cent. This would indicate that if all the eggs as laid persevered through to puparia, the percentage of sound plants at the end of the season would be practically nil, despite the fact, as above noted, that the season was light in comparative prevalence.

Our field records, however, from careful root examination of both cabbages and cauliflowers, show clearly that during the past season rarely, if ever, were more than 25 larvæ and puparia found at any one time. In other years I have taken as many as 100 larvæ and puparia from single roots of cabbages, but not so this year, which is comparable to the egg deposition records in Table A.

The question then arises: What happens to all these eggs and small maggots?

One answer is that it is probable the larval mortality is high in the very early stages. I have experienced difficulty in bringing through young larvæ from the eggs under laboratory conditions, and further from observations taken on the movements of newly-hatched larvæ on the surface of the soil, I am convinced a great many never reach the roots at all. However, I am not prepared to say much on this point.

One may judge from these statements that the fly was not so serious as usual, but, nevertheless, under such a degree of prevalence it was found that large numbers of eggs were laid, as indicated in the following table:—

TABLE A—EGG DEPOSITION RECORD.

Crop. No. Plants.	Dates or Month.	No. of eggs deposited, removed and counted.	Basis of 1 plant.
25 Radishes	April 17th–May 31st....	3,437 eggs	137.5
*12 Cabbages......	May 21st–May 31st.....	86 "	7.
	For month of June	3,126 "	260.5
	July......	2,477 "	206
	August ...	758 "	63.2
	September	155 "	12.9
	October...	....	....
			Total..6,602
* 6 Cauliflowers...	June 25th–July 31st	2,221 "	370.
	For month of August...	1,555 "	259.
	September	1,311 "	218.5
	October...	428 "	71.3
			Total..5,515

Another answer is that of the control by parasitic insects. On several occasions the Cynipid parasite *Cothonaspis gillettei* has been bred from puparia collected in the field. Unfortunately we cannot, from our study up to the present time, consider this parasite of any practical benefit in the control of the fly at Agassiz, B.C., its numbers are shown to be entirely too few. From the large numbers of puparia that have been taken and studied this past summer, only twelve Cynipid adults appeared. They started to emerge from puparia on August 16th and continued until October 18th. Further, there is little doubt that some carry over the winter within the puparia of the maggot to emerge in the spring.

Except for this Cynipid parasite, no other true parasite has been observed or recorded in British Columbia.

The third answer to the above question, and probably the most important, is the control by predatory insects and mites.

RED TROMBIDIUM MITE.

A Red Mite may very commonly be found on the surface of the soil in the vicinity of cruciferous plants. It has been shown by laboratory experiments that this mite will attack the eggs of the Cabbage Maggot fly. Several investigators have shown mites of this nature of great importance in the natural control of the fly, but our studies at Agassiz do not show that it is of such importance and not comparable in usefulness to certain Carabid and Staphilinid beetles.

Several Staphylinids are of importance, notably:

Orus punctatus Casey.

Xantholinus hamatus Say.

Hisperobium californicum Lec.,

* (Cabbages and Cauliflowers transplanted on May 13th and 14th)

and several species of Carabids, notably, *Celia farcta* (1)*, *Bembidium mutatum* G. - H., *Bembidium trechiforme* Lec., *Platynus cupreus* Dej., *Pterostichus lucublandus* (2)*.

An attempt was made to determine the appetites of some of these predaceous insects. The following methods were used in determining this point. Ordinary small vials were employed in which single specimens of beetles were placed. A small piece of moistened blotting paper was also inserted in the vial and the whole tightly corked. Eggs of the Cabbage Maggot fly, freshly-hatched larvæ, and more mature larvæ of varying lengths were placed in the vial on the blotting paper ever so often, and allowed to remain with the beetle under observation. Daily records were taken over a certain length of time and the amount of material devoured noted. In this way we have the maximum appetite of the beetles recorded.

Another system was employed in which two ordinary microscopic slides were laid over one another and kept separate by means of a small strip of thin linoleum placed around three sides and glued on both sides to the glass. The fourth side was left open to be plugged with a piece of cotton wool. In this way we have a flat glass-encased chamber which may be easily handled and operated under the microscope. A little pulverised soil was then sifted into the chamber thus formed and the beetles to be observed placed within. Food was regularly supplied and the amount devoured recorded.

It may be seen from both these systems that the beetles were confined within a small area and that the food supplied had no opportunity of escape. Hence due latitude must be given the appetite record. Attempts were made to carry on the work under more natural conditions, but it was felt that the results recorded were of little value. It was too difficult to give the beetles full liberty of action and at the same time keep them under observation. Furthermore, it was impossible to discover whether a small newly hatched larva had been actually devoured by the beetle when given full liberty of action, or whether it had died a natural death. It is true that we devised a cage over some plants in the field, consisting of ordinary chicken wire mesh, which was entirely covered with cheesecloth, with the exception of a couple of inches on the ground surface. In this way the flies were prevented from oviposting and the ground beetles were allowed free access to the plants, and provided one knew how many eggs were around the plant at a given time, a series of notes on this point would offer some evidence on the matter of the natural control. However, even this method did not give the results expected.

I shall give, nevertheless, the results of the vial experiments, which may be taken to record the maximum appetite and the length of life of the beetles.

In this Table B the symbol "n, h, m," represents the words "newly-hatched maggots," while "l m" represents the words "large maggots." The figures in brackets in connection with these symbols represent the amount of food offered throughout the course of the beetle's life.

The species involved in this work are as follows:—

Type 1.—*Bembidium mutatum.*

Type 2.—*Bembidium trechiforme.*

Type 3.—*Pterostichus lucublandus.*

Type 4.—*Orus punctatus.*

Type 5.—*Xantholinus hamatus.*

Type 6.—*Hisperobium californicum.*

* (1) Identified by Dr. E. C. Van Dyke.
* (2) Identified by Col. T. L. Casey.

All the Carabids were actually observed at work devouring maggots in the field, hence are predacious on the maggot under strictly natural conditions. The Staphilinids occurred in numbers in such close vicinity to infested roots, that there is little doubt they also are predacious under natural conditions. Their habits were mostly studied in confinement.

TABLE B—CARABID ADULT APPETITE RECORD.

Beetle Type No.	Vial No. Exp.	Food Consumed.			Life of beetle in days.	Food consumed per day.		
		n, h, m,	eggs	l, m,		n,h,m,	eggs	l, m,
1	1	305 (352)	53 (71)	7 (13)	51	6	1	.5
	14	262 (319)	34 (46)	½ (8)	81	3.2	.4	.09
2	4	210 (308)	82 (116)	7 (19)	120	1.8	.8	.006
	6	51 (79)	21 (31)	2 (4)	12	4.2	1.9	.18
3	21	....	....	10 (23)	10	....	....	1.

STAPHYLINID ADULT APPETITE RECORD.

4	2	497 (549)	78 (128)	1 (19)	87	5.7	1	0
	5	12 (12)	17 (22)	0	3	4.	6	0
	7	16 (25)	19 (38)	0	12	1.3	1.6	0
5	3	242 (313)	73 (112)	10 (22)	120	2	.2	.1
	9	185 (226)	10 (29)	0 (4)	76	2.5	.2	0
	10	165 (227)	45 (63)	0 (2)	51	3.2	.9	0
6	17	....	....	2 (5)	4	....	....	.5

To interpret the Table B correctly it is necessary to understand that the beetles were offered food according to what happened to be on hand to feed them, and further that on several days the beetles were deprived of their favorite food, i.e., small maggots and eggs and were fed on large maggots. In this way, in the first place, therefore, they were not allowed to choose their own food, hence the above record does not indicate any special choice of food, and in the second place while the beetles lived for some considerable time, part of that time they were starved, in the effort to induce them to devour the large maggots, hence the appetite record is lower per day than it would be if the diet had consisted entirely of small maggots and eggs.

The detailed daily record of these several beetles makes exceedingly interesting reading from the original notes. I do not consider it possible to include them in this paper, or to publish them in the proceedings, as they would occupy too much space. The Table B gives merely the bald statements without those fine points of interest incident to the feeding.

Control by Predacious Larvæ.

In addition to establishing the appetite record of the adult beetles, both Carabid and Staphilinid, an attempt was made to mature carabid larvæ. Carabid beetle eggs may frequently be seen on the soil surface, and at different times some of these were taken from the field, at other times some eggs were deposited in the tubes in the laboratory. Poor success seemed to attend the hatching of these eggs, and in fact many disappointments were encountered in bringing the larvæ to maturity. Without detailing all these troubles I will relate some of the facts obtained. The eggs and larvæ of these beetles were handled in the same way as the adults, in vials, etc.

Table C—Carabid Larvae Appetite Record.

Vial Exp. No.	Size of larva in mm.	Food consumed. n, h, m,	eggs.	l, m.	Remarks.
11	hatched from egg	....	5 (5)	......	Larva died, having eaten 5 eggs in 2 days.
20 & 22	8 x 1	79 (100,	....	6½ (20)	2 Larva lived 20 days, having eaten per day 4 n,h,m, and 1 2 mm. maggot.
8	9 x 1	6 (6)	17 (37)	0	Larva died in three days.
12	9 x 1	2 (2)	4 (18)	......	Larva moulted and then died after 2 days.
15	12 x 2	....	7 (11)	4 (9)	Larva died after 3 days.
18	16 x 2	0 (20)	....	8 (28)	Larva died after 18 days, eating about 1, 2, 5 mm. maggot per day.

Summary.

Even from these records it is impossible to state with accuracy the actual appetite record of any predacious beetle or its larva. The limitation in the manner in which the work was done does not allow us to form any definite conclusion.

We are justified in stating, however, that despite the artificial methods employed, these predacious beetles present an immense aid in the control of the maggots. Their voracious appetites in confinement and from the fact that they did not hesitate to attack the food offered clearly proves some marked similar action in nature. Further than this, on many occasions, both Carabid and Staphilinid beetles, and the larvæ, at any rate of the former, may often be found embedded in the roots of plants in close association with maggots, and have been observed actually at work devouring maggots. The actual amount of food they dispose of in a day or throughout their life is the point of which we cannot be too sure from the records obtained. We might, however, be perfectly justified in assuming that five eggs or five young maggots a day would represent a normal appetite. We have also seen that a beetle will live with food for four months (120 days). On the above ratio it will destroy about 600 eggs or young maggots. This in itself would just about equal the number of eggs deposited by a fly on a single plant in a season, under conditions we have mentioned. Possibly this may be a little high, but nevertheless, we cannot avoid the fact that the percentage of usefulness of these little beetles is exceptional, and of unquestionable value.

THE PRESIDENT: There are so many points to be discussed in these papers that I think it would be best to postpone the discussion until this afternoon, when we will have more time, and when Mr. Treherne will have more time to bring out certain points.

FRIDAY, NOV. 5th.—AFTERNOON SESSION.

THE PRESIDENT: We will now commence the afternoon session and will first take up, before proceeding with the regular business, the discussion which was postponed this morning of Mr. Treherne's paper on the Cabbage Maggot. This paper is now open for discussion.

MR. TOTHILL: I would like to ask if the headings "May," "June," "July," "August," and "September," etc., represent generations?

MR. TREHERNE: Not in this chart. As a matter of fact, there are at least three generations of this maggot in British Columbia; the first generation ends about the end of May, the height of the second generation is early in July, and the third generation towards the latter part of August.

MR. BURGESS: I would like to ask Mr. Treherne if he has any definite records of the maggot coming through any stage in the winter.

MR. TREHERNE: We have no larval or adult records of hibernation, but only as yet pupal records.

MR. GIBSON: With regard to the question that Mr. Burgess has asked, last year and the year before we made observations at Ottawa in the hope of getting further information as to how the insect passes the winter. We found the puparia abundantly in an old turnip field at varying depths, the lowest being nine inches below the soil. We only found what we considered the larva of the Cabbage Maggot fly in one instance, in April. The species in Eastern Canada most probably hibernates to a more or less degree in the larval stage, in addition to the regular hibernating form, namely, the puparium.

THE PRESIDENT: The only other point, I think, which might arise from this paper which might be discussed is the comparative absence of internal parasites, particularly the absence of Staphilinid parasites such as we find in the East.

We will now proceed to the business meeting of this session, which consists in the election of officers. As in the case of last year, the Council in order to facilitate the proceedings of the meeting has recommended a list of officers for the guidance of the meeting, and I might ask the Secretary to read the list of officers as selected by the Council:—

President, Mr. A. F. Winn; Vice-President, Prof. L. Caesar; Secretary-Treasurer, Mr. A. W. Baker; Curator, Mr. J. B. Spencer; Librarian, Dr. Bethune; Directors, to be re-elected, with the exception of Division No. 6, where J. W. Noble is recommended.

DR. FYLES: It gives me very great pleasure to nominate Mr. Winn as President of the Entomological Society. I have followed Mr. Winn's work for a number of years, and think he is fully capable of holding the position.

MR. MORRIS: I second the motion.

DR. HEWITT: It has been moved and seconded that Mr. Winn be elected President of the Society. I am sure it is a matter of great gratification to all Mr. Winn's fellow workers to see him occupying the Presidential chair. We all appreciate the work which he has done in the Province of Quebec, especially in the production of those excellent insect lists which he is getting up. There being no other nominations, I declare Mr. Winn duly elected. I will call now upon Mr. Winn to take the chair.

MR. WINN: I certainly do not deserve this honour. I never got it correctly into my head how I came into this office. Two years ago the Fiftieth Annual Meeting was held at Guelph and I was on hand. About two months later Mr. Gibson surprised me by telling me that I had been elected Vice-President, and as it was then too late to undo what seemed an inexplicable error, I came to the conclusion that an honour to the Montreal Branch, with which I have been connected since a schoolboy, was intended rather than on account of anything I may have been able to accomplish personally. It has been suggested to-day that in reality it is a form of punishment meted out for not attending all our meetings regularly.

In some of our sessions reference has been made to the work of professional or practical entomologists, and that of amateurs, who by inference are unpractical, as if there were two well marked divisions. Really I do not think such a distinction exists except in the application of the results obtained. If it does exist, I hope it will cease and that our Society will remain united from Atlantic to Pacific as we see it here to-day, and that some of those who attended our fiftieth anniversary will also be present at the one hundredth.

There is one point in particular that both the so-called divisions agree upon, and that is the importance of learning the life-histories of insects from the egg to the perfect stage, and this has been emphasized in nearly all the papers we have been listening to. This point reminds me of a matter about which I had some correspondence with Dr. Bethune a few years ago—the question of having a suitable crest and motto to use in connection with a book-plate, for, old as our society is, it cannot boast of owning either, "Ab ovo usque ad imaginem"—from egg to imago. No particular insect was mentioned to serve as an emblem, and as I do not know what views the members have on the subject, suggestions would be acceptable.

I feel sure, however, that thoroughness in following out the life-histories of insects, thus getting at the bottom of things, is one of the most important objects to keep before us, for we do not really know an insect till we know it in all its stages.

I shall not take up any more of your time except to thank you very sincerely for the honour conferred upon me.

THE PRESIDENT: I think all who have had to do with the society have been impressed with Professor Caesar's ability. I do not think we could have a better Vice-President in support to Mr. Winn than Professor Caesar, and I have much pleasure in moving that Professor Caesar be elected Vice-President.

Seconded by MR. SWAINE. (Carried.)

(For complete list of officers see p. 6.)

MR. WINN: I will now ask Mr. Sanders to read his paper on "Some of the Methods followed in Nova Scotia in controlling the Brown-tail Moth."

Mr. Sanders' paper read.

SOME OF THE METHODS FOLLOWED IN NOVA SCOTIA IN CONTROLLING THE BROWN-TAIL MOTH.

G. E. Sanders, Field Officer for Nova Scotia, Dominion Entomological Laboratory, Annapolis Royal, N.S.

The control of the Brown-tail Moth in Nova Scotia presents many difficulties peculiar to that Province which go to show in rather a striking manner the value of investigating each insect locally, in the light of a knowledge of local conditions and methods, extending even to such details as the method of fixing charges for packing out the staple crop in the warehouses.

The Brown-tail Moth has not yet become established in the forest areas of Nova Scotia, 92.6 per cent. of the total number found in the Province being on fruit trees; the few found on ornamental and forest trees being on trees near to or in orchards.

Area Infested.

The area infested with Brown-tails is about two hundred miles long and some thirty miles wide, including the Counties of Shelburne, Yarmouth, Digby, Annapolis, Kings, Hants and Cumberland; or, in other words, all but one of the Counties of Nova Scotia touching on the Bay of Fundy.

This area may be divided roughly into four districts, in each of which we have a different proposition. In the first district, which includes Cumberland, Shelburne, Yarmouth, and all but a small section of the east end of Digby, we have small orchards averaging less than twenty apple trees each; usually the orchards are separated from each other by strips of woodland or open fields. As apples in this section are grown on a very small scale, as a rule for home use only, practically no spraying is done.

In the second district, which includes Eastern Digby and Annapolis County as far east as Annapolis town, we find apple trees in profusion. This district was settled about the time of the American Revolution, and many old, gnarly trees remain of the orchards planted by the original settlers. The land throughout this section is full of granite boulders, and in common with all such land in Nova Scotia and roadsides, fence-rows, pastures, and even scrubby woods are filled with seedling apple trees of every age and description. As this district is for the most part the west end of the Annapolis Valley, it falls into the regular fruit district and the orchards are of moderate size, covering probably one-tenth of the cultivated land, and adjoin each other quite closely. In spite of the natural advantages that this section possesses in the production of fruit, very little care is taken of the orchards, not more than 5 per cent. of the trees being sprayed.

The third district extends from Annapolis to Middleton. The western end of this section is granite land similar to the second district, and seedling apple trees are to be found everywhere. Over 50 per cent. of the cultivated land is in apple trees, so the whole district is practically one continuous orchard. About seventy per cent. of the orchard in this district is sprayed.

The fourth district extends from Middleton to Windsor, and includes the largest orchards in Nova Scotia, probably sixty per cent. of the cultivated land being in orchard, with the exception of a small section south of Wolfville, seedling apple trees are almost unknown. The orchard is for the most part less than fifty years old, orchard that a man can spray or inspect for Brown-tail easily: and, according to Prof. Brittain's census, some 87 per cent. of the trees in the district are sprayed.

Comparison of Controls.

In the first district, Yarmouth and Digby Counties, where the orchards are small and widely scattered, we find it very easy to control the Brown-tails by having our inspectors pick the nests from the trees in the winter. One inspection of this district can be relied upon to give a decrease in ordinary years, the only increases coming from the adult moths, which occasionally are blown across the Bay of Fundy into the district from the New England States. This district is on the whole flat country, and the normal increase very small. Evidently the adult moths are for the most part blown out of the orchards in which they originated, and the orchards being scattered they perish before they find other apple trees.

In the fourth district, Kings County, etc., the orchards are large and practically continuous, so if a moth is blown out of one orchard it will more often than not blow into another. In spite of this the large amount of spraying done, and the scarcity of seedling trees makes it quite easy for our inspectors to keep the Brown-tail within reasonable bounds. Occasionally we have small outbreaks in the western end of this district, but a little persuasion usually results in the orchards being sprayed and the Brown-tails exterminated.

In the third district, which is situated in the eastern end of Annapolis County, where 30 per cent. of the orchard is unsprayed and we have a great quantity of wild seedling apple trees, we have great difficulty in controlling Brown-tails. In many sections we have had very large increases which we followed up by very careful work, often persuading the owners of the worst orchards to spray, and so obtained decreases in infestation.

In the fourth district, or Western Annapolis County, with practically no spraying, medium-sized orchards and plenty of wild seedling apple trees, we have had great difficulty in holding the Brown-tails. Practically all of the work there has been done by our inspectors with no appreciable assistance, either in spraying or in picking nests, from the inhabitants.

Normal Increase in Nova Scotia.

The coldest season ever recorded in Nova Scotia was 1913-14. The extreme low temperature in the Annapolis Valley was—21F. at Kentville, while at Yarmouth the lowest was —6.4F.; in the most heavily infested district, *i.e.*, near Annapolis, the lowest temperature ran —19F. and less here. Brown-tails came through with an average of about 40 per cent. winterkill. Counting the actual number of nests within twenty-five yards of old nests found in 1914-15, including those that gave no progeny, we found the actual increase the Province over to average 6.3 new nests from each old nest—this was not counting the number of female moths that had blown over twenty-five yards from the old nests. The increase in ordinary years is much larger than this.

Winter Drop of Nests.

Formerly we started the inspectors at their winter work on January 1st, but we found at that time a very large proportion of the nests hanging by a thread, and a few of the nests gone, leaving a bit of web attached to the tree where the nest had been. We placed some nests on the ground and found that the young larva lived over in them with a very small winterkill. In fact, at one station where all of the Brown-tails suspended in the air were killed by the winter, those on the ground lived over with only a small winterkill, having been protected from the extreme cold by the deep snow.

The questions that arose from this were: The proportion of nests that dropped from the trees, when they dropped, and whether the larva which lived over in the dropped nests would reach the trees from which they fell. We have not by any means finished these lines of enquiry, but we have one year's work on each, which shows up their importance.

On November 1914-15 we tagged a number of nests in each of two orchards, and in one we got 10 per cent. dropped during the winter, and in the other 25 per cent.

In regard to the time that the greatest drop takes place the heavy gale of Sept. 26, 27, 28, 1915, loosened a great quantity of nests, but the greatest drop appears to take place in November and December, soon after the leaves fall, and continues to a certain extent all winter. The heavy gales break down the nests and cause them to start swinging, but do not actually blow as many off the trees as one would expect, but the lighter winds following, constantly twisting the nests about, gradually wear the thread off and cause the drop to be spread quite evenly over the whole season.

In regard to the young larvæ in the dropped nests finding the trees, we found, from nests placed equidistant from four trees in an orchard planted 35 by 35 feet, that 11 per cent. of the larvæ contained in the nests found the trees and ascended to a tanglefoot band placed to catch them. The spring weather influences the movements of the young larvæ to a very great extent. In bright weather the larvæ will travel over the ground due south, toward the sun; in cloudy weather, such as we had when the larvæ were emerging in 1915, they will travel in any direction.

These preliminary investigations would indicate the importance of removing as many nests as possible before the nests begin to drop from the trees. These views are supported in practice by the ease with which the Brown-tails are controlled in districts where the drop is light, as compared with districts where the drop is heavy.

We now start our inspectors on November 1, when the leaves are about 90 per cent. off the unsprayed orchards, but have scarcely started to come off the sprayed orchards. They work the unsprayed orchards in the most heavily infested territory first, trying to get just as many nests as possible off the trees as quickly as possible, returning later to work every tree and bush in the district, and, if they have time, to return a third time to go over the trees again. As light and moisture conditions often prevent the best work being done in many orchards, a second thorough inspection is found to be of value in the most heavily infested localities.

Fall Picking of the Nests.

We have found that a large proportion of the winter nests can be gathered by the pickers when picking the apples in September and October, the cluster of brown skeletonized leaves that the larvæ feed on when forming the winter nest showing up for a foot around the nest against the dark green of the tree. At the beginning of the season we published notes in the papers requesting growers to have their pickers look for these clusters of leaves and destroy the nests when found. We have already had reports of a large number of nests collected and destroyed this season by the pickers.

Educational Work.

In addition to having our ten inspectors collect as many nests as possible from the trees, we plan to have them carry on as much educational work as possible, in order to persuade growers to examine their own trees and collect Brown-tail nests and to spray. All of our inspectors have all available data in regard to spraying right at their finger tips, and they are instructed to see the owner of every property giving over five Brown-tail nests, and endeavor to get him to spray his trees the next season.

More Spraying Campaigns.

The one thing outside of the work of our own inspectors in collecting nests that has had an appreciable effect in Brown-tail control has been the campaign for more spraying. In this we have the co-operation of the United Fruit Companies, whose warehouses extend over the whole fruit district, and of the Dominion Fruit Inspectors, who, under the Dominion Fruit Commissioner, Mr. D. Johnson, are now inspecting most of the fruit in the orchards and warehouses instead of at Halifax, so they come in direct contact with the growers and are a tremendous power in causing more spraying to be done. I am this winter spending two or three days with each of these inspectors, visiting warehouses, etc., and keeping them supplied with data on spraying. Mr. Johnson tells me that he wants his inspectors to be an educative rather than a police force—that they can do more good in showing people how to grow better fruit than, as he puts it, "going at the grower with a club to fine him if possible."

This attitude deserves the very highest commendation, and in teaching the Nova Scotia growers how to produce good fruit he must teach them how to control Brown-tails, for spraying, which controls the Brown-tail, is absolutely necessary in the production of good fruit in Nova Scotia.

The manager of the United Fruit Companies, Mr. A. E. McMahon, and his officials have been untiring in their efforts to get more and better spraying done, and their work has been particularly effective. About 60 per cent. of the total crop of Nova Scotia is handled through the 48 warehouses of the Companies, and all of the spraying material for their members is purchased by them. On their 60-ton order of lead arsenate, with other spraying material in proportion, they are able to get the very finest prices possible, and they give their members the full benefit of these prices and sell to non-members at a price that will barely cover expenses, preferring to take their profit in the benefits their members will receive from having their neighbors spray. The Fruit Companies' Inspectors, who visit every warehouse at least once a week, the warehouse managers and the packing foremen are every one active advocates of spraying, and persuade a great many people to spray by calling them into the warehouse when their poor lots are being packed out and comparing them with other well-sprayed lots.

The companies are also proving themselves of great value in the spraying campaign, by changing the methods of charging the cost of packing. In all of the warehouses, no matter under what system they are run, the culls, owing to the difficulty in apportioning them, are confiscated by the company and sold to be credited against general cost of packing. In most of the old companies the members were charged on the pack out of apples, that is, a member who delivered 50 barrels of apples from the trees which packed out 40 barrels of shipping apples, paid the same as the member who delivered 100 barrels, which packed out 40 barrels of shipping apples, the culls in both cases being confiscated, the larger amount of culls about offsetting the extra cost of packing. In some of the last formed companies the cost of packing was charged on the number of barrels delivered at the warehouse, so that the man who delivered 50 barrels which packed out 40 paid only one-half as much as the man who delivered 100 barrels which packed out 40, the culls still being confiscated. The companies that operated under this last system had no difficulty in persuading their members to spray. When a man has to buy a barrel costing 26 cents for cull apples, pay 20 cents per barrel for having them handled, and then have the apples confiscated, it is quite easy to persuade him to spend 15 cents per barrel on spraying, and make shipping apples of them. Where the last system is operating, spraying is increasing rapidly, and the executive of the United Fruit Companies are gradually persuading the subsidiary companies to change over to the last system, as they find it the very strongest argument they can use in getting more spraying done.

These three complete and far-reaching organizations, some of which are in direct personal touch with almost every fruit grower in the valley, at least once a month have, to use a military phrase, " to be kept in ammunition." We are carrying on a number of experiments and observations to find out just what insects are doing the most damage, the extent to which each can be profitably controlled, the profits derived from controlling them; the actual cost of spraying; the best nozzles to use and the best materials to use. In this work we have the co-operation of the Provincial Entomologist, Prof. W. H. Brittain, who has taken over the investigations on the sucking insects of the apple, leaving the biting insects to the Dominion Laboratory. We have demonstrated that in an ordinary orchard in the Annapolis Valley, the benefit derived from controlling bud moth, fruit worms, and Codling Moth will pay for the entire cost of spraying, at least twice over; in addition the grower has his insurance against blackspot or scab free, and the most progressive of the Nova Scotia growers are now realizing that they cannot operate an orchard profitably in the Annapolis Valley without spraying.

Newspaper Work.

The *Co-operative News,* a paper conducted by the United Fruit Companies, and mailed to every one of the members of the Companies, or about sixty per cent. of the growers in the Annapolis Valley, twice a month, has reserved a page for any articles we may choose to write or solicit on spraying problems. By this means we are able to publish timely articles, give advance notice of insect outbreaks and methods of combatting them, as we will do with the Tussock Moth next season; give the growers the benefit of our findings just as soon as we are sure of our results, and have our papers and articles in handy form for the use of our inspectors, in carrying on their personal canvass for more and better spraying.

The work in increasing the amount of spraying, we realize, is the most important part of the work of controlling Brown-tail in Nova Scotia, and a large portion of the summer is devoted to spraying experiments and demonstrations, in order that we may devise the most economical sprays possible for Nova Scotia, as the cheaper and more effective the spray is, the more growers we can persuade to use it.

Spraying to Control Brown-tails in the Fall.

For two years we have been working on the possibility of controlling Brown-tails with the last summer spray, and this year we demonstrated that where arsenate of lead is used with Lime Sulphur in the last summer spray, or that applied from June 28th to July 15th, the poison will adhere to the leaves enough to poison the young Brown-tails when they emerge from the egg and start feeding in August.

Parasite Work.

In addition to the spraying, which will control more and more Brown-tails every year, as the amount of spraying increases, Mr. J. D. Tothil, of the Entomological Branch, is supervising the colonizing of the various parasites. Besides the colonizing of parasites, we have devised in Nova Scotia a practical means of preventing the reducing in numbers of the imported parasite *Apanteles lacteicolor* by the destruction of the winter webs of the Brown-tail. We build a large matched board cage, about 5 feet high, 6 feet wide, and 12 feet long with an open top and earth floor; two narrow boards are placed edgewise on the inside, and tanglefoot placed on the underside as in the Fiske tray. All of the Brown-tail webs collected are saved, and each of these cages stocked with two or three thousand of them. The Brown-tails are fed on short, leafy twigs for about three weeks in the spring until the first Apanteles larvæ emerges to spin its cocoon, then they are fed on willow catkins three or four times a day, giving them plenty of food so as to have as little Brown-tail web as possible in the food containing the Apanteles cocoons. The willow catkins seem to be the best material we can find for the Apanteles to pupate in. After about one week's feeding on catkins and the majority of the Apanteles have emerged, we feed broad leaves of some sort, heavily dusted with Paris green. Two days feeding will usually kill all of the Brown-tails, and then the green poisoned leaves can be rolled off to one corner and the willow containing the Apanteles cocoons exposed, so that the adults can fly free as soon as they emerge.

OBSERVATIONS ON THE BROWN-TAIL AND GIPSY MOTH SITUATION IN RELATION TO CANADA.

J. D. Tothill, Field Officer, Dominion Entomological Laboratory, Fredericton, N.B.

The parasites and predators that Mr. McLaine has just spoken of are being introduced of course as a measure of protection against possible injuries in Canada from the Gipsy and Brown-tail Moths.

How great a nuisance these two insects could become under Canadian conditions is not known. The farther north they travel the more vigorous will be the climate and the general conditions for existence. Somewhere between their present range and the arctic zone they will cease to be injurious. If the exact location of this "somewhere" could be precisely forecasted, fewer difficulties would no doubt be experienced in dealing with the spread of the infestation in the future.

The Brown-tail Moth, the less serious insect of the two, is now endemic in the transition zone of Nova Scotia. This indicates that this insect could become, if once established, a serious pest in all parts of the Dominion falling in this zone. In the middle west, however, food supplies would be inadequate and the insect would not be expected to flourish. The endemicity of *Euproctis* in the transition zone of Nova Scotia indicates, therefore, that the insect would also be a pest in the transition portions of British Columbia, Alberta, Ontario, Quebec, New Brunswick, and Prince Edward Island, if it once became established in any of these places.

In boreal parts of New Brunswick, and most of the Province is boreal, the same insect is epidemic. It remains to be seen whether or not it will become endemic.

The Gipsy Moth is a very serious shade tree and forest insect of the transition zone. It would undoubtedly flourish were opportunity afforded in the transition zone of Canada, excluding again that part of it falling in the treeless region of the middle west.

The behaviour of this insect in the boreal life zone cannot be forecasted. In this zone Mr. F. H. Mosher has shown that the insect would have an abundant food supply. It is also known that the insect hibernates successfully in boreal parts of Northern Maine. These two straws seem to show the direction in which the wind is blowing; they seem to show that there is a very grave danger menacing over immense boreal forests from attacks by this insect.

It is primarily to affect this seeming danger that the parasites and predators are being introduced.

They are being hibernated at strategic points, that is at points in Canada nearest to the infested area in New England and nearest to international trade routes. One of these points is near the international boundary in southern Quebec; another is in New Brunswick, and a third in Nova Scotia.

During the last four years large numbers of these beneficial insects have been introduced at these places. One of these species, *Apanteles lacteicolor,* is doing well in its new environment; another, *Compsilura concinnata,* is expected to be doing well, the third, *Calosoma sycophanta,* is known to be at least holding its own.

These same insects in New England are now helping materially and perceptably to relieve the situation.

It is hoped that by the time the Gipsy Moth reaches the Dominion there will have developed a living wall of its natural enemies strong enough to prevent disastrous results.

THE WORK CARRIED ON IN THE UNITED STATES AGAINST THE GIPSY AND BROWN-TAIL MOTHS.

A. F. Burgess, in Charge of Moth Work, Bureau of Entomology, United States Department of Agriculture.

The Gipsy Moth and Brown-tail Moth work in New England, as most of you know, is carried on in each State concerned by State and local agencies. Work to prevent the spread of these moths outside the territory where they now exist is maintained by the United States Department of Agriculture through the Bureau of Entomology. All of the work is of importance, as upon its thoroughness depends the chances of these insects spreading rapidly to the Dominion of Canada. The Brown-Tail Moth flies strongly and is attracted to lights and has already become established in districts in Nova Scotia and New Brunswick. The Gipsy Moth does not spread in the adult stage, but the small caterpillars may be carried long distances by the wind. Greater spread of this insect is shown toward the north and north-west. This is due principally to the fact that the prevailing warm winds during the time the small caterpillars are active blow from the south and south-east. A large number of men are employed in the outside part of the territory to scout the area for the purpose of determining how far the gipsy moth has spread and to treat carefully the infestations in the outside towns. This work consists, aside from scouting and creosoting of egg clusters in the winter, of thinning out infested areas where trees are growing too closely, or where the stand is of favored food plants, and of destroying the caterpillars in the spring and early summer by the use of arsenate of lead spray and the application of bands of tanglefoot. This work has an important bearing on the spread of the Gipsy Moth. If tanglefoot bands are applied to trees before the caterpillars hatch it serves to keep any of those that may hatch from egg clusters on the ground from climbing to the tops of the trees and being blown long distances and establishing new infestations.

The territory inside the area known to be infested by the Gipsy Moth as well as that infested by the Brown-tail Moth, has been placed under quarantine by the Federal Horticultural Board, in order to prevent the shipment of trees or plant products which might disperse these insects to uninfested territory. For the purpose of enforcing these quarantines the infested territory is divided into sections in each of which an inspector is located, whose duty it is to examine all such plant products, as well as stone and quarry products which are shipped outside the infested area. This work has prevented the dissemination of the Gipsy Moth and Brown-tail Moth to many widespread areas. In connection with the inspection work, as related to the Brown-tail work, it should be of interest to residents of the Dominion to know that during the past three years inspectors have been maintained at junction points where long distance trains have passed out of the infested area in order to examine the trains and destroy any Brown-tail Moths that might be attracted to the lights. Large number of moths have been destroyed as a result of this work, especially heavy infestations having been destroyed on trains passing through White River Junction, Vermont, north bound.

Other phases of the work carried on by the Bureau of Entomology are largely experimental.

Silvicultural experiments are being carried on to determine the most resistant stands and the best composition of tree growth to withstand continued Gipsy Moth attack.

The parasite work was first begun in Massachusetts by a co-operative arrangement between the State and the United States Department of Agriculture. Parasites attacking these insects in different stages were imported for several years from Europe and Japan, and up to the present time, several species have become firmly established, and progress has been made toward checking the increase of these pests.

As has already been stated by Mr. McLaine, three of the species concerned, namely, *Apanteles lacteicolor, Compsilura concinnata,* and *Calosoma sycophanta,* have been introduced into Canada during the last two or three years, as a result of a co-operative arrangement between Dr. Hewitt and the Bureau of Entomology. These species have become so abundant in certain sections of the infested area that they can be collected in considerable numbers in the field, and they are secured in this way for colonization in areas where the species are not known to exist. This work is also being done by the Bureau in order to bring about the rapid establishment of these insects in the infested area.

Apanteles lacteicolor, which is a parasite of the Gipsy Moth, as well as of the Brown-tail Moth, has been colonized over practically all the area where these species are now known to exist. During the past year, many colonies were liberated in eastern Maine, and it is not considered necessary to make liberations next year.

Compsilura concinnata has been colonized over a slightly smaller area. It attacks both the Gipsy and the Brown-tail caterpillars, and more colonization will be necessary, particularly in eastern Maine next summer.

The spread of *Calosoma sycophanta* has been slower than the other species previously mentioned, although they are present in practically all the territory that is badly infested with the Gipsy Moth. Further colonization will be necessary next summer.

In addition to the parasites already mentioned which are the most prominent that have been liberated are two parasites of Gipsy Moth eggs, namely, *Anastatus bifasciatus* and *Schedius kuvanæ* which are doing excellent service. These tiny insects spread slowly, hence it is necessary to liberate large numbers of colonies. By the end of another season it is hoped that the area most heavily infested with the Gipsy Moth will have been thoroughly colonized with these species.

Since the work was begun at the Gipsy Moth Laboratory, an effort has been made to learn as much as possible concerning the life history and habits of the parasites introduced, as well as their behavior, both under laboratory and field conditions.

The principal effort that has been made, however, has been to secure all information possible that had any bearing on the methods of successfully colonizing the species in the field, and obtaining information which would enable the work to be intelligently handled.

Since it is not deemed necessary to recolonize the area where the parasites are known to exist, a limited amount of time has been given to studying more closely the habits and relations of the introduced species and of our native parasites as well as native hosts. This work is showing some interesting results, but much of the data is far from complete.

In closing, I would like to express my pleasure at the cordial and satisfactory relations that have already existed between the work which is being carried on at Melrose and that which is under the direction of Dr. Hewitt. A hearty spirit of co-operation has existed among the men connected with the work and most satisfactory results are being secured.

Mr. Gibson: I would like to ask Mr. Burgess what the total number of food plants now is upon which the Gipsy Moth feeds?

Mr. Burgess: I cannot say just at the present moment but there are a large number.

Mr. Treherne: We took some specimens of Gipsy Moth from Japan a few years ago. Has a study been made of the parasites of this insect there?

Mr. Burgess: There has been some work done in Japan on the Gipsy Moth. Professor Kincaid from the University of Washington made a trip to Japan for the Department some years ago and studied the Gipsy Moth to a limited extent while making collections of parasites for shipment to this country. As far as I know, that is the only study by an American that has been made of the Gipsy Moth of Japan. I should consider that it would be dangerous to import the eggs of the Gipsy Moth into any uninfested section of this country.

Mr. Winn: If there are no more discussions on the Brown-tail and Gipsy Moths I will now ask Mr. Gibson for his paper on "Locust Control Work with Poisoned Baits in Eastern Canada in 1915."

LOCUST CONTROL WORK WITH POISONED BAITS IN EASTERN CANADA IN 1915.

Arthur Gibson, Chief Assistant Entomologist, In Charge of Field Crop Insect Investigations, Department of Agriculture, Ottawa.

At the meeting of the Society held in Toronto in November, 1914, I gave an account of our experiments at Bowesville, Ont., with poisoned bran baits to control locusts.* Such work we considered very encouraging. During the present year, 1915, the Lesser Migratory Locust, *Melanoplus atlanis* Riley, was again enormously abundant in Ontario and Quebec Provinces and to a lesser extent the Pellucid Locust, *Camnula pellucida* Scudd. We were, therefore, able to conduct further experiments and to demonstrate the value of new poisoned baits which had not previously, under field conditions, been used in Canada.

Poisoned Baits Used in 1915.

In June last (1915) arrangements were made to conduct twenty-three experiments with various poisoned baits near Bowesville, Ont. Each experiment was on five acres and the land chosen was from adjacent farms upon which the Lesser Migratory Locust was exceedingly numerous. No poisoned bait had previously been used on any of this land. In addition to bran, shorts and sawdust were also used as carriers for the poison. Formulæ containing bran were easily mixed; shorts did not mix satisfactorily owing to the fact that it becomes sticky and lumpy which, of course, makes it more difficult to spread properly. Sawdust, if fairly well free of small pieces of wood, spreads easily, but in mixing the formulæ containing it care had to be taken to add the water slowly, as the sawdust does not absorb liquid as quickly as bran, otherwise the Paris green is liable to be washed off. In many districts where it is difficult to obtain bran sawdust may often be had for practically nothing.

The following table gives concisely the results of some of our experiments conducted at Bowesville:

*See Rep. Ent. Soc. Ont., 1914 (1915), pp. 97-100.

	Mixture	Crop (5 acres)	Weather	Infestation	Death counts per square yard, 10 made in each field, 4 days after application, beginning at one corner of the field and walking diagonally across to the opposite corner.	Highest	Lowest	Average	Cost of single application per acre including labour	Date of application
1	Bran, 20 lbs. Paris Green, $\frac{1}{2}$ lb. Molasses, 2 qrts. Lemons, 3 Water, $2\frac{1}{2}$ gals.	Millet, 6 in. high	warm and dry	Very heavy. Locusts in all stages. Some winged	75, 10, 7, 575, 10, 40, 100, 241, 70, 90	575	7	121.8	$18\frac{1}{2}$ cents	June 24
2	Bran, 20 lbs. Paris Green, $\frac{1}{2}$ lb. Molasses, 2 qrts. Oranges, 3 Water, $2\frac{1}{2}$ gals.	Pasture	warm and dry	Heavy. Locusts very active. Some beginning to migrate	155, 250, 163, 241, 54, 50, 65, 140, 200, 710	710	50	202.8	19 cents	June 29
3	Bran, 20 lbs. Paris Green, 1 lb. Molasses, 2 qrts. Lemons, 3 Water, $2\frac{3}{4}$ gals.	Oats, 9 in. high	warm and dry	Very heavy. Locusts active. Medium number of winged individuals	26, 736, 38, 300, 36, 50, 230, 100, 300, 25	736	25	184.1	21 cents	June 25
4	Bran, 20 lbs. Paris Green, 1 lb. Molasses, 2 qrts. Oranges, 3 Water, $2\frac{1}{2}$ gals.	Oats, 9 in. high	warm and dry	Very heavy. Locusts active	819, 691, 84, 630, 121, 918, 63, 80, 540, 120	918	63	406.6	$21\frac{1}{2}$ cents	June 28
5	Bran, 10 lbs. Sawdust, 10 lbs. Paris Green, $\frac{1}{2}$ lb. Molasses, 2 qrts. Oranges, 3 Water, $2\frac{1}{2}$ gals.	Pasture	warm and dry	Heavy. Locusts from very small to winged state	127, 100, 15, 40, 360, 35, 30, 25, 100, 200	360	15	103.2	$16\frac{1}{2}$ cents	June 24

	Mixture	Crop (5 acres)	Weather	Infestation	Death counts per square yard, 10 made in each field, 4 days after application, beginning at one corner of the field and walking diagonally across to the opposite corner.				Cost of single application per acre including labour	Date of application
						Highest	Lowest	Average		
6	Bran, 10 lbs. Sawdust, 10 lbs. Paris Green, 1 lb. Molasses, 2 qrts. Lemons, 3 Water, 3 gals.	Oats, 6 in. to 9 in. high	warm and dry	Heavy. Locusts in various stages. Some winged	25, 400, 530, 44, 80, 60, 125, 90, 23, 15	530	15	139.2	18½ cents	June 25
7	Bran, 10 lbs. Sawdust, 10 lbs. Paris Green, 1 lb. Molasses, 2 qrts. Oranges, 3 Water, 2½ gals.	Oats, 6 in. to 9 in. high	warm and dry	Heavy infestation. Locusts active.	118, 116, 197, 33, 70, 258, 204, 200, 190, 104	258	33	149	19 cents	June 25
8	Sawdust, 20 lbs. Paris Green, ½ lb. Salt. ¼ lb. Water, 3 gals.	Oats, 9 in. to 12 in. high	warm and dry	Heavy. Locusts active. Many winged from adjacent uncultivated land	30, 121, 404, 46, 720, 650, 100, 35, 80, 100	720	30	228.6	7 cents	June 25
9	Bran, 20 lbs. Paris Green, 1⅙ lbs. Molasses, 4½ qrts. Water, 2 gals.	Oats, 9 in. to 12 in. high	warm and dry	Heavy. Locusts active.	246, 840, 509, 473, 210, 368, 230, 1,200, 616, 450	1,200	210	514.2	27 cents	June 30

From the above table it will be seen that in fields where mixtures Nos. 2 and 4 containing oranges were used, higher death counts per square yard were obtained. The mixtures in which sawdust was used are, indeed, very promising and further work with these mixtures will be conducted. The results obtained with mixture No. 8 are certainly remarkable and indicate the value of this new and very cheap poisoned bait. In the report of the Society for 1914,* Mr. Norman Criddle stated that he had experimented with sawdust and salt in Manitoba and claimed that with the salt and sawdust he obtained about the same results as with salt and bran. In the experiments tabulated above the highest death rate was obtained, as will be seen, in the use of mixture No. 9, which killed, on an average, 514 locusts per square yard of field.

As above mentioned each mixture treated an area of five acres. In the sawdust mixtures the amount of water necessary, of course, will vary with the dryness or otherwise of the material at hand. Two gallons may be sufficient, or more may be required. The carrier, whether this be sawdust or bran, should be noticeably moistened, not made into a mash, or moistened too much to prevent its being crumbled through the fingers. The farmers in general on whose lands the experiments were conducted were much pleased with the success of the mixtures. Those on whose fields mixtures 3, 4 and 8 were used have specially reported that the crops were saved by the treatment. In all of these experiments only the one application was made. The work of spreading the mixtures and making the death counts was satisfactorily accomplished by Mr. T. Rankin, a student assistant.

At Lanoraie, in Quebec Province, a series of similar experiments were conducted under my direction by Messrs. Beaulieu and Beaulne, officers of the Entomological Branch. Unfortunately, the work here was seriously interfered with by exceptional heavy and continuous rain and wind storms. In heavily infested fields where mixtures similar to Nos. 1, 2, 3 and 4, but with shorts instead of bran, the locusts were much reduced in numbers by the application, but the heavy rains which followed soon after the mixtures were spread made it impossible to make important observations as to the death counts. On June 17, mixture No. 6, as above, was spread in a field of oats. Five days later three counts only were made owing to a misunderstanding and these gave 300, 305 and 328 dead to the square yard. A heavy rain and wind storm took place between 3 p.m. and 9 p.m. on June 17, and undoubtedly many locusts which had fed on the mixture in the early morning were poisoned and later washed away by the deluge. On June 28, mixture No. 1 distributed over a pasture field resulted in an average of 129 dead locusts to the square yard. Sixteen counts were made across the field and on the date mentioned many of the insects were in the winged condition. On June 25 I visited Lanoraie and in a field of rye in which mixture No. 3 with shorts used instead of bran large numbers of dead insects were observed. The following counts in different parts of the field were made, 220, 635, 408, 235, 195, 523, 609, 395, 259, an average of 386 dead to the square yard. Dead locusts were found in numbers as far as 249 feet from the treated field.

Organization and Co-operation Necessary to Control Locusts Over Widespread Areas.

In 1915 the value of early organization to control serious outbreaks of locusts was strikingly illustrated in the Province of Quebec. In the Parish of St. Etienne de Gres where our Entomological Circular No. 5 had been freely

*Rep. Ent. Soc. Ont., 1914, p. 102.

distributed, and where control work had been conducted in 1914, the farmers organized under the immediate direction of Father J. I. Trudel, the resident Parish Priest and Agricultural Missionary. In this parish, practically all farm land—estimated at over 21,000 acres—was treated with mixture No. 1, using Paris green, however, in the strength of 1½ pounds for each 20 pounds of bran. The bran, Paris green, molasses and lemons were purchased in large quantities at wholesale rates, and the mixture distributed over the land during the week beginning June 4, at which time the locusts were from one-quarter to one-half an inch in length. Counts made a few days after the application in various fields ranged from 80 to 120 dead locusts to the square foot. I visited St. Etienne de Gres on June 23 and examined many of the treated fields. Comparatively few living locusts could be seen and the farmers generally were much pleased with the effectiveness of the mixture. Father Trudel estimated that 90 per cent. of the locusts had been killed. Of the area treated about 7,000 acres

Oat field at St. Etienne de Gres., Que., saved by one application of poisoned bait. (Original.)

were in oats. These crops, as well as fields of other grains and vegetables, were saved from destruction. According to the Parish Priest, not a single field was devastated and the pasture lands in addition were protected from injury. The cost of the application at St. Etienne de Gres was 15 cents an acre, exclusive of labor.

Following the advice given in our Entomological Circular No. 5, similar work was carried on in 1915 in the following additional parishes of the Province of Quebec: Mont Carmel, Pointe du Lac, St. Boniface de Shawinigan, and Almaville. The Quebec Department of Agriculture, I am informed by Mr. J. A. Grenier, Provincial Deputy Minister of Agriculture, made the following grants to assist the farmers in the purchase of bran, Paris green, etc.:

St. Etienne	$1,013 00
Mont Carmel	675 00
Pointe du lac	200 00
St. Boniface de Shawinigan	100 00
Almaville	100 00

I have already referred to the results obtained in the Parish of St. Etienne. In the Parish of Mont Carmel the farmers, under the guidance of Father E. Fusey, treated 7,400 acres, of which 2,000 acres consisted of farm land which had been abandoned owing to the continuous outbreaks of the locusts. In some fields, in 1915, crops of vegetables and grain were harvested for the first time in eleven years. The Parish priest reported complete success in the use of mixture No. 1, with Paris green used in the strength of 1½ pounds to the 20 pounds of bran, in his opinion 95 per cent. of the locusts having been killed. On June 22, I visited the parish and very few living locusts, indeed, were present in the fields examined. Mr. G. Beaulieu, Field Officer of the Branch, who was also present in the same district during the period June 20 to 29, could not find any fields sufficiently infested to enable him to undertake control experiments similar to those conducted at Bowesville, Ont. In some fields a second treatment was given owing to very heavy rains following the first spreading.

Part of abandoned farm, Valmont, Que., now a breeding ground for locusts. (Original.)

In the Parishes of Pointe du Lac, St. Boniface de Shawinigan and Almaville, similar satisfactory results were obtained and the farmers generally were well pleased with the poisoned bait, which certainly saved from destruction many fields of crops.

The question of the control of locusts is a very important one to many farmers in Eastern Canada, but we are extremely hopeful as a result of our experimental and field demonstration work, that the destruction of these insects in future outbreaks will be a comparatively simple matter—largely one of proper co-operation. Farmers living in districts where locusts are destructive should organize in early spring so that a sufficient quantity of poison, etc., will be readily available to distribute over the fields when the locusts are about the size shown at *a* and *b* of figure herewith of the Lesser Migratory Locust. The poisoned bait should be applied early in the morning (before or very soon after sunrise) on or about the same day. Twenty pounds of poisoned bait is sufficient to treat five acres. It is, of course, not necessary that the mixture be applied to all of the land, but by scattering it thinly here and there throughout the fields sufficient of the bait will be distributed to attract the locusts from considerable distances. In the preparation of the bait it is wise to guard against the breathing of the fine particles of the Paris green. This may be avoided by tying a handkerchief, loosely, over the mouth and nose.

DR. FERNALD: I would like to ask if there were any experiments made as to the variation in number of the oranges and lemons.

MR. GIBSON: In every case we used only the three fruits to the 20 pounds of carrier.

MR. TREHERNE: In British Columbia we have a lot of range land. Last year we had about 100 square miles destroyed by the Migratory Locust, *M. affinis*. I would like to hear from Mr. C. P. Lounsbury on this.

Lesser Migratory Locust, *Melanoplus atlanis: a, b*, young hoppers; *c*, adult male; *d*, adult female.
(Author's illustration.)

MR. LOUNSBURY: Our South African matters are so very different that I am afraid there would be very little advantage in my discussing them. All our work in South Africa for many years has been done with poisoned baits or spraying. We use arsenite of soda more than Paris green because it is cheaper.

We have never attained anything with the citrus fruits. Does the fruit juice add much to the attractiveness of the bait?

MR. GIBSON: The fruit juice is, of course, supposed to add to the attractiveness of the bait. We have never had any definite experiments to bear out this fact. In the case of the new sawdust mixture containing salt alone, the salt is undoubtedly the attractant.

MR. WINN: If there are no further discussions on Mr. Gibson's paper I will call on Professor Caesar to give his paper on "Apple Leaf-rollers in Ontario."

LEAF-ROLLERS ATTACKING APPLES.

L. Caesar, Ontario Agricultural College, Guelph.

On the discovery last year that in at least two well-cared-for commercial orchards much loss had been done by the Fruit-tree Leaf-roller* [*Tortrix* (*Cacœcia*) *argyrospila*], which has the last few years become a very troublesome pest in many parts of the United States, it seemed to me wise to study the habits and life-history of this insect in Ontario so that I might be in a position from actual experience to advise as to the best methods of control in case the insect should increase in numbers and attack more orchards. In this and other investigation work I had the assistance of my colleague, Mr. G. J. Spencer, for a few weeks, and of Mr. H. G. Crawford, a recent graduate, for the whole season. The investigations were conducted chiefly in the large apple orchard of Mr. Jas. E. Johnson, Simcoe, Norfolk County.

Species of Leaf-rollers Found in the Orchard.

We expected to find two species of Leaf-rollers [*Tortrix* (*Cacœcia*) *argyrospila*] and the Oblique-banded Leaf-roller [*Tortrix* (*Cacœcia*) *rosaceana*]. I knew, however, from the large number of unidentified egg masses on the trees that there was another insect present, but what it was I had no idea. Later on we found that it too, was a leaf-roller, which proved to be *Tortrix* (*Cacœcia*) *semiferana,* the Box-Elder (Manitoba Maple) Leaf-roller. We thus had three species working side by side.

A very peculiar circumstance in connection with our work was that though there were about 60 acres of large apple trees in one solid block, the three most important pests studied, the Fruit-tree Leaf-roller, the Box-Elder Leaf-roller and the Capsid (*Neurocolpus nubilus*) were all found together towards the centre of this orchard on a block of Spy trees of 6 to 10 acres in extent. Bordering rows of Baldwin trees were also attacked but those some distance removed, as also distant Spy and Greening trees, were very little injured. The explanation of this localization of insects is hard to discover. This part of the orchard had been in sod longer than the other parts but that scarcely seems sufficient explanation. Prof. Gillette has remarked upon the tendency of the Box-Elder Leaf-roller to appear at the same time and in the same neighborhood, but not on the same kinds of trees as the Fruit-tree Leaf-roller. It is well known that the latter very commonly centres itself in one locality injuring perhaps a single orchard severely and scarcely attacking at all another a few rods away.

Relative Abundance of Each Species.

Though the egg masses of *semiferana* were almost as abundant as those of *argyrospila* the larvæ of the latter were many times more numerous, at any rate towards the end of the season. This may have been due to the former species being less immune to poisonous sprays (Lugger of Minnesota reported that Paris green controlled this species) or to some other unknown cause. *Rosaceana* was not nearly so abundant even as *semiferana.* About nine-tenths of the total injury was done by *argyrospila.*

*Mr. August Busck states that the generic name "Archips" has been dropped and "Cacoecia" is tentatively retained as a subdivision of Tortrix.

Distribution in the Province.

Argyrospila is so common and so widely distributed all over the United States that it is not at all surprising to find that it exists almost, if not quite, all through the fruit districts of Ontario. I have either captured or reared adults from places here and there all the way from Ottawa to Norfolk County and feel sure I could, with a little searching, find them in almost all other fruit counties. This clearly indicates that it is by no means a new pest, but that through some peculiar absence of natural means of control has the last two or three years suddenly become a very destructive one in a few orchards and may yet become so in others.

Rosaceana was until the last couple of years considered our most common and destructive apple leaf-roller. It is seldom present, however, in large numbers. It, too, has existed all over the Province for many years.

Semiferana is very little known in Ontario. There is one specimen in the collection of the Ontario Entomological Society, but without any data as to where and when it was taken. A specimen was taken by Dr. Fyles at Levis, Quebec, and one is reported as being in Mr. Winn's collection, but he has no recollection of having seen or taken any. There is no record of it from Nova Scotia. In Ontario, Mr. Crawford and I have searched in several localities this fall for egg masses, but found none outside of the orchard at Simcoe. It is very probable, however, that a careful search of forests would show its presence in quite a number of localities, otherwise it is difficult to account for its abundance at Simcoe.

Host Plants.

At Simcoe we found the Fruit-tree Leaf-roller (*argyrospila*) preferred apple trees to any other kinds. A few were observed on pears, plums and peaches, and also on oaks. In the orchard it was seen that the larvæ fed freely upon almost any kind of succulent or moderately succulent weed beneath the trees. They were very fond, too, of the leaves and heads of clover and of vetch in such positions. A study of the literature on the subject shows that it has a very large number of food plants, including numerous weeds, forest and shade trees, and shrubs. So that it is by no means limited to fruit trees.

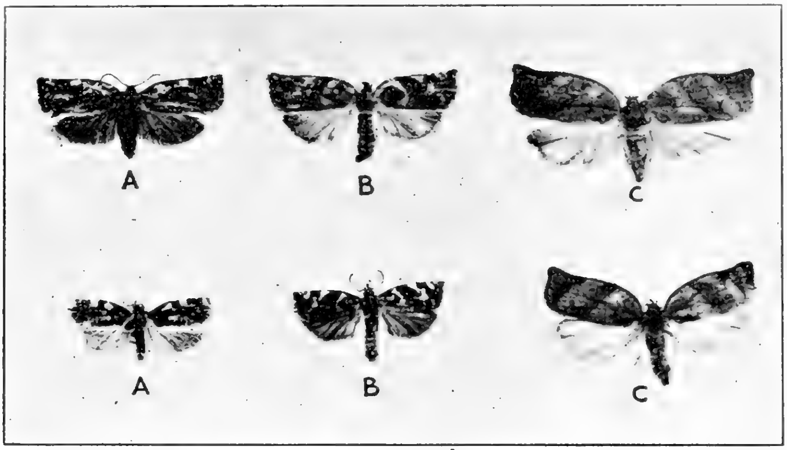
The Oblique-banded Leaf-roller (*rosaceana*) is found most commonly on apples and pears but from the list of host plants given by Slingerland and Crosby, which include several weeds and clovers, it must be almost as omnivorous as the Fruit-tree Leaf-roller.

The Box-elder Leaf-roller (*semiferana*) has never before, so far as I can find, been reported as attacking apples. A few wild cherries and currants beside Box-elders have been found by Lugger slightly infested. Its favorite food, however, is the Box-elder, often called the Manitoba Maple. In Colorado and Minnesota it has been reported as occurring at times in great numbers on these trees. It is recorded also from oaks and hickory.

Nature and Extent of the Injury Done.

So far as we could see from a single season's work, the feeding habits and injuries done in the orchard by all three species were so similar that a description of what was closely observed in the case of the Fruit-tree Leaf-roller will serve for all.

We were not able to begin our work until May 3rd and by this time the majority of the larvæ had hatched and entered the opening leaflets of the infested Spy trees and were feeding on the interior. The larvæ had apparently begun to hatch, as stated by various writers on the subject, soon after the buds began to burst. By May 3rd, the leaflets were about one inch long but the blossoms were not yet ready to burst. Leaflets containing a larva inside were prevented by the silken threads from opening for some time. Later-hatching larvæ rolled the expanded leaves up, either the whole leaf being folded or only a portion of one side. When the fruit buds were ready to burst these were in many cases preferred to the leaves and the larvæ bored into them and fed upon the stamens, pistils or ovaries, thus destroying the promise of fruit. Sometimes, as the cluster of blossom buds opened, a silken web was spun around these and perhaps an adjoining leaf or two, and the larvæ fed on the parts inside the web. Under these circumstances the blossom stems were often cut off. When that was not done, the blossoms themselves were usually unable to open properly because of the web. When the fruit began to form many of the caterpillars deserted the leaves for this and ate large or small areas in it. Sometimes the areas were only shallow, but some-



Adults of (*a*) *Archips agryrospila;* (*b*) *A. semiferana;* (*c*) *A. rosaceana.* (All natural size.)

times they extended right through to the core. In the case of plums they often reached right into the pit. Almost all apples with very deep injuries dropped soon. The others, if they remained on the tree, were always more or less deformed and as a rule rendered culls. A callous growth with russet surface soon formed over the injured area and protected it from the air and rain. Feeding on small apples was usually done under some kind of protection, such as a leaf fastened by the larva to the apple or a little web spun over the hole made. When the larvæ fed upon the large expanded leaves they nearly always chose those last formed and therefore most succulent. These they rolled either upwards or downwards, about 66 per cent. being rolled up so that the upper surface was the enclosed one, the remainder being rolled the opposite way. Migration from older leaves to younger seemed to be quite common and helped to explain the difficulty of killing the larvæ by arsenicals. The larvæ, when in the large rolled leaves, fed either by eating holes through the leaves or by devouring the apical or basal portions, leaving the rest intact. When disturbed they readily dropped down by a single thread and usually crawled back to the leaf when all was quiet.

Where the larvæ were very abundant they did a great deal of damage both to the foliage and the fruit. Large numbers of the terminal leaves in such cases, especially on the top of the tree, were badly tattered and riddled by them, but none of the trees were defoliated as had happened in some cases in Colorado and elsewhere. In the orchard at Simcoe there was so light a setting of fruit on most of the Spy trees this year that it was difficult to form any estimate of the amount of loss. On one well-laden tree, however, of another variety in among the Spy trees fully 50 per cent. of the fruit was ruined either by the destruction of the fruit blossoms or by the killing of the young fruits themselves or by rendering much of what remained culls. In an orchard near Hamilton I estimated that some large Greening trees had fully 50 per cent. of the crop destroyed. Mr. Sexsmith of Trenton estimated that in his ten or twelve acre orchard the crop had been lessened fully 50 per cent. in the infested orchard both last year and this. Another orchard of his, and all the neighboring orchards visited by me, had suffered almost no injury. In Norfolk County we found only the one orchard at all seriously infested, though a few larvæ were to be found all through the district.

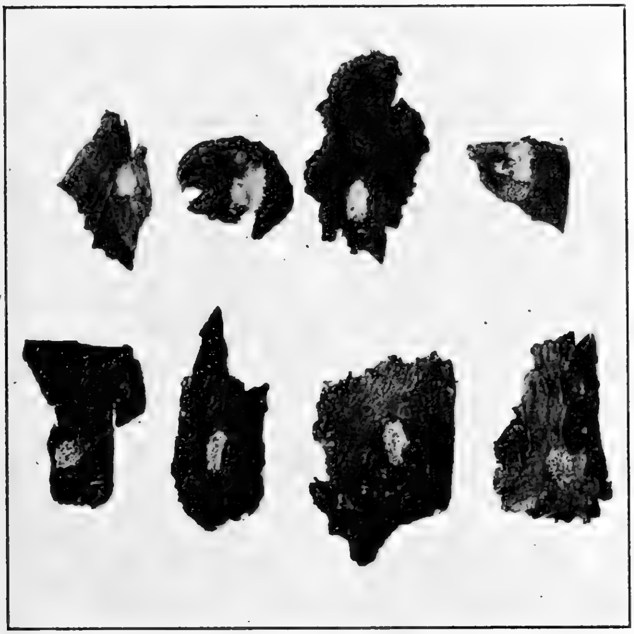
Egg masses of *A. argyrospila*. The four to the right have hatched. and are white; the remainder are unhatched and are dark brown. (Natural size.)

An examination of the only three badly infested orchards known to me showed that any variety of apple was subject to attack and that there was no reason to believe that there was any special attractiveness in the Spy over other varieties.

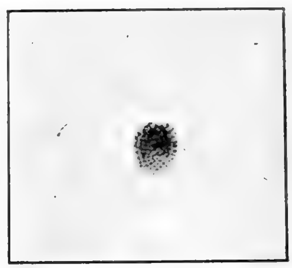
Brief Descriptions of the Adults of Each Species.

The adult of the Fruit-tree Leaf-roller is a moth with a wing expanse of from two-thirds of an inch to one inch. The general colour of the fore wings is a rusty brown with several silvery-white or silvery-gray markings which vary somewhat in different individuals, but are usually of the size and arrangement shown in the photograph. The hind wings are a light ashy brown color without any markings.

The Box-elder Leaf-roller adult resembles very closely in shape, size and whitish markings, the above species. It differs, however, from it in that the general color of the forewings is a much lighter brown, almost a fawn color. The hind wings in the former species contrasted strongly in colour with the fore wings but in this species they are practically the same pale brown or fawn color only a little lighter in shade. Moreover, the white markings, as seen in the photograph, usually continue farther in from the front margin forming in the case of two of them irregular oblique transverse bands reaching most of the way across the wing. In many males there is a noticeable dark brown spot, the size of the head of a pin, enclosed or nearly enclosed by white areas and situated in the middle of the front wing at about the outer part of the first third. There are some very light colored specimens in which the white markings are very indistinct.



Egg masses of *A. semiferana* on pieces of apple bark. Those in the upper row, with one exception, are unhatched; the remainder have hatched. (Natural size.)

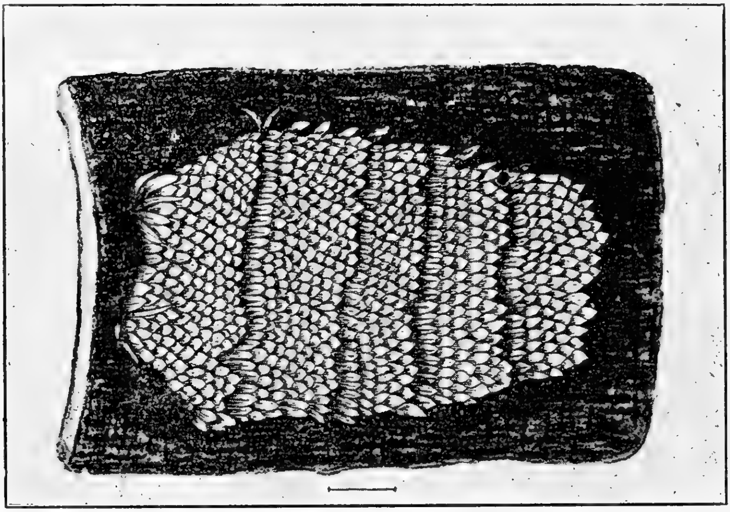


Egg masses of *A. rosaceana*, laid on glass. The little line to the side is a young larva just emerged from an egg. (Natural size.)

The adult of the Oblique-banded Leaf-roller is, as seen in the photograph, considerably larger than either of the above species though many specimens are smaller than those pictured. It can easily be distinguished from either species by the absence of white markings and by the front wings being a dull light brown with two wide darker brown transverse bands on the outer half running obliquely outwards from the front margin. The outer of these bands is sometimes incomplete. The hind wings are of a lighter brown than the front. There are some very pale specimens of this species, too, compared with the typical forms.

Description of Egg Masses of the Different Species.

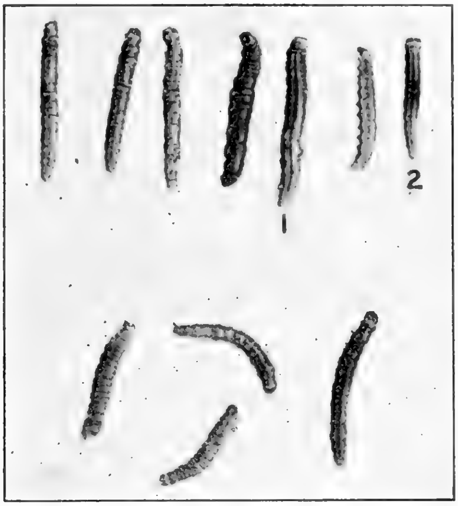
All three species lay their eggs in clusters as seen in the photographs. The egg masses of the Fruit-tree Leaf-roller are roughly oval in shape, about three-sixteenths of an inch in length, and are covered with a protective secretion. They are, with very rare exceptions, laid on twigs of two or three years' growth, and commonly on some slight slope on these such as occurs at the base of a branch or fruit spur. They are nearly always deposited on the upper surface or sides of the twig, only two or three having been found on the underside. Freshly laid masses are yellowish green but soon turn dark brown, a little darker brown than the twigs on which they are laid. After hatching they gradually become grayish white and are then more easily seen. The little openings show where the caterpillars emerged. Old egg masses sometimes remain on the trees for two years before weathering away. Each egg mass contains an average of about 95 eggs, the smallest number found being 6 and the largest 143.



Egg masses of *A. semiferana* much enlarged to show the scales from the moth's abdomen that form the covering. (After Gillette.)

The egg masses of the Box-elder Leaf-roller are easily distinguished from any other egg mass likely to be found in that they are covered over with scales. We have not observed the female laying the eggs, but there seems no doubt that after she has deposited and covered them over with a sticky secretion she presses her abdomen down upon this secretion and leaves all the scales there arranged as in nature. This would lead us to infer that only one egg mass is laid by each female. The masses are, as seen in the figure, roughly oval, are a little smaller than those of the Fruit-tree Leaf-roller and are glossy cream in color. They usually appear to contain from 20 to 60 eggs. Unlike those of the first species the egg masses are not laid on twigs but chiefly in the axils of branches of from about one to two inches in diameter, and on the bark of the larger branches of 1½ inches and upwards in thickness. A few are found on the trunk. The eggs are usually placed in a slight depression on the bark.

Only four egg masses of the Oblique-banded Leaf-roller were seen. Two of these were laid on the glass in rearing cages (one of these is shown in the photograph) one on a leaf in the orchard and another on the bark of a young apple tree. The mass is pale green before hatching and then becomes transparent and almost colorless. The eggs lap one over the other somewhat as shingles. The mass is a little larger than that of the Fruit-tree Leaf-roller and contains an average of about 100 eggs. When ready to hatch, as in the photograph, the black heads of the little larvæ show through the mass very distinctly and make it easy to count the eggs.



Full-grown larvae: 1 and 2 of *A. semiferana*, the remainder of *A. argyrospila*. (Natural size.)

Empty pupal cases (*a*) of *A. semiferana*, (*b*) of *A. argyrospila*. Note that the former are very much lighter in colour, often being nearly white. (Natural size.)

Comparison of the Larvæ.

The larvæ of all three species closely resemble each other both in appearance and habits, and therefore will not be distinguished by the fruit growers. In the early part of the season up to the time when the fruit begins to be attacked the larva of the Oblique-banded species will nearly always be the largest of the three because it reaches maturity earliest. It is, when full grown, nearly an inch long, green in color, with a black or blackish head and thoracic shield.

The full grown larva of the Fruit-tree Leaf-roller is usually more of a pale yellowish-green color; it also has a black head and thoracic shield in all stages except the last when these usually change to brown.

The full grown Box-elder larva is like the above two in being nearly an inch long. It is a very pale apple green color and can be distinguished from either of the above species by the head and thoracic shield being a whitish green instead of black. There is often a slight mottling of brown on these parts, and in some specimens at least, the segments are indistinctly divided by pale yellowish-white lines. There is a dark green line down the middle of the back.

Comparison of the Pupæ.

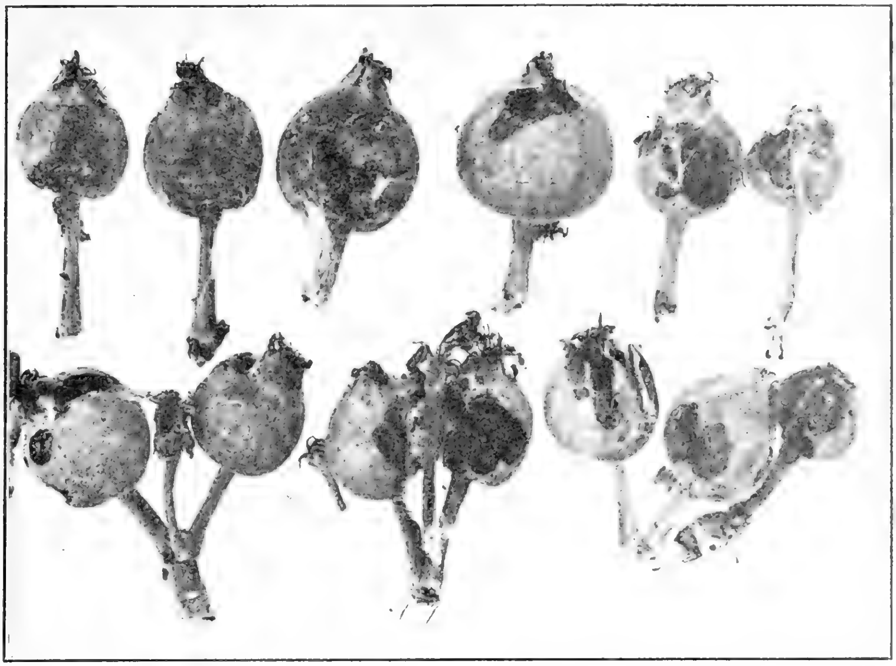
It does not seem worth while to go into details in regard to the differences between the pupæ, further than to remark that those of the Fruit-tree Leaf-roller and of the Oblique-banded species are brown, whereas those of the Box-elder species are whitish both before and after the adults emerge.

Life-Histories.

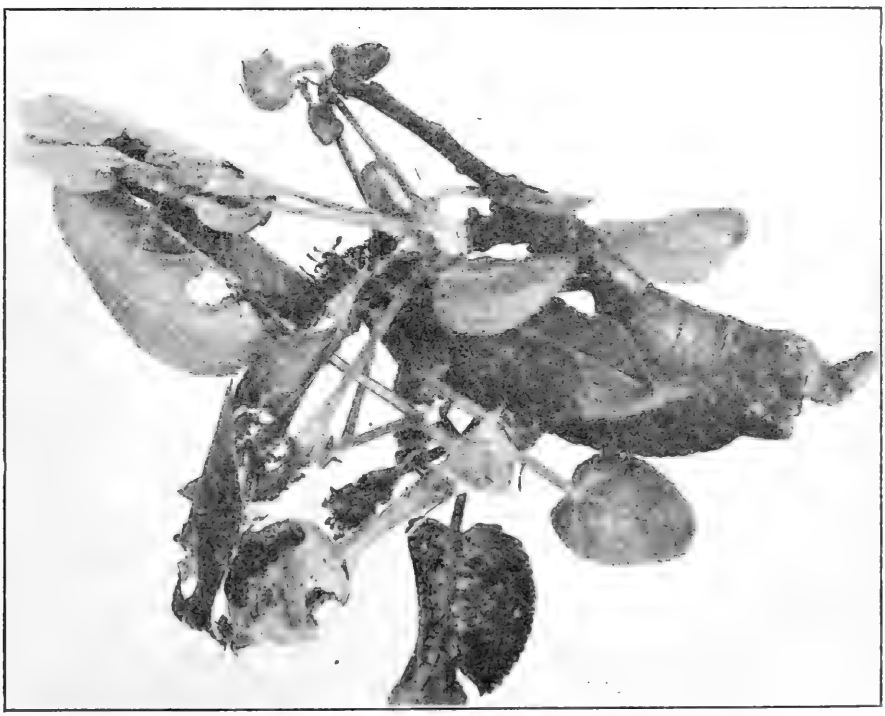
The winter is passed by all the species in the egg stage on the trees. We did not prove this of the Oblique-banded species because the larvæ of the second brood of this species all died in the cages, but Herrick, of Cornell, has shown that eggs are laid by the second brood adults and the winter passed in that stage. The eggs of all three begin to hatch near the same time, which is usually very soon after the buds are beginning to burst. Almost all those of the Box-elder Leaf-roller and also of the majority of the Fruit-tree Leaf-roller had hatched by May 3, which was a few days before the blossoms on the Spy began to burst. At this date the larvæ of these two species were still very small, being only about ⅛ inch long. Hatching of *argyrospila* eggs continued for a month, the last newly hatched larva being seen June 8th.

By May 25th the Oblique-banded Leaf-roller had begun to pupate and by June 10 the first adult was seen. The latter date was about two weeks after the blossoms fell from the Spy trees. The pupal stage of this species, judged from the few specimens reared, lasted about 13 days. The larvæ of the Fruit-tree Leaf-roller began to pupate about June 14, but larvæ were present for three weeks or more later. Adults were first seen in the orchard on June 26th. After this they soon became quite common. By July 12 they seemed to have reached the maximum, and then quickly decreased in number, the last being seen on July 22. The length of the pupal stage averaged 11.5 days. Adults in cages lived only five or six days.

The first pupa of the Box-elder species was found on June 26th, but there must have been pupæ earlier than this for adults were found on July 3rd, and cage experiments showed that the pupal stage lasted about 12 days on an average.



Young apples injured by Leaf-roller larvae. (Natural size.)



Work of Leaf-rollers on leaves and fruit clusters. Note the rolled leaves and the young dead fruit stems fastened to them. (Natural size.)

From July 3rd they increased rapidly and were still abundant July 20th, but soon after disappeared. They were seen, however, a week or more later in the orchard than the preceding species.

The above data shows that this year *T. rosaceana* adults began to emerge about two weeks earlier than those of *T. argyrospila* and the latter about a week earlier than those of *T. semiferana.*

Rosaceana and *semiferana* seemed to pupate almost invariably in the leaves, but much to our surprise fully half of the pupation of *argyrospila* either took place on weeds or in the grass or else the pupæ were shaken by the wind out of the leaves into the grass beneath. For instance, we spread a covering of cheesecloth, 8 x 10 ft. in size, on the ground beneath a tree on June 26th after emergence had begun and under this 320 pupæ or empty pupal cases were found and

Some of the parasites that help to control Leaf-rollers. On the left are Tachina Flies and their puparia; on the right Ichneumons.

upon it 84 pupæ, making a total of more than 400 which we estimated was a larger number than the total of the pupæ on the corresponding part of the tree above the sheet. There was no lack of food on the trees to force them to descend and very few weeds other than withered blue grass. Wherever there were succulent weeds under infected trees many larvæ fed and pupated in these.

None of the species of moth fly around in the day, unless disturbed, and then with a rapid zigzag motion they fly down into the grass to hide. Owing to the distance (2½ miles) of the orchard from our boarding places and the fact that the moths did not lay during the day time so far as we could tell, we did not see any of them ovipositing but know that the eggs outside are laid within a few days after the emergence of the adult, just as they are in the cages.

There is clearly only one brood a year of the Fruit-tree Leaf-roller and of the Box-elder Leaf-roller respectively, but there are two broods of the Oblique-banded species. The eggs of this last species, laid in the cages, began to hatch in seven days after they were laid. The young larvæ once they began to emerge out of the mass did so in a very short period and were seen to be very active from the moment of emergence. They were placed upon succulent shoots at the base of a tree and caged in but for some unknown reason died before reaching maturity.

Natural Enemies.

1. Spiders, ants, syrphid-fly larvæ and pentatomids each destroyed some larvæ but not a large number compared with the total.

2. A number of instances were observed where very active Leaf-roller larvæ devoured their more sluggish brothers, the sluggishness being due either to disease or preparations for moulting or pupation.

3. Birds feed to some extent upon them, but there were very few birds in the Johnson orchard.

4. Disease almost all through the larval season destroyed a considerable number, especially towards the end of the season. Pupæ, too, were evidently diseased for many were found that shrivelled up and turned black. Some of these had been parasitized but many had not. The dead larvæ were not killed by spraying as they were found also on unsprayed trees.

5. Tachinid parasites were present in moderate numbers. There were two species of these: *Masicera eufitchiæ,* Townsend, and *Exorista cæsar,* Aldrich, n. sp. The latter were far the more numerous. (Dr. J. M. Aldrich kindly indentified the Tachinidæ for me.)

6. At least two and possibly three species of Ichneumons were common but we have not yet been able to get them determined.

Apparently not more than 5 per cent. of the larvæ were destroyed by parasites. They would probably have been much more abundant if the weather had been warmer. The month of June was very cold and on cold days parasites scarcely appeared at all. Disease evidently played a greater part in control than parasites.

For some reason more than half of the eggs of the first brood moths of *rosaceana* failed to hatch though the larvæ could be seen very plainly inside, but, as stated above, we found only four egg masses of this species.

Methods of Control.

We, probably like everyone else who has examined the work of *Tortrix* (*Cacœcia*) *argyrospila,* found it hard to believe that a caterpillar that left the leaves in such an eaten, ragged condition could not be satisfactorily combated with arsenical sprays but our experience this year leads us to agree with Herrick, Childs and several others that arsenical sprays are not satisfactory. They kill a considerable number but not nearly enough to prevent great loss. There are two reasons for the failure of these poisons to be effective:—(1) While the larvæ are still small and will die if they eat the poison, their habits of feeding prevent the great majority of them from getting access to it. This is because as soon as they hatch they usually seek an opening bud or leaf just beginning to unfold itself, and work into the centre of these, feeding in the interior and therefore unpoisoned part, and retarding for a considerable time the opening. On Spy trees, at least, unfolded leaves suitable for the later hatching larvæ to hide in are present until the blossoms are wide open, and are sought by the majority of the young larvæ in preference to open leaves. The undeveloped fruit buds are also sought. (2) When the larvæ become large they seem to be very little affected by the poison. We found many well poisoned leaves being eaten and the larvæ perfectly healthy.

That the poison will kill the younger larvæ if they eat it was proved by Mr. Crawford by immersing infested twigs in various strengths of arsenate of lead in water. He used 2, 3, 4 and 5 lbs. to 40 gals. of water respectively, and killed all larvæ with each strength except those in the undeveloped leaves that were so closely folded that the liquid did not get in. It entered all loosely rolled leaves. This sort of dipping, however, is very different from the very best spraying even with power machines that can be done, especially on large trees, because the spray fails to get into many a loosely rolled leaf, or mass of blossom clusters or leaves webbed together.

Unfortunately, I was too busy conducting spraying experiments for San José Scale, Canker Worms, Codling Moth and Apple Scab in an orchard in the Niagara district to do the spraying myself at Simcoe, and Mr. Crawford was too busy watching the three Leaf-rollers and the Capsid to devote much of his time to it. Mr. Johnson, however, had a good outfit and certainly sprayed more thoroughly than most men would do. He was just as eager to kill these insects as we were. Four applications with double strength arsenate of lead (almost 4 lbs. to 40 gals. of dilute lime-sulphur) were used. The first was just as the leaflets began to appear, the second just before the blossoms opened, the third as soon as the blossoms fell, and the last two weeks later. Black-leaf-40 was used at his own desire with the last of these to destroy Aphids. The foliage showed whitish all summer long with these heavy sprayings.

Mr. Sexsmith, of Trenton, on my advice also sprayed his orchard very heavily before the blossoms opened and used double strength arsenate of lead. He also sprayed heavily for the Codling Moth. Yet in both orchards the results were very disappointing for there were numerous larvæ left and many observations in the former by Mr. Crawford and myself convinced us that only a small percentage of the larvæ had been poisoned. I intend, however, to re-test this next year and supervise all the spraying myself.

Black-Leaf-40, it is claimed by some, will control this pest if applied while they are young. Gill, of Washington Bureau, tested this but did not get so good results as from arsenate of lead alone. It certainly had no lasting effect upon the medium sized larvæ at Simcoe, though for a little while it seemed to stupify some of them. It doubtless would help in the spray just before the blossoms burst, but would not kill the larvæ in the closely folded leaves and buds. It seems to me we could not possibly hope to get satisfactory results from it even with two applications. It is, moreover, very costly.

Lime-sulphur is known to be useless against the eggs.

Miscible oils alone have given really satisfactory results to most investigators. This spray is used only against the eggs.

I sent Mr. Johnson ten gallons of Scalecide and instructed him to dilute this 1 to 5 and to spray just as the buds were ready to burst. He was told to centre his spraying on the twigs of the infested Spys and pay no attention to the bare branches and trunk. He did so and used about from 4 to 5 gals. to a tree One Baldwin tree he sprayed heavily. The result was that this tree showed approximately 80 per cent. of unhatched eggs, unsprayed trees only about 2 per cent., and the lightly sprayed Spy trees not more than from 10 to 25 per cent. The explanation, however, of the poor result is simple but very instructive.

Scalecide will not kill the eggs unless they are thoroughly wet and *4 to 5 gallons per tree was not more than half enough to wet all the twigs on these large 40-year-old Spy trees.* It only allowed for a fine mist. Both he and I were afraid to risk heavy spraying with a miscible oil without further experience with it. I also observed that on large Spy trees with their tendency for upright twigs and branches the same care would be necessary to do thorough work as if one were spraying for San José Scale, otherwise numerous twigs at the farther side of a tree would have only one side of their bark wet because of the failure of the spray to reach through that far. Most reported experiments with miscible oils have been done on trees 12 to 14 years of age, but these are vastly easier to spray thoroughly than trees twice or three times their size. A strong wind would help greatly in this spraying. Also well pruned trees would be a great boon. Mr. Johnson's, however, were very well pruned.

Scalecide and another as yet unnamed miscible oil, and also Caustic Soda solution, were tested this August on egg masses, and though used very strong, have had no effect upon the eggs of either *argyrosphila* or *semiferana,* so that fall spraying appears to be useless.

Recommendations.

From the experience gained this year, we feel like recommending the following methods of control:

1. Prune trees well, thinning out the excessive branches and twigs and lowering the trees where possible. This is to make spraying easier, cheaper and more effective.

2. Spray very thoroughly with Scalecide or some other good miscible oil, just as the leaf-buds are almost ready to burst but so as to finish before they have done so. Take care to wet well the top and both sides of all the twigs. There are scarcely any eggs on the underside of twigs or on any large branch at least in Ontario.

3. Use 3 to 4 lbs. arsenate of lead to 40 gals. of dilute lime-sulphur or Bordeaux mixture in the application just before the blossoms burst, and drench the foliage, covering even the underside of the leaves.

4. Spray again heavily for Codling Moth with 3 instead of 2 lbs. arsenate of lead.

Note.—If Scalecide or other good miscible oil is considered too expensive or cannot be secured, add Black-Leaf-40 or some equally strong tobacco extract to the spray before the blossoms burst, using a little stronger than for Aphids, and using lime-sulphur, not Bordeaux, with it.

5. If the fruit grower has many chickens and can establish these in the orchard, they will destroy great numbers of larvæ and pupæ whether the orchard is cultivated or not.

6. Cultivation up to as late as safe for the district, with moderately deep discing the last time, should help to destroy many larvæ and pupæ that reach the ground or that are feeding on the weeds that may spring up from time to time. Adults from pupæ buried 2 inches deep by Mr. Crawford were found by him to be unable to emerge.

Mr. Winn: I am sure you have all enjoyed Professor Caesar's paper.

Prof. Caesar: As to dust sprays for Leaf-rollers, I should say that there is some reason to believe that the dust spray would enter better into the places where these little larvæ are concealed than the liquid spray.

Mr. Treherne: May I ask a question? Have you tested the effect of sprays like Bordeaux and lime-sulphur in relation to the oil coating on trees?

Prof. Caesar: We could not make any definite statements in this connection.

Mr. Sanders: Did you find any variation in the color of the heads of *Archips rosaceana?*

Prof. Caesar: I may say that we laboured under difficulties as at first we did not know which larvæ were which. I am not sure how much variation there was. This species was rare in the orchard.

Mr. Petch: In regard to this new pest in the Province of Quebec for three years out of the last four we have not had them at all. Last year they appeared and attacked 75 per cent. of the fruit in some orchards; this year in the very same orchards after the ordinary spraying there was no injury. We have both species that were mentioned. It seems to me that this pest has, through some climatic conditions or through some assistance, come over to our fruit land and, through some other means which I do not know, disappeared. Previously I do not know that it has been recorded in the Province of Quebec as a serious pest.

Mr. Winn: I think there is some doubt as to where that species came from.

Prof. Caesar: I would like to say that there is little doubt that this insect will come under control within a few years.

Mr. Winn: There are fifteen minutes left to be devoted to questions that may be asked. The meeting is open for general discussion.

Mr. Treherne: I would like to start the discussion by asking for some information on the latest sprays, like Soluble Sulphur, Blackleaf 40, and the different kinds of oil sprays.

Mr. Sanders: We had very much experience with Soluble Sulphur this year, but we are not in a position to make any recommendations on this material, although some day we may be able to make a spray of it.

Dr. Fernald: I have had a little experience with soluble sulphur and I may say that under the conditions in which I used it it did did not prove a good poison. Some experiments made years ago and not published until after they had long been duplicated, beginning first with the analysis of the lime sulphur and determinations of the ingredients found in it, show conclusively that the results at that time under those circumstances were obtained with polysulphids and thiosulphate, and that when these reduced to sulphite we got absolutely no results whatever. I have some hope, however, for soluble sulphur, though I may have nothing whatever to base my hope on after all. It is, perhaps, among the possibilities that the Red Spider may yet prove to be more or less successfully attacked by such a substance as soluble sulphur. It is one of the things that I hope yet to carry on experiments with. I can only say, therefore, that I am hoping there is something in it, and yet I do not know.

Mr. Sanders: Did you ever have any experience with Barium sulphide.

Dr. Fernald: Yes. We tried it this year and watched the results carefully all summer on San José Scale. The results have been quite satisfactory. The same trees which a year ago last spring were treated with the lime sulphur, and this year with Barium sulphide, were on the whole in better condition than they were a year ago. That does not mean, you will realize, that the treatment was distinctly better than lime sulphur, because there might have been other factors this summer which did not appear a year ago, but if we can get anything like the same results we found it a much more convenient substance to handle. It is much more easily shipped.

Mr. Petch: I would like to say from our experience in Quebec, although small, that the use of these various spray mixtures ought to depend upon the insects which we have to control. For instance, we know that ordinary lime sulphur will largely control the Tent Caterpillar if sprayed at the proper time, and when we used a soluble sulphur we had absolutely no results at all in controlling the Tent Caterpillar. Furthermore, this year I have used arsenite of lime, one quart to forty gallons, and there has been absolutely no injury to the foliage. It was combined with Bordeaux mixture.

Mr. Sanders: The arsenite of lime we used burned the foliage very badly in almost every case.

Prof. Caesar: As for Soluble Sulphur, I may say we tested this mixture on old, badly infested apple orchards two years ago in the Niagara district and again this year, and found it gave very good satisfaction against San José Scale, just as good as lime sulphur or Scalecide. We have not tested Barium sulphide because the company could not supply us with it. We have also obtained good results from soluble sulphur as a summer spray, but found it, when used with arsenate of lead, more inclined to burn than the lime sulphur.

Arsenite of lime with lime sulphur is a decidedly dangerous spray to use. I have burned nearly every leaf off trees with it, but there are some people who still use it and get very little burning. When used with Bordeaux mixture it is usually safe. It is particularly good for spraying potatoes used along with Bordeaux.

The matter of injury from sprays to apple foliage depends to a great extent upon moisture condition. If the spray, particularly lime sulphur, dries quickly after being applied there is usually no burning, but if it remains in a liquid state on the leaves for some considerable time due to fog or rain, it may do a good deal of burning.

Mr. Sanders: I think that has been the experience all over the country this year; it has become a question of moisture.

Mr. Winn: I will ask Dr. Hewitt to make a few remarks about the smoker.

Prof. Lochhead: Before adjourning, I have much pleasure in rising to move a vote of thanks to our retiring President. I have observed him for the last three years, and during that time Dr. Hewitt has presided over our deliberations and carried the meetings through to a most successful conclusion. For the last two years he has been President by right of choice and he has brought the society to a most flourishing condition. Last year we had a most enjoyable meeting in Toronto, and this year it has been still better. I think all will agree that our proceedings have been most excellent. I would like also to include in my motion the thanks of the society to our visitors. We are very much indebted to Professor Fernald and Mr. Burgess for coming up to Canada, and we are also extremely pleased to have Mr. Lounsbury, of South Africa, with us. They are all distinguished visitors, and they have been helping us out wonderfully. I know that the society will show their appreciation in a fitting manner.

Prof. Caesar: There is not one of us here but endorses what Professor Lochhead has just said. Dr. Hewitt has certainly done wonders for the Society the last few years. Of course, behind Dr. Hewitt has been Mr. Gibson and the other members at Ottawa. It is really a great pleasure and a great source of benefit to be able in the discussions we have had to call upon those who have come from outside, and we have had a broader view of entomology and a greater amount of benefit from the presence of these men.

MR. GIBSON: I would like to move a vote of thanks to Dr. F. J. White, the Principal of the Normal School, for allowing us the use of the Assembly Hall last evening.

MR. TOTHILL: In rising to second this motion I may say that this has been one of the most enjoyable meetings of this organization.

A PRELIMINARY LIST OF PARASITIC INSECTS KNOWN TO OCCUR IN CANADA.

R. C. TREHERNE, FIELD OFFICER, ENTOMOLOGICAL BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA.

The following list of parasitic insects of some of the more common pests is presented to guide entomologists in Canada in the numbers and names of parasites recorded in Canada. This list does not claim to include all known parasitic insects recorded in Canada, but it is hoped that as times goes on it may be supplemented by additional data and become a more complete guide for reference.

In preparing this present list the following literature has been consulted:—

(1) The Reports of the Ontario Entomological Society, 1870-1914.

(2) The Reports of the Dominion Entomologist in the Experimental Farms Reports and separate Reports of the Department of Agriculture of Canada, 1884-1914.

(3) The Bulletins of the Division of Entomology and the Entomological Branch of the Dominion Department of Agriculture until the close of March, 1915.

(4) The Annual Reports of the Department of Agriculture, Ontario, 1880-1913.

(5) The various Agricultural and Entomological publications from Nova Scotia, New Brunswick, Quebec, and British Columbia, until the close of 1914.

(6) The Annual Reports of the Quebec Society for the Protection of Plants, 1909-1914.

An occasional reference is made to *The Canadian Entomologist,* but no effort has been made to include the many valuable records incorporated within the pages of this journal. This will be done on a later occasion. The same applies to the Proceedings of the United States National Museum, and other publications issued in the United States, in which many original records of parasites named from Canadian material may be found.

As a general rule I have recorded in the following list only the names of parasitic insects mentioned as definitely determined species, and further so as far as possible, only records in which the host and its parasite or parasites are clearly shown to be associated and to occur in Canada.

Alsophila pometaria Harris. The Fall Canker Worm.

APANTELES PALÆACRITÆ Ril.

Braconid.. *Report* XXIV., Ent. Soc. Ont., 1893, p. 25. Harrington, On larva. Ottawa, Ontario.

HEMITELES SESSILIS (Gmel) Grav. (? secondary).

Ichneumon. Rpt. XXIV., Ent. Soc. Ont., 1893, p. 25. Harrington. On larva. Ottawa, Ont.

Ambesa walsinghami Rag. The Hickory Leaf Roller.
MESOSTENUS THORACICUS Cress.
Ichneumon. Rpt. XXIV., Ent. Soc. Ont., 1893, p. 25. Harrington. On larva. Ottawa, Ont.

Ampelophaga myron Cram. The Lesser Grape Vine Sphinx.
APANTELES CONGREGATUS (Say) Prov.
Braconid. Rpt. Dom. Ent., Cen. Exp. Farm, Canada, 1892, p. 161. Fletcher. Ex pupa; generally distributed over Western Ontario.

Anosia plexippus Linn. The Monarch.
TRICHOGRAMMA MINUTUM Ril.
Chalcid. Rpt. XXI., Ent. Soc. Ont., 1890, p. 72. Harrington, Ottawa, Ont. On egg.

Apatela hastulifera A. and S.
RHOGAS INTERMEDIUS Cress.
Braconid. Rpt. XXV., Ent. Soc. Ont., 1894, p. 55. Fyles. Ontario. On larva.

Aphids.
See Macrosiphum, Aphis.

Aphis (Siphocorynæ) avenæ Fab. The European Grain Aphis.
APHIDIUS OBSCURIPES Ashm.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1895, p. 137. Fletcher, Muskoka, Ont.

Aphis brassicæ L. The Cabbage Aphis.
LIPOLEXIS (APHIDIUS) RAPÆ Curtis.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, 1904, p. 228. Fletcher, Ottawa, Ont.

Aphis—on Raspberry.
LYGOCERUS STIGMATUS (Say) Ashm.
Proctotrupid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1887, p. 36. Fletcher, Ottawa, Ont.

Apina.
See Bees, Megachile.

Argyresthia thuiella Pac. The White Cedar Twig Borer.
PENTACHNEMUS BUCCULATRICIS How.
Chalcid. Rpt. Dom. Ent. Cent. Exp. Farm, Canada, 1906, p. 231. Fletcher, Ottawa, Ont.
DEROSTENES TRIFASCIATUS Ashm.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1906, p. 231. Fletcher, Ottawa, Ont.

Asparagus Beetle.
See Crioceris.

Army Worm.
See Cirphis.

Aspidiotus ostræformis Curtis. The European Fruit Scale.
APHELINUS MYTILASPIDIS Baron.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Aspidiotus perniciosus Coms. The San José Scale.
APHELINUS FUSCIPENNIS How.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 53. Jarvis, Ontario.
Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

APHELINUS MYTILASPIDIS Baron.

Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 53. Jarvis, Ontario.
Rpt. XLI., Ont. Ent. Soc., 1910, p. 74. Eastham, Guelph, Ont.

Aster Gall Moth.
See Gelechia.

Aulacaspis rosæ Bouche. The Rose Scale.
APHELINUS DIASPIDIS How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Bassus albosignatus Grav. See Syrphus ribesii.
ASAPHES VULGARIS Walk.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 172.
Fletcher, Ottawa, Ont.

Bees.
FOENUS INCERTUS Cress.
FOENUS TARSATORIUS Say.
Evaniids. Faune Ent. Canada, 1883, p. 246. Provancher, Quebec.
Rpt. XXI., Ent. Soc. Ont., 1890, p. 66. Harrington, Ontario.
LEUCOSPIS AFFINIS Say.
Chalcid. Rpt. XXI., Ent. Soc. Ont., 1890, p. 71. Harrington, Ontario.

Birch Sawfly.
See Hylotoma.

Blackberry Scale.
See Eulecanium.

Brown-tail Moth.
See Euproctis.

Bud Moth.
See Tmetocera.

Cabbage Aphis.
See Aphis brassicæ.

Cabbage Root Maggot.
See Phorbia.

Cabbage White Butterfly.
See Pontia.

Cecropia Moth.
See Samia.

Cedar Twig Borer.
See Argyresthia.

Celery Caterpillar.
See Papilio.

Cigar Case Bearer.
See Coleophora.

Chionaspis furfura Fitch. The Scurfy Scale.
ABLERUS CLISIOCAMPÆ (Ashm) How.
Chalcid. Rpt. XXXVIII., Ent. Soc. Ont., 1907, p. 71. Jarvis, Ontario.
Rpt. XLI., Ent. Soc. Ont., 1910, p. 75. Eastham, Guelph, Ont.

Chionaspis pinifoliæ Fitch. The Pine Leaf Scale.
APHELINUS MYTILASPIDIS Baron.
Chalcid. Rpt. XLI., Ent. Soc. Ont., 1910, p. 74. Eastham, Guelph, Ont.
PHYSCUS VARIICORNIS How.
Chalcid. Rpt. XLI., Ent. Soc. Ont., 1910, p. 75. Eastham, Guelph, Ont.

Chionaspis salicis Linn. The Willow Scale.

APHELINUS MYTILASPIDIS Baron.

Chalcid. Rpt. XLI., Ent. Soc. Ont., 1910, p. 74. Eastham, Guelph, Ont.

Cimbex americana Leach. The Willow Sawfly.

OPHELTES GLAUCOPTERUS (L) Holmgr.

Ichneumon. Faune, Ent. Canada, 1883, p. 350. Provancher, Quebec.

Can. Ent. XIX., 1887, p. 80. Fletcher, Ottawa, Ont. On pupa.

5th Ann. Rpt. Quebec Society Protection of Plants, 1912-1913, p. 28. Fyles.

Cirphis (Leucania) unipuncta How. The Army Worm.

OPHION PURGATUS Say.

Ichneumon. Faune. Ent. Canada, 1883, p. 351. Provancher, Que.

Rpt. XXI., Ent. Soc. Ont., 1890, p. 67. Harrington, Ontario.

Rpt. XXVII., Ent. Soc. Ont., 1896, p. 51. Panton. Generally distributed in Ontario.

ICHNEUMON LEUCANIÆ Fitch.

Ichneumon. Rpt. XXVII., Ent. Soc. Ont., 1896, p. 51. Panton, Ontario. Generally distributed.

PANISCUS GEMINATUS Say.

Guelph, Ont. Treesbank, Man.

PIMPLIDEA PEDALIS (Cress).

Nova Scotia.

ICHNEUMON CANADENSIS Cr.

Ontario. Nova Scotia.

ICHNEUMON LÆTUS Br.

Nova Scotia. New Brunswick.

ICHNEUMON JUCUNDUS Br.

Guelph, Ont.

Ichneumons. Bull. 9, Ent. Branch Dom. Can. Dept. Agr., 1915. Gibson.

APANTELES MILITARIS Walsh. (Ontario.)

APANTELES LIMENTIDIS Riley. (Nova Scotia.)

METEORUS COMMUNIS Cr. (Ontario.)

Braconids. Bull, 9, Ent. Branch, Dom. Can. Dept. Agr., 1915. Gibson, Ont.

WAGNERIA (PHORICHÆTA) SEQUAX Will.

Tachinid. Bull. 9, Ent. Branch Dom. Can. Dept. Agr., 1915. Gibson, Guelph, Ont.

EXORISTA FLAVICAUDA Ril.

Tachinid. Rpt. Dom. Ent. Cen. Exp. Farm, 1896, p. 238. Fletcher, Ontario.

NEMOREA LEUCANIÆ Kirkp.

Tachinid. Rpt. XXVII., Ent. Soc. Ont., 1896, p. 102. Fyles, Levis, Que.

WINTHEMIA QUADRIPUSTULATA Fab.

Tachinid. Bull. 9, Ent. Branch, Dom. Can. Dept. Agr., 1915. Gibson, Ontario; Nova Scotia.

PHOROCERA (EUPHOROCERA) CLARIPENNIS Macq.

Tachinid. Bull. 9, Ent. Branch, Dom. Can. Dept. Agr., 1915. Gibson, Guelph, Ont.

PHRYXE (EXORISTA) VULGARIS Fall.
Tachinid. Bull. 9, Ent. Branch, Dom. Can. Dept. Agr., 1915. Gibson. New Brunswick. Nova Scotia.
Coccotorus scutellaris Le Conte. The Plum Gouger.
SIGALPHUS CANADENSIS Prov.
Braconid. Faune. Ent. Canada, 1883, p. 530. Provancher, Que. Can. Ent. XXII., 1890, p. 115. Gillette.
Coccus hesperidum Linn. The Soft Scale.
COCCOPHAGUS COGNATUS How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Codling Moth.
See Cydia.
Coleophora fletcherella Fernald. The Cigar Case Bearer.
MICRODUS LATICINCTUS Ash.
Braconid. Rpt. XXVII., Ont. Ent. Soc., 1896, p. 67. Fletcher, Port Hope, Ont.
Colias philodice Godt. The Clouded Sulphur.
MEGORISMUS NUBILIPENNIS Ashm.
Ichneumon. Rpt. Ent. Cen. Exp. Farm, Canada, 1887, p. 18. Fletcher, on larva, Ottawa, Ontario.
Conotrachelus nenuphar Herbst. Plum Curculia.
THERSILOCHUS CONOTRACHELI Ril.?
Ichneumon. Rpt. XXI. 1890, p. 67. Ont. Ent. Soc. Harrington, Ont.
Cottony Maple Scale.
See Pulvinaria.
Crioceris asparagi L. The Asparagus Beetle.
TETRASTICHUS ASPARAGI Cwfd.
Chalcid. Agricultural Gazette, Canada, November, 1915, p. 1055. Ross, on egg, Vineland, Ont.
Currant Sawfly.
See Pteronus.
Cutworm.
See Hadena, Mamestra, Noctua, Peridroma.
Cydia pomonella Linn. The Codling Moth.
PIMPLA PTERELAS (Say) Walsh.
Ichneumon. Rpt. XXXVII. Ent. Soc. Ont., 1906, p. 5. Brodie, Freeman, Ont.
EPHIALTES sp.
Ichneumon. Rpt. XXXVII. Ent. Soc. Ont., 1906, p. 5. Brodie, Prescott, Ont.
Diamond Back Moth.
See Plutella.
Dog-wood Sawfly.
See Harpiphorus.
Eriopeltis festucæ Fonse. The Grass Scale.
LEUCOPSIS BELULILA.
Dipterous. Rpt. XLI., Ent. Soc. Ont., 1910, p. 76. Jarvis, Nova Scotia.
Eulecanium caryæ Fitch.
CHILONEURUS ALBICORNIS How.
Chalcid. Rpt. XLI., Ent. Soc. Ont., 1910, p. 75. Eastham, Guelph, Ont.

EUCOMYS SCUTELLATA (Swed.) D. T.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
AGENIASPIS FUSCIOOLLIS (Dalm) Thoms.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Eulecanium cerasifex Fitch. The New York Plum Scale.
PACHYNEURON ALTISCOTA How.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 65. Jarvis, Ont.
EUNOTUS LIVIDUS Ashm.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 65. Jarvis, Ont.
CHILONEURUS ALBICORNIS How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
EUCOMYS FUSCA (How.) D. T.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
COCCOPHAGUS LECANII Smith.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
COCCOPHAGUS FLAVOSCUTELLUM Ashm.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
COCCOPHAGUS COGNATUS How.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 65. Jarvis Ont.
Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
AGENIASPIS FUSCICOLLIS (Dalm.) Thoms.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
APHYCUS PULVINARIÆ How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
APHYCUS JOHNSONI.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
APHYCUS FLAVICEPS.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Jarvis, Guelph, Ont.
BLASTOTHRIX LONGIPENNIS How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Eulecanium fitchii Sign. The Blackberry Soft Scale.
ENCYRTUS FUSCUS How.
APHYCUS ANNULIPES (Ashm) How. (Chalcids.)
COCCOPHAGUS FLAVOSCUTELLUM Ashm.
EUTOCHUS XANTHOTHORAX Ash. (Proctotrupid.)
Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1901, p. 241. Fletcher, Trenton, Ont.

Eulecanium fletcheri Ckll.
COCCOPHAGUS LECANII Smith.
COCCOPHAGUS COGNATUS How.
COCCOPHAGUS FLETCHERI How.

Comys bicolor How.
Chiloneurus albicornis How.
Aphycus jarvisi How.
Aphycus pulvinariæ How.
Blastothrix longipennis How.
Chalcids. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Euproctis chrysorrhoea L. The Brown Tail Moth.
Pentarthrum minutum Ril.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, 1911, p. 217. Hewitt, St. Stephen, New Brunswick.
Apanteles lacteicolor Vier.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1914. p. 860. Hewitt, Bear River, Nova Scotia.
Compsilura concinnata Meig.
Tachinid. Rpt. XLIII., Ont. Ent. Soc., 1912, p. 57. Tothill, Fredericton, New Brunswick.
Phorocera leucaniæ Cog.
Tachinid. Rpt. XLIII., Ont. Ent. Soc., 1912, p. 58. Tothill, Charlotte County, New Brunswick.

Euthisanotia grata Fab. The Beautiful Wood Nymph.
Exorista leucania.
Tachinid. Rpt. I., Ont. Ent. Soc., 1870, p. 99. Saunders, Ont.

Fall Canker Worm.
See Alsophila pometaria.

Fall Webworm.
See Hyphantria.

Gelechia gallæasteriella Kell. The White Aster Gall Moth.
Bracon furtivus Fyles.
Braconid. Can. Ent. XXIV., 1892, p. 34. Fyles, South Quebec, Que.
Pimpla pterelas (Say) Walsh.
Ichneumon. Can. Ent. XXIV., 1892, p. 35. Fyles, South Quebec, Que.
Trychosis tunicula-rubra Fyles.
Ichneumon. Rpt. XXXIV., Ent. Soc. Ont., 1903, p. 73. Fyles, Levis, Que.

Grain Aphids.
See Aphis avenæ.

Grapta satyrus Edw. Polygonia satyrus Edw.
Ichneumon caliginosus Cress.
Ichneumon. Entomological Record, Ont. Ent. Soc., 1907, p. 16. Gibson. Ex pupa. Kaslo, B.C.; Ottawa, Ont.
Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 128. Fletcher. Ex pupa. Ottawa, Ont.

Grapevine Sphinx.
See Amphelophaga.

Grass Scale.
See Eriopeltis.

Hadena devastatrix Brace. Glassy Cutworm.
Berecyntus bakeri How. Var.
Chalcid. Bull. 10, Ent. Branch, Dom. Can. Dept. Agri., 1915. Gibson, Ottawa, Ont.

Halisidota maculata Harr.
Ichneumon. THERONIA MELANOCEPHALA (Brulle) Prov.
Rpt. XXI., Ont. Ent. Soc., 1890, p. 69. Harrington, Ottawa, Ont.
PIMPLA PEDALIS Cress.
Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1908, p. 209. Fletcher, Eastern Canada.

Harmologa.
See Tortrix.

Harpiphorus tarsatus (Say) Nort. The Dog-wood Sawfly.
HEMITELES MUCRONATUS Prov.
Ichneumon. Rpt. XXX., Ont. Ent. Soc., 1899, p. 104. Fyles, Levis, Que.

Hemerocampa leucostigma S. and A. The White Marked Tussock Moth.
PIMPLA INQUISITORIELLA D.T. Recorded as Inquisitor.
Ichneumon. Rpt. XXVII., Ont. Ent. Soc., 1896, p. 53. Panton, Toronto, Ont.
DIGLOCHIS OMNIVORA Walk.
Chalcid. Rpt. XXXVI., Ont. Ent. Soc., 1905, p. 19. Lyman, Montreal, Que.

Hessian Fly.
See Phytophaga.

Heterocampa manteo Dbl.
OPHION BILINEATUS Say.
Ichneumon. Rpt. XXXIV., Ont. Ent. Soc., 1903, p. 58. Gibson, Meach Lake, Que. On larva.

Hickory Leaf Roller.
See Ambesa Walsinghami Rag.

Hop Vine Borer.
See Hydroecia.

Hylotoma pectoralis Leach. The White Birch Sawfly.
PIMPLA INQUISITORIELLA D.T. (Recorded as Inquisitor.)
Ichneumon. Rpt. XXX., Ont. Ent. Soc., 1899, p. 104. Fyles, Levis, Que.
5th Annual Rpt. Quebec Society for Protection of Plants, 1912-1913, p. 30. Fyles, Quebec.

Hyphantria cunea Dru. Fall Webworm.
LIMNERIUM VALIDUM Cress.
LIMNERIUM PILOSOTUM Cr.
EXOCHILUM MUNDUM Say.
Ichneumons. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1914, p. 861. Hewitt, New Brunswick.
COMPSILURA CONCINNATA Meig.
Tachinid. Rpt. XLIII., Ont. Ent. Soc., 1912, p. 57. Tothill, on larva. Fredericton, New Brunswick.

Hydræcia immanis Guen. Hop Vine Borer.
ICHNEUMON JUCUNDUS Brulle.
Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, 1892, p. 150. Fletcher, Bethel, Ont.

Iris Pod Weevil.
See Mononychus.

Isosoma tritici Fitch. The Wheat Joint Worm.
HOMOPORUS CHALCIDIPHAGUS Walsh.
EUPELMUS EPICASTE Walk.
Chalcid. Rpt. XXIX., Ont. Ent. Soc., 1898, p. 77. Fletcher, Verdun, Ont.
Kermes pubescens Bogue.
APHYCUS PULCHELLUS How.
BLASTOTHRIX LONGIPENNIS How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Larch Sawfly.
See Nematus.
Lecanium Scale (Soft Scale).
See Coccus.
Lepidosaphes ulmi Linn. The Oyster Shell Scale.
APHELINUS MYTILASPIDIS Baron.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 188. Fletcher, generally distributed in South Western Ontario.
Rpt. Dominion Entomologist, 1887, p. 31, British Columbia.
Rpt. Dominion Entomologist, 1903, p. 188, universally distributed.
Rpt. Dom. Ent. Exp. Farm, Canada, 1887, p. 31. Fletcher, New Westminster, B.C.
Lyctus unipunctatus Herbert.—linearis. The Powder Post Beetle.
HECABALUS LYCTI Cress.
HECABALUS UTILIS Cress.
Braconid. Rpt. XXXII., Ont. Ent. Soc., 1901, p. 108. Fletcher, Ottawa, Ont.
Macrosiphum granaria Buckton. Grain Aphis.
APHIDIUS GRANARIAPHIS Cook.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1898, p. 179. Fletcher, Ont.
Can. Ent. Vol. XXIV., 1890, p. 125.
LYSIPHLEBUS TRITICI Ashm.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1908, p. 194. Fletcher, Ontario.
APHIDIUS AVENÆ Fitch.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 171. Fletcher, Ottawa, Ont.
ASAPHES VULGARIS Walk.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 171. Fletcher, Ottawa, Ont.
LYGOCERUS NIGER How.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 171. Fletcher, Ottawa, Ont.
ALLOTRIA TRITICI Fitch.
Cynipid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 171. Fletcher, Ottawa, Ont.
Macrosiphum pisi Kalt. The Pea Aphis.
TRIOXYS (PRAON) CERASAPHIS Fitch.

APHIDIUS FLETCHERI Ash.

Braconid. Rpt. XXX., Ont. Ent. Soc., 1899, p. 107. Fletcher, Ottawa, Ont.

Rpt. Dom. Ent. Cen. Exp. Farm, 1899, p. 172. Fletcher, Ottawa, Ont.

MEGORISMUS FLETCHERI Crawford.

Chalcid. Rpt. XL., Ont. Ent. Soc., 1909, p. 14. Gibson, Ottawa, Ont.

Malacosoma disstria Fab. The Forest Tent Caterpillar.

APANTELES LONGICORNIS Prov.

Braconid. Rpt. XXXIV., Ont. Ent. Soc., 1903, p. 73. Fyles, Levis, Que.

PIMPLA CONQUISITOR (Say) Ril.

Ichneumon. Rpt. XXI., Ont. Ent. Soc., 1890, p. 69. Harrington, Ottawa, Ont.

PIMPLA PEDALIS Cress.

Ichneumon. Rpt. XXI., Ont. Ent. Soc., 1890, p. 69. Harrington, Ottawa, Ont.

Mamestra picta Harris. The Zebra Caterpillar.

OPHION PURGATUS Say.

Ichneumon. Can. Ent. XVI., 1884, p. 122. Caulfield, Montreal, Que.

CHAETOSTRICHA (TRICHOGRAMMA) PRETIOSA D.T.

Chalcid. Rpt. XXVII., 1896, Ont. Ent. Soc., p. 64. Fletcher, Ottawa, Ont.

Rpt. Dom. Ent. Cen. Exp. Farm, 1892, p. 161. Fletcher, on egg, Ottawa, Ont.

Mamestra trifolii Rott. Clover Cutworm.

OPHION PURGATUS Say.

Ichneumon. Rpt. XIX., Ont. Ent. Soc., 1888. Fletcher, Ontario, on pupa.

Marumba modesta Harris.—Pachysphinx modesta Harr.

WINTHEMIA QUADRIPUSTULATA Fab.

Tachinid. Entomological Record, Ont. Ent. Soc., 1903, p. 99. Gibson, St. John, New Brunswick.

Megachile brevis Say. Leaf Cutter Bee.

LEUCOSPIS AFFINIS Say.

Chalcid. Rpt. XVII., Ont. Ent. Soc., 1886, p. 52. Guignard, Ottawa, Ontario, on larva.

Megachile centuncularis L. Leaf Cutter Bee.

SEMIOTELLUS CUPREUS Prov.

Chalcid. Rpt. XVII., Ont. Ent. Soc., 1886, p. 52. Guignard, Ottawa, Ont., on larva.

Meromyza americana Fitch. (Causing "Silver Top" in grass.)

COELINIUS MEROMYZÆ Forb.

Braconid. Rpt. XXII., Ont. Ent. Soc., 1891, p. 13. Bethune, Ont.

Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1887, p. 68. Fletcher, Ottawa, Ont.

Monarch Butterfly.

See Anosia.

Monohammus confusor. The Pine Borer.

RHYSSA PERSUASORIA (L.) Grav.

Ichneumon. Faune. Ent. Canada, 1883, p. 448. Provancher, Quebec.

Monohammus scutellatus. The Pine Borer.

RHYSSA PERSUASORIA (L.) Grav.

Ichneumon. Faune. Ent. Canada, 1883, p. 418. Provancher, Que.

Mononychus vulpeculus. The Iris Pod Weevil.

? PIMPLA PTERELAS (Say) Walsh.

Ichneumon. Rpt. XXI., Ont. Ent. Soc., 1890, p. 69. Harrington, Ottawa, Ont.

? PIMPLA INQUISITORIELLA D.T. Recorded as Inquisitor Say.

Ichneumon. Rpt. XLI., Ont. Ent. Soc., 1910, p. 31. Fyles, Hull, Que.

Nematus erichsonii. The Larch Sawfly.

COELOPISTHIA NEMATICIDA Pack.

Chalcid. Bull. 10, 2nd Series, Div. of Ent., Dom. Can., Dept. Agr., Hewitt, on pupa, Ottawa, Ont.

Noctua c-nigrum Linn. The Spotted Cutworm.

EUPLECTRUS FRONTALIS How.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1900, p. 228. Fletcher, Ontario.

Notolophus antiqua Linn. The Rusty Tussock Moth.

TELENOMUS DALMANII (Ratz) Mayr.

Proctotrupid. Rpt. XLI., Ont. Ent. Soc., 1910, Ent. Record, p. 118. Gibson, ex egg, Little Bras d'Or, Cape Breton, N.S.

Oak Looper.

See Therina.

Orgyia sp.

TELENOMUS ORGYIÆ Fitch.

Proctotrupid. Bull. 45, U.S.N.A., p. 53. Ashmead, per Harrington, Ottawa, Ontario, on egg.

Ostræformis Scale.

See Aspidiotus.

Oyster Shell Bark Louse.

See Lepidosaphes.

Papilio eurymedon Boisd.

TROGUS FLETCHERI Harrgt.

Ichneumon. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 128, on pupa, Wellington, B.C. Taylor.

TROGUS FULVIPES Cress.

Ichneumon. Entomological Record, Ont. Ent. Soc., 1907, p. 16. Gibson (Cockle), Kaslo, B.C. Ex pupa.

Pamphila metacomet Harr.

TELENOMUS PAMPHILÆ Ash.

Proctotrupid. Rpt. XXV., Ont. Ent. Soc., 1894, p. 4. Fletcher, Ottawa, Ont.

Papilio polyxenes Fab. The Celery Caterpillar.

TROGUS VULPINUS (Syn. Exesorius).

Ichneumon. Faune. Ent. Canada, 1883, p. 303. Provancher, Que.

Rpt. XXI., Ont. Ent. Soc., 1890, p. 66. Harrington, Ont.

Papilio troilus Linn.

TROGUS FULVIPES Cress.

Ichneumon. Rpt. XL., Ont. Ent. Soc., 1909, p. 82, on pupa. Fyles, Que.

Papilio turnus L.

TROGUS FULVIPES Cress.

Ichneumon. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 128, on pupa, Digby, N.S. Aweme, Man. Fletcher.

Entomological Record, Ont. Ent. Soc., 1907, Gibson, Digby, N.S. Aweme, Man.

TRICHOGRAMMA INTERMEDIUM How.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1892, p. 160. Fletcher, on egg, Ottawa, Ont.

Peridroma saucia Hbn. The Variegated Cutworm.

METEORUS VULGARIS Cress.

Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1900, p. 226. Fletcher, Vancouver, B.C.

Phytophaga destructor Say. The Hessian Fly.

MERISUS DESTRUCTOR (Say) Ril.

CHALCID. Rpt. II., Ont. Ent. Soc., 1871, p. 394. Bethune, Ont., on pupa.

Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1889, p. 63. Fletcher, Thornbury, Ont., and Prince Edward Island.

Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Portage la Prairie, Man.

HOMOPORUS SUBAPTERUS Ril.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1889, p. 63. Fletcher, Thornbury, Ont.

PLATYGASTER sp. (? herricki) Pack.

Proctotrupid. Rpt. II., Ont. Ent. Soc., 1871, p. 394. Bethune, Ont., on egg.

POLYGNOTUS HIEMALIS (Forb.) Ash.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Emerson, Man.

TETRASTICHUS PRODUCTUS Ril.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Prince Edward Island.

ENTEDON? METALLICUS (Nees) Walk.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Prince Edward Island.

EUPELMUS ALLYNII French.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Prince Edward Island.

Phorbia (Pegomyia) brassicæ Bouche. The Cabbage Root Maggot.*

TRYBLIOGRAPHA ANTHOMYIÆ.

Cynipid, 5th Annual Rpt. Quebec Society for the Protection of Plants, 1913-1914, p. 41. Du Porte, Macdonald College, Que.

ALEOCHARA ANTHOMYIÆ Sprague.

Staphilinid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1890, p. 164. Fletcher, Ottawa, Ont.

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*(NOTE.—Parasites of this insect are under consideration in a bulletin on Root Maggots now in course of preparation in the Entomological Branch, Ottawa, by Gibson and Treherne, January, 1916.)

PACHYCREPOIDEUS DUBIUS Ashm.
Chalcid. Rpt. XLI., Ont. Ent. Soc. Ent. Record, 1910, p. 118. Gibson. ? Puparia, Ottawa, Ont.

Pigeon tremex.
See tremex.

Pine Borer.
See Monohammus.

Pine Leaf Scale.
See Chionaspis.

Plum Scale.
See Eulecanium.

Plum Curculio.
See Conotrachelus.

Plum Gouger.
See Coccotorus.

Plutella maculipennis Curt. The Diamond Back Moth.
LIMNERIUM PARVUM (Prov.) D. T.
Ichneumon. Rpt. XXX., Ont. Ent. Soc., 1899, p. 108. Fletcher, Ottawa, Ont.
Rept. Dom. Ent. Cen. Exp. Farm, Canada, 1890, p. 167. Fletcher. Generally distributed throughout Canada.
PHÆOGENES DISCUS Cress.
Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1890, p. 167. Fletcher, Indian Head, Sask.; Ottawa, Ont.

Polyphemus moth.
See Telea.

Polygonia interrogationis Fab.
PTEROMALUS VANESSÆ Harris.
Ichneumon. Rpt. III., Ont. Ent. Soc., 1872, p. 32. Bethune. Ontario, on pupa.

Pontia rapæ Linn. The Cabbage White.
PTEROMALUS PUPARUM (L) Swed.
Ichneumon. Can. Ent. Nov., 1871, Vol. III., No. 10. Lintner; introduction report.
Rpt. VI., Ont. Ent. Soc., 1875, p. 32. Saunders, Eastern Canada, on pupa.
Rpt. VII., Ont. Ent. Soc., 1876, p. 40. Saunders, London, Ont.
Rpt. VIII., Ont. Ent. Soc., 1877, p. 5. Saunders, review of distribution.

Powder Post Beetle.
See Lyctus.

Protoparce quinquemaculata How. The Tomato Sphinx.
APANTELES CONGREGATUS (Say) Prov.
Braconid. Rpt. XXIV., Ont. Ent. Soc., 1893, p. 27. Harrington, Ont.
Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1892, p. 161. Fletcher, generaally distributed over Western Ontario, ex pupa.

Pteronus ribesii Scop. The Imported Currant Worm.
HEMITELES NEMATIVORUS Walsh.
Ichneumon. Can. Ent. Vol. II., No. 2, Oct., 1869, p. 11. Walsh, Ont.
Rpt. II., Ont. Ent. Soc., 1871. Saunders (Bethune), Port Hope, Ont.

Chætostricha (Trichogramma) sp. (near pretiosa) Ril.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1892, p. 159. Fletcher, on egg, Arnprior, Ont.

Pulvinaria innumerabilis Rath. The Cottony Maple Scale.
Coccophagus lecanii Smith.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Coccophagus flavoscutellum Ashm.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Pyrameis cardui. The Painted Lady.
Ichneumon rufiventris Brulle.
Ichneumon. Rpt. XI., Ont. Ent. Soc., 1881, p. 29. Huestis, St. John, N.B., on larva.

Raspberry aphis.
See Aphis.

Red Humped Apple Tree Caterpillar.
See Schizura.

Rose Scale.
See Aulacaspis.

Rusty Tussock Moth.
See Notolophus.

Samia cecropia Linn. The Cecropia Moth.
Cryptus nuncius Say.
Ichneumon. Rpt. XXV., Ont. Ent. Soc., 1894, p. 55. Harrington, Ont., on larva.

San José Scale.
See Aspidiotus.

Schizura concinna S. & A. Red Humped Apple Tree Caterpillar.
Ophion purgatus Say.
Ichneumon. Rpt. Dom. Ent. Exp. Farm, Canada, 1887, p. 34. Fletcher, Ont.
Limnerium guignardii (Prov.) D. T.
Ichneumon. Rpt. Dom. Ent. Exp. Farm, Canada, 1887, p. 34. Fletcher, Ottawa, Ont.
Also Nova Scotia, Rpt. Dom. Ent. 1906, p. 228.

Scolytus (Eccoptogaster) rugulosus Ratz. The Shot Hole Borer.
Chiropachys colon (L) Westw.
Chalcid. Rpt. XL., Ont. Ent. Soc., 1909, p. 18. Caesar, St. Catharines, Ont.

Scurfy Scale.
See Chionaspis.

Shot Hole Borer.
See Scolytus.

Syrphus ribesii L.
Bassus albosignatus Grav. (Lœtatorius Fab.)
Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 172. Fletcher, Ottawa, Ont.

Telea Polyphemus Cram. The Polyphemus Moth.
Cryptus nuncius Say. (Syn. extrematis.)
Ichneumon. Faune. Ent. Canada, Hym. 1883, p. 340. Provancher, Que.

Rpt. XXI., Ont. Ent. Soc., p. 67. Harrington, Ont.

OPHION MACRURUS (L) Westw. (Syn. macrurum.)

Ichneumon. Faune. Ent. Canada, 1883, p. 350. Provancher, Que.
Rpt. III., Ont. Ent. Soc., 1872, p. 40. Reed, London, Ont.
Rpt. XXI., Ont. Ent. Soc., 1890, p. 67. Harrington, Ottawa, Ont.

Tent Caterpillar.

See Malacosoma.

Therina somniaria Hulst. Vancouver Island Oak Looper.

ICHNEUMON CESTUS Cress.

Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada. Fletcher, 1890, p. 177. Victoria, B.C.

PIMPLA ELLOPIÆ Harrington.

Ichneumon. Can. Ent. Vol. XXIV., 1892, p. 99. Harrington, Victoria, B.C., ex pupa.
Rpt. Dom. Ent. Cen. Exp. Farm, Canada. Fletcher, 1892, p. 160.

PIMPLA ONTARIO Cress.

Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1904, p. 245. Fletcher, Victoria, B.C.

PIMPLA SCRIPTIFRONS Cress.

Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1905, p. 194. Fletcher, Victoria, B.C.

TELENOMUS sp.

Proctotrupid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1892, p. 160. Fletcher, on egg, Victoria, B.C.

Tmetocera ocellana Schiff. The Bud Moth.

PIMPLA CONQUISITOR (Say) Ril.

Ichneumon. 7th Ann. Rpt. Quebec Society for Protection of Plants, 1914-1915, p. 76. Du Porte, Macdonald College, Que.

PENTARTHRON MINUTUM Ril. Syn. Trichogramma pretiosa Ril.

Chalcid. 7th Ann. Rpt. Quebec Society for Protection of Plants, 1914-1915. Du Porte, Macdonald College, Que., ex eggs.

BASSUS EARINOIDES Cress.

Ichneumon. 7th Ann. Rpt. Quebec Society for Protection of Plants, 1914-1915. Du Porte, Macdonald College, Que.

Tomato Sphinx.

See Protoparce.

Tortrix (Harmologa) fumiferana. The Spruce Bud-worm.

PENTARTHRON MINITUM.

Chalcid. Rpt. XLII., Ont. Ent. Soc., 1911, p. 26. Hewitt, on egg, Ottawa, Ont., Esquimalt, B.C., in Que.

APANTELES, sp.

Braconid. Rpt. XLII., 1911, p. 26. Hewitt, in Quebec and British Columbia.

APANTELES FUMIFERANÆ Viereck.

Braconid. Ent. Rec., 1912, p. 134, Ont. Ent. Soc. Quebec.

NASONIA TORTRICIS Brues.

Rpt. XLI., Ont. Ent. Soc., Gibson, 1910, p. 118, ex pupa, Baskatong, Que.

Tremex Columba Pigeon Tremex.

MEGARHYSSA LUNATOR (Fabr.) D. T.

Ichneumon. Faune. Ent. Canada, 1883, p. 446. Provancher, Que.
Can. Ent. 1882, p. 82. Harrington, Ottawa, Ont.

MEGARHYSSA ATRATA (Fabr.) D. T.
Ichneumon. Faune. Ent. Canada, 1883, p. 444. Provancher, Que. Can. Ent. 1882, p. 82. Harrington, Ottawa, Ont.

Trichotaphe levissella Fyles.
HEMITELES MUERONATUS Prov.
Ichneumon. Rpt. XXXIII., Ont. Ent. Soc., 1902, p. 28. Fyles, Que.
LAMPRONOTA MARGINATA Prov.
Ichneumon. Rpt. XXXVIII., Ont. Ent. Soc. Ent. Record, 1907, p. 128. Gibson (Fyles) Levis, Que.

Tussock Moth.
See Hemerocampa.

Vanessa antiopa Linn. Mourning Cloak.
PTEROMALUS PUPARUM (L) Swed.
Ichneumon. Rpt. XXI., Ont. Ent. Soc., 1890, p. 72. Harrington, Ottawa, Ont.

Willow Saw Fly.
See Cimbex.

Willow Scale.
See Chionaspis.

Wheat Joint Worm.
See Isosoma.

Zebra Caterpillar.
See Mamestra.

THE ENTOMOLOGICAL RECORD, 1915.

Arthur Gibson, Chief Assistant Entomologist, Department of Agriculture, Ottawa.

It is gratifying to be able to state that the collection and study of insects is gradually but surely increasing every year in the different provinces of Canada. This, I think, is largely owing to the fact that economic, or applied, entomology is more and more receiving its due recognition. The importance of local collections of insects to the economic entomologist is indeed of great value, providing, as they do, definite information as to distribution, etc. At Ottawa, as we have previously stated, due provision has been made for a national collection of the insects of Canada, and collectors generally could aid materially in building up this collection by forwarding donations of specimens.

During 1915 much material collected in previous years has been worked over by specialists, in addition to which large collections have been made during the past season in most of the provinces. Many of these are new records for Canada, while the capture of others in certain districts or provinces extend the known range of their distribution.

As in years past we have received invaluable assistance in the determination of many specimens from the recognized authorities in the United States and elsewhere. Our special thanks are due to Dr. L. O. Howard and his associates at Washington—Dr. Dyar, Dr. Banks, Messrs. Schwarz, Crawford, Busck, Rohwer, Gahan and Knab; Sir George F. Hampson, of the British Museum; Prof. H. F. Wickham, of Iowa City, Iowa; Mr. E. P. Van Duzee, of Berkeley, Cal.; Dr. Henry Skinner, of Philadelphia; Col. Thos. L. Casey, of Washington, D.C.; Mr. C. W. Johnson, of Boston, Mass.; Mr. Chas. Liebeck, of Philadelphia, Pa.; Prof. H. S. Hine, of Columbus, Ohio; Dr. J. M. Aldrich, of La Fayette, Ind.; Mr. Chas. W. Leng, of New York, N.Y.; Dr. W. G. Dietz, of Hazleton, Pa.; Dr. F. C. Fall, of Pasadena, Cal.; Mr. M. C. Van Duzee, of Buffalo, N.Y.; Mr. C. A. Frost, of South Framingham, Mass.; Dr. E. C. Van Dyke, of Berkeley, Cal.; Mr. J. R. de la Torre Bueno, of White Plains, N.Y.; Mr. F. H. Wolley-Dod, of Midnapore, Alta., and Dr. E. M. Walker, of Toronto, Ont.

Literature.

Among the books, memoirs, etc., which have appeared during 1915, and which are of interest to Canadian students, the following should be mentioned:

Bethune, Rev. Prof. C. J. S. Bibliography of Canadian Entomology for the year 1913; Ottawa, Trans. Royal Soc. of Canada, Third Series—1914, Vol. VIII, Section IV, 1914. In this contribution references are given to 151 papers; 42 of these relate to Economic Entomology, 18 to General Entomology, 18 to Lepidoptera, 21 to Diptera, etc.

Banks, Nathan. The Acarina or Mites; a review of the group for the use of economic entomologists: United States Department of Agriculture, office of the secretary, Report No. 108. Received December 28th, 1915. This is indeed a very useful contribution of 153 pages. In the introduction information is given on the structure, life-history, classification, etc. Then follows a lengthy discussion on the different families, and many keys are given. Notes on collecting, preserving and rearing mites are given on pages 141 and 142, and on pages 143-145 a list of works, useful in the study of American Acarina, is given.

Braun, Annette Frances. Evolution of the color pattern in the Microlepidopterous Genus Lithocolletis: Journal of the Academy of Natural Sciences of Philadelphia, Vol. XVI, Second Series, Philadelphia, pp. 105-168, plates III and IV, 26 text figures. A separate of this article (issued February 12th, 1914) has recently been received. Under "Methods and Observations" the author discusses (a) Systematic Position and Characteristics of Lithocolletis, (b) Color Classes Represented and Structure of Scales, (c) Comparative Study of the Adult Markings, (d) Ontogenetic Development of the Color Pattern and (e) Phylogenetic Development of the Color Pattern. The two plates, in colors, at the end of the article well illustrate the various species of the genus. The paper is a most interesting one and undoubtedly of much value.

Brues, Charles T., and Melander, A. L. Key to the Families of North American Insects: published by the authors; Boston, Mass., and Pullman, Wash., 1915, pp. 1-140. As stated by the authors this manual brings together a brief, yet complete, key to the families of American insects, unhampered by more than the explanations needed to make such a tabulation available to the general student. It has been prepared to meet the requirements not alone of college courses in systematic entomology, but also of agricultural high schools and of physicians, fruit inspectors, the modern farmer, the nature lover, or anyone who is concerned with the practical identification of insects. This very useful work will undoubtedly be widely received. 18 full-page plates, illustrating structural characters, etc., are included.

Casey, Thos. L. Memoirs on the Coleoptera, VI; published by the New Era Printing Company, Lancaster, Pa.; issued November 27th, 1915, pp. 1-460. The contents of this the sixth memoir by this well-known coleopterist consists of: Part I, A Review of the American Species of Rutelinæ, Dynastinæ and Cetoniinæ, pp. 1-394; Part II, Studies in some Staphylinid Genera of North America, pp. 395-450. A large number of new species are described, seventeen of which are from Canada.

Fracker, Stanley Black. The Classification of Lepidopterous Larvæ, with ten plates: Illinois Biological Monographs, No. 1, Vol. II, July, 1915; published by the University of Illinois, under the auspices of the Graduate School, Urbana, Ill., pp. 1-169, (contribution No. 43, from the Entomological Laboratory of the University of Illinois). This contribution is divided into two sections, namely, Part one—The Homology of the Setæ, and Part two—Systematic Outline of Families and Genera. The work is a most interesting one. The author in Part One suggests the adoption of Greek letters in place of the Roman numerals now generally used to designate the different tubercles. In the second part, family and generic keys are given, based on larval characters. The plates at the end illustrate arrangement of setæ, etc. This contribution is indeed a valuable one and will doubtless receive much consideration from lepidopterists generally.

Hampson, Sir George F. (Bart). Catalogue of the Lepidoptera Phalaenæ in the British Museum; Supplement, Vol. I, Catalogue of the Amatidæ and Arctiadæ, (Nolinæ and Lithosianæ). Received 19th January, 1915. Since the publication of the first two volumes of the "Catalogue of Moths" a large number of species in the families of which they treat have been described, and the newly published supplement brings the subject matter of Vols. I and II up to date. In the Family Amatidæ, 29 species are described as new, none of which, however, are from North America. In the Arctiadæ, descriptions of 122 new species appear—all exotic. Plates, in colours, numbered I to XLI accompany the volume.

Herrick, Glenn W. Insects Injurious to the Household and Annoying to Man. New York, The Macmillan Company, pp. 1-470. This book which appeared late in 1914, was written particularly for the housekeeper and for those who desire information regarding household pests and practical methods of controlling them. The work is a valuable one and will certainly prove a handy volume of reference. It is profusely illustrated and is one of the Rural Science Series.

Holland, W. J. The Butterfly Guide; a pocket manual for the ready identification of the common species found in the United States and Canada. Published by Doubleday, Page & Co., New York. This pocket guide is similar in form to the popular bird, flower and tree guides. It consists of 237 pages and is illustrated with 295 colored figures, representing 255 species and varieties. There are also five plates, in explanation of structure, venation, metamorphosis, and the apparatus required for collecting, rearing and mounting specimens. This convenient little manual should have a ready sale among nature lovers generally.

Hopkins, A. D. Contributions Toward a Monograph of the Scolytid Beetles; Part II, Preliminary Classification of the Superfamily Scolytoidea. Tech. Series No. 17, United States Department of Agriculture, Bureau of Entomology; issued January 9th, 1915. The author states in the introduction that the object of this contribution is to discuss the taxonomy and present a preliminary classification of the families and subfamilies of the scolytid beetles of the world. The discussion and classification are based on a study of representatives of about 122 described and undescribed genera, and about 1,000 species of North America and other countries, in the collections of the United States National Museum and other institutions.

Howard, L. O., Dyar, H. G. and Knab, F. The Mosquitoes of North and Central America and the West Indies—Vol. Three, Systematic Description, Part I; Washington, D.C. Published by the Carnegie Institution of Washington, pp. 1-523. This sumptuous volume of descriptive matter appeared in October, 1915. The species of the tribes Sabethini and Culicini are described. Most of these are southern in distribution. Several species are described as new. Canadian records of nine species are given. Short chapters precede the descriptive matter, namely: "Mosquitoes, Their Definition and Position in the Classification of Insects," "Statement of Some of the Characters used in the Tables," "Outline of the Geographical Area Covered" and "Historical Sketch of the Classification of Mosquitoes."

Malloch, John R. The Chironomidæ, or Midges, of Illinois, with particular reference to the species occurring in the Illinois River; Bulletin of the Illinois State Laboratory of Natural History, Urbana, Ill., Article VI, Vol. X, May, 1915, pp. 275-538, plates XVII-XL. The opening chapters discuss "Methods of Collecting," "Methods of Rearing," "Methods of Preservation," "Synonymy Affecting Family Names" and "Biology and Taxonomy." Keys to the subfamilies follow, with a treatment of the Ceratopogoninæ, the Tanypinæ and the Chironominæ. The distribution of the Chironomidæ in the Illinois River is then stated and also a summary given of Illinois genera and species in comparison with those recorded for other states. Many species are described as new and a number of Canadian references given. The plates illustrate structural detail.

Morley, Claude. A Revision of the Ichneumonidæ based on the collection in the British Museum (Natural History), Part IV, Tribes Joppides, Banchides and Alomyides: British Museum (Natural History), 1915, pp. 167, 1 plate, coloured. Part I appeared in 1912, Part II, in 1913, and Part III, in 1914. In Part IV, issued in March, 1915, 459 species are included, 40 of which are described as new. Records are given of a number of species from Canada which are in the British Museum, one of which is described as new.

PACKARD, The late ALPHEUS SPRING. Monograph of the Bombycine Moths of North America, Including their Transformations and Origin of the Larval Markings and Armature; Part III, Families Ceratocampidæ, Saturniidæ, Hemileucidæ and Brahmæidæ. Vol. XII, First Memoir, National Academy of Sciences, Washington, D.C., 516 pp., 4to, 113 plates, 34 of which depicting larvæ are colored. Edited by T. D. A. Cockerell. This, the third part of the late Dr. Packard's work on the Bombycine Moths, appeared in the first half of the year. It is indeed a most valuable contribution and one which will be welcomed by lepidopterists everywhere as the species described are not confined to North America but occur in various parts of the world. The successful issue of this sumptuous volume is largely due to Prof. Cockerell, who undertook to edit it.

RILEY, W. A., and JOHANNSEN, O. A. Handbook of Medical Entomology; Ithaca, N.Y., The Comstock Publishing Company, 1915, pp. 1-348. This handbook will be found of much value to those of our students who are interested in the study of medical entomology. It is an outgrowth of a course of lectures along the lines of insect transmission and dissemination of diseases of man, given by the senior author in the Department of Entomology of Cornell University, during the past six years. More especially is it an illustrated revision and elaboration of his "Notes on the Relation of Insects to Disease," published in January, 1912.

THOMPSON, MILLETT TAYLOR. An Illustrated Catalogue of American Insect Galls. Edited by E. P. Felt. Published and distributed by the Rhode Island Hospital Trust Company. Received, 26th June, 1915. This catalogue is divided into: Part I, Classification by Galls, and Part II, Classification by Genera. Both of these parts treat of the Cynipidæ. On pages 50 to 66 a "Supplemental List of American Gall-making Insects" is given. At the end of the volume are 21 plates, illustrating 247 different kinds of galls. These are from photographs and are splendid reproductions. This catalogue is an important contribution. It is to be regretted that only a portion of Dr. Thompson's investigation was completed at the time of his death.

WINN, A. F. and BEAULIEU, GERMAIN. A Preliminary List of the Insects of the Province of Quebec: Part II, Diptera. Published as a supplement to the 7th Report of the Quebec Society for the Protection of Plants; received 14th June, 1915. This publication of 159 pages is a welcome one and will undoubtedly be of much value to Canadian students of diptera. It is indeed a very creditable contribution. Under each genus the species known to occur in the Province of Quebec are listed, the definite localities and months of capture being recorded. A short introductory paragraph precedes each family.

COLLECTORS.

The following is a list of the names and addresses of collectors heard from during 1915:

Baird, Thos., High River, Alta.
Beaulieu, G., Ent. Branch, Dept. Agr., Ottawa.
Beaulne, J. I., Ent. Branch, Dept. Agr., Ottawa.
Bethune, Rev. Prof., O.A.C., Guelph.
Blackmore, E. H., Victoria, B.C.

Bowers, H. L., Oshawa, Ont.
Brimley, J. F., Wellington, Ont.
Brittain, W., Agric. College, Truro, N.S.
Bush, A. H., 1105 Broadway, Vancouver, B.C.
Caesar, L., O.A.C., Guelph, Ont.
Carr, F. S., Edmonton, Alta.
Chagnon, Gus., Box 521, Montreal.
Chagnon, W., St. John's, Que.
Chrystal, R. N., Ent. Branch, Dept. Agr., Ottawa.
Cockle, J. W., Kaslo, B.C.
Cosens, Dr A., Parkdale Collegiate Institute, Toronto.
Crew, R. J., 561 Carlaw Ave., Toronto.
Criddle, Evelyn, Aweme, Man.
Criddle, Norman, Aweme, Man.
Dawson, Horace, Hymers, Ont.
Day, G. O., Duncans, B.C.
Dod, F. H. Wolley-,Midnapore, Alta.
Dunlop, James, Woodstock, Ont.
Emile, Rev. Bro., Longueuil, Que.
Evans, J. D., Trenton, Ont.
Fyles, Rev. Dr. T. W., 268 Frank St., Ottawa.
Germain, Rev. Bro., Three Rivers, Que.
Gibson, Arthur, Ent. Branch, Dept. Agric., Ottawa.
Hahn, Paul, 433 Indian Road, Toronto.
Hanham, A. W., Duncan, B.C.
Harrington, W. H., P. O. Dept., Ottawa.
Hewitt, Dr. C. Gordon, Ent. Branch, Dept. Agric., Ottawa.
Hudson, A. F., Millarville, Alta.
Johnson, Geo. S., Moose Jaw, Sask.
Kitto, V., Inland Revenue, Dept. Interior, Ottawa.
Leavitt, A. G., St. John, N.B.
Macnamara, Chas., Arnprior, Ont.
McIntosh, W., St. John, N.B.
Mignault, Rev. J. B., Saint Lambert, Que.
Moore, G. A., 850 St. Hubert St., Montreal.
Perrin, Jos., McNab's Island, Halifax, N.S.
Petch, C. E., Hemmingford, Que.
Phair, A. W. H., Lillooet, B.C.
Ruhmann, Max M., Vernon, B.C.
Ross, W. A., Vineland Station, Ont.
Roy, Henri, Quebec, Que.
Sanders, G. E., Bridgetown, N.S.
Sanson, N. B., Banff, Alta.
Simpson, W., Dominion Observatory, Ottawa.
Simms, H. M., 192 Ontario East, Montreal.
Sladen, F. W. L., Experimental Farm, Ottawa.
Strickland, E. H., Experimental Station, Lethbridge, Alta.
Swaine, J. M., Ent. Branch, Dept. Agric., Ottawa.
Tams, W. H. T., Midnapore, Alta.
Taverner, P. A., Victoria Memorial Museum, Ottawa.
Tothill, J. D., Fredericton, N.B.

Treherne, R. C., Agassiz, B.C.
Venables, E. P., Vernon, B.C.
Walker, Dr. E. M., Univ. of Toronto, Toronto.
Wallis, J. B., 265 Langside St., Winnipeg, Man.
Whitehouse, F. C., Red Deer, Alta.
Willing, Prof. T. N., Univ. of Saskatchewan, Saskatoon, Sask.
Wilson, Tom, 1105 Broadway, Vancouver, B.C.
Winn, A. F., 32 Springfield Ave., Westmount, Que.
Young, C. H., Victoria Memorial Museum, Ottawa.

NOTES OF CAPTURES.

(Species preceded by an asterisk (*) described during 1915.)

Lepidoptera.

(Arranged according to Dyar's List of North American Lepidoptera, U.S. Nat. Museum Bull. No. 52.)

(Dyar's number.)

Papilionidæ.

16. *Papilio machaon* var. *aliaska* Scudd. Fort Chipewyan, Alberta, June 18, 1914, (F. Harper).

Sphingidæ.

730. *Smerinthus cerisyi* Kirby. Murray Bay, Que., July, (J. H. Holmes). Rare in Quebec Province. In Winn's list only two localities given—Cowansville and Montreal, (Gibson).

Saturniidæ.

766. *Pseudohazis hera* Harr. Recently I received a specimen of this species taken at Lillooet, B.C., (Phair). It is almost a perfect match to the specimen figured by Strecker on Plate XV of his Lepidoptera, Rhopaloceres and Heteroceres. Mr. Phair reported that he has only found the species where there is sage bush. Mr. Tom Wilson has also taken the insect at the same place. These are the first records I have for British Columbia, (Gibson).

Arctiidæ.

861. *Phragmatobia assimilans* Walk., var. *franconia* Slosson. Several at light, on Pine Creek, near Millarville, Alta., April 29, (Dod and Tams).
883. *Apantesis quenselii* Paykull. 141 Meridian, north of Mount Natazhat, July 1, 1913, (E. W. Nesham).
889. *Apantesis williamsii determinata* Neum. St. Agath, Que., June 25, 1910, (L. Gibb).

Noctuidæ.

996. *Apatela manitoba* Sm. Kaslo, B.C., (Cockle). First record from British Columbia.
1049. *Arsilonche henrici* Grt. Lethbridge, Alta., (Strickland). Rare in Alberta; the North American representative of European *albovenosa* (Dod).
Perigia albimacula B. & McD. Kaslo, B.C., (Cockle).
1145. *Hillia vigilans* Grt. Red Deer, Alta., Sept. 2, (Whitehouse and Tams).
1212. *Hadena passer* var. *incallida,* Walk. Lethbridge, Alta., (Strickland). This is the form with the ground colour pale ochreous. It has often passed in collections as *morna* Strk., (Dod).
1266. *Polia contacta* Walk. Kaslo, B.C., (Cockle).
1271. *Polia acutissima* Grt. Red Deer, Alta., Sept. 3, (Whitehouse and Tams). This is a prior name for *medialis* Grt. As it happens, the type of *acutissima* has the t.a. and the t.p. lines more deeply dentate than type *medialis.* The species has often been recorded from the West under the name of *confragosa* Morr., the correctness of which cannot at present be ascertained, (Dod).
1277. *Dryobota illocata* Walk. Red Deer, Alta., Sept. 4, (Whitehouse and Tams). New to Alberta, (Dod).
1297. *Heliotropha reniformis* Grt. Pine Creek, near Millarville, Alta., Aug. 27, (Tams). First record for this district, (Dod).
1324. *Oncocnemis hayesi* Grt. Kaslo, B.C., (Cockle).
Oncocnemis poliochroa Hamps. Kaslo, B.C., (Cockle).
1329. *Oncocnemis tenuifascia* Sm. Kaslo, B.C., (Cockle).
1331. *Oncocnemis levis* Grt. Lethbridge, Alta., (Strickland). Very rare in Canada, previously taken in the same locality by Mr. Wallis.
1339. *Oncocnemis riparia* Morr. Lethbridge, Alta., (Strickland).
Noctua dislocata Sm. Pine Creek, near Millarville, Alta., June 27, (Brill and Tams). Mr. Tams has prepared mounts of the genitalia of this and *calgary* and finds them very distinct. Those of *dislocata* are exactly like those of British *conflua,* whilst superficially *conflua* is much nearer to *calgary* than to *dislocata,* (Dod).
1483. *Noctua jucunda* Walk. St. John's, Que., (W. Chagnon). Only one record, "Meach Lake," in Winn's Quebec list. This latter is about 170 miles distant from St. John's, (Gibson).
1492. *Noctua patefacta* Sm. Lethbridge, Alta., (Strickland).
* *Rhizagrotis querula* Dod. Red Deer River, about 50 miles to the north-east of Gleichen, Alta., July 1, 3, 1915; July, 23, 24, 1907, (Hudson and Dod). Can. Ent. XLVII, 36. Recorded in 1906 and 1907 Ent. Records as *lagena.*
1535. *Feltia robustior* Sm. Lethbridge, Alta., (Strickland). First Alberta Record, (Dod).
1547. *Feltia vancouverensis* Grt. Pine Creek, near Millarville, Alta., June 24, (Tams). This species has rarely been met with before from east of the Rockies, one or two only having been recorded from Alberta. Mr. Strickland has found it not uncommon at Lethbridge. As a rule, there is less contrast between the light and dark shades than in Vancouver Island specimens, the dark shades being paler and less purplish and the ground colour decidedly darker, but occasional specimens from the two localities are almost exactly alike, (Dod).

Euxoa (Rhizagrotis) perolivalis Sm. Lethbridge, Alta., (Strickland). This species was referred to *Rhizagrotis* by Smith, by reason of the male antennæ being ciliate merely. The character does not appear to be quite constant, and one of the Lethbridge males has the antennæ more obviously serrate than any I had before seen, (Dod).

Euxoa pestula Sm. Lethbridge, Alta., (Strickland). This species is very close indeed to *pleuritica* Grt., and may be a dark form of it, (Dod).

Euxoa thanatologia var. *sordida* Sm. Lethbridge, Alta., (Strickland). Breeding results, in conjunction with a study of Kaslo, B.C., material and previous examination of type, has convinced me that *boretha* Sm. and *sordida* Sm. are both forms of one extraordinarily variable species previously described as *Porosagrotis thanatologia* by Dyar, but best referred to *Chorizagrotis* Smith, which Hampson treats as merely a section of *Euxoa*, (Dod).

1589. *Euxoa sponsa* Sm. Kaslo, B.C., (Cockle).

1590. *Euxoa choris* var. *cogitans* Sm. Lethbridge, Alta., (Strickland).

1593. *Euxoa hollemani* Grt. Maple Bay, Vancouver Island, B.C., Aug. 24, (Day).

1672. *Euxoa pallipennis* Sm. (Syn. *alcosta* Sm.). Lethbridge, Alta., Aug. 21, 1914, (Strickland). A new Canadian record, (Dod).

1689. *Euxoa holoberba* Sm. Kaslo, B.C., (Cockle).

1801. *Mamestra trifolii* Rott. Lethbridge, Alta., Aug. 20, 1914, (Strickland). A new Alberta record, all previous records being my *mutata*, which Hampson claims is a *Cardepia*, very close to *nova* Sm., (Dod).

1849. *Mamestra segregata* Sm. Bow River, at the mouth of Fish Creek, Alta., April 17-24, (Tams). Pine Creek, near Millarville, Alta., April 1, (Dod), and May 8 (Tams). *Segregata* was described from Laggan. *Gussata* Sm. described from here, appears to be a synonym of this, and *negussa* Sm., also described from here a variety without the blackish markings. The species is very variable, the forms easily intergrading, and an examination of male genitalia gives no evidence suggesting two species, (Dod).

2021. *Graphiphora uniformis* Sm. Lethbridge, Alta., (Strickland). The first Alberta record. This species has usually stood as *furfurata* or *peredia* in Manitoba collections. The two latter names refer to one species, very closely allied to *uniformis* (Dod).

2031. *Graphiphora præses* Grt. Kaslo, B.C., (Cockle). Not in Dyar's Kootenai list.

2048. *Stretchia muricina* Grt. Midnapore, Alta., April 12, 16, 28, May 12, (Dod and Tams). I have previously recorded the form occurring here as *plusiæformis*, but whilst I have not so far recognized a distinct species under that name, I consider it probable that all Alberta and British Columbia specimens which I have seen are *muricina*, (Dod).

2067. *Cleoceris populi* Strk. Lethbridge, Alta., (Strickland).

Xylina vivida Dyar. Kaslo, B.C., (Cockle). Not in the Kootenai list.

2079. *Xylina petulca* Grt. Kaslo, B.C., (Cockle). Not in the Kootenai list.

2093. *Xylina ferrealis* Grt. Kaslo, B.C., (Cockle). Not in the Kootenai list.

2095. *Xylina innominata* Sm. Red Deer, Alta., Aug. 30, and Sept. 4, (Whitehouse and Tams). New to Alberta (Dod).

2113. *Xylina capax* G. and R. Blackfalds, Alta., Aug. 17-24, (Whitehouse). New to Alberta, (Dod).

2121. *Calocampa curvimacula* Morr. Kaslo, B.C., (Cockle). Recorded in B.C. list from Vancouver Island.

* *Papaipema humuli* Bird. Cartwright, Man.; Can. Ent. XLVII, 112.

2175. *Papaipema harrisii* Grt. Midnapore, Alta., bred from larvæ found in flower and leaf stems of *Heracleum lanatum*, emerged Aug. 18—Sept. 1, (Dod and Tams). This is the No. 368 of my Alberta list, formerly recorded as *impecuniosa* on Smith's authority. It was a great surprise to discover some numbers of the larvæ feeding close to my house, after I had been on the look out for it for years (Dod).

2205. *Conservula anodonta* Gn. Bondville, Que., July 20, (Winn). Rare in Quebec Province; only two localities given in Winn's list—St. Margaret and Meach Lake, (Gibson).

Orthosia aggressa Sm. Lethbridge, Alta., (Strickland). The first Alberta record. Described from Colorado and Cartwright, Man. Very close to *puta* Grt. (Syn. *euroa* Grt. and *dusca* Sm.), for a large specimen of which it might easily be taken. Its distinction is not unquestionable, (Dod).

2244. *Scopelosoma devia* Grt. Kaslo, B.C., (Cockle). Not in Dyar's Kootenai list.

2262. *Ipimorpha subvexa* Grt. Lethbridge, Alta., (Strickland). The first Alberta record. Recorded in last year's Record from Moose Jaw, Sask., (Dod).

2288. *Nycterophæta luna* Morr. Lethbridge, Alta., (Strickland).

2289. *Copablepharon grandis* Morr. Lethbridge, Alta., (Strickland).

2307. *Rhodophora florida* Gn. Lethbridge, Alta., (Strickland). First Alberta record, (Dod).

Autographa sansoni Dod. Kaslo, B.C., (Cockle). New to B.C. list.

2529. *Autographa snowi* Hy. Edw. Pine Creek, near Millarville, Alta., July 21, (Tams).

2846. *Catocala pura* Hulst. Red Deer and Blackfalds, Alta., Aug. 17 to Sept. 6, (Tams and Whitehouse). The species is very closely allied to *unijuga*, which occurs with it, but *pura* is more variable. It seems probable that *semirelicta* Grt. is the same species, though I am in doubt as to what exact forms the two names apply. According to Smith's catalogue, Grote repeatedly referred Hulst's name to his *semirelicta*, whilst Hulst persisted that the latter was a variety of *briseis*. Pale specimens of the latter are not unlike some forms of *pura*, (Dod).

2851. *Catocala mariana* Hy. Edw. Peachland, B.C., Aug. 6, 10, 1912, (Wallis). Dr. McDunnough informs me that as *mariana* is preoccupied in Europe, *edwardsi* Kuz. will have to be used instead, (Gibson).

3006. *Erebus odora* L. Although this southern species has previously been recorded from Quebec Province (Metis, Quebec, Montreal and Meach Lake), it is of interest to record the capture of a specimen at Newport, Gaspe Co., Que., Aug. 15, by Mrs. G. Chapados. The specimen was donated to the collection of the Ent. Branch by the collector through Miss J. McInnes (Gibson).

3072. *Bomolocha toreuta* Grt. Agassiz, B.C., Aug. 1 (Treherne).

Notodontidæ.

3150. *Schizura semirufescens* Walk. Agassiz, B.C., Aug. 1-15, (Treherne).

Geometridæ.

3236. *Nyctobia nigroangulata* Strk. Red Deer, Alta., April 18, (Whitehouse).
* *Hydriomena speciosata* var. *ameliata* Swett. Victoria, B.C., July 7, 9, 1914. (Blackmore); Can. Ent. XLVII, 64.
3387. *Hydriomena nubilifasciata* var. *cupidata* Swett. Quamichan district, B.C., May 22, 1914, new to B.C. list. Identified by Mr. Swett, who stated that this is a rare variety and rather unexpected from British Columbia. He had only seen the variety from California, (Day).
* *Hydriomena grandis* var. *saawichata* Swett. Victoria, B.C., May 5 to June 20, 1914, (Blackmore); Can. Ent. XLVII, 157.
3393. *Hydriomena edenata* Swett. Mt. Tzouhalem, B.C., Apl. 5, (Hanham).
3401. *Hydriomena multiferata* Walk. Midnapore, Alta. (de Mille's Lumber Mill), July 13, (Brill and Tams).
* *Stammodes blackmorei* Swett. Victoria, B.C., July 2-27, 1913; July 3, 1914, (Blackmore); Can. Ent., XLVII, 155.
* *Petrophora defensaria* var. *mephistaria* Swett. Victoria, B.C., Jan. 9, 1909; Ladysmith, B.C., Feb. 3, 1906, (C. Livingston); Victoria, B.C., (Blackmore); Can. Ent. XLVII, 156.
3450. *Xanthorhoe abrasaria* H.-S. Midnapore, Alta. (de Mille's Lumber Mill), July 13, (Brill and Tams).
3605. *Orthofidonia exornata* Walk. Pine Creek, near Millarville, Alta., May 6, (Tams).
3784. *Alcis sulphuraria* Pack. Lethbridge, Alta., (Strickland). The only previous Alberta record was one taken at Midnapore and recorded in the 1914 Ent. Record, (Dod).
3804. *Spodolepis substriaria* Hulst. Pine Creek, near Millarville, Alta., April 29, (Dod).
3867. *Lycia cognataria* Gn. Quamichan Lake, B.C., April 2, (Hanham).
3963. *Euchlæna astylusaria* Walk. Pine Creek, near Millarville, Alta., May 31, (Tams).
3976. *Synaxis pallulata* Hulst. Quamichan Lake, B.C., Sept. 15, (Hanham).
4016. *Sabulodes lorata* Grt. Lethbridge, Alta., (Strickland); only one specimen previously recorded from Alberta, (Dod).
4026. *Sabulodes transversata* Dru. Lethbridge, Alta., (Strickland). New to Alberta, (Dod).
4040. *Leucobrephos brephoides* Walk. Klutlan Glacier, elev. 5,500 feet, (141 Meridian, north of Mt. Natazhat), May 2, 1913, (E. W. Nesham). Mr. Dod tells me that this insect was common in 1915 on Pine Creek, near Millarville, Alta., April 7-10, (Tams), flying in sunshine, (A. G.).

Tortricidæ.

5207. *Episimus argutanus* Clem. Aweme, Man., reared from *Rhus toxicodendron*, (N. Criddle).
5367. *Archips negundana* Dyar. Aweme, Man., July 8, 1914, (N. Criddle).
5396. *Tortrix pallorana* Rob. Aweme, Man., July 16, 1914, (N. Criddle).

Yponomeutidæ.

5491. *Trachoma falciferella* Walsm. Quamichan Lake, B.C., March 21, the second I have captured, (Hanham).

Gelechiidæ.

Recurvaria nanella Hbn. Toronto, Ont., reared from pear, (Cosens), Bridgetown, N.S., July 30, (Sanders).

* *Gnorimoschema gibsoniella* Busck. Aweme, Man., (N. Criddle); Proc. Ent. Soc. Wash. XVII, 82.

Elachistidæ.

* *Coleophora manitoba* Busck. Aweme, Man., (N. Criddle); Proc. Ent. Soc. Wash., XVII, 88.

6179. *Walshia amorphella* Clem. Aweme, Man., July 25, 1914, (N. Criddle).

Tineidæ.

* *Incurvaria itoniella* Busck. Kaslo, B.C., (Cockle); Proc. Ent. Soc. Wash., XVII, 92.

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

Cicindelidæ.

18c. *Cicindela longilabris* var. *montana* Lec. Athabaska Landing, Alta., Aug. 11, (Strickland).

34. *Cicindela pusilla* Say. Estevan, Sask., June 20, (N. Criddle).

Carabidæ.

408. *Bembidium dubitans* Lec. Vernon, B.C., April 10, (Ruhmann).

416. *Bembidium mutatum* G. & H. Agassiz, B.C., (Treherne).

422. *Bembidium trechiforme* Lec. Agassiz, B.C., (Treherne).

* *Trechus borealis* Schaeffer. Labrador, Battle Harbor, (Engelhardt); Bay of St. George, Newfoundland, (Engelhardt). Jour. N.Y. Ent. Soc. XXIII, 47.

510. *Pterostichus brunneus* Dej. Armstrong, B. C., Sept. 12, (Ruhmann).

558. *Pterostichus scitulus* Lec. Vernon, B.C., July, 1914, (Ruhmann).

571. *Pterostichus corvinus* Dej. Winnipeg, Man., April 29, 1911, (Wallis).

578. *Pterostichus mutus* Say. Winnipeg, Man., June 10, 1910, (Wallis).

643. *Amara adstrictus* Putz. Miami, Man., Aug. 14, 1914, (Wallis).

749. *Calathus advena* Lec. Vernon, B.C., Aug. 1914, (Ruhmann).

750. *Calathus impunctatus* Say. Husavick, Man., Aug. 2, 1912, (Wallis).

776. *Calathus piceolus* Lec. Winnipeg, Man., May 3, 1911, (Wallis).

818. *Platynus cupreus* Dej. Agassiz, B.C., (Treherne).

1067. *Discoderus parallelus* Hald. Peachland, B.C., July 24, 1912, (Wallis).

1084. *Harpalus faunus* Say. Winnipeg, Man., June 18, 1911, (Wallis).

1087b. *Harpalus longior* Kirby. Winnipeg, Man., June 2, 1911, (Wallis).

1090. *Harpalus fulvilabris* Mann. Winnipeg, Man., June 1, 1912, (Wallis).

1096. *Harpalus ventralis* Lec. Treesbank, Man., July 26, 1910; Miami, Man., July 1, 1914, (Wallis).

1106. *Harpalus lewisii* Lec. Miami, Man., July 21, 1914, (Wallis).

Amphizoidæ.

1215. *Amphizoa insolens* Lec. Peachland, B.C., July 13, 1912, (Wallis).

Staphylinidæ.

2124. *Staphylinus badipes* Lec. St. Rose, Que., April 22, 1914, (Beaulne).
* *Philonthus pumilio* Casey. Aweme, Man., (N. Criddle): Memoirs on the Coleoptera, VI, 431, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus nematocerus* Casey. Metlakatla, B.C., (Keen): Memoirs on the Coleoptera, VI, 437, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus ottawensis* Casey. Ottawa, Ont., (Harrington): Memoirs on the Coleoptera, VI, 438, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus cephalicus* Casey. Aweme, Man., (N. Criddle); Memoirs on the Coleoptera, VI, 438, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus linearis* Casey. Metlakatla, B.C., (Keen); Memoirs on the Coleoptera, VI, 439, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus vulgatus* Casey. Ottawa; Memoirs on the Coleoptera, VI, 442, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus finitimus* Casey. Hull, Que., (Beaulne); Memoirs on the Coleoptera, VI, 443, by Thos. L. Casey, issued Nov. 27, 1915.
* *Megaquedius manitobensis* Casey. Aweme, Man., (N. Criddle); Memoirs on the Coleoptera, VI, 423, by Thos. L. Casey, issued Nov. 27, 1915.
* *Quediochrus quadriceps* Casey. Aweme, Man., (N. Criddle); Memoirs on the Coleoptera, VI, 421, by Thos. L. Casey, issued Nov. 27, 1915.
* *Microsaurus curtipennis* Casey. Aweme, Man., (N. Criddle); Memoirs on the Coleoptera, VI, 414, by Thos. L. Casey, issued Nov. 27, 1915.
* *Microsaurus breviceps* Casey. Stikine River, B.C., (Wickham): Memoirs on the Coleoptera, VI, 411, by Thos. L. Casey, issued Nov. 27, 1915.
* *Microsaurus criddlei* Casey. Aweme, Man., (N. Criddle); Memoirs on the the Coleoptera, VI, 410, by Thos. L. Casey, issued Nov. 27, 1915.
* *Microsaurus canadensis* Casey. Kazubazua, Que., (Beaulne); Memoirs on the Coleoptera, VI, 409, by Thos. L. Casey, issued Nov. 27, 1915.
* *Distichalius oculens* Casey. Inverness, B.C., (Keen); Memoirs on the Coleoptera, VI, 407, by Thos. L. Casey, issued Nov. 27, 1915.
* *Distichalius agnatus* Casey. Aweme, Man., (N. Criddle); Memoirs on the Coleoptera, VI, 406, by Thos. L. Casey, issued Nov. 27, 1915.
Orus punctatus Casey. Agassiz, B.C., (Treherne).
2501. *Hesperobium californicum* Lec. Agassiz, B.C., (Treherne).
2863. *Anthobium pothos* Mann. Ottawa, Ont., May, 13, (Germain).

Phalacridæ.

3007. *Olibrus nitidus* Melsh. Ottawa, Ont., May 31, (Germain).

Corylophidæ.

Orthoperus brunneus Casey. Ottawa, May, (Germain).

Coccinellidæ.

Anatis lecontei Casey. Lethbridge, Alta., July 27, (Strickland).
3089. *Pentilia marginata* Lec. Ottawa, Ont., June 17, (Germain).

Corydiidæ.

3281. *Deretaphrus oregonensis* Horn. Peachland, B.C., July 13, 1912, (Wallis).

Cucujidæ.

3348. *Dendrophagus glaber* Lec. Bird's Hill, Man., May 6, 1911, (Wallis).

Cryptophagidæ.

3363. *Paramecosoma serratum* Gyll. Ottawa, Ont., June 27, 1914, (Germain).
3443. *Trogoderma tarsale* Melsh. Ottawa, Ont., July 12, 1914, (Germain).

Histeridæ.

3495. *Hister furtivus* Lec. Millarville, Alta., April, May, 1914, (Tams).
3533. *Epierus regularis* Beauv. Ottawa, Ont., July 3, (Germain).
3552. *Paromalus æqualis* Say. Husavick, Man., June 22, 1912; under debris on lake beach, (N. Criddle and Wallis).
3586a. *Saprinus distinguendos* Mars. Winnipeg, Man., June 1, 1912, (Wallis).
3588. *Saprinus infaustus* Lec. Peachland, B.C., July 19, 1912, (Wallis). Dr. Fall when determining the specimen stated that probably this beetle is the one that Horn mentions in his Synopsis as possibly a form of *infaustus*.
3602. *Saprinus incertus* Lec. Peachland, B.C., July 22, 1912, (Wallis).
3610. *Saprinus fimbriatus* Lec. Peachland, B.C., July 22, 1912, (Wallis).

Elateridæ.

4115. *Cardiophorus amplicollis* Mots. Grand Forks, B.C., 1913, (Ruhmann).
4252. *Drasterius livens* Lec. Grand Forks, B.C., 1913, (Ruhmann).
4415. *Paranomus estriatus* Lec. Ottawa, Ont., June 25, (Germain).

Throscidæ.

4548. *Throscus invisus* Horn. Ottawa, Ont., June 17, (Germain).

Buprestidæ.

10,112. *Agrilus masculinus* Horn. Aweme, Man., June 5, (N. Criddle).

Lampyridæ.

4914. *Silas munita* Lec. Vernon, B.C., April 8, (Ruhmann).

Malachidæ.

5030. *Malachius ulkei* Horn. Aweme, Man., May 31, (N. Criddle).

Ptinidæ.

Ptinus villiger Reit. Winnipeg, Man., May 17, 1911, (Wallis).
10,149. *Xestobium elegans* Horn. Winnipeg, Man., May 23, 1911, (Wallis).
5265. *Oligomerus obtusus* Lec. Ottawa, Ont., June 25, (Germain).

Scarabæidæ.

5439. *Canthon perplexus* Lec. Macleod, Alta., June 30, 1902, (J. Fletcher).
5510. *Aphodius hamatus* Say. Quebec, Que., (Roy).

5629. *Trox scaber* L. Miami, Man., July 1, 1914, (Wallis).

5648. *Hoplia laticollis* Lec. Aweme, Man., July, 1903 to 1910, (Criddle Bros.). First Canadian record we have.

Serica intermixta Blatchley. Aweme, Man., May 26, 1910, (E. Criddle).

5686. *Serica anthracina* Lec. Vernon, B.C., April 8, (Ruhmann).

5705. *Diplotaxis obscura* Lec. Aweme, Man., April, May, (Criddle Bros.).

Lachnosterna grandis Smith. Halifax, N.S., July 18, (Perrin). It is also interesting to record the capture of a specimen on Sable Island. A single specimen was received at Ottawa with a small collection of lepidoptera. Sable Island is about 140 miles due east of Guysborough County in Nova Scotia.

* *Anomala* (subq. *Paranomala*) *canadensis* Casey. Ontario, Canada; Memoirs on the Coleoptera, VI, 33, by Thos. L. Casey, issued Nov. 27, 1915.

* *Cremastocheilus pocularis* Casey. Aweme, Man., (Criddle); Memoirs on the Coleoptera, VI, 33, by Thos. L. Casey, issued Nov. 27, 1913.

Cerambycidæ.

5973. *Nothorhina aspera* Lec. Peachland, B.C., July 12, 1912, (Wallis).

6201. *Neoclytus erythrocephalus* Fab. Miami, Man., July 2, 1914, (Wallis).

6252. *Anthophylax viridis* Lec. Halifax, N.S., Aug. 22, (Perrin).

6259. *Acmæops bivittata* Say. Miami, Man., July 3, (Wallis).

6304. *Leptura subhamata* Rand. Halifax, N.S., Aug. 21, (Perrin).

6332a. *Leptura erythroptera* Kirby. Halifax, N.S., Aug. 22, (Perrin).

Chrysomelidæ.

6531. *Donacia porosicollis* Lec. Onah, Man., May 24, 1912, in flowers of Marsh Marigold, (S. and E. Criddle and Wallis).

6535. *Donacia distincta* Lec. Ottawa, Ont., July, 1913, (Germain).

6538. *Donacia pubescens* Lec. Winnipeg, Man., June 22, 1912, (Wallis).

6539. *Donacia æqualis* Say. Ottawa, Ont., July, 1913, (Germain).

6541. *Donacia emarginata* Kirby. Ottawa, Ont., July, 1913, (Germain).

6545. *Donacia metallica* Ahr. Ottawa, Ont., July, 1913, (Germain).

6550. *Donacia atra* var. *childreni* Kirby. Winnipeg, Man., May 28, 1911, (Wallis). The same collector has also taken at Winnipeg the varieties *tibialis* (June 29) and *trivittata* (June 17).

10,337. *Syneta hamata* Horn. Vernon, B.C., April 9, (Ruhmann).

* *Pachybrachys relictus* Fall. Toronto, Ont.; Trans. Amer. Ent. Soc., XLI, 424.

* *Pachybrachys carborarius janus* Fall. Brandon, Man.; Trans. Amer. Ent. Soc., XLI, 462.

Pachybrachys elegans Blatchley. Winnipeg, Man., June 24, 1911, (Wallis).

Tymnes canellus var. *thoracica* Melsh. Winnipeg, Man., June 24, 1911, (Wallis).

6769. *Graphops marcassita* Cr. Winnipeg, Man., (Wallis); Ottawa, Ont., May 25, (Germain).

6809a. *Chrysomela spirææ* Say. Treesbank, Man., April 17, 1908, (Wallis).

6905. *Galerucella nymphææ* L. Fort Chipewyan, Alta., June 13, (F. Harper).

6920. *Hypolampis pilosa* Ill. Winnipeg Beach, Man., Aug. 25, 1910, (Wallis).

6974. *Haltica tombacina* Mann. Ottawa, Ont., May 25, (Germain).

Bruchidæ.

7135. *Bruchus aureolus* Horn. Aweme, Man., July 6, (N. Criddle).

Tenebrionidæ.

Eleodes letcheri var. *vandykei* Blaisd. Vernon, B.C., April 8, (Ruhmann).
7355. *Eleodes cordata* var *rotundipenne* Lec. Vernon, B.C., April 8, (Ruhmann).
7391. *Nyctobates pennsylvanica* DeG. Winnipeg, Man., May 5, 1911, (Wallis).
Arrhenoplita bicornis Oliv. Ottawa, Ont., May and June, (Germain).

Cistelidæ.

7631. *Androchirus erythropus* Kirby. Ottawa, Ont., July 21 (Germain).

Melandryidæ.

7653. *Melandrya striata* Say. Winnipeg, Man., June 19, 1912, (Wallis).
7655. *Emmesa labiata* Say. Quebec, Que., (Roy).
7658. *Xylita lævigata* Hellw. Ottawa, Ont., Aug., 1914, (Germain).
7663. *Scotochroa atra* Lec. Ottawa, Ont., July 18, 1914, (Germain).
7664. *Scotochroa basalis* Lec. Ottawa, Ont., June 12, (Germain).
7666. *Serropalpus barbatus* Schall. Winnipeg, Man., July, 1909, (Wallis).

Pythidæ.

7708. *Boros unicolor* Say. Winnipeg, Man., June 4, 1914, (Wallis).

Mordellidæ.

7804. *Mordellistena intermixta* Helm. Miami, Man., July 6, 1914, (Wallis).

Anthicidæ.

Stereopalpus vestitus Say. Ottawa, Ont., July 14, (German).

Pyrochroidæ.

7997. *Dendroides ephemeroides* Mann. Agassiz, B.C., June 20, (Treherne).

Otiorhynchidæ.

8261. *Panscopus erinaceus* Say. Ottawa, Ont., July 3, (Germain).
8285. *Otiorhynchus rugifrons* Gyll. Ottawa, Ont., July 1, (Germain).
8293. *Mylacus saccatus* Lec. Vernon, B.C., April 10, (Ruhmann).

Curculionidæ.

8673. *Orchestes pallicornis* Say. Ottawa, Ont., July 29, (Germain).
8688. *Proctorus decipiens* Lec. Ottawa, Ont., June 3, (Germain).
Cœliodes apicalis Dietz. Ottawa, Ont., June 29, (Germain).

Scolytidæ.

* *Pityogenes hopkinsi* Swaine. "In limbs of pine throughout eastern part of Canada and United States"; Tech. Publication No. 2, N.Y. State College of Forestry, Vol. XVI, 7.

* *Ips perroti* Swaine. Isle Perrot, Que., 1912, (Swaine); Can. Ent., XLVII, 357.

* *Dryocœtes sechelti* Swaine. Sechelt, B.C., Can. Ent., XLVII, 359.

* *Dryocœtes piceæ* Hopk. "North Carolina to Canada, and westward to Michigan"; Rep. No. 99, U. S. Dep. Agr., Office of the Secretary, p. 51, issued March 10, 1915.

* *Dryocœtes pseudotsugæ* Swaine. Inverness and Vancouver, B.C., Can. Ent., XLVII, 360.

* *Phlœosinus pini* Swaine. Riding Mts., Man., (Swaine); Can. Ent. XLVII, 362.

* *Hylastes ruber* Swaine. Golden, B.C., Creighton Valley, B.C., Can. Ent., XLVII, 367.

* *Conophthorus resinosæ* Hopk. "Ontario, Canada," (Harrington); Jour. Wash. Acad. Sci., Vol. V, 431.

* *Conophthorus monticolæ* Hopk. "Cowitche Lake, Canada," Jour. Wash. Acad. Sci., Vol. V, 432. The locality should be corrected to read "Cowitchan Lake, B.C."

Diptera.

(Arranged according to a catalogue of North American Diptera, by J. M. Aldrich, Smithsonian Misc. Coll. XLVI, No. 1, 444. The numbers refer to the pages in the catalogue.)

Large collections of these insects have been made in certain of the provinces during 1915. The appearance of Winn and Beaulieu's list of Quebec diptera will doubtless encourage collectors in that province to add to the list. Recently we had the pleasure, at Ottawa, of a visit from Prof. J. M. Aldrich, who came to study the collection of diptera in the collection of the Entomological Branch. Many species were determined by him, and the records of a number of these are undoubtedly new to Canada.

Tipulidæ.

* *Dicranomyia aquila* Dietz. Described in Can. Ent. XLVII, 331. The type localities there given, viz.: "Fort Resolution, Aug. 24, 1914; Island at mouth of Rocker River, Aug. 16, 1914, (F. Harper)" were tentative ones, I am informed by Mr. Harper, and should be corrected to read, "District of Mackenzie along the south shore of Great Slave Lake," (Gibson).

* *Limnobia gracilis* Dietz. Described in Can. Ent. XLVII, 329. The type locality there given, viz.: "Tsolinoi, about 5 miles north of Athabaska Lake, July 5, 1914, (F. Harper)," should be corrected to read, Tsal-wor Lake, Sask., about 8 miles from the north shore of Lake Athabaska at a point about midway of its length, (Gibson).

* *Gonomyia mathesoni* Alex. Truro, N.S., July 7-26, 1913, (R. Matheson); Ent. News, XXVI, 170.

* *Limnophila (Dactylolabis) hortensia* Alex. London Hill Mine, Bear Lake, B.C., July 29, 1903, (A. N. Caudell); Proc. Acad. Nat. Sciences, Philadelphia, LXVI, 591.

* *Phalacrocera neoxena* Alex. Nipigon, Ont., June 17, 1913, (Walker). Proc. Acad. Nat. Sciences, Philadelphia, LXVI, 603.

100. *Tipula augustipennis* Loew. Vernon, B.C., (Ruhmann); Athabaska River, between Grand Rapids and mouth of Little Buffalo River, Alta., May 24, 25, 1914, (F. Harper).
104. *Tipula serta* Loew. Soulier Lake, southern Mackenzie, July 18-22, 1914, (F. Harper).
104. *Tipula tessellata* Loew. Lake Athabaska, near mouth of Charlot River, northern Saskatchewan, June 29, 1914, (F. Harper).

Chironomidæ.

108. *Ceratopogon cockerelli* Coq. Banff, Alta., Aug. 29, 1910, (Sanson).

Culicidæ.

132. *Grabhamia curriei* Coq. Banff, Alta., June 26, 1909, (Sanson).

Cecidomyidæ.

* *Dasyneura torontoensis* Felt. Toronto, Ont., May 3, 1915, (Cosens); Jour. Econ. Ent. 8, 405.

Bibionidæ.

164. *Plecia heteroptera* Say. DeGrassi Point, Lake Simcoe, Ont., Aug. 26, 1914, (Walker).
166. *Bibio nervosus* Loew. Vernon, B.C., (Ruhmann).
166. *Bibio nigripilus* Loew. Ottawa, Ont., May and June, (Germain).
166. *Bibio obscurus* Loew. Banff, Alta., Sept. 29, 1911, (Sanson).
166. *Bibio xanthopus* Wied. Ottawa, Ont., June 18, (Germain).
167. *Dilophus serraticollis* Walk. Banff, Alta., Sept. 29, 1911, (Sanson).
167. *Aspistes analis* Kirby. Banff, Alta., (Sanson.)
168. *Scatopse pygmæa* Loew. Ottawa, Ont., May 30, (Germain); Toronto, Ont., June 7, 1914, (Walker).

Simuliidæ.

169. *Simulium bracteatum* Coq. Ottawa, Ont., May 12, (Germain).
170. *Simulium vittatum* Zett. Ottawa, Ont., May 5, (Germain).

Stratiomyidæ.

179. *Sargus decorus* Say. Departure Bay, B.C., July 25, 1913, (Walker); Toronto, Ont., May 4, June 11, 1914, (Walker).
180. *Sargus viridis* Say. Spruce Brook, Nfd., July 29, 1914, (Walker).
182. *Stratiomyia discalis* Loew. Kelowna, B.C., June 2, 1914 (Ruhmann).
183. *Stratiomyia lativentris* Loew. Prince Albert, Sask., June 26, 1913, (Walker).
183. *Stratiomyia nymphis* Walk. Banff, Alta., Aug. 5, 1909, (Sanson).
184. *Stratiomyia normula* Loew. Prince Albert, Sask., June 29, 1913, (Walker).

Tabanidæ.

194. *Pangonia tranquilla* O. S. Halifax, N.S., Aug. 20, 22, (Perrin).
195. *Chrysops callidus* O. S. Toronto, Ont., June 30, 1914, (Walker).
195. *Chrysops celer* O. S. Prince Albert, Sask., June 23, 1912, (Walker); Spruce Brook, Nfd., July 27, 1914, (Walker).
196. *Chrysops carborarius* Walk. Toronto, Ont., June 7, 1914, (Walker).

196. *Chrysops frigidus* O. S. Spruce Brook, Nfd., July 29, 1914, (Walker).
197. *Chrysops montanus* O. S. Ottawa, Ont., May 20, (Germain).
197. *Chrysops niger* Macq. Spruce Brook, Nfd., July 27, 1914, (Walker); Toronto, Ont., June 13, 1914, (Walker).
197. *Chrysops plangens* Wied. MacNab's Island, Halifax, N.S., July 19, 1914, (Perrin).
201. *Tabanus astutus* O. S. MacNab's Island, Halifax, N.S., Aug. 16, 1914, (Perrin).
Tabanus centron Marten. Fort McMurray, Alta., May 29; Fort Chipewan, June 16-18, (F. Harper).
Tabanus fulvescens Walk. MacNab's Island, Halifax, N.S., Aug. 2, 1914, (Perrin).
208. *Tabanus stygius* Say. Pt. Pelee, Ont., July 19, 1913, (Taverner and Young).

Leptidæ.

Arthropeas magna Jns. Calgary, Alta., (J. Fletcher); Aweme, Man., June 20, 1903, (N. Criddle).
212. *Rhachicerus nitidus* Jns. Lake McGregor, Que., July 12, (Germain). New to Quebec Province.
214. *Triptotricha disparilis* Bergr. Agassiz, B.C., Aug., (Treherne).
214. *Leptis maculifer* Bigot. Vancouver, B.C., June, 1914, (Chrystal).
215. *Leptis plumbea* Say. Jordan, Ont., May 10, (Ross).
215. *Leptis scapularis* Loew. Bowmanville, Ont., July 10, 1913, (Ross); Lake McGregor, Que., July 12, (Germain).
216. *Chrysopila ornata* Say. Jordan, Ont., June 16, (Ross).
216. *Chrysopila proxima* Walk. Toronto, Ont., June 13, 1914, (Walker).
217. *Symphoromyia atripes* Bigot. Banff, Alta., (Sanson); Lake Louise, Alta., July 20, (Ruhmann).
217. *Symphoromyia hirta* Jns. Prince Albert, Sask., July 24, 28, 1907, (J. Fletcher).
* *Symphoromyia kincaidi* Aldrich. Victoria, B.C., Aug. 6, 1903, (Kincaid); Gabriola Island, B.C., May 30, 1908, B. Elliott, (Kincaid); Stickeen River Canyon, B.C., (Wickham); Proc. U. S. N. M. Vol. 49, 129.
* *Symphoromyia montana* Aldrich. Prince Albert, Sask., May 18, 1905, (Willing); Ungava Bay, (Turner); Farewell Creek, Sask., (C. W. J.); Proc. U. S. N. M. Vol. 49, 133.
217. *Symphoromyia plangens* Will. Elbert, B.C., June 19, 1914, (Chrystal).

Nemestrinidæ.

219. *Rhynchocephalus sackeni* Will. Vernon, B.C., June 23, 1902.

Bombyliidæ.

223. *Spogostylum pluto* Wied. De Grassi Point, Lake Simcoe, Ont., Aug. 14, 1895, (Walker).
230. *Anthrax fulviana* Say. De Grassi Point, Lake Simcoe, Ont., Aug. 28, 1914, (Walker).
230. *Anthrax fulviana* var. *nigricauda* Loew. Banff, Alta., July 25, 1910, (Sanson).
236. *Bombylius lancifer* O. S. Kelowna, B.C., June 2, 1914, (Ruhmann).

Therevidæ.

247. *Psilocephala munda* Loew. Banff, Alta., July 16, 1909, (Sanson).
248. *Thereva flavicincta* Loew. St. Johns, Que., Record from Stettiner Entomologische Zeitung, 1912, p. 261. New to Quebec list.

Mydaidæ.

251. *Mydas clavatus* Dru. Pt. Pelee, Ont., July 19, 1913, (Taverner and Young).

Asilidæ.

254. *Leptogaster badius* Loew. Jordan, Ont., June 29, (Ross).
Laphystia flavipes Coq. Aweme, Man., July 13, 1907, (J. Fletcher).
258. *Myelaphus lobicornis* O. S. Invermere, B.C., June 30, 1914, (Sladen).
259. *Cyrtopogon dasyllis* Will. Banff, Alta., (Sanson).
260. *Cyrtopogon nebulo* O. S. Banff, Alta., March 6, 1911, (Sanson).
269. *Atomosia puella* Wied. Jordan, Ont., Jan. 29, (Ross).
271. *Dasyllus columbica* Walk. Banff, Alta., June 30, 1913, (Walker).
271. *Dasyllis thoracica* Fabr. De Grassi Point, Lake Simcoe, Ont., July 2, 1896, (Walker).
272. *Laphria pubescens* Will. Sudbury, Ont., June 7, 1913, (Walker).
273. *Laphria vultur* O. S. Kaslo, B.C., June, (Cockle).
281. *Tolmerus callidus* Will. Banff, Alta., July 11, 1911, (Sanson).
282. *Tolmerus notatus* Wied. De Grassi Point, Lake Simcoe, Ont., Aug. 23, 1914, (Walker).
282. *Asilus annulatus* Will. Toronto, Ont., Aug. 8, 1914, (Walker).
283. *Asilus orphne* Walk. Lake McGregor, Que., July 23, (Germain).
283. *Asilus paropus* Walk. Jordan, Ont., Aug. 6, 1914, (Ross).

Dolicopodidæ.

285. *Psilopodinus patibulatus* Say. Lake Louise, Alta., July 4, 1914, (Ruhmann).
289. *Chrysotus obliquus* Loew. Bridgetown, N.S., Aug. 29, 1912, (Sanders).
291. *Argyra albicans* Loew. Toronto, Ont., June 13, 1914, (Walker).
293. *Sympycnus lineatus* Loew. Brockville, Ont., Aug. 23, 1903, (W. Metcalfe).
296. *Medeterus veles* Loew. Aweme, Man., June 12, (N. Criddle).
* *Thrypticus comosus* Van Duzee. Toronto, Ont., July 4; Psyche, XXII, 86.
299. *Dolichopus bifractus* Loew. Aweme, Man., July 6, (N. Criddle); Dauphin, Man., June 22, 1913, (Walker).
300. *Dolichopus brevipennis* Meigen. Summerside, P.E.I., Aug. 21, 1914, (Walker).
301. *Dolichopus cuprinus* Wied. Dauphin, Man., June 22, 1913, (Walker).
301. *Dolichopus dakotensis* Ald. Dauphin, Man., June 22, 1913, (Walker).
301. *Dolichopus eudactylus* Loew. Jordan, Ont., June 12, (Ross).
304. *Dolichopus reflectus* Ald. Jordan, Ont., July 8, (Ross).
304. *Dolichopus renidescens* M. & B. Dauphin, Man., June 22, 1913, (Walker).
306. *Gymnopternus tristis* Loew. Vancouver, B.C., June 30, 1914, (Chrystal).

Empidæ.

311. *Drapetis medetera* Melan. Aweme, Man., Sept. 21, (N. Criddle).
311. *Platypalpus æqualis* Loew. Ottawa, Ont., June 18, (Germain).
312. *Platypalpus crassifemoris* Fitch. Aweme, Man., July 20, (N. Criddle).

313. *Tachydromia pusilla* Loew. Ottawa, Ont., May and June, (Germain).
318. *Syneches thoracicus* Say. Lake McGregor, Que., July 12, (Germain). New to Quebec Province.
319. *Leptopeza compta* Coq. Ottawa, Ont., July 16, (Germain).
319. *Ocydromia glabricula* Fallen. Aylmer, Que., June, (Germain). New to Quebec Province.
326. *Hilara tristis* Loew. Spruce Brook, Nfd., July 27, 1914, (Walker).
331. *Rhamphomyia irregularis* Loew. Ottawa, Ont., July 3, (Germain).
331. *Rhamphomyia lævigata* Loew. Ottawa, Ont., July 3, (Germain).
331. *Rhamphomyia longicauda* Loew. Toronto, Ont., July 12, 1914, (Walker).
332. *Rhamphomyia pulla* Loew. Toronto, Ont., May 31, 1914, (Walker).
Microsania imperfecta Loew. Aweme, Man., Sept. 18, (Criddle).

Phoridæ.

339. *Gymnophora arcuata* Meigen. Ottawa, Ont., July and August, (Germain).

Platypezidæ.

340. *Agathomyia notata* Loew. Ottawa, Ont., June 27, (Germain).

Pipunculidæ.

342. *Chalarus spurius* Fallen. Ottawa, Ont., July 20, (Germain).
Pipunculus appendiculatus Cr. Aweme, Man., July 6, (N. Criddle).
343. *Pipunculus albofasciatus* Hough. Ottawa, Ont., May and June, (Germain).
343. *Pipunculus cingulatus* Loew. Ottawa, Ont., May and June, (Germain).
Pipunculus confraternus Banks. Aweme, Man., July 23, (N. Criddle).
343. *Pipunculus flavomaculatus* Hough. Ottawa, Ont., May and June, (Germain).

Syrphidæ.

346. *Microdon tristis* Loew. Field, B.C., July 1, 1908, (J. C. Bradley); Vineland, Ont., June 4. (Ross and Curran).
348. *Chrysotoxum ventricosum* Loew. Revelstoke, B.C., July 8-13, 1905, (J. C. Bradley).
348. *Chrysogaster bellula* Will. Vineland, Ont., Aug. 18, 1914, (Ross and Curran).
349. *Chrysogaster stigmata* Will. Carbonate to Prairie Hills, Selkirk Mts., B.C., July 12-18., 1909, (Bradley).
349. *Pipiza albipilosa* Will. Ottawa, Ont., July 3, (Germain).
350. *Pipiza calcarata* Loew. Vineland, Ont., May and June, (Ross).
350. *Pipiza femoralis* Loew. Toronto, Ont., June 6, 1914, (Walker); Vineland, Ont., May and June, (Ross and Curran).
350. *Pipiza pistica* Will. Vineland, Ont., July 10, (Ross and Curran).
350. *Pipiza pisticoides* Will. Vineland, Ont., May 11, (Ross and Curran).
350. *Pipiza pulchella* Will. Ottawa, Ont., July 3, (Germain).
Eumerus strigatus Fall. Victoria, B.C., reared from Narcissus bulbs, April 7-9, 1910, (E. A. Wallace).
351. *Paragus angustifrons* Loew. Revelstoke, B.C., July 1, 1905, (J. C. Bradley).

351. *Paragus tibialis* Fall. Vineland, Ont., July 17-Aug. 6; also reared from larvæ feeding on *Aphis gossypii,* (Ross and Curran).
352. *Chilosia lasiophthalmus* Will. Carbonate to Prairie Hills, Selkirk Mts., B.C., July 12-18, 1908, (J. C. Bradley); Wellington, B.C., April 16, 1903, (R. V. Harvey).
353. *Chilosia tristis* Loew. Carbonate on Columbia River, July 7-12, 1908, (J. C. Bradley).
359. *Pyrophæna rosarum* Fabr. Ottawa, Ont., June 27, (Germain).
359. *Platychirus peltatus* Meigen. Carbonate to Prairie Hills, Selkirk Mts., July 12-18, 1908, (J. C. Bradley).
359. *Platychirus hyperboreus* Stæger. Vineland, Ont., (Ross and Curran), Bowmanville, Ont., (Ross).
360. *Melanostoma obscurum* Say. Vineland, Ont., May and June, (Ross and Curran).
362. *Leucozona lucorum* Linné. Metlakatla, B.C., (Keen).
362. *Didea fasciata* Macq. Vineland, Ont., May 10, (Ross and Curran).
362. *Didea fasciata* var. *fuscipes* Loew. Carbonate, B.C., July 7-12, 1908, (J. C. Bradley); Macnab's Island, Halifax, N.S., July 4, 1914, (Perrin).
363. *Didea laxa* O. S. Halifax, N.S., June 27, (Perrin).
364. *Syrphus amalopis* O. S. Banff, Alta., June 24, 1911, (Sanson).
365. *Syrphus geniculatus* Macq. Spruce Brook, Nfd., July 29, 1914, (Walker); Ground Hog Basin, Bend Country, Selkirk Mts., B.C., Aug. 4, 1905, (J. C. Bradley); Ottawa, Ont., May 3, (Germain).
366. *Syrphus grossulariæ* Meigen. Carbonate, Columbia River, B.C., July 7-12, 1908, (J. C. Bradley).
367. *Syrphus opinator* O. S. Ground Hog Basin, Selkirk Mts., Aug. 4, 1905, (J. C. Bradley).

Syrphus perplexus Osb. Toronto, Ont., May 30, 1909, (M. C. VanDuzee).

368. *Syrphus torvus* O. S. Spruce Brook, Nfd., July 27, 1914, (Walker).
368. *Syrphus umbellatarum* Fabr. Spruce Brook, Nfd., July 27, 1914, (Walker).
368. *Syrphus velutinus* Will. Ground Hog Basin, Big Bend Country, Selkirk Mts., B.C., July 24, 1905, (J. C. Bradley).
368. *Syrphus xanthostoma* Will. Vineland, Ont., May 17, (Ross and Curran).
371. *Xanthogramma polita* Say. Vineland, Ont., Sept. 8, (Ross and Curran).
373. *Sphærophoria scripta* L. Ottawa, Ont., April 20, (Germain). Mr. C. W. Johnson, when naming this specimen, stated: "This is the true *S. scripta;* although long recorded from America, I have not seen it before."
374. *Sphegina campanulata* Rob. Vineland, Ont., July 9, (Ross and Curran).
374. *Sphegina infuscata* Loew. Ground Hog Basin, Selkirk Mts., B.C., Aug. 4, 1905, July 24, 1908; Carbonate, Columbia River, B.C., July 7-12, 1908, (J. C. Bradley).
374. *Sphegina lobata* Loew. Ground Hog Basin, B.C., July 24, 1905, Aug. 4, 1905, (J. C. Bradley).
375. *Neoascia distincta* Will. Ottawa, Ont., May 13, (Germain).
375. *Neoascia globosa* Walk. Carbonate, B.C., July 7-12, 1908, (J. C. Bradley).
378. *Volucella esuriens mexicana* Macq. Victoria, B.C., April 15, 1905, (Hanham).
378. *Volucella fascialis* Will. Midnapore, Alta., June 15, (Tams); Invermere, B.C., June 30, 1914, (Sladen).

382. *Sericomyia chalcopyga* Loew. Spruce Brook, Nfd., June 29, 1914, (Walker).
383. *Arctophila flagrans* O. S. Rogers Pass, B.C., Aug. 1, 1908; Ground Hog Basin, B.C., July 22-Aug. 7, 1905, (J. C. Bradley); Vernon, B.C., (Ruhmann).
Eristalis arbustorum L. Ottawa, Ont., May 5, (Germain). St. John, N.B., (G. P. Engelhardt); Labrador, Battle Harbor, (G. P. Engelhardt). A European species. Jour. N.Y. Ent. Soc. XXIII, 143.
385. *Eristalis compactus* Walk. Halifax, N.S., July 11, (Perrin).
386. *Eristalis flavipes* Walk. Vineland, Ont., April 27, Sept. 16, (Ross and Curran).
386. *Eristalis hirtus* Loew. Agassiz, B.C., July, (Treherne).
386. *Eristalis inornatus* Loew. Mt. Cheam, B.C., July 22, (Treherne).
387. *Eristalis montanus* Will. Leduc, Alta., (J. Fletcher).
Eristalis nemorum, L. Vernon, B.C., Aug. 31, 1904, (R. V. Harvey); Kaslo, B.C., July 11; Revelstoke, B.C., July 14, (R. C. Osburn); Kaslo, B.C., May 7, 1910, (Cockle); Montreal, Que., Sept. 1, 1905, (Beaulieu). A European species—Jour. N.Y. Ent. Soc., XXIII, 144.
Eristalis rupium Fab. Atlin, B.C., (Anderson). A European species—Jour. N.Y. Ent. Soc., XXIII, 143.
393. *Helophilus hamatus* Loew. Aweme, Man., Aug. 25, (J. Fletcher); Vineland, Ont., Aug. 18, (Ross and Curran).
393. *Heliophilus lætus* Loew. Carlsbad Springs, Ont., June 1, 1903, (Gibson); Vineland, Ont., June 6, (Ross and Curran).
393. *Heliophilus latifrons* Loew. Vineland, Ont., Aug. 28 to mid-October, (Ross and Curran).
396. *Triodonta curvipes* Wied. Quebec, Que., (Roy). New to Quebec Province.
398. *Xylota angustiventris* Loew. Vineland, Ont., July 13, (Ross and Curran).
398. *Xylota anthreas* Walk. Vineland, Ont., June 14, July 2, (Ross and Curran.
398. *Xylota barbata* Loew. Kaslo, B.C., May 21, (Cockle).
398. *Xylota chalybea* Wied. Vineland, Ont., June 24, 29, (Ross and Curran).
398. *Xylota curvipes* Loew. Vineland, Ont., June 12, (Ross and Curran). Recorded from Ottawa.
399. *Xylota notha* Will. Vineland, Ont., June 24, (Ross and Curran).
Xylota segnis L. Macnab's Island, Halifax, N.S., July 4, 1914, (Perrin). A European species not heretofore reported from North America. See Verrall, British Flies, VIII, 598, for description and figure, (J. M. A.).
400. *Xylota vecors* O. S. Spruce Brook, Nfd., July 29, 1914, (Walker).
401. *Crioprora cyanella* O. S. Kaslo,, B.C., (July 20, (Cockle).
402. *Criorhina intersistens* Walk. Ground Hog Basin, B.C., July 24, 1905, (J. C. Bradley).
403. *Criorhina scitula* Will. Ground Hog Basin, B.C., Aug. 4, 1905, (J. C. Bradley).
403. *Criorhina umbratilis* Will. Spruce Brook, Nfd., July 28, 1914, (Walker).
404. *Spilomyia fusca* Loew. Ottawa, Ont., Aug. 1, 1906, (J. Fletcher).
404. *Spilomyia interrupta* Will. Similkameen, B.C., Sept. 12, 1913, (Wilson).
404. *Sphecomyia brevicornis* O. S. Duncan, B.C., May 10, 1908, (Hanham).
Sphecomyia occidentalis Osb. Ground Hog Basin, B.C., July 22-Aug. 7,

1905, (J. C. Bradley). Only specimen known, I understand, except unique type.

405. *Temnostoma æqualis* Loew. Spruce Brook, Nfd., June 29, 1914, (Walker).

Conopidæ.

409. *Physocephala tibialis* Say. De Grassi Point, Lake Simcoe, Ont., July 11, 1895, (Walker).
412. *Oncomyia loraria* Loew. Ottawa, Ont., July 28, (Germain); Jordon, Ont., July 9, 1914, (Ross).
412. *Myopa clausa* Loew. Halifax, N.S., July 26, (Perrin).
412. *Myopa versiculosa* Say. Ottawa, Ont., May 20, 1915, (Germain).

Œstridæ.

419. *Cuterebra scutellaris* Brauer. Peachland, B.C., July, 1902, (A. H. Huston).

Tachinidæ.

423. *Phorantha occidentis* Walk. Aweme, Man., July 6, 13, (N. Criddle); Ottawa, Ont., June 3, (Germain).
424. *Alophora pulverea* Coq. Ottawa, Ont., June, (Germain).
433. *Hypostena flaveola* Coq. Simcoe, Ont., (Caesar).
434. *Hypostena floridensis* Tns. Ottawa, Ont., July 10, 1914. (Beaulieu).
442. *Besseria brevipennis* Loew. Lethbridge, Alta., June 26, 1914, (Strickland).
451. *Ocyptera carolinæ* Desv. De Grassi Point, Lake Simcoe, Ont., July 19, 1895; Toronto, Ont., June 13, 1895, (Walker).
451. *Ocyptera dosiades* Walk. Jordon, Ont., July 28, 1914, (Ross); Prince Albert, Sask.; June 23, 1913, (Walker).
453. *Gymnochæta alcedo* Loew. Vernon, B.C., (Ruhmann).
458. *Exorista nigripalpis* Tns. Pincher, Alta., July 18, 1913, (Strickland).
482. *Microphthalma disjuncta* Wied. Aweme, Man., July 10-21, (N. Criddle).
Trixosceles fumipennis Mall. Aweme, Man., July 23, (N. Criddle).
460. *Phorocera doryphoræ* Riley. Grimsby and Vineland, Ont., (Caesar).
Dichætoneura leucoptera Jns. Simcoe and Guelph, Ont., reared from *Archips cerasivorana*, July 22-Aug. 12, 1912, (Caesar).
484. *Peleteria ænea* Stæger. Pincher, Alta., July 18, 1913, (Strickland).
488. *Echinomyia dakotensis* Tns. Vernon, B.C., (Ruhmann).
* *Saskatchewania canadensis* Smith. Farewell Creek, Sask., June, Aug. and Sept., 1907; Can. Ent., XLVII, 153.

Sarcophagidæ.

510. *Sarcophaga assidua* Walk. Ottawa, Ont., Aug., 1915, (Germain).
511. *Sarcophaga cimbicis* Tns. Ottawa, Ont., Aug. 14, 1912, (Beaulne); Regina, Sask., June 12, 1903, (Willing); Guelph, Ont., (Sanders); Port Hope, May 30, 1907, (W. Metcalfe).
Sarcophaga hæmorrhoidalis Mg. Ottawa, Ont., Sept. 4, 1908, (H. Groh).
512. *Sarcophaga helicis* Tns. Ottawa, Ont., June 30, 1912, (Beaulne).
Agria affinis Fall. Victoria, B.C., reared from *Vanessa antiopa*, (J. R. Anderson).

Miltogrammidæ.

* *Arabiopsis cocklei* Tns. London Hill Mine, Bear Lake, B.C., July 21, 1903, (Cockle); Can. Ent. XLVII, 285.

Salmaciidæ.

* *Knabia hirsuta* Tns. Oxbow, Sask., April 30, May 13, 1907, (F. Knab); Can. Ent. XLVII, 287.

Larvævoridæ.

* *Okanagania hirta* Tns. Okanagan Falls, B.C., April 27, 1913, (E. M. Anderson); Can. Ent., XLVII, 290.
* *Panzeriopsis curriei* Tns. London Hill Mine, Bear Lake, B.C., July 21-29, 1913, (R. P. Currie); Can. Ent., XLVII, 291.
* *Rhachogaster kermodei* Tns. Penticton, B.C., July 4, 8, 1913, (E. M. Anderson); Can. Ent. XLVII, 291.

Minthoidæ.

* *Pseudodidyma pullula* Tns. Victoria, B.C., April 2, 1906, (E. M. Anderson); Can. Ent., XLVII, 288.
518. *Cynomyia cadaverina* Desv. Vernon, B.C., (Ruhmann).
527. *Mesembrina latreillei* Desv. Agassiz, B.C., July, 1915, (Treherne).
Hypodermodes solitaria Knab. Agassiz, B.C., Aug., (Treherne). Described in Can. Ent., Sept., 1910, from Alberta and Montana.

Anthomyidæ.

539. *Fannia serena* Fall. Ottawa, Ont., June 27, (Germain).
547. *Limnophora diaphana* Wied. Ottawa, Ont., June 3, (Germain).
550. *Anthomyia pluvialis* L. Ottawa, Ont., May 13, (Germain).
552. *Hylemyia lipsia* Walk. Ottawa, Ont., May 3, (Germain).
553. *Eustalomyia vittipes* Zett. Ottawa, Ont., July 14, (Germain).
557. *Phorbia latipennis* Zett. Lake Athabaska, near mouth of Charlot River, Northern Saskatchewan, June 29, 1914, (F. Harper).
558. *Pegomyia calyptrata* Zett. Ottawa, Ont., May 13, (Germain).
563. *Schœnomyza dorsalis* Loew. Aweme, Man., Sept. 18-21, (N. Criddle).

Scatophagidæ.

565. *Cordylura adusta* Loew. Ottawa, Ont., April 27, (Germain).
566. *Cordylura volucricaput* Walk. Ottawa, Ont., June 18, (Germain).
566. *Parallelomma varipes* Walk. De Grassi Point, Lake Simcoe, Ont., July 10, 1895, (Walker).
567. *Hydromyza confluens* Loew. Ottawa, Ont., June 15, (Germain).

Heteroneuridæ.

Clusia czernyi Jns. Ottawa, Ont., July 12, (Germain).

Helomyzidæ.

572. *Helomyza longipennis* Loew. Spruce Brook, Nfd., July 28, 1914, (Walker).
572. *Anorostoma marginata* Loew. Ottawa, Ont., June 27, (Germain).
572. *Scoliocentra helvola* Loew. Ottawa, Ont., July 14, (Germain).

Sciomyzidæ.

578. *Sciomyza pubera* Loew. Ottawa, Ont., July 14, (Germain).
578. *Neuroctena anilis* Fall. Ottawa, Ont., June 3, (Germain).
580. *Tetanocera valida* Loew. De Grassi Point, Lake Simcoe, Ont., Aug. 26, 1914, (Walker).
581. *Sepedon fuscipennis* Loew. Spruce Brook, Nfd., July 29, 1914, (Walker).
581. *Sepedon pusillus* Loew. De Grassi Point, Lake Simcoe, Ont., Aug. 26, 1914, (Walker).

Sapromyzidæ.

Lonchæa laticornis Mg. Banff, Alta., Aug. 29, 1911, (Sanson).
582. *Lonchæa rufitarsis* Macq. Toronto, Ont., May 13, 1914, (Walker).
582. *Palloptera jucunda* Loew. Inverness, B.C., July, 1910, (J. H. Keen).
582. *Palloptera superba* Loew. Ottawa, Ont., June 21, 1904, (W. Metcalfe).
585. *Sapromyza decora* Loew. Ottawa, Ont., Aug. 11, 1909, (W. Metcalfe).
587. *Sapromyza vulgaris* Fitch. Ottawa, Ont., June, (Germain); Aweme, Man., July 13, (N. Criddle).

Ortalidæ.

587. *Pyrgota chagnoni* Jns. Ottawa, Ont., May 16, (Germain).
589. *Rivellia flavimanus* Loew. Toronto, Ont., May 30, 1896; June 6, 1914. (Walker).
589. *Rivellia viridulans* Desv. Toronto, Ont., June 19, 1895; Dauphin, Man., June 22, 1913, (Walker).
592. *Tephronota narytia* Walk. Aweme, Man., July 23, (N. Criddle).
597. *Chætopsis massyla* Walk. Aweme, Man., Sept. 7, (N. Criddle).

Trypetidæ.

603. *Acidia fratria* Loew. Toronto, Ont., June 8, 1914, (Walker).
604. *Spilographa electa* Say. Smith's Cove, N.S., July 15, 1914, (Gibson).
604. *Spilographa setosa* Doane. Reared from hips of *Rosa nutkana* collected at Cowichan Lake, B.C., Sept. 18, 1906, by J. Fletcher; emerged at Ottawa, Ont., June 25, 1907, (Gibson).
605. *Trypeta occidentalis* Snow. Larvæ destroying seeds of *Cirsium drummondii* at Elphinstone, Man., collected by W. A. Burman; adults reared, (Gibson).
Rhagoletis fausta O. S. Victoria B.C., June 19, 1907, (R. M. Palmer).
607. *Rhagoletis rubicola* Doane. Aweme, Man., July 3, (J. Fletcher and N. Criddle).
611. *Tephritis albiceps* Loew. Ottawa, Ont., July 1, 1914, (Beaulne).
611. *Tephrites clathrata* Loew. Aweme, Man., Sept. 18, (N. Criddle).
613. *Urellia aldrichii* Doane. Aweme, Man., Oct. 4, (N. Criddle).

Micropezidæ.

616. *Calobata alesia* Walk. Ottawa, Ont., June 27, (Germain).
616. *Calobata antennipes* Say. Toronto, Ont., June 13, 1895, (Walker).
617. *Calobata univitta* Walk. Ottawa, Ont., June 15, (Germain); Toronto, Ont., June 11, 1914, (Walker).

Psilidæ.

621. *Loxocera collaris* Loew. Ottawa, Ont., June 20, (Germain).

Ephydridæ.

623. *Dichæta caudata* Fall. Ottawa, Ont., June 3, (Germain).
623. *Notiphila bella* Loew. Ottawa, Ont., May 27, (Germain).
623. *Notiphila carinata* Loew. Toronto, Ont., June 13, 1914, (Walker).
Psilopa compta Mg. Aweme, Man., Oct. 14, (N. Criddle).
627. *Hydrellia obscuriceps* Loew. Brockville, Ont., Sept. 20, 1903, (W. Metcalfe); Ottawa, Ont., Aug. 28, 1908, (J. Fletcher).
627. *Philygria opposita* Loew. Ottawa, Ont., July 28, (Germain); Aweme, Man., July 23, (N. Criddle).
628. *Ochthera mantis* DeG. Lake McGregor, Que., July 12, (Germain). New to Quebec Province.
628. *Pelina truncatula* Loew. Aweme, Man., Oct. 17, (N. Criddle).
629. *Parydra bituberculata* Loew. Ottawa, Ont., July 3, (Germain); Ottawa, July 21, Aug. 6, 1914, (Beaulieu); Toronto, Ont., June 13, 1914, (Walker).
629. *Ephydra atrovirens* Loew. Ottawa, Ont., June, July, (Germain).
630. *Scatella oscitans* Walk. Aweme, Man., Oct. 14, (N. Criddle).
630. *Scatella stagnalis* Fall. Bridgetown, N.S., Aug. 29, 1912, (Sanders); Port Hope, Ont., May 24, 1897, (Metcalfe); Aweme, Man., Sept. 7, Oct. 14, 17, (N. Criddle).

Oscinidæ.

Meromyza flavipalpis Mall. Aweme, Man., July 20, (N. Criddle).
Meromyza marginata Beck. Beaver River, Alta., Aug. 20, (Strickland).
632. *Anthracophaga maculosa* Loew. Montreal, Que. Record from Becker's Mon. of Chloropidæ IV, 1912, p. 44.
632. *Anthracophaga eucera* Loew. Brockville, Ont., Aug. 23, 1903, (Metcalfe); Bridgetown, N.S., Aug. 29, (Sanders).
Chlorops seminigra Becker. Type locality, Montreal, Que. Described in Becker's Monograph of Chloropidæ, IV, 66, 1912.
633. *Diplotoxa microcera* Loew. Aweme, Man., July 2, (N. Criddle).
633. *Diplotoxa versicolor* Loew. Aweme, Man., June 25, (N. Criddle).
Chlorops stigmata Becker. Type locality, Vancouver Island, B.C., (Livingston). Described in Becker's Monograph of Chloropidæ, IV, 60, 1912.
Chlorops integra Becker. Aweme, Man., July 20, Aug. 8, (N. Criddle).
Chlorops rufescens Coq. Ottawa, Ont., July 4, (Beaulne).
Chloropisca clypeata Mall. Regina, Sask., June 18, 1904, (J. Fletcher); Ottawa, Ont., June 24, 1904, (W. Metcalfe).
633. *Chloropisca obscuricornis* Loew. Aweme, Man., July 23, (N. Criddle).
Chloropisca obtusa Mall. Ottawa, Ont., July 17, 1904, (W. Metcalfe).
634. *Chloropisca variceps* Loew. Athabaska, Alta., Edmonton, Alta., Aug. 10, (Strickland); Prince Albert, Sask., July 28, 1907, (J. Fletcher).
635. *Eurina exilis* Coq. De Grassi Point, Lake Simcoe, Ont., Aug. 26, 1914, (Walker).
635. *Hippelates flavipes* Loew. Aweme, Man., Sept. 16, (N. Criddle).
Hippelates pallipes Loew. Aweme, Man., June 12, (N. Criddle).

636. *Elachiptera costata* Loew. Ottawa, Ont., May 27, 1905; Chelsea, Que., May 27, 1905; Carlsbad Springs, Ont., June 26, (W. Metcalfe).
638. *Elachiptera decipiens* Loew. Aweme, Man., Oct. 17, (N. Criddle).
636. *Elachiptera longula* Loew. Aweme, Man., July 6, (N. Criddle).
Mosillus subsultans Fab. Aweme, Man., Aug., Sept., (N. Criddle).
637. *Siphonella oscinina* Fall. Brockville, Ont., Sept. 13, 1903, (W. Metcalfe).
Siphonella parva Ad. Aweme, Man., June 12, (N. Criddle); Ottawa, Aug. 26, 1908, (Fletcher).
638. *Oscinis dorsata* Loew. Aweme, Man., June 6, July 23, Aug. 6, Sept. 7, (N. Criddle).
Oscinis marginalis Mall. Aweme, Man., Aug. 6, (N. Criddle).
Oscinis melanchulica Beck. Aweme, Man., July 23, (N. Criddle).
639. *Oscinis trigramma* Loew. Aweme, Man., Sept. 7, 21, Oct. 10., (N. Criddle).
639. *Oscinis umbrosa* Loew. Aweme, Man., July 13, 23, (N. Criddle).

Drosophilidæ.

641. *Drosophila amœna* Loew. Brockville, Ont., Aug. 12, 1903, (Metcalfe); Ottawa, Ont., June 2, 1878, (Fletcher).

Agromyzidæ.

Phytomyza acuticornis Loew. Aweme, Man., July 13, (N. Criddle).
Phytomyza flava Fall. Aweme, Man., Oct. 12, (N. Criddle).
Cerodonta femoralis Mg. Aweme, Man., Oct. 9-17, (N. Criddle).
647. *Agromyza angulata* Loew. Aweme, Man., Aug. 6, (N. Criddle).
Agromyza coquilletti Mall. Aweme, Man., June 25, (N. Criddle).
Agromyza genualis Mel. Aweme, Man., Oct. 9, (N. Criddle).
648. *Agromyza jucunda* Van der Wulp. Aweme, Man., Oct. 10, (N. Criddle).
Agromyza immaculata Coq. Brockville, Ont., Oct. 25, 1903, (W. Metcalfe); Aweme, Man., Oct. 14, (N. Criddle).
Agromyza laterella Zett. Brockville, Ont., Sept. 13, 1903, (W. Metcalfe).
648. *Agromyza marginata* Loew. Ottawa, Ont., Sept. 1, 1908, (Fletcher); Aylmer, Que., Oct. 20, 1905, (W. Metcalfe). New to Quebec Province.
Agromyza nasuta Mel. Aweme, Man., July 6, (N. Criddle); Montreal, Que., July 11, 1914, (Winn); Port Hope, Ont., May 24, 1897, (W. Metcalfe); Ottawa, Ont., Aug. 26, 1908, (J. Fletcher).
Agromyza scutellata Fall. Aweme, Man., July 20; June 25, (N. Criddle).
649. *Agromyza terminalis* Coq. Dauphin, Man., June 22, 1913, (Walker).
649. *Agromyza vireus* Loew. Ottawa, Ont., Aug. 17, 1907, (J. Fletcher); Brockville, Ont., Aug. 23, 1903, (W. Metcalfe).
Meoneura vagans Fall. Aweme, Man., July 23, (N. Criddle).
649. *Desmometopa latipes* Mg. Aweme, Man., July 6, (N. Criddle).
649. *Desmometopa m-nigrum* Zett. Brockville, Ont., Sept. 20, 1903, (W. Metcalfe).
Desmometopa sordida Fall. Ottawa, Ont., June 1, 1900, (Gibson).
651. *Milichia arcuata* Loew. Ridgeway, Ont., July 23, 1910, (Walker).
Pseudodinia pruinosa Mel. Aweme, Man., Aug. 6, (N. Criddle).
652. *Ochthiphila elegans* Panz. Carlsbad Springs, Ont., June 26, 1904, (W. Metcalfe).
652. *Ochthiphila polystigma* Mg. Aweme, Man., Aug. 6, (N. Criddle).

HYMENOPTERA.

During the year 1915, many specimens in this order were collected in the various provinces in Canada, and some of the interesting captures are here recorded. Species collected in former years have been definitely determined, and some of these, too, we are now able to include. The records of these give further information on their distribution within the Dominion.

Tenthredinidæ.

Strongylogastroidea aprilis Say. Toronto, Ont., June 13, 1895, (Walker).
Parasiobla rufocinctus Nort. Toronto, Ont., June 13, 1895, (Walker).
Dolerus aprilis Nort. Toronto, Ont., June 19, 1907; May 5, 1914, (Walker).
Dolerus cohæsus MacG. Ottawa, Ont., July, 1914, (Germain); Spruce Brook, Nfd., July 27, 1914, (Walker).
Dolerus stugnus MacG. Ottawa, Ont., July, 1914, (Germain).
Dolerus unicolor Beauv. Toronto, Ont., April 19, 1895, (Walker).
Loderus apricus (Nort). Ottawa, Ont., July, 1914, (Germain); Toronto, Ont., June 13, 1914, (Walker).
Tenthredo basilaris Say. De Grassi Point, Lake Simcoe, Ont., Aug. 22, 1914, (Walker).
Macrophya trisyllaba Nort. Toronto, Ont., May 24, 1889, (E. M. Morris); Spruce Brook, Nfd., July 27, 1914, (Walker); Pictou, N.S., July 22, 1914, (Walker).
Cimbex laportei Lep. Dauphin, Man., June 23, 1913, (Walker).
Cimbex 10-maculata Urban. Prince Albert, Sask., June 26, 1913, (Walker).
Gymnonychus appendiculatus Hart. Ottawa, Ont., June 13, 1914, (Germain).
* *Euura cosensii* Rohwer. Toronto, Ont., (Cosens). Proc. U. S. N. M., Vol. 49, 213.
Amauronematus semirufus (Kirby). Ottawa, Ont., Aug. 3, 1913, (Germain).
Pachynematus extensicornis Nort. Ottawa, Ont., Aug. 7, 1914, (Germain); De Grassi Pt., Lake Simcoe, Ont., Aug. 23, 1914, (Walker).
Pristiphora bivittata Nort. Ottawa, Ont., May 22, 1914, (Germain).
Monophadnoides concessus MacG. Ottawa, Ont., Aug. 25, 1914, (Germain).

Cynipidæ.

Callirhytis gemmarius Ash. On island near Hamill's Point, Lake Joseph, Muskoka, Ont., (Cosens). First Canadian record (W. B.).
Andricus clavula O. S. On island near Hamill's Point, Lake Joseph, Muskoka, Ont., (Cosens). First Canadian record (W. B.).
Andricus piger Bass. On island near Hamill's Point, Lake Joseph, Muskoka, Ont., (Cosens). First Canadian record (W. B.).
Andricus ventricosus Bass. On island near Hamill's Point, Lake Joseph, Muskoka, Ont., (Cosens). First Canadian record (W. B.).
* *Diastrophus fragariæ* Beut. Toronto, Ont., (Cosens). Can. Ent., XLVII, 353.

Braconidæ.

Meteorus loxostege Vier. Iron Springs, Alta., May 18, 1914, (Strickland).
Sigalphus bicolor Cr. Grimsby Ont., June 20, 1914, (Walker).
Spathius canadensis Ashm. Toronto, Ont., May 26, 1895, (Walker).

Ichneumonidæ.

Crematus retiniæ Cr. Toronto, Ont., June 13, 1914, (Walker).
Campoplex expertus Cr. Toronto, Ont., June 7-11, 1914, (Walker).
Campoplex vitticollis Nort. Toronto, Ont., June 11, 1914, (Walker).
Thyreodon morio Fab. De Grassi Point, Lake Simcoe, Ont., Aug. 16, 1914, (Walker).
Exochus pallipes Cr. Toronto, Ont., July 12, 1914, (Walker).
Spanotecnus concolor Cr. Toronto, Ont., June 13, 1914, (Walker).
Spanotecnus discolor Cr. St. Catharines, Ont., June 21, 1914, (Walker).
Odontomerus mellipes Say. Toronto, Ont., (Walker).
Megarhyssa nortoni Cr. Pictou, N.S., July 22, 1914, (Walker).
Rhyssa persuasoria Linn. Quebec, Que., (Roy).
Rhyssa albomaculata Cr. Spruce Brook, Nfd., July 29, 1914, (Walker); Edmonton, Alta., (Carr).
* *Pseudorhyssa sternata* Merrill. Toronto, Ont., Aug. 20, 1892. Trans. Amer. Ent. Soc., XLI, 150.
Lissonota superba Prov. Edmonton, Alta., May 22, 1911, (Carr).
Arenetra canadensis Cr. Macleod, Alta., July, 1913, (Strickland).
Lampronota parva Cr. Toronto, Ont., April 19, 1895, (Walker).
Arotes vicinus Cr. Morris Island, Muskoka, Ont., July 30, 1888 (E. M. Morris).
Coleocentrus occidentalis Cr. Departure Bay, B.C., July 5, 1913, (Walker).
Cryptus robustus Cr. De Grassi Point, Lake Simcoe, Ont., Aug. 16, 1914, (Walker).
Ichneumon bimembris Prov. Prince Albert, Sask., (Walker).
Ichneumon canadensis Cr. Spruce Brook, Nfd., July 29, 1914, (Walker); Departure Bay, B.C., July 6, 1913, (Walker).
Ichneumon comes Cr. Morris Island, Muskoka, Ont., July 8, 1888, (E. M. Morris).
Ichneumon cincticornis Cr. Edmonton, Alta., Nov. 10, 1910, (Carr); Prince Albert, Sask., June 26, 1913, (Walker); Toronto, Ont., Aug 8, 1914, (Walker).
Ichneumon cæruleus Cr. Muskoka, Ont., July 30, 1888, (E. M. Morris).
Ichneumon devinctor Say. Edmonton, Alta., April 23, 1910, (Carr).
Ichneumon funestus Cr. Toronto, Ont., Aug. 8, 1914, (Walker).
Ichneumon feralis Cr. Spruce Brook, Nfd., July 27, 1914, (Walker); Edmonton, Alta., (Carr).
Ichneumon flavicornis Cr. Departure Bay, B.C., July 4, 1913, (Walker).
Ichneumon galenus Cr. Toronto, Ont., Aug. 8, 1914, (Walker).
Ichneumon grandis Br. Departure Bay, B.C., July 29, 1913, (Walker).
Ichneumon orpheus Cr. De Grassi Point, Lake Simcoe, Ont., Aug. 16, 1914, (Walker).
Ichneumon pervagus Cr. Morris Island, Muskoka, Ont., (E. M. Morris).
Ichneumon putus Cr. Edmonton, Alta., (Carr).
Ichneumon seminiger Cr. Toronto, Ont., April 12, 1895, (Walker).

Ichneumon suadus Cr. Lake Simcoe, Ont., (Walker).
Ichneumon sublatus Cr. Hamilton, Ont., June 20, 1914, (Walker).
* *Coelichneumon barnstoni* Morley. Hudson Bay, 1884, (Geo. Barnston); Revision of the Ichneumonidæ in the British Museum, Part IV, p. 130.
Amblyteles montanus Cr. Sault Ste. Marie, Ont., June 10, (E. M. Morris).
Amblyteles quebecensis Prov. Departure Bay, B.C., July 7, 1913, (Walker).
Amblyteles stadaconensis Prov. De Grassi Point, Lake Simcoe, (Walker).
Amblyteles subrufus Cr. Sault Ste. Marie, Ont., June 7, 1889, (E. M. Morris).
Amblyteles suturalis Cr. Lethbridge, Alta., July 23, 1914, (Strickland).
Amblyteles tetricus Prov. Toronto, Ont., (Walker).
Trogus fulvipes Cr. Okanagan Landing, B.C., Aug. 16, 1913, (Walker).
Trogus obsidianator Br. De Grassi Point, Lake Simcoe, Ont., Aug. 6, 1895, (Walker).
* *Xenoschensis gracilis* Cushman. Banff, Alta. Proc. Ent. Soc. Wash., XVII, 141.
* *Xenoschensis slossonæ* Cushman. Spruce Brook, Nfd., July 24, 1914, (Walker); Proc. Ent. Soc. Wash., XVII, 140.

Eulophidæ.

Tetrastichus asparagi Cwfd. Vineland, Ont., (Ross).

Formicidæ.

Lasius niger L. var *sitkaensis* Pergande. Treesbank, Man., Sept. 23, (Hewitt).
* *Formica fusca* L. var *algida* Wheeler. Kenora, Ont., (J. C. Bradley); Saguenay River, Que., (Geo. Englehardt); Digby, N.S., (J. Russell); also from Newfoundland and Labrador; Psyche, XXII, 205.
Formica neogagates Em., subsp. *vetula* Wheeler. Banff, Alta., Sept. 16, (Hewitt).
Formica rufa L. subsp. *aggeranus* Wheeler. Banff, Alta., Sept. 16, (Hewitt).
Formica ulkei Em. Treesbank, Man., Sept. 23, (Hewitt).
* *Aphænogaster subterranea borealis* Wheeler. Lardo, Kootenay Lake. B.C., (J. C. Bradley); Bull. Amer. Mus. Nat. Hist., XXXIV, 413.

Psammocharidæ.

* *Ageniella cupidella* Banks. Ridgeway, Ont., Can., July 9, (Van Duzee); Can. Ent., XLVII, 400.

Apidæ.

Osmia armaticeps Cr. Invermere, B.C., female, June 30, 1914, (Sladen); Okanagan Landing, B.C., April 23, 1914, (Wilson).
Osmia quadridentata Cr. Hull, Que., April 25, (Sladen); Toronto, Ont., April 19, 1896, (W. Brodie).
Osmia bucephala Cr. Banff, Alta., May 21, (Sladen); Toronto, Ont., May 6, 1894, (W. Brodie).
Osmia cœrulescens Linn. Ottawa, Ont., May and June, (Sladen); Toronto, Ont., June and July, (W. Brodie). Mr. Sladen considers *purpurea* Cr. to be the same insect known in England as *cœrulescens*.

Osmia lignaria Say. Ottawa, Ont., male, April 5, 23, (Sladen); Golden, Invermere and Sydney, B.C.; Banff, Alta., (Sladen).

Osmia coloradensis Cr. Spulamacheen, B.C., female, Aug., (Wilson); Shawnigan, B.C., July; Revelstoke, B.C., May; Invermere, B.C., May, (Sladen).

Bombus fervidus Fabr. Vernon, B.C., (Venables).

Bombus moderatus Cr. Banff, Alta., (Sanson); Banff, Alta., on *Arctostaphylos uva-ursi,* May 21, (Sladen).

Psithyrus latitarsus Morrill. Aweme, Man., Sept. 16, (N. Criddle).

Hemiptera-Heteroptera.

(Arranged according to Banks' Catalogue; Amer. Ent. Soc., 1910; the numbers refer to the pages in the catalogue.)

Saldidæ.

12. *Salda humilis* Say. Ottawa, Ont., May and June, 1913 and 1914, (Germain).

12. *Salda littoralis* Linn. Ottawa, Ont., May and June, 1913 and 1914, (Germain).

Reduviidæ.

16. *Zelus luridus* Stal. Bondville, Que., (Moore).

Nabidæ.

22. *Reduviolus propinquns* Reut. Bondville, Que., (Moore).

Capsidæ.

30. *Plagiognathus politus* Uhler. Ottawa, Ont., June 27, 1914, (Germain).
37. *Dicyphus vestitus* Uhler. Ottawa, Ont., July 30, 1914, (Germain).
40. *Resthenia insitiva* Say. Aylmer, Que., Aug. 1914, (Germain).
41. *Miris vicina* Prov. Ottawa, Ont., Aug. 23, (Germain).
44. *Horcias marginalis* Reut. Ottawa, Ont., July 20, 1914, (Germain).
46. *Lygus viticollis* Reut. Ottawa, Ont., May 27, 1914, (Germain).
47. *Phytocoris lasiomerus* Reut. Ottawa, Ont., June, 1914, (Germain).
49. *Stenotus binotatus* Fabr. Ottawa, Ont., Aug. 3, 1914, (Germain).
49. *Pœciloscytus basalis* Reut. Ottawa, Ont., Aug., 1914, (Germain).

Tingitidæ.

56. *Galeatus peckhami* Ashm. Ottawa, Ont., Aug. 1914, (Germain).

Lygæidæ.

58. *Ischnodemus falicus* Say. Ottawa, Ont., July 23, 1914, (Germain).
59. *Crophius disconotus* Say. Ottawa, Ont., July 3, 1914, (Germain).

Pentatomidæ.

86. *Menecles insertus* Say. Quebec, Que., (Roy).

Orthoptera.

Some interesting records of these insects have been received. Considerable collecting in the order has recently been accomplished and our knowledge of the distribution of many of the species considerably widened.

Mantidæ.

Mantis religiosa L. This species known as the European Praying Mantis, and recorded in last year's Entomological Record, has evidently established itself in the Province of Ontario. This year it was again found near Picton, in Hallowell Township, on Oct. 1, (Brimley).

Acridiidæ.

Acrydium obscurum Hanc. Aweme, Man., May 28, Sept. 16, 1915, (Criddle).

Chlöealtis conspersa Harr. Athabaska Landing, Alta., Aug. 11, 1915, (Strickland). Previously reported from Banff, by Walker.

Orphulella speciosa Scudd. Aweme, Man., Aug. 7-17, (E. and N. Criddle).

Chortophaga viridifasciata DeG. Treesbank, Man., June 11, (E. Criddle).

Arphia frigida Scudd. Fort Chipewyan, Alta., June 14, 15, 1914; Fort McMurray, Alta., May 29, 1914, Hill Island Lake, Southern Mackenzie, July 13, 1914, (F. Harper).

Hippiscus tuberculatus Beauv. Fort Chipewyan, Alta., June 15, 1914, (F. Harper).

Trimerotropis monticola Sauss. Aweme, Man., Sept. 16, 1914, (N. Criddle).

Circotettix verruculatus Kirby. Athabaska Landing, Alta., Aug. 11, (Strickland); Island in Tsu Lake, Southern Mackenzie, Aug. 6, 1914; Fort Resolution, Mackenzie, Aug. 24, (F. Harper).

Melanoplus bivittatus Dodge. Athabaska Landing, Alta., Aug. 12, 1915, (Strickland).

Melanoplus bruneri Scudd. Athabaska Landing, Halcourt and Water Hole, Alta., Aug. 11, 12, (Strickland).

Melanoplus fasciatus Walk. Athabaska Landing, Alta., Aug. 11, (Strickland); Fort Resolution, Mackenzie, Aug. 24, 1914, (F. Harper).

Locustidæ.

Scudderia pistillata Brun. Rosedale, Alta., (Miss E. Moodie); St. Louis, Sask., July 25, 1898, (E. Coubeaux); new to Saskatchewan.

Conocephalus fasciatus DeG. Peachland, B.C., Aug. 6, (Wallis).

Udeopsylla nigra Scudd. Oxbow, Sask., July 31, 1897, (W. Noble).

Gryllidæ.

Nemobius fasciatus DeG. Near Souris, P.E.I., Aug. 27, 1915, (A. G. Huntsman).

Œcanthus niveus DeG. Penticton, B.C., Aug. 1908, (Mrs. Fowler).

Œcanthus nigricornis quardipunctatus Beut. Peachland, B.C., Aug. 2-12, (Wallis).

Neuropteroid Insects (Except Odonata).

(Arranged according to a catalogue of the Neuropteroid Insects (except Odonata) of the United States, by Nathan Banks; American Entomological Society, 1907. The numbers refer to the pages of the catalogue.)

Corrodentia.

Psocidæ.

7. *Pterodela pedicularis* L. Spruce Brook, Nfd., July 29, 1914, (Walker).
9. *Psocus campestris* Aaron. Toronto, June 30, 1914, (Walker).
9. *Psocus hageni* Bks. Algonquin Park, Ont., Aug. 17, 1903, (Walker).

Archiptera.

Perlidæ.

10. *Pteronarcys regalis* Newm. Athabaska River, between Grand Rapids and mouth of Little Buffalo River, Alberta, May 24, 25, (F. Harper).
10. *Pteronarcella badia* Hag. Coldwater, B.C., July, 1914, (Wilson).
11. *Isogenus frontalis* Newm. Hymers, Ont., June 19, 1908, (Dawson); Athabaska River, between Grand Rapids and Fort McMurray, Alta., May 28, 1914, (F. Harper); Tazin River, near Tha-inka Lake, Northern Saskatchewan, July 11, (F. Harper).
13. *Isoperla bilineata* Say. Ottawa, Ont., Aug. 13, 1909, (H. Groh); Ottawa, Ont., June 11, 1913, (Beaulne).
13. *Isoperla ebria* Hag. Bartlett Bay, off Glacier Bay, Alaska, June 19, 1907, (D. H. Nelles).
14. *Tæniopteryx frigida* Hag. Hull, Que., May 22, 1904, (W. Metcalfe).
15. *Arsapnia decepta* Banks. Wellington, B.C., March 9, 1907, (G. W. Taylor).

Ephemeridæ.

16. *Ephemera simulans* Walk. Tazin River and Hill Island Lake, Southern Mackenzie, July 14, 1914, (F. Harper).
* *Callibætis semicostata* Banks. Stony Mt., Man., Sept. 16, (Wallis); Proc. Acad. Nat. Sciences, Philadelphia, LXVI, 614.

Neuroptera.

Sialidæ.

22. *Sialis infumata* Newm. Casselman, Ont., May 22, 1904, (J. Fletcher); La Seine River, Rainy River District, Ont., June 30, (W. McInnes).

Trichoptera.

Limnephilidæ.

35. *Neuronia semifasciata* Say. Tsal-wor Lake, about 8 miles north of Lake Athabaska, Northern Saskatchewan, July 5, 1914, (F. Harper).
36. *Glyphotælius hostilis* Hag. Spruce Brook, Nfd., July 29, 1914, (Walker).
Limnephilus bifidus. Lake Athabaska, near mouth of Charlot River, Northern Saskatchewan, June 29, 1914, (F. Harper).
36. *Limnephilus indivisus* Walk. Hamilton, Ont., June 20, 1914, (Walker).
36. *Limnephilus nebulosus* Kirby. Fort Chipewyan, Alta., June 16-18, 1914, (F. Harper).

37. *Anabolia bimaculata* Walk. St. Lawrence River, between Montreal and Quebec (on steamer), July 15-16, 1914, (Walker).
Anabolia nigricula Banks. Fort Resolution, Mackenzie, Aug. 24, 1914, (F. Harper).
38. *Halepsyche indistinctus* Walk. Spruce Brook, Nfd., July 27, 1914, (Walker).
38. *Pycnopsyche guttifer* Walk. De Grassi Pt., Ont., Sept. 22, 1914, (Walker).
39. *Platyphylax designata* Walk. Tazin River, near Tha-inka Lake, Northern Saskatchewan, July 11, 1914, (F. Harper).
40. *Chilostigma difficilis* Walk. Toronto, Nov. 22, 1913, (Walker).

Sericostomatidæ.

42. *Brachycentrus similis* Banks. Athabaska River, above mouth of House River, Alta., May 22, 1914, (F. Harper).

Leptoceridæ.

46. *Leptocella exquisita* Walk. St. Lawrence River near Quebec (on steamer), July 16, 1914, (Walker).
46. *Mystacides sepulchralis* Walk. Sydney, N.S., July 24, 1914; Spruce Brook, Nfd., July 27, 1914, (Walker).
46. *Setodes grandis* Bks. Toronto, June 30, 1914, (Walker).

Hydropsychidæ.

47. *Hydropsyche scalaris* Hag. St. Lawrence River near Quebec (on steamer), July 16, 1914, (Walker).
48. *Nyctiophylax vestitus* Hag. Spruce Brook, Nfd., July 27, 1914. (Walker).

ODONATA.

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

Coenagrionidæ.

39. *Lestes uncatus* Kirby. Red Deer, Alta., 1915 (Whitehouse). New to Alberta.
48. *Argia moesta putrida* Hag. St. John's, Que., July 11, 1914, (Chagnon).
54. *Enallagma antennatum* Say. St. John's, Que., July 11, 1914, (Chagnon). New to Quebec.
56. *Enallagma carunculatum* Morse. St. John's, Que., July 11, 1914, (Chagnon).
59. *Enallagma ebrium* Hag. St. John's, Que., June 24, 1914, (Chagnon).
59. *Enallagma exsulans* Hag. St. John's, Que., July 11, 1914, (Chagnon). New to Quebec.
85. *Ophiogomphus rupinsulensis* Walsh. St. John's Que., June 22, 1914, (Chagnon).
94. *Gomphus intricatus* Hag. Saskatoon, Sask., July 28, 1910, (Willing). First Canadian record. (Determined by P. P. Calvert.)
114. *Aeshna sitchensis* Hag. Red Deer, Alta., 1915 (Whitehouse).
114. *Aeshna umbrosa* Walk. Red Deer, Alta., 1915, (Whitehouse). New to Alberta.

SIPHONAPTERA.

* *Ceratophyllus ignotus recula* J. and R. Okanagan Landing, B.C., July, 1913, off *Putorius arizonensis,* (J. A. Munro); Okanagan Falls, B.C., April, 1913, off *Thomomys talpoides,* (C. Grant); Kelowna, B.C., Dec. 1910, off *Mustela* sp. (A. Tate); Ectoparasites, 1, 58.

* *Ceratophyllus ignotus albertensis* J. and R. Blackfalds, Alta., collected off *Geomys* sp., *Mustela* sp., and *Lynx canadensis,* (A. D. Gregson); Ectoparasites, 1, 56.

* *Megarthroglossus sicamus* J. and R. Eagle River, Sicamous, B.C., found on *Canis latrans,* Sept. 1903, (G. F. Dippie); Ectoparasites, 1, 50.

* *Megarthroglossus procus* J. and R. Chilliwack, B.C., collected on *Spilogale,* Sept. 1899, and on *Peromyscus,* Dec. 1899, (Allan Brooks); Ectoparasites, 1, 47.

* *Catallagia decipiens* Rothschild. Horse Creek, Upper Columbia Valley, B.C., Oct. 13, 1913, off *Peromyscus,* (G. F. Dippie); Blackfalds, Alta., (A. J. Gregson); Red Deer, Alta., April 25, 1901, off *Evotomys saturatus,* (G. F. Dippie); British Columbia, off *Neotoma cinerea* (W. Wenmann); Ectoparasites, 1, 43.

* *Neopsylla inopina* Rothschild. Calgary, Alta., found on *Spermophilus richardsoni,* April 11, 1907, (C. Garrett); Calgary, Alta., on *Putorius longicaudatus* and *Evotomys saturatus,* (G. F. Dippie); Ectoparasites, 1, 30.

* *Doratopsylla curvata* Rothschild. Blackfalds, Alta., off Kangaroo Mouse and Shrew Mouse, (A. D. Gregson); Ectoparasites, 1, 25.

ARANEIDA.

(Arranged according to Banks' Catalogue of Nearctic Spiders, U. S. N. M., Bulletin 72. The numbers refer to the pages in the catalogue.)

During 1915, collections of spiders have been made in some of the provinces, and also in Labrador, but many of the species have not, as yet, been determined. In 1914, Mr. J. H. Emerton collected in Alberta, and through Mr. N. B. Sanson, of Banff, some of the records are included here. Mr. Sanson has also made collections for several years and recently Mr. Emerton has named these.

Drassidæ.

10. *Drassus coloradensis* Em. Banff, Alta., July 4, 1914, (Sanson).

10. *Drassus neglectus* Keys. Natashkwan, South Labrador, July, (C. W. (Townsend).

Clubionidæ.

* *Clubiona obtusa* Em. Banff, Aug., 1914, (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 153.

Agelenidæ.

15. *Cryphœca montanata* Em. Banff, Alta., Aug. 15, 1914, (J. H. Emerton).

15. *Hahnia agilis* Keys. Old Romaine, South Labrador, July, (C. W. Townsend).

Theridiidæ.

20. *Theridium sexpunctatum* Em. Lake Louise, Alta., Aug. 1914, (J. H. Emerton).
21. *Steatoda borealis* Hentz. Banff, Alta., Aug. 15, 1914, (J. H. Emerton); South Labrador, July, (C. W. Townsend).
26. *Hypselistes florens* Camb. Colpoy's Bay, Ont., Ompah, Ont., (A. B. Klugh).
* *Lophocarenum dentipalpis* Em. Goat Mountain, Jasper, Alberta, (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 149.
* *Lophocarenum erectum* Em. Tackakaw Falls, Yoho Valley, B.C., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 150.
* *Gongylidium tuberosum* Em. Battle Harbor, Labrador, (C. W. Leng); Trans. Conn. Acad. Sci., Vol. 20, 150.
* *Gongylidium canaliculatum* Em. Prince Albert, Sask., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 151.
* *Tmetis reticulatus* Em. Lake Louise, Laggan, Alta., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 148.
* *Tmetis obtusus* Em. Lake Louise, Laggan, Alta.; Jasper, Alta., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 149.

Linyphiidæ.

33. *Linyphia nearctica* Banks. Blanc Sablon, South Labrador, July, (C. W. (Townsend).
33. *Linyphia phrygiana* Koch. Banff, Alta., Aug. 15, 1914, (J. H. Emerton); South Labrador, July, (C. W. Townsend).
* *Bathyphantes arborea* Em. Banff, Alta.; Laggan, Alta.; Yoho Valley, B.C., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 150.
* *Bathyphantes occidentalis* Em. Vancouver, B.C., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 151.
* *Microneta pinnata* Em. Prince Albert, Sask., (J. H. Emerton); Trans. Conn. Acad. Sc., Vol. 20, 152.
* *Microneta flava* Em. Lake Louise, Laggan, Alta., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 152.

Epeiridæ.

* *Singa campestris* Em. Kenora, Ont.; Edmonton, Alta., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 153.
41. *Epeira carbonaria* Koch. Laggan, Alta., Aug. 12, 1914, (J. H. Emerton).
41. *Epeira marmorea* Clerck. Banff, Alta., Aug. 27, 1914, (Sanson).

Thomisidæ.

48. *Xysticus ferrugineus* Em. Banff, Alta., July, 1913, (Sanson).
48. *Xysticus triangulosus* Em. Banff, Alta., July, 1913, (Sanson).
49. *Coriarachne brunneipes* Banks. Banff, Alta., Aug., 1914, (Sanson).
51. *Thanatus coloradensis* Keys. Banff, Alta., June, 1912, (Sanson).
52. *Philodromus inquisitor* Thor. Banff, Alta., (Sanson).

Lycosidæ.

55. *Lycosa albohastata* Em. Banff, Alta., (Sanson); Mecatina, South Labrador, July, (C. W. Townsend).
55. *Lycosa beani* Em. Banff, Alta., Sept. 7, 1913, (Sanson).
56. *Lycosa fumosa* Em. Banff, Alta., Sept. 7, 1913, (Sanson).
57. *Lycosa quinaria* Em. Old Romaine, Southern Labrador, July, (C. W. Townsend).
59. *Pardosa gracialis* Thor. Laggan, Alta., Aug. 1914, (J. H. Emerton).
* *Pardosa albiceps* Em. Spray River, near Banff, Alta., (Sanson); Trans. Conn. Acad. Sci., Vol. 20, 153. Type locality with description, given in error as "Spray River, B.C."
59. *Pardosa grœnlandica* Thor. Banff, Alta., June 25, 1912; Sept. 7, 1913, (Sanson); Old Romain and Natashkwan River, South Labrador, (C. W. Townsend).
59. *Pardosa glacialis* Thor. Blanc Sablon, South Labrador, July; Natashkwan River, South Labrador, July, (C. W. Townsend).
60. *Pardosa luteola* Em. Banff, Alta., Aug. 8, 1914, (Sanson); Old Romaine, South Labrador, July, (C. W. Townsend).
60. *Pardosa tachypoda* Thor. Banff, Alta., July 4, 1914, (Sanson).

Attidæ.

66. *Dendryphantes flavipedes* Peck. Banff, Alta., (Sanson).
* *Pellenes sansoni* Em. Spray River, near Banff, Alta., (Sanson); Trans. Conn. Acad. Sci., Vol. 20, p. 154.

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Forty-Seventh Annual Report

OF THE

Entomological Society

OF ONTARIO

1916

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE)

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
1917

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Printed by
WILLIAM BRIGGS
Corner Queen and John Streets
TORONTO

To His Honour, Sir John Strathearn Hendrie, a Lieutenant-Colonel in the Militia of Canada, etc., etc., etc.,

Lieutenant-Governor of the Province of Ontario.

May it Please Your Honour:

The undersigned begs to present for the consideration of your Honour, the Report of the Entomological Society for 1916.

Respectfully submitted,

William H. Hearst,

Minister of Agriculture.

Toronto, 1917.

CONTENTS

FORTY-SEVENTH ANNUAL REPORT

OF THE

Entomological Society of Ontario

1916

To the Honourable William H. Hearst, Minister of Agriculture:

SIR,—I have the honour to present herewith the Forty-seventh Annual Report of the Entomological Society of Ontario, containing the proceedings of the Fifty-third Annual meeting, which was held at Guelph on the 2nd and 3rd of November, 1916.

The meeting was well attended and the interest shown by those present in the papers and addresses presented was evident from the lengthy discussions by which they were followed. A full report of these papers and discussions is contained in the following pages, together with the reports of the various officers and branches of the Society.

The work of the Society continues to expand and has been much increased by the activities of the British Columbia and Nova Scotia Branches.

The Canadian Entomologist, the Society's monthly organ, continues to maintain a wide circulation and a high standard of scientific value. In the forty-eighth volume now completed the series of articles on Popular and Practical Entomology, begun in the preceding volume, has been continued regularly and has done much to widen its usefulness and interest to the general reader.

I have the honour to be, Sir,

Your obedient servant,

EDMUND M. WALKER,
Editor.

Biological Department,
University of Toronto.

Entomological Society of Ontario

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Delegate to the Royal Society of Canada—MR. F. J. A. MORRIS, Peterborough, Ont.

FINANCIAL STATEMENT

For the Year Ending October, 31st, 1916.

Receipts.		*Expenditures.*	
Balance from 1914-15	$23 82	Cork and pins	$91 59
Dues	151 60	Printing	1,185 49
Subscriptions	428 73	Expense	70 20
Advertising	38 25	Salaries	250 00
Government grant	1,000 00	Library	6 53
Reports and back numbers	105 31	Annual meeting	59 15
Cork and pins	111 07	Annual report	170 00
Bank interest	11 91	Bank exchange	10 15
		Balance on hand	27 58
	$1,870 69		$1,870 69

To balance due printers	$66 96
By cash on hand	27 58
Net deficit	$39 38

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

Respectfully submitted,
A. W. BAKER,
Secretary-Treasurer.

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Scott, Prof. J. M. ....Truro.
Shaw, Prof. P. J. .... "
Shipton, J. W. ....Moschelle.
Sinclair, Nellie ....South River Lake.
Smith, M. Lois ....Truro.
Spittall, J. P. .... "
Trevoy, Nellie M. ....Brighton.
Wetmore, Ralph ....Yarmouth.
Whitehead, W. E. ....Kentville.
Whitman, C. F. U. ......Lawrencetown.
Williams, C. M. ....Nappan.
Young, Ermina ....Brighton.
Young, M. E. ....Middleton.

Saskatchewan.

Androchowicz, E. ....Humboldt.
Bentley, Miss L. ....Mellville.
Hutchinson, H. ....Starblanket.
Neville, S. J. ....Cottonwood.
Ritchie, J. D. ....Vanguard.
Willing, Prof. T. N. .....Saskatoon.

Manitoba.

Criddle, Norman ....Treesbank.
Hippesley, Mrs. W. W. ..Winnipegosis.
Hunter, Dr. A. J. ....Teulon.
Wallis, J. B. ....Winnipeg.

British Columbia.

Abriel, T. ....Nakusp.
Anderson, E. M. ....Victoria.
Anderson, J. R. .... "
Baggs, A. E. ....Vancouver.
Bayley, H. .... "
Blackmore, C. H. ....Victoria.
Brinkman, M. .... "
Bryant, T. ....Ladysmith.
Bush, A. H. .... Vancouver.
Cockle, J. W. ....Kaslo.
Cunningham, C. ....Victoria.
Day, G. O. ....Vancouver Island.
Downes, N. ....Saanichton.
French, P. E. ....Salmon Arm.
Gavet, D. ....Vancouver.
Gemmel, M. ....Sechelt.
Getchell, F. H. ....Vancouver.
Hadwen, Dr. S. ....Agassiz.
Hamilton, J. A. ....Vancouver.
Hanham, A. W. ....Duncan's Station.
Harris, Miss M. ....Deroche.
Hoy, B. ....Vernon.
Hook, G. ....Cobble Hill.
Howitt, M. W. ....Prince Rupert.
Hugh, W. .... Victoria.
Lallemand, C. F. ....Lytton.
Leach, D. H. ....Salmon Arm.
Martin, A. ....Vancouver.
Matthews, C. W. .... "
Middleton, M. ....Nelson.
Parham, G. L. ....Invermere.
Raley, G. ....Chilliwack.
Robertson, W. H. ....Victoria.
Robson, A. C. U. .... "
Ruhman, M. ....Vernon.
Sherman, R. S. ....Vancouver.
Stevens, M. G. .... "
Taylor, L. E. ....Kelowna.
Thornber, C. L. ....Vancouver.
Thornber, H. ....Kamloops.
Treherne, R. C. ....Agassiz.
Venables, E. P. ....Vernon.
Ward, W. E. ....Vancouver.
Warren, Miss E. ....Barnston Island.
Wilkerson, G. E. ....Victoria.
Wilson, Tom ....Vancouver.
Winslow, R. M. ....Victoria.
White, E. W. ....Sardis.

HONORARY MEMBERS

Cockerell, Prof. T. D. A...Boulder, Col.
Comstock, Prof. J. H. ....Ithaca, N.Y.
Cresson, Ezra T. .... Philadelphia, Pa.
Felt, Dr. E. P. ....Albany, N.Y.
Howard, Dr. L. O. ......Washington, D.C.
Wickham, Prof. H. F. ...Iowa City, Ia.

LIFE MEMBERS

Bethune, Rev. C. J. S. ... Professor of Entomology, Ontario Agricultural College, Guelph.
Evans, John D., C.E. ....Trenton.
Fyles, Rev. Dr. T. W. ....Ottawa.
Reed, E. Baynes .... " Director of the Meteorological Station, Victoria, B.C.

The Entomological Society of Ontario

ANNUAL MEETING

The Fifty-third Annual Meeting of the Entomological Society of Ontario was held at the Ontario Agricultural College, Guelph, on Thursday and Friday, November 2nd and 3rd, 1916. The President of the Society, Mr. A. F. WINN, Westmount P.Q., occupied the chair. The following were present during the sessions: Dr. L. O. Howard, Chief of the Bureau of Entomology, Washington, D.C.; Prof. P. J. Parrott, Geneva, N.Y.; Prof. E. M. Walker, University of Toronto; Prof. W. Lochhead, Macdonald College, P.Q.; Prof. W. H. Brittain, Truro, N.S.; Dr. C. Gordon Hewitt, Messrs. A. Gibson and J. M. Swaine, Entomological Branch, Ottawa; Messrs. W. H. Harrington and F. W. L. Sladen, Ottawa; Rev. Father Leopold, La Trappe, P.Q.; Mr. F. J. A. Morris, Peterborough; Mr. J. Dunlop, Woodstock; Prof. J. Dearness, London; Mr. W. A. Ross, Vineland Station; Mr. W. E. Biggar, Hamilton; Mr. N. Criddle, Treesbank, Man.; Mr. A. B. Baird, Fredericton, N.B.; Professors C. A. Zavitz, J. E. Howitt, C. J. S. Bethune, L. Caesar, J. W. Crow, D. H. Jones, E. J. Zavitz and S. B. McCready, Dr. R. E. Stone, Capt. G. J. Spencer, Messrs. A. W. Baker, A. H. Tomlinson, G. H. Unwin, C. R. Klinck, G. F. Kingsmill, E. Hearle, A. W. Guild, R. M. Aiton, J. B. McCurry and W. Evans, Ontario Agricultural College.

On Thursday morning a meeting of the Council was held in the Entomological Laboratory, at which the report of the proceedings during the past year was drawn up and various matters relating to the Society's welfare were discussed. A recommendation was made that Mr. John D. Evans, of Trenton, a past President of the Society and a most useful adherent for many years, should be elected a life member. This was subsequently done at the general meeting. It was decided that the next annual meeting be held at Macdonald College, Que. The President proposed that information regarding the principal collections of insects in Canada, both public and private, should be procured and published in the *Canadian Entomologist* from time to time.

At 1.30 p.m., the Society met in the Entomological Lecture-room. The President, Dr. Hewitt, took the chair and the proceedings commenced with the reading of the reports of the various officers of the Society and directors of the various divisions on the insects of the year.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1915-1916.

The Fifty-second Annual Meeting of the Society was held at Ottawa on Thursday and Friday, November 4th and 5th, 1915; the President, Dr. C. Gordon Hewitt, occupied the chair. The attendance was very gratifying, members being present from nearly every Province of the Dominion, and also several eminent entomologists from the United States, and Mr. C. P. Lounsbury, Chief of the Division of Entomology, Pretoria, South Africa. A large number of papers of interest and importance were read and discussed. The usual public lecture was given by Prof. H. T. Fernald, of Amherst, Mass., on "Life Zones in Entomology and Their Relation to Crops," on the Thursday evening, and on Friday evening the members were the guests at a smoker given by the Ottawa Field Naturalists' Club. The morning and afternoon sessions were occupied by the reading of papers and the presentation of reports from the officers of the Society and the Directors of several of the Divisions.

The following is a list of the papers: "Insects of the Season in Ontario," and "The Imported Willow or Poplar Borer or Curculio," by Prof. L. Caesar; "Side Injury and Codling Moth," by Dr. E. P. Felt; "The Home of Gortyna stramentosa," by Mr. A. F. Winn; "Insects of Ste. Anne's, Que., Season of 1915," and "The Occurrence of Tychius picirostris on Clover at Ste. Anne's, Que.," by Mr. E. M. Du Porte; "Observations on Parasitic and Predaceous Hymenoptera," by Dr. T. W. Fyles; "The Leaf-weevil in New York," by Messrs. P. J. Parrott and H. Glasgow; "The Green Apple-bug in Nova Scotia," by Mr. W. H. Brittain; "A Capsid Attacking Apples," by Mr. H. G. Crawford; "The Founding of the Science of Cecidology," by Dr. A. Cosens; "The Army Cutworm in Southern Alberta," by Mr. H. E. Strickland; "Life Zones in Entomology and Their Relation to Crops," by Prof. H. T. Fernald; "Some Notes Regarding Nose and Other Bot-flies," by Prof. W. Lochhead; "The Seasonal Prevalence of Hypoderma bovis in 1915," by Dr. S. Hadwen; "Progress of Entomology in Canada during 1915," by Dr. C. Gordon Hewitt; "The Life-history of Chermes cooleyi in Stanley Park, B.C.," by Mr. R. N. Chrystal; "The Cabbage-maggot—Autumn Development in B.C.," "The Cabbage-maggot in B.C.—Natural Control," and "Preliminary List of Canadian Parasitic Insects," by Mr. R. C. Treherne; "The Brown-tail Moth and Gypsy-moth situation in Relation to Canada," by Mr. J. D. Tothill; "Control of the Brown-tail Moth in Nova Scotia," by Mr. G. E. Sanders; "The Work Carried on in the United States Against the Gipsy and Brown-tail Moth," by Mr. A. F. Burgess; "Leaf-rollers Attacking Apples," by Prof. L. Caesar; "Locust Control Work with Poisoned Baits in Eastern Canada in 1915," and "The Entomological Record," by Mr. A. Gibson.

The Canadian Entomologist, the official organ of the Society, has been regularly issued each month; the forty-seventh annual volume was completed in December, 1915. It contained 417 pages and was illustrated with seventeen plates and thirty smaller figures in the text. A series of monthly papers on "Popular and Economic Entomology" added much to the interesting character of the contents; 21 new genera and 101 new species and sub-species were described. The contributors to its pages numbered sixty-one, and included writers in Ontario, Quebec, Nova Scotia, Manitoba, Alberta, British Columbia, fourteen of the United States, Honolulu, Japan and Finland. It is gratifying to know that, while subscriptions from the enemy countries of Europe have been discontinued, the number of subscribers has considerably increased.

Owing to the fact that most of the members of the Society in Guelph were taking military drill, the regular meetings of the Society during 1915-16 were few in number, and were largely of a business character. During the year, however, the following papers were read:

"Methods of Rearing, Studying and Combating Cut-worms and Army-worms in Western Canada," by Mr. F. W. Walsh; "Parasitic Work in Nova Scotia," by Mr. A. B. Baird; "Syrphus Flies and Their Role in the Control of Aphids," by Mr. H. Curran.

During the year seventy-six new members have been added to the rolls of the Society. Many members are absent on military service; where the dues of these members have not been paid they have been retained in membership without payment of dues wherever the Council knew they were in service.

It is with much regret that the Council has to record the loss of Captain R. V. Harvey, for many years the energetic Secretary of the British Columbia Branch, who was severely wounded in action in France and died in a German prison. We have also to deplore the loss of one of our esteemed honorary members, Mr. F. M. Webster, chief of the section of Cereal and Forage Insect Investigations in the Bureau of Entomology at Washington, D.C., who died at Columbus, Ohio, immediately after the meeting of the American Association for the Advancement of Science on the 2nd of January last. He was elected an honorary member of our Society in October, 1899, and always took an interest in our proceedings. His last visit to us was in August, 1913, when he attended our Jubilee meeting and read an interesting paper. An appreciative obituary notice by Dr. Hewitt was published in the March number of *The Canadian Entomologist.*

REPORT OF THE CURATOR.

During the past year no accessions have been made to the Society's collections. They have all been gone over several times and are kept entirely free from Museum pests. Donations of uncommon species of Lepidoptera and Coleoptera, and of almost anything in the other orders, would be very acceptable and gratefully acknowledged.

G. J. SPENCER, *Curator.*

REPORT OF THE LIBRARIAN.

During the year ending October 31st, 1916, forty-two bound volumes have been added to the Library, making the number on the register 2,262. A large number of unbound bulletins, reports, periodicals and pamphlets continue to be received from authors and publishers and in exchange for *The Canadian Entomologist.* Many of these are arranged in pamphlet-cases, and can be referred to without much difficulty. A certain amount of binding has been done recently, and, if funds permit, a considerable number more of important periodicals will be rendered available in this way for easy reference and a permanent place upon the shelves.

The excellent Library that we possess is being constantly made use of by the staff and students of the Biological Department of the Ontario Agricultural College, and to some extent by members of the Society at a distance.

Respectfully submitted,

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE MONTREAL BRANCH.

The 43rd annual meeting of the Montreal Branch was held at 794 St. Urbain St., Montreal, Que., on Saturday evening, May 13th, 1916.

The Secretary read the report of the Council as follows:

The Branch has held, during the season 1915-1916, eight monthly meetings, the average attendance being nearly seven.

We record with pleasure three new members added to our roll during the year.

During the year the following papers were read:

1. Annual Address of the President .... A. F. Winn.
2. Notes on the Natural History at the Toronto Fair .... Geo. A. Moore.
3. Collecting Hemiptera at Bondville, Que., August 1-13, 1915 .. Geo. A. Moore.
4. Lepidoptera taken by Geo. A. Moore at Bondville, Que...... A. F. Winn.
5. The Home of Gortyna Stramentosa, Guenée .... A. F. Winn.
6. Notes on Hemiptera taken at Bondville, Que. .... Geo. A. Moore.
7. The Reduviidae and Allied Families taken at Bondville, Que.... Geo. A. Moore.
8. A Few Remarks About the Genus Plagodis .... A. F. Winn.
9. Colias Alexandra, Edwards .... A. F. Winn.
10. Talk on the Entomology of British Columbia .... R. C. Treherne.
11. Talk on Insect Behaviour .... E. M. Du Porte.
12. Membracids taken at Bondville, 1915 .... Geo. A. Moore.
13. Variation .... A. F. Winn.
14. Talk on the Making of Microscope Sections of Insects' Eggs. Dr. J. A. Corcoran.
15. Talk on Making Slides of Genitalia .... G. Chagnon.

Our meetings were held at the residences of members except the February meeting which was held in the "Lyman Entomological Room," Redpath Museum, McGill University. This meeting was of particular interest. Fifteen were present, amongst whom were Prof. Lochhead with four others from Macdonald College and Mr. Treherne, Secretary of the British Columbia Branch. A pleasing event of this meeting was a presentation to our President, Mr. Winn, of an engraved silver plate from Lord Rothschild in recognition of his work in entomology. The presentation was made by Mr. Gibb who was in Canada on a visit.

One outing was held to St. Hilaire on May 24th.

The report of the Librarian showed our library in good order.

The report of the Treasurer showed a good balance in hand.

The following officers were elected for the ensuing year:

President .... A. F. Winn.
Vice-President .... G. Chagnon.
Secretary-Treasurer .... Geo. A. Moore.
Librarian .... G. Chagnon.
Council .... G. A. Southee, E. C. Barwick, H. M. Simms, Dr. Corcoran.

Geo. A. Moore,
Sec.-Treas.

REPORT OF THE TORONTO BRANCH.

The Toronto Branch of the Entomological Society of Ontario begs to report as follows on the work of the Branch for the year 1915-1916.

The twentieth annual meeting was held in the Biological Building on Thursday, October 26th, 1916, the President, Dr. Walker, in the chair.

The minutes of the previous meeting having been read and approved the reports of the Council and the Treasurer were presented and adopted.

Eleven meetings, including the annual meeting and one field meeting, were held during the season, the average attendance at the regular meetings being about twelve, including visitors, of which a few were present at most of the meetings.

During the past year seven new members were elected. These are: Miss B. K. E. Mossop, Miss Marjorie Ford, Miss Norma Ford, Kenneth Kirkwood, T. B. Kurata, George Graham, and H. V. Andrews.

The financial statement showed a balance in hand of $3.52.

The following list comprises the papers and lectures of the season:

Oct. 14. "The Founding of the Science of Cecidology." A. Cosens.
Nov. 18. "Notes from Newfoundland." E. M. Walker.
Jan. 4. "The Spiders of Canada," illustrated by lantern slides. Prof. J. H. Emerton, Boston, Mass.
Jan. 27. "Canadian Longicorn Beetles," illustrated with specimens. E. M. Walker.
Mar. 2. "The White Wax Industry of Sey Chuan," illustrated by lantern slides. P. M. Bayne.
Mar. 30. "Bacterial Control of Insects." C. E. Petch, Ottawa.
Apr. 25. "Bombidae," illustrated with specimens. C. W. Nash.
May 30. "Mosquitoes and Their Relation to Human Disease," illustrated with lantern slides. E. M. Walker.
June 22. "Some Important Achievements in Entomology." A. Cosens.

On June 30 a field meeting was held at Lambton.

The election of officers for the ensuing year resulted as follows:

President .... Dr. E. M. Walker.
Vice-President .... Dr. W. A. Clemens.
Secretary-Treasurer .... Shelley Logier.
Librarian .... Miss B. K. E. Mossop.
Council .... Dr. A. Cosens, Mr. T. B. Kurata, Mr. C. W. Nash and Mr. J. Hannibal.

The Toronto Branch regrets to record the death of one of its oldest and most valued members, Mr. J. B. Williams, who died on the 28th of May, 1916.

Respectfully submitted,

Shelley Logier,

Secretary-Treasurer.

REPORT OF THE NOVA SCOTIA ENTOMOLOGICAL SOCIETY.

The second annual meeting of the Entomological Society of Nova Scotia was held at Truro, on August 4th, 1916, some 105 persons being in attendance. The proceedings took the form of a short business session in the morning, followed by the reading of papers at the afternoon and evening meetings. Following the afternoon session a short collecting trip was made, during which a number of interesting captures were made and discussed.

The following officers for the year were elected:

Hon. President .... Dr. A. H. McKay, Halifax.
President .... E. C. Allen, Truro.
Vice-President .... L. A. DeWolfe, Truro.
Secretary-Treasurer .... W. H. Brittain, Truro.
Assistant Secretary-Treasurer... G. E. Sanders, Annapolis.
Committee .... J. M. Scott, Truro; A. G. Dustan, Annapolis.

W. H. Brittain,

Secretary-Treasurer.

REPORT OF THE ENTOMOLOGICAL SOCIEY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

F. J. A. MORRIS, *Peterborough.*

I have the honour to present a report of the Entomological Society of Ontario for the year 1915-1916.

The Society continues to flourish; its growth in the short interval since our Jubilee Year has been remarkable, and to a close observer will reveal a most healthy condition—deepening as it broadens; this vertical growth (marked by a greater intensity of work) is even more vital than the lateral expansion of the Society over a wider field.

The branching tendency of the parent stem is amply evidenced both west and east; for in the still young B.C. branch there has been dichotomy into branchlets at Victoria and Vancouver, while in Nova Scotia an entirely new and vigorous branch has lately thrust forth. Both these extensions are due to members of the Society employed in the work of economic entomology: Mr. Treherne in the west and Dr. Brittain in the east.

There can be no question that the Society owes its present exuberance in very great measure to the comparatively recent institution of our Agricultural Colleges and the giant strides over the Dominion, in the last decade, of Economic Entomology. The scientific training in biology, acquired by a whole army of field officers and other Government employes in connection with Agriculture, enables these young and energetic students of nature to grapple with problems in insect anatomy and physiology, in life-histories, in systematic and descriptive work that would baffle, should they ever confront, the amateur. And these graduates are called to the most distant and diverse fields of labour.

All this is clearly reflected in the pages of our magazine: every month shows work of permanent value in economic entomology, and articles that may fairly claim the title of monographs in many special departments of the Science, articles coming from writers in all parts of the Dominion and beyond.

It is worthy of note how many contributors to our Ontario magazine are distinguished authorities of the U.S.A.—some of them men of world-wide reputation. Insects, of course, are too doggedly cosmopolitan to be daunted by the immigration officer, whether clearly undesirables or belonging only, like the rest of us, to the great class of those who have not yet been found out. Under these conditions our Science knows no artificial boundary and will not be so confined. But it has often been remarked by members of the Society, and at our annual meeting last November, where it found ample illustration, it drew a comment from the guest of honour, Dr. Fernald, of Amherst, Mass., how cordial are the relations of give-and-take in Entomology between the United States and Canada.

Obviously, in the borderland, steps taken by one country's Government to control insect pests, benefit the other; but it is not in economic work only that these friendly relations are found to subsist. Many of the finest articles contributed to the "Canadian Entomologist" by specialists over the line, have reference to rare, entirely new, or hitherto unrecorded captures made within our borders by Canadian members of the Society, and sent for determination to recognized masters of the craft.

Among contributions of importance from native pens may be mentioned articles by the emeritus editor, Dr. Bethune; the editor, Dr. Walker; the Dominion

Entomologist and ex-President of the Society, Dr. Hewitt; the President of the current year, Mr. Winn, of Montreal; Messrs Caesar and Baker, of Guelph; Dr. Cosens, of Toronto; Messrs. Gibson, Swaine and Sladen, of Ottawa; Messrs. Wolley Dod and Strickland of Alberta; Messrs. Criddle and Wallis, of Manitoba; and Mr. Sanders, of Nova Scotia.

We have noticed also in the pages of the magazine since last report, reference to the insect fauna of Chile, Guatemala, British Guiana, the Philippines, Australia, India, Sweden and Finland.

Among *personalia* may be mentioned a delightful sketch of the late Prof. Croft, of Toronto University, from the pen of our esteemed Dr. Bethune, an appreciation of the great Jean Henri Fabre, and an obituary notice of our late honorary member Francis Marion Webster, both written by Dr. Gordon Hewitt.

The interest of the Society's periodical has greatly broadened under the capable hands of its editor, not only by the inclusion of two new sections, one of Popular Entomology, the other of Notes and Queries, but still more by systematic insertions from authoritative centres of activity, selected with wise judgment from diverse points of the United States and Canada.

The annual meeting held in Ottawa last November was one of the most successful in the whole history of the Society, representing practically all its interests over the whole wide area of its membership. The papers and articles there presented are now in the press and will shortly appear as the 46th Annual Report of the Society. They include a very large amount of research work of the greatest practical value and of a high order of scientific merit.

The titles and authors' names (see 46th Annual Report, Table of Contents) may be left to speak for themselves and for the full significance of that November meeting; with perhaps a single exception, which I crave leave to make more explicit; to wit, the supreme importance of work done on the spot by field laboratories, no fewer than nine of which have now been established in various parts of the Dominion, under the auspices of the Entomological Branch of the Dominion Department of Agriculture.

REPORTS ON INSECTS OF THE YEAR.

Division No. 1, Ottawa District—Arthur Gibson, Entomological Branch, Ottawa.

Attacking Field Crops.

Fortunately there were no serious outbreaks of field crop insects in the district of eastern Ontario which I have the honor to represent. The dull, rainy weather of spring and early summer undoubtedly interfered in the development of many species.

Locusts. Early in the season a few reports were received which indicated that young hoppers were appearing in numbers, but on investigation later we learned that the insects disappeared suddenly, owing to adverse weather conditions. We had arranged to conduct further experiments in the control of these insects with poisoned baits, but no fields sufficiently infested with locusts could be located in the Ottawa district.

Cutworms. Reports of damage by these caterpillars received early in June referred particularly to injury to cucumbers, beans, peas and other vegetables in gardens. The Red-backed Cutworm, (*Euxoa ochrogaster* Gn.), was most in evidence.

ROOT MAGGOTS. The Cabbage Maggot (*Phorbia brassicae* Bouche), and the Onion Maggot (*Hylemyia antiqua* Mg.) were again present in the Ottawa district, but the damage was not so extensive as in 1915. Some experiments which we conducted in the control of the latter insect by spraying with sodium arsenite indicated that such control is promising, and further work along this line will be done as opportunity occurs. Such control is discussed in Bulletin No. 12 of the Entomological Branch, issued in May, 1916.

THE POTATO FLEA BEETLE (*Epitrix cucumeris* Harr.). In the latter half of June this insect was present in noticeable numbers. Injury to the leaves of tomato was especially complained of.

THE CORN EAR WORM (*Heliothis obsoleta* Fab.). A few complaints of injury to the ears of sweet corn were received in early September. On September 5th larvae in the last stage were found. The work of the caterpillars is seldom noticed until the injury has taken place. Fortunately this insect is not an important one in the Ottawa district.

THE BANDED IPS (*Ips fasciatus* Oliv.). On September 22, I found this beetle present in a few ears of corn in our experimental plots at the Central Experimental Farm. Several kernels in one ear had been destroyed. This injury is an unusual one, and so far as I know has not previously been reported in Canada. Similar injury has been recorded in the United States.

THE SALT MARSH CATERPILLAR (*Diacrisia acraea* Dru.). This woolly bear was found in small numbers (August 11th) feeding on leaves of cabbages at Rivermeade, close to Ottawa. Although this caterpillar has a wide range of food plants the injury it causes is local. It can hardly be classed as a pest of importance. Handpicking will usually be sufficient as a control measure.

THE PARSNIP WEBWORM (*Depressaria heracleana* DeG.). At the Central Experimental Farm, the Dominion Horticulturist reported, on July 10th, an outbreak of the caterpillars of this insect in a patch of parsnip which he was growing for seed purposes. The larvae were numerous, on one day 170 were removed by hand from the plants.

THE ZEBRA CATERPILLAR (*Ceramica picta* Harr.). An interesting outbreak of this well-known caterpillar occurred in eastern Canada during the autumn of 1916. In some sections the larvæ were present in thousands, stripping the tops of turnips, and also injuring other plants, chiefly mangels and cabbages. One outbreak which occurred near Ottawa effected particular damage to rhubarb.

THE ASH-GRAY BLISTER BEETLE (*Macrobasis unicolor* Kby.). Reports of injury by this blister beetle to potatoes were received in early July. In one field which I visited on July 13th many of the plants had been entirely defoliated. Numbers of the beetles were present on the vines. Unfortunately, they have the habit of appearing suddenly and oftentimes eating the entire foliage of plants upon which they alight in a day or two. One grower protected his potato crop by dusting with arsenate of lead.

ATTACKING FRUIT AND FOREST TREES.

No special outbreaks of insects attacking fruit or forest trees came to my attention during the season. The Pear-leaf Blister Mite (*Eriophyes pyri* Pag.) was found freely on the foliage of apple on July 11th. The Black Walnut Caterpillar, (*Datana integerrima* G. & R.) was more than usually abundant, being found on walnut and hickory. Other common pests such as the Oyster Shell Scale, (*Lepidosaphes ulmi* L.), the Imported Currant Worm, (*Pteronus ribesii* Scop.), the Codling Moth, (*Carpocapsa pomonella* L.), etc., were more or less destructive in the district.

Garden and Greenhouse Insects.

Cutworms were frequently complained of as injuring plants in gardens. Sweet peas were freely attacked in one garden in the first half of June. At Meach Lake, Que. (near Ottawa) flowering plants were being injured at the end of June. The Red-backed Cutworm was the most commonly-occurring species.

The Tarnished Plant Bug (*Lygus pratensis* Linn.), was present in conspicuous numbers. Some growers of dahlias and zinnias claimed that large numbers of the buds had been destroyed by the insect. In one garden in Ottawa the bugs were very numerous in the middle of July, one lady reporting that almost all the zinnia plants in her garden had been destroyed. Unfortunately, there is no satisfactory remedy known for the control of this insect. Some growers claim to have had partial protection by dusting powdered tobacco over the buds or other portions of the plants which are attacked.

The Yellow Woolly Bear (*Diacrisia virginica* Fab.). Noticeable injury was caused by this caterpillar in gardens, particularly to the foliage of hydrangea. In the middle of July when some leaves were examined the larvæ were about half an inch in length. The leaves were conspicuously skeletonized in places.

Household Insects.

Ants. Some interesting experiments in the control of ants in houses were conducted during the past season. Near Chelsea, Que., about nine miles from Ottawa, perfect results in ridding summer cottages of ants were obtained by dusting sodium fluoride where the insects were numerous. This new remedy was also used in Ottawa and other places, and reports of success in all cases were received. In our own experiments the species of ants concerned were the common carpenter ant (*Camponotus pennsylvanicus* DeG), and the shed builder ant (*Cremastogaster lineolata* Say). An account of these experiments was published in the November 1916, issue of the "Canadian Entomologist."

Roaches (*Blattella germanica* Linn.). Sodium fluoride was also used with success in Ottawa in ridding a house of these objectionable insects. The powder was simply dusted in the places which were frequented by the roaches and almost immediately they began to disappear. Within a week no individuals were to be seen, where previous to the use of the powder the insects were present in numbers.

Carpet Beetles. The two carpet beetles, namely, the true Carpet Beetle, or Buffalo Moth (*Anthrenus scrophulariae* L.), and the Black Carpet Beetle (*Attagenus piceus* Oliv.), were reported as being present in destructive numbers in houses in Ottawa. No exceptional injury however was noted.

A few complaints were also received of the presence in houses of the Indian Meal Moth (*Plodia interpunctella* Hbn.) and the Confused Flour Beetle (*Tribolium confusum* Duv.). The former was found attacking breakfast cereals and the latter infested flour.

DIVISION No. 3, TORONTO DISTRICT—A. COSENS.

In spite of the extremely hot, dry weather of July, August and September, nothing particularly striking was noted to indicate that the insect life was affected by the unusual character of the season. Some injurious insects were indeed rather more plentiful than usual, but others were not so common.

THE ZEBRA CATERPILLARS, *Mamestra picta,* were exceedingly abundant on several species of plants. Even at the date of writing, the end of October, specimens of these yellow-striped larvæ are occasionally seen, crawling over the still green foliage of such plants as the clovers and asparagus. North of the city considerable damage was done to crops of turnips by this pest.

While the aphides were not so troublesome this season on the cultivated honeysuckles, another insect was found to be seriously injuring them. On some shrubs nearly every leaf was puckered and deformed by the mining of the larvae of

Galls produced by *Pontania petiolaridis* Rohwer on the leaves of *Salix petiolaris* Sm.

Phyllonorycter (*Lithocolletis*) *fragilella* Frey and Boll. The work of the insect is very characteristic and easily recognized, since the under sides of the infested leaves are covered with blister-like patches owing to the lower epidermis having been left intact, when the underlying mesophyll was eaten out. The larvae are from 5-6 mm. in length, and light-yellow in colour. They enter the ground after the fall of the leaves and emerge as moth early in the Spring. Gathering and destroying the leaves before the larvæ leave them, is, at this time of the year, the most apparent method of bringing the pest under control.

An almost spherical, sawfly gall is produced on the leaves of *Salix petiolaris* Sm., a native willow that is not uncommon in low ground near the city. The deformity closely resembles the conspicuous apple-like gall of *Pontania pomum* Walsh, but differs from this species in some details of structure. The host plants of the two galls differ as *Pontania pomum* is restricted almost, if not entirely, to

Salix cordata Muhl. In their attachment to the leaves of their hosts they also vary as the species on *Salix petiolaris* is almost equally divided by the blade, while *Pontania pomum* projects, only very slightly, from the upper side of the leaf. Further, the former species is hollow from the earliest stages, but the latter only becomes so when eaten out by the larvæ. A number of the galls from *Salix petiolaris* Sm. were collected in 1915, just before the fall of the leaves, and were kept, out-of-doors, in jars containing earth, during the winter. The adults began to emerge April 15th, and were sent to Mr. S. A. Rohwer, Washington, D.C., who has kindly replied as follows: "I have made a preliminary examination of the species and find that it may easily be distinguished from *Pontania pomum* and that it comes near to *P. pisum*. I think the species is undoubtedly new."

An interesting observation was made concerning this new species of sawfly, namely that the aperture of exit is prepared a considerable length of time before the larvæ leave the galls. Just what conditions finally prompt their departure and why their means of escape have to be ready, are points not yet cleared up.

Since all sawfly galls are well advanced in development before the larvæ are hatched, it is safe to conclude that the chief stimulus to abnormal growth must emanate from the ovipositor of the insect. The sawflies, when depositing eggs, clasp the opening buds with their legs and insert their sawlike ovipositors into the young leaves from the under side. Into each of the incisions, thus made, an egg is injected. The larvæ, as soon as hatched, commence to feed upon the substance in the interior of the gall, but leave the rind uninjured.

Since the pear-slug, *Eriocampa cerasi* Peck makes a similar incision in the leaf, without causing an abnormal production of tissue, it is highly probable that in the case of the sawfly gall-producers, the stimulus is not due to the mechanical effect of the cutting, but to a chemical action arising from the introduction of some substance by the ovipositor of the insect.

A specimen of the Compton Tortoise, *Vanessa j-album*, seen April 7th, marked the opening of the entomological season, and throughout the summer butterflies in general, were plentiful. In this connection the unusual abundance of the Monarch, *Anosia plexippus* L. should be noted. Since 1906, specimens of this species, have not been so numerous in this locality. During August, abundant evidence was furnished at different places of their congregating habits. On the island the poplars and willows were favorite resting sites for large flocks. The instinctive tendency to migrate southward in the autumn must have been the stimulus that impelled them to seek this outlying station. At different times straggling lines of these insects were noted moving westward along the lake shore.

Pontania petiolaridis New Species. Rohwer.

Belongs to Group 3 of Marlatt, and is closely allied to *salicis-pisum* Walsh, but may be distinguished from that species by the dark brown stigma, and by having the third antennal joint shorter than the fourth, and the third cubital cell much longer than high.

Toronto, Ontario. Described from a number of females and males reared by A. Cosens from galls on *Salix petiolaris*.

Type.—Cat. No. 20697, U.S.N.M.

A more extended description of this species will be published in connection with other species of this genus.

Division No. 5, Port Hope District— Francis J. A. Morris, Peterborough.

Your Director has been specializing almost entirely in *Cerambycidae* this season, and few observations in other families and orders have been made. The Report for the year will present, in brief pageantry, the procession of summer months from Spring to Autumn.

Early in April before the snow had entirely gone two or three specimens of *Disonycha triangularis* were noticed in the muddy ruts of a side road west of Peterborough; nearly a fortnight later two more specimens of the same beetle were captured in a similar situation north of Port Hope. During two very hot bright days in Easter week, large numbers of a beetle about the size of the common "June bug" were observed flying rapidly along just over the grass, and occasionally soaring up about the boulevards in Toronto; no capture was made, but the habit of flight makes probable their identification as *Euphoria inda*. This beetle we have never seen captured in the district of Port Hope or Peterborough; it is probably abundant west of Toronto, and has been taken about Orillia. Whether it breeds in S.W. Ontario or not, I do not know; at any rate it would seem to have spread by flight to a great distance from its original breeding ground. Its absence from the central district immediately north of Lake Ontario may be due to its low habit of flight; this would render a wide stretch of water a formidable barrier.

During the last week of April, and the first week of May, three specimens of *Hylotrupes ligneus* were taken in and about the City of Peterborough. From the first week of May for more than three weeks, specimens of *Pachyta monticola* were abundant; on Victoria Day upwards of 30 were captured in various blossoms, such as Crinkle-root (*Dentaria diphylla*), white Trillium (*Trillium grandiflorum*), large-flowered Cranesbill (*Geranium maculatum*), and—its favorite host—Early Elder (*Sambucus racemosa*). On the same shrub in the third and fourth weeks of May, several specimens of *Syneta ferruginea* were observed, and about the foliage of wild raspberries in the first two weeks of June this beetle was very abundant. *Lina interrupta* was taken feeding (as usual in this neighbourhood) on alder, and its next of kin, *Lina scripta* was found abundant on willows—especially low bushes bordering wet meadows and swamps. Observations made in 1914 and 1915 in regard to forms of the genus Chrysomela and their various food plants were renewed; one or two specimens of a more robust *Chrysomela scalaris* than that noticed on alder were captured; these had a more normal sculpture of the elytra and would seem to have bred out on basswood foliage.

On June 4th, while collecting about the margin of a wood some miles southeast of Peterborough, we noticed among some *Cyrtophorus verrucosus*, feeding on blossom of choke-cherry, a beetle very similar, but smaller and less prominent on the thoracic disc and elytral bases. Close examination of the insect showed it to be identical with a unique specimen captured in Port Hope on spiked maple in the year 1907. This insect had been returned from Montreal in 1909, labelled as the male of *Microclytus gazellula* Hald.; it being assumed for purposes of such determination that the length of the antennal joints 2, 3 and 4 *inter se* in that genus (as described by LeConte and Horn) was true only of the female, while the male had them proportioned as in *Cyrtophorus*. Twelve specimens of the beetle were captured on this day (June 4th, 1916) all on choke-cherry and among them a pair in conjunction; they all proved to have the proportion of joints 2, 3 and 4 constant, and as in *Cyrtophorus*. Between June 12th and June 18th, three more specimens were taken on the blossom of spiked maple. With the unique specimen of 1907, there was therefore a series of sixteen for purposes of comparison.

In all sixteen the second joint of the antennae was distinctly less than half the length of the fourth, somewhere between a quarter and a third the length. In the genuine *Microclytus gazellula,* the second joint is distinctly more than half the length of the fourth, somewhere between two-thirds and three-quarters the length. After the specimens had been thoroughly relaxed the antennae were drawn out taut over the back; in eight specimens the antennae proved as long as the insect, and in eight they were about three-quarters the length. One may fairly assume such a difference to be a sex distinction; probably the same difference will be found to distinguish the two sexes of *Microclytus gazellula* Hald., but it is most improbable that any difference in the proportionate length of joint 2 to joint 4 of the antennae should be found separating the sexes. Other differences are noticeable between this guest of the choke-cherry and *M. gazellula,* but whether the insect should be placed under the genus *Cyrtophorus* or under *Microclytus* I am not in a position to decide.

On June 13th seven specimens of *Callidium ianthinum* were captured on the bark of white cedar—newly cut fence rails. In the third week of June many Longicorns were captured on dogwood blossom; these included *Molorchus bimaculatus, Callimoxys sanguinicollis, Clytanthus ruricola, Cyrtophorus verrucosus, Encyclops caeruleus, Gaurotes cyanipennis, Leptura capitata, L. exigua, L. vittata, L. pubera, L. ruficollis* (with var. *sphaericollis*), *L. vibex, L. mutabillis;* these were all abundant: a single specimen of *L. sanguinea* was also captured, and a species not yet identified. In the same week along the C.P.R. east of the City of Peterborough, several colonies of *Lema trilineata* were observed on patches of ground cherry (Physalis), and on wild convolvulus 3 species of tortoise-beetle, *Coptocycla aurichalcea, C. guttata,* and *Chelymorpha argus.* Feeding on pollen the female of *Hoplia trifasciata* was frequently seen at this time, but only a single male; a collector in Port Hope who noticed this beetle earlier in the season, found the male predominant; this appears to be the rule of that species; the male appears first in great numbers about hawthorn and other blossoms; a week or two later, the males become rare and the females then become abundant. Owing to the unusually wet and cold weather in May and June many beetles seem to have been retarded. The first newly emerged Elder-borer this season was taken on June 22nd, nine days later than last year's record. In the third and fourth weeks of June many interesting species of *Elater* and *Buprestid* were taken, especially the genus *Corymbites.* On June 25th, north of Port Hope, a single specimen of *Lina tremulae,* a European leaf-eater, was captured on a poplar; it is known to occur in Massachusetts and Michigan. On the same day a small Longicorn hitherto new to your Director was observed on the leaf of a wild grapevine; a careful search resulted in the capture of a second specimen on grapevine about a mile further east in the district north of Port Hope; a third specimen on grapevine was taken in Trenton on June 27th; but persistent search of grapevines for more than a week failed to secure any more; the beetle was *Hyperplatys aspersa.*

While staying for a few days in Trenton at the end of June, your Director made some interesting captures. At Weller's Bay on June 28th, *Leptura lineola* was taken in abundance on dogwood blossom in low-lying wet hardwood bushes. At Glen Ross on the Trent, June 29th, was captured a small black *Oberea,* said to be the variety of *bimaculata* known as *basalis Lec.* It was taken on a wooded hillside among the undergrowth. Six specimens of the same creature were captured in flight, a few years ago, in an almost identical situation north of Port Hope; among the flora characteristic of such upland slopes are hazel bushes, wild rose, bergamot, Painted Cup (*Castileia*) and Orange Lily. The insect is about eight millimetres in length, slightly over a millimetre wide across the thorax, entirely black, except for a patch of dusky orange on the disk of the thorax which serves to throw into relief, but still indistinctly, a pair of black spots at the centre. In the same district several leaf-eating beetles were observed in great abundance; on oak bushes *Attelabus analis*—over a score being counted on a single twig; on two or three species of undergrowth a large black *Pachybrachys;* and on Fragrant Sumach (*Rhus canadensis*) the larvæ and beetles of *Blepharida rhois.* Last year we ventured to claim for this larva absolute immunity, due to its disgusting coat of liquid excrement. To our astonishment we observed this day a large yellow plant-bug regaling himself on these unsavory morsels with all the relish of a sand boy picking out periwinkles with a pin.

On July 1st, during a tramp about the Big Swamp, Murray Township, north of Wooller, three or four specimens of *Leptura chrysocoma* were found feeding in the blossoms of that beautiful flower, the Swamp Valerian (*V. silvatica*). They were right out among the tamaracs almost in the heart of the swamp. Besides tamarac, a very few white pine and several spruce trees stood in this corner of the swamp. On July 2nd, at the same spot, *Leptura chrysocoma* was found feeding round the edge of the swamp, rare on fleabane, occasional on valerian, and abundant on yarrow heads; over 30 specimens were captured.

On July 5th a trip to some woods east of the Otonabee River, just north of Hiawatha, yielded good results. On some dying balsam a pair of *Acanthocinus obsoletus* and a pair of *Xylotrechus undulatus* were taken. On some fallen beech three species of *Agrilus* were seen, including *bilineatus* and *obsoletoguttatus;* also seven specimens of *Neoclytus erythrocephalus,* two of *Xylotrechus colonus,* two of *Urographis fasciatus,* and a single specimen of *Hoplosia nubila.* Of this last, four specimens have been taken about Peterborough since 1914, three on basswood and one on beech, confirming the hearsay statement of Blatchley in regard to the hosts of this beetle. Some fallen beech were examined in another quarter on July 14th, and a large number of *Xylotrechus colonus* and *Urographis fasciatus* were taken on the under side of the trunks. On July 10th and 13th, a newly felled grove of white pine was visited. Trunks, limbs, branches, twigs and foliage were all carefully examined, as well as the surrounding shrubs and herbage. Two species of *Monohammus* were found abundant, *confusor* and *scutellatus,* while a third, *titillator* was taken occasionally. These were mostly on the trunks; about limbs and branches, especially where broken and piled up— decay being further advanced here—were found several specimens of *Acanthocinas obsoletus* and *Leptostylus sex-guttatus;* besides these, eight or nine specimens of *Neoclytus muricatulus* were captured, running rapidly over the trunks and limbs in the hot sunshine. Till 1916 we had never seen this insect except on white pine, but two specimens were captured this July on white spruce, one on July 14th near Peterborough, and the other at the end of July in the Algonquin Park. Close by these pines, both fallen and standing, three *Acmaeops* were taken, two *Acmaeops pratensis* (on yarrow heads) and a single *Acmaeops proteus.* During the same trip a very minute specimen of *Pogonochaerus mixtus* was noticed on the bark of a pine log. Three or four only of these beetles have been taken on white pine during ten years of collecting, and it has never appeared common till this season. During the second week of July two hosts were discovered for the little Lamiinid *Hyperplatys aspersa.* These were the American aspen (*Populus tremuloides*) and the staghorn sumach (*Rhus typhina*); as several other borers were found in the same company, the two accounts are kept separate.

It was on July 6th that we first noticed *Hyperplatys aspersa* on the top of a woodpile. This pile consisted entirely of *Populus tremuloides,* cut into short-length cylindrical billets, the bark still on; the billets ranged from two or three to six or seven inches in diameter. During ten days, six visits were made to the woodpile; on each of the last three visits every billet in the pile was lifted and turned over for inspection, with the following result:

Hyperplatys aspersa, 117. (These insects were not collected after the fourth visit, though several were seen).

Liopus variegatus 13.
Liopus cinereus 6.
Acanthoderes sp? 2.
Pogonochaerus mixtus 2 (var. *salicola,* Casey.)
Parandra brunnea 1.
Saperda calcarata 1.

Also, several species of Endomychid, Clerid, Elaterid, Buprestid, Tenebrionid, and Rhynchophorid beetles.

During the same period Dr. Watson, of Port Hope, was having a similar experience about dying branches of sumach; his captures included *Goes oculata, Leptostylus macula, Liopus cinereus, Lepturges signatus* and *Hyperplatys aspersa.*

The weeks from July 18th to the end of August, were spent in the Algonquin Park. About Cache Lake, on fallen balsam and spruce (besides white pine), *Monohammus confusor* and *M. scutellatus* were both observed; on spruce were captured single specimens of *Tetropium cinnamopterum, Neoclytus muricatulus* and the Melandryid, *Phloeotria quadrimaculata* (*Dircaea liturata*); on balsam, a single specimen of *Xylotrechus undulatus.* Apparently breeding about the branches of a small felled white pine over 100 specimens of *Pogonochaerus mixtus* were captured in five weeks. Several specimens of *Leptostylus 6-guttatus* were also taken on white pine. Half a dozen specimens of *Leptura canadensis* (all female) were taken about the woods, and as many (all male) feeding on spiræa blossom; no female was seen on blossoms. On spiræa were also taken both sexes of *L. subhamata, L. proxima, L. vagans* and some other common species; also two specimens of a very dark form of *L. plebeia;* this beetle had never been taken before 1916; but on July 6th we had been fortunate enough to observe a specimen settle on the trunk of a large white pine, just low enough not to afford one more tantalizing example of how the human enthusiast's reach exceeds his grasp.

Not many observations of economic interest were made during the season. Depredations of the willow-boring weevil were in further evidence about Port Hope where some specimens were noticed as early as the first week of June; in that neighbourhood it was found also on *Populus tremuloides,* and near Oshawa on Balm of Gilead; a patch of willows near Peterborough was noticed in September badly damaged by this insect. The wet May and June caused aphids to be quite a severe scourge to foliage, especially elm, poplar and maple. Grasshoppers in the later summer were terribly destructive, though less so in the Port Hope district (Mr. Duncan tells me) than elsewhere. Apple and other fruit trees whose branches were a riot of blossom in May and June managed to set very little fruit, the disastrous rains of the early summer having prevented insect fertilization.

Division No. 6, Essex District—J. W. Noble, Department of Agriculture, Essex.

Attacking Field Crops.

Wire Worms and White Grubs. During the wet spring of 1916 these pests did considerable harm to corn and other cereals; sugar beets were also destroyed and some damage was done in the onion fields. June beetles and click beetles seemed quite plentiful during the summer months and the writer obtained several of the former by the use of a lantern and pan of water covered with kerosene.

Attacking Fruit Trees

Codling Moth (*Carpocapsa pomonella*). Owing to the continued rainfall during the month of June the codling moth was very prevalent this spring. Very few side entrances have been found which would suggest that most injury was caused by first brood. In neglected orchards it seems that there is over ninety per cent. of the fruit affected.

Plum Curculio (*Conotrachelus nenuphar*). The injury of this beetle was very prevalent on plums especially during the past season; although not so plentiful upon the apples.

San José Scale (*Aspidiotus perniciosus*). Practically all uncared for orchards have been ideal breeding grounds for this pest this season and a large quantity of affected fruit is offered upon the markets. The pest is practically absent in well kept orchards.

Tent Caterpillars (*Malacosoma americana* and *M. disstria*). These pests seemed more prevalent than usual this year; the unsightly webs of both species were found in several orchards and woods. *M. americana* is the more common although neither can as yet be considered of great economic importance.

Aphids. These insects have done considerable harm in deforming the fruit in neglected apple orchards. On some of the smaller crops they did great damage and will be discussed later.

Cherry Fruit Fly (*Rhagoletis cingulata*). This was the most important pest of the sour cherry this year. Very few sweet cherries bore fruit this season but in former years this fly injured both types.

Lesser Peach Tree Borer (*Aegeria pictipes*). Some orchards have been ruined by this pest.

Insects Affecting Small Fruits and Vegetables.

Strawberry Sawfly (*Empria ignota*). On a number of patches during the past season the writer has observed injury from this species, the chief injury being that the fruit failed to ripen. Spraying with hellebore was successfully carried out in two fields.

Melon Aphids (*Aphis gossypii*). Fifteen thousand dollars is a conservative estimate of the damage borne by the melon growers during the past summer and a great loss to the pickle growers was also sustained. Twenty-five per cent. of the crops of inside cucumbers was lost by the lice. Successful spraying outside with tobacco decoction was demonstrated by this Department and good results were shown by inside fumigation with nicofume and black leaf 40.

Cabbage Root Maggot (*Pegomyia brassicæ*). Probably for the first time in this district this insect has caused a great deal of damage this season. Some crops of early cabbage were almost a failure.

ONION ROOT MAGGOT (*Pegomyia ceparum*). This is another arrival to report this season. In Mr. Caesar's report of last year I note he states that he could scarcely find a root maggot in this district. Unfortunately this is not the case in 1916. Great damage was wrought during the past season to the onion growers.

ONION THRIPS (*Thrips tabaci*). The writer has seen thousands of these insects in small areas during the past season. The characteristic white lines on the leaf indicated that they were doing considerable damage. We have tried almost all recommended remedies with indifferent success. They especially thrive in tobacco decoction. The writer has taken an onion covered with thrips, immersed it in the strong solution of tobacco for five minutes, then laid it in the sun and in a few minutes the insects seemed invigorated by the experiment.

TOBACCO WORM (*Phlegethontius quinquemaculatus*). As in former years this insect has cost the tobacco growers thousands of dollars in injury and labor to pick the worms. Successful work is being done by some growers in having the worms picked by ducks. The method of poisoning by attracting the moth to baits has been found satisfactory. This season one grower has killed more than a half bushel from three poisoned Jamestown plants (*Datura stramonium*).

GREENHOUSE INSECTS.

The chief greenhouse pests during the past season have been aphids, white fly and cucumber beetle. Successful fumigation for the former two has been carried on with nicofume, black leaf 40 and hydrocyanic acid gas, but a great deal of harm has been done by the beetle and methods of control are rather difficult. Hand picking has been practiced with the greatest success, but is rather laborious.

DISTRICT NO. 7, NIAGARA DISTRICT—WILLIAM A. ROSS.

ORCHARD INSECTS.

Comparatively few complaints were made this past season about the depredations of apple insects. This was largely due, I think, not to the scarcity of noxious insects but to the fact that evils such as the codling worm and the plum curculio were overshadowed by a greater evil—apple scab.

CODLING MOTH (*Carpocapsa pomonella*). Side injury by this species was more noticeable on apples this season than it was last year.

PLUM CURCULIO (*Conotrachelus nenuphar*). This insect was less injurious in the Vineland district than it has been for some time past.

THE GREEN APPLE APHIS (*Aphis pomi*). Early in the summer conditions were very favorable for the rapid development of plant lice. The weather was warm and there was a superabundance of food—succulent growth produced by the heavy spring rains. The apple aphis took full advantage of these conditions and it multiplied and spread at an alarming rate. During July the infestation was so severe that in certain orchards which I had under observation all the young shoots and watersprouts were covered with masses of green lice. The outbreak reached its height about the end of July and then, thanks to the effects of the drought, it commenced to decline very rapidly until by the last of August very few aphides were present on the trees.

SAN JOSÉ SCALE (*Aspidiotus perniciosus*). Apart from noticing an unusual quantity of scale-infested apples in certain Vineland orchards, I made no observations on this pest.

The Pear Psylla (*Psylla pyricola*). The cold, wet weather of spring was so fatal to the eggs and newly hatched nymphs of this species that our spraying tests in a Vineland orchard were completely nullified. The check pear trees proved to be as clean as the sprayed trees.

The Imported Spider Mite (*Tetranychus pilosus*). This acarid was again common on plums and apples. Our experiments with the mite prove that lime sulphur wash (summer strength) will readily control it.

Beneficial Orchard Insects.

One of the most important enemies of the green and rosy aphides of the apple in the Niagara district is a small reddish cecidomyiid maggot. I have observed this creature at work during the past three seasons but did not have it identified until this year. The species is *Aphidoletes meridionalis,* Felt.

The feeding habits of this cecidomyiid are interesting. In attacking its victim the maggot, as a general rule, attaches its mouth parts to a leg joint and then proceeds to gorge itself on the body juices. The favorite point of attack is the articulation of the femur and tibia. (In one instance a maggot was observed with its mouth parts attached to the base of an antenna.)

The ladybirds *Hippodamia convergens* and *Coccinella novemnotata* were exceptionally common. During the summer both species were found feeding freely on the green apple aphis.

Pests of Small Fruits.

The Blackberry Leaf Miner (*Metallus rubri*). A large blackberry plantation near Vineland was seriously infested by this sawfly.

So far as I am aware no satisfactory method of combating the miner has yet been discovered.

The Raspberry Sawfly (*Monophadnus rubi*). This species was again very injurious.

The Imported Currant Borer (*Aegeria tipuliformis*). Complaints about the work of the borer were received from Burlington.

Shade Tree Insects.

Black Walnut Caterpillar (*Datana integerrima*). It was no uncommon sight this past season to see Black Walnut trees which had been wholly or partially defoliated by this caterpillar.

Fall Web-Worm (*Hyphantria cunea*). The ugly nests of this insect were unusually abundant on shade and fruit trees. In several instances all the foliage on young trees was destroyed.

Linden Insects.

The Basswood Leaf-miner (*Chalepus rubra*), and an undetermined species of lace-bug were very common on Linden in the Horticultural Experiment Station wood-lot.

Miscellaneous Pests.

Onion Thrips (*Thrips tabaci*). What might have been a serious outbreak of onion thrips in the Horticultural Experiment Station vegetable gardens was kept within bounds by the effective work of a predaceous flower bug, *Triphleps tristicolor*. B. Wh.

Associated with *Thrips tabaci,* but not so numerous as it, was another species of *Thysanoptera,* viz.: *Aeolothrips fasciatus.*

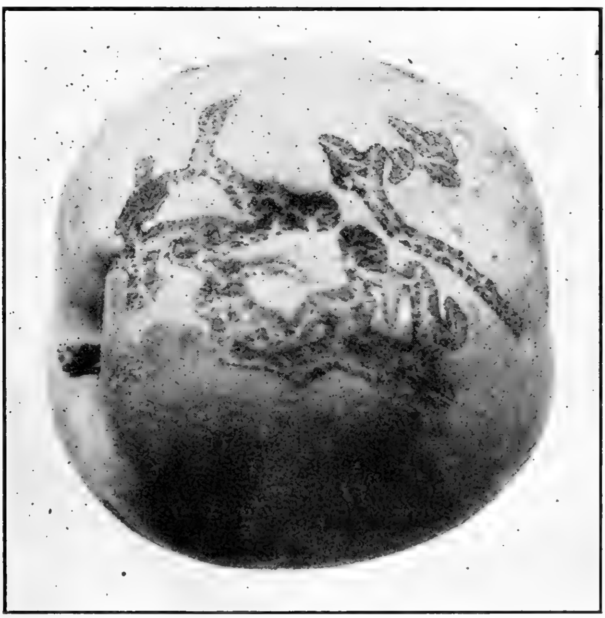
Potato Beetle (*Leptinotarsa decemlineata*). This well known pest was more abundant around Vineland this past season than it has been for the last three years.

Horse Flies. During the hot weather of July and early August the green-headed horse fly, *Tabanus costalis,* was remarkably abundant and unusually trouble-some.

The Clover Mite (*Bryobia pratensis*). Early in June I received an urgent call from a horrified householder in Vineland to help him to expel or to exterminate certain minute horrors which had invaded his "best" bedroom. On visiting the house I found the bed clothes in the infested room literally alive with clover mites. As the invaders were in possession of the bed only, I suggested the immediate removal of the mattress and clothes to the lawn. This was done. The mattress was aired for some time, the bed clothes were laundered and nothing more was seen of the mites.

Scarred Apples.

Last month a local fruit grower drew my attention to a peculiar type of insect injury which was very common on the fruit of several Rhode Island Greening trees. The apples were marked here and there with calloused blemishes, which varied in shape from dots to long, irregular, serpentine areas. Although the blemishes were only skin deep they were sufficient in themselves to degrade No. 1 fruit to No. 3.



Scarred Apple.

As I was unable to determine the cause of the injury I submitted specimens to Profs. Caesar and Parrott, but neither could diagnose the trouble. Prof. Parrott's answer to my inquiry is quoted herewith:

"I am by no means certain as to the cause of the injury. During the past year we have discovered such injury upon apples, and specimens of peaches have been forwarded to us injured in a manner quite similar. I spoke to Mr. Knight of Cornell University regarding the damage and he intimates that such injuries may attend the work of red bugs. In the specimens of fruit that have been sent to us from New York it is certain that the apples were first punctured by either red bug or an insect with similar habits. However, the remarkable thing about the injury is the development of a large irregular callous that stands out in marked contrast to the normal epidermis of the fruit."

I have brought some of the scarred apples along with me for your examination and I hope that some one present will be able to enlighten me as to the cause of the injury.

THE NATURALIST IN THE CITY.

Rev. Thomas W. Fyles, D.C.L., Ottawa.

The lover of nature, whose avocations or infirmities limit his field of observation, may yet have opportunities for gratifying his tendencies, and adding to his knowledge of living things.

With your permission I will tell briefly of a few creatures that have engaged my attention during the periods of my life in cities.

In a paper I read before the Society last year, I told of an assembly of *Thalessa lunator* Fab. upon a scar on a limb of a Red Maple growing beside the house I now occupy. Early in the present year (1916), a strong gust of wind took the limb I speak of and snapt it off at the injured part. On examining it I found that decayed wood extended for at least two feet from the point of fracture. This touch-wood presented an interesting appearance. In it were the tunnels formed by *Tremex columba* Linn., closely packed with frass for much of their length. In them the larvæ of *Thalessa lunator* had found and devoured their prey. There were other tunnels (some of which opened out into those of the Tremex) and these were stored with dead flies of various kinds. Among the flies were the capsule-like cases, or cocoons of a species of wasp. They somewhat resembled the cocoons of the mud-wasp, *Pelopœus cementarius* Drury; but whereas the Pelopæus cocoons were brown and semi-transparent, showing the insect within, these were of a clay-yellow and opaque. They were also somewhat smaller.

At intervals in the beginning of June there came from these cocoons specimens of *Crabro singularis* Smith.

I also found in the decayed wood the mangled remains of *Tibicen rimosa* Say.

The fate of the fine limb of the shade tree I have spoken of should be a warning against injudicious pruning.

In my studies of the Mud-daubing Wasps I have been able to follow the life-history of *Pelopœus coeruleus* Linn. This is a more compact insect than *cementarius,* and in hue it is of a brilliant royal purple. Its cells resemble those of *cementarius,* and are found in association with them. The perfect insects, about the first week of July, bite neat round ways of exit from their winter prisons, and commence active operations very soon after. They are industrious collectors of spiders. I have counted as many as nine spiders in one of their cells. One egg only is laid by the mother wasp in each cell, and the grub that comes from it feeds upon the spiders. It is full-fed by the end of August and commences to spin its cocoon. The grub is of the usual sphex shape—somewhat attenuated towards the head, which is small and has dark nippers. The cocoon resembles that of *cementarius.* In it the larva remains quiescent through the winter. In June the larval skin shrivels up, and the pupa, a wonderfully beautiful object, appears. It is as if it were formed of the purest translucent white wax. Its various parts are exquisitely fashioned, and symmetrically arranged. Towards the end of June the pupa begins to take colour: the eyes assume a pale chestnut tint—this changes to black. The thorax and wing-cases also become deep black. In the first week of July the complete metamorphosis has taken place, and the perfect insect comes forth in all its beauty.

I have mentioned *Tibicen rimosa* Say. This is a rare insect in Quebec Province, but its near relative *Cicada canicularis* Harris is very abundant.

One afternoon, in the early sixties, I was walking under a row of noble elm trees that grew along one of the upper-town streets of Montreal, when I noticed a large insect of rather a disreputable appearance crawl from the earth and begin to ascend a tree. Its proceedings interested me. After climbing for a foot it dug its claws—and it was well provided with claws—into the bark of the tree, to secure its hold, and then began to sway itself violently from side to side, as if troubled with a sharp internal disorder. Something will result from this paroxysm, I thought to myself, and something did result. Its skin parted along the back, from face to abdomen, and then the creature began to crawl through the gap it had made, drawing its legs from their cases as if it were taking off its boots. Its wings, which had been neatly plaited in side cases, were gradually unfolded, and in a quarter of an hour the perfect insect seemed to be ready for flight.

That large insects, such as *C. canicularis,* where they are present in numbers, must damage the trees by tunneling in them is evident. In passing, and by way of bringing this home, let me say, that, in my grounds at South Quebec there stood, in the open, a well-grown, shapely spruce—I suppose fifteen inches in diameter at the base. One windy day in the summer the tree broke off at the base. It was pierced, in every direction, by the mines of the "Forgeron" (as the French call it—the Blacksmith (*Monohammus scutellatus* Say), the black, titillating beetle, with the white lunette on its shoulders.

Leaving the insects let us for a few minutes consider some of the birds that frequent the city or occasionally visit it.

Last year, in the month of June, a young Night-hawk (*Chordeiles virginianus* Linn.) fluttered down from the flat roof of the after part of the house I now occupy on Frank Street, Ottawa. It lit upon the kitchen door-steps. When approached it merely cowered down, and then, without a struggle, allowed itself to be carried back to the roof from which it had fallen. A few days after another young bird, a male of the same species, tumbled to the same spot. I secured it with my entomological net, carried it up-stairs and let it go through a window. It partly opened its great length of wing and shuffled away behind a chimney.

The past summer was marked by frequent thunder-storms. On the 25th of June there was one of extreme violence. A stately elm, that grew in the vacant ground behind my house, was rent, through the centre, from top to bottom, by a lightning flash. When the storm was at its height I looked out upon the roof I have spoken of, and I was startled. Within three yards of me was a female Night-hawk sheltering her young with her ample wings. The rain descended in torrents, but, with marvellous patience, she maintained her position.

The greys and browns of the night-hawk's plumage, together with its white markings, blend with the tints of the pebbled roof of the city dwelling—or those of the waste place in the country—which the mother bird may select on which to deposit her eggs. The eggs resemble pebbles.

Another bird, the plumage of which befits its customary haunts, is the Ruffed Grouse (*Bonasa umbellus togata* (Linn.) Ridgw.). The females of this species when brooding on their nests are no doubt often saved from molestation by their colouring and the death-like stillness that they keep when foes are near.

The Ruffed Grouse (in the vernacular—*Partridge*) is not a familiar object in our city streets; but some years ago, when my home was in Hull, P.Q., I, one day, received a great surprise: I looked from an upper window and saw, amidst the potted plants on the roof of the balcony to my front door, standing in alert attitude, with outstretched neck, a Grouse.

So perfect was the bird in form and plumage that I could not think it had passed through the hands of a taxidermist; so motionless was it that I was doubtful whether it was really alive. My attention was called off for a few moments, and the bird seized the opportunity to fly away. How can I account for its presence? In this way:

Behind my house ran the creek which surrounds the City of Hull, and beyond it were the beautiful grounds of Mrs. Ellery Lord and Front Street. Then came the meadows (including the well-known "Beaver Meadow") and strips of woodland. Surveyors and axe-men had just commenced to convert the Beaver Meadow into town lots. Their operations probably had disturbed the grouse, and a succession of alarms had kept it on the wing till it whirled round the street corner near my house and took refuge in the greenery on the balcony. This, of course, is supposition.

One of our most welcome summer visitors is the robin. When friends meet, a frequent greeting in the end of April or beginning of May, is "Good morning! Did you hear the Robin?" What accounts for the popularity of the bird? (1) Its hearty morning call is a pleasant sound. (2) It is a trim, handsome bird, that adorns our city grass plants. (3) It is a sociable bird and loves to build its nest on or near our dwellings. (4) It is a cleanly bird and makes no litter in building, and keeps its nest and its surroundings unsullied. Its confidence in man wins man's protection.

A friend in Hull has under the veranda of his house a preserved head of a Virginia Deer. Between the horns of this, in the year 1909, a pair of robins built their nest and reared their brood. The same pair (it is thought) returned to it the next season and were again successful and raised their young.

It was interesting to watch the approach of a parent bird to the nest. It would alight on a branch of a cedar tree that grew at the end of the veranda and look around. If only members of the household were near it would come on at once. If a stranger were present it would pause, as if to judge of his disposition, before making its approach.

Of quadrupeds, perhaps the most remarkable I have seen in a Canadian city is the Black Rat (*Mus rattus*). The specimen I found was a dead one. I had occasion one day to go to the Louise Embankment, Quebec City, and while walking along one of its wharves I found the body of the little beast I speak of (I am sorry that I did not have it preserved). The creature had probably landed from a vessel from Europe, and been set upon and killed by the Brown Rats with which the Embankment abounds.

The Black Rat, in olden times, was the common rat of England, and it was plentiful enough. Its enemy, the Brown or Norway Rat (*Mus decumanus*) found its way to that country about the period of the English revolution, and the Jacobites called it the *Hanover* rat, very much in the same spirit that *Cecidomyia destructor* was called in America the *Hessian* fly. The Black Rat is a great rarity in England now.

The Flying Squirrels are interesting little animals. I purchased a pair of them in Bonsecour Market, Montreal, from a farmer's boy. This was in 1863. I carried the little creatures home and they became great pets. They slept curled up in their snuggery most of the day, but at dusk they became very lively. We were accustomed to open their cage door and let them have the run of two adjoining rooms. They would leap from piece to piece of the furniture in the rooms, and from picture to picture on the walls, and have a grand chase and frolic. When tired they would go back to their cage of their own accord. Unfortunately, one evening, our maid left a window open in the outer room, and our pets bounded through it and we saw them again no more.

Seals sometimes come up the St. Lawrence as far as Montreal. On the 23rd of April, 1863, I travelled to Laprairie. My business accomplished I hired a French Canadian and his son to row me back to the city in their canoe. The weather was delightful and the water calm. Masses of ice were floating about and wild ducks were flitting near. When we were drawing nigh the city a round head suddenly rose from the water not far away. "*Sacrè!*" cried my old boatman "*Un veau marin! Un veau marin!*" Then breaking into English for the benefit of his passenger, "She am worth five *ou* six dollare. *Helas,* me gun she gone home!" Presently we saw another head. *Two* seals, attracted, the old man said, by his red shirt, were following us. We had their company for nearly a mile.

I have said enough, I trust, to remind you that, to those who have eyes to see, nature affords tokens of her presence, even in the busy haunts of men.

Dr. Hewitt: I think we should send Dr. Fyles the greetings of the Society, and also its thanks for the paper that he has contributed this afternoon. Dr. Fyles has always been present at every meeting of the Society that he could possibly attend. He has become so infirm now that he cannot move from his home at times, and therefore I think it is only right for us to send Dr. Fyles our greetings and thanks for the paper.

Mr. Winn: In Dr. Fyles' paper mention is made of the emergence of the Cicada. It has often been stated that the Cicada comes out early in the morning, but how long it takes to dry its wings is a matter of dispute.

Capt. Spencer: This summer I watched a Cicada emerge later than two o'clock in the afternoon at Camp Borden. It crawled out of the ground, left its case, and its wings were hard enough to fly a short distance (two or three feet) within half an hour.

DUSTING FRUIT TREES AND GRAPES FOR THE CONTROL OF DISEASES AND BITING INSECTS.

L. Caesar, O. A. College, Guelph.

The success of the Cornell experiments with the so-called "Dust Spray" aroused much interest in Ontario as well as elsewhere, and led to our performing a series of tests with this new method of controlling biting insects and diseases. All these experiments were conducted in the Niagara District, because I considered this not only the most convenient place, but also the district most infested with Codling Moth.

Composition of the Substance Used in Dusting.

In all my tests where both insects and diseases were to be combated, I used a mixture composed of 85 per cent very finely ground sulphur and 15 per cent. arsenate of lead powder, supplied ready mixed by The Niagara Brand Spray Co., Burlington. The price of the mixture was $6.50 per 100 lbs. When biting insects were not present, as on grapes, and on plums in the later sprayings, the arsenate of lead was omitted and finely ground sulphur alone used. This reduced the cost greatly as the sulphur alone cost only $2.90 per 100 lbs. Some persons used the sulphur mixed with finely ground limestone.

Outfit for Applying the Dust.

I had the larger type of dusting outfit supplied by the Niagara Brand Spray Co. They have a smaller outfit, but it cannot cover nearly so may trees. The outfit consists of a 2½ horse-power gasoline engine, a blower and a receptacle or

Dusting fruit trees for insects and diseases.

hopper capable of holding about 100 lbs. of the dust. The dust is blown out upon the trees through a galvanized iron pipe of about 3 inches diameter. This pipe is connected wth the blast passage by a thick rubber tube of the same diameter. The flexibility of the rubber allows the operator to direct the pipe in any direction quickly and easily. For small trees a short pipe about 3 feet long is used, but for large trees the pipe must be longer. I used one about 6 feet in length. Too long a pipe is awkward as the branches interfere with it; too short will not throw the dust high enough. The amount of material used can be regulated by the operator by a small lever on the hopper. The outfit costs complete about $265.

Kinds of Weather Best Suited for Dusting.

Dusting should not be done in a strong wind, because this carries the material too rapidly through the air instead of allowing it to float slowly through the trees and settle thickly upon the foliage and fruit. A strong wind, moreover, will often drive the dust down and not permit it to reach the top of the tree. The ideal condition is a perfectly calm day, or one with almost no breeze. The driver should go up and down the rows parallel with the wind so that the operator may shoot the spray into the trees at right angles to the row, thus finishing the whole orchard as he goes. It will not do to dust one side of the trees; both must be done just as in the case of the liquid spray; otherwise the results will not be satisfactory. Sometimes, especially at the Codling Moth spray, it is impossible to watch for an ideal day, and one has to spray with the wind. Then if it does not change soon, the remainder of the tree can be sprayed by blowing the dust in from each side at right angles to the wind. The spraying may be done in the morning or evening when the wind usually moderates.

It is just possible that grapes in the earlier dustings before the leaves are large and abundant could be dusted against the wind so that the dust would be blown back to the opposite side of the next row, in this way covering both sides and saving time and labor. This cannot be done, however, when the foliage is dense.

Dusting apparently may be done with safety either when the foliage is dry or moist.

Amount of Material Required Per Tree.

For very large apple trees requiring about 12 gals. per tree of liquid for the Codling Moth spray, I use an average of nearly 4 lbs., but found that 3 lbs. would, if properly applied, suffice. For an average size apple tree about 25 years of age, I should use at least 2 lbs. Plum, cherry and peach trees require anywhere from about 1/4 to 2 lbs. per tree. It requires a good deal of careful watchfulness to determine how much to use. A careless man may use 100 lbs. in a few minutes, where one-quarter the amount would have been sufficient.

Need of Care in Applying the Dust.

I found that to cover either a large or small tree thoroughly with the minimum loss of material required much quickness of movement and constant watchfulness. It is no job for a lazy or an indifferent man. As a rule the best method was to move the outlet pipe up and down quickly, and not to drive so close to the tree that the branches would be in the way. This, however, often had to be varied for a sudden gust of wind from time to time would carry the dust away from the desired direction. This necessitated a different stroke to cover the missed area. Sometimes too, the branches were too close to spray them except by shooting the dust back quickly when the wagon had passed. One would be very tired after a hard day of careful dusting of large trees.

There is very little danger to the operator from the dust, but it is expedient to use goggles.

Comparison of Time Required for Dusting vs. the Usual Method of Spraying With a Power Machine.

The dusting method is very much quicker than the other method. It took me an average of 1½ hours to spray both sides of 92 very large apple trees. With a power outfit and liquid spray applying 960 gals. per day, it would have taken at least 12 hours to do the work as thoroughly. This means that on such trees the dust spray was eight times the more rapid. On smaller trees, such as plums or cherries, which with a liquid outfit may be well sprayed as the horses move slowly but continuously along, the advantage in saving of time would not be great were it not that it takes a good while to fill up the tank with liquid, whereas it requires only a minute or two to fill the hopper with dust. On these small trees the dust method would probably be from two to four times as rapid as the liquid.

Comparison of Cost on Large Trees.

The following data for the large apple trees sprayed by us give what I believe to be a fairly accurate estimate of the cost of each kind of spraying where there are no delays of any kind, and where both outfits are working well in every way.

Cost of Dusting 92 Large Apple Trees Using 3 lbs. per Tree.

92 large apple trees at 3 lbs. each = 276 lbs. material at 6½c.	$17.94
Gasoline at 35c. per gal.	.15
Oil	.04
2 men at 20c. per hour, for 1½ hours	.60
1 team at 30c. per hour, for 1½ hours	.45
Total cost for 92 trees	$19.18
Average cost per tree	20.8c.

Cost of Spraying 51 Large Trees with Lime-Sulphur and Arsenate of Lead.

612 gals. dilute lime-sulphur (strength 1.008 sp. gr) = 16½ gals. commercial lime-sulphur at 15c. a gal.	$2 46
30½ lbs. arsenate of lead at 11c.	3 36
Gasoline	60
Oil	15
3 men for 6⅜ hours at 20c.	3 82
1 team for 6⅜ hours at 30c.	1 91
Total cost for 51 trees	$12 30
Average cost per tree	24.1c.
Average cost for dusting	20.8c.
Balance per tree in favour of dust	3.3c.

COMPARISON OF COST ON LARGE, SWEET CHERRY TREES.

Cost of Dusting 55 Large Trees.

100 lbs. dust at 6½c. per lb.	$6 50
Gasoline	05
Oil	20
2 men ½ hour at 20c.	20
1 team ½ hour at 30c.	15
Total cost of 55 trees	$6 92
Average cost per tree	12.6c.

Cost of Spraying 45 Trees with Lime-Sulphur and Arsenate of Lead.

160 gals. lime-sulphur (strength 1.008) = approximately 4⅓ gals. commercial lime-sulphur at 15c.	$0 65
10 lbs. arsenate of lead at 11c.	1 10
3 men, 1½ hours at 20c.	90
I team, 1½ hours at 30c.	45
Gasoline	15
Oil	05
Total cost for 45 trees	$3 30
Average cost per tree	7.3c.
Average cost for dust per tree	12.6c.
Balance in favour of liquid per tree	5.3c.

The balance in favour of the liquid would be still greater on small trees taking less material. If, however, the arsenate of lead were omitted the dust price would fall from 12.6c to 6c and the liquid from 7.3c to 5c, leaving the liquid still the cheaper.

One must not forget that all the above figures are based on the assumption that the outfit used for the liquid spray was a power one, applying 960 gals. per day of 10 hours, whereas many of our fruit-growers still use the hand pumps, which take double the amount of time, and would thus increase the cost in comparison with the dusting, though the initial difference in price of the two outfits would offset much of this.

Experiments on Large Apple Trees.

The orchard chosen for the experiments consisted of 162 very large trees almost any one of which was capable of bearing 10 barrels and upwards of fruit. The varieties were Baldwin, Greening, Golden Russet, Spy, Yellow Harvest, Astrachan, Gravenstein and Twenty-ounce Pippin. The orchard was in a neglected condition, and had not been sprayed for years. All the trees were infested with San José Scale, some of them badly. Codling Moth abounded in this and other unsprayed or poorly sprayed orchards of the district, and as the trees extended up to the base of the so-called Mountain, which was covered with uncared for apple, pear, plum and cherry trees, and also with many shrubs and weeds, the Plum Curculio was more abundant here than in most orchards. The leaves on the ground in spring, as examined by Prof. Howitt and myself, showed great numbers of the perithecia of the Apple Scab fungus.

Before the spraying, the owner of the orchard pruned the trees moderately well, and scraped off the rough bark. Then in order to give the different substances used a fair chance, we sprayed the whole orchard heavily for San José Scale with lime-sulphur, strength 1.035 except that soluble sulphur was used on 19 trees (strength 12½ lbs. to 40 gals.). About half the dust plot was sprayed for scale before the buds began to burst, the remainder and most of the liquid plots as or just after the buds burst. Buds began to open May 2nd. All plots were finished by May 5th. The spraying for the scale gave satisfactory results on all except six trees which, owing to their situation, could not be thoroughly treated. Out of the total of 162 trees, 92 which formed a block by themselves east of the house were chosen for the dust test, and the remaining 70 were used for the liquid sprays. Of these 70 we chose four central rows containing the 19 trees mentioned above for a comparative test with soluble sulphur and calcium arsenate. The rest (51 trees) were treated with lime-sulphur and paste arsenate of lead.

The Dusted Plot (92 trees).

The trees were each dusted twice, the work being thoroughly done on both occasions. On August 22nd, 61 trees were redusted on one side only, but as this partial application had no visible effect on the trees compared with the remainder either upon insects or diseases, it need not be considered.

The first dust application was just as the blossom buds were ready to burst, May 19th and 20th. I delayed it just as long as I could and until a few blossoms had actually opened. The dust, therefore, had an excellent opportunity to get on the base or receptacle of the blossom and protect it against early infection with Scab.

The second application was soon after the blossoms fell. One side of the trees was dusted June 3rd, the other June 6th. The calyces were beginning to close at the latter date, but were not too far advanced for best results.

The Lime-Sulphur and Arsenate of Lead Plot (51 trees).

The first application after the leaves opened was, as in the case of the dust, given just before the blossoms opened, one side of the trees being done on May 15th, and the other on May 20th. The lime-sulphur was used at the strength of 1.010 sp. gr. and the arsenate of lead (paste) at 2½ lbs. to 40 gals. of diluted lime-sulphur.

The second application was given soon after the blossoms fell, one side of the trees being done on June 1st, the other on June 3rd. The lime-sulphur was used at the strength of 1.008 sp. gr. and the arsenate of lead (paste) at 2 lbs. to 40 gals. of diluted lime-sulphur.

The Soluble-Sulphur and Calcium Arsenate Plot (19 trees).

The first application was just before the blossoms burst, one side May 17th, the other May 20th. Soluble-sulphur 1½ lbs. and calcium arsenate (powder) 1-2/3 lbs. to 40 gals. of water were used.

The second application was just after the blossoms fell, on June 3rd, both sides being sprayed the same day. The soluble-sulphur was used at 1¼ lbs. and calcium arsenate at 1⅖ lbs. to 40 gals. of water.

Note.—In each plot it will be observed that including the early application for San José Scale, only three sprayings were given, except that in the dust plot 61 trees were dusted from only one side in August.

Treatment of Soil on the Plots.

No part of the orchard received any fertilizer. The dusted part had rich soil and was left in sod, in fact two cows pastured on it for a couple of weeks while the apples were small. Later the weeds were mown down. The liquid sprayed part had poorer soil, hence the owner on our advice ploughed and cultivated it to give the trees a fair chance.

Check Trees.

As check trees we relied upon the uncared for trees on the mountain side, on neighboring orchards and on a row of ten trees consisting of R. I. Greening, Baldwin, Spy and Gravenstein, belonging to a neighbor, and in the same relative position to the mountain as our own orchard. These ten trees we dusted before the buds burst with soluble-sulphur dust and hydrated lime to see the effect upon San José Scale. Somewhat unfortunately for us, perhaps, the owner seeing the excellent amount of bloom gave the trees a moderate spraying with lime-sulphur and arsenate of lead soon after the blossoms fell.

Results.

1. *Effect on the Foliage.*—We may mention here that on neither apples, cherries, plums, peaches nor grapes did the dust, so far as we could judge, cause any burning or injury. On the apple trees the dusted leaves were much superior to those on the liquid sprayed plots, being more glossy and more perfectly expanded than those that were sprayed with lime-sulphur and arsenate of lead. The soluble-

sulphur and calcium arsenate burned the foliage very severely, causing fully half of the leaves to drop and leaving dead spots on most of the remainder.

2. *Effect on Apple Scab.*—On each of the plots apple scab was well controlled. The liquid sprayed parts were a little better than the dusted, but not much. There is no doubt that fully 99 per cent. of the fruit in the lime-sulphur and arsenate of lead plot was free from scab. The soluble-sulphur and calcium arsenate plot gave at least 98 per cent. free and the dusted part averaged as nearly as we could judge 97 per cent., though one Greening tree situated at the extreme north-east corner where it was difficult to dust it thoroughly had about 10 per cent. scab, and a Spy tree possibly 8 per cent. A count at picking time of 1,500 apples on a dusted Yellow Harvest, a variety very subject to scab, gave 51 scabby apples, or 3.4 per cent., leaving 96.6 per cent. free of scab. A count of 400 Red Astrachans, nearly all there were, gave 12 scabby = 4 per cent., leaving 96 per cent. clean.

Neither my assistant nor I could be present at picking time owing to College duties, but we examined carefully at the end of August every Baldwin, Greening, Russet and Spy tree that had fruit on it on all the plots, and made a note of the number of scabby fruits on each. No further development of scab has taken place since. The results are shown in the following table.

TABLE SHOWING THE NUMBER OF SCABBY FRUITS AS SEEN ON THE TREES AT THE END OF AUGUST.

Variety	No. of Trees	Mixture used	No. of Scabby Fruits
R. I. Greening	12	Dust	120 (55 of these on one tree)
" "	12	Li-sul and arsenate of lead	10
" "	10	Sol-sul and calcium arsenate	38
Baldwin	61	Dust	102
"	10	Sol-sul and arsenate of lead	1
"	6	Sol-sul and calcium arsenate	3
Golden Russet	3	Dust	4
" "	2	Li-sul and arsenate of lead	1
" "	2	Sol-sul and calcium arsenate	2
Spy	1	Dust	50
"	Part of 1 tree a graft	Li-sul and arsenate of lead	0

These figures do not of course represent the total number of scabby fruit, but we believe that they do represent at least half the total number. Since writing the above Mr. W. E. Biggar, the Provincial Fruit Pests Inspector, has counted many bushels of the dusted fruit picked from various trees and corroborates my estimate of the percentage of clean fruit. The dusted part of the orchard I estimated to have over 300 barrels of a crop, the other about 85. Some trees were heavily loaded, others very lightly.

Checks.—On the mountain side Baldwin trees averaged approximately 50 per cent. scabby fruit, Golden Russets approximately 10 per cent. There were no Greenings or Spys. On the row of ten trees on the adjoining farm, where the trees received the Codling Moth spray, but not the one just before bloom, the Greenings and Spys averaged from 25 to 30 per cent. scabby fruit, and the Gravenstein 50 per cent. or upwards, while a heavily loaded Gravenstein in the dusted plot averaged 5 per cent. scab, but it should be mentioned that this tree, owing to its blooming earlier than the other trees of the orchard, had been sprayed with lime-sulphur three days before it was dusted. (The dust had not arrived yet).

An examination of many trees throughout the district led us to estimate that in general unsprayed Spy trees were about 60 per cent. infested with Scab, Greenings and Baldwins about 40 per cent. These figures show that in spite of the wet season, the scab fungus was not specially abundant in the Grimsby district, and therefore much better results were obtained by spraying there than would likely have been obtained in almost any other part of the Province. The average unsprayed orchard elsewhere would show 95 per cent. of scabby apples.

Another view of the dusting machine at work.

What has been said shows that dusting as done by me under Grimsby weather conditions, gave satisfactory results on Apple Scab, but I fear I could not have obtained nearly so good results in most, or perhaps, in any other part of the Province. Mr. Kydd, of the Fruit Branch, Toronto, who is just as thorough an experimenter as I am, did not secure nearly so good results from the dust spray as from the lime-sulphur liquid spray. The contrast is a striking one.

TABLE SHOWING RESULTS OBTAINED BY MR. W. F. KYDD.

Place	Variety	Mixture used	No. of applications	Scab-free Apples
Paris............	Spy	Lime-sulphur and arsenate of lead....................	4	95
"	"	Dust (sulphur and arsenate of lead, powder)	4	28
Wellington	"	Lime-sulphur and arsenate of lead....................	4	83
"	"	Dust (sulphur and arsenate of lead, powder)	4	24

The unsatisfactory results obtained by Mr. Kydd and, as I am informed, by many other men in the United States, show that it would be very unwise to recommend unreservedly the dust spray as a substitute for the lime-sulphur and arsenate of lead.

As weather conditions are the chief factors determining the amount of scab, I have inserted here the weather record from April 23rd to June 25th, during which time all the scab infection of the season took place.

	A.M.	P.M.	Temperatures		
			Maximum	Minimum	Precp'n.
April 23	Dull	Slight rain, dull	49	39	
24	Cloudy	Sunny and warmer	51	40	$\frac{3}{4}$"
25	Cloudy	Cloudy, with little rain towards night	51	42	
26	Dull to clearing	Bright, distant thunder	57	41	
27	Fairly bright	Mostly bright, turning colder	52	42	
28	Early fog to 8 a.m., bright	Warm and bright	59	39	
29	Beautiful and bright	Sunny and warm	60	42	
30	Bright and pleasant	Mostly bright with few clouds	71	42	
May 1	Cloudy, with small amount of fog	Bright and windy, S.-W., light showers at night	72	45	
2	Bright and cool	Mostly bright, North breeze, apple leaf buds beginning to open	72	39	.10
3	Rain and cool, N.	Dull, very little rain and cool	72	37	.35
4	Bright and fair	Bright, W.	72	41	
5	Early morning bright, cloudy about 9 a.m., Strong S. winds	Some clouds	72	47	
6	Fairly bright, few clouds	Some clouds, but sunny at times	72	42	.20
7	Fine, warm and clear	Fine, warm and clear.	72.5	30	
8	Rain, clearing at 10 a.m.	Bright and breezy	70	43	.19
9	Bright and cool, W.	Bright, breezy, cool, W.	61	44	
10	Rain until 12 a.m.	Very little rain, mostly cloudy	70	45	.23
11	Bright and breezy	Bright and very windy, W.	68	29	
12	Bright and cool	Bright, breezy and slightly cool.	59	41	
13	Bright, cool breeze, E.	Bright and warm	66	37	
14	Dull and cool	Rain all p.m.	65	43	.22
15	Rain 5 to 8 a.m., turning brighter	Dull, misty, damp	50	41	.97
16	Very light showers in early morning	Rain all p.m., moderately heavy	56	43	.14
17	Cold, cloudy and damp,	Cloudy, colder and windy	56	45	.07
18	Cloudy, windy & chilly.	Cloudy, windy & chilly	55	40	
19	Cleared about 8 a.m.	Clear	62	40	.11
20	Bright and fairly warm	Bright and fairly warm	60	38	
21	Bright and fairly warm	Bright, turning cloudy.	60	39	

	A.M.	P.M.	Temperatures		
			Maximum	Minimum	Precp'n.
22	Rain	Rain	58	43	.44
23	Dull till 9 a.m.	Clear and warm	75	45	.13
24	Clear and warm	Clear and warm	78	49	
25	Warm, few clouds	Warm, few clouds	72	56	
26	Bright and warm	Bright and warm	63	46	
27	Heavy thunderstorm, 5 to 8 a.m.	mostly cloudy	62	44	.42
28	Bright and clear	Bright and clear	76	46	
29	Bright and clear	Bright and clear, began to rain at 6 p.m.	60	51	
30	Heavy rain during night, cloudy	Mostly hot and bright.	62	51	1.36
31	Clear and cool	Clear and cool	64	45	
June 1	Clear and fine	Clear and fine	65	41	
2	Rain at 10 a.m.	Rain, heavy	69	44	1.43
3	Clearing	Fine	68	51.5	.10
4	Bright	Mostly bright	70	51	
5	Bright	Bright	70	54	.16
6	Fair	Fair, E.	61	47	
7	Cloudy	Heavy rain	64	48.5	.12
8	Dull and cool	Rain and dull	61	52	.17
9	Sunny	Dull with showers, rain at night	55	44	.53
10	Cloudy	Dull	58.5	50	.01
11	Fair	Fair	60	46	.03
12	Clear and fine	Clear and fine	73	48	
13	Clear and hot	Clear and hot	80	54	
14	Clear and warm	Clear and warm	79	56	
15	Rather dull	Rain 1.30 to 3.30 p.m.	72.5	60	.08
16	Cloudy	Cloudy, cooler at night	66.5	50	
17	Fine and warm	Fine and warm	70	50	
18	Dull with some rain	Dull with some rain	62	56	.66
19	Dull with some rain	Clearing	64	49	.29
20	Cloudy and cool	Cloudy and cool	58	49	
21	Rain, clearing at 11 a.m.	Clear	61.5	47	.16
22	Bright	Bright	69	46	
23	Fair	Fair	66	47	
24	Fair	Heavy rain, 4 to 5 p.m.	65	56	.83
25	....	....	68	55	
	Fine dry spell began here.				

3. *Effect on Leaf-Spot.*—Experiments performed by Mr. W. F. Kydd, of the Horticultural Branch, in an orchard at Wellington this year, showed that the dormant spray, or the spray as the buds are bursting, has much value in the control of leaf-spot, and hence in our plots the spray for the San José Scale doubtless helped. In the dusted parts we saw no leaf-spot. The lime-sulphur part was also almost entirely free, and any slight amount there was may have been due not to the fungus, but to burning by the mixture. On the soluble-sulphur and calcium arsenate plot, the spray injury was so great as to make it impossible to determine anything about this disease. On unsprayed trees there was a considerable amount of leaf-spot, but we did not estimate the percentage, as this disease is not of much importance in Ontario.

4. *Codling Moth.*—On all the plots the Codling Moth was well controlled, especially when we consider that the orchard had been neglected for several years. Only two apples in the whole orchard were found in which the worms had entered

the calyx end. There were a number of side worms, but not so many as we expected. My estimate made the first week in October for the total of the fruit both on the trees and the ground was that it ran somewhere between 5 and 10 per cent., with an average of probably 8 per cent. There was very little difference between the different plots.

Check trees and poorly sprayed orchards nearby varied from 30 per cent. to 80 per cent. wormy with about 75 per cent. of these entering at the calyx end. It is quite clear, therefore, that the dusting will control the Codling Moth satisfactorily.

5. *The Plum Curculio.*—With the exception of one or two rows of trees bordering upon the mountain, and in some thickets along one side of the dusted part of the orchard Curculio injuries were scarce. Even on the worst infested trees much fewer apples dropped or were deformed than I had expected. The vigorous condition of the trees may have had something to do with this. The liquid sprayed part was freest from Curculio injuries, but owing to a difference in surroundings it is impossible to determine whether the spraying was the cause. The check trees were much worse infested, but in most cases their surroundings were more favorable for these insects.

6. *Other Biting Insects.*—All the plots were to some extent infested with Fall Cankerworms, Bud-moth, Case-bearers and Lesser Apple-worms. The percentage of these killed could not with the time at our disposal be determined; there was, however, not much difference in the amount of injury done in the various plots.

Results on Sweet Cherries, Plums, Peaches and Grapes.

As very few of the members of our Society, or of the others present are specially interested in plant diseases, I shall not go into details of the experiments with the dust on plums, peaches, cherries and grapes, but merely state that on sweet cherries, which are much more subject to rot than sour, the dust spray gave about equally as good results as either lime-sulphur or Bordeaux mixture, and that all these plots were much cleaner than the check. On plums (Lombard variety) the rot was controlled. On the checks of the same variety there was considerable rot. On peaches there was so little rot even on the unsprayed trees that no conclusions could be drawn.

On Roger varieties of grapes, which are of course specially subject to Powdery Mildew, this disease was thoroughly controlled, whereas on checks there was considerable of the disease both on the leaves and berries. The season was, however, not specially favorable for Mildew, and there was almost no Black Rot.

Conclusions.

My results with the dust spray apply only to Grimsby district and Grimsby weather conditions. I have some doubt whether in other districts with the closest study of the weather and a good knowledge of the life history of the apple scab fungus, I could have so chosen the dates and numbers of application as to control the scab on apples. It is certain that in some places the ordinary recommendations would have had to be modified.

A great drawback to the dust method is that we have not yet found a really satisfactory powder that will control scale insects or other sucking insects. Finely ground soluble-sulphur mixed with hydrated lime gave me fairly good results on San José Scale, but there is almost sure to be trouble with this mixture, because of its tendency to absorb moisture and then harden, thus clogging the slit in the hopper and the blast passage. It seems necessary also to apply it to the trees when they are moist. Another defect is that the dust does not adhere nearly so well as the liquid lime-sulphur especially on glossy fruits and foliage. This is somewhat counteracted by the fact that one can use the dust on fruit a short time before picking without fear of staining, but cannot do this with the liquid.

I believe that some tests on Pear Psylla at Burlington, probably with hydrated lime, have proved successful.

I am also told that some tests in New York, possibly with tobacco dust, promise well against aphids.

Should the hopes of the advocates of the dusting method of spraying be realized we can see a great field of usefulness for it not only on fruit trees, especially large fruit trees, but also on valuable shade trees in cities and parks. It should be a great boon in the control of the Elm Leaf-beetle, Tussock Moth, Tent Caterpillars, and many other biting insects. Leaf diseases on shade trees could also in some cases be controlled. I believe it has already been tested on the Leaf-spot or Leaf-blight of the horse chestnut.

It should not be at all difficult to improve the outfit so that even the tallest trees could easily be reached.

Father Leopold: May I ask Prof. Caesar what is the cost of your spraying outfit; that is, for the blower alone?

Prof. Caesar: The total cost for engine, blower and hopper was $260; it will be a little higher this next year, probably $275. Probably $150 or $140 would be the price for the blower and the hopper; I think you could get the engine for about $100.

A Member: What horse-power engine did you use?

Prof. Caesar: Two and one-half horse-power.

Prof. Brittain: Did you have anyone here contract lead poisoning from the use of that dust mixture?

Prof. Caesar: There would be a possibility of injury from the dust if you were reckless and tried to spray against the breeze, but the spraying should always be done, if possible, on a calm day, and you should spray at right angles to any little wind there may be.

Prof. Brittain: I have been told of one experimenter who contracted a very bad case of lead poisoning from using the dust spray.

Prof. Caesar: I sprayed a good many days this year, and I consider that the danger from the dust amounts to practically nothing both to the eyes and to the lungs. I should say, however, that I wore goggles part of the time.

Prof. Brittain: I should think that the great weakness with this dust spray would be that it does not control sucking insects successfully. Where scale insects and sucking insects like Capsids are very abundant, that would be a very serious drawback.

Prof. Caesar: In a large part of Ontario we do not need to spray for Aphids and our Capsids, though they are bad in a few orchards, are very seldom bad enough to necessitate spraying for them.

Mr. Dearness: I understood Prof. Caesar to say that the spraying for Scab was done at an exceptionally favourable time, and I wish to ask what time that was.

Prof. Caesar: The Apple Scab is of course one of the interesting things from the standpoint of plant pathology. I found in our experiments—and I have been spraying for Apple Scab for eight years—that the great danger period for Apple Scab is either the period from the time the blossoms begin to burst on to the time when the apples are about the size of a good marble (about half an inch in diameter), or from about the middle of August to the time of picking. The first period I have mentioned you will find will be the one for about five seasons out of six. I have never sprayed more than three times. If you have your orchard perfectly clean for the first period, it takes a long time for the scab fungus to become abundant again that year.

MR. DEARNESS: In regard to the scattering of the summer spores, do you find this to be about the first of July? This fungus has its first period of infection, of course, directly from the over-wintering spores.

PROF. CAESAR: I may say in regard to the times of infection that the first infection comes on the leaves nearly always, and it comes from the ascospores on the leaves on the ground. As soon as those develop to fructification—which is in about two weeks usually—you have then what you call the summer spores. You can never be sure of the date; it depends upon the weather conditions.

MR. BIGGAR: Has the dormant spray anything to do with the control of Scab?

PROF. CAESAR: Some seasons it has, and I think probably in our case it had because we gave a very heavy application for San José Scale, and everything on the ground was drenched.

GENERAL NOTES ON APHIDES WHICH OCCUR ON APPLE TREES.

WILLIAM A. ROSS, VINELAND STATION.

The purpose of this paper is to present brief notes on ten species of aphides which have been taken on the apple in Ontario. Four of the insects, viz., *Aphis pomi, Aphis malifoliæ, Aphis avenæ* and *Eriosoma lanigera*, are noxious; the others, viz: *Aphis bakeri, Aphis brevis, Aphis* sp. (near *gossypii*), *Macrosiphum solanifolii, Myzus persicæ* and *Macrosiphum pelargonii* (?) are, so far as our observations have gone, of little or no economic importance.

THE GREEN APPLE APHIS (*Aphis pomi* De Geer). This species is the most troublesome plant-louse with which Ontario orchardists and nurserymen have to contend. It attacks, curls and sometimes kills the foliage, and in cases of severe infestation, it may even feed on the fruit. It has a very pronounced predilection for succulent shoots and water sprouts, and in fact, if not provided with these delicacies, it will not thrive and multiply rapidly. The aphis produces a generous supply of honey-dew, and because of this it is well patronized by ants. The black fungus which develops in this honey-dew gives the foliage, twigs and sometimes the fruit of an infested tree a sooty and very unsightly appearance.

The eggs of *Aphis pomi* hatch in April when the buds of apple trees are swelling and commencing to burst. The stem-mothers, *i.e.*, the aphides which hatch from the eggs, reach maturity, and commence reproducing in somewhat less than three weeks. During the next month or so each female which survives all the perils to which plant-lice are subject, gives birth on an average to 70 young (74 was the average obtained from 18 individuals in our 1915 experiments). The progeny of the stem-mothers for the most part develop in from two to three weeks into apterous viviparæ. A number of this generation, however, and a still larger number of the third generation become alate and migrate to other apple trees. The third generation is succeeded by brood after brood of wingless and winged viviparæ until by the close of the season as many as fourteen or fifteen generations may have arisen. In the fall, apterous oviparæ and apterous males put in an appearance. The sexes mate and the females deposit their eggs on twigs and water sprouts.

THE ROSY APPLE APHIS (*Aphis malifoliæ* Fitch). Like many another rogue, this insect has been living amongst us under a false name. In a recent letter, Mr. A. C. Baker, of the U. S. Bureau of Entomology, informs me that its correct appellation is *Aphis malifoliæ* Fitch, and not *A. sorbi,* nor yet the more recent *A. kochii.* It appears that Kaltenbach's *A. sorbi* from Sorbus and Schouteden's *kochii* (*pyri* Koch) from apple are quite distinct from our rosy aphis.

This species is often very destructive in apple orchards. It has a marked preference for, and confines its work largely to the lower, inner and shady portions of the trees. It not only curls and destroys foliage, but by feeding on the leaves adjacent to fruit clusters, and on the fruit itself, it produces bunches of deformed, dwarfed and unmarketable apples. The rosy aphis is essentially a pest of the bearing orchard. So far as our observations have gone, it seldom occurs on, and is never injurious to nursery stock. This partial immunity is largely due, I think, to the fact that young trees do not afford the aphis—a shade loving insect—suitable shady quarters.

The eggs of this species hatch about the same time as those of *Aphis pomi.* The stem-mothers become mature in twenty days or so, and begin to give birth to young at an alarming rate. According to our 1915 experiments each female may produce from 67 to 260 young (data obtained from 12 individuals). The second generation resemble their mothers to a great extent in rate of development, in fecundity and in the absence of wings. During a period extending from mid-June to the latter part of July, the third generation lice acquire wings and migrate to and establish colonies on *Plantago lanceolata,* and *P. major,* chiefly the former. (It should be mentioned here that a small percentage of the migrants may belong to the second and fourth generations). On the secondary food plants, the aphides breed rapidly, and as many as eleven broods may arise. In the autumn alate sexuparæ and alate males appear and fly back to the apple. The sexuparæ give birth to young, which in three or four weeks' time became mature apterous oviparæ. After being fertilized by the males the oviparæ lay their eggs on twigs and branches—in crevices and around the base of buds.

THE OAT APHIS (*Aphis avenæ* Fabricius). In the spring, this aphid, as a general rule, is much more abundant than the two preceding species, but as it only remains on the apple for a comparatively short time, it is not so injurious as they are. It attacks the foliage, the blossom stems, and sometimes the petals.

The eggs of the oat aphis commence to hatch several days before those of *Aphis pomi* and *Aphis malifoliæ.* The stem-mothers develop rapidly, and most of them are mature and are reproducing by the time the apple blossoms are showing pink. In the matter of reproductive capacity, they are very much like the stem-mothers of *A. pomi*—each female may give birth on an average to 76 young (average obtained from 9 individuals, 1915 experiments). The majority of the second and the whole of the third generation become alate, and during a period extending from mid-May to mid-June, migrate to their summer food plants—various grains and grasses. On these hosts, the aphides feed and breed until fall, at which time the return migration to apple takes place. As in the case of *malifoliæ,* the males are produced on the secondary, and the sexual females on the primary host.

THE WOOLLY APHIS OF THE APPLE (*Eriosoma lanigera* Hausmann). This cosmopolitan bark-feeding aphid is a very destructive apple pest in certain countries, *e.g.*, The United States, South Africa and England; however, in Ontario, fortunately for everyone concerned, it is only of minor importance. It is present in all our apple growing sections—on orchard and nursery tree, but it is seldom abundant and injurious enough to cause any alarm, or to warrant the adoption of remedial measures.

During the summer, colonies of flocculent apterous viviparæ occur on the twigs and water sprouts and around pruning wounds on the limbs and trunk. Rarely the lice are also found feeding on the roots of nursery stock, where they cause the formation of knotty enlargements. (Personally, I have never found the root-inhabiting aphides in Ontario. Nurserymen, however, inform me that they occasionally see them.) In September, alate forms appear and, according to Dr. E. Patch, of Maine, migrate to the American Elm, where they give birth to the sexes—minute wingless creatures. After mating, the females lay their eggs in crevices on the bark. The migration back to apple takes place in June of the following year.

The Clover Aphis (*Aphis bakeri* Cowan). This plant-louse does not appear to be common in Ontario. Personally, I have only taken it thrice on apple. In Colorado, however, *A. bakeri,* according to Gillette and Taylor, "ranks next to the green apple aphis in numbers as a leaf infesting species of the apple."

As the name suggests, the clover aphis migrates from apple to clover.

Ontario collections: Migrants—Arkona, 6.10.16; Migrants and young—Vineland, 14.10.16 and 17.10.16.

The Long-beaked Clover Aphis (*Aphis brevis* Sanderson). This insect is essentially a hawthorn species, and it only occasionally occurs on apple. I have made but three collections of it from the latter host.

Like the preceding species, it spends the summer on clovers.

Ontario collections: Migrants and males—Vineland 3.11.15; Males—Arkona, 6.10.16; Migrants, males and immature oviparæ, Vineland 17.10.16.

Aphis sp. (*near gossypii*). In June, 1915, Mr. Howard Curran, my assistant, collected specimens of an unfamiliar, pale green aphid from an old apple tree growing on the O.A.C. campus at Guelph. According to Mr. Curran, the plant-louse was quite abundant at the time the collection was made.

This aphid is either a new species closely allied to *Aphis gossypii,* or it is a variety of the melon aphis. It differs from typical *A. gossypii* in having sensoria on antennal joint IV and sometimes on V, but whether this difference is of specific value I am at present not prepared to say. Only a careful study of the antennal variations of *A. gossypii* from different hosts will settle this point.

The following table affords a comparison between *Aphis* sp. and *Aphis gossypii* in the matter of antennal sensoria, and it likewise indicates the variability of the melon aphis.

Laboratory No.	Aphid	Sensoria on III	Sensoria on IV	Sensoria on V
6287.1......	Aphis sp..............................	7–11	3–6	0-2 and the sub-apical
——	Aphis gossypii as described by Pergande	5–7	None	Sub-apical
6287.4......	Aphis gossypii from cucumber	5–8	None	Sub-apical
6305........	Aphis gossypii from begonia............	6–8	0–1	Sub-apical
6294.3......	Aphis gossypii bred on apple	7–10	0–2	Sub-apical
6405........	Aphis gossypii bred on apple	8–11	0–2	Sub-apical

THE POTATO APHIS (*Macrosiphum solanifolii* Ashmead). Dr. E. Patch points out in her recent publication on the Pink and Green Aphis of the Potato, that this insect has a very varied dietary ranging from grasses to composites. In view of this, it is not at all surprising that the aphid sometimes feeds on the apple. I have two Ontario collections of it from this host. Mr. A. C. Baker, of the U. S. Bureau of Entomology, also records its occurrence on apple at Washington, D.C.

Ontario collections: Alatæ, apterous viviparæ and nymphs—Guelph, 20.6.15; Alate form—Vineland, Ont., 3.6.16.

THE PEACH APHIS (*Myzus persicæ* Sulzer). This very common general feeder has frequently been found feeding on apple seedlings growing in the Horticultural Experimental Station greenhouses at Vineland Station, Ont. Fall migrants and their young have also been taken on orchard trees. (Vineland, 1916).

THE GERANIUM APHIS (*Macrosiphum pelargonii* Kalt). (?) Small colonies of a large green *Macrosiphum* were frequently found this spring on some seedling apples which we had growing in our greenhouse insectary at Vineland.

I cannot be positive about the identity of this louse, but I think it is *Macrosphum pelargonii*. It differs from typical *pelargonii* in having the abdomen of the alate form ornamented with five transverse, broken, dark bands, but it is very questionable if this slight difference has any specific significance.

PROF. BRITTAIN: The study of aphids in Nova Scotia has been only a minor problem with us. Our results have been very much the same as those of Mr. Ross, with the exception of course, of the differences due to climate. You have about 13 or 14 generations of *pomi;* we never have more than 8 or 9. As for *avenæ,* I never saw it until this year, when it appeared in rather large numbers. This spring I could not find a specimen of *pomi,* and if we had not kept eggs over from last year we would not have had any at all to work with. Late in the summer, however, winged forms began to appear in numbers and soon the insect was quite numerous. *Malifoliæ,* with us, also has 8 or 9 generations per year. The greater number of the 3rd generation are migrants. A small proportion, under certain conditions, remain wingless and continue breeding on the apple throughout the season, but their number is usually negligible.

In 1915 a number of those which we kept in the insectary breeding upon the apple became winged in the 7th generation. These winged forms were the true spring migrants, though it was September.

In each generation we transferred some young aphids from the plantains back to apples, and vice versa. Hundreds of such experiments gave negative results; but in one case young from an ordinary wingless female of the 3rd generation on the apple, came to maturity on the plantain and became typical plantain forms.

In studying the natural control of these aphids we found that click beetles preyed upon them and sometimes destroyed large numbers.

DR. HOWARD: What species?

PROF. BRITTAIN: *Dalopius lateralis.*

PROF. CAESAR: This comes right down to the matter that a number of us are so much interested in, that is the control. Mr. Ross spoke about the different dates of eggs hatching of the different species, and I should like to ask him whether all the eggs of all the important species are hatched by the time the buds have begun to burst.

Mr. Ross: Judging from our results in the orchard the vast majority of the eggs hatch before the buds burst. This year we sprayed as usual just before the buds burst and while they were still compact, and we destroyed practically 100 per cent. of the aphids. As we did not see any aphids on the sprayed trees afterwards it led me to think that all or practically all the eggs had hatched before the buds burst. In our insectary experiments, however, the eggs still continued to hatch after the buds burst.

Prof. Brittain: I came across a very curious thing in British Columbia. I found a small number of aphids hatching when the snow was still on the ground in March, on days when the sun was hot. In Nova Scotia I have found them hatching outdoors until about the time the blossoms burst, though the vast majority of them, as Mr. Ross says, come out by the time the leaf buds burst.

Mr. Biggar: Can you control the aphids in the greenhouse by spraying?

Mr. Ross: Yes, by using a nicotine extract, either by fumigating or by spraying.

Prof. Caesar: Prof. Parrott has just come in and I believe is very much interested in work with aphids. I wonder if he has any information about the time of hatching of the eggs in relation to the different sprays.

Prof. Parrott: One of my objects in coming to these meetings was to hear some of the papers given this afternoon, but I appear to have arrived too late to hear some of them. I am very much interested in the discussion of what I take to be the paper dealing with Apple Aphids. I agree with what was said by one speaker that by the time that the buds have broken and the leaves of the more advanced buds are out from ¼ to ½ inch, the eggs of the three species, *pomi, sorbi* and *avenæ* have hatched. I make this statement with considerable assurance, because in two years' experience on one variety of apple we have been able to combat all three species, that is to eliminate the insects by drenching the trees.

Q.—What was that variety?

Prof. Parrott: Rome Beauty. As a matter of fact one of the papers that I want to present at the Association of Economic Entomologists is one dealing with the control of the Rosy Aphis, as a problem for the extension entomologist. I believe we can get as clean-cut results in spraying for *sorbi, avenæ* and *pomi* as for almost any of the common insects on fruit trees. In our work we use several combinations of spraying materials, but the one we are recommending is composed of lime-sulphur solution, using the stock material at the rate of 1 to 7 or 1 to 8 of water, if scale insects are on the trees, and then to 100 gallons of the lime-sulphur we add ¾ pint of nicotine sulphate. This is the spray we use on the Station grounds.

Prof. Caesar: Your 100 gallons are equal to about 80 gallons of the measure which we use.

Prof. Parrott: Yes, you use the imperial gallon measure. We have the San José Scale in nearly all the leading fruit growing sections of New York, and so we use the combination to combat the scale, apple scab and the rosy aphis. I don't know how the idea that one cannot rely on spraying at this time to combat the rosy aphis was so firmly established in the minds of some entomologists. I have been wondering if in breeding experiments by various workers, infested wood was in all cases obtained from identical situations. A miscellaneous assortment of infested wood, taken from trees subject to different conditions, might lead to wrong inferences as to the length of the incubation period. At Geneva, *Aphis avenæ* hatches first. As regards *pomi* and *sorbi* I don't think there is a great difference in time of hatching. I must admit that until this year we did not know the nymph of the first instar of *sorbi*, and the time of hatching was determined by spraying at different dates. This year we were able to recognize the nymphs of the first instar of sorbi, and now that their identities are established we may safely say that most of the nymphs of the three species are out by the time that the leaves of the more advanced buds are projecting from one-fourth to half an inch.

MR. BIGGAR: Which do you think would be more effective, concentrated or soluble sulphur?

PROF. PARROTT: I am unable to advise you as to the wisdom of combining nicotine sulphate with soluble sulphur. You doubtless know that soluble sulphur depends for its insecticidal and fungicidal properties upon polysulphides and sulphides of sodium while lime-sulphur depends on sulphides of calcium. In New York we do not recommend a combination of arsenate of lead and soluble sulphur because soluble arsenic is formed. Soluble sulphur can be supplied by itself for the control of San José Scale or Leaf Blister Mite or for the control of Leaf Curl. We take a great deal of pains in our recommendations that fruit growers and farmers should clearly understand that they should not use sodium sulphide in combination with either arsenate of lead or other arsenicals.

PROF. CAESAR: I have used calcium arsenate in combination with soluble sulphur and burned half the leaves off the trees. Is it not possible that your excellent results with the strong lime-sulphur (1 gallon to 8) and black leaf 40 on the aphids was due partly to the action of lime-sulphur on the eggs that were almost hatching?

PROF. PARROTT: Yes, that is possible for a small percentage of the eggs; and has already been suggested by the manufacturers of nicotine sulphate. However, now that we are able to recognize the nymphs of the first instar, both Mr. Lathrop and myself were able this year, by observation, as by experimental operations, to show that as far as Rome apples were concerned, *sorbi* had all hatched by the time we began spraying. Now had you asked me in 1915, as I have previously stated, I could not have spoken so definitely on this point because we did not know the nymphs in their first instar.

MR. ROSS: This spring we obtained excellent results in the control of *A. malifoliæ, A. pomi,* and *A. avenæ* in a twelve acre orchard near Vineland, but later on our work was somewhat spoiled by *pomi* migrants which flew from neighbouring apple trees into the orchard and reinfested the trees.

PROF. PARROTT: I may say in addition, that some of our associates in New York who have been somewhat reluctant to agree with us in some of our statements relative to *sorbi* are beginning to change their minds. After seeing the sprayed plants one could hardly draw conclusions very different from those I have presented. The problem for experimental workers now is to ascertain if it is profitable for the average grower to spray each spring in order to avoid losses by the rosy aphis.

DR. DEARNESS: I should like to ask Mr. Ross whether that migration season seems to hold in the case of the Rosy Aphis. Did I understand you right that the generation that comes from the Plantago is oviparous, that there is a migration of viviparæ to the Plantago, and then that there is a generation of oviparous from that and whether that seems to be necessary?

MR. ROSS: The alatæ which migrate from the apple to the plantain are viviparous, and their progeny are viviparous. The return migrants from Plantago to apple are likewise viviparous, but their progeny—the sexual females—are oviparous.

DR. DEARNESS: You think that the migration to the Plantain is necessary to that species?

MR. ROSS: I am not quite sure about that. We have been able to make *sorbi* complete its cycle on the apple. I have some sexual females on the apple at the present time that we obtained from colonies that were on the apple all year. Of course I have been breeding the aphids under insectary conditions.

DR. DEARNESS: Does it stimulate sexual development to be on the Plantago?

MR. ROSS: I do not know. The oviparous forms are given birth to by the migrants that fly back to the apple. In working with *avenæ* I was rather interested to find that I could not get that species to remain on apple even where I kept the specimens isolated, and I came to the conclusion that the migration instinct was much more strongly developed in this case than in the case of *malifoliæ.*

PROF. BRITTAIN: The important point is that a number of our farmers will have to spray for this green apple bug. We do no spraying for this insect until just before the blossoms open. Is it going to be necessary to spray for *malifoliæ* and make two separate sprayings for the green apple bug? One of the orchards in which we were spraying for this latter pest had quite a severe outbreak of *sorbi;* but we omitted that first spray. We find that when we spray to control the green apple bug we have to give an extraordinarily thorough application, and we found that such an application gave us a fair commercial control of *malifoliæ* as well, though we did not destroy all of them, for the leaves curl right around them and provide a fine protection.

Q.—What spray gave you the best results against *malifoliæ?*

PROF. BRITTAIN: At the time the small leaves were just about the size of a ten cent piece.

MR. ROSS: I should like to ask Prof. Parrott if he ever recommends that second spray when the blossoms are just showing pink for the aphids.

PROF. PARROTT: I do not, Mr. Ross; but if you study the literature on spraying for apple aphides you will find all sorts of recommendations. If in New York we deferred treatment until that time, a great many of the stem-mothers would be missed by the application, on account of the curled leaves. I thoroughly endorse what was just said, that farmers as a rule do not spray thoroughly enough to control green apple bug. Certainly they do not control *malifoliæ* or *sorbi* for the same reason, and that is without doubt one of the problems now before us. We should encourage spraying practices that are calculated to hold the aphides in check.

PROF. BRITTAIN: Spraying with nicotine is expensive. With us we frequently have to put on two applications, but if we had to put on three it would ruin us.

PROF. PARROTT: I think in your case it would be worth experimenting to determine if you can delay the spray.

PROF. BRITTAIN: In our work it is certain that we did not miss enough to pay us to put on a third application, but the work was done with great care.

PROF. CAESAR: We have sometimes omitted the first application, and for San José Scale waited until just as the pink was showing, yet obtained good results on the scale without appreciable injury to the foliage.

MR. WINN: Mr. Ross states that he has specimens of these aphides. I should like to know what method he takes of mounting or preserving such minute insects.

MR. ROSS: We use 70 per cent. alcohol for preserving aphides.

NOTE ON PHYSONOTA UNIPUNCTA (COLEOPTERA).

ALBERT F. WINN, WESTMOUNT, QUE.

In several parts of Mt. Royal Park, Montreal, there flourish large patches of a wild sunflower, *Helianthus decapetalus,* notably around the edges of the open area south and west of the toboggan slide, known as the "riding ring." This plant has long been known to local entomologists as the food of a species of Tortoise-beetle, and the early volumes of the *Canadian Entomologist** contain several articles by Caulfield and others relative to its habits and life-history.

Like most other insects, *Physonota unipuncta* has its years of abundance, and years when it seems to be wholly absent; but when common it is a most attractive beetle, resting quietly on the upper side of the leaves on a hot July day, its brilliant green and gold hues looking as if they belonged to a tropical insect. The ugly, soft, spiny larvæ with their forked tails recurved over the body and covered with remnants of cast off skins and excrement as is usual among the Cassidini; and the yellow and black pupæ—vaguely recalling in shape the horse-shoe crabs of the Atlantic coast—are also common on the plant.

By the end of August and early September, beetles again are seen on the leaves, but very different from the midsummer ones. There is not a trace of metallic green, but a sombre black and white, some examples mostly white, others with the black preponderating. Mr. Caulfield, who spent a good deal of time studying the beetle always used to refer to the summer and the autumn *broods* in just the same way that Lepidopterists speak of seasonally dimorphic butterflies and moths. On many occasions I have observed the beetles at rest and the larvæ at work, but as the adults, both green and black and white, have a most unfortunate habit of losing all their beauty and markings, becoming a uniform sickly yellow in cabinet specimens I have not paid much attention to the insect further than occasionally collecting a few larvæ along with other live stock to rear at home.

A few years ago, however, I was hunting around in the late fall for evidences of Lepidopterous boring larvæ in various plants, and this Helianthus came in for a little digging up by the roots, but very little injury was found. During the operations, among the earth upturned, a Physonota was noticed, and to my great surprise it was in its glorious green dress. No others were found, and although the matter seemed puzzling and contrary to what might be expected, a possible explanation was that occasional specimens of the early or summer brood went into hibernation.

Recently I had occasion to ask our good friend Mr. Morris, of Peterborough, whose papers on the relation of beetles to certain plants have been so interesting, whether Physonota was among his acquaintances. He replied that he had not found it, but would like to get some, so a look-out was kept for larvæ, and in July a box of larvæ and some leaves was sent. They reached him just before he was leaving for a vacation and he had a considerable amount of difficulty in finding an acceptable substitute for *Helianthus decapetalus,* and then had to find some one willing to look after the welfare of the repulsive looking grubs. He succeeded in doing both and reared some of the beetles.

Early in September I found that the sunflower had spread very much at the back of the western part of our Mountain, where it used to be rarely met with, and

*Caulfield, Can. Ent., xvi, 227 (1884); xviii, 41 (1886.)
Hamilton, Can. Ent. xvi, 134 (1884); xviii, 113 (1886.)

that beetles were in hundreds on the leaves as well as larvæ and pupæ, and a few were brought home. A week later the plants were again examined and among the many black and white beetles was one of a green color—not so brilliant as the July ones, but still decidedly green. Things were looking interesting now, so I hunted very carefully for nearly an hour and found two more green ones. These were boxed and brought home alive along with scores of the black and white ones. The following day when changing the food the green ones were looked for but instead of three there were *four* in the box. My first thought was that possibly one had been introduced into the box unnoticed beneath a leaf; but when they were taken out of the box it was seen that while all were green, they were not all of the same brilliancy. The four were then placed in a separate box from the black and white ones to see what would happen next. Next day showed clearly what was going on: the black and white ones were all slowly but surely assuming the green color, the lower edges of elytre becoming green first and gradually spreading to the suture, the black becoming an olive green and the white yellowish. As the green brightens the yellow spots disappear and in a couple of days they are so altered that one could hardly believe it possible unless the change was actually seen going on.

I can recall no reference to such a change of color in an apparently mature insect, and would like to know what explanation can be given of the changes that go on and will gladly try to furnish living material next year to anyone wishing to investigate. The unearthing of the green one in the fall was now explained, but I took the first opportunity of revisiting a Helianthus patch and poked around a little amongst the dead leaves and surface soil. Sure enough, the beetles found on and below the ground were all green, while the black and white ones were plantiful on the leaves and flowers.

Among the hundreds of beetles observed on the plants during September and the many kept alive at home there was no apparent disposition to mate, and it seems certain that this does not occur till they emerge from winter quarters. It also seems that instead of two annual broods we have but one in Montreal; the glorious green beetles of midsummer are the transmuted black and white ones that quitted the plants and entered the ground in the previous September. Like other hibernating imagoes the time of appearance differs in individuals, and mating and egg laying are spread over an extended period, hence the finding of the insects simultaneously in all stages on the plants. It is, of course, possible that a partial second brood occurs under favorable conditions, and this could easily be found out by breeding from the egg. The larvæ are not at all difficult to rear if one has a supply of fresh Helianthus leaves at hand. I have never seen the insects except on Helianthus in the fields, but see that Blatchley* states that "it occurs on flowers of Crataegus; on the horse-mint (Monarda) and on resin-weed—both larvæ and adults feeding on the latter." It is interesting to note that he refers to the color of imago as pale greenish-yellow.

*Coleoptera of Indiana, p. 1229.

PRELIMINARY NOTES ON THE USE OF REPELLENTS FOR HORN FLIES AND STABLE FLIES ON CATTLE.

A. W. BAKER, ONTARIO AGRICULTURAL COLLEGE, GUELPH.

The following notes are on the results of work done during the summer of 1914. The summer of 1915 was so excessively wet that satisfactory spraying experiments on cattle could not be carried on, and it was found impossible, due to stress of other work, to continue these experiments during the summer of 1916. Since the results obtained, however, may be of interest to some, it was thought advisable to give these preliminary notes at this time.

CATTLE USED IN THE TESTS.

The tests of repellents were conducted on part of the beef herd of the Ontario Agricultural College. Fifteen milch cows and seven yearlings were used. On certain of these the same repellent was used continuously, and some also were retained as checks throughout all the tests. All repellents, however, were given a test on cattle of various types and colors, and cattle of various types and colors were also used as checks. It was found that the repellent action of all the sprays was practically lost in a week or ten days, so some cattle were used as checks which were used for spray tests earlier or later in the work. This shifting of sprays and checks made it more possible to get thorough results in all tests. The tests were continued without interruption, save on rainy days, throughout the months of July and August. The cattle were sprayed immediately following the morning milking. Notes were made in the pasture in the middle of the afternoon, and in the stable in the morning before spraying.

The writer was assisted in the work by Messrs. A. R. Burrows and R. S. Hartley, student-assistants in the Department of Entomology of the Ontario Agricultural College.

OBJECT OF THE WORK.

This work was undertaken with a view to securing if possible a fly repellent which could be prepared cheaply by the farmer, which would give repellent action for at least two days if possible, and which at the same time would not taint the milk, blister the animal or make the coat unsightly.

REPELLENTS USED.

Four commercial fly repellents were tested and ten home-made repellents. Of the latter, three were repellents which had previously been recommended by various workers, and the remainder were mixtures which were devised by the writer.

The following is a list of the various repellents used, with the formulæ for preparation, and a very brief summary of the results secured.

COMMERCIAL REPELLENTS.

The commercial fly repellents used were La Lo, Williams and Coopers. All three gave good repellent action, but this was not so long continued in the case of Williams and Coopers as with La Lo. Where cattle were thoroughly sprayed it was found that the cost of all commercial repellents used was excessive. Some blistering was noted on three animals sprayed with La Lo, and some very slight blistering on one sprayed with Williams.

Black Leaf 40 was also tested as a repellent. This was used in the proportion of one part to 686 parts of water, both with and without oil of citronella. Fair repellent action was secured in the latter case, but this was evidenced for such a very short time that the mixture could not be considered of any practical value as a fly repellent.

HOME-MADE REPELLENTS.

I. Kerosene Emulsion:

½ lb. yellow soap.
1 gal. soft water.
2 gals. kerosene.

After preparation, add 1 gal. water.

This was used in proportions of 1 to 5 and 1 to 3 of water, both with and without oil of citronella. At no strength used was repellent action secured, which was sufficient to enable us to consider it of any value for practical use.

II. Flour Emulsion:

6 oz. flour.
1 qt. kerosene.
2 gals. water.

As with Kerosene Emulsion, the repellent action secured with this mixture was so slight and of such short duration as to be of no practical value.

III. Milk Emulsion:

Slightly sour milk, one part.
Kerosene, two parts.

This stock solution was used in proportion of 1 to 15, 1 to 12, and 1 to 8, of water, both with and without oil of citronella. When used in the proportion of 1 to 8, with oil of citronella, very fair repellant action was secured, which was quite plainly evident on the day following the spraying. This suggested to us that the milk emulsion could be used as a medium for the application of some substance with a stronger repellent action. The milk emulsion we found could not be used as a practical repellent in itself, because of the large quantities which it was found necessary to apply to each animal.

IV. Milk Emulsion and Olive Oil:

1 part slightly sour milk.
1 part kerosene.
1 part olive oil.

This stock solution used 1 to 8 parts of water. The repellent action secured was comparatively slight and in any case the introduction of olive oil made the spray so costly that it could not be considered of practical value, even though much smaller quantities could be used than was the case with milk emulsion itself.

V. Milk Emulsion and Linseed Oil:

Stock Solution No. 1.

2 parts slightly sour milk.
2 parts linseed oil.
3 parts kerosene.

Used in proportions of 1 to 8, 1 to 4, 1 to 2, both with and without oil of citronella. Even in the proportion of 1 to 2 with the addition of oil of citronella, the repellent action secured was only fair, and the cost was such that the mixture could not be considered of practical value.

Stock Emulsion No. 2.

1 part slightly sour milk.
1 part linseed oil.
3 parts kerosene.

This stock solution was also used in the proportions of 1 to 8, 1 to 4, and 1 to 2, both with and without oil of citronella. As with the first stock solution the repellent action was such that considering the cost the mixture could not be looked on as of practical value.

VI. Milk Emulsion, Olive Oil and Linseed Oil:
1 part slightly sour milk.
1 part olive oil.
1 part linseed oil.
3 parts kerosene.

Used in the proportions of 1 to 8, 1 to 4, and 1 to 2, both with and without oil of citronella.

The repellent action secured by this mixture was only fair, even when used in the proportion of 1 to 2, with oil of citronella, and the cost was such that the mixture could not be considered of practical value.

VII. Milk Emulsion and Fish Oil:
Mixture No. 1.
2 parts milk emulsion, stock solution.
1 part fish oil.
4 parts water.

When used with oil of citronella the repellent action secured was good, and it was found necessary to apply only small quantities of the mixture.

Mixture No. 2.
1 part milk emulsion, stock solution.
1 part fish oil.
4 parts water.

When used with oil of citronella good repellent action was secured, and it was found necessary to apply only small quantities of this mixture.

The success of the milk emulsion as a repellent when fish oil was added to it led us to believe that if we incorporated fish oil in the stock solution and then diluted this with water in the necessary proportions, that we should have a rather satisfactory repellent. This led us to compound the following mixture.

VIII. Fish Oil, Kerosene and Milk.
1 gal. fish oil.
1 gal. Kerosene.
1 gal. slightly sour milk.
6 oz. oil of citronella.

This stock solution was used in proportions of 1 to 2, 1 to 3 and 1 to 4, of water. The repellent action secured in all cases was good, so much so that the mixture can be recommended as having decided practical value.

This mixture gave far the best results of any home-made mixtures tested, and the amount required is so small that the cost of spraying is extremely slight as compared with that of commercial repellents.

Another summer's work will doubtless improve the stock solution, in that the proportion of the ingredients may be varied somewhat, but the writer feels that the mixture essentially as given will form the basis for a very satisfactory home-made repellent.

Since the work outlined here was undertaken this mixture has been recommended for trial to a considerable number of farmers, and in all cases where reports have been received from them, the mixture has given very good results as a repellent.

It was found necessary when this spray was first started to apply it every day to secure good results. The writer feels sure, however, that if spraying was continued throughout the whole season with the one mixture that the time of spraying could be reduced to once in every two days, or even once in every three days. In the same way probably the strength of the spray could be reduced after using for some time.

Amount of Spray Used.

When used in the proportion of 1 to 2, one imperial quart was sufficient for eleven cows, that is one gallon as applied at 1 to 2 was sufficient for 44 cows. At 1 to 4, one gallon as applied was sufficient for 32 cows. It should be borne in mind that in spraying each cow was absolutely covered from horns to hoofs with the mixture, not simply a band along the back and sides, as is so often done.

It was found that better results could be secured in spraying the cattle by using a cheap hand-atomizer sprayer than by using a knapsack-sprayer.

Working with these hand sprayers two men in ten minutes could thoroughly spray 13 cows, averaging about one and two-third minutes per cow.

The Cost of Spraying.

The following cost summary is based of course on pre-war prices:

Fish oil, 1 gal.	$0 80
Kerosene, 1 gal.	20
Milk, 1 gal.	20
Oil of citronella, 6 oz.	60
	$1 80

i.e., $1.80 for 3 gallons of stock solution.

In the proportion of 1 to 2, the cost as applied was 20 cts. per gallon.

In the proportion of 1 to 4, the cost as applied was 12 cts. per gallon.

The cost then of spraying thoroughly with this mixture at 1 to 2 is 5/11 cts. per cow. The cost of spraying at 1 to 4 is 3/8 cts. per cow.

As mentioned above the writer found this mixture by far the most satisfactory of all the home-made repellents tested, but he would like it borne in mind that it is the result of only one season's work, and although he is satisfied that it will form the basis of a very satisfactory repellent, he feels that the proportions used can probably be improved in another season's work, and so does not recommend this mixture as finally satisfactory.

Prof. Parrott: Was any work done while you were carrying on this experiment with the repellents to determine the effect of the treatments on the yields of milk or butter?

Mr. Baker: None. I hope before I put it in final form to do this work: to run check animals exposed to all the attacks of flies outside, and to treat others with a series of sprays of different proportions, and then keep a record of milk returns in both lots. So far as I know there has been only one record of systematic work done along this line.

Prof. Parrott: Nineteen years ago I was given the problem of determining the most efficient materials for protecting animals from flies, and the conclusions you have drawn are in the main quite similar to the results I obtained. It was not very hard to decoct a preparation as efficient as some of the repellents on the market. I found also that both commercial and home-made mixtures gave only temporary relief, and there was always the question of whether or not the applications had any effect on the yields of milk or butter. When at the Ohio Experiment Station I was actually confronted with data obtained by another department showing that applications of commercial and home-made insecticides did not give any protection at all as measured by milk yields. I considered the data inconclusive, and I do believe that a careful experiment would show that flies do diminish production. If so, data along this line would encourage farmers to give their animals proper care.

Mr. Baker: There is no doubt that it gives increased beef production.

Prof. Parrott: I am of the impression that it is possible to divide a dairy herd so as to get conclusive data. Such an experiment would certainly be worth while.

Dr. Hewitt: The experiences in the Texas Fever Tick uphold that idea, if only you can convince the farmers of the advanced milk production so that they will undertake measures of control.

Mr. Baker: The primary reason this work was undertaken here was because of the fact that every summer we have numerous requests from farmers for a satisfactory fly repellent, and they seem to be unanimous in the statement that the milk production of the cattle is seriously injured. I can call to mind probably half a dozen communications last year definitely stating that the cattle had gone back on the milk flow where the flies were extremely bad.

Prof. Parrott: If a dairy expert would co-operate with a entomologist on the problem, one ought to get very valuable data, because fly attacks must cause great discomfort to cattle, and thus reduce the yields of milk.

Dr. Howard: I should like to ask Mr. Baker if oil of citronella can be purchased in this country for ten cents an ounce now. We have been trying to buy oil of citronella this past summer, and after the apothecaries had sold out their previous stock it was impossible for them to obtain any more. The situation was worse than the price being prohibitive, for we could not get it at all.

Mr. Baker: The prices I have quoted were those prevailing before the war. Until the druggists ran out of oil of citronella, we could get it at a price considerably increased, but since then we have tried and were not able to get it in the city of Guelph.

Mr. Criddle: I have seen a good deal of the cattle business in Western Canada. There is a very marked decrease in the milk production during the fly season. For that simple reason very many cattlemen keep their cattle until after the fly season is over so that they can fatten them up again.

EVENING MEETING.

On Thursday evening the auditorium of Massey Hall was filled with students of the College and the Macdonald Institute, in addition to the members and visitors from the town of Guelph, who came together to hear a lecture on "The Relation of Insects to Disease in Man and Animals," by Dr. L. O. Howard, Chief of the U. S. Bureau of Entomology at Washington. A large number of lantern slides were exhibited, which added greatly to the interest, and rendered more intelligible to the student body the more technical positions of the address.

In the absence of President Creelman, the Society was welcomed to the College by Prof. Zavitz, and at the close of the meeting a vote of thanks, proposed by Dr. Hewitt, and seconded by Prof. Lochhead, was tendered to Dr. Howard for his instructive and highly interesting address.

THE RELATION OF INSECTS TO DISEASE IN MAN AND ANIMALS.

Dr. L. O. Howard, Washington, D.C.

There are many here to-night to whom much that I shall say will be an old story. In fact, more than sixteen years ago, in a lecture which I gave before the Royal Society of Canada, May 30th, 1900, I showed some of the same lantern slides, which I shall show to-night, and even then the interest in the subject was very keen and was still keener when three and one-half years later I spoke before the Entomological Society of Ontario, at its September, 1903, meeting at Ottawa, on the transmission of yellow fever by mosquitoes. That time my lantern slides were held up at the border, and I am able to-night to show them for the first time to the members of this Society.

After all, what is a period of sixteen years in the history of medicine and of medical discoveries? The whole great field has practically developed within the last twenty years. Take some standard medical work of twenty years ago, such as the 1896 editions of Osler's "Theory and Practice of Medicine," and you will find absolutely no mention of insects as connected with the etiology of disease either of man or of the higher animals.

And yet the foundations were already laid. In 1889 Theobald Smith, eight years out of Cornell, and six years out of the Albany Medical College, and already farther advanced as an investigator than any of his teachers, discovered the causative organism of the so-called Texas fever of cattle, in the shape of a minute pear-shaped protozoan in the red blood corpuscles, to which was given the name *Pyrosoma bigeminum* (now known as *Babesia bovis*). With the experimental aid of F. L. Kilbourne, a doctor of veterinary medicine and engaged, as was Dr. Smith, in research work under the Bureau of Animal Industry of the United States Department of Agriculture at Washington, he showed that this organism is carried from southern cattle to non-immune cattle by the so-called southern cattle tick (*Margaropus annulatus*). The results of this experimental work were published in 1893.

Even before this, Dr. Patrick Manson, now Sir Patrick Manson, demonstrated the carriage of the parasitic worm, *Filaria nocturna,* responsible for certain of the diseases grouped under the name filariasis, from mosquitoes to man.

This, however, was by no means as significant as the discovery of Theobald Smith, and undoubtedly attention would have been directed at an earlier date to the possible transfer by insects of diseases caused by blood-inhabiting micro-organisms with man, had the revolutionary paper by Smith and Kilbourne attracted more general attention. But it came from a veterinary service, and was published in the Annual Report of the United States Department of Agriculture, a publication which at that time unfortunately received but little attention from the scientific world in general.

So it was not until 1897 that Ross, at the suggestion of Manson, began out in India his work on the possible carriage of malaria by certain mosquitoes, an investigation which resulted triumphantly in 1898, and which ranks as one of the monumental discoveries in medical science.

Ross's work was immediately corroborated by Italian workers, and intensive investigations of the blood-inhabiting protozoa were immediately begun. In a very short time sound proof of the carriage of yellow fever by *Aedes calopus* was brought forward by Walter Reed and his co-workers, Carroll, Lazear and Agramonte, and research in this direction was taken up all over the world. Constantly increasing in volume, discovery after discovery has been made, until at the present time, practically only a score of years after its inception, the literature on this subject has become enormous, the workers in the field constitute an army, comprehensive volumes on medical entomology have been published (two in the United States within the past year), advanced students are taking up the subject as their life work, and as the months go by the field opens further and further until it is evident that its importance especially regarding the etiology of tropical disease, can scarcely be exaggerated.

So numerous have the discoveries become of late that it would take a course of lectures to display the results, and I must confine myself to-night to comparatively few, easily illustrated aspects.

It is convenient, and in fact necessary, to divide the field in any discussion into three categories:

First, insects as simple carriers of disease, the accidental carriers as it were; that is, insects frequenting places where disease germs are likely to occur, and conveying these in their stomachs or on their bodies to food supplies. This class is notably illustrated by the house fly.

Second, insects as direct inoculators of disease. These are biting insects which feed upon diseased men or animals, and carry the causative organisms on their beaks and insert them into the circulation of healthy individuals. In this way anthrax is carried by biting flies; surra is carried the same way, as is also the *nagana* or tsetse-fly disease of cattle. So also is bubonic plague carried in this manner by rat fleas, but here there is more than a passive carriage, as is also the case with the tsetse-fly disease.

The third category, and this is perhaps the most important, insects as essential hosts of pathogenic organisms. These are the cases in which the parasitic organism undergoes its sexual generation in the body of its insect host and another, non-sexual, generation or generations in its warm-blooded host. To this class belong the malarial mosquitoes, the yellow fever mosquito, and the rapidly increasing number of species that carry Trypanosomiases, Leishmaniases, Spirochætoses, and the ticks that carry relapsing fevers and other fevers of man and animals, and the lice that carry typhus fever.

Insects as Simple Carriers of Disease.

The House-Fly. (Lantern slides and general discussion).

Cockroaches, ants and other insects. It is perfectly possible, as above stated, that any insect which comes in contact with, either accidently or for feeding purposes, excremental or other material containing pathogenic organisms and then passes to the food or bodies of men and animals may thus become a simple carrier of disease. There are plenty of obvious illustrations of this. Darling, in the Canal Zone, has shown that ants which flourish in the tropics may thus carry disease, and in fact the little house ants in temperate regions may also function in this way. The same thing may be said of cockroaches, and especially of the small so-called German cockroach, which multiplies excessively in unclean establishments, and it may also be said of the latrine fly (*Fannia scalaris*) which breeds in latrines and which has frequent access to food, although not so greatly attracted to food supplies as is the true house-fly. And there are numbers of other insects which may from time to time play this part, although, speaking of flies, I pointed out many years ago that over 97 per cent. of the flies found all over the country in dining-rooms and kitchens, are true house-flies.

Insects as Direct Inoculators of Disease.

This is another simple relation, and the insects which carry disease in this way are piercing species, taking up germs and inserting their contaminated mouth parts into their healthy victim. This transfer is precisely analogous to blood-poisoning from the prick of a contaminated needle or pin. A little earlier this method of carriage of disease was considered to be more easily possible than it is at present. A study of the habits of many of these blood-sucking insects indicates that, while they take a very full meal, they frequently wait for many hours before attempting another bite, and in the meantime ingested bacteria may be digested or excreted and the beak become cleansed or the micro-organisms dried up.

Nevertheless this method still holds, and it is in this way that certain biting flies carry the disease known as anthrax or malignant pustule, and in the same way the very destructive disease of domestic animals in oriental regions, known as surra, is carried by gadflies. In this same way also the disease of cattle in Africa long known as fly sickness or nagana is carried by one or more of the tsetse flies of the genus Glossina. Although, while it is possible for this disease to be almost immediately inoculated after the first bite of a diseased cow, by simple transfer, the fact that after a term of days has elapsed inoculation again becomes possible indicates that the parasitic organism may undergo a sexual development in the body of the fly. This will be brought out later in speaking of sleeping sickness.

In the case of the rat fleas and bubonic plague, about which so much has been written of late years, there occurs also something more than a passive carriage, although the causative organism of bubonic plague is one of the bacteria, and is known as *Bacillus pestis*. The story of the discovery of the carriage of this dread disease by fleas is a most interesting one, but cannot be told at length. Any flea which attacks both rodents and man may be an agent in the transmission of the disease, and several species are thus implicated. Inasmuch as the causative organism of the disease is a Bacillus, and is not dependent upon any insect for the completion of its development, theoretically any blood-sucking insect which feeds upon a plague-infected man or animal, and then passes to a healthy individual may carry the disease. Thus bacilli have been found in a head-louse taken from an infected man, and in a louse taken from an infected squirrel.

Moreover, it has been found that in bubonic plague the disease may be spread from man to man without any intermediary whatever. Conclusive evidence to this effect was found by Dr. Strong and Dr. Teague during the Manchurian epidemic of 1910-11. This type of the disease, however, forms a very small percentage of the human cases, and in the great majority of cases of a plague epidemic fleas are the responsible carriers, and as a rule rats or other rodents, such as the ground-squirrels of California, form the other end of the chain. So practically all the measures in the modern cities are based upon the destruction of rats, and we in the United States recall with pride the campaign against the rats and the plague carried on so successfully only a few years ago in San Francisco, under the direction of the present Surgeon-General of our Public Health Service, Dr. Rupert Blue.

While feeding, fleas are in the habit of squirting blood from the anus, and where they have been feeding upon mice and rats dying of plague, this excreted blood is found to be full of the plague bacilli. Thus, not only may the disease be caused by the bite, but by subsequent scratching. Moreover, Bacot and Martin have shown very recently that plague-infected fleas regurgitate blood through the mouth, and that the disease may be thus transmitted.

Insects as Essential Hosts of Pathogenic Organisms.

Beyond the mere statement that a number of tapeworms undergo their sexual stage in some insect or other Arthropod, and that of these at least two are occasional parasites of man, while others commonly affect domestic animals, it may be well to point out that one of these species, *Hymenolepis diminuata,* living commonly in the intestines of rats and mice, has as its alternate host certain insects which feed in meal, and that man may become infected by eating the dejecta of such insects in dirty cereals.

It should also be stated in passing that several nematode worms have this dual relation. Sir Patrick Manson's discovery of the carriage of *Filaria nocturna* by *Culex fatigans,* thus producing filariasis, is exemplified most terribly by certain forms of elephantiasis. Further, recently Dr. Ransom, of Washington, has shown that a common nematode parasite of the house fly. known as *Habronema muscæ,* is, in another stage, a stomach parasite of the horse, and that the embryos produced by the parent worms in the stomach of the horse pass out with the fæces and enter the bodies of fly larvæ, which are developing in the manure. Infested flies, dead or alive, are accidently swallowed by horses, and the parasite completes its development to maturity in the stomach of this definitive host.

There is still another nematode which may be mentioned on account of the fact that it brings in an entirely new type of insect host, namely *Echinorhynchus gigas,* a common parasite of the pig, and reported as occurring in man. In Europe the usual intermediate hosts are the larvæ of the cockchafer, and in the United States the common white grub or larva of the so-called June-bug.

Mosquitoes and malaria. (Discussion and lantern slides).

Mosquitoes and yellow fever. (Discussion and lantern slides).

Insects and trypanosomyiasis. The curious, flagellate protozoa known as Trypanosomes are coming more and more to the front as causative organisms of various diseases, especially in the tropics. It is one of these organisms which causes the nagana of African cattle, and is carried by the tsetse fly known as *Glossina morsiians.* As noted above, this insect is not only a direct inoculator of the disease, but is an essential host of the parasite. Sir David Bruce, of England, discovered the causative organism, and established the fact of its transfer by tsetse flies, but it was a German observer, Kleine, who demonstrated in 1909, that a part of the life cycle of the parasite takes place in the fly, which becomes infective again after ten days, and able to transmit the disease for weeks thereafter.

Another trypanosome disease which has become famous is the one which causes the sleeping sickness of Africa, and of this disease the tsetse fly *Glossina palpalis* is the necessary secondary host. This disease is said to have caused thirty thousand deaths between 1902 and 1905, in the British Province Bugosa on the Victoria Nyanza.

Down in Brazil it has been quite recently discovered that a disease known as Opilaçao, a wasting disease of children, is caused by *Trypanosoma cruzii,* and that the definitive host of this organism is one of the large biting true bugs known as *Conorhinus megistus,* a close relative to the so-called giant bedbug of this country. *Conorhinus sanguisuga.* This discovery by Chagas, of the Oswaldo Cruz Institute, was considered so important that another learned member of the Institute, Arturo Neiva, visited the United States and Europe just before the war, in order to monograph competently the biting bugs of this group.

Insects and Leishmanioses. The Leishmania organisms are intracellular parasites allied to the trypanosomes. These parasites are responsible for a number of tropical diseases, especially the one known as *kala azar* of human beings, and here the evolutive cycle is claimed by Patton to take place in the common bedbug, but this, however, is not generally accepted.

Ticks and Spirochætoses. The spirochætes are probably protozoa. Spirochætosis is also referred to in the literature as Spiroplasmosis and Babesiosis. These organisms are responsible for several serious diseases of animals and two of man. The organism of Texas fever of cattle, referred to in our opening remarks, and which is carried by the cattle tick, is an example. The sexual reproduction of this organism in the blood of cattle is well known, but the sexual reproduction in the tick has not yet been made out, although in a related species, *Babesia canis,* of the dog, causing maligant jaundice in Africa and parts of southern Europe, this cycle has been worked out by Christopher.

The life cycle of a spirochæte has been especially worked out in the disease known as spirochætosis of fowls, which occurs in southeastern Europe, Asia, Africa, South America and Australia. This disease is transmitted from fowl to fowl by a tick known as *Argas persicus.* The full life cycle has been worked out especially well by Balfour and Hindle, and is diagrammatically represented on the accompanying slide.

Ticks and Rocky Mountain Spotted Fever. This is the first of the probable spirochæte diseases of man carried by ticks. (Discussion and lantern slides).

The other human disease referred to is the European relapsing fever, which at first was supposed to be carried by bedbugs, but which has since been shown to be carried by lice.

This brings us to *Typhus fever and lice.* (Discussion and lantern slides).

But now we must stop. There are many subjects in the field which we have not touched. Tick paralysis, for example, is a most interesting and novel subject. This disease occurs in Australia, Africa and North America. In Oregon thirteen cases have been found in the practice of a single physician. The attachment of a tick brings about progressive paralysis involving motor, but not sensory nerves. It seems a unique malady. Hadwen and Nuttall, showing that it is not infectious and that there is apparently an incubating period in the tick, suggest a specific causative organism, but others hold to the theory of nerve shock.

Attention should also be called to the fact that, in spite of the host of discoveries already well established, there is a danger in our tendency to exaggerate the importance of insect transmission, and to overlook, even in cases where insects may occasionally be concerned, the greater importance of other modes of infection. This is indicated by Sambon's theory of transmission of pellagra by Simulium—a theory which was advanced with enthusiasm on the ground that it fitted into the known facts in the epidemiology of the disease. It took two years of hard work on the part of members of the force of the Bureau of Entomology, working in collaboration with the Thompson-McFadden Pellagra Commission, to upset this theory in a thoroughly scientific manner. As has been pointed out several times of late, there is always considerable danger in conclusions based on epidemiological findings. Transmisson experiments are necessary.

One conclusion must be drawn which can hardly be disputed: There is an enormous field for the entomologist in the careful study of all of the aspects of the biology, of not only those insects which have already been shown to be disease carriers, but of those which are likely to be implicated. It is to the trained economic entomologist that we must look for the methods of destruction of those insect carriers, and the prevention of this class of diseases lies at his door, rather than at that of the physician. Either that, or sanitarians must be trained in what is now known as medical entomology.

SECOND DAY'S SESSION—FRIDAY, NOV. 3RD.

THE WOOD OF DESIRE.

FRANCIS J. A. MORRIS, PETERBOROUGH.

In September, 1913, about a week after my arrival in Peterborough, I found myself toiling, one hot afternoon, up a steep hill-side just east of the city. All the explorer's romantic sense of adventure thrilled me, for these were pioneer days in a new district, and I was very curious to know what lay beyond the hill, what sort of view would unroll before me from the little knot of pines that topped the height. Up and up I struggled, like stout Cortez, till at last I won to the coveted vantage-ground, and found myself staring out over a wide and varied strath that rolled ocean-like between the Otonabee and Indian River.

In the foreground, to the south, lay Burnham's wood, brimful as a magician's box with insect marvels I was to conjure forth next season. And east of there, after a mile or more of open country, the timber lands began again; at first just scattered farm lots of elm and maple, but, from a point in the middle distance, not far south of the C.P.R. there stretched across the background a wood far larger and denser than any of these; widening as it went, it spread to the south-east verge of sky in the form of an enormous fan. In view of its distance, this must, if continuous, be a veritable forest, and field glasses trained upon it revealed no break in all its surface; it stood the test—a solid fan of timber, ribbed with hemlock and spruce, fringed with pine, the framework compact of beech and maple.

Though I found enough to engross my attention next season, in the forefront of this woodland paradise, yet always in imagination loomed up that mysterious background; and when, in May of last year, I drew the covers of Burnham's wood repeatedly without a single view-halloo of novel game, elfin fingers from the far horizon, beckoning fast and furiously, would no longer be denied. So in the first week of June, with a fardel as varied as that of Autolycus, I set out across country for this wood of my desire and merrily hent the stile, as light-hearted and innocent a snapper up of unconsidered trifles as any son of Hermes in the land.

Like every fastness worthy the name, it had its approaches well guarded; for a mile or more along its northern frontier I probed vainly for a point of penetration; thickets of prickly ash, a broad belt of willow and alder, a meandering stream of uncertain channel, all combined to form a zariba moated and impervious. At last, by the north-east corner of the wood, the swamps drew to a narrow neck, and along an old winter road strewn with elm logs I stole my first entrance—the planet in the ascendant doubtless Mercury, lucky star of all pedlars and the light-fingered gentry.

No sooner had I crossed the threshold and won to the heart as it were of this dark tower of romance than I became the butt—the more than willing target—for a perfect bombardment of new discoveries. On one of the elm logs that had served me for drawbridge in the passage of the moat, I caught a gleam of steely blue about the corrugated bark. It was *Physocnemum brevilineum,* and I soon found this interesting longicorn settling in considerable numbers on the logs. It had evidently lately emerged from its bores in the elms. I captured several pairs hidden under flakes of the bark, and about a dozen running along the logs after flight in the sunshine. Only once before had I taken this creature and that had been on the trunk of a standing elm, green and flourishing. It was, therefore, of interest to note that these logs were dead, and had been lying—some of them—for three or four seasons.

The excitement of this first find was hardly spent before I spied a newly emerged specimen of *Saperda tridentata*, slowly waving its antennæ and preening itself in the ecstasy of a first sun bath. The elm saperda is no doubt a common insect, and on summer evenings I have occasionally taken a stray specimen, attracted to light through an open window; but I had never before happened on its chosen breeding grounds. *Larvæ* and *pupæ* were frequent in the inner bark of several logs and stumps, and while it seemed emerging most abundantly in the first ten days of June (exactly the season of the basswood saperda), occasional specimens were taken throughout the month. This first day's bag tallied 17.

The winter road turned sharply west at the neck of the swamp, leading past a couple of woodpiles and a heap of brush. Here I captured (besides 3 more elm borers) 2 basswood borers, a fine specimen of *Callidium antennatum*, and (on a billet of white pine) a strange beetle that looked like a small *Criocephalus* or a light-colored, long and narrow specimen of *Asemum moestum;* it proved to be *Tetropium cinnamopterum;* evidently a rarity, for I have only seen one other; that was last July in the Algonquin Park, taken resting in shadow on the underside of a newly fallen white spruce.

In the middle of June I returned to the scene and right in the same tract captured on a basswood log *Pogonochæruss mixtus*, and my third specimen of *Hoplosia nubila*. The season of 1915, however, proved far from ideal for sun-worshippers, cold east winds more than countervailing the bright sunshine. It was on this second trip that I noted, at the north edge of the wood, some large bushes of thimbleberry crowded with sprays of bud that promised well. While following the winter road south through the heart of the wood I came across several patches of the rare striped coral-root in full bloom. Then, after crossing a couple of hardwood ridges, I descended to a rich piece of tamarac swamp, and groping my way through a dense mist of mosquitoes, along a track of sphagnum moss and decaying corduroy emerged at last on a gravel road intersecting the wood from west to east. Despite bloodsuckers and bogholes I was not empty-handed when I reached *terra firma*. From willow foliage I had gathered half a dozen specimens of *Lina scripta*, on a hemlock stump *Rhagium lineatum*, and in blossoms of buttercup and fleabane several specimens of *Anthaxia æneogaster* and *Leptura vibex*.

To the making and through the heart of as pretty a piece of landscape as you might find in all the Province went this gravel road; wooded on both sides and flanked on the north by a fringe of heaths—Labrador tea, andromeda and American laurel—all in bloom; on the south by a shallow ditch filled with marsh fern. To the west, at a bend in the road, the ditch was backed by a low escarpment of shaded bank, based with clumps of crested and prickly shield fern and occasional masses of giant osmunda; the whole forming a kind of natural ha-ha, behind which spread, well above swamp level, a hardwood of maple and beech. Due south at somewhat greater distance the woods climbed suddenly out of the swamp and rose rapidly to the sky-line, presenting to the enraptured eye tier above tier of balsam and silver birch, elm and maple, in the varied shades of lush soft green that mark the leafy month of June. South-east alone, bounded on three sides by woods, you caught a glimpse of open meadow, a tiny wedge driven into the forest by the hand of man.

In the swamps of old Ontario, though the whole Dominion go dry, you may still drink deep of this wine of life, till you fairly reel with the beauty of it all. Over the road dragonflies hover and dart; butterflies flutter in varied hue, little Blues and Coppers and Hairstreaks; once in a while a great Fritillary or a Swallow-tail comes sailing along; far up in the vault of sky a pair of hawks wheel and poise, their faint keening, from that giddy height, falls feebly on the ear. From the depths of the swamp come at intervals the gentle croon of the Mourning Dove, the sweet, long-drawn whistle of the Whitethroat; presently, drowning all else, from some hidden turret in a Balm of Gilead showers down a flood of delicious music, sweeter than the carol of a robin, perhaps the notes of that master-singer, the Rose-breasted Grosbeak. Who could be blind and deaf to all this? Not even an entomologist in the last stage of "cerambyciditis." Mosquitoes and deer-fly are soon forgotten; indeed, when taken in bulk, as it were, they are much less of a nuisance than retailed in ones and twos; I had far rather move imperturbably through an open swamp, the pincushion for a thousand, than sit on a verandah and smash desperately at half a dozen, or crouch abjectly under canvas listening to the shrill slogan of one. In the open they are mere pin pricks and we can cry with happy-go-lucky Launcelot Gobbo—"Here are simple scapes! If fortune be a woman, she's a good wench for this gear."

Refreshed as by a draught of spring water I plunged once more into the swamp, following a woodman's path to the south of the gravel road. A little way in, the path bore to the right and at length debouched on a dry upland pasture west of the wood. Beside the path were a number of straggling shrubs of spiked maple, and the bloom was not quite over. In just such surroundings near Port Hope I had taken on these blossoms not a few beetles of interest and one or two of considerable rarity. Above all, a unique specimen of a small *Anaglyptus,* which had been declared in Montreal the male of *Microclytus gazellula.* Spiked maple, too, is the favorite haunt of *Corymbites hamatus,* a very prettily marked click-beetle. It was too late, however, and all I could find were a few specimens of *Leptura capitata* and *Callimoxys sanguinicollis.* But I marked the place in my mind for an early visit in 1916, and made my way home by the newly found gravel road, a forced and zig-zag course, uphill and downdale, along the claw of my spreading fan of woodland, past Burnham's, to the Lift Locks and the City.

In the fourth week of June I made my third visit to the Wood of Desire, holding to the gravel road till almost the end of the journey, when I skirted a fence due north to where the thimbleberry bushes grew. They were a snowy mass of blossom now, and two of the sprays, either from situation or from the greater maturity of their flowers, had quite a number of beetle visitors; among others a solitary *Leptura 6-maculata,* and (better still) along with two specimens of *Leptura proxima*—the first that season—behold! *Leptura chrysocoma.* This last I had never taken, though, two or three seasons before, I had heard of a lucky collector in Port Hope making quite a haul.

Altogether the experience of this first season served only to enshrine the Wood of Desire in my heart as a haunt that age could not wither nor custom stale. Again and again in fall and winter I found myself longing for the spring. Alas! its coming was advertised in the almanac weeks before it appeared, and it was actually Victoria Day before I exchanged New Year greetings with my inamorata.

Now perhaps it may spell for you a cozening fancy—the glamour of imagination—but so sure was I the mere sight of this wood must kindle in everyone longings ardent as my own, that I got together a picnic party to visit the place. The approach by the gravel road was admitted on all sides to be lovely, but just as we reached the outposts of beech and maple, our foremost team began to kick and plunge; we were ambushed, and next moment all our cavalry was thrown into confusion and we were hotly engaged in hand conflict with hordes of fierce mosquitoes. Further in, as I knew, the swamp was even denser; where horses were too restive to be tethered, it was impossible for bipeds (at least the petticoated variety) to bivouac in any comfort; so we beat a hasty retreat to the upland pasture. Here a strong wind, coming to our support, checked the advance of the foe; and here, much abashed, in the lee of a snake fence, we rallied our forces and sat down to an *al fresco* banquet.

A diner at Delmonico's would have turned up the nose at our bucolic bill of fare; but nature, kind indeed to all her children, added, in the keenest of outdoor appetites, a relish to this plain and homely food not a city in the world could supply; she even provided us, in true up-to-date style, with refreshing interludes of music; a rare treat, in the form of a series of solo selections. For without being closely attentive we were yet, throughout the repast, fully alive to what seemed the clear carol of a robin.

The song came from the leafy gable of a Balm of Gilead beside the road; the same hidden turret, the same sweet notes I had marked the June before. The very persistence of the song at last caught and held the attention of us all; closely studied it was certainly no robin's, being sweeter in quality and of far greater range; soft as the fluting of a bluebird, yet full and rich (almost) in tone as an oriole's, wonderfully varied, still more wonderfully sustained, came the notes of the singer, a silvery shower of sound. We managed, two of us, to draw close enough to note the bird's outline as he sat on a spray near the top of the tree; then, at length, he paused in his song and flew; as the wings were spread in his first movement we could see a streak of white across them.

It was indeed the Rose-breasted Grosbeak; a week or two later I had an opportunity of studying him at leisure through field-glasses as he sat on this his favorite perch—singing (doubtless) to a mate on the nest. The black of the head and throat, the white of the lower body, and in delicious contrast a splash of rich crimson on the upper breast, left no doubt of his identity, even had the vaulted boldness of his bill not been in evidence. Mr. Schuyler Matthews contends that the bird owes his power as a songster—a certain resonance and fulness of tone, perhaps—in some measure to the shape of his beak; nor need the contention be thought fanciful; the English bullfinch, for one, might be cited in support.

Some weeks later, when halcyon days had really come to stay, and I ventured to suggest to some of my friends that we forgather again at the Wood of Desire, they one and all refused. In their memory the song of the Grosbeak wakened no echo, but the winged darts of Liliputian hosts renewed all their venom, and my rambles since Victoria Day have been companionless.

If I were put in the witness box and cross-examined by some matter-of-fact plaintiff's counsel, many startling admissions would doubtless be made to appear; as, that the round trip involves no less than 15 miles of tramping; that often I have been so parched with thirst as to lie down and lap, at the girdling moat, water that was tepid and tasted of cows; that once, on venturing a few rods in towards an enticing nook, the gravel road I had left vanished (by some sinister necromancy) as completely as the highway out of which Childe Roland turned aside in his quest of the Dark Tower, and I was left for over an hour to wade knee deep and flounder to the waist through mazy labyrinths of swamp; that no sooner had I escaped this involuntary dipping, than a thunderstorm came up and baptised me all over again, a cold douche and a shower (so to speak) being thrown in gratis on the top of the foot and hip baths already so lavishly provided; and again, that, early and late, mosquitoes and deerfly swarm there in countless myriads.

Damning evidence to you jurymen, perhaps; to me, proof positive of Mr. Bumble's famous apothegm, "The Law is a hass." One tithe the facts in the other scale of the balance would serve to kick the beam. Witness the troop of black squirrels I met, hotfoot at a game of tag; the little couple of fellow-entomologists I surprised, pouncing on ground beetles in the carpet of dead leaves, as pretty a pair of young skunks as you would wish to see anywhere; the bittern I watched stalking frogs, with all the cunning and the zest of a human hunter; the hen partridge that held me at bay to cover the retreat of her brood; the whip-poor-wills, flitting in ghostly silence from their nesting place; the grosbeak, in his leafy hermitage, all its belfries a-peal with melody; to say nothing of the flower-clusters of chokecherry I found, sheltering in their midst the rare little *Anaglyptus* I had vainly sought for eight years and now took nearly a score of; and the windfall of beech trees I happened on last July—an illustration (come to think of it) of the struggle for existence, no less striking, if less gruesome, than the fly-blown carcase already writhing with new life of an alien order—three giant beeches, thrown in some titanic westling-bout with Boreas, their dying shafts alive with Longhorns, Buprestids and other brooding insects; gangs of pigmy foresters, drilling, boring, and charging, "throng" at their self-imposed task of wood-scavenging; strange medley of life in death, such as fed the melancholy of Shakespeare, when he wandered, moralising, with Jacques through the Forest of Arden.

These and a score of other scenes remain, tapestried in the rich brocade of memory; while all the tale of misadventures has long faded into nothingness. Every trip I made last June and July brought me home at nightfall, footsore indeed, but laden with treasure-trove, and eager for the morrow's sun, to light up once more that land of glamour, elf-haunted still and fraught with mystery, the Wood of Desire.

INSECTS AS MATERIAL FOR STUDIES IN HEREDITY.

W. LOCHHEAD, MACDONALD COLLEGE.

For some years I have given attention to problems of heredity, and have been impressed with the importance of the place insects have taken in the solution of some of the problems. I thought, therefore, that it might be of interest if I brought together the many scattered references in current literature to the investigations that have been made with insects.

TOWER'S EXPERIMENTS.

No question in heredity has been more keenly discussed than "Are acquired characters transmissible?" The neo-lamarckians assert that characters impressed upon an organism by its environment may be and often are transmissible. Weismannists, on the other hand, maintain that such characters are never transmitted. Tower's investigations set forth in "An Investigation of Evolution in Chrysomelid Beetles of the Genus Leptinotarsa" (Carn. Inst. Publ. No. 48) are interesting in this connection. He subjected beetles, when their reproductive organs were developed to a certain stage, to unusual conditions of temperature and moisture. As a result variations appeared in the offspring in regard to color markings and certain details of structure. These variations, moreover, were not all alike; some were immediate, others appeared after a time; some of the germ cells were affected, others were not. But the important point was that the variations produced did not revert to the original parent forms in subsequent generations. These experiments indicated that *environmental stimuli may, under certain conditions, produce germinal variations.*

Standfuss and Fischer, by changing the temperature and food of the larvæ of Vanessa and Arctia, induced in the following generations certain variations which persisted even when crossed with the parent form.

The investigations of Johannsen, of Copenhagen, with Pure Lines of beans and barley showed that variations within a Pure Line are not inherited, and that they have little or no influence on the permanent improvement of a race. In Tower's experiments with Pure Lines of the Colorado Potato Beetle (*Leptinotarsa 10-lineata*) dark to light colored variations appeared in the same Pure Line. When dark males and females were mated the progeny were not dark, but they fluctuated about the average of the Pure Line, even after twelve generations of such mating. *Tower's results, therefore, confirm the conclusions reached by Johannsen.*

Selection Value of Variations.

Darwinism has been criticized on the ground that variations often occur which cannot possibly be of value to their possessors in the struggle for existence. Kellogg and Bell in their "Studies of Variation in Insects" made a careful scrutiny of the color patterns of 1,000 specimens of *Hippodamia convergens* and found 84 aberrations of pattern varieties, ranging all the way from no spots to eighteen spots, although twelve is the species character. If some of the intermediate patterns should disappear the systematist would have data for making several new species. Other forms studied showed variations in antennal structure, spinal armature of tibiæ, and venation. The conclusion is that "continuous" variations are in all probability not the foundation stones of new species. This view has of course been emphasized by De Vries, Johannsen, Morgan and others.

Examples of Mendelism.

Toyama's experiments with Siamese silk moths are interesting. He paired a moth with yellow cocoons with one having white cocoons. The offspring produced only yellow cocoons. In the next generation some of the cocoons were yellow and some were white in the proportion of 3 to 1. The whites bred true, while the yellows broke up again, yellows and whites in the usual ratio.

Miss McCracken's work with spotted and black varieties of *Lina lapponica* is also confirmative of Mendel's laws, the spots being dominant and the black recessive.

Coutagne, 1902, found that when a silk moth whose larvæ had transverse stripes was crossed with one whose larvæ were white, the striped form was dominant. Toyama also found the striped form dominant.

Standfuss's experiments in crossing the moth *Aglia tau* with its dark variety *lugens* do not harmonize with those of Doncaster with Abraxas. The dark color of *lugens* was dominant over the light color of *tau*, but in subsequent matings of heterozygous *lugens* and with *tau* the results were such that cannot be brought into line with Abraxas.

Lutz found that when a normal *Crioceris asparagi* with three yellow spots on blue-black elytra was crossed with a variety where the upper spot was united with the middle one, the normal form was dominant. Intermediate conditions occur, but these may be heterozygous forms.

In-Breeding.

Darwin's memorable work on cross-fertilization with morning-glories, pansies, cabbage, lettuce, buckwheat and beets showed conclusively the value of cross-fertilization over self-fertilization in the maintenance of the vitality of these plants. But it has also been shown that many self-fertilizing plants, like tobacco, wheat and barley, are vigorous and have retained their vigor for thousands of years. Dr. East says very properly that Darwin's phrase "Nature abhors perpetual self-fertilization" should read: "Nature resists any sudden change in long established conditions."

Regarding the effects of in-breeding among animals differences of opinion exist, but Mendelism has cleared away some of the difficulties. It shows that in-breeding in itself is not necessarily injurious, but great care must be exercised to prevent injury. The duplex dose of determiners develops prepotency in all characters, good and bad alike.

Castle in-bred Drosophila for about sixty generations without any appreciable loss of vitality.

The Sex Chromosome.

On account of the fact that approximately the same number of males and females of the human species are born, students of heredity have suspected that sex is a character dependent upon factors which act in a Mendelian manner. The explanation of this equality of sexes was forthcoming by comparatively recent researches in which insects played an important part. Henking, in 1890, discovered two kinds of sperm cells in the firefly, *Pyrrhocoris*. McClung, in 1902, found two kinds of chromosomes in the sperm cells of the grasshopper. Stevens, in 1905-1908, found accessory chromosomes in certain species of aphis and Diptera. Wilson, in 1905-1907, discovered different kinds of chromosomes in certain Hemiptera; and Morgan, in 1908, described two kinds of sperm cells in Phylloxera. Later researches by Doncaster, Raynor, Morgan and others have extended the list.

This accessory chromosome has been called the *sex* or *X chromosome* inasmuch as its presence in the germ cell is believed to determine the sex of the offspring. In most animals, including man, all the female germ cells contain an X chromosome, while it is present in only half of the male germ cells. On the other hand, in chickens, ducks, canaries, and in the English currant moth (Abraxas) all the male germ cells, but only half the female germ cells, contain the X chromosome.

In the first case investigations have revealed the fact that when fusion occurs between an egg and a sperm, both containing an X chromosome, the result is a female, but when an egg and a sperm without an X chromosome fuse the fertilized egg has only one X chromosome and the result is a male. In fertilization, therefore, the chances are that approximately an equal number of males and females are produced, as shown by diagram:

O = egg cell; S. sperm with an X chromosome.
s = sperm without an X chromosome.
Z = zygote with two X chromosomes.
z = zygote with one X chromosome.

		S	s	= male gametes.
Female gametes	O	Z	z	= 2Z + 2z, giving an equal number.
	O	Z	z	

In the second case where the female is heterozygous for sex and the male homozygous, the chances in fertilization are again approximately an equal number of males and females.

O = egg cell with an X chromosome.
o = egg cell without an X chromosome.
S = sperm cell with an X chromosome.
Z = zygote with two X chromosomes (male.)
z = zygote with X chromosome (female.)

		S	S	= male gametes.
Female gametes	O	Z	Z	= 2Z + 2z, an equal number of males and females.
	o	z	z	

Heredity in the Aphids and Bugs.

The life-history of aphids is well known. The fertilized egg hatches out a female, the stem-mother, the following spring, followed by a succession of generations of females. On the approach of autumn a brood of sexual males and females appears. The explanation of these phenomena is not clear, but some progress has been made in clearing the mystery. Morgan has shown that the spermatids of Phylloxera are of two kinds, but those containing no accessory chromosome degenerates. Consequently only those containing an accessory chromosome take part in fertilization, and the fertilized eggs produce females. The problem of the production of the males parthenogenetically, however, at the approach of autumn has not yet been solved. It is probable, however, that external or environmental factors are to some extent responsible. In *P. caryæcaulis* one stem-mother gives rise to the line ending in sexual females, and another stem to the line ending in the males. On the other hand in other species of Phylloxera and in many aphids the same stem-mother may produce both lines.

In this connection it is interesting to observe the production of males and females among bees, wasps and ants. It is well known that fertilized eggs of the queen bee produce females, and unfertilized eggs males. The mature egg has one sex chromosome, consequently the male cell has but one, but when the egg is fertilized by a male cell and product has two sex chromosomes, characteristic of the cells of a female bee.

Foote and Strobell have recently made interesting studies of two species of *Euschistus.* The male of *variolarius* has a well-defined black circular dot on the sixth segment of the abdomen, but in both sexes of *servus,* the other species, the spot is absent. When a female *variolarius* was crossed with a male *servus* many of the F_1 hybrids showed the spot. Again, the cross between a pure male *variolarius* and the F_1 female and spot appears. In the F_2 generation some specimens showed the spot, while others did not. A satisfactory explanation of the inheritance has not yet been given.

Experiments with the English Currant Moth.

The work of Doncaster and Raynor (1908) in connection with the crossing of two varieties or sub-species of Abraxas, *grossulariata* and *lacticolor*, was important in that it furnished additional evidence that certain characters are sometimes linked up with sex or with the sex factor. For example, color-blindness in man seems to be linked up with sex. Men cannot hand on the defect without having it, whilst women can. Doncaster and Raynor's results are explained on the assumptions that the female is heterozygous for sex, femaleness being dominant, the male a homozygous recessive, and the factor for color for *grossulariata* is dominant. The gametic formulæ for the crossings are given below:

C. = dominant factor for color (grossulariata.)
c. = recessive factor for color (lacticolor.)
F.f. = sex factors in female.
F.F. = sex factors in male.

Case I. Grossulariata (male) x lacticolor (female).

		CF	CF
Female gametes	CF	Gross. male	Gross. male
	cf	Gross. female	Gross. female

= male gametes.

= all grossulariata (heterozygous) 50% female, 50% male.

Case II. F_1 Grossulariata (male) x F_1 Grossulariata (female).

		CF	cF
Female gametes	Cf	Gross. female	Gross. female
	cF	Gross. male	Lact. male

= male gametes.

= 50% grossulariata females (½ normal, ½ heterozygous). 25% gross. males (heterozygous, 25% lacticolor male (normal).

Case III. F_1 Grossulariata (male) x lacticolor (female).

		CF	cF
Female gametes	cF	Gross. male	Lact. male
	cf	Gross. female	Lact. female

= male gametes.

= 25% gross. female (heterozygous), 25% gross. male (heterozygous), 25% lact. female (normal), 25% lact. male (normal).

Case IV. Lacticolor (male) x F_1 Grossulariata (female).

		cF	cF
Female gametes	Cf	Gross. female	Gross. female
	cF	Lact. male	Lact. male

= male gametes.

= 50% gross. heterozygous females. 50% lact. heterozygous females.

An interesting case arose in the reciprocal of Case I when a pure wild grossulariata (female) was crossed with a lacticolor (male). The result was the same as in Case IV, showing that the wild grossulariata female is heterozygous with regard to that color.

Experiments with the Pomace Fly.

Morgan's recent investigations with hybrids of *Drosophila ampelophila,* the common pomace fly, have added much to our knowledge of factors in heredity. He found that each visible character is due to the action of a number of factors in the germ plasm, each factor in turn influencing a large number of other traits. Moreover, these factors are linked together in groups, in chromosomes, where they are arranged in a linear series, sometimes changing places by crossing over. With Drosophila, which was normally red-eyed, there appeared in the course of breeding experiments as many as 25 distinct mutations in this eye-color. Morgan supposes, therefore, that at least 25 factors are concerned in the production of this red eye, and that when a single one changes a different color is obtained. This one factor, however, may be called the *unit* factor for this particular color, so it may be treated in a simple Mendelian factor in segregation. The following examples illustrate one of the simpler cases of inheritance:

Case I. Red-eyed (female) with white-eyed (male).

Female gametes	rF	rf
RF	Red-eyed female	Red-eyed male
RF	Red-eyed female	Red-eyed male

rF, rf = male gametes.

Progeny all red-eyed.

The diagram of the F_2 generation is:

Female gametes	RF	rf
RF	Red-eyed female	Red-eyed male
rF	Red-eyed female	White-eyed male

RF, rf = male gametes.

= 50% red-eyed females.
25% red-eyed males.
25% white-eyed males.

Case II. White-eyed (male) x F_1 red-eyed female (heterozygous).

Female gametes	rF	rf
RF	Red-eyed female	Red-eyed male
rF	White-eyed female	White-eyed male

rF, rf = male gametes.

= 25% red-eyed females.
25% red-eyed males.
25% white-eyed females.
25% white-eyed males.

Case III. Red-eyed (male) x white-eyed (female).

Female gametes	RF	rf
rF	Red-eyed female	White-eyed male
rF	Red-eyed female	White-eyed male

RF, rf = male gametes.

= 50% red-eyed females.
50% white-eyed males.

showing that the red-eyed male parent is heterozygous for color.

Case IV. Red-eyed (male) x F_1 red-eyed (female) heterozygous.

		RF	rf
Female gametes	RF	Red-eyed female	Red-eyed male
	rF	Red-eyed female	White-eyed male

= same as the F_2.

If a white-eyed male Drosophila is mated to a red-eyed female the offspring are red-eyed. If these are in-bred all the F_2 daughters are red-eyed, but half the sons are white-eyed. "In a word, the grandfather transmits his characters visibly to half of his grandsons but to none of his granddaughters." (Morgan.)

R = dominant unit factor for red eye color.
r = recessive unit factor for white eye color.
F.F = sex factors in female.
F.f = sex factors in male.

The experiments of Morgan and his colleagues with Drosophila are perhaps the most important in recent genetic research. They are valuable both by reason of the large number of specimens under observation and on account of the significance of the results. Bateson says: "If we accept the whole scheme of interpretation without reserve we are provided with a complete theory of heredity, so far as proximate phenomena are concerned."

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AN HISTORICAL ACCOUNT OF THE FOREST TENT CATERPILLAR AND OF THE FALL WEBWORM IN NORTH AMERICA.

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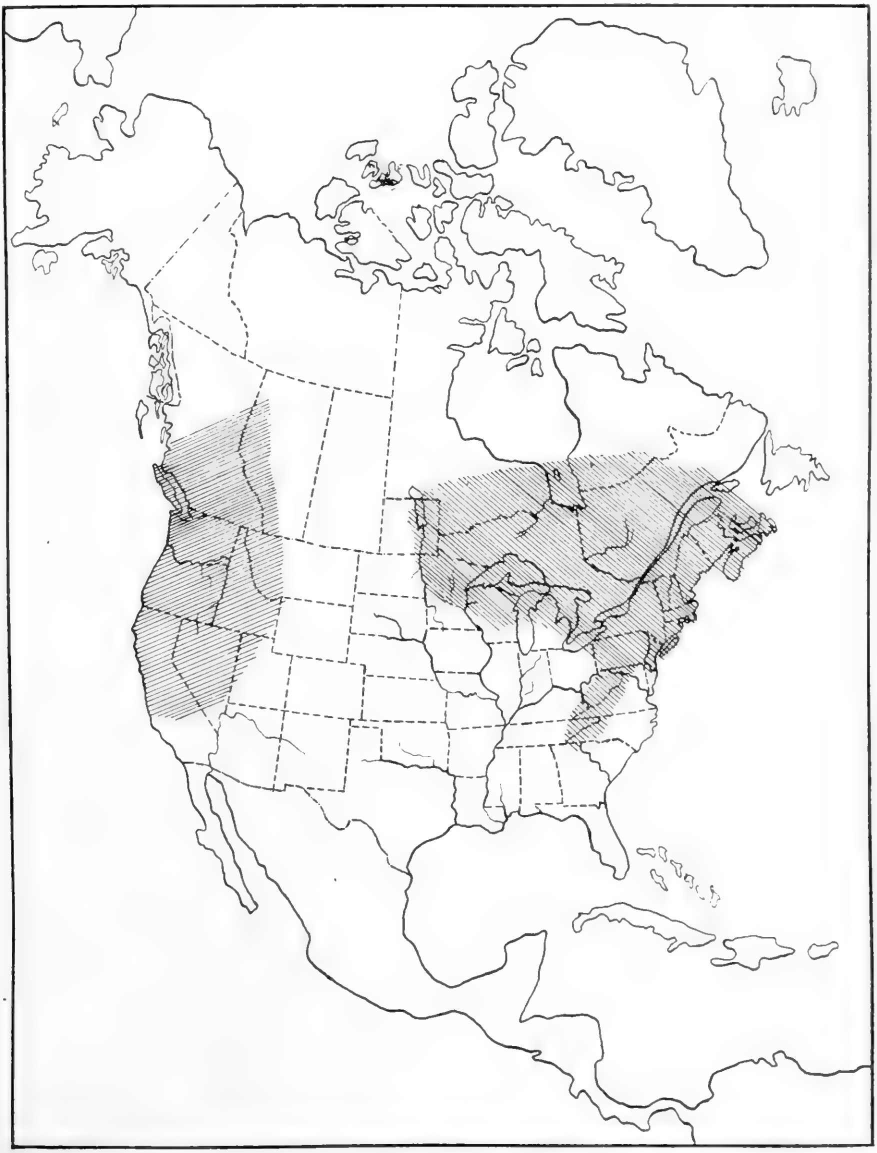
INTRODUCTION.

Since 1911, the Entomological Branch of the Dominion Department of Agriculture has been conducting a study of the natural control of two common insects that from time to time are very injurious to forest, orchard, and shade trees throughout the Dominion. The work is being carried on from the Fredericton



Map of North America, showing the three regions referred to in the text.

laboratory by Mr. J. D. Tothill and his assistants, and is under the general direction of the Dominion Entomologist, Dr. C. Gordon Hewitt.

The insects in question are the Forest Tent Caterpillar and the Fall Webworm. The object of the work has been to study the control of each insect at the same places for a period of consecutive years. The work has resolved itself into a study of the causes of outbreaks of these and other insects, and of the factors that in the natural course of events, cause these outbreaks to subside.

In 1911, when the study was commenced, both the Forest Tent Caterpillar and the Fall Webworm were exceedingly abundant, and were doing great damage throughout the Eastern United States and Canada. Since then they have become less and less numerous and in 1915 there remained only a few local infestations and practically no damage was reported.

This story of great abundance followed by a period of scarcity is merely a repetition of a story that has been told and retold many times in the past history of this continent. It is the purpose of this paper to give an historical account of these two insects as gleaned from the records of the White Man written during his few centuries of residence in this land.

For the purposes of this account it has been found convenient to divide the continent into three regions. On the map (p. 73) these are indicated, the Eastern and Western being marked with parallel lines and the Central occupying the intervening territory. The Regions are treated separately. The accounts of these insects are much more complete and satisfactory for the Eastern Region than for either of the others. A glance at the charts (pp. 76, 81) will show to what extent the abundance of the insects has been uniform for the three Regions.

In these charts the term "local ravages" has been used to designate outbreaks which are recorded as occurring only in smaller sections of the main divisions, or Regions. As will be noticed these outbreaks occurred largely previous to 1860, and there are at least two explanations for their seemingly local distribution: (1) The limited number of observers recording such data prior to that time and (2) The more or less limited food supply of the insects. It seems quite probable that the food plants of both species, but especially of the Forest Tent Caterpillar have greatly increased with the spread of civilization. This question is, however, too many-sided to permit of a full discussion here and will be left for another paper, dealing with this subject, which it is hoped will be published from the laboratory at a later date.

The author wishes to take this opportunity of thanking Dr. C. J. S. Bethune, Professor of Entomólogy at Guelph, for his kindly assistance in connection with the library work at Guelph. He also wishes to thank Mr. Tothill for his many helpful suggestions and kindly criticisms.

Forest Tent Caterpillar.

Eastern Region.

The original habitat of the Forest Tent Caterpillar in North America seems to have been in the Eastern Region, for it is here that we find its ravages first recorded.

The first authentic record of the presence of the Forest Tent Caterpillar is that compiled from earlier observations by Mr. Abbot and published by Sir J. E. Smith in 1797 in his 'Lepidopterous Insects of Georgia.' He gives good colored figures of the larva and imago, and states that "This kind is sometimes so plentiful in Virginia as to strip the oak trees bare but is rather rare in Georgia." This makes it certain that there were outbreaks of the insect, in Virginia at least, previous to 1797; and that it was not so abundant farther south. As early as 1791 there was an outbreak of an insect in Vermont which was probably the Forest Tent Caterpillar, and may have been a part of the last outbreak noticed by Mr. Abbot in Virginia.

We have no further record of the insect until 1820, when it was noticed in Massachusetts. In the 'Entomological Correspondence of T. W. Harris,' we find a description of the species and the following notes on its history, "The moths appeared about the last of June, 1820. . . . One cast its skin June 13th and came out an imago July 1st, 1821." "Found the larvæ on the apple tree, June 3rd, 1826." Harris again mentions it in his "Treatise on Insects," 1841, and publishes an account of it in the "New England Farmer," 1844, which would indicate the presence of the caterpillar in Massachusetts at that time.

The earliest authentic record of an outbreak in New York is given by Fitch in his Second 'Report of the Insects of New York,' pp. 198-199. He says, "his neighbors state that this species gnaws the stems of young apples causing them to fall as well as eating the leaves." This was probably a part of the same outbreak as that recorded from New Hampshire in 1854 by Eaton ('Trans. N. H. State Agr. Soc.' 1854-1855, pp. 199-207). There is evidence that small outbreaks had previously occurred in New York for in the *Country Gentleman* of 1861 (Vol. 45, p. 299) "Acer" says with reference to this species, "These insects have disappeared three times during the last thirty years." The first of the outbreaks thus implied probably occurred between 1826 and 1830, the second between 1840 and 1844, the third was the one referred to by Fitch and Eaton.

In his 'Fifth Report of the Insects of New York,' 1859, Fitch says of these caterpillars, "a few are seen every year and occasionally there is a season when they are more common but never numerous." He also states that they were about the same in Baltimore, nothing approaching stripping having been known in that vicinity in his generation.

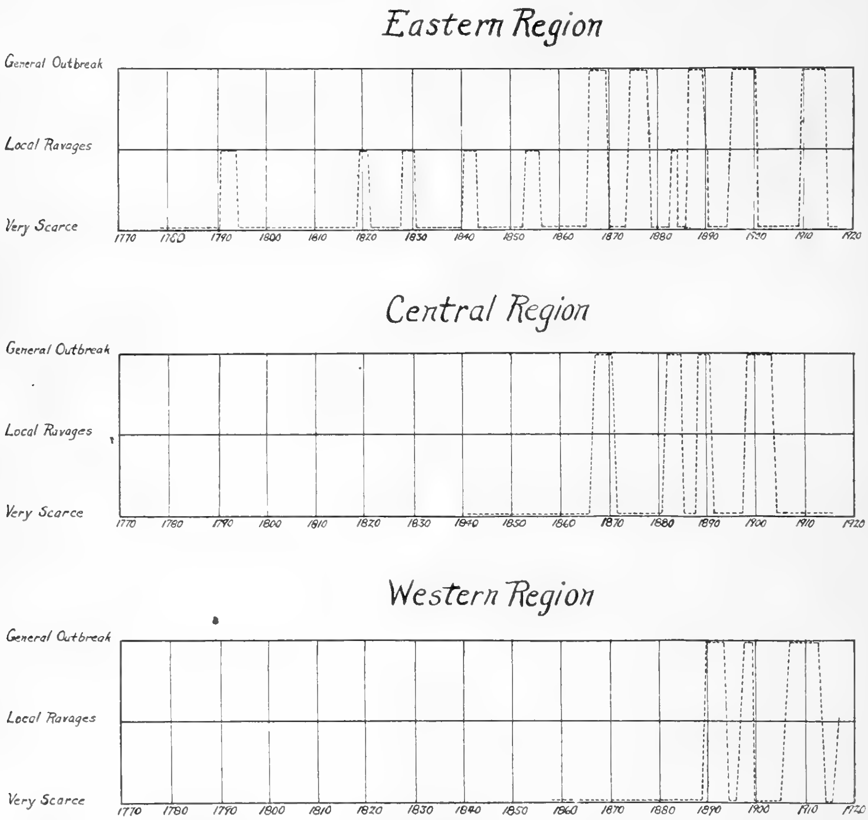
The *Country Gentleman* of 1868, makes several references to the severe outbreak of that year in New York. The caterpillars were reported as "more numerous and destructive in New York State than ever before," and it is also stated that "they have twice disappeared in this place."

From the foregoing notes on its history we have reason to believe that the ravages of the Forest Tent Caterpillar were not very severe previous to 1859, as there is no record of stripping except that by Smith and Abbot, concerning the oaks in Virginia. These ravages were probably restricted to a few of the northeastern States. We note, however, that the insect was present previous to 1797, that there were outbreaks of a more or less serious nature in Massachusetts in 1820; in that State and in New York between 1826 and 1830; again between 1840 and 1844; and about ten years later in New Hampshire and New York.

The next outbreak, noted in the *Country Gentleman* of 1868, was much more widespread and severe than any of the preceding. Its ravages now extended over the entire region. The editor of the *Canada Farmer* reported "many orchards defoliated" near Toronto in June of that year. Walsh (*Practical Entomologist* 2, pp. 112-113) noted its occurrence "in large numbers" in the orchards in Maine in 1866 and in the following year on oak in Virginia and in orchards in New York. Brackett[1] reports their ravages in Maine in 1867. Riley in his

[1]1867. Brackett, G. E., Am. Journ. of Hort., Sept., 1867.

'Third Report of the Insects of Missouri,' recorded them as very destructive in the Eastern States in 1867 and 1868. In his second Report in 1870, he says regarding the caterpillars, "For a number of days last June in Western New York they might have been seen marching single file up the railroad track on Pilot Knob in the scorching rays of the noon day sun." Bethune ('First Ann. Rep. Ent. Soc. Ont.,' p. 15) reported them as very abundant in Western Ontario in 1870, but said they had decreased east of Toronto. In 1872 Saunders says of the same district ('Can. Ent.,' 4, p. 134) "We have not met with a single full grown specimen this year although in years past they have swarmed on our trees and fences." This outbreak thus covered a period of about five years, 1866 to 1870, and the resultant damage was very much greater than any previously reported from this species.



History of the Forest Tent Caterpillar in North America. The dotted lines indicate the abundance of the insect.

Four years after their disappearance, Mr. H. H. Lyman, of Montreal, published an account of the unusual abundance of the insect. In the *Canadian Entomologist,* Vol. 6, p. 158, he says, "The caterpillars of this pest are swarming on almost every description of tree or shrub in the vicinity, many trees being completely denuded of foliage."

This was the first notice of another outbreak and the following notes throw some light on its severity and distribution. "The Forest Tent Caterpillar was excessively abundant and destructive to fruit and forest trees in many parts of

Ontario," (Bethune, 'Ann. Rep. Ent. Soc. Ont.,' 1875, p. 7). "Very serious ravages of this insect in Maine during the past two years," (Fernald, 'Agr. Maine,' 1875-1876, pp. 19-21). "Millions upon millions of them in Western Ontario," (Saunders, 'Ann. Rep. Ent. Soc. Ont.,' 1877, p. 4). "Very active and on constant parade over shrubs, fields, orchards, and gardens. They are recruited so plentifully from the forests, that we fairly sicken of the fight and despair of the prospects of victory," ('Gott, Ann. Rep. Ent. Soc. Ont.,' 1877, p. 41). "Had a fire passed through our orchards it could not have left our apple trees under more barren poles," (Burnet, 'Rep. Fruit Growers' Assn. Ont.,' 1877, p. 10). "Not so numerous as last year. . . . Mites destroyed many of the eggs and severe frosts in May, fungus diseases, parasites and birds, killed off many of the larvæ," (Saunders, 'Ann. Rep. Ent. Soc. Ont.,' 1878, p. 5 and pp. 28-30). "The tent caterpillars have almost entirely disappeared," (Saunders, 'Ann. Rep. Ent. Soc. Ont.,' 1880, p. 9). In these notes we have given very briefly the story of this outbreak which extended from 1874 to 1878 and did enormous damage over the greater portion of the Eastern Region.

In the year 1884 the insect was reported as very injurious in New Brunswick and Nova Scotia by Fletcher ('Rep. Ent. and Bot.,' 1885, p. 32). It was also referred to by Packard in the 'Fifth Report of the U. S. Entomological Commission,' pp. 117-118. This outbreak seems to have been quite local in character, but may have been the beginning of the next general outbreak, which began to attract attention in Vermont in 1886, when Lintner reported it as causing considerable injury to apple trees in that State. By the following year its ravages had spread over the entire Eastern Region, and in fact over the entire continent. Fletcher ('Rep. Exp. Farms, Canada,' 1887, p. 29) says, "The tent caterpillars were in great abundance all over Canada during the past season and seemed to attack almost every kind of deciduous tree." In 1888 it was reported as abundant in Maine ('Me. Agr. Exp. Stn. Rep.' 1888, p. 164) and the following year its ravages in that State were extremely severe. Most of the orchards and all the poplars, oak, cherry, and many other deciduous trees were completely defoliated in several sections, and railway trains were held up on several occasions for two and three hours at a time, by the innumerable legions of them crossing the tracks. Riley and Howard 'Insect Life,' 2, pp. 58-59). The same year Caulfield (Montreal) reports them as "all too common on our forest trees," ('Ann. Rep. Ent. Soc. Ont.,' 1889, p. 64). This was the end of the general outbreak for Bethune on page seven of the "Annual Report of the Entomological Society of Ontario," 1890, says "The tent caterpillars have been remarkable for their absence or rarity in all parts of Ontario." Only two local infestations are recorded that year, one being in the Penobscot Valley, Maine ('Me. Agr. Exp. Stn. Rep.,' 1890, p. 138), and the other in Washington County, New York (Lintner, '6th Rep.,' p. 106).

In 1891 a very severe local infestation was reported by Riley and Howard ('Insect Life,' pp. 477-478) on oak and gum trees in Carolina during which train traffic was seriously interfered with for several days.

In 'Bulletin No. 76 of the Vermont Agricultural Experiment Station' (1900) Perkins says that the insect began to attract attention in Vermont in 1895, and its ravages on maple became very extensive the following year, but it was not until 1897 that we again find general mention of the ravages of this pest. In that year Fletcher[1] reports them as "so abundant at Ottawa that they actually

[1]1897. Fletcher, Ann. Rep. Ent. Soc. Ont., p. 34.

starved themselves out by stripping." Harrington (Ont.) also reports the appearance of the caterpillars "in great numbers" on poplars and other trees. Perkins[1] in the same year reports it widely distributed over Vermont, many woods and orchards being entirely stripped. Their depredations were even more severe the following year, when Fletcher says ('Ann. Rep. Ent. Soc. Ont.,' 1898, pp. 84-85) "the Tent-caterpillars have been even more abundant than last year in almost every Province of Canada." Hutt and Moffat, ('Ann. Rep. Ent. Soc. Ont.,') both report them being so abundant as to interfere with the running of trains in many parts of Ontario. Their excessive destructiveness is reported by Weed in New Hampshire ('Bull. N. H. Agr. Exp. Sta.,' No. 59, pp. 199-201). Felt in his Fourteenth 'Report of the State Entomologist of New York,' says, "the ravages of 1897 and 1898 have been unprecedented in the annals of the State." In 1899 he[2] reports serious outbreaks, particularly in the Catskill Mountains and in the borders of the Adirondacks. "Ten cents per quart," he says, "were offered for the cocoons in many villages." The reports of Lowe ('Geneva N. Y. Bull.' 159) and Slingerland ('Cornell Exp. Sta. Bull.,' 170, pp. 559-564) corroborate those of Felt. Perkins[3] reports very great damage in Vermont in 1898 and 1899 and also states that "There have been occasional outbreaks since 1791, but the ravages of the present exceed any of the past both here, and in New York, Maine and Canada." Similar reports from other sections clearly point to this outbreak as exceeding both in severity and in extent, the ravages of any of the preceding ones. In 1900, the outbreak subsided, and in 1901 the caterpillars were reported as very scarce, all over the country. Three years later in the 'Annual Report of the Entomological Society of Ontario,' Fletcher states "not a moth or caterpillar of this species was seen at Ottawa this year," and in 1905, Evans ('Ann. Rep. Ent. Soc. Ont.,' p. 50) says, "The Tent caterpillar seemingly has disappeared entirely."

The insect did not again become numerous until 1910 when Hewitt ('Ann. Rep. Ent. Soc. Ont.,' p. 29) reported its occurrence in very large numbers in the Eastern Provinces and British Columbia. This marks the beginning of our latest outbreak in the Eastern Region, and its ravages are too well known by this generation to require much discussion here. Gibson reports hordes of the caterpillars and says, ('Ann. Rep. Ent. Soc. Ont.,' 1912, pp. 15-16) "It is the most remarkable outbreak of an injurious insect on record at Ottawa," and further stated that in the Gatineau Valley especially near Chelsea, many trains were held up, the evening passenger trains having been forced to use two and sometimes three engines in order to get along at all. Lochhead reported it equally bad in Quebec and their depredations were just as severe in New Brunswick and the Eastern States. Their ravages began to decrease in 1914, and in 1915 the insect had practically disappeared.

Central Region.

There seems to be no record of the Forest Tent Caterpillar in the Central Region until 1867, but it had no doubt been present in greater or less numbers for some time previous to this.

In his Third 'Report of the Insects of Missouri,' Riley reported this species as very destructive in 1867, and also the following year, in Arkansas and Missouri. The *American Entomologist,* Vol. 1, p. 208, records an outbreak of the insect in

[1]1897. Perkins, G. H., Vt. Agr. Exp. Sta., Bull. No. 60, p. 529.
[2]1899. Felt, E. P., Bull. No. 20, N.S., U.S. Div. Ent., pp. 60-62.
[3]1900. Perkins, G. H., Vt. Agr. Exp. Sta., Bull. 76, pp. 113-137.

Missouri in 1869, and in Vol. II of the same publication (1870) Riley states that the infestation was severe in Arkansas and Illinois, both that year and the preceding, and that it had been very destructive in Missouri during the past three years. Riley again reports it, ('Report Insects of Missouri,' VIII, pp. 22-26) as sometimes appearing in countless numbers in the oak forests of the South, and says, that in 1872 it was so abundant at Memphis, Tennessee, as to hold up trains on several occasions.

It may be well here to note that the above-mentioned outbreak was co-incident with the first general outbreak in the Eastern forests.

No further ravages of the insect are recorded until 1883, when Forbes reports them ('Thirteenth Ann. Rep. of the Illinois State Ent.,' 1883, p. 10) as having made a frightful inroad upon the apple orchards in Southern Illinois. He also mentions the same outbreak in his Seventeenth 'Report of the Insects of Illinois,' 1885, p. XIII. In his Fourth 'Report of the Insects of New York,' Lintner refers to this infestation in Illinois and states that it was arrested by a contagious disease known as muscardine.

As previously noted in the history of the Eastern Region, Fletcher, in 1887, stated that the Tent Caterpillars were in great abundance that season all over Canada so they were in all probability present in the Central Region or in the northern part of it at least. Bruner notes their occurrence ('Neb. Agr. Exp. Sta. Bull.,' 14, pp. 33-38) in Nebraska in 1890, and says they are frequently met with upon the prairies several miles from natural groves. In 1891, Murtfeldt ('U. S. Div. Ent. Bull.,' 26, pp. 40-41) reported a remarkable outbreak in Minnesota. She says the papers reported armies of them throughout the forests of the North-west, and a large portion of the forests were defoliated as well as many orchards.

The next outbreak recorded is in 1898, when Pettit[1] reports a severe infestation in some parts of Michigan. The same year Lugger ('Minn. Agr. Exp. Sta. Bull.,' 61, pp. 194-199) said the insect was fairly abundant in Minnesota, being more common than the Orchard Tent. Three years later, in the "Annual Report of the Entomological Society of Ontario," p. 119, Gregson states that the caterpillars were abundant that year in Assiniboia, and the insect was recorded for the first time, in Red Deer and Lacombe districts. Hudson[2] found a brood on *P. tremuloides* at Millarville, Alberta, in 1902; and Fletcher ('C. E. F. Report,' 1904) mentions finding what he thought was this species near Edmonton, "The moths," he states, "were in thousands just emerging." From these notes we would infer that the outbreak was quite general over the Central Region.

The infestation which was so severe in the Eastern Forests from 1910 to 1915, does not seem to have extended its ravages to the Central Region, and no further outbreaks have so far been recorded.

Western Region.

No information is available concerning the early history of this pest in the Western Region. The first reference to it is found in Saunders' "Insects Injurious to Fruits," published in 1883. In this he gives an account of the Forest Tent Caterpillar, and states that it is often very abundant in the West. This does not give us definite data concerning any outbreak, but assures us that the insect

[1]1898. Pettit, R. H., Mich. Agr. Exp. Sta., Bull. 175, pp. 349-350.
[2]1906. Dod, F. H. Wolley. Canadian Entomologist, XXVIII., N.o 2, p. 54.

was present for some time previous to that date, and that it was not so abundant some years as in others.

The first authentic record of an outbreak is given by Koeble, who states, ('U. S. Div. Ent. Bull.,' 23, p. 42) that this insect was found very abundant on Crataegus, alder, hazel and other trees in Washington in 1890. The same outbreak is recorded two years later, in the Third 'Annual Report of the Horticultural Society of British Columbia,' where it is stated (pp. 83-84) that "in some old orchards the foliage was entirely devoured." Also in the Third 'Report of the B. C. Department of Agriculture,' p. 1840, Mr. Wiltshire writes, "last year there were billions of these creatures and they completely stripped the crab-apple trees. This is the first year we have found them in the orchards." Dyar gives a full description of the insect in 'Psyche,' 6, 1892, stating that it was abundant in the valley of Columbia, and that in Portland, Oregon, many trees were defoliated by the larvæ. In 1894, Washburn, ('Oreg. Exp. Sta. Bull.,' 33, p. 16) records it as very abundant in Oregon, and the same year it was also reported as causing serious damage in many sections of British Columbia. From the foregoing notes we see that this outbreak was quite general over the Western Region and its ravages extended over a period of about five or six years.

Two years later, its presence was again reported in British Columbia, and the infestation had become very severe in 1898. In his 'Annual Report' for that year, Fletcher reports "countless thousands" of them, especially around Victoria and Agassiz, and, that many of the larvæ were parasitized and diseased. The following year only a few caterpillars were seen.

The history of the next outbreak is given by Tom Wilson in the 'Proceedings of the B. C. Entomological Society,' 1914, p. 37. He notes a slight infestation in 1907. The following year, a severe outbreak occurred from Washington and the United States boundary northward. In 1909 the infestation was doubled, and during the next two years enormous damage was done by the caterpillars. In 1912 the outbreak subsided and the following year they had nearly all disappeared. This outbreak thus seems to have extended over the whole of the Western Region, and its ravages greatly exceeded any previously recorded.

In 1915, the insect again began to attract attention in British Columbia, and this summer quite extensive ravages were reported on Vancouver Island. This infestation probably marks the beginning of another outbreak throughout the Western Region.

Fall Webworm.

Eastern Region.

Like the preceding insect, the Fall Webworm seems to have been originally a native of the Eastern Region. The first record we have of this species is that of Drury,[1] who described it from specimens collected in the vicinity of New York about the year 1770.

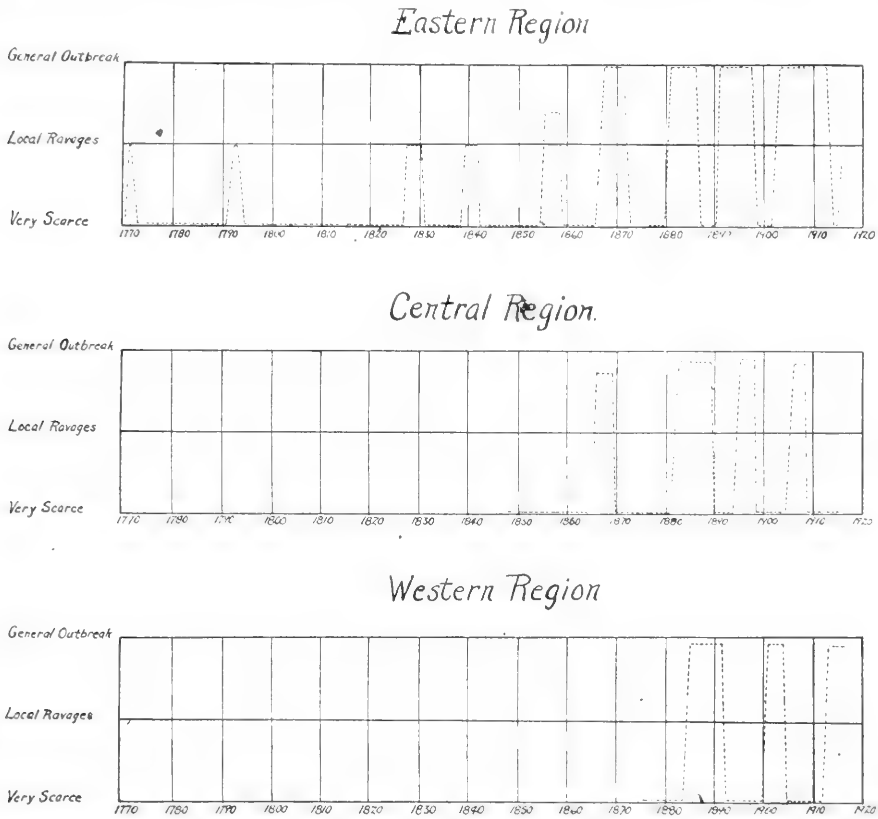
Twenty-seven years later, we find it described by Sir J. E. Smith, in his 'Lepidopterous Insects of Georgia,' as a native of Virginia and a very destructive pest.

In 1828, it was again described by Harris in the *New England Farmer,* Aug. 22nd, pp. 33-34, and six years later, he included it in his 'Catalogue of the Insects of Massachusetts,' No. 591.

[1]Drury. Ill. Nat. Hist., 1, p. 36, pl. 18 fig. 4, 1770.
Drury. Illustrations of Exotic Entomology, 1773.

Harris, again described the insect in his 'Treatise on Insects,' published in 1841, and here states, that the larvæ are "common and destructive little caterpillars whose large webs sometimes extending over entire branches with their leaves may be seen on our native elms and also on apple and other fruit trees."

No further notice was taken of the insect until 1856, when Fitch[1] reported it as "quite common around New York and Brooklyn," but he continues, "I have no knowledge of its occurrence north or west of the highlands." In the same year, Samuel Fowler[2] reported its ravages in Massachusetts, and in the



History of the Fall Webworm in North America. The dotted lines indicate the abundance of the insect.

Country Gentleman, Oct. 14th, 1858, p. 239, Fitch stated that it was "very abundant in New York State three or four times worse than for twenty-five years at least."

This was the first serious outbreak on record, and from the foregoing account it seems that the ravages of the insect have been increasing in severity, and that its sphere of destructive operations has widened. The next outbreak was much more widespread than any previously recorded, and extended north into Canada. It was first reported by Brackett, in the *Maine Farmer,* of Aug. 30th, 1866. The following year, Bethune states (*Canada Farmer,* Sept. 1st, 1867, p. 269) that a few colonies were reported from Hastings County, Ontario, and says that it is the first record for the insect in Canada, so far as known to him. He again

[1]1856. Fitch Asa., 3rd, Rep. Ins. N.Y., pp. 64-66.
[2]1856. Fowler, Samuel, 4th Ann. Rep. Sec. Mass., Bd. Agr., pp. 438-451.

refers to it in the *Canadian Entomologist,* 1868, p. 44, as "a common insect and likely to become only too familiar to apple growers." The same year, an account of the insect was given in the *American Entomologist,* Nov., p. 59, by Walsh and Riley, and they recorded it as "so numerous at Franklin, N.Y., that almost every apple tree contains half a dozen nests." In 1870, Hartwell ('Am. Ent. and Bot.,' 5, No. 2, p. 336) reported it as 'unprecedently numerous' at Wilkinsonville, Mass., and Bethune[1] recorded its great abundance in Ontario, that year and the year following. In the *Canadian Entomologist,* Aug., 1871, Saunders refers to it as "a serious pest just now affecting the apple trees. It has found its way into Ontario from the Eastern States within a few years past and is rapidly spreading." The following year, Bethune gave a popular account of it in the same publication ('Can. Ent.,' 1872, p. 141-143) and stated that it was extremely abundant and destructive throughout Ontario and the neighboring northern and central States. Saunders[1] refers to the destruction wrought by the larvæ in 1873, but no further accounts of their ravages were published for some time, so this was probably the end of the outbreak.

Seven years later, Riley ('Am. Ent. and Bot.,' Vol. 3, pp. 22-23) published an account of the widespread destruction of black ash by this species in New York; and the following year, he notes ('Am. Nat.,' 15, pp. 747-748) the beginning of an outbreak in Washington, D.C. Claypole[2] reported its presence on walnuts in Pennsylvania in 1882, and Saunders[3] (Ontario) in 1884, said the caterpillars had been found in great abundance on all kinds of trees. In the *Canadian Entomologist,* 1886, p. 23, Jack records their abundance in Quebec during the past three or four years; and the following year Harrington says ('Ann. Rep. Ent. Soc. Ont.,' p. 29) they were "very abundant and obnoxious throughout Canada." Riley also records the larvæ as exceptionally prevalent in the Atlantic States in 1886, when they became such a nuisance in the City of Washington that thousands of dollars were spent in their eradication. He later records in 'Bull. 10, U. S. Div. of Ent.,' that they were scarce the following year, which indicates that the outbreak came to an end about 1887.

It was not long, however, until the insect was again on the increase, for in 1890 it was recorded by Bethune[4] as exceedingly abundant in all parts of Ontario; and by Harvey[5] as very injurious in Cumberland County, Maine. The following year, Bethune ('Ann. Rep. Ent. Soc. Ont.,' 1891, p. 14) said it was even more abundant than ever in Ontario, and in *Garden and Forest,* 1891, pp. 291-292, Robbins, in a popular account of the insect given under the title "A Struggle with the Webworm," refers to its extreme abundance in New York State. In 1892, it was referred to several times by Bethune and Fletcher, as one of the most serious pests of our orchard and shade trees and rapidly increasing in numbers. The following year, Harrington[6] reported it as very abundant in Ontario and the Maritime Provinces and "as one of our most noticeable pests." Fernald ('Bull. 20, Mass. Agr. Exp. Stn.,' 1893, pp. 10-12) stated that it was very abundant throughout Massachusetts. Smith[7] states that the insect was

[1]1870. Bethune, C. J. S., First Ann. Rep. Ent. Soc. Ont., p. 20.
[1]1873. Saunders, Wm., Ann. Rep. Ent. Soc. Ont., p. 13.
[2]1883. Claypole, E. W., Ann. Rep. Ent. Soc. Ont.
[3]1884. Saunders, Wm., Ann. Rep. Ent. Soc. Ont., p. 12.
[4]1890. Bethune, C. J. S., Ann. Rep. Ent. Soc. Ont., p. 7.
[5]1890. Harvey, F. L., Ann. Rep. Me. Agr. Exp. Sta.
[6]1893. Harrington, W. H., Ann. Rep. Ent. Soc. Ont., p. 27.
[7]1895. Smith, J. B., Ann. Rep. New Jersey, Exp. Stn., p. 386, 458-460.

decidedly on the increase in New Jersey in 1895, the outbreak being the worst in his experience. Howard also mentions it in the 'Year Book of the U. S. Dept. of Agr.,' 1895, pp. 361-384, and says that it did much damage in Washington, D.C., in 1895. In 1896 it was still fairly abundant in some localities for Dearness in the 'Ann. Rep. Ent. Soc. Ont.,' p. 24, says "I know of two localities where every black ash, of which there were a great many trees, was completely defoliated. Weed ('Bull. 59, N. H. Agr. Exp. Stn.,' Nov., 1898) also recorded the caterpillars as "extraordinarily abundant" in New Hampshire and as causing serious injury. An infestation occurred in Maine in 1899, and probably in New York as well, since Felt gave an account of the insect that year in the *Country Gentleman,* p. 593.

The insect does not seem to have attracted attention again until 1903, which marks the beginning of our latest outbreak. In the 'Ann. Rep. Ent. Soc. Ont.,' for that year, Fletcher records it as "noticeably on the increase of late." Two years later Lochhead[1] found it "unusually numerous" at Guelph although it was apparently still quite rare in some parts of the Province (Ontario). In 1906, Young[2] (Ottawa) says its conspicuous nests were noticed in many orchards and also in the forest. In the 'Annual Reports of the Entomological Society of Ontario' for 1908 and 1909, its great abundance was noted by Gibson and Lochhead, and in the 1910 Report, Gibson states (p. 13) "During my residence in Ottawa since 1899 I have never seen so much injury by this well known pest as was done this year. It has been abundant this year all through Eastern Canada and the United States." Gibson[3] again refers to it as being present in "unusually injurious numbers" in 1912. The next year the infestation began to decrease and in 1914 the insect practically disappeared. This last outbreak was by far the most widespread and severe of any which have been recorded.

Central Region.

The first record of the presence of the Fall Webworm in the Central Region is given by Walsh, in the *Practical Entomologist,* July, 1866, p. 101. In this, he states that this insect was reported by Marion Hobart as found on apple and other trees and more commonly on pignut-hickory in Illinois. The following year, he says (*Practical Entomologist,* March, 1877, 2, p. 72) that reports from Illinois indicate many nests on wild cherry the previous autumn. In 1868 Walsh and Riley ('Am. Ent.,' 1868, Nov., p. 59) record them as having "covered the hickory trees with webs" at Madison, Wisconsin. Three years later, in his 'Second Report of the Insects of Illinois,' p. 18, Walsh writes "The Fall webworm has heretofore not been regarded as holding more than a third rank in the catalogue of noxious insects but they seem to be on the increase this season." The same year, Riley states in his 'Third Report of the Insects of Missouri,' p. 130, that this insect was "unprecedently numerous all over the country during the summer and fall of 1870." Kridelbaugh[4] reports its ravages in Iowa during the same year.

The next available record of the insect was given by Osborn in the *Iowa State Leader,* Oct. 14th, 1882. Four years later, its ravages were reported in this region by Weed in the Prairie Farmer, July 24th, 1886, p. 409, and in 1888 MacMillan[5]

[1]1905. Lochhead, Wm., Ann. Rep. Ent. Soc. Ont., p. 137.
[2]1906. Young, C. H., Ann. Rep. Ent. Soc. Ont., p. 16.
[3]1912. Gibson Arthur, Ann. Rep. Ent. Soc. Ont., p. 15.
[4]1871. Kridelbaugh, S. H., Ann. Rep. Iowa State Hort. Soc., pp. 153-167.
[5]1888. MacMillan, Conway, Bull. Agr. Exp. Stn., Neb., Feb. 1888, pp. 64-68 and 96-100.

records it as a common insect of Nebraska. Its great abundance in Missouri the same year, was noted by Mary E. Murtfeldt in the 'Ann. Rep. Ent. Soc. Ont.,' 1892, pp. 58-59. Garman noted its "excessive ravages in Kentucky" in 1890, but says that fifty per cent. of the larvæ were killed by a fungus disease, so this was presumably nearing the end of the outbreak.

There was probably another outbreak between 1895 and 1898, but the following references, seeming to indicate this outbreak, were not available to the writer. H. E. Weed gave an account of the Fall Webworm in the *Southern Cultivator,* Sept., 1895. Webster published some notes on several species of injurious insects including the Fall Webworm in the *Ohio Farmer,* May 30th, 1895. In the *Kansas Farmer,* June 20th, 1899, pp. 438-439, the Fall Webworm among other insects, was treated by E. A. Popenoe. The same account was also given in the "Transactions of the Horticultural Society of Kansas," 1898.

In 1906 the insect was reported as very abundant in Ohio by Berger,[1] and two years later Smith of the Nebraska Division of Entomology (Circ. No. 5) records its depredations on shade trees of towns and cities all over the State. Its ravages were reported in the same year from Minnesota by Washburn ('Minn. Agr. Exp. Stn. Bull.,' 112, pp. 180-183). This is the latest outbreak recorded from the Central Region, and although it seems to have been very severe but little information concerning it is available.

Western Region.

Our information concerning this insect in the Western Region is very meagre. The first record of its presence is given by Bethune in the 'Ann. Rep. of the Ent. Soc. Ont.,' 1887, p. 58. Here he states that "last autumn (1886) Professor Saunders observed it defoliating trees in British Columbia." The next reference found is in the 'Fourth Ann. Rep. of the Hort. Soc. of B.C.,' where it is referred to as "very destructive" around Chilliwack in 1893. It is also referred to in the 'Fifth Report' of the above society, and the following year Piper stated ('Bull. 17, Wash. Agr. Exp. Stn.') that it was common all over the State of Washington.

In the 'Report of the Experimental Farms,' 1903, Fletcher states that "The webs of this Arctiid were very conspicuous in British Columbia" that season, which would indicate another outbreak of the insect at about that time.

The next reference to it is by Brittain in 1912 ('Proc. B. C. Ent. Soc.,' p. 15) when he noted the "abundance of the webs on apple and wild shrubs" in British Columbia. This was no doubt the beginning of the present outbreak which attracted so much attention last year.

MR. WINN: Is any record being kept of any particular locality, such as Fredericton, without going so many miles away for a record? Are you attempting to keep any record of your own individual locality of either of these insects.

MR. BAIRD: Yes, we have a fairly complete record of the different localities in New Brunswick.

MR. WINN: About five years ago I wanted to get the eggs of the Forest Tent Caterpillar to send to a friend in Yorkshire, England, and I could not get the eggs for love nor money. Prof. Swaine, however, very kindly procured some eggs for me; these were from Nova Scotia and were extraordinarily abundant. It shows that in certain localities there is a great abundance while there are none

[1]1906. Berger, E. W. Bull. U.S. Bur. of Ent., No. 60, pp. 41-51.

in other parts. During this past year you may say both the American and the Forest Tent Caterpillars have become extinct on Montreal Island, while at St. Hilaire, Que., only 22 miles east, on the 24th of May this year there were thousands of caterpillars in a space as large as this room; I should think without exaggeration there were 500 *americana* webs there. A fungus disease killed off both insects apparently and not only killed off the Tent Caterpillar, but a very large number of other caterpillars as well. We don't know when they are coming back, and if any record could be kept of the number of years between certain outbreaks we might know when the next infestation or migration or whatever it may have been is likely to occur so that we could prepare for them. Fruitgrowers would no doubt like to know ahead of time so that they could head them off.

Dr. Hewitt: In reference to your enquiry as to whether any definite record is being kept, this is work of which Mr. Tothill has charge primarily. He has charge of the investigations on the natural control measures of three of our most common deciduous pests, viz.: Forest Tent Caterpillar, Fall Webworm and Spruce Budworm. Our idea in carrying on these investigations—which have already covered a period of four years—is to study all those factors which go to control these pests. For that purpose we have established in the Province of New Brunswick nine different points at which observations have been made every year at least for the last three years and in some cases for four years, so that we have exact records of what has taken place in regard to abundance, parasites and other means of natural control. In addition to that we are now undertaking investigations to cover the whole of Canada so far as we can. Next year Mr. Tothill will probably be in the West making observations on the occurrence and, so far as he can, the natural means of control of some of these insects, particularly the Fall Webworm and the Western Forest Tent Caterpillar in the Prairie Provinces and in British Columbia, our idea being to secure as thorough a knowledge as we can of the factors which go to control these insects under natural conditions. We have been rather prone to attribute everything to insect parasites; that has been in some cases an assumption not based on sufficient evidence and already very interesting results have come out, but of course, as I have said, we are undertaking to carry on these investigations for a number of years.

I have not had time to discuss this paper with Mr. Baird yet but there is one point which seems to me of interest and importance. You will notice from his charts that there is a certain amount of regularity in regard to the outbreaks in what I would call the historical period which goes back to about the middle of last century but if we call the period before that the pre-historic period so far as exact observations by entomologists are concerned I think we can explain the nature of the evidence of that period. I feel rather inclined to attribute the apparent local restriction of the ravages as Mr. Baird has termed them in his charts of the Fall Webworm and the Forest Tent Caterpillar not so much to the fact that they were actually local but to the fact that the observations did not extend over a large area. Consequently the records of abundance were confined to certain localities.

Prof. Lochhead: These charts are very interesting to me and I think the study is very timely. The charts reveal a great deal, it seems to me. There is one thing that stands out and which impresses me very much, a point which applies to the Forest Tent Caterpillar as well as the Fall Webworm. It seems that the chief factor in the limitation of these pests is that the parasites are apparently everywhere at the same time and that the outbreaks occur in the same years almost throughout the three different regions. It looked that way to me when looking at those charts just now.

Dr. Hewitt: I do not think they quite coincide, *e.g.*, the 1870 and 1880 outbreaks.

Prof. Lochhead: Outbreaks are coincident, and the parasites must have developed in the different regions at the same time and in greatly increasing numbers. That would seem to eliminate any method of control—for example, the distribution of parasites that would tend to prevent the outbreaks. In the Northern Forest Districts between those of the Central or Western at different times it might be possible, if we had better resources at our hand, to carry parasites from one district to the other.

Dr. Bethune: I might mention one instance of very exceptional natural control in connection with the American Tent Caterpillar. It was about 25 years ago when at Port Hope we had a steadily increasing abundance of these insects from year to year; they were extremely numerous. In this particular spring the caterpillars had emerged from their cocoons when the apple buds were just opening and we had a very severe frost that killed them all; we saw no more of those tent caterpillars for three or four years. Of course that would be a very exceptional case.

Mr. Harrington: In reference to the tent caterpillar I may say that the first time I was in British Columbia, that is about 1888, there was a serious infestation then in the district around Victoria. Parasites were lessening the ravages. That would correspond apparently with the first outbreak that is on that chart of the Western Region in 1888. The infestation was very heavy. With regard to more recent infestations which we have had in this eastern section of the country, of course three or four years ago the ravages were very serious in certain districts of Quebec Province. Some species of trees, poplars, etc., were almost totally defoliated for two or three years and the caterpillars were so numerous as to stop the trains. I know this is a fact, because I was on a train which was stopped by caterpillars on the track. That infestation has been checked now, and I think principally by the tachina flies as the infestation reached its maximum. There is no doubt, I think, that the caterpillars were almost entirely wiped out by these tachinids although last year there were, of course, webs to be seen in the same district. They build almost entirely on the wild cherries which are the natural habitat of the caterpillar under ordinary conditions. They seldom spread to other trees until the infestation increases towards the maximum, and that appears to be about every ten years, as far as my recollection goes, of the occurrences which I have seen in thirty or forty years. Sometimes, of course, caterpillars are subject to a fungus disease but the reduction of the numbers I think is chiefly due to our good friends, the tachinids.

Prof. Caesar: I wonder if Mr. Harrington has reared those tachinids.

Mr. Harrington: I did a good many years ago.

Prof. Caesar: The reason I ask is because I collected quite a number of Forest Tent Caterpillar cocoons and reared the parasites from them, and they were all *Sarcophaga aldrichia*, a new species described two years ago. I do not mean that those Mr. Harrington saw were not tachinids, but all I reared were sarcophagids.

Mr. Gibson: We collected a large number of the cocoons and I remember distinctly sending a lot to Mr. Tothill who failed to report on them.

Mr. Baird: I do not think anything was ever reared from those; they were in poor condition when they arrived as they were a long time in reaching the laboratory.

Prof. Caesar: I merely mention this matter because it is possible we are not doing justice to the sarcophagid flies.

Dr. Hewitt: I think Mr. Tothill has raised both tachinids and sarcophagids.

FRIDAY AFTERNOON.

Mr. Winn: The programme is a very lengthy one and this year I think it would again be advisable to dispense with the Presidential address. As practically all matters connected with our season's work have been covered by our various reports the address would be either largely repetition or else be merely a paper and I have already read one. Before the programme was completed and found to require all the available time, I thought of two subjects that might be of interest. One was to show a series of slides that I had begun preparing with Mr. H. M. Simms of our Montreal Branch, calling attention to the very curious microscopic objects known in Europe as "battledore" scales or "bladder-scales" of the Blue butterflies. These are found on the wings of the males only and are much smaller than the regular wing scales and apparently each species has its own characteristic size, shape and pattern of "battledore." We have not succeeded in obtaining specimens of quite all the North American so-called species, but with the kind assistance promised it is hoped that by the time Mr. Simms returns from "somewhere in France" we may have an almost complete series to show.

The other idea that occurred to me was in connection with the Society having spread from a centre which was originally Toronto, then London, now Guelph, always in Ontario, to a national Society extending from the Atlantic to the Pacific. We have branches in Nova Scotia (represented by Prof. Brittain) the Montreal Branch, Toronto Branch and the parent Society in Guelph, individual members scattered through all the Provinces and a very flourishing Branch in British Columbia. I thought the annual address might take the form of a composite article by all the different branches regarding the insect collections of the Dominion of Canada. I have spoken to Dr. Walker and he thinks this can be arranged by a series of articles published in the *Canadian Entomologist* as part of the popular series now being printed. It would be impossible to read such a report at a meeting like this; I leave it for your consideration, and if found feasible, your co-operation.

CAMP HYGIENE.

Capt. G. J. Spencer, O.A.C., Guelph.

The main object of military hygiene is to keep men healthy, or else they cannot march. In camp certain factors control this, such as food, work, exercise and the condition of the body. As far as food is concerned, a Canadian soldier is fed more generously than one of any other nationality, as he is allowed five pounds of food a day. Beef constitutes the invariable meat ration, because it can be more easily obtained, is cheaper, and is more preferable to the men; potatoes, peas, beans, carrots and cabbages, are the standard vegetables; coffee and tea are supplied at breakfast and supper. Meals are drawn up a week ahead on a diet sheet, and it lies with the Quartermaster of each battalion to vary this, and to make the meals as appetizing as possible. The men are generally allowed to have as much as they can eat. Extras of food such as pie, cookies and fruit in season, are supplied when canteen funds permit.

I need not say anything about work. Exercise is supplied by a carefully arranged syllabus of physical training and bayonet-fighting, on a system calculated to stretch all the muscles of the body, and to produce speed and quickness, rather than over-developed, hard muscles. No apparatus is employed. The bayonet-fighting is a combination of the British and French systems, and was made up to meet the exigencies of trench warfare. Men are taught to kill their opponent, or to put him out of action in any way possible without any "gentlemanliness" or rules of fair fighting. Boxing, which is much akin to bayonet work, and games of skill, are always taught and encouraged.

To insure immunity against typhoid and smallpox, every officer and man is inoculated and vaccinated.

Life in a training camp, as far as it concerned Camp Borden, was intended to fit for the front, as far as could be done in this country, men who were already hardened to military life, and had already received their preliminary training. The general health of the camp was excellent. The problem of sanitation was reduced to a minimum on account of an extensive and excellent system of plumbing, which provided almost hotel conveniences. Strict rules were made against throwing rubbish around or committing a nuisance anywhere in the camp area, and because the wash houses were at one end of every battalion area, tubs were placed in each company line for the convenience of the men at night. These were removed the first thing in the morning. The men slept in bell tents, 8 to 10 men in a tent, and the notorious Camp Borden sand was soft to lie on, until wooden tent floors were brought from Niagara Camp for some of the battalions.

What with the open air life, the work and exercise, the freedom from city evils and an abundant supply of the purest water for drinking and shower baths, the health of the men was excellent, and their physical condition greatly improved through the summer.

As far as Entomology is concerned, I know of only three cases of lice in our battalion all the summer, one of head and two of body lice. The treatment was one of prevention, but where a case of infestation occurred, the subject was at once taken to medical headquarters and given a prolonged hot bath, while his clothes, blankets and kit, and that of all the other men in his tent, were passed through carbolized steam under pressure for half an hour, and were ready for him after the bath. This treatment worked admirably, and no second application was necessary. The carbolized steam installation was used to sterilize the blankets of the camp, and could treat those of a battalion, *i.e.*, about 4,000, in a day. This was done once a month, for each battalion. A system of the same kind is being installed at the headquarters of each military district and it is proposed to periodically treat the blankets of the battalions in winter quarters.

House flies were a nuisance and increased rapidly throughout the summer. The five cook-houses of each battalion were wire screened and provided with spring wire doors, but flies were troublesome in the men's tents. With regard to our brigade, I could not account for the pest of flies, because the most stringent rules were enforced about garbage and refuse of all kinds. Special bins were provided for all waste matter and horse manure, and were emptied daily by a Government contractor, who carted it away. Fatigue parties picked up all rubbish twice daily, and later in the summer, sheet iron incinerators were provided, that burnt all garbage, waste paper, horse manure and camp sweepings. And still the flies increased! If all the brigade areas were as well kept as was our own, I am at a loss to explain the pest of house flies, as I could not discover any breeding places. In the Quartermaster's stores, the Canteen, the Hospital and some of the office tents, the men used Jeyes' fluid, which was issued from the stores, in the proportion of one half to one pint per pail of water, for spraying around on tent walls and furniture. This was fairly effective as a preventive, and I showed some of the orderlies how to make nets from wire and cheese cloth, which they used all the rest of the summer, taking keen interest in fly hunts for competition.

One other point of Entomological interest occurred this summer. A private in my company, formerly a High School student and a boy of clean habits, was admitted to the Base Hospital in Toronto for an abdominal operation. When he got to Toronto he suffered with slight earache, and two days after admittance this increased to intense pain, and he found newly hatched maggots crawling in his ear. He promptly reported it to the doctor, who ordered irrigations of boracic acid, followed by alcohol and bichloride, 1 to 8,000. After three days of this treatment, all trouble ceased. To my disappointment, I found that neither patient nor doctor had preserved any of the maggots, and they were not identified.

In conclusion, hygiene on the march is much as I have outlined it for camp. Meals cook in travelling field-kitchens as the wagons follow the column. The water supply is inspected by the Medical Officer, who rides on ahead with a Field Officer, to select a site for the camp. As soon as a force halts, temporary latrines are dug as far away from the kitchens as possible, and after use are covered in and marked with the letter "L" in stones or sods, as a warning for troops following on behind.

THE EXPERIMENTAL RESULTS IN APPLE MAGGOT CONTROL.

Prof. W. H. Brittain, Truro, N. S.

The work of our department with the apple maggot began in 1913, when an inspector, sent to investigate a report of this pest near Digby, uncovered a severe infestation in that locality. One of the worst infested orchards was selected for experimental purposes the next season.

The work for the next two seasons was conducted by my assistant, Mr. C. A. Good, who has given a full account of his work in the Report of the N. S. Entomological Society for 1915.

In the first year of our work, the mistake was made of spraying only a portion of the orchard, leaving the rest as a check on our work. There was, it is true, a decided advantage of the sprayed over the unsprayed portion, the former showing an infestation of 12 per cent. in the fruit of all varieties, and the latter of 44.7 per cent. We also sprayed isolated trees in infested orchards, getting no reduction in injury, one such tree showing an infestation of 99 per cent. From this it was evident to us that it was useless to spray only a portion of the orchard, on account of re-infestation of sprayed trees from neighboring unsprayed ones.

In the meantime our inspectors had uncovered another severe outbreak of this pest in the neighborhood of Windsor. Both the Digby and Windsor districts, one situated on the west, the other on the east of the main fruit belt, afford exceptional facilities for spraying work with this pest. The orchards are small and isolated, and a number of them suffer from very severe outbreaks of the maggot. This gave us an opportunity of thoroughly testing the use of the sweetened poison in this locality, since it was an easy matter for us to secure suitable orchards for spraying, and take neighboring ones for use as check orchards. Five orchards were accordingly selected in each district, three being treated twice with arsenate of lead and molasses, and two left as checks. In checking up the results of our work we counted, as nearly as possible, all the fruit from the experimental trees, a total of 260,000 in 1915.

The results of this work having already been published, it is unnecessary for me to refer to them in detail, except to say that they were a striking success, though the season was a very wet one. Orchards in which the fruit of susceptible varieties had been a total loss for a number of years past, gave us fruit that was 95 per cent. free from infection.

A number of experiments were conducted during the season with flies confined in cages over apple seedlings, which were sprayed with various poisons, both with and without molasses. The results showed the interesting fact that, under these conditions molasses was of no particular benefit. Though these conditions were not by any means normal for the flies, this experiment suggested the possibility that the molasses might be eliminated without lowering the efficiency of the spray.

Next season additional orchards were chosen, making altogether three sprayed and two check orchards at Windsor, and six sprayed and two unsprayed at Digby. Three arsenicals, viz: lead arsenate, calcium arsenate and barium arsenate, were used, both with and without molasses. Briefly summarized the results were, that all these sprays effectively controlled the maggot, and that there was no noticeable advantage in those containing the molasses.

This fact that we have thus demonstrated experimentally is substantiated by much indirect evidence. The most significant fact brought out by our inspection is that both the badly infested districts are outside the main fruit belt, where spraying has never been practised. As soon as we get into the well sprayed parts of Kings and Annapolis, the pest begins to disappear. In spite of this, we have been able to find the pest in the haws at various points throughout the Annapolis Valley. In one such locality I have been informed that years ago there were severe infestations of this pest in the orchards of the district, but that with the advent of arsenical sprays it gradually disappeared. A very careful search also revealed the presence of the insect in apples at widely separated points. Inquiry here also elicited the information that formerly the pest was much worse in such localities, but finally died out as spraying became general.

There can thus be little doubt from the evidence on hand, that sprays of arsenicals alone will control the apple maggot, and that the arsenical residues from the sprays ordinarily applied in the orchard are usually sufficient to keep it in check.

Prof. Caesar: I have listened with a great deal of interest and pleasure to Prof. Brittain's paper, especially as his results corroborate so fully those secured by Mr. Ross and myself during the last four years. Our first tests with sweetened arsenate of lead as a means of control for the insect were on undivided trees or groups of trees in an orchard instead of on the whole orchard, because at that time we believed, along with most other entomologists, that this insect did not fly much from one tree to another, but remained close to the same tree through its life. Our results showed that if this were true, spraying with sweetened arsenate of lead was quite unsatisfactory as a control measure. Fortunately that same year I was studying the very closely related two species of Cherry Fruit-flies, and found in the course of my work proof that these moved around freely from tree to tree, though we should not have suspected it to watch them. This discovery along with the excellent results obtained against the Cherry Fruit-flies by the use of arsenate of lead and molasses, led us to hope that by spraying a whole orchard at a time, or at least very large blocks of trees, the same good results from the poison on the Apple Maggot might be obtained as had been so easily obtained against the Cherry Fruit-flies. Acting on this hope we conducted a series of spraying experiments with sweetened arsenate of lead in 1914, 1915 and 1916, and as a result of these experiments both of us were thoroughly convinced that arsenate of lead and molasses was a simple and satisfactory means of control. We did not try, except in cage experiments, arsenate of lead, or any other poison alone, simply because we found it difficult to discover a sufficient number of orchards in which to make satisfactory and separate tests of more than the one remedy. We plan next year to make such tests, and also some others that we have been working on this year in a small way in cages, and that seem to promise well.

As to the length of time it takes arsenate of lead to kill the adult, I cannot recall the results Messrs. Ross and Good obtained, but this year I conducted a series of cage experiments begun shortly after the flies began to emerge, and continued until they disappeared from the orchard. These showed that flies caught in the orchard without injuring them and put into cages with poisoned and unpoisoned leaves and fruit in the same cage and watered daily, died on an average in less than three days, whereas the check flies lived a much longer time. Moreover, there is good reason to believe that even though an orchard is not sprayed until a number of flies are ready to lay eggs, the poison acts in such a way as to stop egg laying almost at once after it is eaten by the fly, even though she herself may live a few days longer before death ensues.

As to the sweetened poison attracting flies from some distance, I have never been able to see the least proof that this was true either of the Cherry Fruit-flies or of the Apple Maggot. They merely eat it if it happens to be on the leaf or fruit where they are feeding; they do not go in search of it.

EXPERIMENTS ON THE CONTROL OF LOCUSTS WITH COCCO-BACILLUS ACRIDIORUM D'HERELLE.

E. Melville DuPorte and J. Vanderleck, Macdonald College, Que.

Since 1910, when d'Herelle isolated from diseased locusts in Mexico a bacterial organism causing an epidemic disease in these insects, efforts have been made in various parts of the world to utilize this organism in the destruction of locusts. D'Herelle himself in the year following his investigations in Mexico, conducted experiments in the Province of Santa Fé in Argentina, and reported remarkable success.

Sergent and l'Heritier, working in Algeria in 1913, did not have an unqualified success in their attempts to disseminate this disease, for while they were able to collect dead locusts by hundreds in the areas which they had infected, they found that the size of the swarms was not appreciably diminished. They attributed their failure to three contingencies. Either the infection did not spread through the majority of the migrating swarms, or many of the locusts possessed a natural immunity, or else they easily acquired an active immunity against the organism.

As a result of his work in South Africa Lounsbury, in 1913, came to the conclusion that in this country the method of d'Herelle can be used only as a supplementary measure, and that only under certain conditions. It cannot be used as a substitute for arsenical poisoning.

Further work in Algeria, in Tunisia and in Morocco, has demonstrated that this method can bring about a considerable reduction in the size of the swarms of the migratory locusts which invade these countries. In each case it was found possible to create an epizootic centre by placing a few diseased locusts among the healthy ones.

In the summer of this year (1916) at the request of Dr. Hewitt, the Dominion Entomologist, we conducted experiments at Macdonald College, to determine whether d'Herelle's infection method could be effectively used in combating the locusts of Eastern Canada.

Increasing the Virulence of the Organism. D'Herelle found that when kept for some time in artificial culture the organism gradually loses its virulence, but that the virulence could be progressively increased by passing the organism successively through a series of locusts. The culture sent us by Dr. Hewitt was obtained by him from d'Herelle, and was consequently quite old when our work was commenced. In order to obtain an active culture, and to have this on hand for daily use, we inoculated several locusts each day with a suspension of the intestinal contents of one of the locusts dead from the previous day's inoculation.

The first lot of nymphs was inoculated directly with d'Herelle's pure culture. At the end of twenty-four hours thirty-three per cent. were dead, and at the end of forty-eight hours fifty per cent. In five days all of the inoculated locusts had succumbed to the disease. Plates poured from the intestines of the dead locusts gave a pure culture of *Coccobacillus acridiorum.* One of the locusts which had died during the first twenty-four hours was carefully opened with sterilized instruments and a suspension of a portion of its intestinal contents made in sterilized water. This suspension was used to inoculate the second lot of locusts. This second lot died slowly, only 83 per cent. having perished at the end of five days. The third and fourth lots showed an increase in the virulence of the organism, but in each case there were three insects surviving after twenty-three days. Of the sixth lot sixty per cent. were dead at the end of twenty-one hours and the remaining forty per cent. at the end of thirty-four hours. Sixty-four per cent. of the seventh lot died in twenty-two hours, and the remainder were all dead within thirty hours from the time of inoculation. After this the virulence of the organism progressively increased; no locusts survived, the deaths occurring in four to twelve hours. Thus our experience in increasing the virulence of the organism coincides with that of other workers.

Insects Affected by the Disease. The pathogenicity of the organism was tested for all species of locusts and grasshoppers commonly occurring in this region. These were *Melanoplus femur-rubrum, M. bivittatus, M. atlanis, Dissosteira carolina, Camnula pellucida, Stenobothrus curtipennis* and *Xiphidium* sp. The coccobacillus proved to be pathogenic to all these species. It gave us considerable satisfaction to observe that the animal parasites were apparently not affected by the disease. Innumerable individuals of *Gordius* emerged alive from inoculated locusts, and we were able also to rear several adult *Sarcophagids* from these diseased insects.

An Indigenous Organism. On August 16th, before any experiments were started outdoors, a dying *bivittatus* was found about a quarter of a mile away from the laboratory. The intestines were decayed into a black mass resembling that of insects killed by *C. acridiorum*, but not quite so slimy. Agar plates were made from the contents of the intestines and a practically pure culture of a bacillus closely resembling that under study was obtained. Twenty locusts were inoculated with this organism, and all but one died within forty-eight hours. From these dead locusts a series of successive inoculations was made to determine whether the organism would increase in virulence similarly to *C. acridiorum*. We found that this was the case; the later ones in the series dying very much sooner than the earlier ones.

A very large number of other locusts, healthy, sickly or dead were collected on Montreal Island, and other islands in the Ottawa as well as on the mainland along the north shore of the Ottawa. In almost every case this organism was found in the intestines. We are at present making a study of it to determine whether it belongs to the same group as *Coccobacillus acridiorum*.

Experiments in the Laboratory.

In order to become acquainted with the nature of the disease before working with it in the field, we conducted numerous experiments in the laboratory, the results of which are here briefly summarized.

Several locusts were sprayed with a suspension of the coccobacillus, and put into a sterilized cage. At the end of eight days fifty per cent. of these were dead. The others remained alive for several days after when their death could not with certainty be attributed to the organism, because several of the dead locusts were parasitized, and it was often difficult to tell whether death was due to the disease or to animal parasites; it must therefore be borne in mind that an appreciable proportion of the deaths recorded in this and other experiments was probably due to parasites.

Experiments were tried to determine whether the disease would spread rapidly from dead or diseased locusts to healthy ones. To this end a number of healthy insects were placed in cages with dead ones. The species used was largely *M. femur-rubrum* with a few individuals of other species. A very low mortality was obtained. It was observed, however, that occasionally a *bivittatus* would feed on the dead insects, and in order to determine the effect of this habit on the spread of infection *M. bivittatus* and *M. femur-rubrum* were placed in equal numbers in a cage with fragments of dead locusts. At the end of eight days eighty per cent. of *bivittatus* were dead, and only twenty per cent. *femur-rubrum*. In this connection it may be stated that in the cases in which investigators have obtained successful results in the artificial dissemination of *Coccobacillus acridiorum* the locusts experimented upon showed marked cannibalistic tendencies, the healthy ones devouring the sick and dead.

Placing healthy locusts in unsterilized cages in which diseased locusts had been confined and had died but a few hours previously caused no disease or death.

A number of locusts were fed with a bran mash to which a suspension of *C. acridiorum* had been added. At the end of seven days fifty per cent. were dead, four days later the mortality had reached seventy-five per cent. The remainder were removed to a clean cage, and eight days after their removal were all dead. It is thus evident that ingestion of the organism will produce disease and death.

Field Experiments.

An attempt was made to establish an epizootic centre in a field of clover badly infested with *M. femur-rubrum,* and to a lesser extent with most of the other species used in the laboratory. A small area of this field was treated with bran mash, to which a culture of the organism had been added. The field was examined carefully for several days, but no evidence of the establishment of an epidemic among the locusts could be obtained. A large number of locusts was collected from the infected area and placed in cages in the laboratory, but the disease failed to develop among them. The experiment was repeated on a badly infested lawn with a similar result.

In order to check results more definitely outdoors, a small area of a lawn was enclosed with a wire screen, and a large number of locusts included. First of all the enclosed area was sprayed with a bouillon culture of the coccobacillus. At the end of a week there were no deaths. The failure of this experiment may have been partially due to the death of the organism, as a result of its exposure to bright sunlight.

The wire cage was next moved to a new locality and bran mash sprinkled on the grass. From this a high mortality was obtained.

Twenty locusts inoculated with a virulent culture of the organism were next introduced among the healthy locusts in a new enclosed area. The cage was examined every day, and at the end of the fifth day there were only thirty-nine dead, including the twenty inoculated individuals. The experiment was continued for several days, but no further deaths were observed.

Conclusion.

The foregoing investigations point to the conclusion that the infection method of d'Herelle for the control of locusts is not practicable in Eastern Canada, because of the probable immunising effect of a native bacillus, and also because the principal means of the natural dissemination of the organism seems to be the eating of the dead or diseased locusts by the healthy ones, a cannibalistic tendency which exists only in a very slight degree in our native species.

There may, however, be conditions under which this method may prove effective, so that we hesitate to say definitely after only one year's work, that it can have no place in control methods in Eastern Canada.

Dr. Hewitt: Perhaps if I were to explain the genesis of this work it might facilitate discussion afterwards. I have been in correspondence with Dr. d'Herelle for some years, and in 1913 obtained specimens of his culture from him, and had one of our officers, Mr. Petch, work with it that year, and the two following years, and we found that *C. acridiorum* was pathogenic to our native species, especially the species which are most abundant. In 1914, we carried out our first field experiments in control, but the climatic conditions were such that we did not feel justified in placing any definite conclusions. In 1915 the conditions were more favorable, and we used the bouillon exactly as d'Herelle had instructed in his letters to me. as well as in his papers, but we were unable in that year with every condition favorable to find that it could be used in Eastern Canada at least in the Province of Quebec, where these experiments were tried.

As I knew that the authors of the paper just read were studying the micro-organisms affecting insects, I took the matter up with Dr. Harrison, and suggested that they carry on these experiments with *C. acridiorum* still further, because I realized that the combination effects of a bacteriologist and entomologist were required. As I had no bacteriologist on our staff, I thought this a favorable opportunity, and I am very pleased to find that the conclusions of one season's work confirm the conclusions that we had come to as a result of our experiments.

I think the suggestions they make in regard to the reasons for the lack of success, viz: that in the first place we may have comparative immunity among some of our species of grasshoppers owing to the presence of a specific Coccobacillus of our own, and secondly the absence of any cannibalistic habit are the most probable. To get the cannibalistic habit in the pronounced degree that you would require to obtain success in your experiments you would have to have enormous number of locusts. I think the two reasons advanced will probably prove to be the cause of the inability to use this Coccobacillus in Canada, and it certainly cannot be recommended at the present time.

SOME FEATURES OF INTEREST IN CONNECTION WITH OUR STUDIES OF FOREST AND SHADE TREE INSECTS.

J. M. Swaine, Entomological Branch, Department of Agriculture, Ottawa.

This season, as usual, British Columbia furnished many interesting forest insect problems, though but two are mentioned here. The work with the Western Cedar Borer, a species of *Trachykele,* has afforded us valuable information upon the life history and habits of the beetle, and especially upon the districts at present affected, and the types of trees most subject to attack. There is apparently little hope of obtaining an effective control for an insect that breeds freely in the heartwood of living forest trees, but we expect to materially assist the lumbermen in avoiding loss from its work. It is interesting that while the borers do occur in apparently normal healthy cedars their work is usually found in dead top cedars upon the ridges. It is evident that burning the slash from infested trees, before the early spring, will materially reduce the numbers of beetles in the limit, and that the infested timber should be utilized, so far as practicable, for such purposes as it is still suitable.

The bark beetle outbreaks in the yellow pine and black pine of Southern British Columbia have been spreading rapidly until the present season. In some of the valleys, where three years ago the outbreak was evidenced by clumps of red-tops here and there, numbering each from five to about fifty trees, the injury is reported now as beyond any reasonable hope of control. However, an interesting condition has apparently arisen in at least the western portion of the infested area, where our reports would indicate that some influence other than parasites has succeeded in at least temporarily checking the spread of the beetle. Mr. Chrystal examined the infested valleys of the Nicola region, and is satisfied that there has been little extension of the infestation this summer. The cause of this check is not yet apparent, but it is worth noting in this connection that the summer and winter of 1915 afforded most unusual weather conditions in the area concerned. The summer of 1915 had an extremely heavy rainfall over this normally dry country, and the following winter will be long remembered throughout Southern British Columbia for its extreme cold. In the spring of 1916, wide definite belts of timber well up on the mountain sides were turning yellow and were apparently killed, in the Nicola country, as well as at other places, such as Field, B.C. The explanation appears to be that the unusually wet weather had resulted in excessive tree growth for the season with much unripened wood at the time winter set in. This could be expected to obtain to a fairly definite altitude well up the mountain sides. The excessive cold acting upon this unripened wood could be expected to cause considerable injury as far down the mountain sides as a sufficiently low temperature obtained. Much of this timber that appeared seriously injured or killed has in large part recovered. It is possible that a combination of weather conditions that has so seriously affected the timber, may have been affective in checking the development of the Dendroctonus beetles. Next summer's work in this region should afford much interesting information.

The Willow Leaf Beetle (*Galerucella decora*) on the Prairies.

The Canadian Prairie Provinces were visited this summer by most extraordinary flights of the Willow Leaf Beetle, *Galerucella decora*. The beetles were very numerous and injurious from Alberta to Southern Manitoba, and in many localities they appeared in immense flights, defoliating the shade trees with extraordinary rapidity, and attacking a variety of foliage. Under normal conditions this species breeds chiefly upon the willows, but feeds also upon poplars, and can be effectively controlled by poison sprays. When the great flights occur, however, unusual control measures must be employed, and without loss of a moment's time. If the facilities for the spraying are ready for immediate use, applications of strong kerosene emulsion to the beetles swarming upon the trees will prevent serious defoliation, and some of our correspondents were able to save their most valuable trees by smudges made of horse manure and litter, and kept burning until the flight of the beetles was over.

Pine and Spruce Borers.

Throughout the history of lumbering in Eastern Canada, there has been, each season, more or less serious loss from boring grubs in pine and spruce logs left in the woods unprotected over one or two summers. Special studies of these injuries and of the most practical methods of averting them under varying conditions, recently undertaken, have supported the recommendations that we have been making to our correspondents. Without going into the details of the experiments the results may be briefly given. The injury to white and red pine logs in our forests is caused by grubs of *Monohammus notatus* and *M. scutellatus*, the injury to spruce logs largely by *M. scutellatus*. *M. marmorator* has been bred by me only from balsam fir, and this species is in any case too rare in most localities to be of economic importance.

Floating the Logs. Logs of pine and spruce which must be left in the limits over a season should, if possible, be placed in water as soon as the ice is gone. If the logs are placed in a loose boom so that there is considerable drift, and therefore the top side of the logs is frequently wet there is rarely any serious injury, but an additional safeguard is employed in turning the logs about one month after they have been floated. I have not known logs handled in this way to be seriously injured by borers. If, as rarely occurs, the logs must be made into a close boom, so that there is little or no wave play over the top side of the logs, the turning should not be omitted, and particular attention should be paid to any so-called "yellow pine" sticks, since these float particularly high out of the water.

Barking the Logs. If the cut, or any part of it, must be left over summer in the woods, such logs can be completely protected by barking them before the middle of July. The beetles will not lay their eggs upon bare wood, and the young grubs feed for nearly a month on the inner bark and sap-wood before boring in below the wood surface.

Covering Logs With Brush. If barking the logs is considered too expensive, or must be discarded for lack of labor, we believe that the logs can be quite as completely protected by covering them densely with brush before the men leave the woods, or at least before June 1st. The logs should, of course, be piled on skidways, and should receive a very thick and complete covering of green spruce, pine or balsam boughs. The spruce brush makes the densest shade, and should, therefore, be used when it is easily available. The beetles love the sunlight, and will not enter the dense shade to deposit their eggs in the bark.

Other methods employed in our tests, and recommended by certain lumbermen, gave a varying amount of protection, but none of them for either cheapness of operation or effectiveness in protection could be compared favorably with covering with brush. For instance, crib-piling the logs in the open does not in our experience protect effectively the under side of large pine logs, since the under side is only moderately shaded and not effectively dried; spruce logs are, apparently, fairly well protected by crib-piling, probably because the bark is thinner and dries more rapidly.

The Imported Alder Leaf-miner, *Kaliosyphinga dohrnii.*

This interesting species has been recorded in American literature several times, apparently under different names. Professor Slingerland's specimens, bred from European alder at Ithaca, N. Y., were determined by Konow as *dohrnii.* Dr. Fletcher referred to the species found in European alder at Ottawa as *Fenusa melanopoda.* Mr. Harrington refers to the same species under *Fenusa varipes* St. Farq. (melanopoda Can.), and Dyer describes the larva of the "Imported Alder Leaf-miner" under *Fenusa varipes* St. F.

The imported alders in the Arboretum at the Experimental Farm, Ottawa, have been attacked by the leaf-miner for many years. Dr. Fletcher stated in 1891 that it had been injurious for the three preeding years to the imported alders in the Arboretum; and in 1893 Mr. Harrington recorded it from native alders in that neighborhood. For the last four summers several species of these imported alders have been very heavily infested so that their beauty has been very largely destroyed. This season spraying was commenced, and the numbers of the insects greatly reduced. A species, probably the same, has been abundant for several seasons in native alders in a swamp about three-quarters of a mile from the Arboretum, so that, as Mr. Harrington has stated, the species is apparently well established.

The Injury. The larvæ excavate mines beneath the upper surface of the leaves, causing unsightly brownish blisters. The blisters increase in size as the larvæ feed, turn brown, merge into each other, and may entirely cover the upper surface so that the upper epidermis is completely separated, and the leaves killed. There are sometimes more than a dozen larvæ working in one leaf.

When the attack is severe the beauty of the foliage is largely destroyed, and the destruction of so much leaf surface must have the effect of weakening the trees.

The Adult. The adult insect is a small, shining, black sawfly about three millimetres in length, with brownish tibiæ and tarsi and dusky wings; the radial

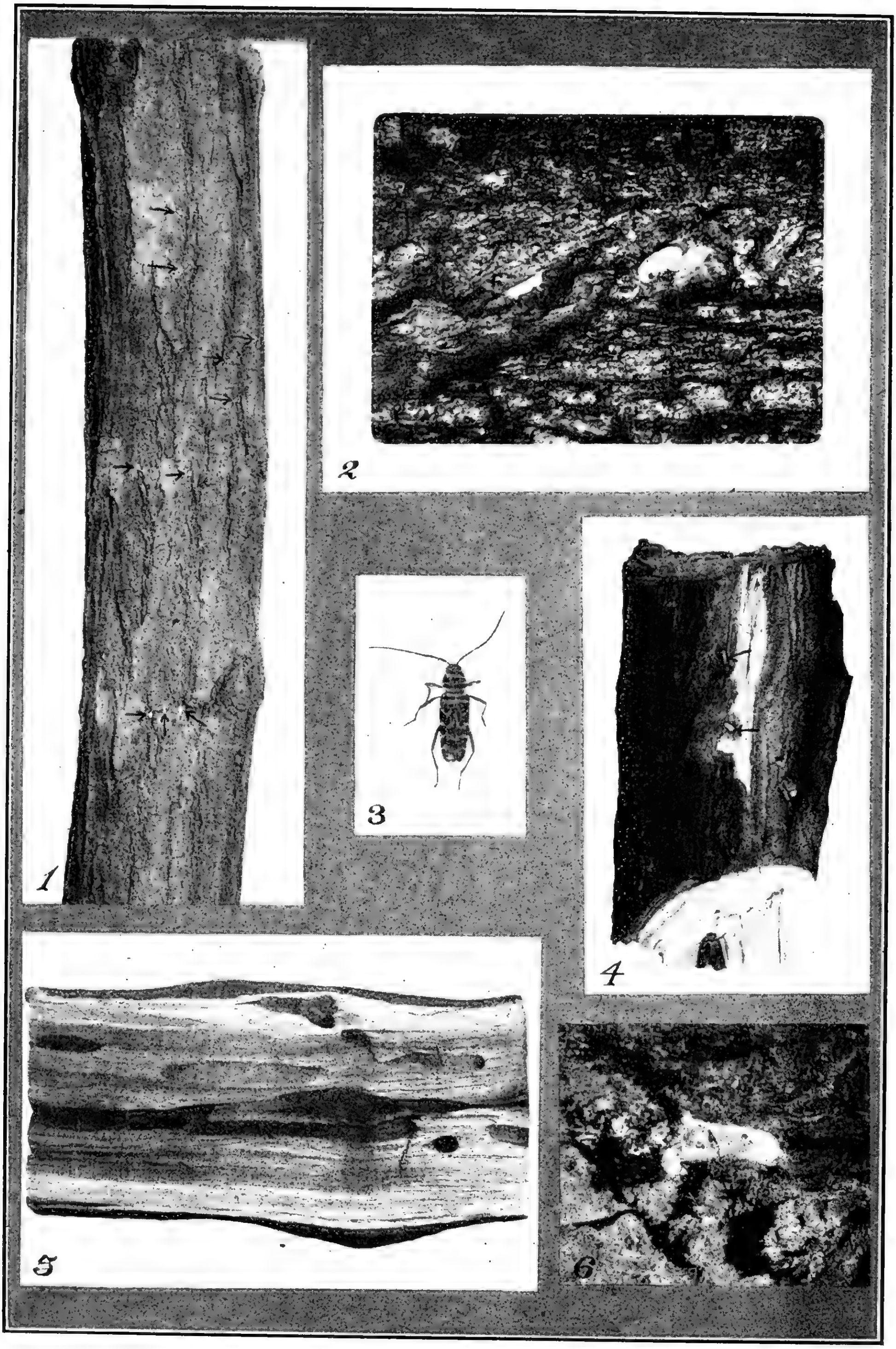


PLATE 1.—The Locust Borer, *Cyllene robiniae.*

Fig. 1.—Eggs in the bark crevices.
Fig. 2.—Eggs in situ, greatly enlarged.
Fig. 3.—The adult beetle, slightly enlarged.
Fig. 4.—The hibernating larvæ in the bark.
Fig. 5.—Larval mines in a locust trunk.
Fig. 6.—An egg, in situ, filled with boring dust.

cross-vein lies behind the second cubital cross-vein instead of immediately before it, as in the closely allied elm species, *K. ulmi* Sund.

The Egg. The small, round, whitish egg is deposited by the female fly beneath the upper epidermis of the leaf through a slit cut with the ovipositor in the upper surface; the egg is easily recognized as a small yellowish swelling in the upper leaf surface.

The Larva. The larva is six or seven millimetres in length, segmented, slender, whitish in color, or greenish from the food particles ingested, the flat head the true legs brownish, and the prolegs rudimentary.

The Life History and Habits. The eggs hatch in a few days, and the young larvæ at once begin feeding upon the pulp of the leaf; the epidermis forming the roof of the blotch mine thus produced, turns brown and makes the work of the larva conspicuous. As the mine increases in size it is frequently bounded on each side by the parellel lateral leaf veins, but when many larvæ are working in one leaf, and there may be as many as twenty in a large one, the mines coalesce and may entirely loosen the upper leaf surface, as has been done in figure 7, pl. 2. When an infested leaf is held to the light the larvæ may be seen distinctly at work within their mines, figure 1, pl. 2.

When the larvæ are full grown they break through the thin, dead, upper skin of the mine, drop to the ground, and spin a thin silken cocoon slightly below the surface; frequently grains of sand and small pebbles adhere firmly to the silk and form a framework or support for the cocoon.

The pupal period of the summer broods lasts for about two weeks. The first cocoons of the second generation were started this season in our cages on August 8th, and the first adults emerged on August 26th.

The Number of Broods. There has been some doubt apparently as to the number of broods each season. Dr. Fletcher has recorded two broods for Ottawa in 1891, and Professor Slingerland estimated for Ithaca "at least two or three broods, perhaps more." Our notes on this species were commenced this season early in June, at which time the larvæ were abundant in the alder leaves in the Arboretum, although none were noticed then on the native alders. The adults from these larvæ commenced emerging about the middle of July, and were abundant by July 20th. Full grown larvæ were spinning cocoons again abundantly during the latter half of August, and adults were again abroad in large numbers during the last few days of August, and the first week in September. Eggs were laid early in September, and larvæ were working in the leaves until the close of the season. The generations of the season overlapped so that medium-sized and large larvæ were present much of the summer, but there was a distinct succession of cocoons, adults and eggs at three times during the season, in late May and early June, in late July, and in the first week of September. There were three generations of larvæ in Ottawa this season, the last spinning the over-wintering cocoons.

Remedial Measures. The larvæ may be killed within their mines very easily with strong contact insecticides, if the application is made while the larvæ are small. Kerosene emulsion and Black Leaf 40 were tested in various strengths. Kerosene emulsion at one part stock to five parts water was fairly effective when applied to foliage containing larvæ of all sizes, with 94 per cent. killed: but was ineffective at one to seven, with only 68 per cent. killed. Probably kerosene emulsion at the strength of one to five would prove satisfactory in the early season while the larvæ were all small.

Black Leaf 40, at one part to 100 gallons of water, with five pounds of soap, killed all the larvæ in the foliage sprayed. This is the application recommended. It should be applied in late May or early June, as soon as the small brown mines appear on the leaves and should be repeated as often as new mines appear from reinfestation by late appearing adults or the migration of adult females from neighboring breeding grounds.

Immune Species of Alders. The various species and varieties of alders growing in the Arboretum are effected to very different degrees by the leaf-miner. Some are very badly affected with other varieties beside them showing no signs of the injury whatever; and there is evidence that individual trees of a variety possess varying degrees of immunity.

The Locust Borer, *Cyllene robiniæ* Forst.

The Black Locust trees of Ontario and Quebec are being so seriously injured by the Locust Borer that it seems advisable to draw attention again to the available means of control. The beetle and its habits are so well known, and have been so thoroughly discussed in literature that only the briefest outline will be included here.

The adult, a beautiful black and yellow-banded, long-horned beetle, slightly over half an inch in length, emerges from the infested trees during August and September, and is found feeding upon the pollen of goldenrod flowers, and laying its eggs in crevices in the bark of living locust trees. The beetles were active at Ottawa this season between August 14th and September 17th. They were captured upon a patch of goldenrod near the infested locusts, and in smaller numbers upon the trunks of the locust trees. A larger area of goldenrod a few hundred yards beyond the first yielded very few beetles. Apparently the beetles seek the nearest goldenrod pollen, and were to be seen flying back and forth between the locust trees and their feeding ground.

The beetles are found crawling upon the bark of the locust trunks and branches, mating and depositing eggs. The female searches with the very sensitive ovipositor in the bark crevices until a suitable place is found, and deposits there an elongate white egg, neatly and securely wedged into the crevice so that very little of the egg is visible, and more safely attached by a mucilaginous secretion coating the egg-shell. The larva emerges through the hidden end of the egg-shell, and bores directly into the inner bark, leaving the egg-shell and the entrance tunnel packed with castings. In the yellow living inner bark it excavates a small shallow cavity within which it remains quiescent until the following spring. During the dormant period of the trees the larvæ are therefore very small, immediately beneath the corky outer bark and with a short overlying mine connecting them with the exterior. In the spring the larvæ extend their tunnels into the wood, sometimes penetrating to the heartwood in branches or small trunks. The tunnels are commonly lengthwise, and are always kept connected with the exterior by an opening as large as the larva, through which the borings are thrust. When full grown, late in July or in August, the larva enlarges the end of its tunnel, closes itself in with chips, and changes to the pupa and then to the adult. The adult beetle leaves the wood through the hole kept open by the larva.

The injury to the trees caused by successive generations of larvæ girdles the trunks and branches partly or completely and kills the branches and areas of bark on the trunk until finally the tree succumbs. Branches and trunks of the smaller

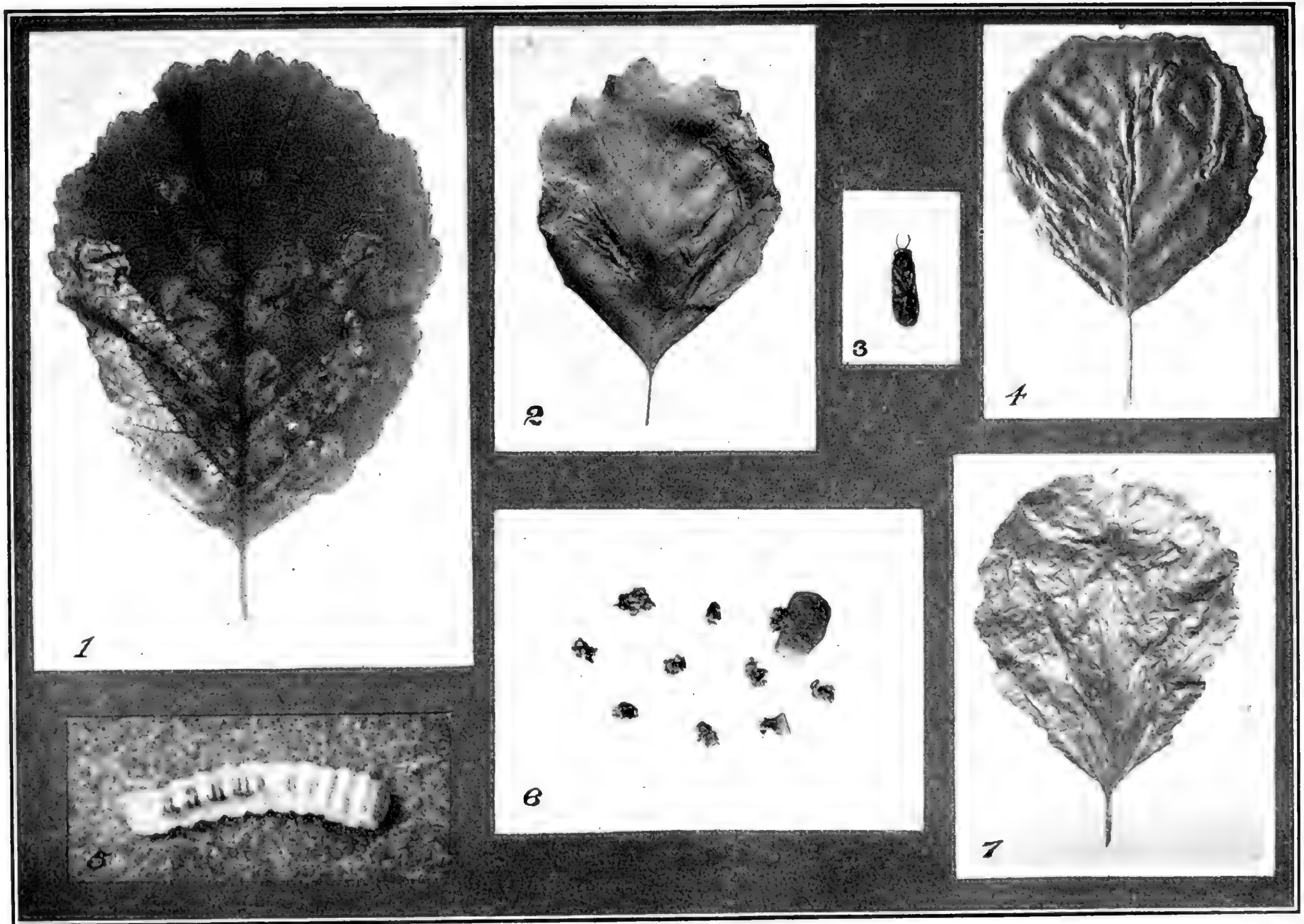


PLATE. 2.—The Alder Leaf Miner, *Kaliosyphinga dohrnii.*

Fig. 1.—Alder leaf showing the larvæ in their mines.
Fig. 2.—Larval mines.
Fig. 3.—An adult sawfly, enlarged.
Fig. 4.—Larval mines.
Fig. 5.—Larva, greatly enlarged.
Fig. 6.—Cocoons of silk encrusted with sand.
Fig. 7.—Larval mines entirely separating the upper leaf surface.

trees are often badly weakened by the numerous tunnels in the heartwood and are broken by heavy wind storms.

METHODS OF CONTROL. Locust trees are grown in this country chiefly for shade or ornamental trees or in hedges. Any cutting or removal of trees will have to do chiefly with dead and dying trees and branches. It is very important in controlling borer infestations that the infested dying and useless wood be removed and burned before the middle of July, to prevent the spread of the beetles. The dying parts can be identified in the early season, and should be cut out as early as possible, and burned as soon as it has dried sufficiently.

If the wood is to be utilized the cutting should be done in winter, or before the end of March, the valuable parts barked to destroy the young hibernating larvæ, and the worthless remainder completely burned.

SPRAYING TO KILL THE YOUNG LARVÆ. The hibernating larvæ lie immediately below the corky outer bark and can be killed by spraying the trunks and branches between October and the end of March with a strong contact insecticide. The United States Bureau of Entomology has recommended kerosene emulsion at a strength of 1 part stock solution to 2 parts water for the purpose; and this strength has been used in our experiments with satisfactory results.

THE BRONZE BIRCH BORER, *Agrilus anxius* Gory.

The cultivated birches are being seriously injured by the Bronze Birch Borer throughout much of Southern Ontario, including the Ottawa Valley. The injury is caused by the young of the beetles, slender whitish grubs, which excavate long winding tunnels through the inner bark and sapwood of the small and large branches and trunks. The trees are killed, sometimes rapidly, and in some cases slowly but surely, by successive generations of grubs. A very large number of our finest cultivated birches have already been killed and cut down, and there is good evidence for fearing that it will eventually be useless to plant white birches in the localities infested by the beetle.

A careful study of the injury was undertaken by the Entomological Branch with the object of finding some effective method of control. We are not yet able to recommend safely any other than the drastic methods suggested by Professor Slingerland years ago.

THE TREES ATTACKED. The varieties of the European white birch, *Betula alba*, are usually planted for ornamental trees in preference to our native species, and have suffered most severely; but our native yellow, white and black birches are killed by the borers when grown under cultivation. We have found the tunnels of the grubs in white and yellow birches in woodlands, but have never known the trees to be killed under natural conditions in the forests. It appears probable that certain varieties or possibly individual trees possess a certain degree of immunity from the borer attacks, and if this proves to be correct we shall have there a partial solution of the problem.

EVIDENCE OF THE INJURY. The infested tree usually dies gradually from top downwards, but by the time the top is dead the borers will be found working in a large part of the trunk and branches. The inner bark and sapwood may be thoroughly interlaced with their tunnels without much evidence of their presence appearing upon the outer surface of the bark. The infestation is betrayed to the careful observer, however, in the zigzag or winding ridges upon the branches overlying the tunnels in the sapwood, and in the "rusty" patches upon the trunk and larger branches, where sap is oozing from cracks in the outer bark caused by the tunnels within.

PLATE 3.—The Bronze Birch Borer, *Agrilus anxius*.

Fig. 1.—White birch injured by borers; top dead.
Fig. 2.—Larval mines on the wood surface; showing a larva in its hibernating cell.
Fig. 3.—The adult beetle.

Fig 4.—The commencement of a larval mine; one-half the entrance hole is shown at the white arrow; the mine passed slightly below the wood surface at the black arrow.

THE ADULT BEETLE. The adult beetle is slender, somewhat flattened, dark olivaceous bronze in color and slightly less than half an inch in length.

The beetles emerge from the bark of the infested trees during June and July. At Ottawa this season, the first adult appeared in our cages on June 27th, and the first adults were taken on trees in the open on June 30th. The early part of the season was very wet, and the emergence of the beetles was undoubtedly retarded thereby, since heretofore we have found adults emerging as early as June 9. The date of emergence will vary considerably with the season, the locality and the latitude. It is possible that in the Niagara Peninsula beetles may sometimes emerge as early as the middle of May, since they are recorded from Ithaca, N. Y., as early even as May 1st. The beetles were found on the trees at Ottawa this season until July 28th.

The beetles were reported by Larsen as feeding freely upon leaves of willow, poplar, birch, elm and other trees. In our experiments they have fed very sparingly upon birch leaves, but could not be induced to feed at all upon willow, poplar or elm. Neither could we find any evidence of their feeding in the open upon those trees, nor to any considerable extent upon birch. We hoped to obtain a partial control by poisoning the adults, but so far have not been successful.

THE LARVAL MINES. The females were frequently observed feeling with the ovipositor beneath bark scales, evidently searching for a suitable place for oviposition. Such places were marked and carefully examined, but neither in the field nor in our cages were we able actually to find the eggs. However, the newly started tunnels in the branches are easily traced backward to minute openings through the outer bark through which the freshly hatched larvæ have entered. It is evident that the eggs are deposited usually beneath the scales on the rougher portions of the bark of the branches and trunk. The larvæ enter the bark through minute openings, and bore directly inward through the bark to the wood surface. The tunnel is then continued between the bark and wood for a short distance, and is further continued in a winding or zigzag manner partly below the wood surface and partly between the bark and wood. Early in the autumn the mature larvæ excavate elongate hibernating cells in the ends of the tunnels a short distance below the wood surface, in which they pupate in the following season and emerge through the characteristic part-oval holes in the bark. In these cells the larvæ are folded, the cephalic third being bent over and closely pressed to the remainder of the body. At the close of the season there are, however, many smaller larvæ in the branches not more than one-half grown; these hibernate in normal tunnel-ends immediately below the bark, and continue their development the following season. There is evidence that in some individuals at least the life cycle lasts for two seasons.

CONTROL MEASURES. The only method of control that we can safely recommend at present is to cut out all infested birches and burn the entire tree, including the small branches, before the middle of May. By the time the top of the tree is dead from the action of the borers, it is useless to attempt to save the tree, since the grubs are then distributed over most of the trunk and branches, as will be evidenced by the reddish patches upon the bark. All that can be done is to preserve for three or four years a mutilated relic, and at the same time retain an ideal breeding ground for the beetles from which they will spread to the remaining birches of the neighborhood.

The results of the most promising of our control experiments will not be definitely determined for another year or longer; and in the meantime we can only urge owners of ornamental birches to watch carefully for evidence of the presence of this destructive borer, and to adopt promptly the drastic measures that seem at present necessary for saving the remaining trees.

PARASITES. The larvæ with which we worked this summer were very heavily parasitized, while the number of beetles to be found on the trees in the open was surprisingly small. The birches about Ottawa apparently have been dying more slowly during the last few years than heretofore, and it is possible that this may be accounted for by an increase in the number of the parasites.

PROF. CAESAR: I should like to ask Mr. Swaine how many species of birch are attacked by the Bronze Birch Borer.

MR. SWAINE: We have a considerable number of species of birch in the Arboretum where our work was carried on, and there is a distinct difference in the species in the degree of immunity to attack by borers. We find the native species attacked and even killed when in isolated conditions under cultivation; out in the woods I find the native birches attacked by the borers not infrequently, but have never known the trees to be killed under such conditions. In connection with the Alder Leaf-miner we find that the different species and varieties of *Alnus* differ widely in their susceptibility to attack; some are very badly infested, and some show little or no evidence of injury.

DR. HOWARD: I was out in Ashland, Oregon, last summer, and for the first time saw the method of determining the damage by Dendroctonus beetles at a distance. Our man was able to point out at a distance Dendroctonus-injured trees. I was interested in Mr. Swaine's statement about the killing off of the new growth by the severe weather of last winter, and I was wondering whether it was possible to detect this killing at a distance, and to distinguish it from Dendroctonus-killed timber. I should be interested to have Mr. Swaine tell us just what the difference is.

MR. SWAINE: The frost-injured trees are usually in a definite belt situated along the sides of the mountains, and the effect may be seen for years, although most of the trees may recover. On Mt. Rundle at Banff, Alberta, there is a belt of such injury still showing, which occurred nine years ago. In the early season following the injury, the foliage appears yellow and gives a decidedly yellowish tint to the belt; in some cases many of the trees actually die. One sees this injury in a definite belt between certain altitudes on the upper benches. The Dendroctonus injury on the other hand appears as clumps of dead trees, "red-tops," with isolated dead trees here and there. There may be from three or four to fifteen or thirty red-tops, or more, in each clump, with here and there isolated trees. The injury is quite characteristic in the earlier stages.

MR. HARRINGTON: Does a small moth that appears in terminal twigs of the yellow pine do much permanent injury? It disfigures the trees greatly by forming large masses of gum, and appears in the terminal shoots. Have you performed any experiments with this insect?

MR. SWAINE: I do not think that species does very much damage except in disfiguring the trees. There is one particularly injurious species known to me occurring in southern British Columbia affecting yellow pine. Near Okanagan Landing there is a large patch of timber in which many trees are badly injured or killed by a species which bores in the cambium of the branches, not in the trunk, but around the branches so that it girdles and kills them. Of course all through that country there is the injury to the tops caused by boring caterpillars.

MR. HARRINGTON: Is the black pine attacked also by Dendroctonus?

Mr. Swaine: Yes, especially when mixed with yellow pine.

Prof. Zavitz: I was very much interested in Mr. Swaine's reference to the turning of logs in the booms. This work can be of great economic value to the lumbermen in our northern country, because I have known lumbermen to get gangs of men and put them on the booms all summer to turn the logs, and when they get such scientific information they will turn their logs less frequently.

Mr. Winn: Does the Locust Borer resort to other flowers to any extent besides the goldenrod?

Mr. Swaine: We have found it only on the goldenrod. We have a nice patch of goldenrod a short distance away from our block of locust trees, and we get the beetles flying back and forth between the flowers and the trees.

Mr. Winn: Some people built a house along side of mine, where I had a very fine patch of goldenrod, and the nearest place where they came from, and I cannot find them on any other flowers at all that were apparently equally attractive. I have never been able to see the beetles on the locust trees, but do not get a chance to go up in the daytime.

Mr. Dearness: Why is the brush useful against the Monohamnus beetles?

Mr. Swaine: It is because of the shade they provide. The beetles love the sunlight. We often see them on a fallen tree lying in the sunlight, but with a portion in the shade; the mating beetles will be found invariably upon the sunny end, and the shaded end will accordingly have few or no eggs laid upon it.

Prof. Zavitz: I had a very interesting experience in that connection at one time. One summer in collecting I noticed a tree had fallen from the dense woods out into the road, and I used to go to that tree during June and along early in July, where numerous specimens were to be found just outside the fence where the tree was in the sunshine, but in the shade I never found a specimen.

Mr. Swaine: It is a very convenient habit for we can use our knowledge of it in protecting logs which have to be left in the woods.

Mr. Dearness: Does the temperature have anything to do with the hatching?

Mr. Swaine: I do not think the females would go into the dense shade to oviposit at all.

Mr. Harrington: I think most of the Cerambycidæ prefer to oviposit in the sunlight.

NOTES ON SOME INSECTS OF THE SEASON.

L. Caesar, O. A. C., Guelph.

It may be worth mentioning that in the Niagara district at least, and apparently in most other parts of the Province, there was a wonderful diminution in the number of most kinds of insects this year, compared with the average season. This may have been due to the abnormally wet May and June destroying the immature stages.

The Clover-hay Moth (*Hypsopygia* (*Pyralis*) *costalis*).

This year for the first time I found the work of this moth on a large scale on July 13th, at Wellington, Prince Edward County. Pea straw from the canning factory had been dried and stored in an open shed some two or more years ago, and in this the insect had bred. At the time of my visit most of the adults had emerged, though there were still a good many pupæ and a few larvæ. The moths were so numerous that they were to be seen in thousands on the inner side of the walls and roof. I pulled out the straw to a depth of a yard, and found that the larvæ had been working at least that far in. They had fed both on the straw and on the empty pods. The pupæ were all near the outside. Along with this species was a considerable number of the Meal Snout-moth (*Pyralis farinalis*), the larvæ of which had doubtless fed on the peas that had been left in the straw.

EVETRIA ALBICAPITANA Busck.

This pretty Tortricid described by August Busck, in 1914, as a new species was found in considerable numbers in the forestry plantation at St. Williams, on June 9th. The larvæ feed on the bark of the new growth at the axils of the twigs

Evetria albicapitana Busck.
Moth and gum mass caused by larva on twig of Jack Pine. Natural size (original).

and cause irregularly globular to irregularly hemispherical gum masses from 1-3 to ¾ of an inch in diameter. They seldom, if ever, completely girdle the twig or cause it to die. There were sometimes two or more gum masses on each branch, but even so the branch looked uninjured. On June 9th a few of the live pupæ were still to be found in the gum, but about 90 per cent. had emerged. The adults were present, and flew out from the trees when disturbed or dropped as if dead to the ground, where their yellowish brown color made them very difficult to distinguish from the fallen staminate flowers. Three females and one male were placed in a bottle along with two fresh new-growth twigs and brought home. After a few days eggs were laid near the base of the young leaf clusters, some separately and some in very irregular clusters, one egg overlapping another shingle fashion. It is doubtful whether in the open they would be laid in clusters. The eggs were cream-colored, flattened, or scale-like and oval in outline, about .5 mm. long by .4 mm. wide. They darken before hatching. Jack Pine (*Pinus banksiana*) (*divaricata*) alone was attacked. (See figure of moth and work of larva.)

The Willow and Poplar Curculio (*Cryptorhynchus lapathi*).

Once more we have found adults of this species in the spring in the nurseries. The excessively wet weather prevented our watching them to see whether they laid any eggs. The insect has been reported from the following places in addition to those given in my last year's account of it: Port Elgin in a nursery, Beachville, Strathroy and Lake Simcoe district. Mr. George Matieu, has also informed me that he has taken it on *Populus deltoides* in a nursery at Berthierville in Quebec.

Fruit-tree Leaf-roller (*Tortrix* (*Cacoecia*) *argyrospila*).

Up to the present time there have been no reports of the presence of this pest in any other orchards than those mentioned in my paper on Apple Leaf-rollers last year. I visited two of these orchards this year in June and July. In the orchard near Hamilton, the insect seems to have largely disappeared, in the other orchard —the large block of 60 acres in Norfolk County—it still persists, and has now spread throughout all the trees. I have had no chance to visit this orchard since the eggs were laid, and so form an opinion on the amount of destruction the insect is likely to do next year. The foliage in the orchard this year was kept heavily covered with nearly double strength of arsenicals, but the result showed clearly that arsenicals alone would not control this pest. Nine or ten acres of spy trees which formed the worst infested part last year, were sprayed this spring before the buds burst with Scalecide, and were noticeably freer from injury than the unsprayed parts. The owner believes that in spite of the cost, he will have to use Scalecide on the whole orchard next spring. In the orchard near Hamilton, the worst infested block was also sprayed with Scalecide, and apparently this was the reason for the great decrease there in the number of the larvæ.

The Oblique-banded Leaf-roller (*Tortrix* (*Cacoecia*) *rosaceana*).

The following additional data was obtained on this pest:

1. The number of eggs that may be laid by a single female is much greater than we had suspected. One female laid one large and two small clusters, or a little over 300 eggs in all. The highest number of eggs we found in a single cluster was 175; the average seemed to be about 100.

2. This species in Ontario is partly single brooded and partly double brooded. In our cages all the larvæ reared from the eggs laid on leaves in June and early July fed for a short time on the foliage, skeletonizing it very much in the way the Pear Slug skeletonizes pear and cherry leaves, and then while still not farther

advanced than the second instar each larva spun about itself a little silken case or hibernacula. I examined some of these hibernacula on August 26th, and found the larvæ still healthy and looking the same as when the cases were constructed. Some of the hibernacula were on very small twigs and were situated alongside the terminal bud; others on these same twigs were in the axil of the leaves, but attached to the twig not to the leaf; others were situated on larger branches in various positions. The latter were usually about the shape of a bud scale and dark on the outside, lined with white silk and easily mistaken for the hibernacula of the Bud Moth. The former were usually whitish in color, from 3 to 5 mm. long and about 1 mm. in diameter.

It is clear, however, that not all the larvæ of this brood formed hibernacula, because throughout most of August we found larvæ, some a little more than half grown, others full grown, and from these we reared adults. We also found adults at Guelph, and at Grimsby, up to September 27th. To make sure there was no mistake we sent these to Mr. August Busck, who verified our determination. Unfortunately our having to shift our quarters from Grimsby to Guelph at the end of August, prevented us from carrying the life-history through. Prof. Herrick, however, states that there is no doubt that eggs are laid in the fall on the bark and that these winter.

Mr. A. G. Dustan, Annapolis Royal, Nova Scotia, in the 1915 report of the Nova Scotia Entomological Society, states that the insect in Nova Scotia winters in the immature larval stage in hibernacula. He seems to imply that this is the only stage in which it winters there.

Red-necked Agrilus (*Agrilus ruficollis*).

A red raspberry plantation near Grimsby was much injured by the larvæ of this insect; the injury was much greater than I had ever seen before. Approximately 25 per cent. of all the canes were infested, and in consequence the crop was lessened to about that extent. An examination of the new canes at the middle of August showed that the injury next year would be as great as this year. Since the adults do not emerge until long after the leaves are out, and since the tops of a large percentage of the infested canes die before the adults leave them a very helpful means of control would evidently be to go through the plot about a month after the leaf buds burst and remove these canes, cutting them low down to be sure of not missing any of the insects in them, and then burn all the cut canes promptly. The tendency of this pest to localize itself was well shown by the fact that it was doing very little injury in any of the surrounding plantations of the same or different varieties.

Apple Capsids or Mirids.

Some further study of certain points about these Leaf-bugs has been made and the following data obtained:

1. *Neurocolpus nubilus,* or the Clouded Leaf-bug as we may call it, has almost disappeared from the large Norfolk apple orchard where it had been very abundant for several years. On July 9th in a half day spent in the orchard I saw only 15 of these. The disappearance was not due to lack of eggs for many of these had been laid last summer. It may have been due to the very wet weather this spring.

2. In at least some of the orchards *Lygidea mendax*, the so-called False Red-bug, was much less numerous than last year. One of these orchards had been sprayed

with a tobacco extract and was almost totally free from the pest. The spraying doubtless helped to bring about this result.

3. The eggs of *Neurocolpus nubilus* do not hatch until more than a week after the blossoms drop, or in fact until after the Codling Moth spray has been applied. This was true last year as well as this year. The first nymph seen this year was on June 9th. The two species of Red-bug, *Heterocordylus malinus* and *Lygidea mendax,* began to hatch a week or more before the blossoms opened. The most practical time to spray for these latter two is just after the blossoms fall, combining tobacco extract with the Codling Moth spray for the purpose. This date, however, would be worthless against *Neurocolpus nubilus* as it would still be in the egg stage, Moreover, as we discovered last year, tobacco extract even at three times the usual strength for green aphids is ineffective against this pest; for it merely stupefies the nymphs and they soon recover. A soap solution, such as one pound of Sunlight soap to 10 gallons of rain water was found satisfactory.

4. The time of the appearance of the adults of the different species this year as observed by us was as follows:

Heterocordylus malinus, June 23rd in the cages, a few a little earlier in the orchard.

Lygidea mendax, June 29th,

Paracalocoris colon, July 6th.

Neurocolpus nubilus, July 10th.

5. Apparently *Lygus communis,* Knight, n. s., the troublesome False Tarnished Plant-bug of New York, and Apple Green Bug of Nova Scotia if present in Ontario plays no part, or a very small part, in injuring apples and pears. *Lygus invitus* occurs almost everywhere, but as shown by Knight does not attack fruit trees.

Local Pests.

Melon Aphis (*Aphis gossypii*) was very abundant and destructive on melon plants in Kent County.

Beet Leaf-miner (*Pegomyia vicina*) injured severely the foliage of mangolds north of Brockville.

Corn Seed-maggot (*Pegomyia fusciceps*) nearly destroyed some fields of beans in Prince Edward County. The fields had been in sod.

Zebra Caterpillar (*Mamestra picta*) was abundant enough on turnips in part of Peel County to be an important pest.

Hickory Leaf-roller (*Eulia juglandana*) was very common on hickory trees in some parts of the Niagara district.

American Tent-caterpillars (*Malacosoma americana*), though rapidly diminishing in numbers east of Toronto, were very abundant at Oakville and Port Credit, and also in parts of Norfolk and Lambton Counties.

Blackberry Leaf-miner (*Metallus bethunei*) attacked in considerable numbers the blackberry foliage at Vineland.

Pear Slug (*Eriocampoides limacina*) was conspicuous by its absence in the Grimsby district.

THREE IMPORTANT GREENHOUSE PESTS RECENTLY INTRODUCED INTO CANADA.

ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, DEPARTMENT OF AGRICULTURE, OTTAWA.

It is important that attention be directed at this meeting to three serious greenhouse pests which have recently been introduced into Canada, namely, the Florida Fern Caterpillar, the Chrysanthemum Midge, and the Rose Midge.

THE FLORIDA FERN CATERPILLAR, *Callopistria (Eriopus) floridensis* Gn.

This southern insect which was described from Florida in 1852 has occasionally been recorded as a serious greenhouse pest. In the Year Book of the United States Department of Agriculture for 1908, the Bureau of Entomology records important losses in greenhouses in Washington, D.C., one florist reporting damage to ferns to the extent of $4,000. This is apparently the first record of this insect as an economic pest. In addition to being destructive in the District of Columbia, this insect has since been recorded as doing serious damage to ferns in the States of Florida, New Jersey, Illinois, Georgia and Ohio. The caterpillar is also believed to have occurred on ferns in Louisiana. Hampson[1] records the species from Florida, Mexico, Guatemala, Costa Rica, Bahamas, Jamaica, Cuba, Haiti, Sta. Lucia, St. Vincent, Venezuela, Br. Guiana, Brazil and S. Trinidad.

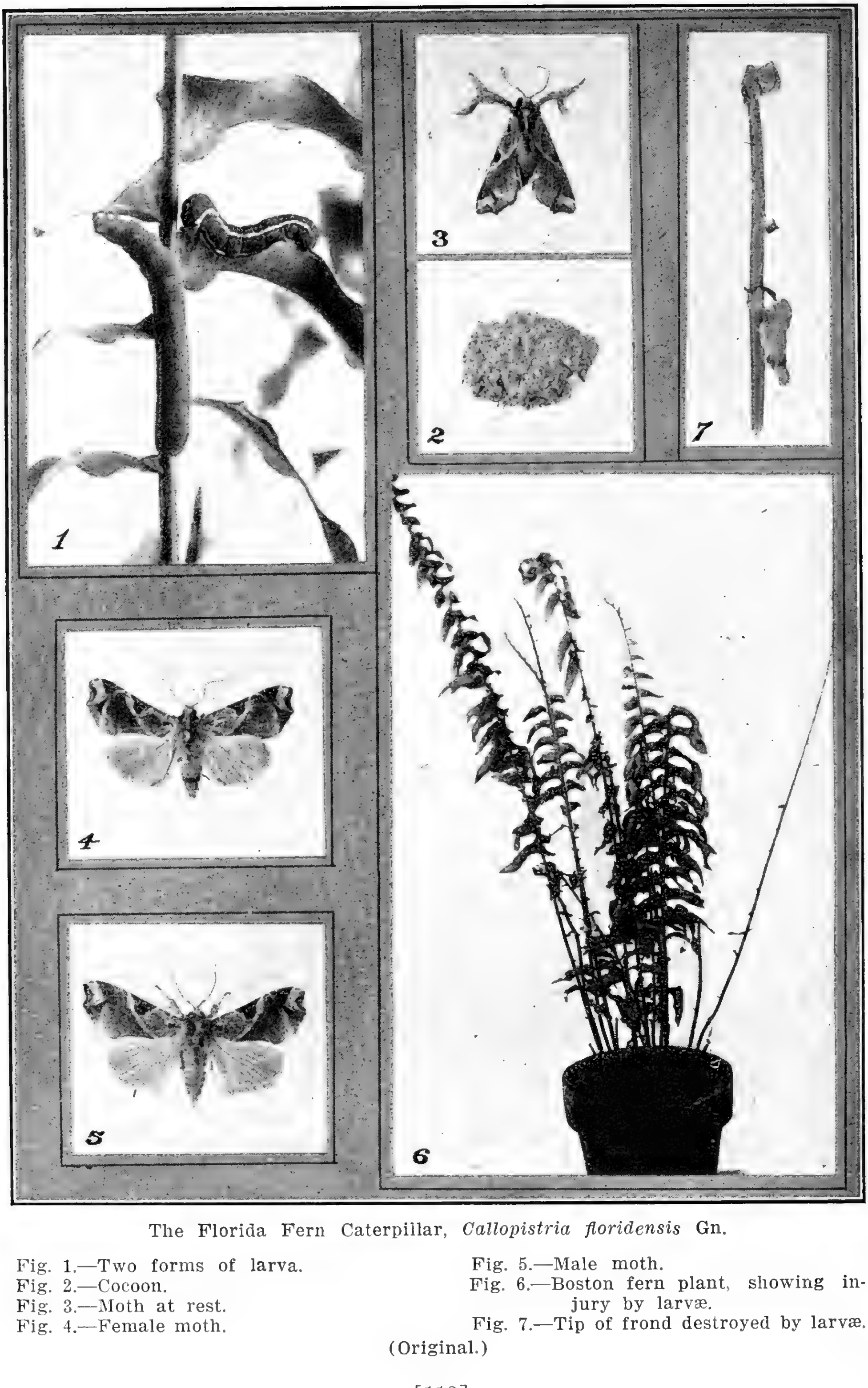
The first occurrence of the Florida Fern Caterpillar in Canada was noted in September, 1915, in the greenhouse of Mr. A. M. Barton, Weston, Ont. The caterpillars were found on some ferns imported from Chicago, and the insect had doubtless been introduced with such shipment. During the winter of 1915-16 we had an opportunity of studying the life-history of the insect and observing its habits. Recently Mr. Hall, of Messrs. Hall and Robinson, forwarded to us specimens of the larvæ from their Montreal West greenhouses, where they were first observed in September, 1916.

LIFE-HISTORY.

The Egg.

We have been unable to secure eggs of the moth, either by searching in the greenhouse referred to or from living moths kept under observation in captivity. Mr. C. E. Petch, Field Officer of the Branch, and the writer have both examined ferns which were being destroyed, as has also Mr. Barton, without any eggs being detected. Davis[2] describes the egg (laid in confinement) as "circular in section, about one-fiftieth of an inch in diameter, slightly flattened, ribbed longitudinally and transversely," and states that in color it "is pale greenish with a faint yellowish tint, much resembling the color of the new fern fronds." The same author states that in confinement the moths deposited their eggs singly on the under surface of the new leaves. Weiss[3] records an incubation period of from five to seven days.

[1] Cat. Lep. Phalaenae in the Brit. Museum, Vol. VII., p. 549.
[2] 27th Report State Entomologist of Illinois.
[3] Can. Ent., XLVII, 23.



The Florida Fern Caterpillar, *Callopistria floridensis* Gn.

Fig. 1.—Two forms of larva.
Fig. 2.—Cocoon.
Fig. 3.—Moth at rest.
Fig. 4.—Female moth.
Fig. 5.—Male moth.
Fig. 6.—Boston fern plant, showing injury by larvæ.
Fig. 7.—Tip of frond destroyed by larvæ.

(Original.)

Description of Larval Stage.

During January, February and March, 1916, several lots of larvæ representing various stages were received at Ottawa. From these the following notes were made:

First Instar. Length 3 mm. Body pale green, no markings. Head concolorous with body, ocelli black. Tubercles black, conspicuous, each with a single, rather long hair. Thoracic feet semi-translucent; prolegs concolorous with body. Spiracles black.

Second Instar. Length 5.5 mm. Head pale green, shining, of a glassy appearance, ocelli black, mandibles reddish. Body pale green with the following rather indistinct stripes: addorsal, subdorsal, and a stigmatal band, all pale whitish in color. About midway between tubercles ii and iii is a rather wide, conspicuous, blackish band. Tubercles black, setæ dark. Feet concolorous with body.

Third Instar. Length 9 mm. The larva in this instar is similar to second instar but the longitudinal stripes are now quite distinct, the addorsal being sinuous in outline. Spiracles pale yellowish, rimmed with black.

Fourth Instar. Length 14 mm. Head green, cheeks pale brownish, clypeus margined on outer sides with blackish. Body green with a more or less yellowish reflection. All the markings distinct: addorsal and lateral stripes and stigmatal band yellowish, the two former quite sinuous in outline. Subdorsal stripe margined below, as before, with a blackish band. Thoracic shield margined anteriorly with black. Spiracles yellow, black rimmed. Feet concolorous with body.

Fifth Instar. Mature Larva. Length 28 mm. Head reddish brown, reticulate with dark brown; clypeus with pale margins; ocelli black; epicranium adjoining clypeus brownish; a noticeable pale space without markings is present immediately above base of each antenna. The color of the body is now totally different, being raw umber,[1] with a faint greenish tinge. The stripes are inconspicuous unless examined with a lens and of a sordid yellowish-white color. All are sinuous in outline. Tubercles blackish, each distinctly surrounded with a ring of sordid yellowish-white: setæ blackish; spiracles pure white with black rim. Between tubercles i and ii there is a conspicuous yellowish-white spot, and on each segment midway between the stigmatal band and subdorsal stripe, a lateral row of the same colored spots. The skin below spiracles is also spotted and streaked irregularly. The stigmatal band on the thoracic segments is partly filled with pale yellow, particularly on segment 2 and in the anterior half of this segment the color is white instead of yellow. Anterior edge of thoracic shield dark brown, forming a distinct band. Thoracic feet shining, pale brown; prolegs dull, concolorous with venter. Length when mature 33 mm.

The above notes were made upon a single larva received on March 1, which was collected with many others by Mr. Petch on February 29.

In February (1916) several larvæ in last stage were received from Mr. Barton. All but one were green, the exception being of a dull reddish color. In the sending from Mr. Petch, received on March 1, several instars were represented. All these specimens were also green, with the exception of two, one of the latter being a dull brown and the other a beautiful reddish-chocolate color. The mature specimens were described as follows:—

Green larvæ.—Length 32 mm. Body yellowish-green. Markings as follows: An addorsal line, a subdorsal line, a lateral line, and a rather indistinct stigmatal

[1]According to Ridgeway, Nomenclature of Colors, 1912.

band, all whitish-green in color. In some specimens the skin between the subdorsal line and the lateral line is of a darker green color and for this reason contrasts rather strongly. Close to the spiracles there are one or two blackish spots on each of the central segments. On the thoracic segments and, in some individuals, on the two or three posterior segments, these spots are more frequent and form a distinct, uneven band, widest on the thoracic segments on segment 2. The color of the intersegmental folds particularly on dorsum is yellow, spiracles cream-colored, ringed with black. Thoracic shield slightly paler than color of dorsum and having a distinct band of black along anterior edge, which joins with the band on sides of thoracic segments. Ventral area glaucous. The head varies in color from pale green with a light tinge of reddish-brown on cheeks to a decided reddish-brown over whole upper portion of cheeks; clypeus bordered on either side with a blackish, rather indistinct, band; mandibles reddish; ocelli blackish, a blackish patch above ocelli.

Brown larva.—Length when extended 37 mm. Head same as in green specimens, but with brown reticulations. Body dull velvety brown with a purplish reflection. Longitudinal lines pale whitish, indistinct. Tubercles blackish, circled with pale whitish. Spiracles cream-colored. The lateral spots close to the spiracles which were black in the green larvæ are in this specimen white and conspicuous, continuing as a striking band on the thoracic segments. Thoracic feet reddish-brown; prolegs concolorous with venter.

Reddish-chocolate larva.—Similar in general to the dull brown larva but having a wide continuous white stigmatal band, as shown in figure 1, page 112.

On March 27 another mature green specimen was described as follows: Length at rest 28 mm. Head 2.8 mm. wide, yellowish-brown; clypeus paler; ocelli black. Body green, slightly darker than the leaves of Boston fern. Stripes yellowish-white as in other specimens. Stigmatal band with more yellow than dorsal and subdorsal stripes and with white areas on first two thoracic segments. Spiracles more or less surrounded with dark purplish-red, particularly on central segments. Thoracic shield paler than body. Venter pale green.

From the above notes it will be seen that the larvæ varied considerably, particularly in color. Such variation has also been noted by Davis[1] and Chittenden.[2] The former, referring to such variation, says: "There are two types of the full-grown caterpillars, one apple-green and the other velvety black, the former predominating." As indicated above, the dark-colored specimens which we examined were of a dull brown color, none were black. The band which extends across the front of the thoracic shield is very distinct and constant, and should serve as a characteristic mark to determine the species.

Description of Cocoon and Pupa.

Most of the larvæ under study were kept in a large breeding cage in which an average sized Boston fern was placed. When the specimens in such cage reached maturity they left the plant and made earthen cocoons (Fig. 2, page 112), on the surface of the soil. The earth chosen for the making of the cocoon is held together by many strands of silk which gives the structure considerable strength. It is by no means fragile, as are the earthen cocoons of our common cutworms belonging to the genus *Euxoa*. In length the cocoon varies from 18 to 20 mm. and in width from 6 to 7 mm.

[1]Davis, J. J., 27th Report of the State Entomologist of Illinois, 1912, p. 91.
[2]Chittenden, F. H., Bulletin No. 125, U.S. Bureau of Entomology, 1913, p. 7.

Pupa.—Length 12-15 mm., 5-6 mm. wide; shining reddish brown, darker at posterior end; cremaster two-spinned, the spines short, stout, and projecting outwardly towards the venter. Wing-covers prominent and slightly wrinkled.

Length of Larval and Pupal Stages.

The larva described in the five instars, received at Ottawa on March 1, was, as noted, 3 mm. in length, and undoubtedly a day, or at the most 2 days in age. It reached maturity on March 26, on which date it began to make its cocoon. By the morning of March 29 the pupa was formed. Another larva also began to make its cocoon on the same day and in this instance too the pupa was formed on the morning of March 29. The larval period, therefore, was about 27 days.

These larvæ had been kept separately in specimen tubes in which there was some earth. Each spun its cocoon on the side of the tube which rested on the earth in the breeding cage. Only sufficient of the earth was used by each larva to make a suitable cover, the glass furnishing the bottom, so to speak, of the cocoon. The obtaining of the length of the pre-pupal period, therefore, was a simple matter.

A moth emerged on April 12 from one of the two pupæ mentioned, the pupal period in this instance being 14 days. The second pupa died. Moths from other pupæ emerged during the period April 1 to 10.

Description of the Moth.

The moth is a rather striking species and quite different from any other form found in Canada. At first glance it reminds one of certain species of the old genus *Plusia*. The fore-wings in general are brown, with a darker velvety, rather V-shaped costal area near the centre of the wings. Towards the apex of the wings and at the base of each wing the color is also dark brown. Some specimens are, in general, of a darker brown shade than others. The markings on the wings are shown in the figure herewith. (Figs. 4, 5, page 112.) The bands across the fore-wings are whitish tinged with pink. The hind wings are of a uniform paler brown color, lighter towards the base. The body corresponds in general to the color of the wings. In the male there is a conspicuous widening of the antennæ near the head. The legs are conspicuously tufted. With the wings expanded the moth measures from about 30 to 34 mm.

Habits.

Food Plants. The ferns attacked in Mr. Barton's greenhouses, Weston, Ont., were Boston, Whitmani and Scotti. Mr. Petch visited the greenhouses on February 29 and found that over 75 per cent. of the fronds had been destroyed. In the Montreal West greenhouse the same varieties were attacked, about 200 plants being more or less injured.

Nature of Injuries. The caterpillars are very active feeders and when several occur on a single plant they soon effect serious damage. Like other noctuid larvæ they prefer the young and tender leaves but will readily attack the older and larger leaves, and even eat into the more tender portions of the stems. In an experimental cage one frond measuring 16 inches in length was entirely denuded by one last stage larva in four days. Mr. Petch, at the time of his visit in February, noticed that the smaller larvæ when disturbed dropped from the plants by means of a silken thread. They were found feeding early in the afternoon. In reporting upon the injury he referred specially to the destruction of the growing tips of the fronds before they unroll (see fig. 7, page 112).

On May 10 I visited Mr. Barton's greenhouses and examined his stock of ferns which had been attacked by the caterpillars. They were, indeed, an unsaleable lot, the fronds of most of them being eaten to a greater or less extent and in many instances the plants almost entirely defoliated. Many had been destroyed to the extent shown in figure 6, page 112. Mr. Barton informed me that when the outbreak was at its height from three to a dozen larvæ could be shaken from a plant growing in a 5-inch pot. A large stock, particularly of Boston ferns, were in the houses, very few of which had been sold during the entire winter. Mr. Barton estimated that his loss would easily total one thousand dollars.

When not feeding the caterpillars rested on the stems chiefly towards the base of the plants. The moths being nocturnal in habit are seldom seen during the day time.

On November 4, 1916, I again visited Mr. Barton and found that the insect had re-appeared in the greenhouse. The latest month in spring during which caterpillars were found in the greenhouses was June. During the summer 2,500 ferns were placed outside in a cold frame, no ferns being kept in the greenhouses during the summer of 1916. About the middle of August the caterpillars were noticed to be destroying the ferns in the cold frame. About 2,000 ferns, in fact, were so badly infested that they were destroyed. The remaining ferns from the cold frame were brought into the greenhouse about October 1st and it was on these plants that the caterpillars were feeding at the time of my visit on November 4.

Towards the end of November, 1916, Messrs. Hall and Robinson, Montreal West, Que., informed us that they also observed the caterpillars feeding outside in a cold frame, the plants attacked being Holly Ferns and also *Pteris albolineata* and *P. winsetti*.

Means of Control.

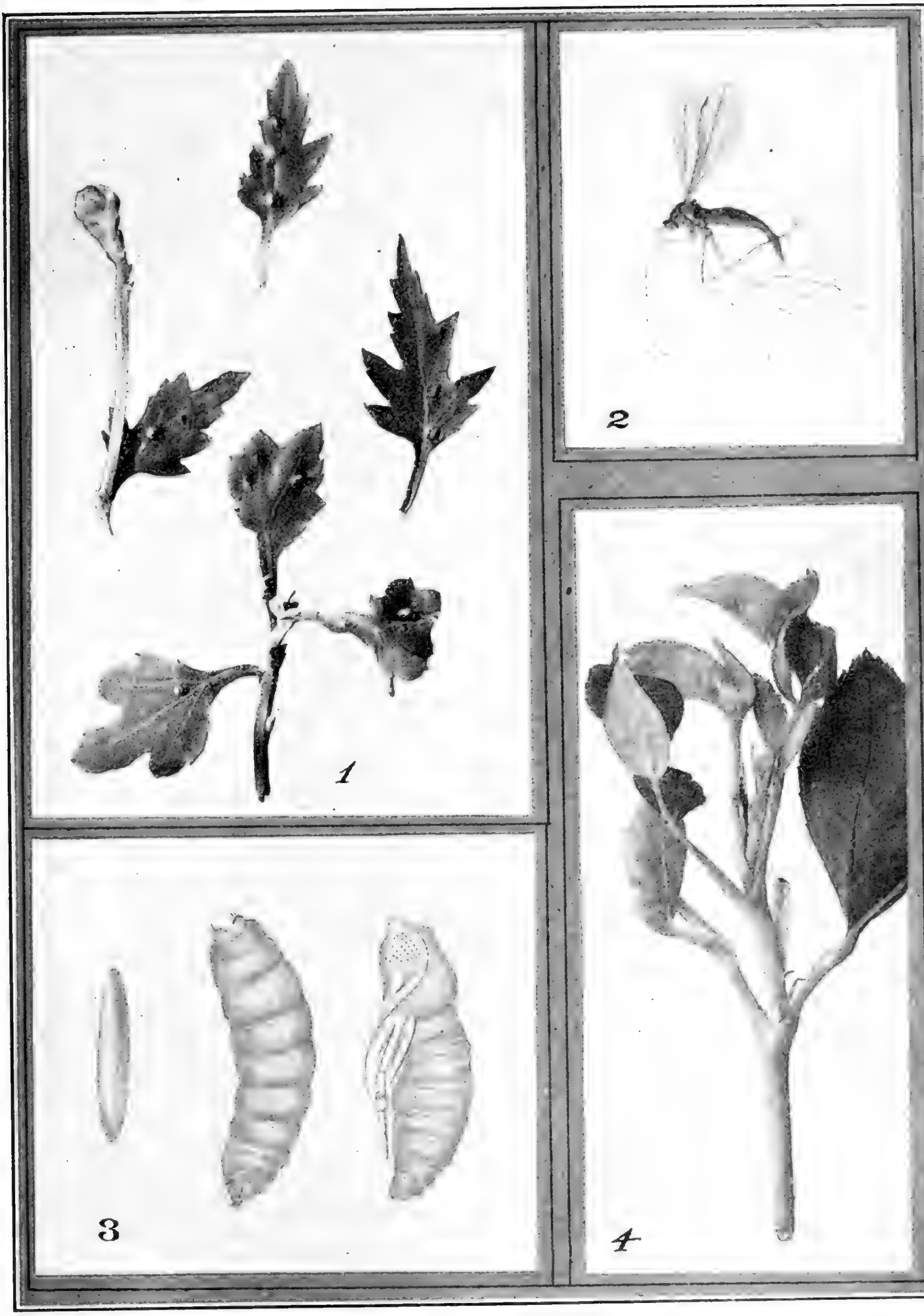
The following methods of control were adopted in the Weston greenhouse:

Tobacco Smoke. In January fumigation with tobacco smoke was tested twice within twenty-four hours, the strength in each experiment being two pounds of tobacco stems to 16,000 cubic feet of space. At the time of the fumigations many larvæ were present. Two days later Mr. Barton could not find a single caterpillar, dead or alive, and he thought at the time that the fumigation had proved entirely successful. Later (February 24, 1916), however, the caterpillar re-appeared, but he reported that such fumigation would not be then possible owing to the fact that the houses contained many small seedlings.

Handpicking. Large numbers of the larvæ were destroyed by handpicking in the Weston house. On occasions the pots were shaken individually and the caterpillars which dropped immediately destroyed. In the United States, also, this rather laborious method has been successfully used. When the shaking is done over the ground the caterpillars are simply crushed with the foot as they fall.

As mentioned above the moths are nocturnal in habit. Oftentimes specimens may be disturbed in the house or may be attracted to a bright light hung in the evening near infested plants. An endeavour, of course, should be made to destroy all specimens seen.

Arsenate of Lead. Experiments with arsenate of lead did not prove successful. Two sprayings at the strength of one-half pound of arsenate of lead to ten



The Chrysanthemum Midge, *Diarthronomyia hypogaea* H. Lw., and the Rose Midge, *Dasyneura rhodophaga* Coq.

Fig. 1.—Galls on leaves of chrysanthemum resulting from the attack of the Chrysanthemum Midge.

Fig. 2.—The Chrysanthemum Midge, much enlarged.

Fig. 3.—The egg, larva and puparium of the Rose Midge.

Fig. 4.—Showing rose bud destroyed by larvæ of the Rose Midge.

Figs. 1, 2 and 4 original; 3 redrawn after Webster.

gallons of water were applied at an interval of five days. Later the plants were again sprayed twice at double the above strength, but even at this latter strength control was not secured. In addition, too, the white deposit remaining from such sprayings was difficult to remove even with forceful watering.

Pyrethrum Insect Powder. Sprayings with fresh pyrethrum insect powder in the strength of two and one-half ounces to five gallons of water were recommended. In New Jersey[1] the following spray has proved successful:

Fresh pyrethrum insect powder	1 ounce.
Common laundry soap	½ ounce.
Water	1 gallon.

The soap should be dissolved in a small quantity of warm water after which the insect powder and water should be added to make up one gallon of mixture. One large fern grower applied such a spray once a week for five or six weeks. The insect powder applied dry by means of a bellows also gave satisfactory results.

The Chrysanthemum Midge, *Diarthronomyia hypogæa* H.Lw.

In 1915[2] the Chrysanthemum Midge was found to be thoroughly established in a large greenhouse at Ottawa. It had undoubtedly been introduced on some chrysanthemum plants imported from the United States. In addition to the Ottawa infestation we have recently received infested material from a florist in Victoria, B.C. This latter outbreak occurred in the greenhouse of Mr. A. J. Woodward, and the injury was first noticed in August, 1915, on chrysanthemums growing outside as well as within the greenhouse. Although these two occurrences are the only Canadian records we have, it would not, of course, be surprising to learn of other greenhouses being infested. Felt[3] states that he has received the insect from the States of Michigan, California, and Oregon, and the same author has recntly informed me[4] that during the present year (1916) he also received the species from the States of South Dakota, Washington and Delaware. The pest is, therefore, widely distributed in North America. In referring to its "Distribution and future probabilities" Felt[5] says: "This species has been recorded from central and southern Europe, and, as stated above, it has already become established in several widely separated localities in this country, probably by the shipment of infested plants or cuttings. It was very likely brought to America without the normal quota of parasites and for a time at least it may prove to be a somewhat difficult insect to control, though it would seem as if the native parasites of our large and varied gall midge fauna might in time prey most successfully upon this midge."

Life-history.

The Egg.

The egg is small and in color pale orange; in shape elongate-oval. It is described by Felt as "Reddish-orange, length .15 mm., diameter .03 mm., the extremities narrowly rounded."

On April 8, 1916, a female was enclosed with a small plant beneath a bell jar. While under observation she was most active running about on the new leaves,

[1]Weiss, H. B., Can. Ent., XLVIII, 141.
[2]46th Rep. Ent. Soc. Ont., 1915, 14.
[3]31st Rep. N.Y. State Entomologist, 51.
[4]In litt., 16 Oct., 1916.
[5]31st Rep. N.Y. State Entomologist, 54.

the favorite places chosen for oviposition being the leaf hairs near the crevices between the young forming leaves. Repeatedly the female would come back to apparently the same spot. With the exception of an absence of seven minutes, the female was observed to be actively engaged in such conduct for a period of twenty-seven minutes. On another occasion eggs were found near the tip of another plant, and were laid, as Felt has already recorded, along the surface of the leaf among the leaf hairs. On one occasion (October 27, 1916), in the Ottawa greenhouse a string of extruded eggs was found attached to a dead female which had not been able to free itself from the gall, and other eggs laid among the leaf hairs were present on the gall. Altogether 44 eggs were counted. The length of the egg stage is estimated by Felt to be probably twenty-four hours or less.

The Larva.

The mature larva is very similar to that of other cecidomyids; in color it is yellowish, or yellowish-orange, in shape plump, rounded at either end, the segments being distinct; in length about 1 mm.

The Pupa.

The pupa is about 1.75 mm. in length. The abdomen is whitish or pale-yellowish; thorax and wing covers pale yellowish-brown, cephalic horns distinct, eyes showing black; leg-cases whitish or pale yellowish.

The Adult.

(Fig. 2, page 117.)

The midge is a small two-winged fly, the length of the body being about 1.75 mm. The wings are transparent, the margins being light yellowish. The body is mostly of an orange color, the legs yellowish.

The Gall.

The gall is a conspicuous oval-shaped swelling, in length from about 2 mm. to 2.5 mm. It is often slightly paler than the color of the leaf or stem upon which it occurs, but on some plants particularly on the stems it is concolorous and inconspicuous. When the flies have emerged the galls are readily seen, particularly on the older leaves, owing to their having turned yellowish or whitish in color.

Habits.

Food Plants. In the Ottawa greenhouse all varieties of chrysanthemums were seemingly attacked. A large number of different varieties were being grown and the kinds which were noted to have been most freely attacked are the following: Chrysolora, Naomah, Radoelii, Ramapo, Hortus Tolsoms, Mrs. Clay Frick, December Gem, Madam G. Rivol, Dr. Enguehardt, Anna, Pacific Supreme, Early Snow, Elberon, Ursula Griswold, Aesthetic and Etherington. The varieties Bob Pulling, Gertrude Peers, Daily Mail, Oconta, Mrs. G. C. Kelly, W. Wood Mason, F. T. Quilleton, and E. T. Quittington were fairly free from injury. All of the above varieties are, of course, the blended product of *Chrysanthemum indicum* and *C. morifolium,* both of which grow wild in China and Japan.

In the Victoria greenhouse these varieties were infested: Smith's Advance, Halliday, Ivory, Polepheum, Chrysolora, Bonnafon, Wm. Turner, Western King, Mrs. Thompson, Englehart, various Pompons. Of these varieties Smith's Advance, Ivory, Bonnafon, Wm. Turner, Western King, and Englehart were practically ruined.

Felt[1] states that the insect has been recorded from central and southern Europe as infesting *Chrysanthemum leucanthemum, C. corymbosum, C. atratum, C. japonicum* and *C. myconis.* In America the pest was first noticed on the variety known as Mistletoe.

Nature of Injury. The gall (fig. 1, page 117) which is caused by the larva irritating the plant tissues occurs commonly on various portions of the chrysanthemum plants. In the Ottawa greenhouse the galls were commonly found on the leaves, stems and buds. The galls at one time were so abundant on some young plants as to entirely deform them, as a result of which development was largely stopped and no flowers borne. Many of the single-stemmed plants show conspicuous malformation of the stem resulting from early attack of the insect. In the material received from the Victoria greenhouse the galls were found freely on the stems and leaves. On some of the terminal leaves the presence of the insect in conspicuous numbers had prevented growth and the leaves were clumped together in more or less rosette fashion.

Means of Control.

In the Ottawa greenhouse some control work was conducted under the immediate direction of Mr. J. McKee. The greenhouse was fumigated during the winter of 1915-16 with hydrocyanic acid gas about once every month. Such fumigation destroyed the adults. The house was also fumigated with tobacco. The cuttings from the stools were dipped before potting (in early December) in nicotine solution in the strength of ¾ of an ounce to one gallon of water; the plants were dipped a second time when repotted from 2½-inch pots to 4-inch pots, and a third time when transferred from 4-inch pots to 6-inch pots. During July and August (1916) the chrysanthemums were sprayed with nicotine, in the same strength, every three weeks. Since the first week of September to the present date (October 16, 1916), the house has been fumigated with tobacco once every ten days.

While the midge is still present in the greenhouse, it is by no means the pest it was in 1915. The above treatment has undoubtedly kept the insect down.

In Mr. Woodward's greenhouse in Victoria, B.C., the following remedies were tested: During the first week of treatment the plants were fumigated with Black Leaf 40 every night; in the following week they were fumigated three times, and sprayed twice with Campbell's Nico Soap; during the third and fourth week the plants were fumigated twice each week and sprayed once each week. Mr. Woodward reported that as a result of this one month's treatment he had succeeded in killing many adults, and thought he was slowly getting the insect under control. The fumigation he reported was used as strong as the plants would stand without burning the foliage.

The Rose Midge, *Dasyneura rhodophaga* Coq.

In the report of the Dominion Entomologist for the year ending March 31st, 1915, a brief mention is made of the occurrence of this pest at London, Ont., specimens of the infested shoots of the variety Mrs. J. Laing having been received at Ottawa in July, 1914. This was apparently the first record of the Rose Midge in Canada. The grower reported that the buds on about 300 plants in his rose

[1]31st Report of the State Entomologist, New York, 1915, p. 51.

garden had been injured, (see fig. 4, page 117). The following summer the pest was again present in the same garden and Mr. W. A. Ross, Field Officer of the Branch, obtained infested material and reared the adults. Some of the latter were forwarded to Dr. Felt who confirmed the determination of the insect. Regarding the injury, Mr. Ross reported: "All 'Hybrid Perpetuals' and 'Hybrid Teas' are subject to attack. Mrs. John Laing is apparently the most susceptible variety. H. T's with strong terminal shoots like those of Killarney are partially immune. All the Polyantha, Bourbons, Hybrid China, Noisette and Wichuraiana roses appear to be immune."

The only other outbreak of the insect in Canada is its occurrence at the present time (autumn of 1916) in the greenhouses of Miller & Sons, Toronto. Its work was first noticed in these latter houses in September (1916). The buds of the young shoots did not develop and on investigation it was found that they were being destroyed by the larvæ. The varieties of roses which have been severely injured in the Toronto greenhouses are Ophelia, Milady and Stanley. The variety Richmond was very slightly attacked. Mr. Miller is of the opinion that the pest was introduced on rose bushes imported from Chicago, Ill.

The first record of the Rose Midge in America was in 1886[1] when it was discovered to be effecting injury to greenhouse roses in the State of New Jersey. It was not until 1900, however, that the insect was described by Coquillett as *Neocerata rhodophaga*.[2] Since 1886 the midge has been reported from New York, District of Columbia, Massachusetts and Illinois.

As the Rose Midge is one of the worst known pests of roses, florists in Canada should realize the danger of its being introduced into their houses. The Entomological Branch will gladly assist growers in any way it can, and will appreciate the receipt of injured plants and information as to suspected occurrence of this insect. It has been recorded that in a single year in two greenhouses in Chicago the Rose Midge has caused damage estimated at $10,000.

Life-history.

But few observations have as yet been made in Canada on the life-history of the insect. In the State of Illinois its life-history was studied by the late F. M. Webster, and his observations were published in 1904[3]. Davis[4] has also investigated the habits of the insect.

The perfect insect, or midge, is two-winged and is closely related to the Chrysanthemum Midge. The female deposits its yellowish eggs, which are so small as to be hardly visible to the naked eye, beneath the sepals of the flower buds or between the folded leaves of the leaf buds. The egg period is recorded as being only two days. When the young, whitish, maggots hatch they at once begin to destroy the terminal leaves and the blossom buds, and in from about five to seven days they become mature and then leave the plant, (fig. 3, page 117), dropping to the soil where they change to the pupal state. Webster has observed as many as twenty-five larvæ in a single blossom bud. Davis states that in summer the fly emerges about six days after pupation occurs. In greenhouses in Chicago the insect has been present from June until October or November in such numbers as to make it impossible to secure a single crop of flowers. During the colder winter months it is assumed that the insect is present in the pupal stage in the greenhouse soil.

[1]Insect Life, 1, 284.
[2]Bull. 22, N.S., Div. of Ent., U.S., Dept. Agr., 47.
[3]Bull. Illinois State Lab. of Nat. Hist., Vol. VII, pp. 15-25.
[4]27th Rep. State Ent., Illinois, 1912.

Means of Control.

The question of controlling the insect has been discussed chiefly by Davis,[1] who recommended two methods: (1) the growing of another crop, such as carnations, instead of roses for one year and (2) the thorough cleaning of the house in midwinter, at which time the insects are dormant in the soil, the plants to be removed and destroyed, all earth in which they have been grown and which may contain puparia to be also removed and deeply buried at some distance from the infested houses, and further that all rubbish beneath benches be also removed and the earth, floors and benches afterwards sprayed with a contact insecticide such as kerosene emulsion.

Fumigating greenhouses with hydrocyanic acid gas will, of course, destroy the flies, but such fumigation has not proved to be a practical remedy. In an infested house it is advisable to go over the plants every day, if possible, to remove the injured buds, which should afterwards be burned.

As to controlling the insect in gardens, Mr. Wood tried many methods to exterminate it but found that the only satisfactory way was to cut off all the green shoots. Such cuttings, of course, should be burned promptly.

EXPERIMENTS IN THE CONTROL OF THE POPLAR AND WILLOW BORER (*Cryptorhynchus lapathi* Linn.).

Robert Matheson, Ithaca, N.Y.

The Poplar and Willow Borer is a serious pest in nurseries of New York State and at present is doing much damage. It is also a serious pest to ornamental poplars and willows, including basket willows. The most extensive depredations of this pest occur in nurseries where large blocks of these trees are grown, and in

Cryptorhynchus lapathi. Adult.

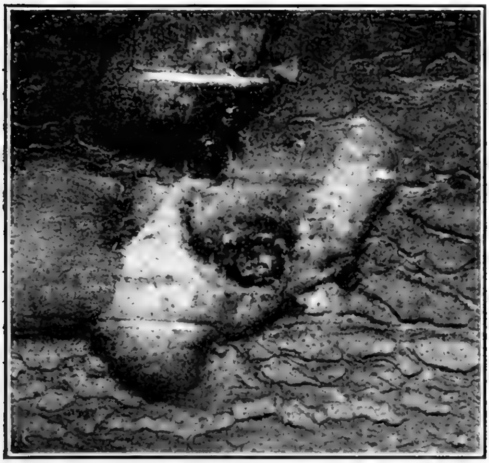
Egg puncture at side of lenticel.

some cases the annual loss is very considerable. During the past three years, as time would permit, control experiments have been conducted in two of our large nurseries. This work has been made possible through the courtesy of the proprietors, and to them I desire to express my thanks.

[1]27th Rep. State Ent. Ill., 111.

Although considerable biological data have been gathered in the course of this work, only the control experiments and their results wil be discussed here. Since the publication of Schoene's work in Bulletin 286 of the New York Experiment Station, at Geneva, very little has been done in reference to this insect. As the result of his work he recommended the use of Bordeaux mixture containing an arsenical. This spray should be applied during late July in order to destroy the adults which feed indiscriminately on the bark of the trees. Owing to the difficulty of spraying nursery trees this recommendation has not been adopted, and I know of no experiments which have been conducted on a large scale in order to test the efficiency of this method.

To present the method of experimentation more clearly a brief synopsis of the life cycle of *C. lapathi* Linn. is necessary. The eggs are deposited in August, September and October in two or three-year-old stock in the nursery rows. I did not succeed in finding eggs in younger stock. The eggs are laid exclusively in the corky portions of the tree, just below the surface of the bark near the cambium



Egg in situ.

Larva, just hatched.

layer. They were found most commonly around lenticels, near buds and branches, or in growths caused by pruning. These eggs hatch in late August, September and October. The young grubs feed on the bark and grow slightly before hibernation. In these small chambers, just below the surface of the outer bark, the young larvæ pass the winter. Feeding begins early in the spring, the larvæ attacking the cambium layer and often girdling the trees. In late June they bore into the heart of the trees, forming the pupal cells. Pupation takes place during July and the adults begin emerging in late July and August. The beetles feed for a short time before beginning to oviposit.

Up to the time that the writer undertook work on this insect no efficient control measures had been devised. The general recommendations had been the cutting out and destruction of infested trees. Schoene in Bulletin 286 of the New York Experiment Station stated that the use of arsenicals during July and August would poison the greater majority of the beetles and reduce infestations in nurseries. In practice it has been found that though Paris green and lead arsenates were used in large quantities it had no effect in reducing the annual loss. At the time (1914) the author began to look into this problem several large nurseries in New York

State had about concluded to cease raising Carolina poplars although there was a steady demand for such stock.

Early observations led the writer to the conclusion that this insect could be destroyed by some contact spray applied to the trunks of the trees in the autumn after the leaves have fallen, or in the spring before the young larvæ have begun actively feeding. This seemed very reasonable, owing to the quite exposed condition of the young larvæ in their burrows. It seemed that some of the emulsions ought to penetrate the outer bark or be absorbed through the very small amount of frass at the entrance to the burrows and destroy them. With this conclusion, varying strengths of miscible oils and kerosene emulsion applied both in the fall and spring were experimented with. In order to secure a stronger penetrating fluid it was felt carbolineum avenarius ought to be given a thorough trial, but very little is known about the constituents of this preparation. Furthermore, very little is known as to its effects on actively growing or dormant trees.

In the fall of 1913 seventy-six badly infested two-year-old poplar trees were secured and planted at the insectary. On December 1, 1913, part of this block was treated with scalecide at varying strengths and also a few trees with carbolineum and its emulsion[1] as indicated in the table. This experiment was closely watched the following spring but no injury to the trees could be noted, except that the carbolineum treated trees did not seem so vigorous. However, they grew and are now (1916) large healthy trees. Examination and careful count of the burrows in all of the trees was made on June 17, 1914. The number of larvæ present per tree is shown in table I.

TABLE I. CRYPTORHYNCHUS LAPATHI, Linn.

Treatment	When Applied	No. Trees	Examined	No. Infested	Larvae per Tree (Average)	Not Infested	Percent. Infested
Scalecide 1-5*	Dec.1, 1913	10	June 17, 1914	3	2.6	7	30
Scalecide 1-8	"	10	"	4	1.25	6	40
Scalecide 1-10	"	10	"	7	2.3	3	70
Scalecide 1-12	"	10	"	8	1.9	2	80
Scalecide 1-15	"	10	"	5	2	5	50
Carbolineum 1-1........	"	2	"	0	....	2	0
Carbolineum Emulsion 1-2	"	2	"	0	....	2	0
Check	"	22	"	10	2.6	12	45.5

In the spring of 1914 a series of experiments was undertaken in a large nursery. Three-year-old stock was chosen as it was the most available at the time of doing the work. Badly infested trees were selected at one side of a large block which had been recently dug. Directly across the roadway was a block of young poplars. On March 31 scalecide, of varying strengths, carbolineum, and carbolineum emulsion were applied to the trunks from the ground up to the young growth. The day was fair but it began raining before the various treatments were completed. However, the rainfall was slight so it should not have had any effect on the insecticidal qualities of the preparations.

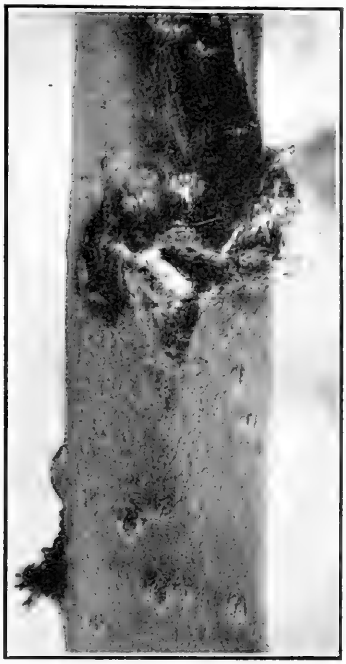
The treated trees were examined carefully on May 14, 1914. The various treatments had no effect on the growth of the trees, every tree growing vigorously,

[1]The carbolineum emulsion was prepared as follows: 1 lb. sodium carbonate, 1 quart hot water, 1 quart carbolineum avenarius. The sodium carbonate was dissolved in the hot water and the carbolineum was then added, stirring vigorously.

*All dilutions are with water.

and their being no difference as far as could be detected between the checks and those under experimentation. In the checks the larvæ were actively at work and their abundance was indicated by the amount of sawdust exuding from the numerous burrows. All the trees treated with different strengths of scalecide showed just as high a percentage of infestation as the checks. This preparation had no appreciable effect. In the trees treated with carbolineum, either pure or as an emulsion, not a trace of infestation could be found. After searching for several hours one shrivelled and blackened larva was discovered in its burrow. However, it was not desirable to injure the trees too much by cutting into all suspicious egg punctures.

The girdling work of the larvæ on nursery trees.



Showing the beginning of the formation of the pupal chamber.

This experiment was again carefully examined on June 18 and confirmed previous observations. The checks and those treated with scalecide were nearly all badly infested, many trees with as many as eight to ten borers present, while a few both in the treated and checks were apparently free. Those trees treated with carbolineum and its emulsion were growing even more vigorously than the untreated ones, and not a single trace of the work of the borer in any one of the twelve treated trees could be discovered. These preparations colored the trunks of the trees a beautiful brown, but other than that no injury could be seen.

Fearing that such a perfect control might be due to other causes than the effect of the treatment, a larger series of experiments was planned for the fall of 1914 and spring of 1915. Discarding the miscible oils, kerosene emulsion was given a trial as it has been recommended for the control of the locust borer (*Cyllene robiniæ*). In a block of over 10,000 trees ready for digging in the fall of 1915 rows were selected at the end which showed the greatest amount of the feeding work of the beetles. On December 4, 1914, groups of twenty trees were each treated with pure kerosene emulsion, carbolineum and carbolineum emulsion. Rows were left between for checks. The material was applied directly to the trunks up to the younger growth. On April 9, 1915, twenty-five trees were treated with pure kerosene emulsion, fifty with carbolineum emulsion and twenty-eight with pure carbolineum. Just previous to these treatments the trees in the whole block had

Three pupal chambers in a small 3-year old nursery tree.

Pupa in its cell.

been pruned carefully. The material was carefully brushed over the trunks, covering all the cut surfaces of the recently removed branches.

The experiment was examined on June 28. The block as a whole showed a severe infestation, sawdust being present at the base of a great many trees, and this could be seen for a long distance down the nursery rows. In the rows treated with carbolineum or its emulsion no sawdust could be seen and the trees were vigorous growers, the trunks showing a beautiful brown color but not an indication of borer work. The kerosene emulsion had no appreciable effect, nor did it injure the trees, though it was applied in large quantities. The treatments applied and results obtained may be quickly ascertained by consulting Table II. Kerosene emulsion applied pure in the fall seems to have had some effect, but one cannot

Effects of borers on nursery stock. The tree in the centre is uninjured, and one year younger than the other two. Note the comparative size and beauty of uninjured tree.

safely draw conclusions. Thirty per cent. infestation is high, though the average number of larvæ per tree is a minimum. The carbolineum applied pure and its emulsion gave almost absolute control and seems to me a very simple and effective means of control under nursery conditions.

TABLE II. CRYPTORHYNCHUS LAPATHI, Linn.

Treatment	When Applied	No. Trees	Examined	No. Infested	Larvæ per Tree (Average)	Not Infested	Percent. Infested
Kerosene emulsion, (pure)	Dec. 4,1914	20	June 28, 1915	6	1	14	30
" "	Apl. 9,1915	25	"	16	2.25	9	64
Carbolineum............	Dec. 4,1914	20	"	0	....	20	0
" emulsion....	Apl. 9,1915	27	"	0	....	27	0
Carbolineum "	Dec. 4,1914	20	"	0	....	20	0
" "	Apl. 9,1915	50	"	0	....	50	0
Check	....	116	"	56	2.4	60	48.3

The success of the preliminary experiments led to the trial of the carbolineum treatment on a commercial scale. In the fall of 1915 arrangements were made to treat two entire blocks of poplar trees in two large nurseries. This was made

One of many piles of discarded poplars in nursery.

possible by the courtesy of the owners who provided all the material, help and necessary equipment, the writer taking charge of the work. Each block of trees contained approximately 14,000 trees. Owing to the excessive snowfall during the winter of 1915 and 1916 it was not possible to apply the carbolineum as early as was intended. Furthermore, it was also delayed somewhat in order that the trees should be pruned.

On April 8, 1916, 21 rows in one block were treated. As the day was cold, threatening snow and sleet, the work was discontinued. During the following day over three inches of snow fell and the remainder of the block was not treated till April 13. In the meantime the borers had begun feeding, in fact were active since about the early days of April. The results of the treatment in this block are shown in the following table:

TABLE III. *Cryptorhynchus lapathi*, Linn.

Treatment	When Applied	No. Trees	Examined	No. Infested	Larvæ per tree	Not Infested	Per cent. Infested
Carbolineum	Apl. 18, 1916	5,000	June 22, 1916	0*	0	1,161	0
	" 13, "	9,000	July 20, "	1	1	1,160	....
Creosote........	" 8, "	136	June 22, "	0	0	136	0
			July 20, "	0	0	136	0
Check	....	313	June 22, "	9	2	304	2.9
			July 20, "	11	2	302	3.5

It will be seen from the above table that practically absolute control was secured with the carbolineum treatment. Unfortunately, the entire check row did not show a high percentage of infestation, but it is sufficient to indicate that the treatment was effective. In addition to the carbolineum a high grade creosote was

Showing treated row on each side of a check. Note the almost black color of the treated rows.

also tried in a limited way. The creosote also gave perfect control and this indicates well, for the row treated stood directly next the check row. The carbolineum gave the bark of the trees a beautiful brown appearance, but it in no way affected the vigor of the trees. This brownish coloration gradually becomes reduced during the summer, but treated trees can be recognized easily at least three

*In order to determine the infestation in the treated trees not all of the 14,000 trees were examined. Rows were selected, however, in different parts of the block and every tree examined carefully. In this way, 1,161 trees were closely scrutinized and not a sign of borer work could be found. Based on the result of this examination the figures in the table have been prepared. In the second examination a single larva was found at work on one of the treated trees, but as this was the *rare* exception the fact has been ignored in the percentage column.

years afterwards. Another point that should be brought out here is that the four trees treated with carbolineum in my experimental plot in 1913 (Dec. 1, 1913), were not attacked during the summers of 1914 and 1915 and only a single larva was found in them during 1916. This would indicate that carbolineum treated trees are not readily selected by the females for oviposition, provided untreated trees are available. This point will be further investigated by the writer.

The results of the treatment of the second block of about an equal number of trees are shown in the following table.

TABLE IV. CRYPTORHYNCHUS LAPATHI, Linn.

Treatment	When Applied	No. Trees	Examined	No. Infested	Larvæ per Tree	Not Infested	Per cent. Infested
Carbolineum....	Apl. 12 & 13, 1916	14,000	June 23, 1916	20	1,4	*1,540	1.28
			July 20, "	20	1.4	1,540	1.28
Check	....	84	June 23, "	8	1	76	9.5
			July 20, "	8	1	76	9.5
Check	....	555	June 23, "	19	1.2	536	3.42
			July 20, "	19	1.2	536	3.42

In this block we have extremely interesting results showing most conclusively the effectiveness of the carbolineum treatment. The author visited this nursery and showed the owner the method of treatment, but did not further supervise the work. In treating the trees the following day the workman failed in many cases to cover the base of the trees with the material, and also failed to apply it sufficiently high on the trunk. As a result all of the infestations, amounting to nearly 1.3 per cent., occurred either at the base or above the highest point of treatment. Another interesting point is in regard to the check row. This row running through the centre of the block contained 639 trees. When the owner saw the excellent results in the treated trees he thought why should he not save most of the check row. So on June 3, 4 or 5, he did not know the exact date, he treated 555 of the trees, leaving some at either end as a true check. The treatment, even at this late date, had a marked effect as shown by the percentage of infestation as found on June 23. During the first week in June all of the larvæ were still at work in the cambium layer and wherever sufficient material was applied most of the larvæ were killed. The trees then readily outgrew the injury. The carbolineum had no apparent effect in the retardation of growth.

METHOD OF APPLICATION.

After many trials it was found that the simplest method of application was by the use of cotton waste. The carbolineum is non-injurious to the hands so each workman carried a small amount of the material in a dipper or tin can. The cotton waste was dipped into the material and then rubbed carefully up and down the trunk. It is not necessary usually to go higher than four or five feet, but great care should be exercised to see that the base of the tree is well treated and all parts of the trunk well covered. At the same time the material should not be allowed to run down to the roots. After the trees are pruned workmen can apply the material at a very rapid rate. It is preferable to make the application on a warm day as the carbolineum is then thinner and more easily put on the trees.

*Only 1,560 trees were examined, but these were selected rows and the percentage of infestation is fairly accurate.

Cost of Treatment.

It was at first thought that the cost of treatment might prevent its use under nursery conditions inasmuch as poplars are not very high priced stock. In one nursery a careful account of the entire cost of treatment was kept and is shown below.

Labor to treat 14,000 trees	$18 50
Material, carbolineum, 7 gals at 90c.	6 30
Total cost	$24 80
Total cost per tree	0.00177

It will thus be seen that the cost per tree is extremely small, not exceeding two-tenths of a cent, a practically negligible charge.

Note work of borer just where treatment with carbolineum ends. Shown by arrow.

Carbolineum treatment ends at arrow point A. Note the two borers near base of the tree.

Summary.

The poplar and willow borer is a serious pest in restricting the production of Carolina poplars in our nurseries. Many nurseries have either given up raising them or are planning to do so.

The trees attacked by this beetle include a wide variety of poplars (*Populus spp.*) and willows (*Salix spp.*). The trees are valuable both as ornamental, shade and forest trees and the depredations of this insect are sometimes serious.

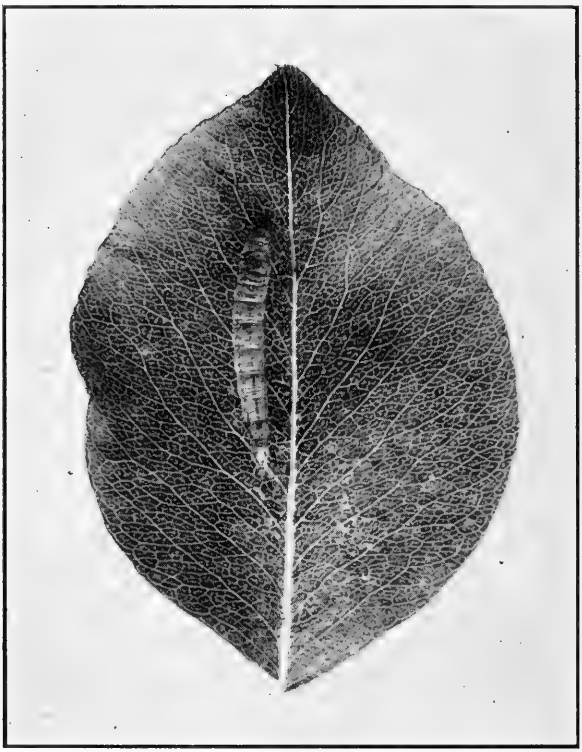
Almost perfect control was secured by treating the trunk of infested trees, under nursery conditions, with carbolineum. The material is inexpensive and easily applied.

The writer does not see any reason why this treatment could not be extended to include willows and experiments will be undertaken with this end in view. Furthermore, if persons who purchase poplars or willows will have them treated at the time of planting the spread of the insect should be greatly checked, and at the same time save the trees.

THE FRUIT-TREE LEAF-ROLLER IN NEW YORK STATE.

Glenn W. Herrick, Ithaca, N.Y.

Because of its varied agricultural and horticultural interests, because of its nearness to the seaboard and the consequent importation and landing of many and various plants and agricultural products, and because it stands in the path of the great carriers to the Western States, New York is especially subject to outbreaks



Larva of the leaf-roller.

of both old and new insect pests and plant diseases. This is true more especially perhaps of those affecting the horticultural interests of the State. Nearly every season witnesses an outbreak of some old pest which has suddenly gained a new foothold, and has taken on new energy or of some foreign importation that has been dropped by the way or been established by the bringing in of new plants or plant products. To the entomologist New York State furnishes a field of perennial interest, but to the horticulturist one of perennial fight and struggle.

Because of the proximity of the principal fruit districts of the State to those of Ontario, Canada, whatever is of interest in the way of insect pests here is also of considerable interest to Ontario entomologists and fruit growers. It was with this thought in mind that the writer chose to discuss briefly the fruit tree leaf-roller in New York.

This leaf-roller is not an insect new to this country for it has been known since 1863 when Walker described it and since 1896, at least, it has been put among the enemies of the apple in New York. It was not, however, until 1911 that the leaf-roller began to attract particular attention in this State. It furnishes a fine example of an insect previously unimportant which has suddenly and inexplicably multiplied to an enormous degree and reached the rank of a serious pest at a single bound, for during the seasons of 1912, 1913, 1914, and 1915, it caused serious and rather widespread injury in Western New York. In addition, it became unusually abundant and injurious in Colorado and New Mexico during the same period. During the past season it was much less in evidence but no prediction can be made regarding it for it may break out again at any favorable time.

Habits and Injuries.

The larvæ appear as the buds are bursting and begin to attack the unfolding leaves. They bend the leaves over and tie them together with silk. Within this sort of nest the larvæ live and eat the leaves. As soon as the blooms

Leaves tied together by the leaf-roller.

Work of leaf-roller on pears.

appear the larvæ begin to eat off the blossom stems and tie them together with silken threads, along with the leaves surrounding the blossom cluster. This webbing and tying together of the blossom clusters is a most pernicious habit, because it interferes seriously with spraying for the Codling Moth. In one Baldwin orchard in which the larvæ were very abundant, the blossom clusters were so webbed together and covered over with silk, dried petals and leaves that it was almost impossible to get the spray mixture into the calyx cup. As soon as the young apples or pears begin to set they are tied together with silk, while the larvæ live inside and gnaw cavities into the sides of the young fruit. Dr. Lintner reports the same habit of the larvæ and refers to some young pears that were eaten into, sent to him by P. Barry, of Rochester, in 1888. Stedman mentions the same kind of injury in Missouri and considers this the most serious form of injury committed by the insect. To give some idea of the number of larvæ present the writer counted 17 worms in nine blossom clusters; Braucher counted 21 larvæ on one twig 21 inches long, and 19 larvæ on another twig 22 inches long.

The larvæ also work on the leaves, rolling them and living within the roll. Here, effectually hidden, they feed on the tender tissues of the leaves. When disturbed they drop down out of their hiding places and remain suspended by silken threads like cankerworms. When all is quiet they climb back to their hiding places and begin their work again. Their injuries to the leaves are often very serious, especially when the larvæ are abundant. Gillette says, "I have seen small orchards entirely defoliated by this species so that not a green leaf could be seen."

Life-History.

Our observations accord with those of other workers for we find but one generation each year in New York.

The eggs are deposited in greatest numbers during the last of June and the first part of July. They are laid in small, oval, convex patches about as large as the end of a lead pencil on the bark of the smaller twigs. Here they remain until the following May or for a period of about ten months.

The hatching period extends over an interval of two or three weeks although the majority of the larvæ appear about the time the buds are bursting.

The full grown larva is about one inch in length, light green in color, with a black head, and black thoracic shield. It takes from three to four weeks for the larva to become full grown. It pupates in a flimsy web in a rolled leaf and in about twelve days the adult moths appear. These soon begin to deposit their eggs thus completing the life cycle.

Natural Enemies.

The fruit-tree leaf-roller seems to have a number of natural enemies. We bred at least four species of hymenopterous parasites from the larvæ and pupæ in our cages. Gill has recorded several species of birds feeding on the larvæ and has also found a few insects which are predaceous on the leaf-roller; notwithstanding this rather large list of enemies the leaf-roller has not been held in check but in spite of them has increased enormously at certain periods.

Methods of Control.

The leaf-roller has been one of the most difficult of lepidopterous apple pests to control. Its habit of rolling leaves, tying them together, and living within these protective coverings makes it difficult to get at. Attempts were made to control the insect by thoroughly spraying the infested trees with arsenate of lead and lime-sulphur about the time the buds were bursting, and again just before the blossoms opened, but the results were not satisfactory.

In the spring of 1911 a badly infested orchard in western New York was thoroughly sprayed, as the buds were bursting with 2 pounds of arsenate of lead to 50 gallons of lime-sulphur solution. On May 13th just before the blossoms opened 13 Baldwin trees in this orchard were sprayed again with arsenate of lead, 2 pounds to 50 gallons of lime-sulphur and 200 gallons of the mixture were put on the 13 trees. Later, after the petals had fallen, the regular codling moth spray was given to these trees thus making three thorough poison sprays. We were much disappointed to find that the number of larvæ was not visibly lessened by these applications.

In the spring of 1912 we projected and carried out an extensive series of experiments in the control of this pest. Mixtures of paste arsenate of lead, arsenite of zinc, black-leaf-40 and soap, and powdered arsenate of lead in different combinations and proportions were tried on various blocks of badly infested trees, principally Greenings. In all, over seventeen combinations of materials were tried on different groups of trees in the orchard. Most of the applications were made before the cluster of flower buds had separated. At this time, however, a large part of the eggs had hatched and many larvæ had already worked their way down among the cluster buds and were feeding on the buds and bud stems.

The results of the whole series of experiments were really very discouraging so far as prevention of injury to the fruit was concerned. There was so little difference between the sprayed and unsprayed portions that it did not seem worth while to make a count of the fruit. The orchard produced only about two hundred and fifty barrels of apples out of a normal eight hundred barrels, and these were mostly in the tops of the trees and in portions of the orchard not so badly infested. In this connection the work of one of the better and more intelligent fruit growers in New York is of interest.

The large orchards of this fruit grower were sprayed five times and sprayed thoroughly and intelligently. The orchards were sprayed first, in the dormant condition, just before the buds burst, with lime-sulphur, 1 gallon to 6½ gallons of water with 1 pint of black-leaf-40 to every 100 gallons for the aphis. The second spraying was made just before the blossoms opened with lime-sulphur 1 to 50 and 3 pounds of arsenate of lead. The third application was made just as the petals had fallen and consisted of lime-sulphur 1 to 50, arsenate of lead 3 pounds and black-leaf-40, ¾ pint to 100 gallons. A fourth spraying was made about ten days to two weeks after the third with lime-sulphur 1 to 50 and 3 pounds of arsenate of lead. At about this time the owners became much worried over the roller and sprayed a fifth time with arsenate of lead alone, 4 pounds to 50 gallons. In spite of this extraordinary amount of careful and thorough spraying the trees and cover crop under the trees were alive with larvæ and 40 per cent. of the crop was ruined.

During the season of 1914 careful experiments were conducted again with the poison sprays in western New York but with indifferent results. To sum up, thorough spraying with arsenate of lead in heavy proportions has not proved effective in cases of severe infestation either in New York or in the western States.

In 1914 the writer and Mr. R. W. Leiby carried out an extensive series of experiments in the field at Hilton, New York. The writer had determined by laboratory experiments made in 1912 that the miscible oils were very effective in destroying the eggs. In 1913 some limited orchard experiments demonstrated the effectiveness of these oils under field conditions and in 1914 we determined to try them on a much larger scale. In these experiments we used Scalecide, Orchard Brand, and Target Brand miscible oils. Suffice it to say, without going into details, that the miscible oils gave very gratifying results. We were able to destroy from 74 to 92 per cent. of the eggs and we believe that these oils furnish a means of control for the leaf-roller if they are intelligently and thoroughly applied. Such has also been the experience and conclusion of Gill in Colorado, Childs of Oregon, and Weldon, in Colorado and California.

Conclusions and Recommendations.

The leaf-roller is difficult to control because of its habit of hiding in the opening buds or in rolled leaves. Thorough spraying with arsenate of lead in heavy proportions has not proved effective in cases of severe infestation, either in New York or in the Western States.

Extended experiments show that the eggs of the leaf-roller are susceptible to the effect of miscible oils, which, when thoroughly applied, have destroyed from 74 to 92 per cent. of the eggs. In Colorado, New Mexico, and Oregon, where these oils have also been used extensively, even a higher proportion of the eggs have been destroyed. In experiments made during the last three years no injury has resulted from the use of miscible oils. The oils have been applied in the spring (April) at as near the active growing period of the tree as possible, but always before the buds burst. They have been used generally at the rate of 1 gallon to 15 gallons of water. Only one application should be made and that on a day when the temperature is above freezing.

In cases of severe infestation the oils should be supplemented by thorough sprayings with arsenate of lead at the rate of 6 pounds to 100 gallons of water or of lime-sulphur solution. At least one application should be made before the blossoms open, and another after the petals fall; the latter will serve also as the regular spraying for Codling Moth. In lightly infested orchards spraying with miscible oils may be omitted and reliance placed on thorough applications of arsenate of lead, at the rate of 6 pounds to 100 gallons of water or lime-sulphur solution. One or two applications should be made before the blossoms open and another after the petals fall.

Dr. Hewitt: It is always a very pleasurable duty at the conclusion of these meetings to thank our hosts, and I have much pleasure, therefore, in moving that the very hearty thanks of the Society be tendered to the President of the College and his staff for the generous hospitality which has been extended to the Society, both in providing for the meeting place for the Society and for our entertainment in the dining hall, and to the President of the Students' Council who so kindly added to the social enjoyment of the members. I think I am voicing the sentiments of all the members who are present when I say that this meeting has been extremely enjoyable from the social point of view from the fact that we have been permitted to lunch in the dining hall—which I may say we hope is a custom which will be continued in future years. It has added greatly to the convenience of the meeting, and to the opportunity of different members meeting each other, and also for the very enjoyable entertainment last night which was afforded us. May I also say how gratifying it is to the visiting members to find Dr. Bethune in such excellent health and still carrying on his work. It is a great pleasure to have him still taking an active part in the meetings, and I hope that pleasure will be continued for many years to come.

Prof. Lochhead: I should like to second that motion proposed by Dr. Hewitt. I have especially enjoyed my visit here. I have looked forward to it for some time, and it is like coming home again to come back here and meet old friends. Of course the student body is different from my time, but there are a sufficient number of familiar faces left to remind me of my old days here. I am very much pleased also to see Dr. Bethune so hale and hearty. I hope he will have many years yet of pleasant work among his beloved insects and also among his beloved students. I have to thank, also, especially Mr. Baker and Mr. Caesar for the untiring efforts they have put forth for our welfare, and for the programme they have got together.

THE ENTOMOLOGICAL RECORD, 1916.

ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, DEPARTMENT OF AGRICULTURE, OTTAWA.

Although the season of 1916 was disappointing, on the whole, for entomological work in general in Canada, there was accomplished, nevertheless, throughout the Dominion, much careful collecting in the various orders of insects. During the early part of the season, cool and rainy weather interfered considerably with such work, and later, in July and August, exceptionally high temperatures were recorded.

In June eastern entomologists had the pleasure of meeting Mr. J. H. Emerton, of Boston, Mass., and Dr. W. T. M. Forbes, of Worcester, Mass., both of whom visited together various districts in the Provinces of Ontario and Quebec. The former collected spiders, and the latter insects in general, but chiefly lepidoptera. Mr. C. H. Young, of the Geological Survey, collected in the district of Lillooet, B.C. Other officers of the Geological Survey, also brought back small collections from distant fields. The insects collected in the far north in the years 1913 and 1914, by Mr. Frits Johansen, while with the Southern Scientific party of the Canadian Arctic Expedition, are now in Ottawa, and are being mounted for immediate study.

It is again our pleasant duty to acknowledge the many favors we have received from specialists in the United States and elsewhere. Our special thanks are due to Dr. L. O. Howard, and his colleagues at Washington—Messrs. Crawford, Busck, Schwarz, Banks, Gahan, Knab and Dr. Dyar; Sir George Hampson, of the British Museum; Dr. J. M. Aldrich, of La Fayette, Ind.; Mr. C. W. Johnson, of Boston, Mass.; Col. Thos. L. Casey, of Washington, D.C.; Prof. H. F. Wickham, of Iowa City, Iowa; Mr. E. P. Van Duzee, of Berkeley, Cal.; Dr. Henry Skinner, of Philadelphia, Pa.; Mr. Chas. Liebeck, of Philadelphia, Pa.; Prof. H. S. Hine, of Columbus, Ohio; Mr. Chas. W. Leng, of New York, N.Y.; Dr. W. G. Dietz, of Hazleton, Pa.; Dr. F. C. Fall, of Pasadena, Cal.; Mr. M. C. Van Duzee, of Buffalo, N.Y.; Mr. C. A. Frost, of South Framingham, Mass.; Dr. E. C. Van Dyke, of Berkeley, Cal.; Mr. J. H. Emerton, of Boston, Mass.; Messrs. Barnes and McDunnough, Decatur, Ill.; Mr. F. H. Wolley-Dod, of Midnapore, Alta., and Dr. E. M. Walker, of Toronto, Ont.

LITERATURE.

Among the books memoirs, etc., which have appeared during 1916, and which are of interest to Canadian students, the following should be mentioned:

ALDRICH, J. M. Sarcophaga and Allies in North America: The Thomas Say Foundation of the Entomological Society of America; La Fayette, Indiana, U.S., date of issue Nov. 30, 1916. The Sarcophagid flies are interesting insects ranging in larval habit from scavengers to parasites of warm blooded animals. Dr.

Aldrich's study of the various species, comprising 301 pages, will be welcomed by entomologists generally. Sixteen plates at the end of the volume illustrate genital characters. Ninety-five species are described as new, five of which are from Canada, and five as new varieties, one of which is Canadian.

BARNES, W., AND MCDUNNOUGH, J. Check List of the Lepidoptera of North America: Decatur, Ill., price $2.00. The appearance of this new check list which has been eagerly awaited by lepidopterists, was an exceedingly welcome one. The authors have our hearty congratulations on the completion of such an arduous task. The classification of the species is considerably different from that in Dyar's catalogue, which most collectors have been using. The arrangement of the text matter is similar to that in Smith's 1903 check list, which it replaces. The new list comprises 197 pages.

BLATCHLEY, W. S. AND LENG, C. W. Rhynchophora or Weevils of North Eastern America: Nature Publishing Co., Indianapolis, Ind.; 1916, 682 pages, 150 text figures, price $4.00 unbound. Like the work of the senior author, the "Coleoptera or Beetles of Indiana," published in 1910, this work on the Rhynchophora, will prove of inestimable value to entomologists generally. With this new manual in hand, students will now be able to arrange, classify and determine the scientific names of the weevils in their collections. Keys to the families, subfamilies, tribes, genera and species have been made an important part of the present work. Following the descriptions of each species are notes on distribution, food habits, etc. The classification used is mainly that of LeConte & Horn (1876) modified where necessary by the recent studies of Casey, Hopkins, Pierce and certain European authors. A bibliography at the end notes the various works on Rhynchophora, which have been consulted in the preparation of the volume.

CASEY, THOS. L. Memoirs on the Coleoptera, VII; issued Nov. 29, 1916; The New Era Printing Co., Lancaster, Pa. This contribution of 300 pages is divided into two parts, namely: I—Further Studies in the Cicindelidæ, and II—Some Random Studies Among the Clavicornia. In the former pages 1 to 35, eleven new species are described, one of which is from Hudson Bay Territory, and thirty-three new sub-species none of which are from Canada. In part II, a large number of new species are described, only three of which, however, are from Canada.

FELT, E. P. A Study of Gall Midges, III: New York State Museum Bulletin No. 180, pp. 127-288, issued Jan. 1, 1916. In this important contribution the species of the tribes Porricondylariæ and Oligotrophiariæ are discussed, several of which are described as new. Descriptions of nine species known to occur in Canada are given. In addition to 101 text figures, 16 plates accompany the memoir, showing gall midge wings, genitalia and galls.

In the 31st Report of the State Entomologist of New York, (June 1, 1916), the same author contributes: "A Study of Gall Midges, IV, pp. 101-172, the Tribe Asphondyliariæ being monographed. Thirty-nine text figures are included.

FERRIS, G. F. A catalogue and host list of the Anoplura: Proc. Cal. Acad. Sci. Vol. VI, No. 6, pp. 129-213, May 12, 1916. This publication will doubtless be a welcome one to those interested in the sucking lice. Following a key to the families, sub-families and genera, the species are listed with the names of the animals upon which they have been found. Before listing the recognized species in each genus, the author describes the important generic characters. The catalogue is complete to April, 1916.

METCALF, C. L. Syrphidæ of Maine: Maine Agric. Exp. Station, Bull. No.

253, pp. 193-264, 9 plates, issued Oct. 14, 1916. This bulletin will undoubtedly prove of much value to Canadian dipterists, particularly those residing in the eastern provinces. Not only are descriptions of the more important or interesting Maine species given, but artificial keys to the larvæ and pupæ of the syrphidæ are also presented. Interesting chapters on the habits, structure and economic importance of the larvæ, etc., are included. The plates illustrate the life-stages of ten different species.

Mosher, Edna. A classification of the Lepidoptera based on characters of the pupa: Bull, of the Ill. State Lab. of Nat. History, Vol. XII, Article II, March, 1916, pp. 17-159, plates XIX to XXVII. In 1895, Packard published a paper entitled "Attempt at a New Classification of the Lepidoptera," based upon pupal characters. The determinations of the homology of the various parts of the pupæ were, it is stated by the above author, far from correct, and this, of course, invalidated many of his conclusions. Since Packard's paper, nothing has appeared in America towards such a classification until Dr. Mosher's contribution. Following the introduction are chapters on "Changes Preceding Pupation," and "External Morphology," under which is discussed in detail the head, the thorax and the abdomen. In the "classification" keys to many of the families are given, and plates XIX to XXVII illustrate valuable characters. The memoir is, indeed, an important one, and the author is to be congratulated on the completion of so useful a study.

Needham, James G. and Lloyd, J. T. The Life of Inland Waters, an elementary text book of fresh-water biology for American students: The Comstock Publishing Co., Ithaca, N.Y., 1916; 438 pages, 244 text figures; price $3.00. This book is divided into seven chapters: I, Introduction; II, The Nature of Aquatic Environment; III, Types of Aquatic Environment; IV, Aquatic Organisms; V, Adjustment to Conditions of Aquatic Life; VI, Aquatic Societies; VII, Inland Water Culture. Chapters IV, V and VI, contains much entomological matter.

Osborn, Herbert. Agricultural Entomology, for students, farmers, fruit-growers and gardeners: Lea & Febiger, Philadelphia and New York, 1916; 347 pages, 252 text figures, 1 colored plate. This book, the author states, has been designed to meet the needs of students and others who wish to learn something of insect life, especially in relation to farm crops and live stock. It will undoubtedly prove a useful work of reference.

Osborn, Herbert and Drake, Carl J. The Tingitoidea of Ohio: Ohio State University Bulletin, Vol. XX, No. 35, pp. 217-251. This study of these insects of Ohio commonly known as "lace-bugs" will be of interest to Canadian students. Ten new species are described. Nine figures occur in the text in addition to which there are two plates.

Van Duzee, Edward P. Check List of the Hemiptera (excepting the Aphididæ, Aleurodidæ and Coccidæ of America, north of Mexico, p. 111: New York Entomological Society, 1916. The appearance of this long-looked for check list was, I feel sure, welcomed by entomologists generally. In the preface the author states that "the present Check List has been drawn off from a complete bibliographical and synonymical catalogue of the Hemiptera of America North of Mexico, which was completed last winter, and later will be published by the University of California Press. Except for the references to the literature of the subjects, this Check List gives most of the information in the large catalogue and includes the systematic arrangements, full synonymy, the date of each name, and roughly the distribution of each species." Copies of the Check List may be obtained from the Treasurer of the New York Entomological Society, the price of the same is $1.50.

VAN DUZEE, E. P. Monograph of the North American Species of Orthotylus (Hemiptera): Proc. Cal. Acad. Sci., Vol. VI, No. 5, pp. 87-128, May 8, 1916. In this paper the author includes the species recorded from America, north of Mexico. Twenty-five species are described as new, one of which is from Canada. One plate showing male genital hooks accompanies the paper.

COLLECTORS.

The following is a list of the names and addresses of collectors heard from during 1916:

Anderson, E. M., Provincial Museum, Victoria, B.C.
Baird, Thos., High River, Alta.
Beaulieu, G., Ent. Branch, Dept. Agr., Ottawa.
Beaulne, J. I., Ent. Branch, Dept. Agr. Ottawa.
Bethune, Rev. Prof., O.A.C., Guelph.
Blackmore, E. H., Victoria, B.C.
Bowman, K., 9914-115th Street, Edmonton, Alta.
Brimley, J. F., Wellington, Ont.
Brittain, W., Agric. College, Truro, N.S.
Caesar, L., O.A.C., Guelph, Ont.
Carr, F. S., Edmonton, Alta.
Chagnon, Gus., Box 521, Montreal.
Chagnon, W., St. John's, Que.
Chrystal, R. N., Ent. Branch, Dept. Agr., Ottawa.
Cockle, J. W., Kaslo, B.C.
Cosens, Dr. A., Parkdale Collegiate Institute, Toronto.
Crew, R. J., 561 Carlaw Ave., Toronto.
Criddle, Evelyn, Aweme, Man.
Criddle, Norman, Aweme, Man.
Dawson, Horace, Hymers, Ont.
Day, G. O., Duncan, B.C.
Dod, F. H. Wolley-, Midnapore, Alta.
Dunlop, James, Woodstock, Ont.
Emile, Rev. Bro., Longueuil, Que.
Evans, J. D., Trenton, Ont.
Fyles, Rev. Dr. T. W. 268 Frank St., Ottawa.
Germain, Rev. Bro., Three Rivers, Que.
Gibson, Arthur, Ent. Branch, Dept. Agric., Ottawa.
Hadwen, Dr. S., Agassiz, B.C.
Hahn, Paul, 433 Indian Road, Toronto.
Hanham, A. W., Duncan, B.C.
Harrington, W. H. 295 Gilmour St., Ottawa.
Hewitt, Dr. C. Gordon, Ent. Branch, Dept. Agric., Ottawa.
Holmes, James G., Westmount, Que.
Hudson, A. F., Millarville, Alta.
Johnson, Geo. S., Moose Jaw, Sask.
Kitto, V., Inland Revenue, Dept. Interior, Ottawa.
Leavitt, A. G., St. John, N.B.
Macnamara Chas., Arnprior, Ont.

Mackie, Donald, Edmonton, Alta.
McIntosh, W., St. John, N.B.
Mignault, Rev. J. B., Saint Lambert, Que.
Moore, G. A., 359 Querbes Ave., Outremont, Montreal.
Payne, H. G., Granville Ferry, N.S.
Perrin, Jos., McNab's Island, Halifax, N.S.
Petch, C. E., Hemmingford, Que.
Phair, A. W. H., Lillooet, B.C.
Ruhmann, Max M., Vernon, B.C.
Roberts, H. L., Winnipeg, Man..
Ross, W. A,. Vineland Station, Ont.
Roy, Henri, Quebec, Que.
Sanders, G. E., Annapolis, N.S.
Sanson, N. B., Banff, Alta.
Simpson, W., Dominion Observatory, Ottawa.
Simms, H. M., 192 Ontario East, Montreal.
Sladen, F. W. L., Experimental Farm, Ottawa.
Strickland, E. H., Experimental Station, Lethbridge. Alta.
Swaine, J. M., Ent. Branch, Dept. Agric., Ottawa.
Tams, W. H. T., Midnapore, Alta.
Taverner, P. A., Victoria Memorial Museum, Ottawa.
Tothill, J. D., Fredericton, N.B.
Treherne, R. C., Agassiz, B.C.
Venables, E. P., Vernon, B.C.
Walker, Dr. E. M., Univ. of Toronto, Toronto.
Wallis, J. B., 265 Langside St., Winnipeg, Man.
Whitehouse F. C., Red Deer, Alta.
Willing, Prof. T. N., Univ, of Saskatchewan, Saskatoon, Sask.
Wilson, Tom, 1105 Broadway, Vancouver, B.C.
Winn, A. F., 32 Springfield Ave., Westmount, Que.
Young, C. H., Victoria Memorial Museum, Ottawa.

NOTES OF CAPTURES.

(Species preceded by an asterisk (*) described during 1916.)

Lepidoptera.

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

Papilionidæ.

5. *Papilio bairdi* Edw. Red Deer, Alta., June 24, 1916, (Whitehouse).

Satyridæ.

120. *Oeneis macouni* Edw. Victoria Beach, Man., July 1, 1916, (Duthie).

Nymphalidæ.

189. **Brenthis aphirape dawsoni* B. & McD. Hymers, Ont., June 15-30, (Dawson); Can. Ent., XLVIII, 222.

193. **Brenthis chariclea grandis* B. & McD. Hymers, Ont., Aug. 1-15, (Dawson); Can. Ent., XLVIII, 222.
202. *Brenthis astarte* D. & H. Lillooet, B.C., (Phair).
305. **Basilarchia arthemis rubrofasciata* B. & McD. Province of Saskatchewan, (Croker); Cartwright, Man.; Calgary, (Dod); Can. Ent., XLVIII, 221.

Hesperiidæ.

Andopea (Pamphila) lineola. Mr. W. E. Saunders, of London, Ont., has informed me that this European species has been found at London, Ont., as follows: July 21, 1910, (10 specimens taken), 1911, (2 specimens taken). Since, taken every year, the name of the collector being Mr. John A. Morden. The determination, Mr. Saunders tells me, was made at Washington.

Sphingidæ.

696. *Sphinx drupiferarum* A. & S. Red Deer, Alta., June 28, 1916, (Whitehouse).
733. *Hæmorrhagia gracilis* G. & R. Petawawa, Ont., June 10, 1910, (record sent by A. F. Winn from specimen in collection of G. A. Southee, Outremont, Que.).

Saturniidæ.

785. **Hemileuca lucina latifascia* B. & McD. Aweme, Man., Sept., (N. Criddle); Can. Ent., XLVIII, 224.

Arctiidæ.

973. *Apantesis parthenice* Kirby. Stellarton, N.S., (C. B. Hills). First record I have for the Province, (A. G.).
982. *Apantesis virguncula* Kirby. Stellarton, N.S., (C. B. Hills). First record I have for the Province, (A. G.).
989. *Apantesis phyllira* Dru. Wellington, Ont., July, (record sent by J. D. Evans). Furthest eastern record for Ontario, (A. G.).
1033. *Haploa lecontei militaris* Harr. Stellarton, N.S., July (C. B. Hills). First record we have for the Province, (A. G.).
1034. *Haploa confusa* Lyman. Stellarton, N.S., July 19, (C. B. Hills). First record we have for the Province, (A. G.).

Noctuidæ.

1214. **Copablepharon viridisparsa* Dod. Lethbridge, Alta., July 20, 1915, (Strickland); Calgary, Alta., Aug. 7, 1902, (Willing); Can. Ent., XLVIII, 60. The species is the No. 385 of Dod's Alberta list, originally recorded as *absidum*.
1379. **Euxoa thanatologia perfida* Dod. Calgary, Alta., (Dod); High River, Alta., (Baird); Miniota, Man., (Dennis); Kaslo, B.C., (Cockle). Can. Ent., XLVIII, 64. This is the moth referred to under No. 224, in Dod's Alberta list.
1409. *Feltia volubilis* Harv. Duncan, B.C., June 3, 1916. New to local list, (Hanham).
1718. *Polia goodelli* Grt. Murray Bay, Que., (Holmes). Only one locality—St. Hilaire—in Winn's list of Quebec lepidoptera.

1887. *Xylomiges dolosa* Grt. Edmonton, Alta., April 17, 1915; April 27, 1916, (Mackie). New to Alberta, (Dod).

2001. **Cucullia omissa* Dod. Head of Pine Creek, near Calgary, Alta., May 18, June 25-Aug. 13, (Dod); Windermere, B.C., June 12, 1907, (Dod); Nelson, B.C., (H. Cane); Aweme, Man., June 6-14, (N. Criddle); Cartwright, Man., (Heath); Hymers, Ont., July 11, 1912, (Dawson); Can. Ent., XLVIII, 58.

2116. *Epidemas melanographa* Hamp. Quamachan Lake, B.C., Oct. 10, 1910; Victoria, B.C., end of Aug., 1916, (Hanham).

2264. *Septis plutonia* Grt. Edmonton, Alta., July, 1915 and 1916, (Mackie). New to Alberta list, (Dod).

2295. *Trachea adnixa* Grt. Duncan, B.C., July, (Hanham).

2390. *Callopistria floridensis* Gn. This insect, the caterpillar of which has appeared in greenhouses in destructive numbers at Weston, near Toronto, Ont., and Montreal West, Que., is a new addition to the Canadian list. Moths from the former locality have been reared at Ottawa, (Gibson).

2440. *Acronycta fragilis* Gn. Edmonton, Alta., May 20-June 23, 1915, (Mackie). New to Alberta list, (Dod).

2441. *Acronycta minella* Dyar. Starblanket, Sask., (H. Hutchinson).

2476. *Acronycta felina cyanescens* Hamp. Victoria, B.C., July 10, 1916, (Hanham).

2497. *Acronycta distans dolorosa* Dyar. Quamichan Lake, B.C., July 29, 1914, (Hanham).

2508. *Acronycta oblinita* A. & S. Edmonton, Alta., April 30-June 15, 1914, (Mackie). New to Alberta list, (Dod).

2528. *Andropolia maxima* Dyar. Victoria, B.C., July, (Hanham).

2613. *Menopsimus caducus* Dyar. Ottawa, Ont., July 13, 1905, (Young).

2651. *Gortyna perobliqua* Hamp. Edmonton, Alta., Aug. 22, 1913, (Mackie). New to Alberta list, (Dod).

2695. *Papaipema frigida* Sm. Edmonton, Alta., Aug. 31, 1915, Sept. 3, 1916, (Mackie). New to Alberta list, (Dod).

3069. *Catocala semirelicta* Grt. Murray Bay, Que., (Holmes). In Winn's list of Quebec lepidoptera, Montreal is the only locality mentioned.

3211. *Panthea furcilla* Pack. Stellarton, N.S., (C. B. Hills). First record we have for the Province, (A. G.). Murray Bay, Que., (Holmes). Previously recorded from Gaspe and Levis in Quebec Province.

3280. *Eosphoropteryx thyatyroides* Gn. Edmonton, Alta., July 23, 1912, Aug. 12, 1916, (Mackie). New to Alberta list, (Dod).

3398. *Calpe canadensis* Beth. Stellarton, N.S., (C. B. Hills). First record we have for the Province, (A. G.).

Notodontidæ.

3611. *Odontosia elegans* Stkr. Edmonton, Alta., July 5, 1916, (Bowman).

Drepanidæ.

3761. *Drepana bilineata* Pack. Edmonton, Alta., May 12, 1915, (Mackie). New to Alberta list, (Dod).

Geometridæ.

3981. *Lygris destinata triangulata* Pack. Edmonton, Alta., July 30-Aug. 10, 1914, also 1915, 1916, (Mackie). New to Alberta list, (Dod).

3990. *Thera otisi* Dyar. Mount Brenton, B.C., (elev. 3,500 ft.)., flying over the snow, July, 1916, (Hanham).

4018. **Hydriomena californiata niveifascia* Swett. Goldstream, B.C., April 19, 1908; Victoria, B.C., June 6, 1908, (Blackmore). Can. Ent., XLVIII, 249.

4042. **Xanthorhoe defensaria gigantaria* Swett. Cowichan Bay., April 26, 1906; Victoria, B.C., April 21-May 20, 1914, 1915, (Blackmore); Duncan, B.C., April 22, 1914, (Blackmore); Can. Ent., XLVIII, 353.

4042. **Xanthorhoe defensaria thanataria* Swett. Victoria, B.C., Aug. 26 to Sept. 25, 1913, 1914, Aug. 1, 1915, (Blackmore); Can. Ent., XLVIII, 352. This is placed in the synonymy by Messrs. Barnes and McDunnough.

4042. **Xanthorhoe defensaria suppuraria* Swett. Victoria, B.C., June 2, 1914, April 25, May 2, 1915, (Blackmore); Can. Ent., XLVIII, 354. Placed in the synonymy by Messrs. Barnes and McDunnough.

4042. **Xanthorhoe defensaria conciliaria* Swett. Victoria, B.C., Sept. 18, 1913, May 14 to Aug. 26, 1914 and 1915, (Blackmore). Can. Ent., XLVIII, 352.

4072. *Euphyia intermediata* Gn. Edmonton, Alta., May 18-June 1, 1914, also 1915, 1916, (Mackie). Mr. Dod informed Mr. Mackie that in his collection *M. lacustrata* had been labelled *intermediata,* but that he now had the real *intermediata* according to Barnes and McDunnough.

4115-1. **Nomenia obsoleta* Swett. Goldstream, B.C., April 19, 1908, (R. V. Harvey); Victoria, B.C., April 19, 26, 1908, (R. V. Harvey); Can. Ent., XLVIII, 249.

4148. *Eupithecia obumbrata* Tayl. Mt. Tzuhalem, B.C., May, (Day).

4362. *Phasiane muscariata* Gn. Genoa Bay, April 24, (Hanham).

4372. *Phasiane neptaria* Gn. Mount Sicker, B.C., (elev. 2,500 ft.), July 1, (Hanham).

4405-1. **Diastictis andersoni* Swett. Atlin, B.C., July 13, 1914, (Anderson); Can. Ent., XLVIII, 251.

4470. *Caripeta æqualiaria* Grt. Cowichan Bay, B.C., Aug., (Day).

4670. *Plagodis approximaria* Dyar. Edmonton, Alta., May 22, 1915. New to Alberta list, (Dod).

4689. *Gonodontis duaria* Gn. Edmonton, Alta., May 12-31, 1913; also 1914, 1915, 1916, (Mackie). New to Alberta list, (Dod).

Pyralidæ.

5225. *Geshna primordialis* Dyar. Hull, Que., June 23, 1916, (W. T. M. Forbes).

5446. *Dicymolomia metalliferalis* Pack. Victoria, B.C., early July, 1916, (Hanham).

Aegeriidæ.

6755. *Paranthrene asilipennis* Bdv. Hamilton, Ont., May 30, 1916. Record sent by Prof. C. J. S. Bethune.

Eucosmidæ.

6778. *Evetria albicapitana* Busck. St. Williams, Ont., on jack pine branches, (Caesar).

Tortricidæ.

7399. *Eulia juglandana* Fern. Grimsby, Ont., (Caesar).

7407-1. **Tortrix oleraceana* Gibson. Larvæ on cabbage, St. John's, Nfd., (A. J. Bayly); moths emerged, Ottawa, Aug. 9-17, (Gibson); Can. Ent., XLVIII, 374.

Plutellidæ.

7656. *Harpipteryx canariella* Wlshm. Aweme, Man., July 25, 1914, (N. Criddle).

Yponomeutidæ.

7721. *Xyrosaria celastrusella* Kearf. Aweme, Man., Sept. 13, 1912, reared from seed of *Parnassia palustrus,* (N. Criddle).

Lyonetiidæ.

8106. *Lyonetia candida* Braun. The author of this species informed me that she observed the mines of *candida* at Field and Glacier, B.C., in 1915, on the white Rhododendron, *R. albiflorum.* The species was described from material reared in California and Washington States, (Gibson).

8153. **Bucculatrix crescentella* Braun. "Toronto, Canada"; Can. Ent., XLVIII, 140.

Micropterygidæ.

8481. *Epimartyria auricrinella* Wlshm. Sherbrooke, Que., Megantic, Que., (W. T. M. Forbes); Mer Bleue, near Ottawa, (Young). New to Quebec list.

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

(Henshaw's number.)

Cicindelidæ.

30. *Cicindela hyperborea* Lec. In the collections of the Dominion Entomological Branch, there is a specimen of this rare species labelled "Sask., Canada."

35. *Cicindela hirticollis* Say. East shore of Lake Winnipeg, Man., on white sand. Years ago Mr. N. Criddle took one specimen near Aweme. It has not been taken since in Manitoba until June 17, 1916, (Wallis).

* *Cicindela hudsonica* Csy. "Hudson Bay Territory"; Memoirs on the Coleoptera VII, p. 29; issued Nov. 29, 1916.

Carabidæ.

87. *Cychrus viduus* Dej. Toronto, Ont., (C. A. Good).

122. *Carabus limbatus* Say.

123. *Carabus vinctus* Web.

Both of these species were recorded in the *Entomological Record* for 1911, from Edmonton, Alta. On further investigation it is believed that both determinations were wrong. These records, therefore, should be removed from the 1911 *Record.* (A.G.)

129. *Calosoma frigidum* Kirby. Edmonton, Alta., June 5, 1915, (Carr).
145. *Calosoma moniliatum* Lec. Millarville, Alta., May, (Tams).
150. *Elaphrus clairvillei* Kirby. Edmonton, Alta., May 22, 1915, (Carr).
163. *Blethisa julii* Lec. Millarville, Alta., June, (Tams).
(9247) *Notiophilus aquaticus* Linn. Edmonton, Alta., May 6, 1916, (Carr).
205. *Pelophila rudis* Lec. Edmonton, Alta., Oct. 11, 1915, June 20, 1916, (Carr).
300. *Nomius pygæus* Dej. Dr. C. J. S. Bethune has forwarded records of this ill-smelling beetle from Bancroft, Ont., Aug. 20, and Royal Muskoka, Ont., Aug. 24, 1916. At Ottawa we also received the species from Gravenhurst, Aug. 1, 1916, (J. A. Cockburn).
321. *Bembidium concolor* Kirby. Aweme, Man., June 13, 1909, (S. Criddle).
352. *Bembidium ustulatum* Linn. Millarville, Alta., March, 1914, (N. Criddle).
364. *Bembidium dyschirinum* Lec. Mt. Lehman, B.C., May, 1910, (Hadwen).
389. *Bembidium nigripes* Kirby. Edmonton, Alta., April 12, 1915, (Carr).
Bembidium consanguineum Hayward. Edmonton, Alta., June 29, 1916, (Carr).
403. *Bembidium scudderi* Lec. Regina, Sask., May 1, 1912, (N. Criddle); Aweme, Man., June 18, 1909, (N. Criddle). New to Manitoba.
423. *Bembidium iridescens* Lec. Mt. Lehman, B.C., April, 1910, (Hadwen).
449. *Tachys nanus* Gyll. Edmonton, Alta., May 3, 1915, (Carr).
519. *Pterostichus adoxus* Say. Kentville, N.S. (Record sent by W. H. Brittain).
562. *Pterostichus cyaneus* Lec. Aweme, Man., June 6, 1910, (E. Criddle). New to Manitoba.
567. *Pterostichus convexicollis* Say. Aweme, Man., May 14, 1914, (T. and N. Criddle).
678. *Amara remotestriata* Dej. Calgary, Alta., April 27, 1912, (N. Criddle).
Amara coelebs Hayward. Aweme, Man., March 28, 1908, April 18, 1909, (N. Criddle); Winnipeg, Man., April, May, (Wallis).
770. *Platynus reflexus* Lec. Smith's Cove, N.S. (Record sent by W. H. Brittain).
776. *Platynus piceolus* Lec. Winnipeg, Man., May 3, 1911, (Wallis).
796. *Platynus corvus* Lec. Aweme, Man., April 5, June 18, 1910, (E. & N. Criddle). New to Manitoba.
830. *Platynus picicornis* Lec. Selkirk, Man., May 24, 1911; Husavick, Man., June 22, 1912, (Wallis).
836. *Platynus nigriceps* Lec. Edmonton, Alta., Oct. 11, 1915, (Carr).
853. *Galerita bicolor* Drury. Guelph, Ont., (C. A. Good).
881. *Lebia marginalis* Dej. Aweme, Man., May 6, Oct. 4, (E. and N. Criddle). New to Manitoba.
893. *Lebia fuscata* Dej. Husavick, Man., July 7, 1915, (Roberts).
978. *Brachynus cordicollis* Dej. Aweme, Man., Aug. 20, 1910, (E. Criddle). New to Manitoba.
1030. *Chlænius alternatus* Horn. Husavick, Man., Aug. 1, 1914, (Wallis).
1031. *Chlænius purpuricollis* Rand. Aweme, Man., April 20, 1905, (N. Criddle).
1125. *Selenophorus pedicularius* Dej. Aweme, Man., May 31, 1910, (N. Criddle). New to Manitoba.
1156. *Bradycellus neglectus* Lec. Winnipeg, Man., May 5, 1909, (Wallis).
1433. *Agabus anthracinus* Mann. Edmonton, Alta., June 7, 1915, (Carr).

1446. *Agabus erichsoni* G. & H. Edmonton, Alta., Sept. 5, 1915, (Carr).
1450. *Agabus clavatus* Lec. Edmonton, Alta., April 8, 9, 10, 1916, (Carr).

Hydrophilidæ.

1550. *Helophorus lineatus* Say. Edmonton, Alta., April 29, 1914, (Carr).
1653. *Hydrobius fuscipes* Linn. Edmonton, Alta., April 29, 1916, (Carr).

Silphidæ.

1695. *Necrophorus americanus* Oliv. Truro, N.S., (record sent by W. H. Brittain); Granville Ferry, N.S., (Payne).
1696. *Necrophorus sayi* Lap. Leduc, Alta., April 25, 1914, (Carr).
1813. *Clambus puberulus* Lec. Miami, Man., June 29, 1914, (Wallis).

Staphylinidæ.

* *Baryodma ontarionis* Casey. Ottawa, Ont., (Gibson); Coaticook, Que., (Beaulne); Can. Ent., XLVIII, 71.
2125. *Staphylinus pleuralis* Lec. Edmonton, Alta., April 10, 1915, (Carr).
2136. *Staphylinus fossator* Grav. Smith's Cove, N.S., (record sent by W. H. Brittain).
Pæderus nevadensis. Edmonton, Alta., Oct. 11, 1915, (Carr).
2911. *Micropeplus tesserula* Curt. Winnipeg, Man., May 3, 1912, (Wallis).

Phalacridæ.

3000. *Olibrus semistriatus* Lec. Treesbank, Man., July 21, 1910, (Wallis).
* *Olibrus tristus* Csy. "British Columbia"; Memoirs on the Coleoptera, VII, p. 52; issued Nov. 29, 1916.

Coccinellidæ.

3052. *Hippodamia falcigera* Cr. Edmonton, Alta., June 26, Oct. 14, 1916, (Carr).
3060. *Coccinella monticola* Muls. Treesbank, Man., July 14, 1915, (Wallis).
3062. *Coccinella tricuspis* Kirby. Edmonton, Alta., May 26, 1916, (Carr); Truro, N.S., (Record sent by W. H. Brittain).
3066. *Adalia frigida* var. *disjuncta* Rand. Edmonton, Alta., May 3, 1915, (Carr).
Cleis hudsonica Casey. Edmonton, Alta., May 18, 1916, (Carr).
3072. *Anisocalvia (Harmonia) 12-maculata* Gebl. Edmonton, Alta., June 10, 1911, (Carr).
3073. *Mysia pullata* Say. Edmonton, Alta., May 10, 1915, (Carr).
3101. *Hyperaspis fimbriolata* Melsh. Three Rivers, Que., May, 1916, (Germain).
3115. *Hyperaspis pratensis* Lec. Winnipeg, Man., June 27, 1915, (Wallis).
3138. *Scymnus americanus* Muls. Husavick, Man., Aug. 2, 1914, (Wallis).
3152. *Scymnus puncticollis* Lec. Husavick, Man., July 5, 1915, (Roberts).

Colydiidæ.

3248. *Synchita fuliginosa* Melsh. Miami, Man., July 2, 1914, (Wallis).

Cucujidæ.

3314. *Pediacus fuscus* Er. Miami, Man., June 29, 1914, (Wallis).
3320. *Læmophlœus biguttatus* Say. Aweme, Man., June 25, 1915, in elm and ash bark, (N. Criddle).
3327. *Læmophlœus adustus* Lec. Winnipeg, Man., June 1, 1912, (Wallis).
3341. *Læmophlœus truncatus* Casey. Montreal, Que., found in flour, Feb., 1916, (Gibson).
3348. *Dendrophagus glaber* Lec. Edmonton, Alta., May 12, 1916, (Carr).

Cryptophagidæ.

3355. *Telmatophilus americanus* Lec. Miami, Man., June 26, 1914, (Wallis).
3363. *Henoticus serratus* Gyll. Winnipeg, Man., May 17, 1911, (Wallis).
Atomaria linearis Steph. Winnipeg, Man., May 17, 1911, (Wallis).
3388. *Atomaria ochracea* Zimm. Winnipeg, Man., May 15, 1909, (Wallis).

Dermestidæ.

3418. *Dermestes marmoratus* Say. Aweme, Man., May 13, 1916, (N. Criddle). New to Manitoba.
* *Attagenus canadensis* Csy. "Canada, (Ottawa and Quebec)"; Memoirs on the Coleoptera, VII, p. 183; issued Nov. 29, 1916.

Histeridæ.

3495. *Hister furtivus* Lec. Edmonton, Alta., May 8, 1915, (Carr); Midnapore, Alta., (Tams).
3523. *Hister æquus* Lec. Husavick, Man., July 13, 1915, (Roberts).
3564. *Paromalus bistriatus* Er. Edmonton, Alta., July 12, 1916, (Carr).

Nitidulidæ.

3681. *Carpophilus brachypterus* Say. Winnipeg, Man., May 19, 1915, (Roberts).
3709. *Epuræa truncatella* Mann. Winnipeg, Man., April 14, 1915, (Wallis); Edmonton, Alta., Sept. 30, 1915, (Carr).
3711. *Epuræa ovata* Horn. Winnipeg, Man., June 6, 1912, (Wallis).
3759. *Ips vittatus* Say. Edmonton, Alta., Sept. 22, 1915, (Carr).
3767. *Rhizophagus dimidiatus* Mann. Edmonton, Alta., Aug. 27, 1914, (Carr).

Latridiidæ.

3781. *Latridius minutus* L. Winnipeg, Man., April 21, 1914, (Wallis).
Melanopthalma gibbosa Herbst. Winnipeg, Man., May 13, 1911, (Wallis).
Melanopthalma distinguenda Com. Peachland, B.C., July 16, 1912, (Wallis).
Corticaria pubescens Gyll. Winnipeg, Man., March 30, 1916, (Wallis).
3799. *Corticaria dentigera* Lec. Winnipeg, Man., May 13, 1911, (Wallis).
3804. *Corticaria ferruginea* Gyll. Miami, Man., June 30, 1914; recorded from Hudson Bay by Hamilton, (Wallis).
3805. *Corticaria serrata* Payk. Winnipeg, Man., March 17, 1915, (Wallis).
Corticaria varicolor Fall. Winnipeg, Man., April 17, 1911, (Wallis).
3810. *Melanophthalma americana* Mann. Winnipeg, Man., April 17, 1911, (Wallis).
3826. *Melanopthalma picta* Lec. Winnipeg, Man., May 13, 1911, (Wallis).

Trogositidæ.

3833. *Trogosita chloroida* Mann. Vernon, B.C., (Brittain).
3851. *Grynocharis 4-lineata* Melsh. Winnipeg, Man., May 14, 1915, (Roberts).
* *Ostoma nigrina* Csy. "British Columbia (Aldermere) Keen"; Memoirs on the Coleoptera, VII, p. 285; issued Nov. 29, 1916.
3856. *Monotoma picipes* Hbst. Winnipeg, Man., June 24, 1911, (Wallis).

Byrrhidæ.

3881. *Simplocaria metallica* Sturm. Truro, N.S., (record sent by W. H. Brittain).

Elateridæ.

(10,049a) *Hypnoidus* (*Cryptohypnus*) *lucidulus* Mann. Edmonton, Alta., May 6, 1916, (Carr).
4210. *Elater cordatus* Horn. Edmonton, Alta., April 1, 1915, (Carr).
4220. *Elater pullus* Germ. Smith's Cove, N.S., (record sent by W. H. Brittain).
4228. *Elater socer* Lec. Edmonton, Alta., June 14, 1916, (Carr).
4245. *Elater phoenicopterus* Germ. Mt. Lehman, B.C., April, 1911, (Hadwen).
4287. *Agriotes limosus* Lec. Edmonton, Alta., June 9, 1915, (Carr).
4297. *Dolopius lateralis* Esch. Millarville, Alta., June, (Tams).
4351. *Limonius crotchii* Horn. Millarville, Alta., May 23, 1914, (Tams).
4380. *Campylus denticornis* Kirby. Husavick, Man., July 5, 1915; Aug. 19, 1915, (Roberts and E. Coates).
4496. *Corymbites inflatus* Say. Millarville, Alta., May 23, (Tams).

Buprestidæ.

4582. *Dicerca asperata* L. & G. Three Rivers, Que., July, 1916, (Germain).
4583a. *Dicerca chrysea* Melsh. Edmonton, Alta., June 3, 1915, (Carr).
Poecilonota erecta. Edmonton, Alta., July 27, 1916, (Carr).
4606b. *Buprestis rusticorum* Kirby. Granville Ferry, N.S., (Payne).
4621. *Melanophila drummondi* Kirby. Edmonton, Alta., June 25, 1916, (Carr).
4625. *Melanophila aneola* Melsh. Peachland, B.C., July 18, 1915, (Wallis).
4630. *Anthaxia viridifrons* Lap. Peachland, B.C., July 14, 1915, (Wallis).
Chrysobothris breviloba Fall. Banff, Alta., July 2, 1915; Peachland, B.C., July 22, 1915, (Wallis).
4651. *Chrysobothris scabripennis* L. & G. Edmonton, Alta., June 18, 1916, (Carr).
4661. *Chrysobothris harrisii* Hentz. Husavick, Man., July 7, 1915, (Roberts).
4739. *Agrilus anxius* Gory. Edmonton, Alta., June 18, 1916, (Carr).

Lampyridæ.

4783. *Eros thoracicus* Rand. Husavick, Man., July 13, 1915, (Roberts).
4826. *Pyractomena lucifera* Melsh. Edmonton, Alta., June 14, 1915, (Carr).
4901. *Podabrus piniphilus* Esch. Banff, Alta., July 3, 1915, (Wallis).
4931. *Telephorus fraxini* Say. Edmonton, Alta., May 29, 1915, (Carr).
4940. *Telephorus scitulus* Say. Husavick, Man., July 4, 1915, (Roberts).
4953. *Telephorus tuberculatus* Lec. Kentville, N.S., (C. A. Good).

Cleridæ.

5136. *Cymatodera bicolor* Say. Husavick, Man., July 5, 1915, (Roberts).
5161. *Clerus apivorus* Germ. Larkin, B.C., (Brittain).

5185a. *Thanasimus nubilis* Kl. Edmonton, Alta., May 8, 1916, (Carr).
5191. *Hydnocera subfasciata* Lec. Peachland, B.C., July 23, 1915, (Wallis).

Ptinidæ.

5236. *Mezium americanum* Lap. Montreal Que., in hotel, Feb. 9, 1916, (Gibson).
5247. *Ernobius mollis* Linn. Kentville, N.S., (record sent by W. H. Brittain).
5292. *Xyletinus peltatus* Harr. Winnipeg, Man., July 1, 1911, (Wallis).
5296. *Xyletinus lugubris* Lec. Winnipeg, Man., June 27, 1915, (Wallis).
5376. *Lyctus planicollis* Lec. Winnipeg, Man., June 13, 1915, (Roberts).

Cioidæ.

Octotemnus laevus Casey. Winnipeg, Man., May 17, 1911, (Wallis); Onah, Man., May 24, 1912, (Wallis).

Scarabæidæ.

5524. *Aphodius congregatus* Mann. Edmonton, Alta., Sept. 27, 1915, (Carr).
Dichelonycha diluta Fall. Kentville, N.S., (Payne).
Dichelonycha vicina Fall. Vernon, B.C., (Brittain).
5705. *Diplotaxis obscura* Lec. Edmonton, Alta., May 20, 1916, (Carr).

Cerambycidæ.

5982. *Tetropium cinnamopterum* Kirby. Edmonton, Alta., June 29, 1916, (Carr).
6012. *Callidium hirtellum* Lec. Banff, Alta., July 4, 1915, (Wallis).
6189. *Clytus planifrons* Lec. Larkin, B.C., (Brittain).
6251. *Pachyta spurca* Lec. Swanlake, B.C., (Brittain).
6259. *Acmæops bivittata* Say. Aweme, Man., June 19, 1912, (T. Criddle).
6273. *Acmæops proteus* Kirby. Edmonton, Alta., July 19, 1916, (Carr).
6315. *Leptura exigua* Newn. Winnipeg, Man., June 19, 1915, (Wallis).
6324. *Leptura sexmaculata* Linn. Truro, N.S., (record sent by W. H. Brittain).
6361. *Leptura mutabilis* var. *luridipennis* Hald. Aweme, Man., June 9, 1906, (Wallis).
6479. *Saperda mutica* Say. Aweme, Man., June 22; July 27, 1911, (N. Criddle).
6480. *Saperda candida* Fab. Edmonton, Alta., July 17, 1916, (Carr).

Chrysomelidæ.

6541. *Donacia emarginata* Kirby. Kentville, N.S., (C. A. Good).
6554. *Zeugophora varians* Cr. Winnipeg, Man., June 13, 1915, (Roberts).
6560. *Syneta simplex* Lec. Edmonton, Alta., May 15, 1916, (Carr).
6605a. *Exema dispar* Lec. Winnipeg, Man., June 26, 1915, (Wallis).
6703. *Monachus saponatus* Fab. Husavick, Man., July 13, 1915, (Roberts).
6820. *Chrysomela basilaris* Say. Vernon, B.C., (Brittain).
6832. *Gastroidea cyanea* Melsh. Edmonton, Alta., June 24, 1915, (Carr).
6864. *Luperus varipes* Lec. Larkin, B.C., (Brittain).
6894. *Trirhabda attenuata* Say. Edmonton, Alta., July 28, 1916, (Carr).
(10,442) *Longitarsis erro* Horn. Winnipeg, Man., April 17, 1911, (Wallis).
7046. *Chætocnema subviridis* Lec. Husavick, Man., July 6, 1915, (Roberts).

Bruchidæ.

7124. *Bruchus discoideus* Say. Edmonton, Alta., July 15, 1916, (Carr).

Tenebrionidæ.

7404. *Haplandrus concolor* Lec. Winnipeg, Man., June 13, 1915, (Wallis).
7444. *Blapstinus interruptus* Say. Winnipeg, Man., June 6, 1911, (Wallis).
7520. *Platydema americanum* Lap. Winnipeg, Man., June 19, 1915, (Roberts).
Helops regulus Blaisd. Larkin, B.C., (Brittain).

Cistelidæ.

7594. *Hymenorus niger* Melsh. Husavick, Man., July 6, 1915, (Roberts).

Melandryidæ.

7665. *Enchodes sericea* Hald. Miami, Man., July 7, 1914, (Wallis).
7687. *Orchesia castanea* Melsh. Husavick, Man., July 8, 1915, (Roberts).
7695. *Canifa pallipes* Melsh. Husavick, Man., July 8, 1915, (Roberts).

Pythidæ.

7709. *Pytho niger* Kirby. Three Rivers, Que., June, 1916, (Germain).
7717. *Salpingus virescens* Lec. Edmonton, Alta., Sept. 1, 1915, (Carr).

Anthicidæ.

7876. *Stereopalpus vestitus* Say. Onah, Man., July 17, 1914, (Wallis).
7955. *Anthicus scabriceps* Lec. Husavick, Man., June 23, 1912, (Wallis).

Pyrochroidæ.

7993. *Schizotus cervicalis* Newm. Edmonton, Alta., May 23, 1915, (Carr).

Meloidæ.

8011. *Meloe strigulosus* Mann. Vernon, B.C., (Brittain).

Rhinomaceridæ.

8196. *Rhinomacer pilosus* Lec. Three Rivers, Que., May, 1916, (Germain).

Rhynchitidæ.

8221. *Rhynchites cyanellus* Lec. Truro, N.S., (record sent by W. H. Brittain; Edmonton, Alta., (Carr).

Attelabidæ.

8228. *Attelabus rhois* Boh. Three Rivers, Que., May, 1916, (Germain).

Otiorhynchidæ.

8258. *Anametis granulatus* Say. Truro, N.S., (record sent by W. H. Brittain).
8278. *Nocheles torpidus* Lec. Vernon, B.C., (Brittain).

Curculionidæ.

Apion finitimum Fall. Husavick, Man., April 22, 1912, (Wallis).
8433. *Phytonomus castor* Lec. Leduc, Alta., May 23, 1914, (Carr).

8437. *Lepyrus colon* Linn. Edmonton, Alta., (Carr).
Pissodes schwarzi Hopk. Edmonton, Alta., (Carr).
8475. *Pissodes affinis* Rand. Kentville, N.S., (C. A. Good).
8476. *Pissodes dubius* Rand. Three Rivers, Que., May, 1916, (Germain); Montreal, Que., (Beaulieu).
8619. *Magdalis subtincta* Lec. Winnipeg, Man., June 27, 1915, (Wallis).
8673. *Orchestes pallicornis* Say. Kentville, N.S., (C. A. Good).
8679. *Orchestes salicis* Linn. Truro, N.S., (record sent by W. H. Brittain).
8835. *Acanthocelis acephalus* Say. Onah, Man., July 15, 1914, (Wallis).

Platypodidæ.

* *Platypus wilsoni* Swaine. British Columbia, abundant on the coast as far north as Seymour Narrows and inland, in the south, to Agassiz; type collected at Campbell River, B.C., (Wilson and Swaine); Can. Ent., XLVIII, 97.

Ipidæ.

* *Orthotomicus lasiocarpi* Swaine. Roger's Pass, B.C.; Can. Ent., XLVIII, 183.
* *Pityokteines jasperi* Swaine. Jaspar Park, Alta.; Can. Ent., XLVIII, 182.
* *Ips chagnoni* Swaine. Montreal Island, Que., (G. Chagnon); abundant in Ontario and Quebec Provinces, (Swaine); Can. Ent., XLVIII, 186.
* *Ips vancouveri* Swaine. Quathiaski Cove, B.C.; on Vancouver Island and the coast of British Columbia; it occurs also at Kaslo, B.C., and probably elsewhere in the interior, (Swaine); Can. Ent., XLVIII, 188.
Conophthorus conicola Hopk. Pender Harbour, B.C., host cones of *Pinus monticola*, April 10, 1914, (Chrystal).
Dryocoetes confusus Swaine. Lesser Slave Lake, host *Abies balsamea*, August, (Swaine).
Dendroctonus murrayana Hopk. Banff, Alta., host *Pinus divaricata*, (Swaine).
Dendroctonus rufipennis Kirby. Algonquin Park, Ont., host *Pinus strobus*, Oct., (Swaine).
9183. *Dendroctonus simplex* Lec. Lesser Slave Lake, Alta., host *Larix americanus*, Aug., (Swaine).
9188. *Scierus annectens* Lec. Lesser Slave Lake, Alta., host White Spruce, Aug., (Swaine).
9195. *Hylastes porosus* Lec. Arrowhead, B.C., host *Pinus monticola*, (Swaine).
9198. (*Hylurgops*) *granulatus* Lec. Nanaimo, B.C., May, host *Abies grandis*, (Wilson).

DIPTERA.

(Arranged according to a Catalogue of North American Diptera, by J. M. Aldrich, Smithsonian Misc. Coll. XLVI, No. 1, 444. The numbers refer to the pages in the catalogue.)

Tipulidæ.

80. *Limnobia parietina* O. S. Ottawa, Ont., Aug. 1, 1906, (J. Fletcher).
* *Gonomyia californica* Alex. Peachland, B.C., May 19, 1912; Can. Ent., XLVIII, 324.
* *Trichocera (Diazosma) subsinuata* Johns. Waubamic, Parry Sound, Ont., June 13, 1915, (H. S. Parish); Jour. N.Y. Ent. Soc., XXIV, 124.
* *Limnophila terræ-novæ* Alex. Sandy Cove, Nfd., July 28, 1906, (O. Bryant); Jour. N.Y. Ent. Co., XXIV, 123.

95. *Bittacomorpha clavipes* Fab. Go Home Bay, Ont., May 23, 1912, (Walker).
95. *Bittacomorpha sackenii* Roeder. Massett, Q. C. I., 1898, (J. H. Keen).
96. *Xiphura frontalis* O. S. Ottawa, Ont., June 6, 1900, (Gibson).
97. *Pachyrhina erythrophrys* Will. Prince Albert, Sask., June 23, 1913, (Walker).
99. *Holorusia grandis* Bergr. Departure Bay, Vanc. Is., B.C., July 18, 1913, (Walker).
101. *Tipula bella* Lw. Go Home Bay, Ont., May 23, 1912, (Walker).
104. *Tipula trivittata* Say. Go Home Bay, Ont., June 20, Aug. 12, 1912, (Walker).
* *Tipula penicillata* Alex. "Hudson Bay Territory, (Kennicott)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 496.
* *Tipula loewiana* Alex. "Fort Resolution, Hudson Bay Territory, (Kennicott)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 489.
* *Tipula imperfecta* Alex. "Labrador, (Packard)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 484.
* *Tipula piliceps* Alex. "Hudson Bay Territory, (Kennicott)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 482.
* *Tipula kennicotti* Alex. "Fort Resolution, Hudson Bay Territory, (Kennicott)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 481.
* *Tipula mainensis* Alex. Grand Lake, Nfd. July 25, 1906, (Bryant); Proc. Acad. Nat. Sci., Philadelphia, LXVII, 475.
* *Tipula pachyrhinoides* Alex. Farewell Creek, Southern Saskatchewan, Sept. 1907; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 471.
* *Tipula algonquin* Alex. Go Home Bay, Muskoka, Ont., Aug. 16, 1912, (Clemens); Proc. Acad. Nat. Sci., Philadelphia, LXVII, 471.
* *Tipula parshleyi* Alex. Barber Dam, N.B., June 25, 1914, (McKenzie); Fredericton, N.B., June 10, 1914, (Tothill); "British America, (Scudder)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 510.

Cecidomyidæ.

Diarthronomyia hypogæa H. Lw. This European insect has recently been found infecting chrysanthemums at Ottawa, Ont., (Gibson), and Victoria, B.C., (A. E. Cameron).
* *Dasyneura sassafras* Felt. Jordan, Ont., (not Gordon as stated in description), Aug. 12, 1915, (Ross); Can. Ent., XLVIII, 29.
156. *Dasyneura rhodophaga* Coq. Infesting buds of roses in greenhouse in Toronto, Ont., larvæ received at Ottawa, Oct., 1916. First occurrence as a greenhouse pest in Canada, (Gibson).

Bibionidæ.

165. *Bibio abbreviatus* Loew. Lethbridge, Alta., April 16, 1915, (Strickland).
166. *Bibio fraternus* Loew. Lethbridge, Alta., April 16, 1915, (Strickland).

Scatopsidæ.

Androvandiella halterata Mg. In Bull. No. 160, (April, 1916), Agric. Exp. Stn., Washington, Melander records this species in America, based on specimens collected at Waubamic, Parry Sound, Ont., June 14, 1915, and Sudbury, Ont., July 22, 1915).

Simuliidæ.

Simulium piscicidium Riley. Smoky R. Crossing, Alta., Aug. 24, 1915, (Strickland).

170. *Simulium vittatum* Zett. Bear Lake, Alta., Aug. 18, 1915, (Strickland).

Stratiomyidæ.

182. *Stratiomyia barbata* Loew. Mt. Cheam, B.C., July 23, 1915, (Treherne).
182. *Stratiomyia discalis* Loew. Kelowna, B.C., June 2, 1914, (Rhumann).
183. *Stratiomyia meigenii* Wied. Ottawa, Ont., June 16, 1913, (Beaulne).
184. *Odontomyia arcuata* Loew. Rosthern, Sask., July 17, 1916, (Sladen).
186. *Odontomyia interrupta* Oliv. Ottawa, Ont., May 29, 1899, (Gibson); July 16, 1913, (Beaulne).
190. *Nemotelus glaber* Loew. Ottawa, Ont., July 2, 1912, (Beaulieu).

Nemotelus polita Loew. Montreal, Que., June 8, 1906, (Beaulieu).

Tabanidæ.

194. *Pangonia tranquilla* O. S. Montfort, Que., July 12, 1916, (G. Chagnon). Only one record, viz., Levis, in Winn and Beaulieu's Quebec list of Diptera; Algonquin Park, Ont., Aug. 1, 1916, (Walker and Lozier).
195. *Chrysops celer* O. S. Algonquin Park, Ont., Aug. 17, 1904, (Hahn); Go-Home Bay, Ont., June 24, 1907, (W. J. Fraser); Toronto, Ont., June 16, 1915, (Walker).
195. *Chrysops moerens* Walk. De Grassi Point, Ont., July 21, 1916, (Walker).
196. *Chrysops delicatulus* O. S. Go-Home Bay, Ont., July 6, 31, 1907, (W. J. Fraser).
196. *Chrysops indus* O. S. Toronto, Ont., June 12, 1895, (Walker).
197. *Chrysops montanus* O. S. Go-Home Bay, Ont., July 1, 1907, (W. J. Fraser).
197. *Chrysops obsoletus* Wied. Ontario, (locality uncertain). Record from E. M. Walker.

Chrysops shermani Hine. Algonquin Park, Ont., July 31, 1916, (Walker).

199. *Hæmatopota americana* O. S. Ducks, B.C., July 20, 1915, (Hadwen).
200. *Tabanus actæon* O. S. Muskoka, Ont., July 29, 1888, (E. M. Morris).
201. *Tabanus astutus* O. S. Algonquin Park, Ont., July 28, 30, 1916, (Walker and Lozier); Go-Home Bay, Ont., June 28, 1907, (W. J. Fraser); Muskoka, Ont., July 21, 1888, (E. M. Morris).
202. *Tabanus coffeatus* Macq. Muskoka, Ont., July 21, 1888, (E. M. Morris).
202. *Tabanus comastes* Will. Mt. Cheam, B.C., July 1915, (Treherne).
204. *Tabanus hirtulus* Bigot. Agassiz, B.C., May 23, 1915, (Hadwen).
204. *Tabanus lasiophthalmus* Macq. De Grassi Point, Ont., June 26, 1915, (Walker).

Leptidæ.

211. *Arthropeas americana* Loew. Aweme, Man., June 25, 1913, (N. Criddle); Kinistino, Sask., July 10, (J. Fletcher).
212. *Xylophagus rufipes* Loew. Ottawa, Ont., June 6, 1909, (J. A. Letourneau).
213. *Glutops singularis* Burgess. Agassiz, B.C., June, 1915, (Treherne).

Bombyliidæ.

221. *Spogostylum pluto* Wied. Kaslo, B.C., July 20, (Cockle).

Asilidæ.

259. *Dioctria albius* Walk. Montfort, Que., July 12, 1916, (G. Chagnon). New to Quebec List.
259. *Dioctria sackeni* Will. Montfort, Que., July 12, 1916, (G. Chagnon). New to Quebec list.
260. *Cyrtopogon montanus* Loew. Victoria, B.C., June 1, 1885, (J. Fletcher).
260. *Cyrtopogon nebulo* O. S. British Columbia, Oct. 2, 1904. Specimen so labelled is in collection of Entomological Branch.
272. *Laphria ferox* Will. Vancouver, B.C., July, 1914, (Chrystal).
272. *Laphria pubescens* Will. Scotia Junction, Ont., July 7, 1907, (J. Fletcher).
280. *Promachus fitchii* O. S. Aweme, Man., July 13, 1907, (J. Fletcher).
283. *Asilus sadyates* Walk. St. John's Que., July 7, 1916, (G. Chagnon). New to Quebec list.

Empidæ.

311. *Drapetis medetera* Mel. Estevan, Sask., May 20, (N. Criddle).

Phoridæ.

* *Phora* (=*Trineura*) *viridinota* Brues. Treesbank, Man., May 30, (N. Criddle); Can. Ent., XLVIII, 394.

Platypezidæ.

* *Callimyia velutina* Johns. Brule Lake, Ont., Aug. 3, 1911, (M. C. Van Duzee); Psyche, XXIII, 32.

Syrphidæ.

346. *Microdon globosus* Fab. Manitoba, Aug. 19, 1900; 2 specimens so labelled in collection of Entomological Branch.

Eumerus strigatus Fall. In the collection at Ottawa is a specimen taken by the late Dr. J. Fletcher at Ottawa on Aug. 19, 1904, which had been placed among specimens of *Xylota ejuncida*. This represents the first capture in the open, that we know of, for Canada. We have a number of specimens reared from imported narcissus bulbs, (Gibson).

362. *Leucozona lucorum* L. Smith's Cove, N.S., July 4-15, 1914, (Gibson).

* *Volucella bombylans arctica* Johns. Labrador: Rama, 1898, (A. Stecker and J. D. Sornborger: Nain, (J. D. Sornborger); Nain, Aug. 18, 1908, (O. Bryant): Psyche XXIII, 163.

* *Volucella bombylans lateralis* Johns. Lewisport, Nfd., July, (L. D. Gratacap); Red Indian Lake, Nfd., June 20, 1906, (O. Bryant); Psyche, XXIII, 161.

383. *Arctophila flagrans* O. S. Banff, Alta., July 18, 1916, (Hewitt).
398. *Xylota analis* Will. Mt. Cheam, B.C., July 21, 1905, (Treherne).
398. *Xylota barbata* Loew. Aylmer, Que., June 24, 1913, (Beaulne). New to Quebec list.
398. *Xylota bicolor* Loew. Chelsea, Que., May 26, 1900, (Gibson). New to Quebec list.
398. *Xylota ejuncida* Say. Stuart River, Yukon Territory, 1909, (D. H. Nelles).
400. *Xylota vecors* O. S. Ottawa, Ont.; St. Louis, Sask., 1898, (E. Coubeaux).

402. *Criorhina armillata* O. S. Inverness, B.C., July, 1910, Metlakatla, B.C., Aug., 1911, (J. H. Keen).

Œstridæ.

416. *Hypoderma lineata* DeV. Cadbora Bay, B.C., on flowers of *Camassia quamash,* May 10, 1916; first capture of the male of this species in British Columbia, (Treherne).

Tachinidæ.

426. *Gymnophania montana* Coq. Lethbridge, Alta., May 15, 1916, (Strickland). New to Canada, (J. M. A.).
* *Exorista caesar* Aldrich. Reared from *Archips argyrospila* from Simcoe, Ont., July 1-15, 1915, (Caesar); Can. Ent., XLVIII, 20.
* *Frontina spectabilis* Aldrich. Waubamic, Parry Sound, Ont., Aug. 5, 1915, (H. S. Parish); Can. Ent., XLVIII, 22.

Sarcophagidæ.

* *Sarcophaga aldrichi* Parker. "Canada, (Quebec)"; Jour. Econ. Ent., Vol. 9, p. 438. Mountain, Ont., larvæ found in great frequency in pupæ of Forest Tent-caterpillar, (Caesar).
* *Sarcophaga pachyprocta* Parker. "Canada, (Manitoba ?)"; Jour. N.Y. Ent. Soc., XXIV, 171.
* *Sarcophaga fletcheri* Ald. Aweme, Man., June 19, 1903, (J. Fletcher); Sarcophaga and Allies in North America, (Thomas Say Foundation), p. 96; issued Nov. 30, 1916.
* *Sarcophaga reversa* Ald. "Montreal, Que., (Harbeck)"; Sarcophaga and Allies in North America, p. 135.
* *Sarcophaga falciformis* Ald. Aweme, Man., July 25, 1913, (not 1813 as in description); Sarcophaga and Allies in North America, p. 137.
* *Sarcophaga aculeata* Ald. "London, Ont., (Hough coll.)"; Sarcophaga and Allies in North America, p. 143.
* *Sarcophaga occidentalis* Ald. Vancouver, B.C., July 27, 1907, (R. V. Harvey); Sarcophaga and Allies in North America, p. 198.
* *Sarcophaga tuberosa sarraceniodes* Ald. Okanagan Valley, B.C., ex. *Anabrus,* emerged April, 1896, (J. Fletcher); Sarcophaga and Allies in North America, p. 227.

Muscidæ.

524. *Protocalliphora azurea* Fall. Ottawa, Ont., Aug. 6, 1914, (Beaulne).

Anthomyidæ.

* *Hydrotœa houghi* Mall. London, Ont., (ex. Coll. Hough); Bull. Brooklyn Ent. Soc., XI, p. 110.

535. *Hydrotœa unispinosa* Stein. Wakefield, Que., June 18, 1915, (Hewitt).
Mydœa punctata Stein. Lethbridge, Alta., June 14, 1916, (Strickland).
* *Mydœa pectinata* Johannsen. Millville, N.S.; Trans. Amer. Ent. Soc., XLII, p. 392.
* *Phaonia apicata* Johannsen. Truro, N.S., Aug.; Trans. Amer. Ent. Soc., XLII, p. 396.

563. *Schoenomyza dorsalis* Loew. Lethbridge, Alta., June 5, 1916, (Strickland).

Sciomyzidæ.

Tetanocera flavipes Loew. Aweme, Man., July 1, 1913, (N. Criddle).
Tetanocera sparsa Loew. Ottawa, Ont., July 17, 1904, (W. Metcalfe).
580. *Sepedon armipes* Loew. Brockville, Ont., Sept. 20, 1903, (Metcalfe).

Ortalidæ.

Tetanops aldrichi Hendel. Lethbridge, Alta., May 15, 1916, (Strickland). New to Canada, (J. M. A.).
598. *Scoptera vibrans* L. Teulon, Man., June 19, 1915, (W. Chesney).

Trypedidæ.

603. *Stenopa vulnerata* Loew. Banff, Alta., (Sanson).
606. *Rhagoletis pomonella* Walsh. Aweme, Man., Aug. 8, 1916, (N. Criddle); Penticton, B.C., July 26, 1916, (Treherne).

Ephydridæ.

Psilota compta Mg. Lethbridge, Alta., May 15, 1916, (Strickland).
627. *Hydrellia formosa* Loew. Ottawa, Ont., July 12, 1916, (Beaulieu).
Philygria picta. Ottawa, Ont., July 12, 1916, (Beaulieu); Estevan, Sask., May 20, 1916, (N. Criddle).
627. *Philygria fuscicornis* Loew. Lethbridge, Alta., May-June, (Strickland).
627. *Hyadina albovenosa* Coq. Aweme, Man., Aug. 3, 1916, (N. Criddle).

Oscinidæ.

633. *Diplotoxa microcera* Loew. Strathroy, Ont., (H. G. Crawford); Ottawa, Ont., Aug. 9, 22, 1916, (Beaulieu).
633. *Chlorops graminea* Coq. Aweme, Man., June 27, 1916, (N. Criddle). New to Canada, (J. M. A.).
633. *Chloropisca grata* Loew. Aweme, Man., Aug. 22, 1916, (N. Criddle); Ottawa, Aug. 31, 1916, (Beaulieu); Sept. 12, (Miss G. Beaulieu).
Chloropisca pulla Ad. Lethbridge, Alta., May 15, 1916; Ogema, Sask., June 18, 1916, (N. Criddle); Aweme, Man., June 9, 12, (N. Criddle). New to Canada, (J. M. A.).
634. *Chlorops producta* Loew. Aweme, Man., Aug. 15, 1916, (N. Criddle).
634. *Chlorops sulphurea* Loew. Ogema, Sask., June 18, 1916, (N. Criddle).
634. *Chloropisca varipes* Loew. Aweme, Man., June 12, 1916, (N. Criddle).
634. *Diplotoxa recurva* Ad. Maryfield, Sask., Sept. 2, (N. Criddle).
635. *Hippelates plebeius* Loew. Ottawa, Ont., Sept. 9, 1916, (Miss G. Beaulieu).
Tricimba cincta Mg. Ottawa, Ont., July 29, 1916, (Beaulieu); Aweme, Man., June 27, (N. Criddle).
Elachiptera decipiens Loew. Ogema, Sask., June 17, 1916, (N. Criddle).
636. *Elachiptera costata* Loew. Estevan, Sask., May 20, 1916, (N. Criddle); Ogema, Sask., June 17, 1916, (N. Criddle); Aweme, Man., Sept. 4, 1916, (N. Criddle); Hemmingford, Que., July 27, 1916, (Petch). New to Quebec list.
636. *Elachiptera eunota* Loew. Aweme, Man., Aug. 22, 1916, (N. Criddle). New to Manitoba.

Siphonella aequa Becker. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list.

Siphonella geniculata DeG. Estevan, Sask., May 20, 1916, (N. Criddle).

Siphonella neglecta Becker. Aweme, Man., Aug. 15, 1916, (N. Criddle).

Siphonella nigripalpis Mall. Strathroy, Ont., June 20, 1916, (H. G. Crawford); Hemmingford, Que., July 28, 1916, (Petch). New to Quebec list.

Siphonella parva Ad. Hemmingford, Que., July 28, Aug. 10, 1916, (Petch). New to Quebec list.

637. *Siphonella pumilionis* Bj. Aweme, Man., Aug. 15, 1916, (N. Criddle).

Oscinis dissidens Tucker. Ottawa, Ont., July 12, 1916, (Beaulieu).

Oscinis melancholica Becker. Ottawa, Ont., Aug. 31, Sept. 9, 1916, (Beaulieu).

639. *Oscinis umbrosa* Loew. Strathroy, Ont., Aug. 9, 1916, (H. G. Crawford); Hemmingford, Que., June 27, July 28, 1916, (Petch). New to Quebec list.

Drosophilidæ.

* *Drosophila sulcata* Sturtevant. "Ottawa, Can.; Annals Ent. Soc. Amer., IX, 330."

Geomyzidæ.

Trixocelis fumipennis Mall. Aweme, Man., June 12, 1916, (N. Criddle).

Anthomyza gracilis Fall. Aweme, Man., Aug. 3, 1916, (N. Criddle). New to Manitoba.

Agromyzidæ.

647. *Phytomyza nigritella* Zett. Estevan, Sask., May 20, 1916, (N. Criddle). New to Saskatchewan.

Phytomyza bipunctata Lw. Estevan, Sask., May 20, 1916, (N. Criddle). New to Saskatchewan.

647. *Cerodonta dorsalis* Loew. Strathroy, Ont., Aug. 23, 28, 1916, (H. G. (Crawford); Ottawa, Ont., Aug. 17, 1916, (Beaulieu); Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list.

Paramyia nitens Loew. Mer Bleue, near Ottawa, Ont., June 26, 1904, (Metcalfe).

Agromyza coniceps Mall. Aweme, Man., June 2, 1916, (N. Criddle). New to Canada.

Agromyza coquilletti Mall. Strathroy, Ont., July 4, 1916, (H. G. Crawford).

Agromyza fragariæ Mall. Estevan, Sask., May 20, 1916, (N. Criddle).

Agromyza immaculata Coq. Ogema, Sask., June 17, 1916, (N. Criddle).

648. *Agromyza jucunda* Van der Wulp. Estevan, Sask., May 20, 1916, (N. Criddle); Hemmingford, Que., July 28, 1916, (Petch). New to Quebec list.

Agromyza laterella Zett. Ottawa, Ont., May 25, 1916, (Beaulieu); Aweme, Man., Aug. 4, 15, 1916, (N. Criddle).

648. *Agromyza longipennis* Loew. Aweme, Man., Aug. 15, 1916, (N. Criddle). New to Manitoba.

Agromyza nasuta Mel. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list. Mines in dandelion, (J. M. A.).

Agromyza scutellata Fall. Estevan, Sask., May 20, 1916, (N. Criddle).

Agromyza vibrissata Mall. Aweme, Man., June 12, 1916, (N. Criddle).

649. *Agromyza virens* Loew. Aweme, Man., Aug. 22, 1916, (N. Criddle); Ottawa, Ont., July 21, 1916, (Beaulieu).

649. *Desmometopa latipes* Mg. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list.

Desmometopa sordida Fall. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list.

651. *Pholeomyia indecora* Loew. Strathroy, Ont., July 4, 1916, (H. G. Crawford).

Ochthiphila aridella Fall. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list. Aweme, Man., Sept. 4, 1916, (N. Criddle).

652. *Ochthiphila polystigma* Mg. Strathroy, Ont., Aug. 9, 1916, (H. G. Crawford).

Hymenoptera.

Much valuable material is being accumulated and worked over as opportunity offers. The aculeate hymenoptera are receiving close study by Mr. F. W. L. Sladen, of Ottawa, who has visited many parts of Canada during 1916 and made valuable collections. Through the courtesy of Dr. H. T. Fernald, of the Massachusetts Agricultural College, Amherst, Mass., Mr. J. F. Martin examined ichneumonid material, and the records of these given below are of interest in adding to our knowledge of their distribution in Canada.

Tenthredinidæ.

Zaschizonyx montana (Cress.). Ottawa, Ont., Aug. 1915, (Germain). New to Canada, (S. A. R.).

Macrophya crassicornis Prov. Ottawa, Ont., June, 1915, (Germain).

Pachynematus extensicornis Nort. Ottawa, Ont., July, 1915, (Germain).

Pachynematus tritici Marl. Ottawa, Ont., July, 1915, (Germain).

Pontania robusta Marl. Ottawa, Ont., June, 1915, (Germain). New to Canada, (S. A. R.).

Blennocampa aperta MacG. Ottawa, Ont., July, 1915, (Germain). New to Canada, (S. A. R.).

Ichneumonidæ.

Exochus propinquus Cr. Lethbridge, Alta., July 3, 1913, (Strickland).

Bassus orbitalis Cr. Lethbridge, Alta., Sept. 21, 1913, (Strickland).

Mesoleius tenthredinis Morley. This European parasite of the Large Larch Sawfly, *Nematus erichsonii*, introduced into Manitoba by Dr. C. Gordon Hewitt (Rep. Dom. Entomologist, for year ending March 31, 1913) has in 1916, been captured near Aweme, Man., by Mr. Norman Criddle, on the dates June 2 to 21.

Cryptus luctuosus Cr. Lethbridge, Alta., Sept. 20, 1913, (Strickland).

Ichneumon calitergus Cr. Ottawa, Ont., Aug. 26, 1899, (J. Fletcher).

Ichneumon lewisii Cr. Ottawa, Ont., Aug. 28, 1906, (Young).

Ichneumon longulus Cr. Aweme, Man., Aug. 20, 1915, (N. Criddle).

Ichneumon vicinus Cr. Ottawa, Ont., April 21, 1900, (Gibson).
Ichneumon subdolus Cr. Nipigon, Ont., July 11, 1907, (J. Fletcher).
Amblyteles montanus Cr. Ottawa, Ont., Aug. 24, 1903, (J. Fletcher).
Trogus quebecensis Prov. Hymers, Ont., July 21, 1910, (Dawson).

Trichogrammidæ.

* *Trichogramma tomyia tortricis* Girault. Guelph, Ont., from eggs of *Tortrix cerasivorana*, (Bethune); Can. Ent., XLVIII, 268.

Encyrtidæ.

* *Aphycus rileyi* Timb. Guelph, Ont., reared from *Lecanium corni* on ash, June 9, 1907, (T. D. Jarvis); Proc. U.S.N.M., Vol. 50, p. 600.
* *Berecyntus bakeri gemma* Girault. Reared at Ottawa from *Euxoa* larva from Queensboro, Ont., also from larva of *Hadena devastatrix*, Ottawa, Ont., July 12, 1914, (Gibson); Psyche XXIII, 49.

Thynnidæ.

Methoca bicolor Say. Prince Albert, Sask., male, July 22, 1916, (Sladen).

Mutillidæ.

Mutilla hexagona Say. Toronto, Ont., males, July, August, 1888-1894, (W. Brodie).
Mutilla canadensis Blake. Weymouth, N.S., female, June 5, 1913, (Sanders).

Myrmosidæ.

Myrmosa unicolor Say. Aweme, Man., male, July 7, 1915, (N. Criddle); Prince Albert, Sask., July 22, 1916, (Sladen).

Tiphiidæ.

Paratiphia albilabris Spin. Okanagan, B.C., female, Aug. 4, 1915, (Anderson); Victoria, B.C., Aug. 13, 1916, (Sladen).

Sapygidæ.

Sapyga martini Sm. Aweme, Man., May 2, 9, 1915, (N. Criddle).

Eumenidæ.

Odynerus capra Sauss. Truro, N.S., Aug. 16, 1915, (Brittain).

Philanthidæ.

Eucerceris superbus Cr. Medicine Hat, Alta., male, Aug. 20, 1916, (Sladen).
Eucerceris bicolor Cr. Medicine Hat., Alta., female, Aug. 20, 1916, (Sladen). Mr. Sladen considers the evidence strong that this species is the female of *E. superbus*.
Eucerceris flavocinctus Cr. Indian Head, Sask., July 14, 1916, (Sladen); Kaslo, B.C., July 20, 1906, (Cockle); Sidney, B.C., July 6, 1914, (Sladen).

Eucerceris fulvipes Cr. Aweme, Man., (N. Criddle); Medicine Hat, Alta., male, Aug. 20, 1916, (Sladen).
Cerceris clypeata Cr. (var. with cream-colored bands). Prince Albert, Sask., female, July 22, 1916, (Sladen).
Cerceris dentifrons. Toronto, Ont., Aug. 1, 1893, (W. Brodie).
Cerceris pleuralis H. S. Smith. Toronto, Ont., Aug. 1, 1893, (W. Brodie).
Cerceris rufinoda Cr. Medicine Hat, Alta., Aug. 20, 1916, (Sladen).
Cerceris rufinoda crucia Vier. & Ckll. Medicine Hat, Alta., Aug. 20, 1916, (Sladen).
Philanthus solivagus Say. Kentville, N.S., Aug. 22, 1915, (Brittain); Aweme, Man., July 29, 1915, (N. Criddle).
Philanthus bilunatus Cr. St. Stephen, N.B., July 18, 1916, (Sanders); Melfort, Sask., July 20, 1916, (Sladen).
Philanthus politus Say. Prince Albert, Sask., July 22, 1916; Calgary, Alta., July 29, 1916, (Sladen).
Philanthus albopilosus Cr. Aweme, Man., Aug. 20, 1914, (N. Criddle); Medicine Hat, Alta., Aug. 20, 1916, (Sladen).
Philanthus sanbornii Cr. Toronto, Ont., Aug. 4, 1895, (W. Brodie).
Philanthus punctatus Say. Thompson River, B.C., Aug. 8, 1914, (Wilson); Crescent, B.C., Aug. 14, 1916; Agassiz, B.C., Aug. 10, 1916; Medicine Hat, Alta., Aug. 20, 1916, (Sladen).
Aphilanthops frigidus Sm. Radisson, Sask., July 30, 1907, (J. Fletcher); Medicine Hat, Alta., Aug. 20, 1916; Lethbridge, Alta., June 28, 1914; Victoria, B.C., Aug. 13, 1916, (Sladen).

Bembecidæ.

Bembex pruinosa Fox. Aweme, Man., Aug. 20, 1914, (N. Criddle).
Bembex amœna Fox. Nicola Valley, B.C., June, 1912, (S. Hadwen).
Monedula emarginata Cr. Prince Albert, Sask., July 22; Lethbridge, Alta., July 25, 1916, (Sladen).

Andrenidæ.

* *Andrena ricardonis* Ckll. Vernon, B.C., June 9, 1902, (Miss Ricardo); Can. Ent., XLVIII, 272.
Andrena cockerelli Graen. Smith's Cove, N.S., May 26, 1915, (Brittain).
Andrena bicolor Prov. Smith's Cove, N.S., June 5, 1915, (Brittain).
Andrena vicina Sm. Smith's Cove, N.S., May 30, 1915, (Brittain).
Andrena carlini Ckll. Smith's Cove, N.S., May 25, 1915, (Brittain).

Nomadidæ.

* *Nomada vernonensis* Ckll. Vernon, B.C., April 15, 1902, (Miss Ricardo); Can. Ent., XLVIII, 273.

Megachilidæ.

Anthidium tenuifloræ Ckll. Banff, Alta., July 24, 1911, (Sanson); Radisson, Sask., July 29, 1907; Saskatoon, Sask., July 18, 1909, (Willing); Invermere, B.C., June 30, 1914, (Sladen).
Anthidium emarginatum Say. Aweme, Man., July 20, 1914, (N. Criddle); Banff, Alta., Aug. 17, 1911, (Sanson).

Dianthidium simile Cr. Guelph, Ont., 1913, (A. Burrows); Ottawa, July 7, 1913, (Sladen).

Microstelis lateralis Cr. Toronto, Ont., June 24, 1894, (W. Brodie); Aylmer, Que., June 5, 1915, on *Potentilla*, (Sladen).

Pavostelis montana Cr. Lethbridge, Alta., June 28, 1914, (Sladen); Banff, Alta., (Sanson).

* *Stelis ontariana* Sladen. Ottawa, Ont., Aug. 16, 1912, (Beaulne); Bethesda, Ont., Aug. 15, 1892, (W. Brodie); Can. Ent., XLVIII, 312.

* *Autochelostoma canadensis* Sladen. Ottawa district, Ont., Aug. 14, 1914, (Germain); Can. Ent., XLVIII, p. 270.

Chelynia subemarginata Cr. Toronto, Ont., June 23, 1891. (W. Brodie); Aylmer, Que., June 24, 1913, (Beaulne); Dalhousie, N.B., July 24, 1915, (Sladen).

Chelynia foederalis Sm. Toronto, Ont., June 9, 1896, (W. Brodie); Ottawa, June 11, 1913, (Sladen).

Chelynia rubri Ckll. Banff, Alta., June 25, 1908, (Sanson).

Heriades carinatus Cr. Invermere, B.C., June 30, 1914, (Sladen).

Chlorosmia fulgida Cr. Banff, Alta., (Sanson); Invermere, B.C., July 1, 1914, (Sladen).

* *Formicapis clypeata* Sladen. Aweme, Man., July 6, 1915, (Criddle); Waterhole, Alta., Aug. 18, 1915, (Strickland); Melfort, Sask., July 20, 1916, (Sladen); Can. Ent., XLVIII, p. 271.

Osmia cobaltina Cr. Shawnigan, B.C., July 7, 1914, (Sladen); Peachland, B.C., July 24, 1909, (Wallis).

Osmia kenoyeri Ckll. White River, Ont., June 3, 1915, (Sladen).

Osmia nigrifrons Cr. Invermere, B.C., June 30, 1914, (Sladen).

Osmia novomexicana Ckll. Aweme, Man., April 30, 1910, (N. Criddle); Medicine Hat, Alta., May 30, 1904, (Willing).

Osmia chalybea Sm., var. *faceta* Cr. Ottawa, Ont., July 26, 1913, (Sladen); Toronto, Ont., July 26, 1890, (W. Brodie).

Osmia chalybea Sm. var. *mandibularis* Cr. Lethbridge, Alta., July 8, 1909, (Wallis).

Osmia densa Cr. Banff, Alta., May 17, 1915; Golden, B.C., May 16, 1915; Shawnigan, B.C., July 7, 1914, (Sladen).

Osmia albiventris Cr. Ottawa, Ont., June 11, 1913; White River, Ont., June 3, 1915; Banff, Alta., May 21, 1915, (Sladen).

Osmia atriventris Cr. St. John, N.B., May 23, 1903, (Leavitt); Aweme, Man., May 2, 1914, (N. Criddle); Ottawa, Ont., May 18, 1913; Banff, Alta., May 21, 1915, (Sladen).

Osmia melanotricha Lov. & Ckll. Toronto, Ont., June 10, 1894, (W. Brodie); Ottawa, Ont., June 18, 1913, (Sladen).

Osmia hudsonica Cr. Banff, Alta., May 21, 1915, (Sladen).

Megachile (*Oligotropus*) *exilis, subexilis*, Ckll. Males, Ottawa, Ont., July 15, 1913; Kaslo, B.C., Penticton, B.C., Aug., 1916, (Sladen).

Megachile fidelis Cr. Summerland, B.C., Aug. 9, 1916, (Sladen).

Megachile pugnata Say. Edmonton, Alta., July 11, 1916, (Carr); Salmon, Arm, B.C., July 4, 1914; Shawnigan, B.C., July 7, 1914, (Sladen).

Megachile manifesta Cr. Davidson, Sask., Aug. 21, 1907, (Willing); Medicine Hat, Alta., Aug. 20, 1916; Lethbridge, Alta., July 28, 1916; Swift Current, Sask., Aug. 22, 1916, (Sladen).

Megachile melanophaea Sm. Halifax, N.S., July 10, 1916, (Perrin).

Megachile melanophaea var. *calogaster* Ckll. Lethbridge, Alta., June 28, 1914, (Sladen).

Megachile latimanus Say. Smith's Cove, N.S., July 15, 1914, (Gibson); Melfort, Sask., July 20, 1916; Lethbridge, Alta., June 28, 1913, (Sladen).

Megachile perihirta Ckll. Salmon Arm, B.C., July 14, 1914, Lethbridge, Alta., June 28, 1914, (Sladen).

Megachile latimanus Ckll., (not Say.). Lethbridge, Alta., June 28, 1914, (Sladen).

Megachile vancouverensis Prov. St. John, N.B., July 13, 1901, (Leavitt); Kaslo, B.C., June 10, 1906, (Cockle); Ottawa, Ont., Aug. 15, 1913; Invermere, B.C., June 30, 1914, (Sladen).

Megachile inermis Prov. (*decipiens* Lov. & Ckll.). St. John, N.B., July 1, 1901, (A. G. Leavitt); Dalhousie, N.B., July 24, 1915; Hull, Que., June 14, 1914; Haileybury, Ont., July 7, 1916, (Sladen); Bondville, Que., July 30, (Winn); Dunvegan, Alta., Aug. 18, 1915, (Strickland); Aweme, Man., June 29, 1915, (N. Criddle).

Megachile parallela Ckll. Thompson River, B.C., Aug. 8, 1914, (Wilson); Medicine Hat, Alta., Aug. 20, 1916, (Sladen); Swift Current, Sask., Aug. 22, 1916, (Sladen).

Megachile generosa Cr. Aweme, Man., July 13, 1916, (N. Criddle); Lethbridge, Alta., July 28, 1916, (Sladen).

Megachile brevis Say. Haileybury, Ont., July 5, 1916, (Sladen); Summerland, B.C., Aug. 10, 1916, (Sladen).

Coelioxys ribis Ckll. Truro, N.S., July 4, 1913, (C. B. Gooderham); Haileybury, Ont., July 5, 1916, (Sladen); Aweme, Man., July 13, 1916, (N. Criddle).

Bombidæ.

Bombus rufocinctus Cr. Charlottetown, P.E.I., Sept., 1916, (Sladen).

Bombus californicus Smith. Prince Albert, Sask., July 22, 1916, (Sladen).

Bombus perplexus Cr. Montreal, Que., (Winn).

Psithyrus ashtoni Cr. Truro, N.S., Aug. 25, 1915, (Brittain).

Psithyrus fernaldae Frank. Banff, Alta., July 15, 1915, (Sanson); Quebec, Que., Aug. 8, 1914, (Sladen).

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; New York Entomological Society, 1916.)

Aphididæ.

Phylloxera querceti Pergande. Vineland, Ont., on oak, Sept. 2, 1916, (Ross).

Phyllaphis quercicola Baker (*querci* Davis). Vineland, Ont., on oak, Sept. 30, 1916, (Ross).

Myzocallis punctatus Monell. Vineland, Ont., on oak, June 4, 1915, (Ross).

Myzocallis discolor Monell. Vineland, Ont., on oak, Sept. 30, 1916, (Ross).

Chaitophorus quercicola Monell. Vineland, Ont., on oak, Oct. 30, 1916, (Ross).

Monellia caryae Monell. Vineland, Ont., on black walnut, Aug. 17, 1916, (Ross).

Macrosiphum crataegi Monell. Vineland, Ont., on hawthorn, Oct. 11, 1916, (Ross).

Macrosiphum pelargonii Kalt. Vineland, Ont., on *Lillium,* Jan. 28, 1916, (Ross).

Myzus circumflexum Buckton. Grimsby, Ont., on *Lillium,* Jan. 1, 1916, (Ross).

Myzus neorosarum Theobald. Vineland, Ont., on *Rosa rugosa,* Aug. 18, Oct. 24, 1916, (Ross).

Myzus rosarum Kalt. Vineland, Ont., on rose, July 26, 1916, (Ross).

Aphis brevis Sanderson. Arkona, Ont., and Vineland, Ont., on hawthorn and apple, Oct. 1916, (Ross).

Aphis bakeri Cowen. Arkona, Ont., and Vineland, Ont., on hawthorn and apple, Oct., 1916, (Ross).

Aphis pseudobrassicæ Davis. Turnips infested with this species were received at Ottawa, from Sarnia, Ont., on Sept. 9, 1916. This is the first record of this aphid in Ontario, (Gibson).

Van Duzee's Number.

Cydnidæ.

28. *Thyreocoris nitiduloides* Wolff. Brantford, Ont., (record sent by W. H. Brittain).

Pentatomidæ.

87. *Brochymena tenebrosa* Walk. St. Hilaire, Que., May 24, 1916, (Moore).
122. *Euschistus conspersus* Uhl. Departure Bay, Vanc. Is., B.C., July 21, 1913, (Walker).
127. *Euschistus ictericus* Linn. Toronto, Ont., Sept. 12, 1906, (Walker).

Coreidæ.

Corynocoris typhæus distinctus Dall. Toronto, Ont., Sept. 28, 1896, (Walker).

Aradidæ.

379. *Aradus crenatus* Say. St. Hilaire, Que., May 24, 1916, (Moore).
414. *Aneurus inconstans* Uhl. Toronto, Ont., April 18, 1895, May 8, 1914, (Walker).

Lygæidæ.

432. *Oncopeltus fasciatus* Dall. London, Ont., (H. S. Saunders).
477. *Ischnorrhynchus geminatus* Say. Toronto, Ont., Guelph, Ont., (C. A. Good).
588. *Stignocoris rusticus* Fall. Truro, N.S., (C. B. Gooderham).

Stignocoris pedestris. Truro, N.S., (record sent by W. H. Brittain, who stated that Mr. Parshley, who determined the specimen informed him that the species was new to North America.)

589. *Trapezonotus arenarius* Linn. (*agrestis* Fall). Ottawa, Ont., Aug. 23, 1914, (Germain).

Tingididæ.

665. *Physatocheila plexa* Say. St. Hilaire, Que., May 24, (Moore).
666. *Leptoypha mutica* Say. De Grassi Point, Ont., Aug. 11, 1916, (Walker).

Nabidæ.

826. *Nabis limbatus* Dahlb. Toronto, Ont., March 29, 1904, (R. E. Coleman).
827. *Nabis flavomarginatus* Schol. Truro, N.S., (record sent by W. H. Brittain).

Anthocoridæ.

865. *Triphleps tristicolor* White. Vineland, Ont., found preying on *Thrips tabaci,* Aug. 25, 1916, (Ross).
871. *Dufouriellus ater* Duf. Toronto, Ont., April 13, 1895, (Walker).

Miridæ.

922. *Phytocoris lasiomerus* Reut. De Grassi Point, Ont., Aug. 6, 1895; Algonquin Park, Ont., Aug. 14, 1903, (Walker).
979. *Paracalocoris scrupeus* Say. Hamilton, Ont., June 20, 1914, (Walker).
996. *Dichrooscytus suspectus* Reut. Pictou, N.S., July 22, 1914, (Walker).
* *Lygus communis novascotiensis* Knight. Kentville, N.S., Wolfville, N.S., Smith's Cove, N.S., July 6-28, 1915, (Brittain); Can. Ent., XLVIII, 349.
1018. *Lygus belfragii* Reut. Hamilton, Ont., June 20, 1914, (Walker).
1127. *Heterocordylus malinus* Reut. Hamilton, Ont., June 20, 1914, (Walker).
1139. *Ceratocapsus pumilis* Uhl. Truro, N.S., (record sent by W. H. Brittain).
* *Orthotylus cruciatus* Van D. St. Hilaire, Que., July 4, 1907, (Metcalfe); Proc. Cal. Acad. Sci., VI, 119.
1172. *Orthotylus flavosparsus* Sahlbg. St. Catharines, Ont., June 19, 1914, (Walker).

Gerridæ.

1285. *Gerris conformis* Uhl. Kentville, N.S., (record sent by W. H. Brittain).

Saldidæ.

1328. *Saldula interstitialis* Say. Guelph, Ont., (C. A. Good).

Nepidæ.

1382. *Ranatra nigra* H. S. Go-Home Bay, Ont., Aug. 10, 1908, (T. R. Hanley).
1384. *Ranatra brevicollis* Montd. Lonely Lake, Vanc. Is., B.C., July 31, 1913, (Walker).

Cicadidæ.

1523. *Okanagana noveboracensis* Emmons. Toronto, Ont., May 8, 1896, (Walker).

Cercopidæ.

1550. *Aphrophora permutata* Uhl. Departure Bay, Vanc. Is., B.C., Aug. 3, 1913, (Walker).
1553. *Aphrophora signoretii* Fh. Toronto, Ont., July 12, 1914, (Walker).

Membracidæ.

1628. *Telamona declivata* Van D. Rainy River, Ont., July 22, 1913, (Walker).
1635. *Telamona reclivata* Fh. Edmonton, Alta., July 7, 1910, (Carr).
1644. *Telamona querci* Fh. Toronto, Ont., July 16, 1906, (Walker).
1646. *Telamona ampelopsidis* Harr. Toronto, Ont., June 19, 1896, (Walker).

Cicadellidæ.

1795. *Idiocerus lachrymalis* Fh. Toronto, Ont., De Grassi Point, Ont., Aug. 22, 1914, (Walker).
1936. *Acucephalus albifrons* Linn. De Grassi Point, Ont., Aug. 22, 1914, (Walker).
2051. *Deltocephalus configuratus* Uhl. Guelph, Ont., (C. A. Good).
2053. *Deltocephalus sayii* Fitch. Bondville, Que., (Moore).
2181. *Eutettix strobi* Fh. St. Catharines, Ont., June 19, 1914, (Walker).
2228. *Phlepsius irroratus* Say. Toronto, Ont., July 12, 1914, (Walker).
2156. *Athysanus curtisii* Fitch. Bondville, Que., (Moore).
2410. *Empoasca pulchella* G. & B. Pictou, N.S., July 22, 1914, (Walker).

Fulgoridæ.

2545. *Cixius misellus* Van D. De Grassi Point, Ont., Aug. 26, 1914, (Walker).
2673. *Lamenia obscura* Ball. De Grassi Point, Ont., Aug. 24, 1914, (Walker).

Chermidæ.

2822a. *Aphalara veaziei metzaria* Crawf. Pictou, N.S., July 22, 1914, (Walker).
2936. *Psyllia floccosa* Patch. Pictou, N.S., July 22, 1914, (Walker).

Orthoptera.

Acridiidæ.

Nomotettix cristatus Scudd. Truro, N.S., (record from W. H. Brittain).

Locustidæ.

Ceutophilus neglectus Scudd. Black Rock, N.S., (record from W. H. (Brittain).

Orchelimum gladiator Brun. Napinka, Man., Sept. 6, 7, 1916, (N. Criddle). Second Manitoba record. This is the species which was redescribed by E. M. Walker as *Orchelimum manitobense.* The latter name has been placed in the synonomy by Rehn and Hebard (Trans. Amer. Ent. Soc., XLI, 44). Recorded from Ontario in 1914, Ent. Record.

Odonata.

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

Coenagrionidæ.

Coenagrion angulatum E. M. Walker. Red Deer, Alta., July 5-21; Innisfail, Alta., July 6. New to Alberta list, (Whitehouse).

Libellulidæ.

123. *Cordulia shurtleffi* Scudd. Red Deer, Alta., June 6-July 5. New to Alberta list, (Whitehouse).
139. *Libellula quadrimaculata* Linn. Red Deer, Alta., June 8-Aug. 6. New to Alberta list, (Whitehouse).
161. *Sympetrum costiferum* Hagen. Red Deer, Alta., Aug. 5-Sept. 30. New to Alberta list, (Whitehouse).
166. *Leucorrhinia borealis* Hagen. Red Deer, Alta., nymph (with teneral), June 18, previously unknown, (Whitehouse).
166. *Leucorrhinia glacialis* Hagen. Red Deer, Alta., July 5. New to Alberta list, (Whitehouse).
167. *Leucorrhinia intacta* Hagen. Red Deer, Alta., June 24-July 20. New to Alberta list, (Whitehouse).
167. *Leucorrhinia proxima* Calvert. Red Deer, Alta., June 17-July 23; New to Alberta list; also the nymph, June 17, previously unknown, (Whitehouse).

THYSANURA.

These insects have, as yet, received but scant attention in Canada. Mr. Chas. Macnamara, of Arnprior, Ont., is keenly interested in the Collembola, and in addition to *Istoma nigra* MacG., mentioned in the 1913 record, he has found on the snow at Arnprior, the following species:

Isotoma palustris Müller. Dec. and Jan.
Isotoma viridis riparia Nicolet. March.
Entomobrya multifasciata Tull. Dec.
Tomocerus flavescens americanus Schött. Dec.
Achorutes socialis Uzel. All winter.
Achorutes armatus Nicolet. Dec.

In a paper entitled "North American Collembolous Insects of the Subfamilies Achorutinæ, Neanurinæ and Podurinæ," by Dr. J. W. Folsom, the following species from Canada is described:

* *Achorutes pseudarmatus* Folsom. Kaslo, B.C., (Cockle); Proc. U.S.N.M., Vol. 50, p. 490.

SIPHONAPTERA.

The following species were determined by the Hon. N. Charles Rothschild:

Ceratophyllus arctomys Baker. Perce, Que., from ground hog, June 19, 1915, (Taverner).

Ceratophyllus bruneri Baker. Aweme, Man., Jan. 15, 1914, from *Taxidea taxus*, (S. Criddle).

Ceratophyllus agilis Roths. Aweme, Man., Feb., 1915, from *Mustela cicognanii*, (S. Criddle).

Ctenocephalus canis. Ottawa, Ont., Oct. 27, 1915, (Hewitt).

Leptopsylla hygini Roths. Aweme, Man., Feb., 1915, from *Mustela cicognanii*, (S. Criddle).

Araneida.

(Arranged according to Banks' Catalogue of Nearctic Spiders, U.S.N.M., Bull. 72. The numbers refer to the pages in the catalogue.)

During the past year Mr. J. H. Emerton, of Boston, has examined many spiders collected in Canada. The collection at the University of Toronto, largely the work of Prof. E. M. Walker and Mr. T. B. Kurata, was studied. This collection contains 110 species from widely separated localities. Collections made at Toronto by Mrs. A. B. Faull and from the Thousand Islands by Miss H. Coleman were also determined by Mr. Emerton. In June, 1916, Mr. Emerton visited Ottawa and the writer spent many happy hours in his company collecting spiders, etc. While in Ottawa he examined the collection in the Entomological Branch, and identified a number of species. After leaving Ottawa, Mr. Emerton made collections at Montreal and Quebec, south to Sherbrooke and Megantic and northward to Maniwaki, Montford and Lake St. John, 92 species in all being taken. Mr. F. W. Waugh, of the Geological Survey, Ottawa, collected 46 species at Long Lake, 60 miles east of L. Nipigon and on Manitoulin Island, Lake Huron.

Many of the records given below refer to well known species, but it seems worth while including them here, as the definite localities add to their known range of distribution.

In the Proceedings of the United States National Museum, Vol. 51, pages 67-72 (separates issued Oct. 16, 1916), Nathan Banks published a list of 51 species of spiders collected by Messrs. Currie, Caudell and Dyar, in British Columbia in 1903.

Theraphosidæ.

2. *Brachybothrium pacificum* Simon. Saanich, B.C., (Wilson), Departure Bay, Vanc. Is., 1913, (T. B. Kurata).

Scytodidæ.

5. *Scytodes thoracica* Lat. Toronto, Ont., Sept. 15, 1915, (T. B. Kurata).

Dysderidæ.

7. *Segestria pacifica* Bks. Departure Bay, Vanc. Is., B.C., 1913, (T. B. Kurata).

Drassidæ.

9. *Gnaphosa conspersa* Thor. Lanoraie, Que., June 20, 1915, (Beaulne); Prince Albert, Sask., June 25, 1913, (T. B. Kurata); Departure Bay, Vanc. Is., July 18-28, 1913, (T. B. Kurata).
9. *Gnaphosa parvula* Bks. Prince Albert, Sask., June 25, 1913, (T. B. Kurata); Dauphin, Man., June, 1913, (T. B. Kurata).
9. *Pythonissa imbecilla* Keys. Chelsea, Que., June, 1916, (Gibson).
10. *Drassus neglectus* Keys. Lanoraie, Que., June 14, 1915; Montreal, Que., May 9, 1915, (Beaulne); Orillia, Ont., June 11-16, 1914; Sudbury, Ont., June 17, 1913, (T. B. Kurata); Departure Bay, Vanc. Is., B.C., July 21, 1913, (T. B. Kurata).
10. *Drassades robustus* Emer. Departure Bay, Vanc. Is., B.C., (T. B. Kurata); Banff, Alta., June 29, 1913, (T. B. Kurata).

Clubionidæ.

10. *Micaria gentilis* Banks. Montreal, Que., May 8, 1915, (Beaulne).
11. *Castianeira crocata* Hentz. Lanoraie, Que., June 14, 1915, (Beaulne).
12. *Agrœca pratensis* Emer. Lanoraie, Que., June 21, 1915, (Beaulne).
14. *Clubiona canadensis* Emer. Montreal, Que., May 11, 1915, (Beaulne); Nipigon, Ont., June 18, 1913, (T. B. Kurata); Metlakatla, B.C., 1912, (J. H. Keen); Departure Bay, B.C., (T. B. Kurata); Dauphin, Man., June 21, 1913, (T. B. Kurata).
14. *Clubiona riparia* Koch. Toronto, Ont., (T. B. Kurata).

Agelenidæ.

15. *Cicurina simplex* Simon. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
15. *Cicurina tersa* Simon. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
16. *Cœlotes montanus* Emer. Orillia, Ont., April 27, 1914; Toronto, Ont., May 8, 1914, (T. B. Kurata).
16. *Agelena pacifica* Banks. Saanich, B.C., (Wilson).

Dictynidæ.

17. *Dictyna maxima* Bks. Dauphin, Man., June, 1913, (T. B. Kurata).
18. *Amaurobius sylvestris* Emer. Banff, Alta., end June, 1913, (T. B. Kurata); Aylmer, Que., June 5, 1915, (Beaulne); Nipigon, Ont., July, 1894, (W. McInnes); Orillia, Ont., May 24, 1914, (T. B. Kurata).
19. *Amaurobius ferox* Walck. Montreal, Que., April 21, 1915, (Beaulne).
19. *Amaurobius severus* Simon. Departure Bay, Vanc. Is., B.C., July 5, 1913, (T. B. Kurata).

Theridiidæ.

19. *Theridium murarium* Emer. Prince Albert, Sask., June 25, 1913, (T. B. Kurata).
20. *Theridium zelotypum* Emer. Manitoulin Island, (F. W. Waugh); Nipigon, Ont., June 18, 1913, (T. B. Kurata); Ottawa, Ont., June, 1916, (J. H. Emerton); Meach Lake, Que., Hull, Que., (Emerton and Gibson).
21. *Lithyphantes corollatus* L. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
21. *Enoplognatha mormorata* Hentz. Departure Bay, Vanc. Is., B.C., (T. B. (Kurata); Prince Albert, Sask., June 25, 1913, (T. B. Kurata).
21. *Crustulina borealis* Bks. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
21. *Crustulina guttata* Reuss. Montreal, Que., May 6, 1915, (Beaulne); Ahuntsic, Que., June 4, 1915, (Beaulne).
22. *Asagena americana* Emer. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
23. *Lathrodectes mactans* Fab. Nipigon, Ont., July, 1894, (W. McInnis); Departure Bay, Vanc. Is., B.C., July 6, 1913, (T. B. Kurata).
27. *Lophocarenum decemoculatum* Emer. Aylmer, Que., June 3, 1915, (Beaulne); Lanoraie, Que., June 25, 1915, (Beaulne).
29. *Grammonota pictilis* Camb. Southern Labrador, 1915, (C. W. Townsend).
31. *Erigone longipalpis* Sund. Metlakatla, B.C., 1912, (Keen).

Linyphiidæ.

32. *Neriene clathrata* Sund. Toronto, Ont., (T. B. Kurata).
32. *Labulla altioculata* Keys. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).

33. *Linyphia diana* Keys. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
33. *Linyphia litigiosa* Keys. Departure Bay, Vanc. Is., B.C.. July, (T. B. Kurata).
33. *Linyphia mandibulata* Emer. Prince Albert, Sask., June 25, 1913, (T. B. Kurata).
33. *Linyphia nearctica* Banks. Nipigon, Ont., (F. W. Waugh). The occurrence of this interesting species at Nipigon extends its range 700 miles further west. It frequents small spruce and balsam trees, (J. H. E.). During Mr. Emerton's visit to Canada in 1916 the species was found at several points in the Ottawa district, (A. G.).
34. *Bathyphantes calcaratus* Emer. Old Romain to Blanc Sablon, Southern Labrador, 1915, (C. W. Townsend).
35. *Bathyphantes subalpina* Emer. Old Romain to Blanc Sablon, Southern Labrador, 1915, (C. W. Townsend).

Tetragnathidæ.

36. *Eucta caudata* Emer. Prince Albert, Sask., (T. B. Kurata).
37. *Tetragnatha vermiformis* Emer. Jordan, Ont., Sept. 24, 1915, (Ross); Toronto, Ont., (T. B. Kurata).
37. *Tetragnatha extensa* Linn. Nipigon, Ont., 1894, (W. McInnis); Hull, Que., June, 1916, (Gibson); Aylmer, Que., June 5, 1915, (Beaulne); Lanoraie, Que., June 24, 1915, (Beaulne).

Epeiridæ.

39. *Zilla montana* Koch. Nipigon, Ont., June 18, 1913, (T. B. Kurata).
41. *Epeira cavatica* Keys. Toronto, Ont., (T. B. Kurata).
42. *Epeira gemma* McCook. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).

Thomisidæ.

48. *Xysticus formosus* Banks. Banff, Alta., end June, (T. B. Kurata); Prince Albert, Sask., June, 1913, (T. B. Kurata).
48. *Xysticus limbatus* Keys. Meach Lake, Que., June 22, 1916, (Gibson); Dauphin, Man., June, 1913, (T. B. Kurata).
51. *Thanatus coloradensis* Keys. Departure Bay, Vanc. Is., B.C., (T. B (Kurata).
51. *Tibellus oblongus* Walck. Spruce Brook, Nfd., July 26, 1914, (Walker); Okanagan Landing, B.C., Aug. 15, 1913, (T. B. Kurata); Prince Albert, Sask., June, 1913, (T. B. Kurata).
52. *Philodromus inquisitor* Thor. Southern Labrador, 1915, (C. W. Townsend).

Pisauridæ.

53. *Dolomedes idoneus* Mont. Chelsea, Que., May, 1913, (Gibson); De Grassi Point, Ont., Aug. 26, 1911, (Walker).

Lycosidæ.

55. *Lycosa albohastata* Emer. North Devon Island, Hudson Bay, Aug. 13, 1904, (A. Halkett).
55. *Lycosa beani* Emer. Southern Labrador, 1915, (C. W. Townsend).

57. *Geolycosa missouriensis* Banks. Aweme, Man., (J. Fletcher). Burrows in sand and occurs along the Great Lakes and south as far as Texas, (J. H. E.).
58. *Pardosa atra* Bks. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
58. *Pardosa diffusa* Emer. Southern Labrador, 1915, (C. W. Townsend); Aylmer, Que., June 5, 1915, (Beaulne); Toronto, Ont., (T. B. Kurata); Fort William, Ont., June 19, 1913, (T. B. Kurata); Banff, Alta., end June, (T. B. Kurata).
59. *Pardosa grænlandica* Thor. Klutlan Glacier, 9,000 feet, June, 1893, (F. H. Lambert); Jasper Park, Alta., Sept. 1, 1915, (Hewitt); District of Mackenzie along the south shore of Great Slave Lake, Aug. 22, 1914, (F. Harper); Departure Bay, B.C., (T. B. Kurata); Prince Albert, Sask., June 25, 1913, (T. B. Kurata).
59. *Pardosa lapidicina* Emer. St. Johns, Que., March 23; Vaudreuil, Que., May 27; Lanoraie, Que., June 24, 1915, (Beaulne); Toronto, Ont., Oct. 4, 1913, (T. B. Kurata).
59. *Pardosa glacialis* Thor. District of Mackenzie along the south shore of Great Slave Lake, Aug. 22, 1914, (F. Harper); Toronto, Ont., May 8, 1914, (T. B. Kurata); Prince Albert, Sask., June 25, 1913, (T. B. Kurata).
59. *Pardosa uncata* Thor. Departure Bay, Vanc. Is., B.C., (T. B. Kurata); Dauphin, Man., June, 1913, (T. B. Kurata); Banff, Alta., end June, 1913, (T. B. Kurata).
61. *Pirata insularis* Em. Toronto Island, Ont., June 10, 1914, (T. B. Kurata).

Attidæ.

62. *Phidippus albovittatus* Koch. Chelsea, Que., June, 1916, (Gibson).
64. *Phidippus johnsoni* Peck. Departure Bay, Vanc. Is., B.C., Aug. 1, 1913, (T. B. Kurata).
66. *Dendryphantes flavipedes* Peck. Prince Albert, Sask., June, 1913, (T. B. Kurata).
66. *Dendryphantes militaris* Hentz. Mr. Emerton informs me that Prof. W. H. Brittain, of Truro, N.S., has sent to him specimens of this familiar spider which has several times been seen eating the adults of the Apple Maggot.
68. *Pellenes oregonensis* Peck. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
70. *Sittacus ranieri* Peck. Banff, Alta., June 28, 1913, (T. B. Kurata).
71. *Icius harti* Emer. Lanoraie, Que., June 21, 1915; Aylmer, Que., June 5, 1915, (Beaulne).

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