P. V.

Forty-Eighth Annual Report

OF THE

Entomological Society

OF ONTARIO

1917

(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
1918

Forty-Eighth Annual Report

OF THE

Entomological Society

OF ONTARIO

1917

(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
1918

Printed by
WILLIAM BRIGGS,
Corner Queen & John Sts.,
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 1917.

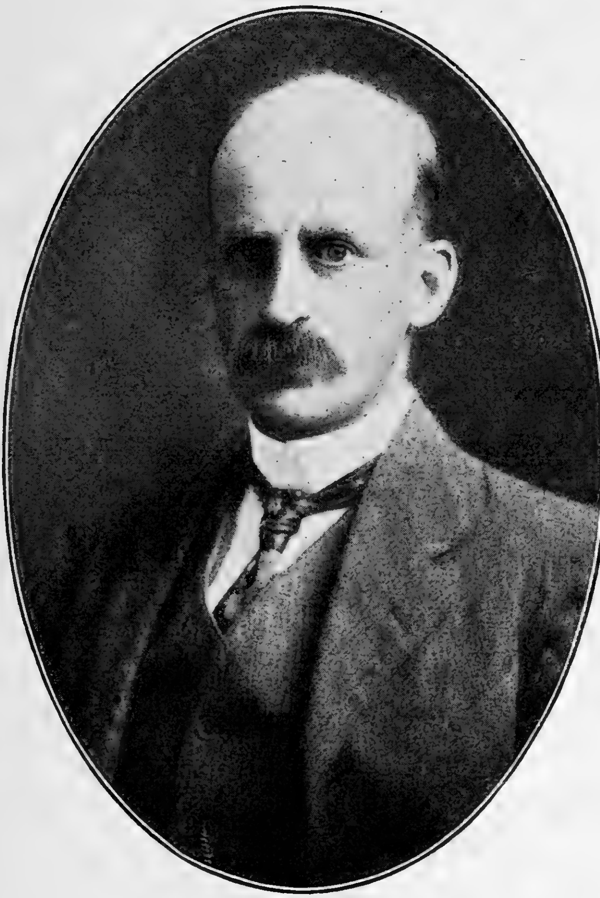
Respectfully submitted,

WILLIAM H. HEARST,

Minister of Agriculture.

Toronto, 1918.

CONTENTS.



MR. ALBERT F. WINN,
President of the Entomological Society of Ontario, 1915-1917.

Entomological Society of Ontario

OFFICERS FOR 1917-1918

President—PROF. LAWSON CAESAR, Dept. of Entomology, Ontario Agricultural College, Guelph.

Vice-President—MR. ARTHUR GIBSON, Division of Entomology, Ottawa.

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

Curator—MR. ERIC HEARLE, 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. J. M. SWAINE, 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. F. J. A. MORRIS, Peterborough; Division No. 5, MR. J. W. NOBLE, Essex, Ont.; Division No. 6, 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. THOS. 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. E. M. WALKER, B.A., M.B., F.R.S.C., University of Toronto; C. GORDON HEWITT, D.Sc., F.R.S.C., Dominion Entomologist, Ottawa; MR. ALBERT F. WINN, Westmount, Que.

Editor of "The Canadian Entomologist"—PROF. E. M. WALKER, Toronto.

Delegate to the Royal Society of Canada—THE PRESIDENT.

FINANCIAL STATEMENT

For year ending October 31st, 1917.

Receipts.		*Expenditures.*	
Cash on hand, 1915-16	$27 58	Printing due on 1915-16	$66 96
Advertisements	53 80	Annual meeting	124 35
Back numbers	231 88	Printing	1,221 90
Cork and pins	100 43	Salaries	225 00
Dues	80 65	Library	24 00
Subscriptions	471 73	Expense	41 27
Government grant	1,000 00	Bank exchange	10 21
Bank interest	14 81	Cork and pins	103 59
		Annual report	121 50
		Cash on hand	42 10
	$1,980 88		$1,980 88

To balance due on printing	$104 14
By cash on hand	42 10
Net deficit	$62 04

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

Respectfully submitted,

A. W. BAKER,

Secretary-Treasurer.

LIST OF MEMBERS

Ontario.

Andrews, H. D.	Toronto.
Astwood, J. C.	Port Arthur.
Baker, A. W.	Guelph.
Beaulne, J. I.	Ottawa.
Biggar, W. E.	Hamilton.
Brimley, J. F.	Bloomfield.
Brobst, C. K.	Toronto.
Burrows, A. R.	Guelph.
Caesar, Prof. L.	"
Calvert, J. F.	London.
Chrystal, R. Neil	Ottawa.
Cleeves, A. C.	Guelph.
Clemens, W. A.	Toronto.
Cosens, Dr. A.	"
Craigie, E. H.	"
Crawford, H. G.	Wilton Grove.
Curran, H.	Guelph.
Dearness, Prof. J.	London.
Doherty, T. K.	Ottawa.
Duff, G. H.	Hamilton.
Dunlop, James	Woodstock.
Fouse, C. M.	Toronto.
Gibson, Arthur	Ottawa.
Gooderham, C. B.	"
Grant, C. E.	Orillia.
Grant, L. J. M.	"
Hahn, Paul	Toronto.
Haight, D. H.	Sudbury.
Hannibal, J.	Toronto.
Hearle, E.	Guelph.
Hewitt, Dr. C. Gordon	Ottawa.
Huntsman, Dr. A. G.	Toronto.
James, L. E.	St. Thomas.
Jolly, Miss	Toronto.
King, Lieut. Vernon	Guelph.
Kirkwood, K.	Toronto.
Kitto, V.	Ottawa.
Kurata, T. B.	Toronto.
Logier, S.	"
Macnamara, C.	Arnprior.
Morris, F. J. A.	Peterborough.
Mossop, Miss B. K. E.	Toronto.
Nash, C. W.	"
Noble, J. W.	Essex.
Petch, C. E.	Ottawa.
Ross, W. A.	Vineland.
Rowland, H. F.	Guelph.
Saxby, J. W.	Toronto.
Shorey, W. P.	Vineland Sta.
Sladen, F. W. L.	Ottawa.
Smith, Arthur	Toronto.
Snazelle, C.	"
Spencer, Capt. G. J.	Guelph.
Swaine, J. M.	Ottawa.
Strickland, E. H.	"
Thompson, J. W.	Toronto.
Tomlinson, A. H.	Guelph.
Walker, Prof. E. M.	Toronto.
Watson, Dr. A. H. R.	Port Hope.
White, James	Snelgrove.
Williams, G. A.	Port Hope.
Wright, Capt. W. H.	Guelph.
Zavitz, E. J.	Toronto.

Quebec.

Barwick, E. C.	Montreal.
Burgess, Dr. T. J. W.	Verdun.
Chambers, C.	Montreal.
Chapais, J. C.	St. Denis.
Chagnon, G.	Montreal.
Clayson, G. H.	"
Corcoran, J. A.	"
Cummings, R. F.	"
Davis, M. W.	Westmount.
Dunlop, G. C.	Montreal.
Du Porte, E. M.	Macdonald College.
Garland, C.	Montreal.
Germain, Bro.	Three Rivers.
Gibb, L.	Montreal.
Hall, G. H.	"
Holmes, J. G.	Westmount.
Huard, Rev. V. A.	Quebec.
Jackson, Dr. F. S.	Montreal.
Leopold, Rev. Father	La Trappe.
Letourneau, F.	Oka.
Lochhead, Prof. W.	Macdonald College.
Moore, G. A.	Montreal.
Southee, G. A.	"
Winn, A. F.	Westmount.

New Brunswick.

Tothill, J. D.	Fredericton.
Baird, A. B.	"

Nova Scotia.

Allen, E. Chesley	Yarmouth.
Baird, W. W.	Nappan.
Blair, W. S.	Kentville.
Brittain, Prof. W. H.	Truro.
De Wolfe, L. A.	"
Dustan, A. G.	Bridgetown.
Good, C. A.	Truro.
Harlow, L. C.	"
Lindsay, Harriet E.	"
Longley, Miss M.	Paradise.
McKay, Dr. A. H.	Halifax.
Payne, H. G.	Granville Ferry.
Payne, S. H.	"
Perrin, Joseph	Halifax.
Sanders, G. E.	Bridgetown.
Scott, Prof. J. M.	Truro.
Wetmore, Ralph	Yarmouth.
Whitman, C. F. U.	Lawrencetown.
Young, Ermina	Brighton.

Manitoba.

Brooker, S. H.	Winnipeg.
Criddle, Norman	Treesbank.
Hippesley, Mrs. W. W.	Dauphin.
Hunter, Dr. A. J.	Teulon.
Wallis, J. B.	Winnipeg.

SASKATCHEWAN.

Androchowicz, E. ....Humboldt.
Bentley, Miss L. ....Mellville.
Hutchinson, H. ....Starblanket.
Neville, S. J. ....Cottonwood.
Willing, Prof. T. N. ......Saskatoon.

ALBERTA.

Antijutti, Miss E. ....Barons.
Baird, Thomas ....High River.
Bentley, Lettice ....Lethbridge.
Bowman, K. ....Edmonton.
Carr, F. S. .... "
Dod, F. H. Wolley ....Midnapore.
Henderson, Mrs. L. A. ...Barons.
Imeson, Miss V. .... "
Mackie, Donald ....Edmonton.
Phillips, E. ....Lacombe.
Whitehouse, F. C. ....Red Deer.

BRITISH COLUMBIA.

Blackmore, E. H. ....Victoria.
Brewn, W. A. .... "
Brinkman, M. .... "
Buckell, W. N. ....Salmon Arm.
Cameron, Dr. A. E. ......Agassiz.
Carter, W. R. ....Victoria.
Cockle, J. W. ....Kaslo.
Cunningham, C. ....Victoria.
Day, G. O. ....Duncan's, V.I.
Downes, N. ....Victoria.
Evans, H. H. ....Vernon.
French, P. E. ....Salmon Arm.
Garrett, C. B. D. ....Cranbrook.
Hadwen, Dr. S. ....Agassiz.
Hanham, A. W. ....Duncan's Station.
Harris, Miss M. ....Deroche.
Hook, G. ....Cobble Hill.
Hugh, G. W. ....Victoria.
Johnstone, W. B. ....Edgewood, Arrow Lake.
Kermode, F. ....Victoria.
Leach, D. H. ....Salmon Arm.
Mathers, G. W. ....Vancouver.
McKeever, F. W. ....Penticton.
Phair, A. W. A. ....Lillooet.
Robson, A. C. U. ....Victoria.
Ruhman, M. ....Vernon.
Stevens, M. G. ....Vancouver.
Taylor, L. E. ....Kelowna.
Treherne, R. C. ....Agassiz.
Venables, E. P. ....Vernon.
Warren, Miss E. ....Barnston Island.
White, E. W. ....Victoria.

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.

MEMBERS OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO ON ACTIVE SERVICE

Bird, M. L. .... Prince Rupert, B.C.
Brewn, L. A. .... Victoria, B.C.
Brodie, H. S. .... Dom. Ent. Lab., Agassiz, B.C.
Burrows, A. R. .... O.A.C., Guelph.
*Bush, A. H. .... Vancouver, B.C.
Cleeves, A. C. .... O.A.C., Guelph.
Creese, H. H. .... Kelowna, B.C.
Curran, H. .... Dom. Ent. Lab., Vineland, Ont.
Dickie, C. M. .... Kentville, N.S.
Dod, F. H. Wolley .... Midnapore, Alta.
Good, Lieut. C. A. .... Truro, N.S.
*Harvey, R. V. .... Victoria, B.C.
Hudson, H. F. .... Entomological Br., Ottawa.
King, V. .... Bureau of Entomology, Washington, D.C.
Martin, A. .... South Vancouver, B.C.
Matheson, J. B. ...... Kelowna, B.C.
McCubbing, C. .... Salmon Arm, B.C.
Neville, S. J. .... Cottonwood, Sask.
Prewett, F. J. .... Toronto, Ont.
Rive, Henry .... Victoria, B.C.
Robertson, W. H. ..... "
Robson, A. B. V. ..... "
Rowland, H. F. .... O.A.C., Guelph.
Simms, H. M. .... Montreal, P.Q.
Snazelle, Chas. .... Thornloe, New Ontario.
Spencer, Capt. G. J. .. O.A.C., Guelph.
Strickland, E. H. ..... Entomological Br., Ottawa.
Venables, E. P. .... Vernon, B.C.
*Walsh, Lieut. F. W. . O.A.C., Guelph.
Williams, C. M. .... Nappan, N.S.
Wilson, Ed. .... Vancouver, B.C.
Wright, Lieut. W. H... O.A.C., Guelph.

*Killed in action.

Entomological Society of Ontario

ANNUAL MEETING

The Fifty-fourth Annual Meeting of the Society was held at Macdonald College, Ste. Anne de Bellevue, Que., on Thursday and Friday, Nov. 8th and 9th. The chair was occupied by the President, Mr. A. F. Winn.

The following members were present: Dr. C. Gordon Hewitt and Messrs. Arthur Gibson, J. M. Swaine and J. I. Beaulne, Ottawa; Messrs. A. F. Winn and G. A. Moore and Dr. J. A. Corcoran, Montreal; Prof. Wm. Lochhead and Mr. E. M. du Porte, Macdonald College; Mr. Geo. Maheux, Quebec; Mr. J. C. Chapais, St. Denis-en-bas, Que.; Father Leopold and Mr. F. Letourneau, La Trappe, Que.; Mr. R. F. Cummings, Maissoneuve, Que.; Mr. J. D. Evans, Trenton, Ont.; Prof. L. Caesar and Mr. A. W. Baker, O. A. College, Guelph; Mr. F. J. A. Morris, Peterborough; Mr. W. A. Ross, Vineland Station, Ont.; Mr. H. F. Hudson, Strathroy, Ont.; Prof. W. H. Brittain, Truro, N.S.; and Messrs. A. L. McLaine and C. E. Petch, Fredericton, N.B.

Others present were Prof. Arthur Willey, Montreal; Dr. F. C. Harrison, Professors T. G. Bunting and Jas. Murray, and Mr. W. P. Fraser, Macdonald College; Mr. J. H. Emerton, Boston, Mass.; Dr. T. J. Headlee, New Brunswick, N.J.; Mr. A. F. Burgess, Melrose Highlands, Mass.; and Prof. W. C. O'Kane, Durham, N.H.

On Thursday morning a meeting of the Council was held in the office of Prof. Lochhead, at which the report of the proceedings during the past year and the financial statement were received and adopted. It was decided that all payments for articles contributed to the Annual Report be discontinued. The Council also decided that the next Annual Meeting be held at the Ontario Agricultural College, Guelph.

In the afternoon the Society met in the Biology Building, and the meeting was called to order by the President. After the reading of the reports of the Council, Treasurer, Librarian and Curator and of the various branches of the Society, the local Secretary, Prof. Lochhead, read a letter from Dr. Hewitt expressing regret at his inability to attend all the meetings. Letters of regret were also read from a number of entomologists from the United States.

At the close of the afternoon session telegrams were sent to Dr. Bethune and Dr. Fyles, conveying to them the Society's greetings and good wishes and expressing regret at their absence from the meeting.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1916-1917.

The Fifty-third Annual Meeting of the Society 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. There was a very satisfactory attendance of members and students; among the visitors from a distance may be mentioned Dr. L. O. Howard, Chief of the Bureau of Entomology, Washington, D.C., and Professor Parrott, Geneva, N.Y. A large number of papers of interest and importance were read and discussed, of which the following is a list: "The Naturalist in the City," by the Rev. Dr. T. W. Fyles; "Dusting Fruit-trees and Grapes for the Control of Biting Insects and Diseases," by Prof. L. Caesar; "General Notes on Aphids which Occur on Apple-trees," by Mr. W. A. Ross; "Further Experiments with the Green Apple Bug," by Prof. W. H. Brittain; "Notes on Physonota unipuncta, the Sunflower Tortoise-beetle," by Mr. A. F. Winn; "Preliminary Notes on the use of Repellents for Horn-flies and Stable-flies on Cattle," by Mr. A. W. Baker; "The Wood of Desire," by Mr. F. J. A. Morris; "Insects as Material for Studies in Heredity," by Prof. W. Lochhead; "The Migratory Tendency in Dragonflies," by Prof. E. M. Walker; "The History of the Forest Tent-Caterpillar and Fall Webworm in North America," by Mr. A. B. Baird; "Three Important Greenhouse Pests recently introduced into Canada," by Mr. A. Gibson; "Camp Hygiene," by Capt. G. J. Spencer; "Experiments in the Control of the Apple Maggot," by Prof. W. H. Brittain; "Summary of Experiments on the Control of Locusts by Coccobacillus acridiorum d'Herelle," by Messrs. E. M. du Porte and J. Vanderleck; "Three Shade-tree Insects," by Mr. J. M. Swaine; "Notes on Some Insects of the Season," by Prof. L. Caesar; and "Parasites of the Larch Saw-fly," by Dr. C. Gordon Hewitt.

The Canadian Entomologist, the official organ of the Society, has been regularly issued each month; the 48th volume was completed in December, 1916. It contained 437 pages and was illustrated with 13 full-page plates and 21 original figures in the text. The contributors of papers numbered 55 and included writers in Ontario, Quebec, Nova Scotia, Manitoba, Alberta, fourteen of the United States, and London, England. The series of interesting and instructive papers on "Popular and Practical Entomology" was continued each month. During the year, 155 new species, subspecies and varieties, and 42 new genera were described, a much larger number than usual. These systematic and descriptive papers render the magazine indispensable to workers in various fields of scientific entomology and cause a constant application for back numbers and volumes.

The attendance of students at military drill during the afternoons when the daily lectures were over prevented most of the members of the society in Guelph from coming to meetings; few, therefore, were held during 1916-17, and those were mostly of a business character, at which thirty new members were elected. The following papers, however were read during the year:

"Some Ontario Mosquitoes," by Eric Hearle.

"The Colorado Potato Beetle," by A. W. Guild.

"Lady-bird beetles," by R. M. Aiton.

Year by year it becomes our sad duty to record the loss and pay tribute to the memory of departed members of our Society. On the 18th of November, 1916, Mr. Edmund Baynes Reed died at Victoria, B.C., after a long illness. He was one of the original members of the Society when it was formed in 1863, and for twenty-five years filled various offices with great industry and enthusiasm. He was largely instrumental in establishing our library and assisted greatly in building up the Society's collections of Canadian insects. His removal to British Columbia in 1890 was a distinct loss to the Society, though he continued to take great interest in its welfare. An appreciative obituary notice by his lifelong friend, Dr. Bethune, was published in the February, 1917, number of the *Canadian Entomologist.* Another of our British Columbian members has been removed from us owing to the tragic death of Mr. Tom Wilson, who lost his life on March 6th in a fire that destroyed the Quaballa Hotel at Hope, B.C. He was engaged at the time in his work of inspecting and improving the orchards on the Indian reserves. He was President of the British Columbia Branch of our Society in 1912 and always took a very active interest in its proceedings. He possessed a remarkable knowledge of the trees, plants and insects of the Province, and had made a large collection of the latter, which he presented to the Canadian national cabinets in charge of the Entomological Division at Ottawa. An interesting sketch of his life by Dr. C. Gordon Hewitt, was published in the *Canadian Entomologist* for August. We have also to record with much regret the sudden death of Mr. A. H. Kilman, of Ridgeway, Ont., who had been a member of the Society for a great many years. He formed a large and valuable collection of Coleoptera which is now in the possession of the Ontario Agricultural College at Guelph.

On Tuesday of this week another of our members has been removed from us in the person of Mr. S. T. Wood, who died in Toronto after a few weeks' illness, in the 57th year of his age. He was for many years on the editorial staff of *The Globe* newspaper, and was widely known as the writter of numerous sketches of the various aspects of nature at all seasons of the year. Many of these were collected together and recently published in a beautifully illustrated volume "The Rambles of a Canadian Naturalist." They form a series of charming papers on wild animal life, birds and insects, flowers, trees and shrubs, observed in the neighborhood of Toronto in groves and ravines which the hand of man has not yet disturbed.

REPORT OF THE LIBRARIAN.

As there were no funds available for the purpose, no books were purchased nor was any binding done during the year ending on October 31st, 1917; there is very little, therefore, to report. Only nine bound volumes were placed upon the shelves, making the total number on the register 2,271; the unbound material, consisting of bulletins, reports, periodicals and pamphlets, continues to increase and, it is hoped, may some day be put in proper shape and made available for convenient reference.

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE CURATOR.

The collections of the Society during the past year have been carefully and regularly examined, and precautions have been taken to prevent injury by museum pests.

Professor T. D. A. Cockerell, of the University of Colorado, Boulder, Col., very kindly sent a number of specimens of bees, and wrote that he had read with great interest Dr. Bethune's account of the collections of our Society. He also said that when the collection was exhibited in London at the Fisheries Exhibition in 1882, he examined it very carefully and made many notes; it was the first collection of North American insects that he had ever seen, and it interested him very much in comparison with the British fauna.

Few other additions have been made to the collections this year, and any presentations, especially of Diptera and Hemiptera would be gratefully received.

Respectfully submitted,

W. G. EVANS, *Curator.*

REPORT OF THE MONTREAL BRANCH.

The 369th regular and 44th Annual Meeting of the Montreal Branch of the Entomological Society of Ontario was held at the residence of Geo. A. Moore, 359 Quebec St., Outremont, on Saturday evening, May 12th, 1917, at 8.15 p.m.

The report of the Council showed that during the season 1916-1917, eight meetings were held with a total attendance of 98 or an average of over 12 per meeting. This is the largest attendance on record since 1874-5 when it totalled 100; that year the average attendance was only 7. The largest average attendance on record formerly was for the season 1898-9 when it was slightly over 10 per meeting. The large attendance this year was due to two special meetings held: one in the Redpath Museum when Dr. Jackson gave a lantern lecture and the other at the Loyola College when a number of the pupils were present.

We report the death of one of our oldest members, the late Albert Griffin.

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

1.	President's Annual Address	A. F. WINN.
2.	Notes on Physonota unipuncta (Col.)	A. F. WINN.
3.	Habits and life history of Nymphula maculalis Chem.	DR. F. S. JACKSON.
4.	Collecting Wasps and Bees	F. W. L. SLADEN.
5.	Hemiptera taken at St. Hilaire, Que., on May 24th, 1916	GEO. A. MOORE.
6.	Diurnal Moths taken at Vaudreuil, Que.	DR. J. A. CORCORAN.
7.	The Season, 1916	L. GIBB.
8.	Belostomatidæ	GEO. A. MOORE.
9.	Description of Annual Meetings of the American Entomological and Washington Societies	DR. CORCORAN.
10.	Insects Attacking Apple Orchards at Covey Hill and Hemmingford in 1916	J. I. BEAULNE.
11.	Leaf-cutting Ants	DR. F. S. JACKSON.
12.	Chinch Bugs	GEO. A. MOORE.
13.	The Study of Insects. Some Practical and Theoretical Aspects of Entomology	DR. F. S. JACKSON.
14.	Sex Characteristics of the Nymphalidæ	G. CHAGNON.
15.	The Making of Lantern Slides	DR. CORCORAN.
16.	Insects in Shore Drift (Hemiptera)	GEO. A. MOORE.
17.	Dimorphism in the Genus Grapta	A. F. WINN.

The Treasurer's report showed a balance on hand of $90.80.

The following officers were elected for the coming year:—

President	A. F. WINN.
Vice-President	G. CHAGNON.
Secretary-Treasurer	GEO. A. MOORE.
Librarian	G. CHAGNON.
Council	G. A. SOUTHEE, DR. CORCORAN, J. G. HOLMES, G. H. HALL.

Respectfully submitted,

GEO. A. MOORE, *Secretary.*

REPORT OF THE TORONTO BRANCH.

The 210th meeting and 21st annual meeting of the Toronto Branch was held in the Biological Building of the University on Thursday, Oct. 18th, 1917, the President, Dr. Walker, in the chair. Those present were Dr. Walker, Dr. Cosens, Dr. Clemens, Miss Mossop, Miss Margery Ford, Miss Norma Ford, Messrs. Andrews, Logier, Hannibal, Brobst, Wright and Reid, and three visitors. After the reading of the minutes the report of the Council and the financial statement were presented by the Secretary-treasurer. Only seven meetings, including the annual meeting, were held during the year, with an average attendance of ten. This small number of meetings was due to the necessity of closing the season with the meeting of April 19th, owing to the fact that a number of the members were absent from the city early in the year. Four new members were elected during the year. The financial statement showed a balance on hand of $7.09.

The papers read during the season were as follows:—

Oct.	26.	Migratory Tendencies of Dragon-flies	E. M. Walker.
Nov.	23.	Life History of Ips pini	W. A. Clemens.
Jan.	18.	Pond Life	C. W. Nash.
Feb.	15.	City and Field Collecting	H. V. Andrews.
Mar.	15.	Ants and Aphids	S. Logier.
Apr.	19.	Mites and Ticks, and their Relation to Disease	E. M. Walker.

The election of officers for the ensuing year resulted as follows:—

President	Dr. W. A. Clemens.
Vice-President	Mr. H. V. Andrews.
Secretary-Treasurer	Mr. S. Logier.
Librarian	Miss B. K. E. Mossop.
Council	Dr. A. Cosens, Dr. E. M. Walker, Messrs. C. W. Nash, J. Hannibal and T. B. Kurata.

Two new members were also elected at this meeting.

The remainder of the evening was devoted to an informal discussion of various entomological subjects, in which most of those present took part.

Interesting observations were made by several members on the migrations of the Monarch butterfly (*Anosia plexippus*) and the Cabbage butterfly (*Pieris rapæ*) during the season of 1917 and many specimens of interest were exhibited and discussed.

Respectfully submitted,

Shelley Logier, *Sec.-Treas.*

REPORT OF THE BRITISH COLUMBIA BRANCH.

The Sixteenth Annual Meeting of the British Columbia Branch was held in the Provincial Museum, Parliament Buildings, Victoria, B.C., on Saturday, March 17th, 1917. The President, Mr. E. H. Blackmore, occupied the chair. There was a good attendance of members from various parts of the Province and much interest was taken in the papers presented.

The reports of the Secretary, Mr. R. C. Treherne and of the Treasurer, Mr. Williams Hugh, showed the Society to be in a very healthy condition and were unanimously adopted. The meeting was divided into two sessions. During the morning session, Mr. E. H. Blackmore delivered his presidential address and the following papers were read:—

A Few Notes from Vernon .... M. H. Ruhman.
(*a*) Hibernation of Larvæ; (*b*) The Movement of Boreus in the Snow .... J. W. Cockle.
Collecting in the Okanagan District .... W. Downes.
On the Hibernation of Lady-bird Beetles (Coccinellidæ) .... T. Wilson.
Insect Notes of the Year .... R. C. Treherne.

Afternoon Session.

Notes on Geometridæ new to British Columbia .... E. H. Blackmore.
Pronunciation of the Scientific Names of Insects .... G. O. Day, F.E.S.
Fossil Insects .... Dr. S. Hadwen; Dr. A. E. Cameron.
Notes on B.C. Diptera .... R. S. Sherman.
Factors in Mosquito Control .... Dr. A. E. Cameron; Dr. S. Hadwen.

The Victoria sub-branch held meetings in the rooms of the Victoria Natural History Society in January, February, March and April, with an average attendance of nine members. The following papers were presented, illustrated with specimens of the subjects taken up:—

The *Parnassidæ* and *Papilionidæ* of British Columbia .... E. H. Blackmore.
Leptarctia californiæ and Its Varieties .... E. H. Blackmore.
The Lepidoptera of the Northern Okanagan .... W. Downes.
The Species of the Genus Xylomyges Occurring in B.C. .... E. H. Blackmore.

The past year has drawn heavily on our list of members; many of them answered the call to arms in the service of the Empire. We regret to record the deaths of two of our oldest and most valued members, Mr. A. H. Bush, of Vancouver, who was killed in action in France during August, 1916, and Mr. Tom Wilson, of Vancouver, who perished in a hotel fire at Hope, B.C., on March 6th, 1917.

The following officers were elected for the year 1917:—

President .... E. H. Blackmore, P.O. Box 221, Victoria, B.C.
Vice-President .... R. S. Sherman, Vancouver, B.C. (Coast).
Vice-President .... L. E. Taylor, Okanagan, B.C. (Interior).
Secretary-Treasurer .... Williams Hugh, P.O. Box 20, Cloverdale, B.C.
Advisory Board .... Dr. A. E. Cameron, M.A.; G. O. Day, F.E.S.; Dr. S. Hadwen, and R. C. Treherne, B.S.A.

Respectfully submitted,

Williams Hugh, *Sec.-Treas.*

REPORT OF THE NOVA SCOTIA BRANCH.

The Third Annual meeting of the Entomological Society of Nova Scotia was held at Truro, Aug. 2nd, 1917. A short business meeting was held in the morning, this being followed by the reading of papers at the afternoon and evening sessions. There was an average attendance of about seventy-five at the meetings and the papers were listened to with interest.

The following officers were elected for the year 1917-1918:—

Honorary President .... Dr. A. H. McKay, Halifax.
President .... L. A. DeWolfe, Truro.
Vice-President .... G. E. Sanders, Annapolis.
Secretary-Treasurer .... W. H. Brittain, Truro.
Assistant Secretary-Treasurer... E. C. Allen, Truro.

W. H. Brittain, *Sec.-Treas.*

REPORT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA, 1916-1917.

Francis J. A. Morris, Peterborough.

I have the honour to present a report of the Entomological Society of Ontario for the year 1916-1917.

The monthly issues of the "Canadian Entomologist" maintain the high standard and the wide range of interest that were noted last year. Well-illustrated, descriptive articles of great importance to specialists in various orders of insects have appeared in every number; several most interesting contributions to insect life-histories have also been made, as well as observations on insect distribution; among these we would mention papers by Dr. Walker, the editor, on the Dragonflies of Ontario, Prince Edward Island, and Newfoundland; an article on "Lake Shore Insect Drift," by James G. Needham, of Cornell, and one on "Beetles of the West Coast of Florida," by W. S. Blatchley, of Indianapolis.

The monthly series of articles on "Popular and Practical Entomology" has proved a great success and several papers of exceptional interest have appeared during the year, notably, "From the Editor's Office Chair," by Prof. R. P. Dow, of the Brooklyn Entomological Society; "Collecting Notes on Beetles in Maine," by C. A. Frost, of Framingham, Mass.; "The Control of Ants," by Arthur Gibson, of Ottawa; "The Plum Curculio," by Lawson Caesar, of Guelph; and, "Notes on the Black Apple Leaf-hopper," by Messrs. Brittain and Saunders, Entomological Division of the Department of Agriculture, Nova Scotia.

We are very glad to be able to call attention, too, to some steps taken in a much needed direction: I mean towards the co-ordination of all entomological interests in the Dominion. For the first recent steps towards this end credit is due, we believe, to our President, Mr. Winn, of Westmount, P.Q. More than a year ago he suggested that members with available duplicates among their specimens should make contributions to the public collections in Montreal and Guelph; this admirable suggestion has now been taken up at headquarters, and we note in the December issue of the magazine a call from Dr. Gordon Hewitt to all members of the Society to join hands in building up the National Collection of Insects at Ottawa. Again, at the last annual meeting, the President suggested that accounts should be published from time to time of all the more important entomological collections in the Dominion, both private and public. In earnest of this, Dr. Bethune, we note with extreme pleasure, has written an article on the Guelph collections, which appeared in the current issue of May, 1917.

Through lack of just such Dominion-wide co-operation, lovers of nature and students of our *flora* and *fauna* have been sadly handicapped in the past. Strangely enough botany is even worse off than entomology in this respect, for not only is the central government of the science defective, but there is neither a Linnæan Society nor a botanical magazine of more than Provincial or merely local importance in Canada, and the work done by champions like good old John Macoun and the late James Fletcher has not been continued in recent years nor brought up to date for a quarter of a century.

Some exceptionally interesting publications, appearing during the year, have been reviewed in the pages of the magazine: e.g., Vol. IV of the "Biologia Centrali-Americana," by Lord Walsingham, which will be eagerly hailed by micro-lepidopterists all the world over; Blatchley and Leng's work on the "Rhynchophora of N. E. America," a long felt *desideratum* among students of the beetles and a worthy companion to the senior author's "Coleoptera of Indiana"; the "Life of Inland Waters," by Needham and Lloyd, the Cornell Professors; Dr. Van Duzee's "Check-list of the Hemiptera of America, North of Mexico"; J. M. Aldrich's "Sarcophagidæ of North America," being the first Memoir of the Thomas Say Foundation of the Entomological Society of America; and some of the articles in a supplement to the 47th annual report of the Department of Marine and Fisheries, Ottawa, 1915, called "Contributions to Canadian Biology," and comprising Dr. Walker's "Odonata of Go-Home Bay," and W. A. Clemens's "Ephemeridæ of the Georgian Bay."

Since your meeting of last May we have recorded with deep regret the loss of several old friends as well as of one of the founders of our Society. In June appeared the notice of Theodore Pergande's death, which occurred in March, 1916; first appointed an assistant in Missouri to C. V. Riley, he was afterwards associated for nearly forty years with the Washington Bureau of Entomology, and not infrequently contributed articles to our magazine. In the same issue was noticed the death (also occurring in March) of Geoffrey Meade-Waldo, of the British Museum of Natural History. He represented that Institution at the Society's Jubilee meeting in Guelph, August, 1913, and all who were fortunate enough to make his acquaintance remember the charm of his personality; his death at the early age of thirty-two means a great loss to British Entomology. A few days after the Royal Society's meeting last May occurred the death of John Bickerton Williams, of Toronto, F.Z.S., an old and faithful member of our Association, a true lover of nature and a man of most modest and gentle disposition. Finally, on November the 18th last, at Victoria, B.C., there passed away Edmund Baynes Reed, in the seventy-ninth year of his age. He was one of Ontario's pioneer entomologists, and a member of the original group who founded our Society more than fifty-three years ago. The very feeling tribute to his memory that appeared last February was from the pen of his life-long friend, our revered emeritus editor, Dr. Bethune, who now remains almost sole survivor of that little band of devotees.

The Society's annual activities culminated very fittingly last November in a grand two-day re-union at Guelph. The popular lecture was delivered by Dr. L. O. Howard, Chief of the Bureau of Entomology, Washington, on the subject of "Insects as Disease-carriers." Reports were presented at this meeting from six different districts of Ontario, as well as from the branches in Toronto, Ottawa, Montreal, Quebec, Manitoba, British Columbia and Nova Scotia. Visitors were present from the length and breadth of the Dominion, and also from several of the United States. Nearly a score of papers were read at the meeting, and the comments and discussions evoked by most of these, particularly by those of an economic character, bore eloquent testimony to the interest with which the proceedings were followed throughout. Practically a verbatim account of this meeting, including all the papers read, is now in the press and will shortly appear as the Forty-seventh Annual Report of the Entomological Society of Ontario.

ADDRESS.

J. C. Chapais, Delegate of the Quebec Society for the Protection of Plants.

Representing here, as a delegate, the Quebec Society for the Protection of Plants, I have thought it might interest you for a moment to hear about a note I found while perusing, recently, a French work on agriculture called "Le Livre de la Ferme," (The Book of the Farm), written by Pierre Joigneaux, an agronomist of France who has edited it at Paris since 1857. This book is considered as one of the classics on agriculture and as an authority in that branch of human knowledge, along with those of De Serres, De Domballes, Gayot, Gasparin, Barral, Isidore Pierre, Heuzé, etc. The note, to which I have just alluded, relates to an essay by a French-Canadian entomologist, Mr. Emilien Dupont who, in 1856, entered it in a competition opened to the entomologists of Canada, as appears from the following quotation:

Bureau of Agriculture and Statistics,
Toronto, 15th August, 1856.

On the 15th August, 1856, there issued from this department the following notice:—

Bureau of Agriculture and Statistics,
Toronto, 15th August, 1856

Prize Essays—£40, £25, and £15.

The above premiums will be paid for the three best essays, respectively, on the "Origin, Nature, and Habits—and the history of the progress, from time to time—and the cause of the progress, of the weevil, Hessian fly, midge, and such other insects as have made ravages on the wheat crop in Canada; and on such diseases as the wheat crops have been subjected to, and on the best means of evading or guarding against them."

The Essay to be furnished to the Bureau....................

P. M. Vankoughnet,
Minister of Agriculture, etc.

The time named in the notice first issued having been extended to the 15th day of April, twenty-two essays were received up to that time. The Boards of Agriculture for Upper and Lower Canada named Professor Hincks, of University College, Toronto, and Professor Dawson, of McGill College, Montreal, as a Committee, to decide upon the merits of the several essays.

According to the decision of these gentlemen, the *first prize* has been awarded to H. W. Hind, Esq., Professor of Chemistry, at Trinity College, Toronto; the *second prize* to the Rev. George Hill, Rector of Markham; and the *third prize* to Emilien Dupont, Esq., of St. Joachim.

Joigneaux, in his "Book of the Farm," fourth edition, edited in 1883, appreciates the prize-awarded essay of Dupont as follows, in chapter LI dealing with "Insects Injurious to Cereals," paragraph Cecidomyiæ, page 955, and I have thought that this quotation made by a French agronomist *d'outre mer* of the work of an entomologist of America would prove of some interest to you as it has for me.

Here is the quotation from Mr. Joigneaux:

"Mr. E. Dupont, who has observed keenly the habits of these insects (the *Cecidomyiæ*), when they were doing a great deal of damage in Canada, in 1834 and during the following years, has made some important observations from which he has drawn valuable indications.

"'*Cecidomyia tritici*,' he says, 'is delicate and can barely do more than move farther than a few acres from its native spot, and, at that, only in calm weather. The fields that have been sown in wheat and which have been attacked by the *Cecidomyiæ* the preceding year, are much more infested with it than recently cleared land. Moreover, an observer has noticed prodigious numbers of *Cecidomyiæ* on potato vines planted in a field which had yielded wheat the preceding summer; these flies were henceforward harmless. Thus the necessity of alternating the crops and keeping wheat as long as possible from the lately infested spots is clearly indicated.

"'It has also been demonstrated through observation,' says Mr. Dupont, 'that by modifying the time of earing of the wheat so as to have it before the 16th of June or after the 20th of July, that is, before or after the time of appearance of the *Cecidomyiæ*, the damages caused by that insect are avoided.'

"Let us then, with Mr. Dupont, say to the farmers: If you dread the wheat fly for next year, do not sow your grain on the same field, nor in its neighbourhood; then, sow, if possible, in April; if this is too early, then wait till the first days of June; lastly, keep your fields clear from weeds which may offer secure shelter for the flies."

That quotation far off echo of what has been done, at a pretty far distant epoch, in Canada, by one of our entomologists, goes to show the spirit of co-operation in the study of the captivating science of entomology which leads the entomologists all over the world, though strangers they may be to one another, to work jointly for the elucidation of the numerous problems offered by that science.*

*The above mentioned essay of Emilien Dupont has been published in French in book form, as a pamphlet of 38 pages, of which the title page reads as follows: Essai sur les insectes et les maladies qui affectent le blé, par Emilien Dupont, Ecr., de St. Joachim, comté de Montmorency. L'auteur a reçu le troisième prix du Bureau d'Agriculture et des Statistiques. Montréal, des presses à vapeur du Canada Directory, rue St-Nicolas, 1857.

The name of Emilien Dupont is a pseudonym. The true name of the author is L'Abbé Léon Provancher, of the Diocese of Quebec, the well-known French-Canadian naturalist, who has written many works on natural history from 1857 to 1891.

REPORT ON INSECTS FOR THE YEAR.

Division No. 1, Ottawa District—Arthur Gibson, Entomological Branch, Ottawa.

Attacking Field Crops.

The Striped Cucumber Beetle, *Diabrotica vittata* Fab. In the early part of the summer a good deal of injury was caused by this insect, particularly to cucumbers and Hubbard's squash. Many plants of the latter examined on June 21st were seen to be seriously eaten. Experiments in controlling the beetle by spraying with ordinary poisoned Bordeaux mixture were successful, the plants being thoroughly drenched with the mixture.

The Ash-gray Blister Beetle, *Macrobasis unicolor* Kby., was again complained of in the district as injuring potatoes in the first half of July. On July 7th from one hill 150 beetles were removed.

The Imported Onion Maggot, *Hylemyia antiqua* Mg. In 1917 we continued our experiments with a poisoned bait spray (sodium arsenite), to attract and kill the flies, and as our results were of considerable value a separate statement on this work appears on page 31.

The Cabbage Root Maggot, *Phorbia brassicæ* Bouché. While not specially numerous, a good deal of injury was effected by the maggots. Complaints were received chiefly from amateur gardeners who found that their cabbage, cauliflower and turnip plants were being destroyed. One gardener brought to me, on July

9th, samples of young, badly-infested turnips, and stated that a patch about twenty feet square had been ruined.

The Colorado Potato Beetle, *Leptinotarsa decemlineata* Say, was responsible for enquiries from many city dwellers who were growing potatoes on vacant lots or other areas for the first time. The insect was present in large numbers throughout the district.

The Potato Aphis, *Macrosiphum solanifolii* Ashm. was also numerous during 1917, large colonies of the plant lice being present in gardens and fields in Ea tern Canada. At Ottawa the insect was controlled satisfactorily by spraying with black leaf 40.

The Potato Flea Beetle, *Epitrix cucumeris* Harr. Potatoes were freely infested with this insect, its injuries attracting particular attention during early July. Tomatoes and, to a much lesser extent, cucumbers, were also attacked.

The Zebra Caterpillar, *Ceramica picta* Harr. In September this caterpillar was present in considerable numbers in various sizes from about one-quarter inch in length to almost full grown individuals. The leaves of turnips and cabbages were freely eaten.

The Woolly-bear Caterpillars, namely the Yellow Woolly-bear, *Diacrisia virginica* Fab. and the Salt Marsh Caterpillar, *Estigmene acraa* Dru . were exceptionally abundant in Eastern Canada in 1917. In the Ottawa district. in August and September, the foliage of low-growing plants of many kinds was much injured. In vegetable gardens cabbages, turnips and other plants were eaten. It is many years since we had such an outbreak of these hairy caterpillars.

Wireworms (*Elateridæ*) and White Grubs, (*Lachnosterna* spp.). Some injury was caused by the former, the complaints referring chiefly to damage to the tubers of potatoes. The worms bored into the tubers and rendered them unfit for use. Practically no injury was caused by White Grubs in the district. There were important flights of *Lachnosterna dubia* during the latter half of May and we may expect injury by the second year grubs in 1918.

Grasshoppers. An outbreak of the Slender Meadow Grasshopper, *Conocephalus fasciatus* DeG., caused noticeable injury to field corn near Norway Bay, Que. The insects were present in large numbers and many hills in several rows had been almost completely eaten. The insects were particularly attracted to the male flowers and the nearby tender leaves. The injured rows were largely in a low lying portion of the field.

Slugs. These creatures were decidedly destructive to many kinds of vegetable crops. The leaves of lettuce, beans, carrots, tomatoes, corn, etc., were freely eaten. In some fields of beans the slugs were present in large numbers and were causing considerable loss. As a remedy we recommended the broadcasting, lightly over the soil before nightfall, of freshly slaked lime. Three applications on consecutive evenings were advised. Reports received afterwards indicated that such control was effective. In gardens the placing of shingles here and there beneath low growing plants is a useful method of trapping slugs. If the shingles are turned over in the morning the slugs there hiding may be easily destroyed by scraping them off and crushing them with the foot.

The Carrot Rust-fly, *Psila rosæ* Fab. In a few gardens in the Ottawa district the work of this insect was readily apparent. Such infestations as we heard of, when investigated, were found to be too far advanced to make possible any control measures.

The Horse Radish Flea-beetle, *Phyllotreta armoraciæ*. Although rather outside of the Ottawa district it is of interest to record here the occurrence of this beetle in considerable numbers at Outremont, Que. One of our correspondents (Rev. Bro. Ouellette), sent to us leaves of horse radish which had been riddled by the beetles. When first discovered no less than 150 specimens were captured by shaking some leaves over a beating net.

Attacking Fruit and Forest Trees.

The Red-humped Apple-tree Caterpillar, *Schizura concinna* A. & S., was more than usually abundant in some orchards in 1917.

The Cherry Slug, *Eriocampoides limacina* Retz., was also present in noticeable numbers.

The Eye-spotted Bud-moth, *Tmetocera ocellana* Schiff., caused important injury in certain unsprayed orchards.

The Halisidota Tussock Caterpillars, namely, the Hickory Halisidota, *H. caryæ* Harr., the Spotted Halisidota, *H. maculata* Harr., and the Checkered Halisidota, *H. tessellaris* A. & S., were remarkably abundant throughout the Ottawa district. The previous outbreak of these caterpillars was in 1907. During the past season they occurred on apple, elm, basswood, maple, birch, and other trees. Conspicuous injury to the foliage of apple by the Hickory Halisidota was observed on August 8th. During the latter half of August and the first half of September the three different Halisidotas were conspicuous almost everywhere in the neighborhood. Around summer cottages they were a decided nuisance from their habit of dropping on people, crawling about verandahs, etc.

Garden and Greenhouse Insects.

In flower gardens, in addition to cutworms, which were more or less in evidence, the Four-lined Leaf Bug, *Pœcilocapsus lineatus* Fab., rendered unsightly the foliage of asters, dahlias, zinnias, etc. The Burdock Borer, *Papaipema cataphracta* Grt., was present in more than usual numbers and destroyed many choice delphinium, dahlia and other plants with succulent stems. The Bordered Sallow, *Pyrrhia umbra* Hufn., was again noticed to be destroying the buds of roses at Ottawa. On July 21st young larvæ about one-quarter inch in length were found.

The above species of woolly-bear caterpillars (*Diacrisia virginica* Fab. and *Estigmene acræa* Dru.) were very numerous in flower gardens. Both of these caterpillars are, in general, of similar appearance and habits and feed on a great variety of plants.

There were no special outbreaks of greenhouse insects during the year. Regularly-occurring species such as the various common aphids, scale insects, etc., required constant attention. In the control of soft scales on ferns we have had satisfactory results by spraying rather heavily with three ounces of Sunlight soap to each gallon of water. Several applications, a week apart, were necessary.

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

Although the average temperature in this district, during July and August, was lower than usual, yet the climatic conditions, in some way not easily explained, have proven favorable to the production of certain forms of insect life as several species were exceedingly abundant.

Especially is this true concerning the Lepidoptera; it has certainly been an ideal season for the development of caterpillars.

The White-marked Tussock Moth, *Hemerocampa leucostigma* S. & A., has not been so plentiful for several years; it took complete possession of the city. In some of the down-town districts the shade trees, especially the horse chestnuts, were almost completely defoliated. In certain parts of the suburbs the caterpillars were numerous, where in former seasons only isolated wanderers were to be seen. In Parkdale, practically all the streets were invaded by them and they even found their way into the houses.

"They were the terror of each favorite walk,
The endless theme of all the village talk."

On the elms of the city the caterpillars of *Acronycta americana* were plentiful enough to do considerable damage. This common species is easily identified by its dense covering of yellow hairs and the long, black pencils of bristles regularly placed on the body.

As a general rule, the "woolly bear" caterpillar, larva of the Tiger Moth, *Diacrisia virginica* Fab., is noticed only in the fall, when it is hurrying about in an eager quest for food before going into winter quarters. This year, however, these reddish-brown larvæ were plentiful in many gardens throughout the entire summer. While they seemed to prefer Virginia creeper they were often seen feeding indiscriminately on grape vines, honeysuckles, lettuce and other plants.

The Isabella Tiger Moth, *Isia isabella* S. & A., the larva of which differs from the preceeding in being black at each end, was seen only in normal numbers although it is generally the more abundant species of the two.

The White Cabbage Butterfly, *Pontia rapæ* Linn., has been a much worse pest than usual this summer. Although cabbage patches were plentiful owing to the general cultivation of vacant land, yet every plant observed seemed always to be an object of interest to a swarm of butterflies.

In connection with the surprisingly large number of these butterflies seen in this district during August, the following note, kindly written at my request by Mr. Andrews of the city, is very interesting:

"Apparent Migration of P. rapæ (Cabbage Butterfly).

"On Sunday morning (about 11.30), Aug. 12th, my attention was attracted by a number of these butterflies coming inland off Lake Ontario.

"Sitting down to watch where they came from, one can imagine my surprise at seeing a huge swarm of these insects flying low over the Lake towards Kew Beach—there were positively thousands of them.

"For three or four days after their arrival they were a perfect pest to people sitting or walking on the beach—they were everywhere and flying with them were the largest number of dragonflies I have ever seen.

"I don't hesitate to add that this swarm of *P. rapæ* came over the Lake, as everything regarding the weather was in their favour. The wind at the time of their arrival was gentle and blew south-south-west, and they seemed to be flying with it."

Although the Monarch Butterfly, *Anosia plexippus* Linn., was very numerous last year, it has been even more plentiful this season. During August ample evidence was furnished concerning the congregating habits of these insects. Flocks of them were seen in High Park, Mimico, and other places, even including the verandahs and shade trees of a street in South Parkdale, where a small swarm collected.

At the same time as the butterflies were gathering together, the Bronzed Grackles were congregating. While among the insects there is of course none of the friendly clamor with which the members of a flock of blackbirds greet each other, yet it would seem that the butterflies are influenced by the same liking for companionship as the birds.

Concerning the starting off of a swarm of butterflies on their long journey to the south, Mr. Andrews, quoted above, has made an important observation. It is only by the collecting of such material that we shall ever be able to unravel the mystery of the migrating tours of this typically American insect the Monarch Butterfly.

"On Sunday afternoon, Sept. 2nd, between 4 and 5 o'clock, I witnessed the departure of a huge swarm of *Anosia plexippus.* The swarm had been congregating for days in Kew Gardens; they flew from the centre of the Gardens towards the Lake and settled on the trees about 100 yards from the Lake. Here they stayed but a few minutes, rising as it were at a given signal they flew off over the Lake in a dense cloud. One thing which I particularly noticed was that their flight was rapid, as if they intended reaching the U.S.A. or wherever they were going in as short a time as possible.

"I forgot to notice the direction of the wind."

A number of Scarlet Oaks, *Quercus coccinea* Muench, in West Toronto, were badly infested with a species of Bucculatrix. Several branches from these trees were examined, and it was found that on nearly every leaf there were two or three of the flat, silken webs, under which the larvæ feed after their first moult.

Among other lepidoptera noted as more than usually plentiful, were the House Moth, *Tinea pellionella,* Linn., and two of the large silkworm moths, *Samia cecropia* and *Telea polyphemus.*

Division No. 5, Peterborough District—F. J. A. Morris, Peterborough.

In spite of an extremely backward season and almost uniformly cool summer, the record of captures is one of the best I have ever had. This is true in regard both to single specimens of great rarity and interest, and to long series of insects either new to me or very poorly represented in my collection. By far the most of my observations have been among the Longicorns, and a great many of them have been obtained by following the clues of last season. My report is, therefore, in many respects a sequel to that of last year and is more nearly related to its forerunner than has usually been the case.

In 1916 I had discovered feeding on choke-cherry foliage a single specimen of a chrysomelian that was new to me. I thought at first it was a species of *Lina* (the change of colour on the thoracic border being mistaken for a thickened margin), but it proved to be *Gonioctena pallida.* The capture had been made about the middle of June. This season I took three specimens in the last week of May, fifteen in the first week of June and a few some days later. They were all found in the same corner of the collecting ground known as "The Wood of Desire"; nearly all on the foliage of choke-cherry, but two on pincherry and one on balm of gilead. Careful search on similar foliage in many other places has so far been without result; I do not know how common or how widely distributed the insect is. In size, shape, and colour it closely resembles *Lina interrupta*: the black marks on the bright reddish-brown elytra vary considerably in weight and are occasionally almost entirely wanting.

Last year's report mentioned basswood as the probable host of some stray specimens of *Chrysomela* captured by the roadside; these were a robust form of *Chrysomela scalaris,* both larger and more strongly marked than the variety found here on alder; another was captured this season at the same spot—west of Jackson's Park—and careful search along the road margins and fences finally disclosed the breeding ground—two basswoods about 100 yards north of the road; here large numbers of the insect were found and upwards of fifty specimens captured about the middle of June.

The usual insect activity about blossoms in June and July was far below the normal, owing to lack of bright, calm days of summer heat. For instance, before Victoria Day in 1916 numbers of *Pachyta monticola* were captured in white trillium, early elder, and other blossom. This year hardly a longicorn of any kind was to be seen in May, and the trilliums were almost over before we had made a single capture. Much of the blossom itself was nearly ten days late: in 1916 choke-cherry had been almost over between June 4th and June 10th; this year it did not open till the latter date. However, during the short season of its bloom I was most fortunate in getting about three good days' collecting round the "Wood of Desire," and the results were well worth recording.

The puzzling little *Anaglyptus—Microclytus* or *Cyrtophorus*—of which we got some fifteen specimens in 1916 and noted two pairs mating, was observed in considerable numbers on June 9th, 11th and 12th, always on choke-cherry; and as late as June 24th four specimens were taken on dogwood blossom (*Cornus alternifolia*) and spiked maple, the choke-cherry being by that date over. A pair was once more seen mating in a flower cluster, and this time was segregated and marked male and female as a verified pair. Altogether over 100 specimens were captured at four different parts of the wood, always just on the edges. On June 12th, a very warm day and bright, over seventy specimens were captured, more than a score being taken from a single tree. Except for its smaller size, the slighter gibbosity of its elytral bases and the less marked compression of its thorax, the beetle can hardly be distinguished in the open from *Cyrtophorus verrucosus*; but it is much more sluggish in habit and crouches or clings in the blossom when approached in a manner quite foreign to *Cyrtophorus.* One of the most interesting points of this year's observations was that about fifty of the insects were brought home alive in small pill boxes, and when released from isolation and put together in a large glass-lidded cardboard box began to mate freely; indeed, within a few minutes I was able to withdraw nearly all the insects in verified pairs. The beetle has several important points of identity with *Cyrtophorus* and at least one essential difference from *Microclytus gazellula.* It can hardly fail to prove extremely close to the European *Anaglyptus mysticus;* it is almost certainly the insect named from Lake Superior by Dr. LeConte as *Microclytus gibbulus;* it is the same as Casey's *Microclytus frosti,* and will be found in many collections, public as well as private, labelled *Microclytus gazellula.*

While ransacking blossom for this little *Anaglyptus,* several longicorns new to me or rare, were taken in June. On the 9th a beetle was distinctly seen to fly from a grove of beechtrees to a cedar near the wood; it proved on capture to be *Anthophilax attenuatus,* an insect entirely new to me. Mr. Harrington has reported it from beech in the Ottawa district. On June 11th, resting on the top foliage of a tall choke-cherry, a beautiful specimen of *Anthophilax malachiticus* was taken, the second insect of this species captured by me in over twelve years' collecting. A curious observation was made on this date, June 11th; it was a dull day and the wind was chilly; I captured only eleven specimens of *M. gibbulus,* and these were all taken alive; but it proved impossible to secure a mating pair; on measuring the antennæ, I found them all short—three-quarters the body length; they were all females, and I infer that in cool weather the males are less active and do not visit their favorite pollen blossoms; both before and after that date, on bright, hot days, the males were almost as plentiful as the females.

Professional duties combined with a wet week end to interrupt field observations between June 12th and 23rd. On the latter date I captured the first of a series of the longicorn *Psenocerus supernotatus*; I had previously captured but one or two isolated specimens at long intervals; this season I captured one on willow, three on sumach, and four or five on newly fallen balm of gilead; these last were all of a very small variety, the others of normal habit. The specimen captured on the 23rd was found resting on a thick limb of willow that was dying from the attacks of *Cryptorhyncus lapathi.* On this date while examining the trunk of a large felled spruce that had been cut into three logs and stripped of its branches I saw what at first I took to be an elater crawling on the bark; its movements and the appearance of its antennæ, however, being suggestive of *Asemum,* it suddenly occurred to me that it was on spruce I had once captured *Tetropium cinnamopterum.* This insect is usually parti-coloured, the head and thorax piceous and the wing-covers light cinnamon brown, whereas the creature before me was all piceous, and both smaller and narrower than any of *Tetropium cinnamopterum* I had ever seen. It proved, however, to be that species. For some time I could see only this one specimen, but just as I was going away I caught sight of a second, small and unicolorous like the first, just disappearing over the far side of the log. I raced round the log to intercept it, but when I got there to my amazement there was no insect, either on the log or on the ground. Now the bark of a spruce is rough and flaky; more or less idly I began lifting the flakes with a jack-knife, when suddenly from under one of them raced into view one of the parti-coloured forms of *T. cinnamopterum*, followed by its mate, the small piceous insect I had been looking for. Acting on this hint I continued to prise up the flakes of bark and succeeded in flushing seven or eight of the insects, of which I captured five; once a pair in conjunction, both sexes being of the small, piceous form. It was really astonishing that pairs of this insect should lie so close under the comparatively small, tight-fitting flakes of bark, but on reflection I had to acknowledge that I had captured once over a score of the robust *Physocnemum brevilineum* pairing just as snugly in the interstices of elm bark. Newly felled spruce, then, in the latter part of June is evidently a breeding ground for this uncommon longicorn *T. cinnamopterum.*

I paid several visits to the spruce, but it was only on the 23rd and 24th of June that I found this beetle. My perseverance was, however, amply rewarded; on July 6th I captured near the axil of a broken branch a specimen of *Merium proteus*; it is hardly safe to generalize from a unique capture, but the date and habitat of felled spruce trunk are perhaps worth noting by Canadian collectors. The descriptions which refer to this insect as yellow-brown have evidently been taken from cabinet specimens; in the live insect, head and thorax are rich violet, and the elytra appear as though dipped in violet dye, the tinge of which may be caught anywhere on their surface if held in the proper light; the elytra being thinner and translucent, appear less dark in hue than the thorax whose density renders it quite opaque. The thighs are bright yellow, almost the shade of the root fibre of Goldthread (*Coptis trifolia*) and very conspicuous. This matter of coloration in published descriptions is very misleading. For instance, *Encyclops* *cœruleus* is spoken of as "blue" or "bluish." I have captured forty or fifty specimens of this beetle, and I never saw one that was not of a beautiful light-green shade with a texture as of silk. If, however, a specimen remains too long in the cyanide bottle, it will turn to a dull bluish colour, losing all the lustre of its surface. Again, *Anthophilax malachiticus* is really a rich and glittering green; it has a metallic lustre which reflects yellow and copper at certain angles, but I can find no trace of the "blue shade" of printed descriptions.

On June 24th a trip to the west edge of the "Wood of Desire" yielded me two specimens of *Leptura pedalis*; a unique specimen captured on the same shrub (a large bush of alternate-leaved dogwood) in 1916 had been my one and only hint of the insect's presence in the neighborhood; it was on this date and on this shrub that I captured my last *Microclytus gibbulus* of the season.

Work and weather prevented further records till July 2nd. On that day during a motor trip west of Chemong I visited a steep hill crowned with basswoods, and while examining the foliage of one of the biggest of these I captured a specimen of *Hoplosia nubila*, which roused me to a vigorous search in the hope of more. Presently on a dead branch jutting from the lower trunk I captured a second; I then got over the fence into an open field so as to be on the sunny side of the tree; on the fence I captured three more specimens, and finally located a dead limb of basswood lying high and dry on a bank of field stone under the tree; here *Hoplosia* was evidently breeding and I had most fortunately come jump with the hour of emergence. I captured altogether some twenty-five specimens on this limb and on rails of the fence beside it. A few days later I took six more at the same place and also captured about ten in other places. In the limb I found several larvæ and an imago in the act of emerging. There seems no doubt that *Hoplosia nubila's* favorite food is dead basswood, and its tunnels are all near the surface, within or just below the inner bark. Several of my captures were made on newly felled basswood; it is probably here that ovipositing first takes place, and then, perhaps, the colony that emerges pairs and oviposits on the home-tree. An interesting observation was afforded by the capture of one specimen on a newly fallen maple; last season I took one on fresh fallen beech. Beech and basswood only are mentioned in Blatchley as hosts of *Hoplosia nubila*.

July 2nd was altogether a phenomenal day in my entomological year. Late in the afternoon on a "brush-head" of dead hemlock thrown on to a snake fence as top rail, I captured two strange weevils; they were several feet away from one another, both on the main stem; on minute examination they proved to be male and female: the male was 5 mm. long and its antennæ were about three-quarters the body length; the female was 6 mm. long and its antennæ only two-fifths the body. The insect was an anthribid, with a white snout, white scutellum, broad white patch near the elytra base, and a dainty little device in fawn-coloured pubescence on the thorax, shaped like a miniature fleur-de-lys or trefoil, otherwise the insect was almost uniformly black, not shining, but dull and rough; it proves to be *Gonotropis gibbosus*, an insect *sui generis* and of great rarity.

From the end of June I kept my eye open especially for *Lamiinids* of the *Acanthoderini* group. In 1916 I had secured quite a range of species on poplar, and an equally wide range had been reported to me as occurring on sumach; as the two ranges only partly coincide, I was anxious to get personal corroboration of both records this year.

I found *Hyperplatys* emerging as early as July 2nd from felled or dying poplar, and a few days later it became quite common, especially on balm of gilead. Two specimens, also, of what appears to be *Liopus variegatus* were captured on fallen or felled trees of this species. I had taken thirteen specimens in 1916 on billets of poplar in a wood pile; there is no doubt that the insect breeds in the balsam poplar with us; a curious thing about my specimens is that they have distinct traces of ciliate fringe under the antennæ, especially on the third joints; many of them are as heavily fringed as *Hyperplatys*. I have specimens of *Liopus alpha* and *cinereus* captured in Ontario that are similarly adorned. Another peculiar feature is the colour; all my specimens of *L. variegatus* (var. *obscurus*?) are very dark grey, almost black. I strongly suspect that both ciliation and "melanism" are a question of latitude. For that reason I find the proportionate length of basal joint to the other joints in the hind tarsi a better test of generic character.

Examination of staghorn sumach during the first part of July resulted as follows: After July 5th many specimens of *Hyperplatys* were captured; a single specimen of *Goes oculata* was taken on a dead limb; a single specimen of *Leptostylus macula* on a bruised shoot; a specimen of *Toxotus schaumii* on the foliage; a specimen of *Lepturges signatus* and about twenty specimens of *Liopus alpha* on the stems.

On July 11th while looking over some newly lopped branches of basswood on the edge of a grain field I captured *Hoplosia nubila,* and a specimen of that dainty little insect with the flying hairs—*Eupogonius subarmatus*. This last I have never found in Ontario except on basswood; more than ten years ago I captured two in the Rideau district on basswood; three or four years ago I took more than a dozen on basswood in the Niagara Glen (towards the end of July), and a few days later two specimens near Peterborough. I have never seen basswood given in any book as the insect's host, but generally elm.

Just after the middle of July we went into our usual camp on Cache Lake, Algonquin Park. I was greatly disappointed not to find any more specimens of *Leptura plebeja* this season on the spiræa blossom; the weather was not favorable for sun-loving insects that frequent flowers, but in other respects the captures this year were exceptionally good. And even in the matter of *L. plebeja* I have, as it proves, been extremely fortunate this summer of 1917. Towards the end of July, during a succession of very hot days, I made on my boathouse window several interesting captures including *Leptura sex-maculata, L. subhamata, L. biforis* and a small black longicorn that I bottled for *Typocerus lugubris*. On removing this last from the jar of moist sawdust in September, I found it had the antennæ annulate with pale brown and devoid of poriferous spaces; it proved, in fact, to be a *Leptura*, and almost certainly the male of *L. plebeja*. When compared with the four other specimens (all apparently female) of this beetle in my cabinet, the insect has two features of special interest, viz.: (1) Its much smaller size, (2) its entirely black abdomen, there being, on the under side, no traces of the brown outer segments that characterize the female.

Two species of *Acmæops* were taken on white pine in the third week of July; a specimen of *Leptura sex-maculata* on July 18th; a specimen of *Leptura pedalis* and several of *L. chrysocoma* (on spiræa) in the fourth week of July; also an unidentified species of *Leptura* (on yarrow). During the last week of July and for three weeks of August *Leptura subhamata* was found abundant on spiræa and elsewhere. After Aug. 5th *Leptura canadensis* became common, both sexes being taken on spiræa blossom and on dead pine and balsam. I notice that these sun-loving *Lepturids* which frequent blossoms seem to prefer standing to fallen timber, and the upper side of branches, whereas the shade-loving *Lamiinids, Monohammi* and others that are not attracted to blossoms, crowd to fallen timber and the under side of the limbs. Among *Lepturas,* it was an agreeable surprise this year to capture quite frequently specimens of the uncommon *Leptura biforis*; I took eight in the second and third weeks of August. A curious thing about the species is that it does not seem to share in the Leptura's generic love of pollen; it is the only species I have never seen on blossom; on the other hand I have more than once captured it settling on newly felled white pine, and nearly all my captures this season were made in front of the tent, the insect flying across the open in the immediate neighbourhood of a large white pine.

For a native of Perthshire, I celebrated the opening days of the grouse shooting season very appropriately: On August 12th I made the largest bag of the season and in some ways the most interesting, while on the 15th I included in my bag of ordinary game a prize as rare as the Capercailzie would be on a Scottish grouse moor—a beautiful specimen of *Monohammus marmorator* ♀; it was captured on a windfall (fresh this season) of balsam fir, while ovipositing on the upper side of the trunk, near a branch axil. It is only the third specimen I have seen in twelve years; my first was captured similarly on fallen balsam near the Village of Lanark, Ont., and the second near Port Hope; all three in my collection are females; the species is recorded as fairly common in the Lake Superior region.

For my last note of the season I shall revert to my captures of August 12th. It was an ideal day for collecting; very hot, bright, and perfectly calm. A party of six or eight of us had paddled up the Madawaska to White's Lake and were lunching on a slope by the shore. It is a favorite spot for picnics, which unfortunately explains how it came to be partly burned over a few years ago. Dead trunks of hemlock, balsam, spruce, pine and birch still stand up among the raspberries that have encroached on the scene of the fire; the rest of the point was saved by the fire rangers' heroic efforts, and it was at the edge of the burnt space, in a hemlock grove with a few scattered pine, spruce, and balsam, that we were lunching. Just after our meal, as my thoughts stole guiltily in the direction of my insect net, I saw something that sent my fingers clutching suddenly for the cyanide bottle: a log-runner (*Xylotrechus*) racing madly up a limb in the direction of the trunk; unfortunately the limb he had chosen to exercise on was the thigh of one of the least entomologically minded members of the party, or the longicorn might either have escaped or at any rate died gloriously without being mutilated, but before I could interfere a horny hand descended in a shower of blows on the "pesky yellow-jacket," and the next moment it lay on the ground "a trunk and a head torn from the shoulders," though not "a body without a name"—*Xylotrechus undulatus*. I was soon busy examining all the standing balsam on the edge of the grove, especially trees that showed signs of languishing and had their trunks in the sun, for it had always been on such trees that I had taken this insect: indeed, only a fortnight before I had captured five on the upright shaft of a dying balsam at Head Lake. Soon my search was rewarded by the capture of six specimens, at the same time I noticed large numbers of *Melanophila fulvoguttata* and two species of *Chrysobothris* settling on hemlock—living trees on the sunny edge of the grove. A close scrutiny of their trunks presently revealed a pair of *Xylotrechus undulatus* mating on the bark and two or three single specimens basking in the sunlight. Before we returned to our canoe I had captured (nearly all on hemlock) sixteen specimens of the longicorn and some thirty-five of the buprestids. On the same day I secured one specimen of *L. subhamata,* two *L. biforis,* and nine *L. canadensis*.

At no other time or place have I seen *X. undulatus* on hemlock, and I fancy the fire is responsible primarily for the prevalence of these woodborers: it has not only killed and wounded a great deal of timber, but has exposed a wide space to the combined action of wind and sun; this has meant greatly increased ovipositing in a restricted area, and as part consequence of such "intensive culture," *Xylotrechus undulatus,* first bred in balsam, has then tackled the neighbouring and not very alien trunks of hemlock, much as the apple web-worm advances from orchard to forest trees in search of fodder as soon as its native pastures begin to fail.

Division No. 6, Essex District—J. W. Noble, Department of Agriculture, Essex, Ont.

Attacking Field Crops.

Wireworms, White Grubs, Cutworms. Considerable damage done to the strawberry beds and spring crops by white grubs; the damage from wireworms and cutworms, however, not so great as in an average year. Adults of all species quite common.

Attacking Fruit Trees.

Codling Moth. Very plentiful on apples and pears in uncared-for orchards, very little damage where spraying was practised. Considerable second brood.

Plum Curculio. Considerable damage to plums, to a less extent to apples.

San José Scale. Still quite plentiful in neglected orchards on hawthorns and some other shrubs, completely controlled in cared-for orchards.

Tent Caterpillars were not common, only a few nests observed during the season. Fall web-worms plentiful, some orchards averaging two webs to a tree.

Aphids. Quite common but more especially troublesome on small vegetables.

Peach-Tree Borer. Has ruined a few orchards this year; seems to be plentiful and rather on the increase.

Attacking Small Fruits and Vegetables.

Melon Aphid and Cucumber Aphid. From these insects we suffered a great loss in Essex County this year. Cucumber aphids were responsible for 75 acres of cucumbers being plowed up. In fields where spraying with tobacco decoction was commenced in time no harm resulted. Some patches were sprayed as many as five times. Two cases came under my notice where the plants were dusted with tobacco flour, spraying being done by two men, one holding the vine while the other did the spraying and the plants were killed. Bees were restrained from visiting the blossoms and the patch had to be plowed up. Melon aphids also killed a large acreage but were controlled by some of the best growers of large plantations by the use of tobacco water, 1 lb. to one gallon.

Onion Root-Maggot. This insect did a large amount of damage in the onion marsh and experiments in this county did very little to control its ravages.

Onion Thrips. Again very common and harmful. No results from spraying this year.

Cabbage Root-Maggot. Very little damage by cabbage root-maggot owing to wet weather during the season the flies were laying eggs.

Asparagus Beetle. These seem to be becoming very common and have done considerable damage by making stems unmarketable.

Bean Root-maggot. Although considerable damage was done in other sections no reports of injury were received from this county.

Tobacco Worm. Very common: controlled in a great many instances by spraying with arsenate of lead, considerable number trapped by poisoned Jamestown weed.

Grapevine Flea-beetle. Common in what small acreages are grown.

Currant Saw-fly. Very common on currants and gooseberries that were not sprayed with hellebore.

Greenhouse Insects.

Considerable damage was done to tomatoes by eelworms (*Nematodes*). This was effectively controlled in some cases where it has been bad in previous seasons by the removal of the soil to a depth of about 8 inches. The general greenhouse pests seem quite active this year including aphids and greenhouse white fly; cucumber beetles doing considerable harm. Hydrocyanic gas was used for the first time in a number of greenhouses for the control of white fly.

Division No. 7, Niagara District—W. A. Ross, Dominion Entomological Laboratory, Vineland Station, Ont.

In spring and early summer, the weather was abnormally wet. At Vineland the precipitation for April, May, June and July was 16.56 inches.

Early in the season, due to the unfavourable meteorological conditions, there was a paucity of insects; later on, however, they became quite abundant. An unusually large number of insect outbreaks were reported to me. Some of the outbreaks were real but many of them were imaginary.

Insects Injurious to Field Crops.

The Wheat Midge (*Itonida tritici*). On July 18th, I was called upon to investigate what was supposed to be a serious outbreak of wheat midge in the Niagara Peninsula. I found the pest generally distributed throughout Welland and Lincoln counties and I understand that it was also present in other parts of the Peninsula. Here and there where the wheat was backward, the midge was abundant, but on the whole, the infestation was very light.

In three of the worst infested fields, I found by counting the plump and shrunken berries that about 35 per cent. of the grain was more or less shrivelled. In heads containing 1,357 kernels 1,001 maggots were found, the number of larvæ per infested kernel varying from 1 to 10.

In a rearing cage in which infested wheat heads had been placed, one adult midge emerged on August 10th.

The Grain Aphis (*Macrosiphum granarium*). During the latter part of July the grain-aphis came into prominence. It was very abundant on oats in certain sections of this district and produced so much alarm among grain merchants that, according to a St. Catharines dealer, the price of oats jumped ten cents. I looked into this outbreak, and, as I expected, found that the reports of serious losses being caused by the insect were without foundation. Natural checks—hymenopterous parasites, ladybird beetles, syrphid larvæ, *Entomophora* etc., as usual prevented any serious injury.

The Oat Midge. The grain-aphis was succeeded by the oat-midge which, according to report, was destroying all the oats in the neighbourhood of Port Robinson. This depredator proved to be oat stamens.

Thrips on Clover. The blood red larvæ of *Haplothrips statices* Hal. were decidedly abundant on the heads of alsike clover in the vicinity of Ridgeway, but, so far as I could make out, they did not cause any appreciable injury to the crop of seed.

My attention was directed to this insect because the farmers mistook it for the notorious clover-seed midge.

THE CLOVER SEED MIDGE (*Dasyneura leguminicola*). In August, I was asked by a Vineland farmer to look at a field of red clover which was blooming very irregularly. On examining some of the clover heads numerous pinkish larvæ of the clover seed midge were found within the flower tubes. According to an estimate I made, at least 44 per cent. of the florets were infested or in other words 44 per cent. of the seed crop was destroyed.

THE CLOVER SEED CATERPILLAR (*Laspeyresia interstinctana*). This species was common on alsike (Ridgeway, July 27th) and on red clover (Vineland, August).

THE SEED-CORN MAGGOT (*Pegomyia fusciceps*). This species was very destructive to beans in Welland County.

FRUIT PESTS.

As Prof. Caesar in his report on "Insects of the Year in Ontario" will deal fully with the fruit insects of the Niagara Peninsula, I shall confine my attention to three species.

THE WHITE-MARKED TUSSOCK MOTH (*Hemerocampa leucostigma*) was unusually abundant on orchard trees, and a considerable amount of injury was done to apples by the larvæ gnawing into the fruit.

N.B.—The calloused blemishes on apples to which I referred in my report for 1916, are undoubtedly the work of this insect.

THE PEAR PSYLLA (*Psylla pyricola*) was very abundant and injurious in certain parts of the district.

THE APPLE MAGGOT (*Rhagoletis pomonella*): As the apple maggot is rarely destructive in the Niagara district, it is worth while mentioning that this insect was decidedly injurious in a small apple orchard near Vineland.

MISCELLANEOUS INSECTS.

CHERMES. The Spruce Gall-louse *C. abietis,* which in the last few years has been comparatively scarce, was abundant this past season on Norway Spruce.

CHERMES PINICORTICIS was very conspicuous on young white pines near Stoney Creek.

WOOLLY-BEAR CATERPILLARS were remarkably common this fall. Complaints were received about them attacking raspberry bushes.

In a Hamilton greenhouse, the YELLOW WOOLLY-BEAR (*Diacrisia virginica*) attacked and skeletonized the foliage of Chrysanthemums.

FURTHER NOTES ON THE IMPORTED ONION MAGGOT (*HYLEMYIA ANTIQUA* Mg.) AND ITS CONTROL.

ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, ENTOMOLOGICAL BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA.

In Entomological Bulletin No. 12 of the Dominion Department of Agriculture, the imported onion maggot is discussed on pages 29 to 32 and its control under field conditions on pp. 47 to 49. Since the publication of this bulletin in May, 1916, further observations on the overwintering habits of the insect have been made and investigations directed towards controlling it under field conditions.

In the spring of 1916, a special search was made for the puparia in land near Ottawa which had been used for onions in 1915. On April 25th, one puparium was found in the soil at a depth of 4½ inches. On April 28th a further search was made with the following results:—

1	puparium	found	at a depth of	3	inches
1	"	"	"	3⅝	"
1	"	"	"	4⅜	"
2	"	"	"	4¾	"
1	"	"	"	4⅞	"
1	"	"	"	5⅛	"
1	"	"	"	5⅜	"
1	"	"	"	6⅛	"
1	"	"	"	6⅜	"

Altogether on the above two days, 11 healthy puparia were found at depths in the soil ranging from three inches to six and three-eighths inches. In addition other puparia were collected but as these were within five inches of the surface, the exact depths were not noted. A close watch for larvæ was kept but none were observed.

The flies from the above puparia emerged during the period, May 12th to 18th.

The above observations bear out our previous supposition that the usual stage in which the insect winters in Canada is the puparium stage.

Control Experiments.

Poisoned Bait Spray Used.

The poisoned bait spray which has been used in our experiments in 1916 and 1917 is the one referred to in our Entomological Bulletin No. 12, as follows:—

Sodium arsenite	5 grams (close to ¼ oz.)
Molasses	1 pint.
Boiling water	1 gallon.

The sodium arsenite was first dissolved in the boiling water and the molasses then added. When the mixture had cooled it was ready for use.

In both years we used a plot one-half acre in extent. In 1916, our work was largely interfered with owing to rains which fell, in several instances soon after the applications were made. Notwithstanding, however, such adverse weather conditions the results from the experiment were certainly of a very promising nature. In 1917, the experiment was continued on the same farm and our results were indeed most satisfactory. Applications of the poisoned bait were made by Mr. I. T. Barnet, who assisted in this work, on June 13 (plants about four inches high) 20th and 27th, and July 4th and 16th—five applications in all. On this latter date the onions were about one foot high on the average and were making such rapid growth that it was decided no further applications would be advisable. The flies were readily attracted to the bait and on occasions, a day or two after the mixture was applied, dead flies were easily found which had fed upon it.

The mixture was applied as coarse drops from a watering can with a small hose. The half-acre plot was quickly gone over. Mr. Barnet began at one end and walked diagonally across the crop continuing from one side to the other in a V-shaped manner, the strips where the liquid would fall being about 15 feet apart at the wide end.

From the half-acre plot 145 bags of good onions were harvested. The stand was certainly an excellent one considering the season. In two other nearby plots of the same size, which were not sprayed, the work of the onion maggot was readily seen and it was estimated that 20 per cent. of the plants were infested.

These experiments were conducted on the farm of Mr. I. A. Farquharson, near Rivermead, Que., which is close to Ottawa. We are very grateful to Mr. Farquharson for allowing us the use of his plots and for his kindly interest and assistance in our work.

The cost of controlling the onion maggot with the above mixture, under conditions prevailing in 1917, was about $1.10 per acre. This estimate includes the cost of the ingredients, as well as a charge for the labour required to apply the five applications. In cases where areas containing several acres were to be treated, the cost per acre could, we think, be somewhat reduced.

From the work which has been done near Ottawa, the results of which correspond with similar work accomplished elsewhere, it seems to us that the commercial grower of onions, in districts where the onion maggot is a regularly occurring pest, should test out the value of the mixture under his immediate local conditions. The cost of the materials is slight and the mixture can be applied quickly even where a number of acres are to be treated. One acre can be treated in less than ten minutes.

PROF. CAESAR: What is the formula for the poison bait referred to?

MR. GIBSON: Five grams sodium arsenite, one pint cheap molasses, dissolved in one gallon of boiling water. We did think of trying mixtures containing slices of onion, which by some were thought to make the bait more attractive to the flies, but we did not think this would make any appreciable difference.

PROF. CAESAR: Is there any injury to the plants by the sodium arsenite and molasses, and also will you tell me just exactly what you mean when you say that it is spread diagonally on the field?

MR. GIBSON: There was no injury to the plants from the use of this mixture. So far as the method of spreading the bait is concerned, the operator walks across the field at one end, and continues crossing the field back again to about fifteen feet from where he first started, so that it is spread over the field in a V-shaped way.

PROF. CAESAR: Backwards and forwards?

MR. GIBSON: Backward and forwards across the field. It is not necessary to apply it all over the onion patch. It is usually applied in the form of large drops.

PROF. CAESAR: And the flies feed on the drops?

MR. GIBSON: Yes. We found them feeding readily on the mixture.

PROF. CAESAR: Was there any difference in the amount of infestation in the adjacent rows of the adjoining plots?

MR. GIBSON: We found the infestation in the adjoining plots to be rather evenly divided.

PROF. CAESAR: My idea was that in those adjacent patches you would expect less infestation than you would get further away, for the reason that the insects would be nearer the bait and would therefore be controlled by it, to a greater extent. For this reason of course you can always get better results by treating large areas.

Mr. Gibson: The chief object, of course, is to control the outbreak early in the season, that is to say during the pre-oviposition period.

Mr. Brittain: How long is that period?

Mr. Gibson: In the onion maggot about ten to fourteen days; in the cabbage maggot six to seven days.

Mr. Brittain: I have tried controlling the cabbage maggot by poison bait placed in shallow pans. The eggs of the maggots were on every plant in the field. I believe that Mr. Sanderson and his staff were working on the onion maggot in the same way, and he claims that their results were very successful. An account of this appears in the last report they got out. They made this treatment in the pre-oviposition period.

THE ENTOMOLOGICAL SERVICE OF QUEBEC.

Georges Maheux, Provincial Entomologist, Quebec.

From an entomological standpoint, America presents this difference from Europe, that she gives hospitality to a greater number of parasites. Even if they are imported from the old countries, these parasites are working more havoc here than in their place of origin. The New Continent, however, affords the Old World a striking example in regard to the creation and organization of various services susceptible of helping the public and more particularly offering appreciable advantages to the agricultural community.

Whilst over there private initiative is often left to its own resources, on this side of the Atlantic, governments, following a different policy, endeavor to give birth to movements, to guide and support them. Thus, it becomes comparatively easy to avoid dangers and to attain the aim in a quicker and safer way.

And we could not find a more convincing illustration of this statement than the creation of the numerous entomological "bureaus" already in operation in North America.

History. It was in the year 1913 that the Government of the Province of Quebec entered this path. Consequently, the history of her entomological service is rather short. In fact, it is hardly four years since our regulation *for the protection of plants* was voted and assented by the Legislature. Nevertheless, the appointment of a Provincial Entomologist dates back from the year before, and it is a disciple of the pioneer of entomology in our Province who became the titular of this post.

It is, indeed, Provancher, this great apostle of science, who stirred up and developed in my predecessor the love for natural history and who lead his first steps. L'Abbé Huard was admirably well prepared to fill the important function to which he had just been appointed. A perspicacious observer, advised naturalist, indefatigable collector for more than thirty years, author of a treatise of Zoology, director since twenty years of *Le Naturaliste Canadien*, curator of the Provincial Museum, he had been good enough to place at the disposal of his country, his extensive knowledge, his wide experience and to devote the last years of his active life to the agricultural class. He organized the Bureau of Entomology, wrote out the law *For the Protection of Plants*. In June, 1916, he published quite a considerable bulletin on "Les Principales Espèces d'Insectes Nuisibles et de Maladies Végétales." But his health, shaken by incessant labour, not allowing him outside excursions, was betraying his energy, and he had to withdraw to a less disturbed life in the month of July of the same year.

The writer of these lines was called upon to succeed him. This was rather a heavy burden for young shoulders to support, but youth has great boldness, and this proverb is often true that says "Audaces fortuna juvat." Confident in the truthfulness of this Latin proverb we have assumed the task and have set to work. Our programme may be summed up as follows:—

INSPECTIONS. The vegetation season requires our presence nearly everywhere in the Province. According to the law, the entomologist must, in the first place, make the official inspection of commercial nurseries between June 15th and September 15th. There are presently about ten large nurseries and some thirty of small or medium area, most of them connected with the Fruit Stations of the Department of Agriculture. These visits require a good part of the summer. Meanwhile, we have to answer to the alarm calls uttered here and there by unfortunate proprietors fighting against an invasion of insects; in most cases we have to take a trip to the battlefield with a view to bringing into action the army of remedies. Occasionally, these trips will afford the chance to make experiments on the control of various insects. Moreover, instructors, disseminated all over the Province are charged with visiting orchards and gardens and have to report—on special forms—on insects which are found by them. This enables us to judge with perfect knowledge as to the territory which requires our efforts.

PROPAGANDA. In a country still young, particularly in the implanting of new ideas, the key to success lies in the education of the people. Our desire is to acquaint all growers with the enemies of their plants, we are desirous to familiarize them with the best preventives and remedies; finally, we are anxious to convince them of the imperative necessity of following our advices without any delay.

This is a work of propaganda, work that is often lengthy and the success of which is depending, in short, on the sole virtue of perseverance. Once this result will have been obtained, we believe that the struggle against injurious insects will be on the eve of being general. With a view to reaching this end, we endeavour to collaborate to all publications which are circulated amongst the agricultural mass. We also take advantage of bulletins, circulars and lectures. Even fairs or exhibitions have been given a test as a means of teaching the public, and I think I am right in saying that this initiative has met with fruitful results.

COLLECTIONS. In concurrence with our inspection trips, we gather the elements of an economical collection that will remain the property of the Department of Agriculture. In this work, I am pleased to say, several collaborators give us their valuable help. I will particularly mention the instructors of the Horticultural Service and the officers of the Forestry Branch to whom the entomologist is indebted for many specimens. In connection with this collection work, we will mention the fact that we aim to the instruction of the young people of rural schools and that we encourage the formation of small collections for school museums. The child's curiosity is very much aroused by this interesting work; when he has grown a man, with greater knowledge, he will be better equipped to enter the struggle. Besides, we will have printed, very shortly, for primary schools, a series of wall maps or posters showing injurious insects and the means at our disposal to combat them; in this manner, we expect to be able to vulgarize rapidly amongst school pupils the elementary knowledge of plant protection.

Our collection comprises the six following items:—

1. Insects injurious to vegetables.
2. " " fruit trees and shrubs.
3. " " cereals.
4. " " forest and ornamental trees.
5. " " animals, men, houses.
6. " " miscellaneous.

GENERAL WORK. The office work necessitates quite a voluminous correspondence if one thinks that the service is a new departure and the question a recent one, at least officially, in this country. Every day provides its share of inquiries of all kinds, chiefly looking for information as to the remedies to be applied in the case of some injurious insects. We see to it that the laws regulating our service are carefully observed and lose no opportunity of trying to complete this regulation. We will submit, within a short time, to the approval of the Hon. Minister of Agriculture, a project of by-law intended to regulate the sale of fruit trees and shrubs.

Here, I take the liberty to make a suggestion. I am of the opinion that our work will never bear good results and many efforts will be lost if we do not have, in the near future, a general by-law obliging every grower to spray his cultures. This is practised in several countries, with success and the same regulation could be enforced in Canada. In the fight against some species which are largely spread, we enroll school boys and girls; the results obtained have proved excellent and will be more so in future. Our Department relies on the Federal Branch for the making of experiments and researches; however, it does not fail to do its share and efficiently co-operates with Ottawa. Finally, we are working in close harmony with the Chief of the Horticultural Service, who does his utmost to procure to the Horticultural Societies or to their members, the best kinds of sprayers at fair conditions. The same method applies to insecticides.

To conclude, I will say that we are now organizing in Quebec, an Entomological Society which will soon be in operation. When this is an accomplished fact, we will come and ask our affiliation to your society. I am sure in advance that our request will be favorably received. The mother society which is yours, could not refuse to adopt a new daughter without losing her distinctive character.

But this shall not be and we will work in co-operation with you to enlarge and make prosperous the Entomological Society of Canada.

PROF. LOCHHEAD: Mr. President, I should like to say a few words about the good work done by Mr. Maheux. I have been in a position to see some of his work, and also the work of the Department at Quebec. I knew his predecessor, Abbé Huard, very well, and I was delighted when Mr. Maheux was appointed. I should like to say a few words to those from the West regarding entomology in Quebec—what is being done by our friends and by the Department at Quebec. We have, I think, under-estimated the work done in Quebec in the past. I do not know if you are aware that Canon Huard has written a very interesting article for the Quebec Society for the Protection of Plants Report, giving the history of economic entomology in Quebec. He says that there is no province in the Dominion where more entomological work has been done than in this Province. He refers to the various reports that have been published by the Department; to Provancher and his works; to different systematic treatises that have been published since his time; to the various collections of insects, etc., in the Province, of which he mentions that he knows personally of 20 collections in large seminaries; but he left the impression that there are far more than this if we could only find them out, for there are many silent workers in all parts of Quebec who are adding to the store of knowledge, working among plants and insects. Some of these workers have come from France; they have introduced this science into Quebec in the schools, and the work of Mr. Maheux at the present time is not, therefore, what we may call a new work. Probably Ontario got a little ahead in having a Provincial Entomologist, and in some other enterprises, but we must not conclude that because Ontario is ahead along certain lines it is ahead in every line. We have only to go through some of the museums in Montreal—Laval, McGill and some of the other colleges—to see what has been done. As an Ontario-born man I wish to acknowledge the great work Quebec has done in entomology.

PROF. CAESAR: I should like to congratulate Mr. Maheux on the programme of work that he has made out for himself. I consider it a very adequate one, and it contains a number of suggestions that I think other provinces would do well to adopt. I was much interested in what he said about the work in the public schools; I have seen the charts he refers to, and I think they are particularly good, and the coloring is true to nature. They should be a very great source of value, and the children should learn more easily by this method, thus making it easier for the teacher. Some of his remarks, too, I think might be of use in connection with the subject of how entomologists can help in the production and protection of food supplies. I welcome Mr. Maheux as a brother provincial entomologist; I shall be very glad to co-operate with him and expect to receive from him help that will be of much value. I am sure we are all pleased to welcome Mr. Maheux among us as one of our members.

SOME IMPORTANT INSECTS OF THE SEASON.

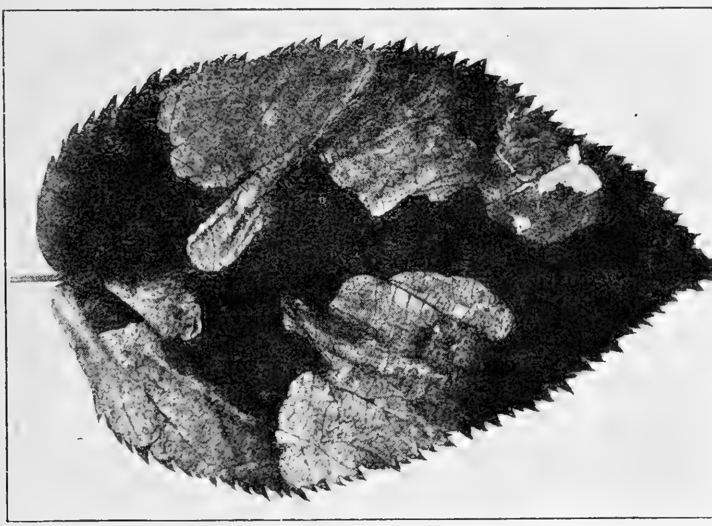
L. CAESAR, O. A. COLLEGE, GUELPH.

THE BLACKBERRY LEAF-MINER (*Metallus bethunei*, MacGillivray).

From time to time the last ten years there have been outbreaks in Southern Ontario of a Blackberry Leaf-miner, which Dr. A. D. MacGillivray says is a new species, *Metallus bethunei*—very closely allied to *Metallus rubi*. So abundant are the insects in these outbreaks and so many mines are made in the leaves that whole fields of blackberries look as if blighted. One of these outbreaks occurred this year at Burlington on Snyder blackberries. When last visited, October 20th, fully 60 per cent. of the total leaf surface was mined and numerous larvæ were still feeding.

LIFE HISTORY. No special attempt has been made to make a close consecutive study of the life-history, but from notes made since 1910 the following facts are gleaned: There are two broods in a year; the adults of the first brood in warm seasons begin to appear about July 1st, but in cooler seasons are evidently considerably later. Eggs are laid in the tissues of the leaf, chiefly beside the main ribs. The female inserts her ovipositor through the upper surface and forces it down to, but not through, the lower epidermis and the egg is placed close to this. Eggs are very pale white or almost colorless, oblong and slightly curved. They swell before hatching and the lower epidermis, thus raised, shows clearly even to the naked eye where they are placed. I counted 61 eggs on one leaf. Mr. Aiton, my assistant, counted 150. The larvæ soon after hatching begin to make irregular shaped mines, and by the time the fruit is ripe (as judged by this year) the larvæ of the first brood are for the most part full grown, and have begun to leave the mines and enter the soil, where they construct a firm little oval earthen case about 5 mm. long by 4 mm. wide. Inside this they pupate. The cases found were from 1 to 2 inches below the surface. The adults of the second brood begin to appear after a couple of weeks and this year were still present in countless numbers by September 21st. Egg-laying was then at its height. A few larvæ of the second brood can be found in leaves as long as these remain green. I found them at St. Catharines one year near the end of November. Most, however, have entered the soil long before this and constructed their earthen cocoons. The winter is passed in these in the larval stage.

Fortunately, this pest does not begin to injure the leaves until two or three weeks before the fruit begins to ripen, and much of the fruit, at least this year, was off before the mines of the second brood were made. Yet in spite of these



Work of Blackberry Leaf Miner.

factors the insect must do considerable damage in the way of weakening the plants and lessening next year's crop. It certainly makes the owner much alarmed lest it will ruin all his plants.

Methods of Control. Cultivation of the soil in late fall and the early part of the next season suggests itself as a practicable method of control, but is ineffective; probably because the cocoons are not easily broken.

It has been suggested by some writers that kerosene emulsion would penetrate the dead portions of the leaf and kill the larvæ, but it does not do so. Black-leaf 40, as shown by Herrick, will kill the larvæ of some Saw-fly Leaf-miners in their mines, but it has no effect upon this species.

Having failed to kill the pupæ or larvæ I next thought it possible to poison the adults. These apparently remain exclusively on the leaves and find their food there. I do not remember seeing one anywhere else, not even on the fruit, neither does Mr. Aiton. Accordingly I made a preliminary test of spraying the leaves with sweetened arsenate of lead and to my delight the adults could almost at once be seen feeding upon it. Encouraged by this, I assigned to Mr. Aiton the task of making definite caged tests with large cheesecloth cages over individual bushes. Cheesecloth was placed also over the ground beneath these cages to make counting dead flies practicable and also prevent new adults coming up out of the soil.

The cages were as follows:—

Cage 1.—Bush sprayed with arsenate of lead in water sweetened with molasses.
Cage 2.—Bush sprayed with arsenate of lead in water without sweetening.
Cage 3.—Bush sprayed with calcium arsenate in water without sweetening.
Cage 4.—Bush unsprayed as check.

In each cage 60 adults were placed.

Results at end of 30 hrs.
Cage 1.—13 dead.
" 2.—12 "
" 3.—25 "
Check 0 "

Results at end of 52 hrs.
Cage 1.—53 dead.
" 2.—51 "
" 3.—60 (all) dead.
Check 8 dead.

Results at end of 72 hrs.
Cage 1.—58 dead.
" 2.—60 (all) dead.
" 3.—60 " "
Check 18 dead.

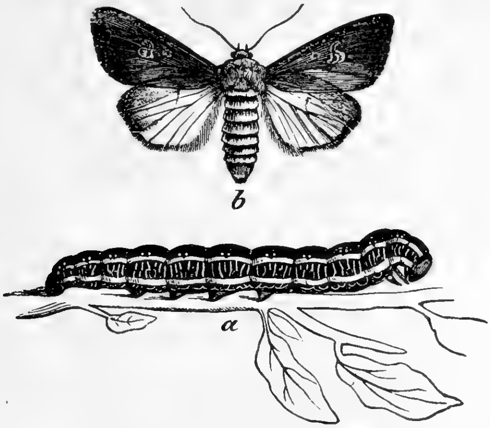
From these tests it seems quite clear that this species of Saw-fly can be poisoned in the adult stage and that molasses is not necessary for the purpose. The question then arises as to when to do the poisoning. It will have to be done before the adults appear in July, and it seems to me the proper time will probably be just before bloom, or just after most of the blossoms are off and the fruit is still so small that there will be no likelihood of the poison being on it when ripe. A second application will possibly be advisable just after picking. Arsenate of lead will probably be the safest poison and if applied heavily without molasses should remain on the foliage for a month or more. Arsenate of lime kills more quickly but would be more likely to injure the foliage, though none of the spraying either in cages or on the part of the row I treated myself, even where molasses was used, caused burning.

I hope to make a careful trial of the poison treatments this coming year and to give a further and more definite report next year.

Zebra Caterpillars (*Ceramica picta*).

In September and October of 1916 there were several turnip fields in Peel County and probably in many other unreported parts of the Province that were severely injured by the Zebra Caterpillar. As it is rare that this insect becomes very numerous I did not expect it to cause much trouble this year, but to my surprise it has been very abundant in many counties west of Toronto and has stripped many a turnip field of all or almost all its foliage. Many fields were thus defoliated by the end of September, thus preventing almost a whole month's growth. Cabbages were also attacked. The larvæ were found feeding on several other plants.

Five kinds of control measures were tested, but only one proved at all satisfactory, namely dusting with Paris green mixed with 20 times or more its bulk of air slaked or hydrated lime. Any other fine, moderately heavy substance such as land plaster should do as well as the lime. I thought that possibly the

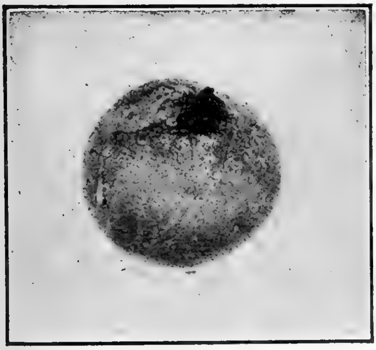


Zebra caterpillar and moth.

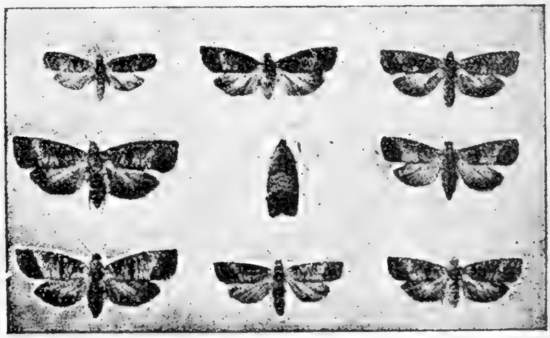
poison bran might work, though the feeding, or rather the resting habit of remaining on the leaf except in wet weather, made it doubtful whether they would ever seek or find the bran. The result showed that while a few did come in contact with it and died, about 90 per cent. did not.

Codling Moth (*Carpocapsa pomonella*).

A remarkable thing about this insect this year was the great number of side injuries it caused all over the Province. This was especially noteworthy in Niagara, because most of the side injuries there are ordinarily caused by the second brood and are made during August and September, but this year about



Dark castings at calyx end, showing where Codling Moth larva usually enters the apple.



Adult Codling Moths, natural size. (After Slingerland.)

90 per cent. of these were to be seen by about the first of August. I have notes on this subject made on August 4th and again on September 15th and October 20th, and the estimate of the percentage of injured fruit on the first date is almost the same as on the last. This shows that it was the first and not the

second brood that was responsible for these side injuries, in fact there was only a very small second brood this year even in Niagara district.

It seems to me we may possibly account for the larger number of side injuries this year in two ways. (1) There were very few apples and hence more larvæ would attack these apples than if there were a larger crop. (2) Many of the moths emerged very late and laid their eggs after the pubescence was off the little fruits, and in the absence of this entered the side of the apples much more readily than if the pubescence had been present. A poison spray three weeks after the blossoms fell gave good results this year in all cases where it was well applied.

THE WHITE-MARKED TUSSOCK MOTH (*Hemerocampa leucostigma*).

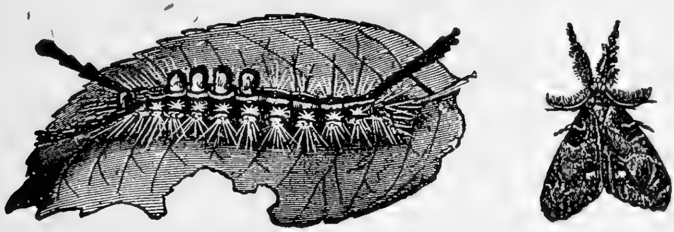
Judging from the number of egg masses to be seen this autumn the Tussock Moth will be very abundant in many of our cities and larger towns next year. Complaints have already come in from as far east as Belleville and as far west as Goderich. In Toronto I counted 500 egg masses on a single maple tree in the Exhibition Grounds.

Not only are the egg masses abundant in cities and towns but also in many orchards. One wide awake young fruit grower said to me a few days ago that in his opinion this would be one of our main orchard pests next year in Western Ontario. In Niagara it is likely to do a good deal of damage and if it is not destroyed will in apple orchards injure a large percentage of fruit.

Work on apples of the larvæ of the White-marked Tussock-moth.

In destroying the insect in orchards and for that matter also on shade trees, a person is very likely to overlook the egg masses concealed in leaves. This spring I asked my men to remove the eggs in one of our experimental orchards, but did not call their attention to the leaves. On visiting the orchard again I saw that these had been overlooked so that the work had to be done again. Mr. W. E. Biggar, the Provincial Fruit Pests Inspector, has used a small wire brush about six inches long and one inch wide and fastened to the end of a pole. A single stroke of this tears the egg masses to pieces. This brush has been used in St. Catharines and some other places and given satisfaction. In my opinion it is very good for the lower part of trees to the height of say 15 or possibly 20 feet, but above that I think a hook, especially if toothed along the sides and ends, will prove better. A test of crude creosote was used, but it seems to me this will prove very unsatisfactory. I cannot help believing that it does not penetrate through in many cases and so does not kill all the eggs, at any rate it did not seem to me to have done so even when eggs were examined several days after treatment.

The removal of egg masses when numerous on tall trees is a very great task. I observed that many of them, in fact a very considerable percentage, were situated near the top of the trees in the crotches of branches, often not more than one inch in diameter. Fortunately, egg masses seem on lateral branches to be situated either in the crotch or on the underside, not on the upper side and so can readily be seen. Some, of course, are in leaves attached to twigs or branches. It is very doubtful whether in badly infested city parks spraying would



Larva and adult male of White-marked Tussock-Moth.

not be much cheaper than removing and gathering egg masses. I have written to two firms to see whether we cannot secure at a reasonable price good outfits that will throw a satisfactory spray from the ground to the top of the tallest trees. I do not mean the costly type of outfit used in the Gipsy Moth work. Both companies claim that they can furnish machines that they believe will prove satisfactory.

I should like information from anyone present as to what percentage of eggs would hatch from egg masses removed in late autumn or winter but left lying on the ground, also as to their experience with crude creosote on egg masses.

Slugs.

I have never seen so much damage from Slugs as this year. Beans were their favorite food, and these in many fields were fed upon ravenously and in some cases almost defoliated. Paris green as tested by myself and also by Mr. Baker failed to control them. Lime was not available in the district where I was, but hydrated lime as applied late in autumn killed them if used freely. I am not sure whether it would prove satisfactory on a large scale in spring or early summer when they are most destructive. Lime-sulphur will kill but not at the strength the plants are likely to stand without injury.

The Seed Corn Maggot (*Pegomyia fusciceps*).

This insect caused much injury to beans in many districts.

The Wheat Midge (*Contarinia tritici*).

Wheat in Wentworth, Lincoln, Welland and Haldimand suffered considerable loss from the Midge. In some districts about 10 per cent. of the kernels were affected. Only eight adults emerged this year under normal conditions in our cages, but we had no evidence that any eggs were laid. The remaining insects either entered the soil to pupate or remained in the wheat heads. Apparently fully 50 per cent. doing the latter.

EIGHT-SPOTTED FORESTER (*Alypia octomaculata*).

Near Toronto the larvæ of this moth were very numerous on grape foliage.

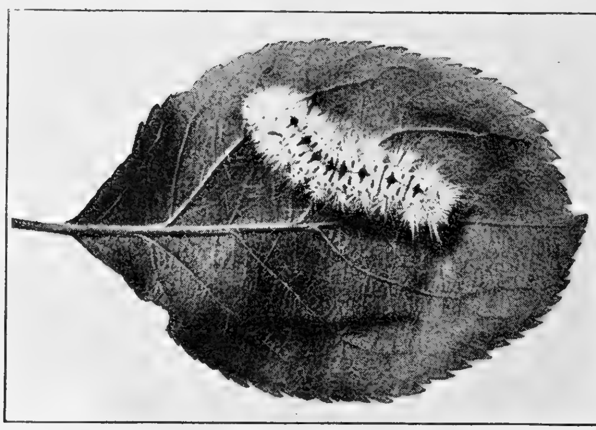
Halisidota tesselaris was unusually abundant this autumn and fed on numerous plants.

Halisidota caryæ attacked in considerable numbers apple leaves in the counties of Elgin, Oxford and Middlesex.

Halisidota harrisii destroyed much of the foliage on sycamore trees in parts of the Niagara district.

Diacrisia virginica was a great pest in gardens in many parts of the Province and attacked numerous flowering and other plants.

Datana integerrima defoliated walnuts in Essex and Kent.



The larva of the Hickory Tussock-Moth (*Halisidota caryæ*).

PROF. LOCHHEAD: Is this Blackberry Leaf-Miner a distinct species from the *rubi?*

PROF. CAESAR: By looking at the two species *rubi* and *bethunei* you would say that they were exactly the same, but Dr. MacGillivray has found a few differences. Both species are black, about 1/4 inch long, and the body is quite black and the legs white, so that it is easy to recognize it as one of the two species. A full description is given in MacGillivray's Tenthredinoidea.

MR. GIBSON: Did you find both species during the work?

PROF. CAESAR: No. Only the one species.

MR. GIBSON: Did you find this pest all through the Niagara district?

PROF. CAESAR: Yes. There is a species this side of Toronto which has also been found almost as far as Port Hope. I do not know whether it is the same.

MR. SWAINE: What was the strength of the spray used?

PROF. CAESAR: The same strength as for orchard sprays, 2½ lbs. to 40 gallons of water.

MR. SWAINE: We have tried kerosene emulsion sprays, just ordinary summer strength, on the leaf surface. I have killed them in strings with kerosene emulsion and also with Black Leaf 40, strong.

PROF. CAESAR: In the case of Black Leaf 40 I tried it decidedly strong, and what is more, I put the insects all together in a tight-fitting box so that the fumes could not evaporate easily, and brought them home packed very closely. The fumes had no effect at the end of two or three hours, and they were strong enough to have acted in a few minutes.

DR. O'KANE: We did some work this summer along the same lines of contact sprays for leaf-miners, chiefly the Apple Leaf-miner. This work was done on quite a large scale, an assistant starting in spring and remaining all summer on the work of penetration of contact insecticides. We worked the previous winter in the laboratory, shaping our results as far as possible. Of course apple is not the same as blackberry, but I may tell you our results. We used a great many different kinds of material including Black Leaf 40, up to 1-50; kerosene emulsion up to 25 per cent.; Black Leaf 40 with soap; lime sulphur at various strengths up to that which burned the tissue. We also used chemical reagents. We tried these through two generations of the Leaf-miner, the first spray when the Miner just hatched, the second when it was ¼ in. long, and the third when it was full grown. We made no penetration whatever into the mines with any substance, except through advantageous openings. If the Miner happened to be next to the mine where there was a good puncture, it got killed; if it was in the middle of the mine it did not get killed. If it was at the far end of the mine it would not be harmed in the least unless the application was sufficiently strong absolutely to destroy the leaf itself, when, of course, the miner was killed too. Pupation would go ahead as usual. As I say, if there happened to be an opening or puncture the material would penetrate, but if there was no such puncture the Miner had a perfectly satisfactory and efficient shelter. I am not certain with regard to elm leaves, but this prevails in the case of apple leaves.

PROF. CAESAR: May I ask a question and suggest an answer? I want a whole lot of information on how to control slugs.

THE PRESIDENT: This has been a most serious problem with nearly everyone on account of the wet season.

MR. GIBSON: At Ottawa this year we have been using air slaked lime.

PROF. CAESAR: Have you tried hydrated lime?

MR. GIBSON: No; only ordinary lime.

PROF. CAESAR: I found last week or the week before when making some further experiments with hydrated lime that at this time of the year it will kill slugs, but whether it would kill them earlier in the season I do not know. I do not know whether it would have any injurious effect on the foliage, say of beans. Lime sulphur if applied very strong will kill slugs, but it has to be too strong and will injure foliage. Hydrated lime when it comes in contact with a liquid forms a pasty substance. I should like to know if anyone else can suggest any other remedy.

DR. CORCORAN: Last season in the garden everything was eaten up by slugs around Notre Dame de Grace. Almost all the lettuce and cucumber patches were spoilt, and even pumpkins were eaten. We would find a pumpkin with a good-sized hole eaten in it by slugs. We tried hand-picking, but that was the only remedy we tried. How is the lime applied?

PROF. CAESAR: You can apply the lime in the evening when the slugs are at work. They work on top of the leaves and by dusting you can get the lime in contact with them. I think this is better than applying it in liquid form, and would have a more lasting effect.

Mr. Baker: When was it applied?

Prof. Caesar: We got the best results by applying it in the evening just before the slugs come out to feed.

Mr. Gibson: We tried this remedy in connection with beans. I would recommend dusting freshly slaked lime every evening before the slugs come out, and when they eat the lime it kills them. If I remember correctly, we had very little trouble afterwards.

Prof. Caesar: The slugs do not seem to be killed with Paris green. Mr. Baker tried, and it killed so slowly that it was not looked upon as a satisfactory method.

Prof. Brittain: Slugs did not appear with us this year to any extent. We were going to make some extensive experiments this year, but there were no slugs.

Prof. Lochhead: Has anyone ever tried poison bait with any success?

Prof. Caesar: No success.

Prof. Lochhead: The old English remedy of course is slaked lime. Whether it is effective all the time or not I do not know.

Prof. Caesar: Tobacco extract does not have much effect upon slugs, but millipedes are usually poisoned by it.

THE APPLE AND THORN SKELETONIZER (*HEMEROPHILA PARIANA* CLERCK).

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

A small European moth which we have termed the apple and thorn skeletonizer has become well established in Westchester and Rockland counties, the centre of the infestation being near Irvington and Nyack, respectively. This insect is classed as one of minor importance in Europe though this is not necessarily to be the case in America. Some of our most destructive insects are of relatively slight importance in their native country. Owing to the fact that the caterpillars feed upon the upper surface of the leaves, it is easy to apply a poison where it will do the most good. It should not be difficult to keep this pest in control until its status can be determined or natural enemies have an opportunity to assert themselves and prevent widespread and material damage. This insect is already sufficiently numerous near the centre of the infested area to defoliate entire orchards and conditions favor a continuation of the spread with its accompanying serious injury unless there is early, thorough and general spraying in the infested area next summer.

Recognition Characteristics. The work of this newly established pest is fairly characteristic. It skeletonizes the leaves in much the same way as the well-known canker-worms, except that these latter more usually devour all the vital tissues of nearly every leaf, whereas this newly introduced caterpillar generally confines its attack to portions of many leaves, feeding near the centre under a slight web and extending upward and outward to include most of the tip of the leaf and frequently turning and webbing down margins of leaves about half an inch wide. Areas on each side of the basal part of the leaf are often untouched. There is no webbing together and inclosing leaves in masses so characteristic of the native fall web-worm and also seen to a less extent with the brown-tail moth caterpillar. The cause of this mischief is an active, yellowish, black-spotted caterpillar about half an inch long.

Description. The moth is an obscure grayish brown or dark brown, sometimes purplish tinged, insect with a wing spread of a little less than half an inch. There is in well marked specimens near the base of the fore wing a rather broad, broken, angulate dark band near the basal third and a less distinct and more regular but somewhat broken dark band near the distal fifth, an area between this and the basal third being a variable grayish. The fringes of both the fore and hind wings are a rich purplish brown.

Pupa. Length about 1/4 inch, moderately stout and dark bronzy yellow, variably marked with fuscous, especially on the posterior abdominal segments. The head is dark brown with a few fine, moderately long hairs. Antennal cases slender, the variably yellow-mottled wing cases extending to the sixth abdominal segment, the leg cases reaching just a little beyond. The mouth-parts and most of the median ventral area between the antennal cases yellowish. The dorsum of the thorax dark bronzy yellow. Scutellum fuscous yellowish and with a very fine short pubescence. Dorsum of the abdominal segments moderately smooth, shiny, the segments when flexed ventrally showing along the anterior margin series of minute closely set teeth. Terminal segment yellowish.

Cocoon. The cocoon is spun upon the upper surface of the leaf and consists of an elongate oval mass of thick white webbing about 5/8 of an inch long and 1/4 of an inch wide. It is frequently near the midrib and covers the true cocoon which is faintly seen beneath. The pupa wriggles out partly from under the webbing before the moth escapes, the pupal shell projecting as in the Sesiids.

Larva. The caterpillars are quite variable in appearance. The smallest observed on the leaves were about 1/8 in. long, mostly pale greenish yellow. The head is a distinct amber shade with a rather conspicuous dark brown mass of closely placed ocelli. There is a narrow irregular dark brown line at the lateral dorsal angles of the head case, a small black fuscous spot ventrally and a pair of small subtriangular black spots sublaterally. Antennæ moderately prominent, mostly yellowish brown, slightly fuscous apically. Thoracic and abdominal segments mostly a uniform yellowish, the true legs pale yellowish and having the second segment fuscous and the distal segment much more slender, tapering and with a distinct claw apically. There are well-developed cylindrical abdominal prolegs on the third, fourth, fifth, sixth and terminal abdominal segments, each leg when extended with a length approximately three times its diameter. The tubercles are a pale fuscous or fuscous, depending on the age of the caterpillar, each bearing one or two moderately long hairs.

Older larvæ with a length of about 3/16 of an inch are decidedly darker though the general color is practically the same. The tubercles are much larger and in some specimens almost confluent so as to give the appearance of submedian black lines, though in reality they are simply series of closely set tubercles. The thoracic legs have a shade of fuscous on the apical portion of the basal segment, the second segment is black and the third practically as in the earlier stage.

Full-grown caterpillars have a length of nearly half an inch and present practically the same characteristics as given above, there being some darker specimens with rather larger black tubercles and lighter ones with somewhat smaller tubercles.

Distribution. This insect is probably widely distributed, since it has been recorded from England, France, Germany, the Balkan Peninsula, Bithynia and west in Asia to Turkestan. This range suggests that the species can maintain itself in the northern United States and southern Canada.

It has become established in New York State in an area determined in co-operation with Dr. G. G. Atwood of the State Department of Agriculture as centering approximately upon Irvington and extending east to White Plains, south to Harrison and north to Croton. It also occurs on the west bank of the Hudson River, ranging for a mile or two north and south of Nyack and west to West Nyack.

LIFE HISTORY. It has not been possible to work out the complete life history of this insect under American conditions though there is no reason for thinking that the moth has departed materially from its habits as recorded in Europe. Mr. J. W. Tutt states that adults occur in September and October on flowers of Compositæ, while William West records capturing specimens among golden-rod.

The adults and probably pupæ hibernate, the former in any shelter such as thatch and the latter in cocoons attached to the leaves. The over-wintered moths or those issuing from pupæ deposit eggs probably when the leaves are partly developed, since Meyrick records larvæ as occurring in England during May, June and August, indicating at least two and probably three generations annually. There is considerable variation in development toward the end of the season, at least under American conditions. Full-grown and very small larvæ were found simultaneously at Irvington in September and even in early October. A few larvæ may feed to the latter part of the month. Larval growth is probably completed within a month or six weeks. The type of injury suggests that the moths deposit a few eggs near the base of each leaf and when numerous may oviposit on almost every leaf. One of the striking features of an infestation is the general distribution of injury throughout the tree.

The feeding on each leaf is, practically speaking, independent of that upon other leaves. There is no inclosing and webbing together as with the fall webworm. The caterpillars feed upon the upper surface, skeletonizing the leaves more or less completely and working from the lower part of the midrib upward and outward so that unless the infestation is unusually severe areas on each side of the basal parts of the leaves frequently remain untouched. This type of injury is characteristic of moderately infested orchards. Those badly infested may have practically every leaf on all the trees completely skeletonized.

FOOD PLANTS. This insect has shown a marked preference for apple though it has also been recorded as feeding upon pear, hawthorn, mountain ash, birch and possibly willow.

NATURAL ENEMIES. Meyrick's statement to the effect that this skeletonizer is local in England indicates moderately efficient enemies and this is borne out by its classification as a pest of minor importance by continental writers and the recording by Reh of a number of parasites. It is presumable that some of its native enemies became established with their host and if this is not the case, the chances favor some of our native parasites becoming accustomed to this new food supply and assisting materially in reducing its abundance. A few parasites (*Diocles obliteratus* Cresson) kindly determined through the courtesy of Dr. Howard, have already been reared from materials received from Westchester County.

CONTROL MEASURES. There is no question but that thorough and timely spraying with a poison such as arsenate of lead will destroy these caterpillars and, owing to their feeding almost entirely upon the supper surface of the leaves, a general application of these measures in infested areas to all trees upon which the pest can subsist would mean its early control and practical elimination so far as material damage is concerned. Residents of the infested section are most strongly advised to watch for the development of the insect next season and to spray all trees showing signs of its work, since it is very important to control it so far as possible, because experience has demonstrated that it is easier to handle an outbreak in its incipiency than to begin after serious losses have occurred.

SOME NOTODONTIAN LARVÆ.

REV. DR. J. A. CORCORAN, LOYOLA COLLEGE, MONTREAL.

The sudden appearance of temporary structures and protective colours and markings of caterpillars are usually attributed to the action of stimuli from without. Whether this deduction will remain unshaken by the facts that the observers of the future may bring to light, or will be discarded, does not concern us. It is sufficient that this theory gives the entomologists of the present day a spur to observe more closely the changes which various larvæ undergo before reaching the stage of pupation, and makes of their observations the solution of a definite problem instead of the compilation of a catalogue of uncorrelated changes. For the external stimuli which have acted in the past must be more or less active to-day, otherwise the structures they have produced will become useless and vestigial, since God in His goodness does not allow a creature to retain a structure, that is a functioning structure, which has become really hurtful to its possessor.

In an endeavour to find a cause for the abrupt appearance of certain colours and temporary armament in the Notodontian larvæ, I had under close observation last summer some colonies of *Schizura concinna* and *Heterocampa guttivitta*. My observations of the habits of these larvæ were too restricted, and my microscopic examination of the sections of the parts before and after the changes were too superficial, to be of value in arriving at a definite conclusion, but I give them in the hope that some of our members may find them of interest and later when the win-the-war problems no longer call for the entomologist's undivided attention, they may record their own studies on the larvæ of these same species.

When first seen the larvæ of *S. concinna* were about 3 mm. in length and arranged themselves in serried ranks on the under surface of the leaves of an apple tree. I divided the colony into two, leaving twenty larvæ undisturbed and placing the rest on a nearby branch of the same tree, so that I might have material for dissection while not depopulating my observation colony. The moth had deposited her eggs on the end leaves of a branch most conveniently placed where they could be seen at all hours of the day.

During the first stage the larvæ fed on the epidermis and tissue of the under side without puncturing the leaf, and hence could not be seen from above. Their yellowish heads which were smooth and unarmed, and their yellowish-green bodies, tinted reddish along the sides, harmonized so well with the surface on which they fed that it was difficult to distinguish them. Neither insects nor birds seemed to spy them, although a dozen two-winged flies passed within a few feet of them, and an aphis lion was seen running about on the lower part of same branch on which the colony fed. The third day after discovery all the members of both colonies moulted and passed to the second stage.

The head was now reddish-black and bore two blunt knobs on top. A section of a larva made the day before the moult shows no evident thickening of the epidermis and underlying tissue. As the insects grew, red lines along the sides of the thorax, a pair of yellow spots and five tubercles of the same colour near the anal end of the uplifted abdomen could be made out. By the time the larvæ were 8 mm. long they were eating both surfaces of the leaves and when feeding arranged themselves along the cut edges. Hairy warts on the head, and dorsal and lateral spines on the body gave the insects, which could now be seen from above, a rather unattractive look. When not feeding the larvæ placed themselves in rows on the stem and bared veins of the leaf.

The numerous two-winged flies which were seen on the leaves of neighbouring apple trees, did not seem to notice the colonies. One larva dissappeared at this stage—perhaps, to the nest of one of the wasps which were decorating the cornice of a near-by room.

After the second moult the head became black again and remained so until the final moult. The various tubercles and spines were more marked and the insects, which were at this time denuding the branch, eating even the veins and midrib of the leaves, could now be seen at a distance of six feet. Numerous insect-eating birds hopped about on the near-by trees and some stopped to examine the colonies. A young song-sparrow disposed of one larva, but the other six which disappeared during the third and fourth stages succumbed to the heavy rains which were of frequent occurrence last August.

At the final moult the larvæ developed the coral-red head and large abdominal hump of the same colour which gives them the common name of the Red-Humped Apple Worm. During the last days of the fourth stage I took a number of larvæ from the control colony that I might make sections of them and follow the changes which immediately precede the final moult, but my time has been so taken up that I have not yet examined them.

During the last stage the larvæ increased in size from 20 mm. at the time of the fourth moult to 30 mm., which they attained before descending the tree to pupate. Although they were conspicuous objects which could easily be made out at some distance, the birds did not molest them.

My colony of Heterocampa larvæ were hatched from a few eggs that were laid by a female caught at night. By means of a smear of gum I attached the eggs to the under surface of a red maple leaf. On the eighth day the larvæ emerged and began feeding on the superficial tissues of the leaf. They were then about 5 mm. long and under a glass showed nine pairs of comparatively enormous horns. The first pair on the prothoracic segment were four-tined like the antlers of a deer, the remaining eight pairs were single-pronged. Section of the insect shows the horns to be pure dermal structures devoid of muscle. On the fourth day the larvæ moulted and lost all trace of the horns except a pair of short stumps on the prothoracic segment.

During the first stage no enemies seem to have discovered these larvæ, but on the third day of the second stage while I was absent in the country they all disappeared. Some predaceous insect probably got them, for they were well hidden from the birds.

The individual larvæ of these species experience no change of surroundings which might call for an abrupt change in colour or armament. They pass their whole larval existence on the tree upon which the parent moth deposits the eggs, indeed, they do not leave the branch, unless compelled by lack of food, until they all, in regimental order, descend the tree to pass the winter as pupæ beneath the dry leaves or in the ground. Nor do the horns of *H. guttivitta* and the hump of *S. concinna* show signs of becoming vestigial, for both are well nourished and the latter bears moveable spines.

Predaceous insects are the usual enemies of small caterpillars, and birds of full grown larvæ. To escape the former the horns of Heterocampa are well adapted, but why should they suddenly disappear at the first moult? The marked increase in size of *S. concinna* during the last larval stage may call for more conspicuous warning colour that the passing bird may more easily see that the insect is not good food. Whatever be the reasons, the entomologist who observes the development of Notodontian larvæ must be impressed by the protection God gives these strange creatures against the enemies who prey upon them.

EVENING SESSION.

The evening meeting was opened at 8 o'clock with an address of welcome by Dr. Harrison, Principal of Macdonald College.

Owing to the fact that he would be unable to remain for the whole of the evening session Dr. Hewitt took this opportunity of introducing the symposium in "Canadian Entomologists and the War," the discussion of which was to take place at the smoker later in the evening.

The public lecture on "The Problem of Mosquito Control" was then delivered by Dr. T. J. Headlee, State Entomologist, New Brunswick, N.J.

THE PROBLEM OF MOSQUITO CONTROL.

Thomas J. Headlee, Ph.D., Entomologist of the New Jersey Agricultural Experiment Stations and State Entomologist.

Introduction.

While interest in anti-mosquito work is now found in nearly all parts of the world, it is engaged in most cases with very limited areas of country. No doubt this is due to the fact that the source of interest is usually the hope of eliminating insect-borne diseases from limited areas.

Anti-mosquito work in New Jersey does not have its roots in the desire to destroy diseases. Malaria, which with us is the only mosquito-borne disease, occurs in only a few very limited areas and forms in each case a strictly local problem. Interest in mosquito control in New Jersey arises from the desire to make the state entirely comfortable and desirable for its citizens.

The north-eastern end of the state is rapidly being transformed from low-priced farm land into urban property and the mosquito pest, such as would come from the unprotected salt marsh, would seriously interfere with and delay that process. In the counties of Hudson, Bergen, Essex, Union and Middlesex, each of which have some thousands of acres of salt marsh within its borders, in the ten year period from 1900 to 1910, 60,000 acres of farm land were transformed into urban property, and the growth during the last seven years has not been less rapid. Within range of these salt marshes lies the County of Passaic, which is really a member of this group, but which has no salt marsh.

County map of New Jersey, showing locations of salt marshes, area of upland formerly covered by flights of salt marsh mosquitoes, portion of the salt marsh which has been more or less completely drained, and area of upland at present covered during the mosquito season with salt marsh broods.

About one and one-half millions of people live within the borders of these six counties.

That part of the southern end of New Jersey included in the counties of Ocean, Burlington, Atlantic, Cape May, and Cumberland have more than 100 miles of fine sand beach nearly all of which might be developed into delightful seaside communities, and 1,700,000 acres of farmland of which about one million are totally undeveloped.

A large part of this territory is covered at times during the summer with dense broods of salt marsh mosquitoes.

Seaside communities build slowly and undeveloped lands are tardily improved under such conditions.

There are about 296,000 acres of salt marsh in the State of New Jersey, of which probably 200,000 are potentially good salt hay land. The drainage necessary to control the salt marsh mosquito seems after its effect is felt to increase the hay yield from about .7 of a ton to 2.6 tons per acre.

While New Jersey was one of the first states to become interested in the problem of mosquito control from the standpoint of human comfort and prosperity, she is certain not to be the last, because there are about 6,400,000 acres of tidal marsh in the United States alone, and the mosquito-borne disease of malaria is now recognized as the great, but by no means immovable, bar to the development of immense areas in our Southern states.

In view of the apparent certainty of a rapidly increasing interest in the elimination of all species of mosquitoes as a means of contributing to human comfort and prosperity, the present paper is an outline of procedure that may be followed in attacking the problem in any specified locality.

To the man not familiar with the nature of insects, anti-mosquito work means mosquito extermination. This misconception leads the professional worker into much trouble because the people whom he is trying to serve demand year by year greater and greater freedom and cannot understand why at times they are troubled.

At the present stage of anti-mosquito work only the problem of control can be considered and that of extermination must be relegated entirely to the future. The object of mosquito control is to reduce the fauna to a point where diseases carried by it do not occur and the householder is unaware of its existence.

The problem of bringing the mosquitoes of any badly infested locality under control involves: (1) A careful and thorough analysis of the mosquito fauna both in larval and adult form for at least one entire season; two or three would be more conclusive; (2) a careful study of the reasonably permanent breeding places from which the adults come, followed by the preparation of a detailed plan showing the methods and the cost of eliminating them; (3) the obtaining of funds with which to do the work; (4) the execution of the plans and the completion of the initial work; (5) maintenance, temporary elimination, and improvement; (6) giving the work a permanent character; (7) evaluation of the results of mosquito control.

Analysis of the Mosquito Fauna.

In planning for future anti-mosquito work the mosquito survey usually means an examination of the territory for places which past experience has indicated as likely to breed and for such places as show breeding at the time of inspection. Unfortunately for this simple procedure, experience has shown that the area may be far more severely infested by mosquitoes which breed outside its limits than by the species that are produced locally. This is well illustrated in New Jersey by all communities within reach of flights from the salt marshes (see map). Before the flight of certain salt marsh species was recognized many local efforts were discredited by the influx of these far-flying species. It is, therefore, necessary to find some way of determining not only the species that are bred within the protected area, but also the species which breeding entirely outside may invade and annul the effect of local work.

Without doubt the most accurate way of determining these points is that type of a seasonal study of mosquitoes on the wing which will enable the operator to map the mosquito fauna at short intervals throughout one or more summer seasons. It is true that a person having long and wide experience with mosquito control can make a rather accurate guess at the nature of the mosquito trouble in a specified area by a study of possible mosquito breeding places within and without of the said area. His forecast is, however, merely a shrewd guess and may go very wide of the mark.

In the collection of data necessary to the preparation of the mosquito distribution maps a limited number of stations must be selected in such a fashion that some definite idea of the conditions throughout the infested area may be obtained. In order that the collection results may be comparable the places selected must be essentially similar, especially as regards cover and light or the difference between them must be evaluated, which is always a difficult matter. The portion of the body from which the collections are made must be the same, and the collector whose body does not attract mosquitoes must be eliminated. Collections must be made at a time of the day when as nearly all species are active as possible. It may be necessary to determine this time by running a set of trial collections covering all hours of the day and night. For the purpose of comparing one collection with another the temperature, moisture and wind conditions during the period when each area-wide collection is made must be recorded and eventually more or less accurately evaluated.

The mosquitoes must be caught and killed without crushing or rubbing them in order that accurate identification of them may be made. The results of each general collection, stated as so many mosquitoes of each species per selected unit of time should be set down on a topographic map of the area and the nature of the weather conditions noted on the same sheet.

If properly prepared this map will afford a picture of mosquito conditions at the time when the collection was made and if properly interpreted will show whether the collection methods should be modified and will indicate what changes should be made.

If the number of specimens of each species caught appears to be perfectly irregular in distribution the results may be attributed to emergence from local breeding. If on the other hand, there is evident an area in which certain species appear in greatly increased numbers which grow larger from some point in the area to its boundaries, it is safe to assume that an invasion of mosquitoes breeding outside the protected area is occurring. If there should appear specimens of a species, the known habits of which would seem to preclude breeding within the area, invasion of that species would be clearly indicated.

Whenever the charts show the presence of invasions, they must be traced at once to the source from which they come. The method employed in these tracings will depend upon the species concerned. When dealing with the salt marsh or the fresh water swamp mosquito, the work may be done during daylight by means of an automobile, but when dealing with the house mosquito, the collections must be made during a period beginning about dusk and ending less than one hour later. In dealing with other less well known species, it may be necessary to determine the time of day when the study can be successfully made. In any case the kind of weather, the time of day and the type of cover under which the species being studied may be caught must be determined.

Tracing invasions of salt marsh species are done very quickly with an automobile by starting in uninfested territory close to the infested area and collecting at regular distances—say, 0.5 of a mile to 2 miles—until the mosquito zone has been traversed and uninfested country found on the other side; this collection to be followed by a similar one pursued in a line at right angles to the first.

Two assumptions are, of course, necessary to the success of this plan, one of which is that the mosquitoes may be collected in daylight and the other that the direction of greatest density indicates the source of the brood. The collections are made in as nearly similar places as possible, especially as regards the character of the growth, and the relative number present is determined by using two small cyanide tubes and catching specimens as rapidly as possible for a definite period of time, then reckoning the catch on the basis of so many per minute.

In actual practice whenever the study began on the first appearance of the brood, these assumptions were found to be correct and many broods have in this manner been traced to their places of origin. At least three important results followed the discovery and use of this method, the first was the finding of immense breeding areas in the Hackensack Valley salt marsh in sections hitherto thought to be free of breeding, the second was the uncovering of inefficiency in the control of salt-marsh breeding on certain especially dangerous areas, and the third a determined and apparently successful effort to eliminate the breeding places thus discovered.

The methods found to be successful for the fresh water swamp mosquito migrations are essentially the same.

It became necessary to find the source of a brood of the house mosquito (*C. pipiens*) which in spite of effort to control local breeding continued to infest North Elizabeth and Union County. It was quickly found that no progress could be made by day collections and that a difference in the hour when the collections were made gave such a difference in the number caught that determination of density by serial collections covering several hours was impracticable. Accordingly, a sufficiently large number of inspectors were furnished by Union and Essex Counties to cover a line extending through North Elizabeth to and through South Newark to the sewage-charged salt marshes, each man collecting for fifteen minutes at three stations, one-quarter of a mile apart from each other, between 8.00 p.m. and 9 p.m. The following evening in the same manner a line from the marshes running at right angles to the first was collected. In this instance the weather of the two evenings was sufficiently similar to render the results comparable, but generally it would be better to have enough inspectors to collect both lines at the same time.

A careful study of the collections showed a zone of house mosquitoes extending from North Elizabeth to the Ebling section of the Essex County salt marsh, a distance of at least 2.5 miles, with practically steadily increasing density as the marsh edge was approached.

Examinations of the marsh, which was heavily charged with sewage, showed enormous numbers of *C. salinarius* and *C. pipiens* with small numbers of *A. sollicitans* and *A. cantator* in larval and pupal stages. The question has been raised as whether supposed house mosquitoes were not really *salinarius.* Undoubtedly both *C. pipiens* and *C. salinarius* were component portions of the zone, but the smaller portion seemed to consist of the smaller, darker, lankier form which was thought to be the latter. It seemed only fair to conclude that while *C. salinarius* played a part in forming this mosquito zone, *C. pipiens* was clearly shown in this case to migrate a distance of 2.5 miles from the place of breeding.

At the same time that an analysis of the mosquitoes on the wing is being made a careful survey of the mosquito breeding places should go forward. A seasonal map of the more or less permanent breeding places should be made.

Preparing Plans for the Elimination of Breeding Places.

Having determined the nature of the mosquito fauna and its source, the next step is the preparation of plans for the elimination of the breeding places. In most cases this involves the solution of rather simple engineering problems for most of the work will be of a drainage character. Plans for the adequate treatment of each place should be prepared. The preparation of this phase of the report may involve the consideration of breeding places, either fresh or salt, existing entirely outside of the protected area.

The actual working out of such a plan is well illustrated in the effort at Princeton, New Jersey. Here each breeding place of a reasonably permanent character has been charted. The type of written matter accompanying this chart gives a description of each place or group of places, describes the methods that should be used in eliminating the breeding, and presents an estimate of the cost of the operation. A simple description of one of the breeding places runs about as follows: "District Number V is an old basin once a part of the D. and R. canal system but long since abandoned. The stagnant water is sheltered from the winds by surrounding trees and the banks are shallow and overgrown with vegetation. It is 130 x 300 feet and has some surface drainage into Stony Brook. Its bottom has at certain points as low an elevation as 52.6 feet above sea level, which shows that the drainage will have to be supplemented by a fill.

"The Committee recommends that an open ditch be cut from this basin to the nearest point of Stony Brook at a cost of from $15 to $20, and that the earth thus removed be used to help fill the remainder of the basin to a level of 53.1 feet or more. This will require 2,655 cu. yards. Part of the earth may be taken from the banks and higher levels in the vicinity, but still more must be obtained elsewhere. The cost of moving the soil and making the fill should be about $1,250. About $100 should be allotted to clearing off the weeds and bushes that will obstruct the ditching and filling operations."

In this way a comprehensive plan of operations and a fairly accurate estimate of the cost of the initial work necessary for mosquito control in a specified locality can be prepared.

Obtaining Funds.

After reasonably accurate plans and estimates are in hand the problem of obtaining funds must be solved. It is safe to assume that if the work has been carried to the stage of completed plans and estimates some one person or some group of persons possessed of a considerable amount of energy and initiative is deeply interested in the success of the movement. If the mover coincides with the person or group who must furnish the means, this problem is extremely simple, but, if on the other hand, the funds must come from a group of large size or from the general public its solution becomes more difficult.

Two ways of getting funds are then open. The person or persons interested may go about among the landowners and residents of the afflicted districts and attempt to persuade them that the work is sufficiently important to merit their financial support. The person or persons interested may, through the medium of lectures, newspaper and magazine articles, educate the public to a point where the desired work may be paid for from the public treasury. In any case, the danger and discomfort of present conditions must be constantly contrasted with the safety and comfort of the time when the desired work has been completed.

Execution of the Plans.

When the moneys have been secured the organization necessary to carry out the initial work must be formed. Perhaps the simplest form of organization is the employment of a competent engineer who may be held responsible for the proper prosecution of the work by contractors. Certainly, such a method will not leave the active agent burdened with a supply of tools and useless machinery.

Maintenance, Temporary Elimination, and Improvement.

When initial work has been completed it must be maintained. Breeding, which occurs in the thousands of shallow pools of various sorts which after heavy rains are found in depressions of the ground and in old receptacles and in places of permanent character such as sewer basins, cesspools, cisterns, etc., must be destroyed before the adult mosquitoes can be produced.

As the work proceeds, many additions to the drainage systems already installed or entirely new plans for districts that may have been overlooked will seem advisable. Provision should be made to meet such conditions.

When trying to meet the problems of maintenance, temporary elimination, and improvement of anti-mosquito work over a large area, some methods of testing the value of such work must be devised. Many men will be employed and more or less efficiently supervised. Data on effectiveness as measured in terms of mosquitoes on the wing must be had. The practice of the regular collections of adults as described earlier in this paper will afford the needed facts. After a certain amount of experience the person in charge of collections will be able to say, under given conditions of temperature, moisture and wind, just how many mosquitoes per selected unit of time mean that the householder living near the point of collection will be troubled. Fortunately, he can usually discover the dangerous increase in time to find the unchecked breeding and head off the trouble.

The local director of the anti-mosquito work is able, by examining his map of collections, to see at once where the dangerous increases are, and by making a thorough re-inspection at these points, to discover the inefficiency of his maintenance and temporary elimination, and to determine the nature of improvement needed. Of course his map may also show an invasion. It will then become necessary to trace it to its source and take measures to correct the conditions which have given rise to it.

Giving the Anti-mosquito Work a Permanent Character.

After the work of mosquito control has been started and carried forward for several seasons, the problem of insuring the continuance of necessary maintenance and improvement must be solved. The first year of successful work will ordinarily bring about such a gratifying reduction in mosquito trouble, or disease carried by mosquitoes, or both, that the work will stand very high in the opinion of the people within the protected districts. This public approval will continue for two or three or even more years, and the occasional appearance of a troublesome number will be discounted.

But as time passes the remembrance of the suffering experienced before any work was done will fade, and the appearance of the occasional outbreaks will be charged to inefficient work on the part of the mosquito control organization, and the appropriations necessary for the support of the work may be discontinued. The public will demand that freedom each year become noticeably greater. Of course, this natural change of public opinion may be delayed by educational work in the course of which the nature of the problem is explained. But sooner or later the public will demand that even this occasional trouble, this apparently irreduceable minimum, be eliminated.

Without doubt methods not now in use must be developed if this demand is met. A more fundamental study of the mosquito's natural history must be made in the hope that a clue to the accomplishment of further reductions may be found. The chemotactic responses of this insect are practically unknown. The development of larvicidal agents has only begun. There is much room for that type of research which will develop new and better methods of getting at the problem of mosquito control.

Evaluation of the Results of Mosquito Control.

The last phase of the problem of mosquito control is the evaluation of the results of anti-mosquito work. In dealing with the species which disseminate well known and definitely diagnosed diseases this phase seems to offer little difficulty. Before the work is done a survey of the number of well authenticated cases of disease should be made. Each year after the work the survey is repeated and the conditions before and after compared. This is well illustrated in the work at Princeton, where in 1914 before the work of control began there were 127 cases of malaria, while in 1915, after the work had made a good start, there were 65 cases, and in 1916, after the large part of the work had been done, there were 8 cases. Still more striking results were presented by Dr. Carter last winter. At Roanoke Rapids, North Carolina, in several mill villages of over 4,000 total population, anti-mosquito work reduced the physicians' calls from 50 per day to 2½ per day the first year, and to one call for each three days the second. At Wilson, Virginia, in 1915, every house visited by Dr. Carter had at least one inmate sick with malaria. The five deaths which occurred in August may be taken to indicate that there were about 500 cases in the place. In the summer season following efficient anti-mosquito work there was only one case.

Thus far the only ways of measuring the value of anti-mosquito work when only the comfort of the people is served, are public approval as voiced by the newspapers and governing bodies, and the advancement in valuation of property for taxing purposes.

The first usually appears in a form similar to the following taken from the Newark *Evening Star* on August 16, 1912:

> "That the work of mosquito extermination in Essex County this season has been well done, nobody can doubt or deny. The pest was not entirely destroyed, but that was not expected. The mosquito extermination Act has been amply justified by results and its repeal by the legislature at the demand of some parsimonious county that is willing to suffer the pest rather than pay the small price for getting rid of it is impossible."

Or in a form similar to the following communication from the Paterson *Press-Guardian.*

"*To the Editor of the Press-Guardian:* Sir,—Now that the Mosquito Commission has announced that its operations for this season are ended, it would seem to be a proper time to call attention to the great success of its operation. I have lived in Paterson more than forty years and in my recollection we have never had so much freedom from mosquitoes as during the past season, and this in spite of the fact that the conditions for breeding mosquitoes early this season were ideal. The result, I believe, can only in fairness be attributed to the mosquito extermination work.

"When this work was inaugurated a few years ago, many people were doubtful of the result and seemed to feel that money appropriated for the mosquito extermination work would be money wasted; but it seems to me that any unprejudiced person comparing conditions during the past summer with previous years must realize that the nuisance has been reduced to a minimum and that the money invested in this work has been well spent.

"Let us give due credit to David Young as well as to the members of the Commission and others engaged in the work who have given the matter time and study and hard work, and when the Commission applies for its next appropriation let it have the money without hesitation. Not only does this work promote the comfort of the residents of Paterson but, if continued, it must enhance real estate values, which have suffered in the past from the widespread and free advertising received by the 'Jersey Mosquito.'

"Paterson, Oct. 10, 1917."

While this sort of approval is necessary it is a rather poor yardstick by which to measure the value of permanent work.

Unfortunately increases in real estate values are dependent upon so many factors that one finds it extremely difficult to separate the effect of mosquito control from the operation of other factors. We can, however, say that the development when it is a matter of building up high-class residence districts will not occur where the country is infested by hordes of mosquitoes. A calculation prepared in 1912 shows that the taxable values of shore properties from Jersey City to Sea Bright had increased since mosquito work had begun at least 6½ millions, and that the increase ranged from about 15 per cent. in the manufacturing districts to 300 per cent. in some of the residence districts.

If we may assume that a reasonable freedom from the mosquito pest is prerequisite to large industrial development, and the writer believes that the assumption is in most cases susceptible of proof, an examination of the increase in taxable values on the Newark meadows, which were formerly as badly mosquito infested as any part of the State of New Jersey, will serve as an instance to show the development which anti-mosquito work has made possible.

The meadow comprises about 4,000 acres. Anti-mosquito work began many years ago, became intensive in 1912, and has continued until the present. The taxable value of those marshes and the tax from them are shown in the following table:

Year.	Taxable Value.	The Tax Increase.
1913	$1,735,000	$19,656
1914	2,192,000	22,064
1915	2,251,000	30,390
1916	3,750,000	64,155

In 1912 the tax was $19,656 and in 1916 it was $64,155, making an increase of $44,499, or over 300 per cent. In 1912, 286 men were employed in factories on these meadows with a yearly wage of $152,000. In 1916, 6,341 men were employed with a payroll of $2,863,000.

In dealing with salt marshes, as a by-product of the drainage necessary for mosquito control, we find a decided increase in the annual yield of salt hay. The undrained marsh yields an average of about .7 of a ton of coarse hay, which hardly repays the cost of cutting and marketing, while the drained marsh produces 2.6 tons of a much better grade, involving an increase of about $15 an acre. It should, of course, be recognized that an average of about three years is required to realize the full benefit.

Conclusions.

Present methods of mosquito control are sufficiently effective to afford much relief from the mosquito pest by freeing protected communities to a very large extent from mosquito annoyance and mosquito-carried diseases. Such results can be obtained only when the matter is gone about in a careful systematic manner, involving a thorough study of the nature of the problem and the creation of an effective organization to carry out the work.

Mosquito control work, because of the large amount of temporary control involved, must become a permanent fixture.

With present methods of control the protected territory will at times be troubled by some mosquitoes, because the enormous increase in breeding surface, brought about by a prolonged rainy period, may be such as the organization cannot cope with.

More thorough or fundamental studies of the life economy of the economic species of mosquitoes are needed in order that still more effective methods of control may be found.

Mr. Gibson: May I ask whether you have used oil to any great extent on the marshy areas?

Dr. Headlee. Oil is used extensively for temporary elimination in small temporary pools, basins, in the treatment of garbage dumps, and to some extent, although only a minor extent, on the salt marsh. It is considered a method of temporary elimination only, and its use is no more extensive than we can avoid. We use a good many thousand barrels of oil in a year, because there is much temporary work to be done, and I think if we take into consideration existing conditions there always will be temporary work to be done. There are always temporary pools under exceedingly rainy conditions, and these pools are breeding grounds for the mosquitoes. We have had the question raised frequently as to why we do not reduce the seed or eggs so that under these extra rainy conditions they could not produce so many insects. We have not got the eggs down far enough yet to notice much difference, although we have made a number of experiments.

Prof. Caesar: What type of oil do you use now?

Dr. Headlee: All kinds of fuel oil. Recently the Standard and other concerns have been making us an oil up to heat strength by putting in a good amount of crude kerosene. We need an oil with a large amount of spread in proportion to holding power, and we are continuously trying all kinds of oil, for until we test it out we do not know the character of it and whether or not it will suit our purpose. The number of fuel oils is tremendous, and the only way we can get the kind we want is to have samples submitted to us and test them for spread and for staying qualities. Some oils will stay for two weeks, and others for two days, some will spread out nicely by themselves, others will have to be sprayed on to make them spread at all. The whole question is a difficult one, and we have tried to get satisfaction from the standpoint of viscosity, but the oil people do not seem able to give us just what we are looking for. In testing a sample of fuel oil we want one that will spread readily, will make a nice complete coating on the water, and will stay at least a week. But even at the best, oil is only a temporary measure.

A hearty vote of thanks, moved by PROF. CAESAR and seconded by PROF. LOCHHEAD, was extended to the speaker in appreciation of his lecture.

MR. A. F. WINN then delivered the President's Address on "The Bladder-scales of Lycænidæ."

After the evening session, a smoker was held in the Men's Residence, when an extensive discussion on "Canadian Entomologists and the War" took place. The discussion was taken part in by Prof. Lochhead, Mr. Winn, Dr. Headlee, Prof. Burgess, Prof. O'Kane, Prof. Caesar, Prof. Brittain, Mr. Gibson, Mr. Petch and others.

FRIDAY MORNING, 9 O'CLOCK.

After a short business meeting at which the officers for the ensuing year were elected, Prof. Caesar, the newly appointed President, took the chair and in a few words expressed his thanks and appreciation of the honor done him.

MR. WINN extended an invitation to members and visitors to visit the Lyman Entomological room at McGill University.

THE BLACK CHERRY APHIS.

WILLIAM A. ROSS, DOMINION ENTOMOLOGICAL LABORATORY, VINELAND STATION.

The experiments on which the following paper is based were carried on this past season at the Dominion Entomological Laboratory, Vineland Station, Ontario. The aphis was studied both in the insectary and in the orchard. In the insectary (a covered bench, situated out-of-doors) the plant lice were reared on small sweet cherry trees and Lepidium plants grown in flower pots.

As we have not had time to prepare technical descriptions of the various forms, only popular descriptions are included in this paper.

HISTORY.

The black cherry aphis has long been known in Europe and North America as a pest of cherry trees. On this side of the Atlantic the species was first recorded in 1851 by Fitch (Cat. Homopt. N.Y. 65, 1851). The same author in a later publication (Rep. Ins. N.Y. 1, 125, 1855) describes the insect and gives an interesting account of its habits. He suggests that it was introduced into America with the tree which it infests. What is probably the first reference to *M. cerasi* in Canadian literature is contained in Fletcher's Report of the Entomologist, 1885. Mention is merely made of the occurrence of aphids on young cherry trees at Victoria V. I.—no name or description is given. In the Entomologist's Report for 1897, Dr. Fletcher gives the following interesting observations made by Mr. Martin Burrell, at that time of St. Catharines, Ont.:—

"The principal damage has been done by the Cherry Aphis (*Myzus cerasi* Fab.), whose attacks on the sweet cherry of this Peninsula (Niagara) were simply disastrous. I do not think I should be overshooting the mark if I said that half of the crop was ruined. I saw many cases where not only the foliage was covered but even the fruit, and especially the stalks, with lice."

Habits and Depredations.

The cherry aphis is primarily a pest of the sweet cherry. It occurs on, but so far as we are aware, is never destructive to, the sour cherry.*

The aphis feeds on the buds and tender foliage and it may even attack the blossoms and fruit, especially the stems. Infested leaves become tightly curled and when badly attacked turn brown and die. Fitch speaks of aphis-infested leaves "looking as though they had been scorched by fire." The fruit may also be seriously damaged. During the summer of 1915, there was an outbreak

Cherry Aphids on underside of sweet cherry leaf, natural size.

of cherry aphis in the Niagara district and in a Vineland orchard the fruit was so badly injured that most of it was left on the trees. The cherries were small, ripened irregularly and many of them were covered with honey-dew and the black honey-dew fungus.

Migration of M. cerasi.

A difference of opinion has existed among entomologists as to whether this species is migratory or not. Crosby (1) considers that the question is unsettled. Sanderson (2) and O'Kane (3) say that so far as known the cherry aphis has

*Since writing the above, Mr. P. J. Parrott, Geneva Agricultural Experiment Station, has kindly placed at my disposal the following note from Mr. H. W. Lasher, of Wolcott: "Replying to your inquiry *re* the black cherry aphids, I find that some years they do infest the sour cherry. They have attacked in my case, Montmorency, Morello, and Richmond trees. They do not take a block but trees scattered throughout an orchard. They destroy all the fruit, it falling off when the size of a pea."

only one food plant. Gillette (4) states definitely that *M. cerasi* lacks the alternating food habit. On the other hand, Quaintance and Baker (5) claim that it is migratory. How are we to account for these apparently conflicting statements? Is it possible that the species is partially monophagous and partially migratory? Our observations and experiments prove that it is. Apterous forms reside throughout the season on the primary host-cherry, and in addition alatæ, produced during the summer, migrate to and establish colonies on a secondary host.

The cherry aphis apparently has an unique life cycle. Some plant lice with the alternating food habit, e.g., *Eriosoma lanigera, Prociphilus tessellata* and *Myzus persicæ* occur at all times of the year on their *secondary* hosts, but, so far as we are aware, no migratory aphid other than *M. cerasi* normally resides on the primary host all year. If we were given to theorizing, we would suggest that at the present time, the black cherry aphis is in the transitional stage between the migratory type (e.g., *A. avenæ*) and the more specialized monophagous type (e.g., *A. pomi*).

Migratory Tests.

In order to discover the secondary host a series of migratory experiments were made with common plants belonging to the following genera: *Agropyron, Dactylis, Poa, Polygonum, Rumex, Chenopodium, Amaranthus, Stellaria, Silene, Ranunculus, Erysimum, Capsella, Lepidium, Brassica, Lobularia, Potentilla, Prunus, Trifolium, Vicia, Medicago, Malva, Nepeta, Stachys, Verbascum, Plantago, Cirsium, Arctium, Hieracium, Lactuca, Senecio, Ambrosia, Aster, Sonchus, Solidago.* The migrants fed to some extent on cherry, *Polygonum persicaria, Chenopodium album, Rumex acetosella, Stellaria media and Malva rotundifolia,* but did not reproduce on these plants. Young were deposited on *Polygonum aviculare, Rumex crispus, Lobularia maritima, Verbascum thapsus, Plantago lanceolata, P. major* and *Solidago* sp., but they did not grow and soon succumbed. Weak colonies developed on *Brassica arvensis, Erysimum cheiranthoides* and *Capsella bursa-pastoris.** On *Lepidium apetalum* strong colonies were readily established and were carried through to the end of the season.

Field Observations.

In the field our search for migrants was rewarded by finding them and their progeny on wild peppergrass, *L. apetalum* growing within two hundred yards of an infested cherry orchard (first collection was made on July 9th, 1917). The aphis was not taken on any other plant but in spite of this we are strongly inclined to believe that other crucifers besides *Lepidium* serve as secondary hosts. Next season, we hope to be able to prove this.

The Egg.

The minute, oval-shaped eggs (.68 mm. x .32 mm.) change within a few days after being laid from watery green to black. They are deposited around the buds and on the rough bark of twigs and branches. They commence to hatch early in spring when the buds are swelling. In the cherry orchard (situated on the lake shore) which we had under observation this past season, the period of hatching extended from the 17th to the 24th of April. All the eggs hatched at least nineteen days before the cherry buds actually burst.

*One colony on *Erysimum* survived until autumn, at which time it gave rise to return migrants and males.

The Stem Mother.

The newly hatched, dark green stem mothers migrate to and settle on the buds, where they feed on the green tissue. Later on, they attack the tender leaves and blossom buds. After moulting four times, they reach maturity in four or five weeks and commence within a day or two to give birth to living young. The first young are produced about the time the most advanced blossoms open.

Description. The adult stem mother is a glossy black, globose insect, about 2.07 mm. x 1.44 mm., with 5-jointed antennæ.

Breeding Experiments.

In our insectary experiments with 15 individuals the following data were obtained:—

Number of instars: Five.*

Length of Nymphal Life: Maximum 37 days, minimum 30 days, average 31.8 days.

Age when reproduction commenced: Maximum 37 days, minimum 30 days, average, 32.6 days.

Reproductive period: Maximum 41 days, minimum 26 days, average 32.9 days.

Fecundity: Greatest number 198 young per insect, smallest number 80 young, average number 154.9 young.

Daily production of young per female: Maximum 18 young, minimum 1 young, average 4.8 young.

Total length of life: Maximum 85 days, minimum 57 days, average 69.5 days.

Summer Forms on Cherry.

The progeny of the stem mothers develop into apterous viviparous females. This generation is then followed by brood after brood of wingless and winged aphids. The apterous forms remain on cherry and may be found on this tree from spring till late autumn. The alatæ on the other hand leave the cherry and migrate to Lepidium.

Apterous Vivipara.

During the early part of the season wingless forms are very common but as the summer wears along they diminish in numbers. This decrease is due to the production of alatæ, to the effective work of predaceous enemies and also to the drying up of the affected foliage. Moderately infested trees are liable to support more apterous lines throughout the season than are heavily infested ones. In fact, on badly attacked cherry trees the aphids may wholly disappear by mid-summer. For example, in 1915, in a seriously infested orchard at Vineland, no plant lice were found on the trees after mid-August.

Description. The adult wingless vivipara like the stem mother is globose and glossy black. Unlike the latter, however, it possesses 6-jointed antennæ. In size, it is about 2.16 mm. x 1.17 mm.

*In order to avoid repetition I might mention here that all the other forms have five instars.

TABLE No. 1—APTEROUS VIVIPARÆ—M. CERASI.

Generation.	No of individuals.	Length of Nymphal Life.			Age when reproduction commenced.			Reproductive Period.			Fecundity per insect.			No. young per day per insect.			Longevity.			Mean Temperatures.*	Dates.*
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
2nd	14	20	14	17.5	20	15	18	28	5	23	184	37	143	18	1	6.2	53	25	44.6	54.6	18/5– 9/6
3rd........	5	14	12	13.2	14	12	13.2	27	12	20.4	156	62	107.4	14	1	5.3	44	25	35.8	61	5/6–19/6
4th........	5	11	8	9.6	12	9	10	24	20	21.8	118	97	105.6	11	1	4.8	41	30	36	63	19/6–30/6
5th........	5	12	10	10.6	12	10	11	24	11	17.6	120	46	88.4	16	1	5	35	23	29.2	63.7	28/6–11/7
6th........	5	10	9	9.2	10	9	9.4	24	12	18.6	88	48	67.4	14	1	3.6	38	22	30	68	9/7–21/7
7th........	5	8	7	7.4	9	7	7.8	26	4	18.6	113	19	74	14	1	3.9	35	11	26.6	78.4	18/7– 1/8
8th........	5	8	6	6.6	9	6	7.2	30	14	22.8	93	44	73.8	11	1	3.2	40	22	31	74.1	26/7–12/8
9th........	5	9	6	7.2	10	6	7.6	27	4	18.4	93	16	60.8	9	1	3.3	39	11	27.2	70.9	1/8–20/8
10th........	5	9	7	7.8	10	8	8.4	37	19	28.8	127	51	93.4	10	1	3.2	47	29	38	69.1	8/8–27/8
11th........	5	12	7	8.6	13	7	9	32	24	27.8	106	42	65.6	7	1	2.4	61	39	49.2	66.7	16/8–4/9
12th........	4	16	10	13.5	16	10	14	43	32	37.5	96	27	62.3	9	1	1.7	72	57	63.8	60.5	24/8–19/9
Last Born Series.																					
2nd L	14	12	9	10.7	13	9	11.1	26	13	18.7	140	65	91.2	13	1	5	43	25	30.8	63.1	13/6– 9/7
3rd...... L	14	11	6	8	13	6	8.6	25	12	18.5	101	46	73	13	1	3.9	40	18	27	72.1	5/7– 1/8
4th...... L	13	13	6	7.9	13	6	8.6	36	10	22.6	117	18	76.3	9	1	3.3	61	19	37.2	70	24/7– 6/9
5th...... L	7	22	8	13.6	22	8	14.6	34	11	19.6	95	20	47.3	8	1	2.4	85	23	43	56.4	20/8–20/10

* During nymphal development.

Breeding Experiments.

In this form, the duration of nymphal life varies very considerably due in a large measure to the great differences in temperature to which the females born early in spring and those born during the summer are subjected. (See table No. 1.) In our experiments the average nymphal life in the second generation was 17.5 days, in the eighth it was 6.6 days.

In the matter of reproductive capacity, this form is slightly less prolific than the stem mother (see table No. 1). One hundred and eleven apterous forms produced an average of 80.9 young per insect.

Summer Migrant.

Migrants are produced on cherry trees during a period extending from mid-June to the middle or latter part of August.* The vast majority of them, however, develop and migrate before mid-July.

Description: The head, thorax, cornicles, and cauda of the migrant are black and the abdomen varies in colour from dark or black green to dark brown. It is about 2.16 mm. long.

Factors Which Produce Alatæ.

A question which should be touched on here is: what agencies tend to produce winged-forms? We are inclined to believe that three of them are, the influence of over-population, the instinct to migrate, and, to a small extent at least, the influence of generation.

With a monophagous species such as *Aphis pomi* the appearance of alatæ is apparently due in a large measure to overcrowding. This hypothesis explains why, by preventing crowding, it is possible to rear apterous lines of the green apple aphis through from egg to egg. With a migratory species, however, such as *Aphis avenæ,* another factor comes into play, viz.: the instinct to migrate. In some of our experiments with the oat aphis one individual was reared on each host plant (apple), but in spite of this superabundance of food and space, all the lines gave rise to migrants—the aphis in order to complete its life cycle had to migrate.

And now to return to the cherry aphis, this louse behaves more like a monophagous than a migratory species. The migratory instinct appears to be attenuated and seemingly is of little or no importance in the production of winged forms. In our insectary work, it was observed that alatæ did not develop unless the plant lice were excessively crowded.

The influence of generation as a minor factor is suggested by the fact that no winged forms occur in the 2nd generation of *M. cerasi*—at least we did not obtain any.

Breeding Experiments.

In our experiments with a large number of migrants the following data were obtained:—

Duration of nymphal life. Migrants took from 7 to 13 days to reach maturity, or in other words, one to four days longer than contemporary apterous viviparæ.

Reproduction: Migrants gave birth to young one or two days after they were transferred to Lepidium.

---

*A few migrants were taken on cherry on August 27th, 1917.

Reproductive period: Maximum 26 days, minimum 2 days, average 11.6.

Fecundity: The average reproductive capacity of 18 individuals was 16.7 young per insect, the maximum and minimum being respectively 37 young and 4 young.

Daily production of young: Maximum 8, minimum 1, average 1.7.

Total length of life: Maximum 56 days, minimum 4 days, average 15.4 days.

SECONDARY APTEROUS VIVIPARA.

The progeny of the cherry to *Lepidium* migrants develop into wingless viviparæ and are followed by brood after brood of their kind until fall at which time return migrants and males are produced, concerning which more will be said later. For want of a better name, the wingless forms on *Lepidium* are referred to in this paper as secondary apterous viviparæ.

DESCRIPTION. This form is much smaller and is lighter in colour than its fellow on cherry. It is dull brown in colour and is about 1.26 mm. x. .68 mm. in size.

BREEDING EXPERIMENTS.

In experiments with 37 apterous forms the following data were obtained.

Length of Nymphal Life: Maximum 19 days, minimum 6 days, average 9.8 days.

Age when reproduction commenced: Maximum 19 days, minimum 6 days, average 10.2 days.

Reproductive period: Maximum 44 days, minimum 9 days, average 24.5 days.

Reproductive capacity per female: Maximum 83 young, minimum 19 young, average 44 young.

Daily production of young per female: Maximum 7 young, minimium 1 young, average 1.8 young.

Total length of life: Maximum 75 days, minimum 17 days, average 40.8 days.

THE ALATE SEXUPARA.

In early autumn migrant aphids* are produced on Lepidium and return to the cherry where they deposit the egg-laying females. At the same time the monophagous lines on cherry give rise to large numbers of winged forms† which also give birth to egg-laying females. In other words the sexupara—the mother of the sexual female—is produced on both the secondary and primary hosts.

DESCRIPTION. This form is very similar in appearance to the summer migrant.

BREEDING EXPERIMENTS.

The data obtained from the sexuparæ bred on cherry (primary host) and on *Lepidium* (secondary host) are presented herewith in tabular form.

*Return migrants were found on *Lepidium* from Sept. 17th to October 29th.

†*Sexuparæ* were produced on cherry from Sept. 9th to the close of the season.

TABLE No. 2—SEXUPARÆ—M. CERASI.

Host.	No. of Individuals.	Length of Nymphal Life.			Reproductive Period.			Fecundity per Insect.			Daily Production of Young per Insect.			Longevity.		
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Nin.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.
Primary (Cherry)	13	44	14	20.3	11	2	6	11	2	7	6	1	1.2	61	19	47.1
Secondary (Lepidium)..	6	19	14	16.3	5	2	3.2	6	3	5	4	1	1.6	70	24	52.3

The Male.

Early in October winged males* appear on the secondary host and fly back to the cherry where they mate with the oviparous females. No males are produced on cherry. This means that, in spite of the pronounced tendency of the black cherry aphis to live a monophagous life on cherry, the completion of its life cycle is still dependent on the existence of a secondary host.

Description. Antennæ, head, thorax, cornicles and external genitals black. Abdomen reddish brown with dark transverse bars, and three black lateral spots. Length 1.53 mm. to 1.62 mm.

Nymphal Life.

The average duration of nymphal life of 29 individuals was 35 days, the maximum and minimum being respectively 25 and 44 days.

The Ovipara.

This form may be found on the leaves, twigs and branches up to the time all the aphids are killed by frost.

Description. The general colour of the ovipara is dark brown. The abdomen may be tinged with green. In size, it is about 1.8 mm. x .8 mm.

Breeding Experiments.

In our experiments with 13 individuals the following data were obtained:—

Length of Nymphal Life: Maximum 33 days, minimum 21 days, average 27.4 days.

Age when egg-laying commenced: Maximum 53 days, minimum 26 days, average 40.2 days.

Reproductive period: Maximum 22 days, minimum 1 day, average 10.2 days.

Fecundity per female: Maximum 8 eggs, minimum 1 egg, average 4.2 eggs.

Longevity: Maximum 71 days, minimum 52 days, average 61.6 days.

Number of Generations.

According to our experiments there are from six to fourteen generations of this insect per year in the Niagara district.

*Males developed on *Lepidium* from October 6th to November 17th.

Natural Control.

Insect Enemies.

Like most species of plant lice the cherry aphis is harassed by many insect enemies. Amongst these enemies are numbered the following:—

Coccinellidæ—*Adalia bipunctata* Linn. (Apparently the most important predator), *Coccinella 9-notata* Herbst., *C. transversoguttata* Fabr., *C. trifasciata*, Linn., *C. sanguinea* Linn., *Anatis 15-punctata* Oliv., *Hippodamia 13-punctata* and *Scymnus collaris*.

Syrphidæ—*Syrphus americanus* Wiedemann, *S. ribesii* Linn., *Allograpta obliqua* Say.

Cecidomyiidæ—*Aphidoletes meridionalis* Felt.

Chrysopidæ—*Chrysopa* sp. (No lace-wing flies were reared).

Acarina—An undetermined, bright, orange red species.

Weather Agencies.

Undoubtedly the most effective weapons employed by Nature in checking the multiplication of this, and other species of plant lice are weather agencies. Heavy rains wash off large numbers of aphids, especially in spring before the pseudogalls are formed. Droughts are frequently disastrous to the lice, chiefly, we think, because such weather deprives the host plants of succulency. Early frosts and wind storms also may destroy countless numbers of immature sexual females by causing the foliage to drop prematurely.

Artificial Control.

The cherry aphis is most vulnerable early in spring just before the buds break. At this time all the eggs have hatched and the young stem mothers, feeding on the buds, are absolutely without protection. Thorough spraying at this stage with a good aphidicide will destroy all or practically all the lice.

Last spring, we tested this remedial measure in a Vineland orchard. One-half of the orchard—the check—was given the usual treatment with lime sulphur. In the other half, lime sulphur combined with Black Leaf 40 (¾ pint to 80 gallons) was used and the application was not made until shortly before the buds burst. Because of the slow multiplication of the lice on the check trees, due to unfavorable meteorological conditions, the results obtained from this experiment did not show up to advantage until early July. At that time, the following notes were made:—

"Examined all the trees sprayed with Black Leaf 40 and found only one small colony. In the check block all the trees are more or less infested and some are badly attacked. By noting the condition of the foliage—normal or curled—it is a simple matter to tell where the treated rows end and the unsprayed section begins."

Literature Cited.

(1) Slingerland and Crosby:
Manual of Fruit Insects, p. 312.

(2) Sanderson, E. D.:
Insect Pests of Farm, Garden and Orchard, p. 666.

(3) O'Kane, W. C.:
Injurious Insects, p. 318.
(4) Gillette, C. P.:
The Monthly Bulletin of State Commission of Horticulture, California, Vol. VI, No. 2, p. 63.
(5) Quaintance and Baker:
Farmers' Bulletin 804, U.S. Dept. of Agr., p. 24.

FATHER LEOPOLD: Is it a fact that there is no male on cherry?

MR. ROSS: The male is produced only on the secondary host.

DR. HEADLEE: We found with apple aphis that there was a peculiarly susceptible stage in the egg just before hatching. The egg has three layers, one of which is a transparent layer, and this layer splits about a week before hatching. The egg is then very susceptible to light, moisture and other influences, and to chemical sprays, etc., and I wonder if Mr. Ross has found a similar condition in the eggs of the Black Cherry Aphis?

MR. ROSS: No. I have not found this with Black Cherry Aphis, but I have with Apple Aphids. We fumigated trees that were heavily stocked with the eggs of the Oat Aphis and *Aphis pomi* about ten days before the buds burst. We destroyed one hundred per cent. of the eggs with hydrocyanic acid gas, 1 oz. to 100 cubic feet, but we have not done anything with the Cherry Aphis.

DR. HEADLEE: Have you experimented with chemicals on the eggs?

MR. ROSS: No.

DR. HEADLEE: We found that carbolic acid was effective in dealing with the apple aphis egg at this stage.

PROF. CAESAR: Was this a laboratory experiment or an orchard experiment?

DR. HEADLEE: Both.

PROF. CAESAR: Dr. Headlee gives us another suggestion, and that is what most workers are seeking for. From my own observations it would appear that lime-sulphur wash seems to have quite an effect during some seasons, and in other seasons it has almost no effect, or a very slight effect.

DR. HEADLEE: The addition of Black Leaf 40 seems to increase the killing effect of lime-sulphur on the egg. I think Parrott and Hodgkiss had some success with this.

A COMEDY OF ERRORS.

FRANCIS J. A. MORRIS, PETERBOROUGH.

It is surely astonishing how often the two Dromios have made their appearance on the entomological stage. These amusing little comedians seem never to pall, and their simple farce, trite as it is, continues—like a Punch and Judy show, or the Marks Bros.—to draw crowded houses and evoke peals of delighted applause. It speaks well for the wholesomeness of our hobby that the entire brotherhood of us should remain so perennially gullible, so good-humoured over mistakes, and so easy of diversion. Masquerading must be as old as the hills, and mistaken identity forms one of the leading motives in the world's literature. It is found in the oldest sagas. Aristotle remarks how effectively Homer uses it in the Odyssey; and still to this day it remains one of the great well-springs of Romance, now sparkling in the lightest of comedies, now darkening the unplumbed gulfs of tragic depth.

All enthusiasts are apt to be uncritical, and collectors for a variety of reasons are probably more prone to error than most people. Our zeal outruns discretion; in the flush of a fresh capture we are at the mercy of two opposite impulses; we would dearly love our prize to prove something quite new, and we fairly ache to get it placed just where it belongs, with its next-of-kin in our cabinet. Now, an insect being a most intricate complex of diverse features, we are very apt—the wish being father to the thought—to seize on something superficial and strain a point of identity or of difference. How often in this way have two individual insects, created male and female of one species after their kind, been divorced to opposite ends of the collecting case from some purely sexual or even accidental distinction of size, marking, or structure? And the contrary error of confusing types essentially different, augmented even, on occasion, by the distracting presence of mimetic forms, beguiles the unwary just as often; and here it is that the two Dromios get their cue to come in and play the cat and banjo with our cabinet. I remember as a small boy arranging my collection of birds' eggs by similarity of colour-pattern, and under the impression that they were just undersized eggs of the common chaffinch, innocently disposing of some very rare red-poll's eggs to a more mature oologist(an Aberdonian and already one of the shrewdest of Scotchmen).

Henshaw's check-list of North American Coleoptera no doubt teems with synonyms; but on the other hand, if you trace back the history of a standard check-list, from its latest edition to its earliest, you will meet almost as many instances of genuine species that have blushed unseen for generations under a pseudonym; and though some authorities are undoubtedly overfond of multiplying species, there can be little question that the most carefully prepared and up-to-date check-list still contains a few rightful heirs, waiting to come into their own, hidden under the bushel of a synonym. It is the story of one of these neglected claimants that I shall try to tell you here.

When I entered the field of entomology more than twelve years ago, it was by way of a bridle-path from the neighbouring realm of botany. And the natural inclination to make my hobby of wild flowers run in double harness with that of beetles, was given a final set in the very first season of 1905; I went over to Great Britain on a botany trip at the end of June, and formed there the habit of carrying a cyanide bottle out with me on all occasions; whatever I saw in the shape of a beetle on stem, leaf or blossom, I captured, noting its season and habit. It was this somewhat peculiar and restricted form of collecting that soon led me to a number of unusual finds and at last landed me, as a sort of monomaniac, among the Longicorns. Moreover, my running mate in Port Hope, the man whose hobby trotted to the same tune as mine, had several years the start of me in entomology, and it was only by drawing on my capital of plant-lore that I could hope to turn the handicap into a neck-and-neck race.

I well remember how closely I watched in 1906 for every new flower to unfold from early April on through the weeks to August and September. And before May was over I had already made some finds quite new to my companion, whose cabinet specimens had hitherto enabled me to determine nearly all the contents of my cyanide bottle. I can still plainly see in memory the hawthorn on the edge of a certain wood where some of my first surprises occurred. And foremost among these was a dusky grey and black insect so like one of the common large black ants, that it was only after passing it over several times that I noticed the long gracefully-curving antennæ, and hastened to bottle my find. As soon as I got home I communicated this new discovery to my fellow-collector, and he included some specimens in a box of material he was on the point of sending away for identification.

Now the fervor of a new pursuit had prompted me to purchase a copy of what has ever since been a kind of bible to me, LeConte and Horn's Key to the Generic Classification of North American Coleoptera.. Pending the return of the box with its inmates labelled, I occupied myself with a lens and the famous key, unlocking the riddles of generic status. After a good deal of trouble I worked down my specimens to the group *Anaglypti,* and once I had done that the rest was plain sailing; the insect had no ivory vittæ and could not be *Euderces;* it had not round eyes, so was not *Tillomorpha;* it must be either *Cyrtophorus* or *Microclytus.* Here the specific name *gazellula* under the latter genus was very tempting, for never had I seen a Longhorn with more graceful outline or more elegantly curving antennæ than this; but there was no room for choice, the fourth antennal joint was more than twice as long as the second, and it simply *had* to be *Cyrtophorus verrucosus*—even though this being interpreted should mean the "lumpy hunch-back," a name more apropriate surely for some African rhinoceros or wart-hog, or for our own American buffalo, than for this dainty little chamois.

Flushed with the pride of my discovery, I ventured to prophesy what name my fellow-collector would find on the label when his box came back. You may imagine how nonplussed I was, when we opened the parcel, to find instead the legend—*Microclytus gazellula.* I was so sure of my identification and so full of faith in my bible of entomology that I had actually the hardihood to write to the curator of the museum explaining my predicament. Almost by return of post came word that our specimen had been identified by comparison with an insect so labelled in a collection to which the Museum had fallen heir; the original owner had wrongly determined it; LeConte and Horn were perfectly correct, and the insect was undoubtedly *Cyrtophorus verrucosus.* So, after all, my trouble had not gone for nothing.

It is obviously impossible in a large collection to verify all the names, unless the institution is fortunate enough to have at its disposal a whole army of expert systematists. But what ever-widening rings of error spread from cabinet to cabinet by this same practice of taking things on trust. No wonder Descartes swore to question everything, even to mathematical axioms, rather than succumb to the tyranny of tradition; the world of thought has indeed good reason to thank God for its sceptics.

This creature captured on hawthorn has long been a great favourite of mine; no doubt partly because it was by pursuing a line of my own that I had made its discovery, and the work had the novelty and fascination of original research. But few who have closely examined this little insect can help admiring the exquisite grace of symmetry and proportion in its outline, the nobly arched dome of the thorax, the bold elevation of the elytral base, balanced by the swelling fullness of form just forward of the terminal declivity; on the whole creature not a single bright tint, nothing startling or bizarre in pattern; the colours very plain and the design of the simplest; almost Quaker-like in the severity of its garb; passing by the gentlest of half-tone gradations from velvety black hood and mantle to skirt of grey-drab, the whole uniform from head to foot broken only by two or three delicately pencilled lines of white, forming a median group of curving diagonals and transverse band between shoulder and waist.

Until midsummer this formed a solitary species in the *Anaglypti* group of the *Clytini;* but throughout July specimens of *Euderces picipes* were captured quite abundantly in a variety of blossoms; this creature, too, is extremely ant-like in appearance and even in movement; moreover, as representing the *Anaglypti* in which ivory vittæ are present, it roused no small interest in us young collectors.

The success of our blossom-hunting experiment made us await the spring of

1907 with great eagerness, and we certainly deserved some reward during the season, for we were very diligent, and must have peered into thousands of floral envelopes in never-tiring search from April to July. There can be no question that it was this extraordinary pertinacity of ours that led to the strange coincidence mentioned in a former paper (Can. Ent. XLI, 12, Dec., 1909). And here the curtain rises on our second act.

On Saturday afternoon, June 15th, 1907, I discovered for the first time how attractive the blossom of spiked maple was to beetles. Spiked maple and dogwood formed a great part of the edge of a swampy piece of wood about one and one-half miles north of Port Hope. On a hot, sultry afternoon such collecting ground proved, as I well remember, a perfect inferno of mosquitoes; but the sight of crowding *Lepturas* never seen before (e.g., *L. vibex, L. exigua, L. capitata*) was simply irresistible, far harder to withstand than a myriad of mosquitoes.

The following morning my fellow-collector and I had agreed to meet on the railway track not far from this spot and tramp up to our favourite *rendezvous* of the "North Wood," near Quay's Crossing. I determined to set out ahead of time and look over the spiked maple before going further north. While busy bottling a splendid haul of *Gaurotes cyanipennis, Encyclops cæruleus,* and *Cyrtophorus verrucosus*—all treasures in those days—I was aware of a small pale-looking specimen of what I took to be this last on a blossom of spiked maple. I can still see it, nestling in the bloom as my fingers approached it, and I well remember wondering whether this diminutive specimen had faded or was merely disguised miller-like for the nonce in a dusty coat of yellow-grey pollen. When I joined my friend we went north and visited (among other things) the hawthorn that had proved so lucky the season before. We both made captures on this tree; among mine a small species of oak-pruner, and among my friend's—a diminutive *Anaglyptus* that he bottled under the impression he had captured *Cyrtophorus verrucosus.*

Only when we got home, and each in his own privacy came like a modern Ali Baba to pour out his jar of treasure, did we become aware of a stranger in the midst. For my part I hastily turned up LeConte and Horn and almost at once concluded that I must have run to earth either *Tillomorpha* or *Microclytus;* the lens revealed an emarginate eye, so *Tillomorpha* was out of the question. And it was then that things began to happen thick and fast; you must remember that I had never seen *Microclytus,* but the book (my bible) declared the second antennal joint in *Microclytus* almost as long as the fourth, and in my insect, do what I might—by the greatest stretch of imagination, it remained barely half as long (Sc. 1:). Next day, Monday, I hurried down to my companion's and had not more than begun to unfold my tale of a stranger when he capped it with his (Sc. 2:). We were both equally eager to compare the two specimens, and no sooner had I set his insect under the lens and taken a glance at the antennæ, than I knew he had captured what I had not, a genuine specimen of *Microclytus gazellula* (Sc. 3:).

But what was my insect? I decided it must be an undescribed species of *Cyrtophorus,* and there the matter rested till some time after the November meeting of 1909, where I read a paper called "Guests at the Banquet of Blossoms." Mr. Chagnon then very kindly offered to determine my beetle, and it was with quite a flutter of excitement and pleased anticipation that I despatched the little enigma to him. You may partly guess my chagrin when I got word from him that it was the male of *M. gazellula,* and that the female only, it had been discovered, had the peculiar proportion of antennal joints 2-4 as described in LeConte and Horn. I felt, I must confess, very sceptical about this determination, and in 1910 I purchased from New York quite a number of Longicorn beetles for comparison;

among them, single specimens of *Tillomorpha* and *Microclytus*; and certainly when I set this last and my capture side by side, I could not help wondering whether anybody had really ever taken a pair of *M. gazellula* in the act of mating. And here the curtain falls on Act II of our little drama.

Ignoring the unities of time and space, let us next suppose ourselves transported to Peterborough in the spring of 1916. Gentlemen! the Wood of Desire! On my first trip through this Eldorado in 1915 I had been struck by the resemblance of a certain trough of swampy ground fringed with spiked maple and dogwood, to the corner of Choate's Wood at Port Hope, where this unique little *Anaglyptus* had been taken. It was too late that season for anything but the last spikes of maple blossom; yet, though I found nothing new on them, there were, nevertheless, anthophilous longicorns enough to bring me to the Wood of Desire very early in 1916.

On Victoria Day I made captures of *Pachyta monticola* about white trillium on the west of the wood, and noted a projecting spur of land at this point well covered with sumach thickets, small balsam poplar, elder, dogwood, choke-cherry, pincherry, thimbleberry, bracken, and other growth: a kind of compromise between the forest at its base and the arable country that confronted and flanked it, a no-man's land that I have always found peculiarly attractive, affording as it does to woodland denizens, sunshine, shelter, and food. Though the spiked maple would not be out before the second week of June at the best, choke-cherry and early elder burst at least a fortnight sooner, and things that season had come on with a rush since the hot spell of the middle of May.

Accordingly, about eleven a.m. on the 4th of June, after a tramp of over two hours, I found myself at this collecting groud. It was a hot, sultry day, and soon after noon thunder began to rumble in the west. The only blossom that seemed to be luring insects—indeed almost the only blossom that was fully out at this time—was choke-cherry, and I had been renewing my acquaintance with quite a number of old friends including *Cyrtophorus verrucosus*, when I suddenly spied a specimen of the strange little *Anaglyptus* of 1907 in a cluster of choke-cherry. The shrub on which I captured it was only a few yards from the rail fence that skirted the wood, but there was choke-cherry in abundance running right out to the end of no-man's land. Every cluster on this fateful shrub I carefully scanned; then every cluster on two or three neighbouring shrubs; then a straggling tree of choke-cherry, drawing down its branches one by one and ranging closely over the flower clusters. By this time I had captured five specimens; then I hunted over most of the choke-cherry towards the outer end of the promontory, and drew an absolute blank; then I came back towards the wood on a more northerly line, still unsuccessfully, till I reached the fence on the skirts of the wood proper; here in a large tree of choke-cherry I captured one more (six); then I returned to the scene of my first captures and almost immediately took a pair mating, and presently (treading on one another's heels) three singletons. And on the instant the sun was blotted out, the sky grew violet ink and the rumbling threats of distant thunder became a present reality; down came the rain and I fled for the road.

I was soaked long before I got there, but took shelter under a large balm of gilead; while standing there I noticed on the opposite side of the road a small shrub of choke-cherry, which served to feed my spleen during the rest of the storm. Everything was deluged before the thunder passed, and more work in wood or field that day was out of the question; but before setting off on my eight-mile homeward trudge, I stepped sardonically over the way to the draggled little shrub of choke-cherry; and there in its clusters, snug and fairly dry, I found two specimens of *Cyrtophorus verrucosus* and one more of my little enigma. The roads were a perfect quagmire, my clothes were wringing wet, my boots were sodden and cheeped and slithered at every step; one of the dreariest, most draggle-tailed trips I ever made; and I verily believe I would have been on the road yet, but for what I knew were the contents of my cyanide bottle, twelve genuine specimens of *Anaglyptus enigmaticus* including both sexes of the species.

The rest of the month proved wet and cold; the wood was so distant that it could only be visited at weekends; on my next trip I found the choke-cherry all over, and on the dogwood and viburnum that were rioting in its place I could find no further trace of the beetle. Right on the north margin of the wood, however, on spiked maple, I captured one solitary specimen on June 12th and two on June 18th. Sixteen specimens—counting the unique capture of 1907—made a fine series for comparison. But I found, now, reason to deplore having put my mating pair into the cyanide bottle instead of segregating them. Not that I had a shadow of doubt myself about this being a genuine species; I was absolutely certain of that before I ever saw a pair together; but how could I convince my fellow-collectors? As soon as I got the insects out of the killing-bottle, I examined the antennæ: all fifteen specimens had the second joint less than half the length of the fourth; not one of them, therefore, was the female of *Microclytus gazellula;* equally certain was it they were all one species and comprised both sexes. Some days later I relaxed them all carefully on damp blotting paper in a covered tin box, and with a fine pair of forceps drew the antennæ taut over the back in a straight line parallel with the suture; in eight specimens the antennæ were as long as the body, in eight they just overlapped the median band of pubescence.

I enclosed a pair in a box which I posted to Mr. C. A. Frost, of Framingham, Mass., asking him if these were not the insect Casey had named for him *Microclytus frosti.* Then I sent to Rochester for a micrometer scale and to Guelph for the loan of one or two specimens of *M. gazellula* from the Society's collections, explaining that I wished to make a comparative study. Presently came a letter from Mr. Frost that my insect *was* his insect, and both (he believed) were Dr. LeConte's insect *M. gibbulus.* Next came a parcel from Guelph containing two more specimens of the identical insect I had just captured, both labelled *Microclytus gazellula.* I then wrote to Mr. Frost and to some other collectors in the States for specimens of the genuine *M. gazellula,* but not one of them so far has been able to secure a specimen for me. For several months I advertised in the *Canadian Entomologist* but with a like want of success.

In the autumn of 1916 I got a letter from Mr. Frank Mason, of Philadelphia, to say that the beetle I wanted was extremely rare and that he had only a single specimen; his letter incidentally served to complicate matters by declaring among other things that the insect in question was now listed not as *Microclytus gazellula,* Hald., but as *Anaglyptus compressicollis,* Castenau and Gory; for it at once began to dawn on me that if there were two insects so similar as to have long been mistaken for one another, the problem of nomenclature was likely to be no less complicated than that of my capture's natural status; unless the types of Castenau and Gory's description in the thirties and of Haldeman's description in the fifties had been preserved, no one would ever know which of these two little jokers had sat in either studio for his portrait.

For my part I was drawn rather to the question of the insect's true place in nature, and proceeded to apply, among other things the micrometer scale I had purchased from Bausch and Lomb to a solution of the problem. To supplement the single specimen of *M. gazellula* in my cabinet, I borrowed Dr. Watson's genuine example of 1907 from Port Hope, and then selected several specimens (male and female) of my insect that tallied in size with these two. The examination resulted in a discovery of no little interest and perhaps some importance. If you refer to LeConte and Horn's classification you will find it stated that *M. gazellula* has the second antennal joint long—fully half as long as the third and nearly as long as the fourth. Now in regard to the relative length of those three joints, this is a perfectly true statement; but the peculiar proportion in this species is due not to the greater length of joint 2, but to the abnormal shortness of joints 3 and 4. The length of the second joint of *Microclytus gazellula, Microclytus gibbulus* and *Cyrtophorus verrucosus,* in specimens of the same size and quite irrespective of sex differs not a hair's breadth, i.e., in all three insects it is extremely short. The peculiarity of *M. gazellula* consists in the third joint being only twice (instead of three or four times) and the fourth joint only one-and-a-third times (instead of two or three times) the length of the second point. The mistake is a natural one, almost inevitable; it is due to an optical illusion; the eye passes in all three insects along the third joint, a very long one, to the fourth, a much shorter one; then back to the second, and finding the second in *M. gazellula* almost the length of the fourth, but in *M. gibbulus* and *Cyrtophorus verrucosus* much less than the fourth, judges the second accordingly to be absolutely long or absolutely short.

In *M. gazellula,* then, the second antennal joint is perfectly normal for the group, but joints three and four are abnormally short; and from this follows an important corollary; the remaining joints bear a fixed relation to the first three, and if in *M. gazellula* these basal joints are shorter than in the other members of the group, the whole antenna will be shorter. I have been able to examine only three specimens of *M. gazellula,* and in none of them does the antenna, when drawn taut, exceed the median band of pubescence, while in one large specimen it does not even reach the second diagonal line of pubescence; I feel confident this last is a female and I would venture to prophesy that no specimen of the genuine *M. gazellula* will be found (even male) with antennæ exceeding the median band. In *M. gibbulus,* as I have said, the male antennæ are as long as the body and the female slightly exceed the median band. There are other differences that I could mention between the insects—as in the white marks on the under side, the prevalence of long flying hairs, and the shape of the prothorax—but I should overstep the limits of time and patience.

These micrometer tests were made in the late fall of 1916, and all this time I was so busy planning for the next season's campaign, that during most of the intervening months I went about like one in a dream. You may have thought, perhaps, you met me, or even stopped and spoke with me that winter, but all you really saw was the empty jacket of my body, a "toom tabard" wholly uninformed: heart and soul, I was far away at the Wood of Desire, stalking *Microclytus gibbulus.* In November I bought a bicycle; in April I learned to ride it; in May I got half a hundred pill-boxes and as many gelatine capsules, and, like some itinerant quack gathering samples for his nostrums, proceeded to trundle myself out to the Wood of Desire.

The choke-cherry, like other blossoms, was more than a week late this year, but I managed to get in about three good days' collecting in June while the blossom was at its height, and the results of my campaign in more than one respect will astonish you. Of this obscure little insect I actually captured over seventy specimens in one day, twenty on a single tree, including a mating pair; all this on choke-cherry and before the 15th, but even in the last week of the month I bagged a belated little covey of five, three on dogwood and two on spiked maple; the captures were made at four different points on the wood's edge, over a mile apart between extremes; and the entire catch for the season was upwards of one hundred specimens. Of these I brought home over fifty alive in the solitary confinement of my little pill-boxes; I then turned the captives loose into a large cardboard box with a slab of glass over the top. In a quarter of an hour I had secured eighteen mating pairs in my insect Agapemone.

While watching the movements of these little beings I found myself curiously reminded of animals we usually reckon far higher in the scale of creation. For I observed the most diminutive male in this assemblage—a perfect Lilliputian—having evidently singled out his mate, make a bee-line for the largest female in sight; and, to complete the analogy, his suit prospered and he presently waltzed away like the hero of Hans Breitmann's party with the Matilda Jane of Brobdingnag. Traces of this same eccentricity of preference, it is whispered, have been found among human beings; nay, specimens have actually been collected by anthropologists and transferred to their cabinets, pinned and labelled "Atavism"; poor hapless freaks of human frailty, caught like Ares and Aphrodite in the meshes of a science as pitiless as the art of Hephæstus, and exposed in all the nakedness and shame of cold print to the inextinguishable laughter of the Olympians and of their fellowmen.

Having now absolute proof of a genuine species, male and female, I proceeded to take up some points that I had left in abeyance last year. Among the letters received while searching for *M. gazellula* I had had a very courteous note from Chas. W. Leng, in which he offered to send me his specimens of the beetle for the comparative study I had been minded to make of these two Dromios. Since that letter of his in 1916 I had found that Mr. Leng was as deeply committed as Dr. Hamilton and Prof. Wickham to the heresy that my capture was the male of LeConte and Horn's *M. gazellula,* Hald. In July last I, therefore, wrote to Mr. Leng suggesting that I should send him five or six specimens (male and female) of my capture for him to compare with the material he had labelled *M. gazellula.*

The evidence of these specimens proved quite convincing, and Mr. Leng has prepared a paper called "Microclytus, a Correction." In the course of it occurs a most interesting passage which records how the confusion first arose. It appears that Mr. Leng had in his collection two specimens from Canada labelled *M. gazellula,* and, when comparing notes sometime in the eighties with Dr. Horn, found in the latter's collection two specimens from New England labelled *M. gazellula;* he then noticed that his insect differed from Dr. Horn's in the proportion of its antennal joints 2-4; the beetles were otherwise so entirely alike that neither collector suspected the presence of two distinct species, and both agreed that the Canadian specimens must be males and the New England ones females of *M. gazellula,* Hald. They thereupon exchanged each of them one specimen with the other! And this was the *fons et origo malorum;* to it may be traced the sinking to a synonym of LeConte's *M. gibbulus* from Lake Superior, and the subsequent identification of all captures made of either insect as *M. gazellula,* Hald., male and female.

In September last I sent some pairs of my capture to Mr. Charles Liebeck, of Philadelphia, and he is still at work on the evidence. Meantime he has made me two communications which serve to support the contention made. *First,* that we have unquestionably two quite distinct species to deal with, and that he has never before seen two insects so essentially different correspond so closely in elytral markings and external appearance; and *second,* that he believes he has put his finger on the very source of the whole error, *for in Dr. Horn's collection he finds the specimens labelled M. gazellula, Hald., male and female, are one of them my insect and the other LeConte and Horn's.* This, fortunately, is quite independent testimony, for Mr. Leng's paper is still unpublished, and I had made no mention of its contents in writing to Philadelphia.

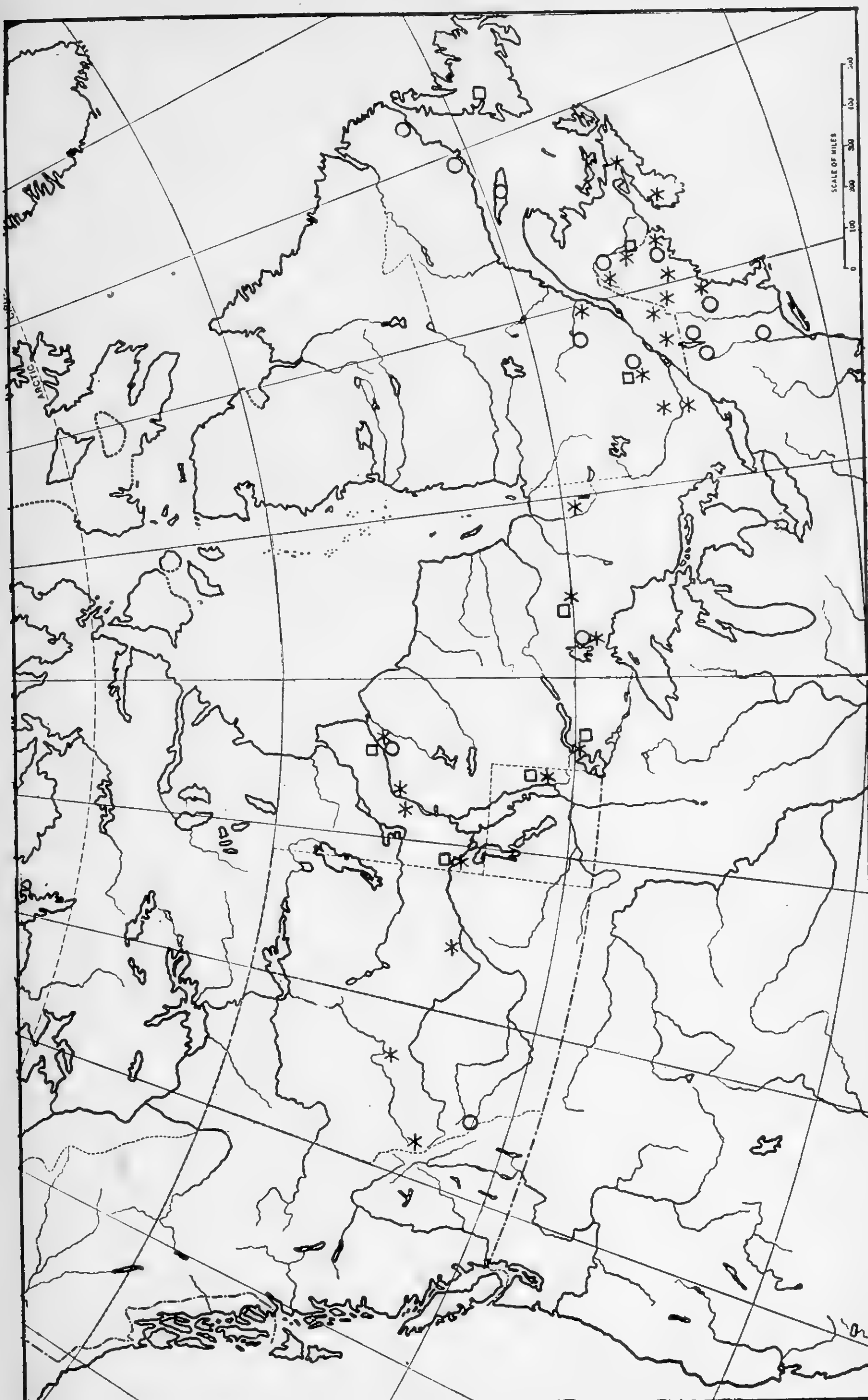
TRANSCANADIAN SPIDERS.

J. H. Emerton, Boston, Mass.

About the year 1890, Mr. J. B. Tyrrell, who was fresh from exploration in the north of Canada, sent me a little collection of spiders. About the same time, Mr. Bean, who kept the telegraph office at the Canadian Pacific Railway Station at Laggan, was collecting insects through the mountains, and incidentally spiders, and he sent me some for identification, so I wrote a paper on Canadian spiders, which was published in 1894 by the Connecticut Academy. Many of these spiders were from the western part of Canada, and nearly all were of species known in the east, but at that time hardly anything was known about their distribution across the continent. Among the species collected by Bean was one since known by the name of *Linyphia nearctica,* which was described in the 1894 paper and not noticed again until fourteen years later, when for the first time I went to the top of Mt. Mansfield, in Vermont, near Lake Champlain, and there found it abundant in the dwarf spruce trees. Going down the mountain it ceased to be found a thousand feet below the summit. Within a few years this species was found on the tops of several of the New England mountains from an elevation of 2,500 feet up to the highest trees. Although I had collected for many years in these mountains, this species had been missed, as my time had been spent either in the valleys or on the top above the trees, neglecting the upper edge of the forest. A few years later *Linyphia nearctica* was found on the coast of Maine, and soon after in bogs, through the northern part of that State, in association with *Theridion zelotypum* which had long been known as far south as Portland and no farther. These two species seemed to have such definite limits, and to be so easily found when they were present, that I was interested in following out their distribution, and so was led to transcanadian spiders in general.

In 1914 I went to the meeting of the Canadian Alpine Club in the Rocky Mountains, and returned east by a roundabout way to see the country north of the Saskatchewan River. In Jasper Park I was surprised to find, in company with distinctly western species, my old acquaintance of down east, *Theridion zelotypum,* living in the small spruce trees in the usual coarse cobwebs and cup-shaped nests. At Athabasca Landing I found it again, and also at Prince Albert. Discussing these finds among my friends led to the discovery of *Theridion zelotypum* by Mr. Waugh, at Nipigon and Manitoulin Island, and *Linyphia nearctica* by Messrs. Townsend and St. John on the southern coast of Labrador. Much of the seasons of 1915 and 1916 was spent in trying to define the southern limits of *Theridion zelotypum* between the White Mountains and the St. Lawrence River. It appears not to go into the White Mountains nor the Adirondacks, but is abundant around the head waters of the Connecticut River and the Rangeley Lakes. In Dixville Notch it is associated with *Linyphia nearctica* at an elevation of 1,800 feet. Westward it occurs at the southern end of Lake Megantic, at Sherbrooke, Montreal, and Ottawa.

Last summer I followed these two spiders along the edge of the Hudson Bay bog, at Cochrane, Minaki and Lake Winnipeg to Le Pas and down the Hudson Bay Railway as far as it is finished. *Theridion zelotypum* was abundant at all these stations and conspicuously absent from the prairie country around Winnipeg and Dauphin; *Linyphia nearctica* only appeared at Kettle Rapids, the most northern station. The spots on the map show the stations of these two species, the *Theridion* in stars and the *Linyphia* in circles, and they form on their southern


ARCTIC
SCALE OF MILES

border a fairly definite line by which the distribution of other species can be measured. The squares show the stations of *Linyphia limitanea.* This was first found on the Aroostook River, near the boundary between Maine and New Brunswick, and at the same time in Newfoundland. It follows westward nearly the same distribution as *Theridion zelotypum,* but does not come quite as far south. To avoid complication these three species are the only ones plotted. *Theridion montanum* covers the southern part of the range of *Theridion zelotypum* and extends farther south but not as far north. It goes into the New England mountains, but is not confined to high elevations like *Linyphia nearctica,* but comes down a thousand feet lower into valleys like the Crawford Notch.

All the spiders which have been mentioned make cobwebs and live in trees, preferably in spruce, and with them follow several other tree species of similar habits, but less definite distribution, *Lophocarenum decemoculatum* and *Grammonata pictilis* being the most constant.

On the ground under and near these trees wherever there is an accumulation of leaf mould or moss, other than sphagnum, lives another group of spiders apparently as regular in their distribution. *Theridion sexpunctatum* is one of these and extends from the coast of Maine to Vancouver. With it are *Pedanostethus fusca, Bathyphantes alpina, Tmeticus montanus, Tmeticus armatus, Tmeticus bidentatus, Cryphœca montana* and *Amaurobius borealis.* The recent Canadian Arctic expedition has brought back two minute spiders, *Tmeticus brunneus* and *Microneta crassimanus* from Nome, Alaska, both of which are rarely found in the upper forest of Mt. Washington, N.H.

Beside the spiders living in trees and in the moss there are some species living on the ground that follow the same distribution. *Lycosa albohastata,* a brilliantly coloured hunting spider, lives at Hopedale and Battle Harbor, Labrador, on islands off the coast of Maine, above the trees in the White Mountains, at Kettle Rapids in the Hudson Bay bog, and on Sulphur Mountain at Banff.

The southern limits of the spiders we have been reviewing correspond roughly with the southern limits of the spruce forest area; their northern limits are yet to be defined. Over the whole forest area and north, and to some extent south of it, range several species of *Lycosidæ* from Labrador to the Pacific coast and from Greenland to the mountains of Colorado. The most diffuse of these is perhaps *Pardosa glacialis.* It is found on both sides of Greenland, along the Labrador coast and south as far as Massachusetts, and at various localities across the continent. The recent Arctic expedition brought it from Coronation Gulf and Nome, Alaska, and it is on all the mountains east and west. *Pardosa groenlandica* is almost as widespread. It comes down the east coast as far as Portland, Maine, and is on the Pacific coast and all high mountain tops. *Pardosa luteola* lives in bogs and on mountain tops across the Continent, and *P. uncata* and *P. tachypoda* in all kinds of country, at a little lower level all the way across.

South of the coniferous forest many of the spiders of the plains and hardwood forest extend across the continent, among them several of the large Epeiridæ, *Epeira trifolium, marmorea, angulata* and *patagiata,* and of course the introduced house species.

Most of the transcontinental spiders extend to the eastern mountains or seacoast, where they were first known, but a few species cross part of the way from the west. *Epeira gemma* of California comes east as far as Medicine Hat. *Epeira aculeata* and *Sittacus rainieri* of the western mountains were found this summer along the Hudson Bay Railway in the same places as the rare *Habrocestum* (*Euophrys*) *cruciatum* and *Dendryphantes montanus* of the White Mountains.

A FURTHER REPORT ON THE VALUE OF DUSTING VERSUS SPRAYING TO CONTROL FRUIT TREE INSECTS AND FUNGUS DISEASES.

LAWSON CAESAR, GUELPH.

At our last annual meeting I gave an account of my experience in 1916 in dusting fruit trees with fine sulphur and arsenate of lead dust compared with spraying with the liquid lime-sulphur and arsenate of lead. This year I again carried out a similar series of experiments.

Before giving my results for this year, it is perhaps wise to mention that this new dust treatment has aroused a great amount of interest among fruit growers and that they are anxiously waiting for definite knowledge as to its merits. Hundreds of machines would be purchased at once if it were certain that dusting were as satisfactory and reliable as spraying. The reasons for this are as follows: (1) Dusting requires only about one-tenth the time in the case of large trees that spraying requires. For instance, the total time for spraying a large 20-acre orchard in any one season would be about three weeks, whereas the time for dusting would be not more than three days. This would be a wonderful boon, especially when labour is so scarce and costly, and when other important work such as cultivation of soil is pressing. (2) Dusting can be done at almost exactly the right time, which of course it is the duty of entomologists and plant pathologists to determine. This means, for example, that one need never fail with dust to treat his trees for Codling Moth before the calyces have closed. With liquid spray it is often impossible in warm, good growing weather to do this. This promptness of application is just as important for Apple Scab and enables the grower to wait until the blossoms or leaves are in just the right stage and yet make sure all will be treated before they are too far advanced. (3) The outfit for dusting is not so heavy as a power spray outfit and will go through wet ground where the latter would mire. (4) Dusting is not nearly so dirty a job or so hard on clothes, face and hands or on horses and harness. It is true that at times it is hard on the eyes, but this can be largely prevented by proper goggles and in any case it is soon over and done with. (5) There is no time spent in returning for fresh material and no time worth speaking of lost in refilling.

With all these advantages it is no wonder that the fruit grower hopes dusting will take the place of spraying, though we may be sure he will ask about the comparative cost.

COMPARATIVE COST OF DUSTING VS. SPRAYING.

We have not so accurate figures on the cost this year of dusting versus spraying, but they lead to the same conclusion as last year's, namely, that on large trees there is very little difference in cost between the two systems, whereas on smaller trees the liquid is considerably cheaper, though much will always depend upon the operator, as a careless man will be much more likely to waste dust than liquid.

SOME CHANGES IN METHODS OF APPLYING THE DUST AND IN THE MATERIAL ITSELF.

We used the same outfit this year as last, namely, the largest outfit sold by the Niagara Brand Spray Co. For grapes we added a short elbow to the pipe with a long opening facing towards the side so that the dust could be driven in at right angles or nearly so.

The materials this year differed chiefly in the fact that finely ground talc was added partly to act as a filler to the sulphur and lead or to the sulphur when used without the lead, and partly to keep it drier. Very fine sulphur alone tends to be sticky and will not scatter well.

The weather for the most part this spring was not calm enough to enable us to dust both sides of the trees on the same day by driving parallel with the wind and shooting the dust in at right angles; hence we were forced to dust at least one side directly with the wind. The fact is I adopted the method of dusting from at least three sides, or if changes of wind permitted it, from four sides, but lessened the quantity in each case, so that the total for each large tree would still remain approximately three pounds.

Acreage Covered per Day.

We never had a chance to test how much one man could do per day, but unless he became too tired he could probably cover at least twenty acres. We may say here that dusting is far from easy and many men cannot do it at all satisfactorily because they move their hands too slowly. There is need of special training for this work and the selection of a man who is not only quick with his hands but has also good judgment and intelligence.

Tests on Large Apple Trees.

Two orchards, which we shall call A and B, situated about three miles apart, both of which had been poorly treated the previous year and had borne almost unmarketable fruit, were chosen for the tests. Orchard A consisted of 262 trees and was about 7 acres in extent. Orchard B included about 9 acres but we treated only about 6 acres or about 200 trees.

In each orchard a block consisting of approximately one-quarter of the total number of trees was treated throughout with lime-sulphur and arsenate of lead. The remaining three-quarters of each orchard being moderately infested with San José Scale, received first a dormant or semi-dormant spray with lime-sulphur to kill the scale. Four rows, however, in each were dusted with sodium sulphide powder as a special test for scale. These trees as well as the remainder of the block in the later applications received only the sulphur-arsenate-of-lead dust. In orchard B only two dustings were given, the first just as the blossoms were ready to burst and the other just after the blossoms fell but before the calyces closed. In orchard A all the dust block received these same two applications, but fifty-three trees received an extra dusting on July 4th, three weeks after the blossoms had fallen. The object of this application was partly to see the effect on scab or sooty fungus, but chiefly to see how it affected Codling Moth.

Results on Foliage.

All the foliage was excellent this year, though that on the dusted area was a little better than on the sprayed, being in fact almost perfect.

Results on Apple Scab.

Orchard A had a crop of approximately 200 barrels fairly well distributed. The chief varieties were Greening, Baldwin and Golden Russet, but there were also a few barrels of Spy and in the dusted area one heavily laden tree of Snow. In both liquid and dust portions on all varieties even on Snow there was less than 1 per cent. scab. A Snow tree in a neighbouring orchard across the fence had over 90 per cent. of scab, and Baldwins and Greenings in it averaged about 50 per cent. scab. These trees had received only the dormant spray for scale.

The part of orchard A that received only two dustings in addition to the dormant spray were just as free from scab as the part that had received three, thus showing the third application was not required for scab this year. This was generally true in most of the Province. In orchard B the liquid portion had not more than 1 per cent. scab. The dusted part varied greatly, some trees being almost totally free while others of the same variety had as high as 15 per cent. scab. The varieties were chiefly Greening and Baldwin. The average of scabby fruit would not be more than 10 per cent. The crop was very light, only about twenty barrels on six acres, so that the test was not a good one. About three acres of the orchard not in our blocks had received the dormant spray and part of the pre-blossom spray. This part showed from 20 per cent. to 80 per cent. scab.

Results on Sooty Fungus.

There was practically no Sooty Fungus even in unsprayed orchards in the district.

Results on Codling Moth.

Codling Moth this year almost all over the Province was exceptionally abundant and caused more than the usual percentage of wormy fruit. This was partly due to the smallness of the crop with the consequent greater number of larvæ attacking the individual apples than if there had been a larger crop and more apples for the worms to distribute themselves among.

In orchard B where no later spraying or dusting than the regular calyx application was done, fully 50 per cent. of Baldwins and Kings were wormy, and about 25 per cent. of R. I. Greenings. There was very little or no difference in the efficiency of the dust compared with the liquid. Almost every worm in each case had entered through the side. On unsprayed trees in the same orchard the percentage of wormy fruits varied from 60 to 90, and of these 50 per cent. or more entered by the calyx.

In orchard A the dust gave just as good results as the liquid where both parts received only the one application for Codling Moth, but both were quite wormy, having as high as 30 per cent. of the fruit infested. The block of fifty-three trees that had received a second dusting three weeks after the blossoms fell showed a great improvement over the rest and had not more than 10 per cent. wormy fruit.

Dusting for San José Scale.

Last year I tried sodium sulphide dust mixed with hydrated lime upon large apple trees before the buds burst as a method of killing San José Scale. The work owing to certain difficulties was poorly done and the results not satisfactory.

This year I planned to dust four rows of trees, forty-eight trees in each case, with sodium sulphide mixed with talc. Several trees in each plot were badly infested. In orchard B both sides of the trees were dusted, dusting of one side being just after a rain, but the other when the trees were dry. Parts of both sides were re-touched. In all about five pounds per tree were used, so that the mixture was given a good chance.

In orchard A the weather during our work was continuously dry, and after dusting one side of the trees I felt so certain that the mixture would not kill the scale that I merely applied the remainder of my material to the same side and did the other side very thoroughly with lime-sulphur.

RESULTS. To my great surprise this year no scale was found on either of these plots. The fact is that we made such a cleaning up of the scale in both orchards that only two scales in all were found and these might easily have been introduced by a bird or insect. I am not surprised at the results from the liquid, but I am surprised at those from the sodium sulphide dust. I thought that if the trees were moist one could hope for such results, but from my observations I did not hope for it when the dusting was done on dry trees. The results clearly justify further tests.

Results Obtained from Dusting Elsewhere in Ontario.

At Guelph, Prof. Crow used the sulphur-arsenate of lead dust on his apple orchard, but failed to control the scab. About 66 per cent. of Snows and 50 per cent. of Spy are scabby, and other susceptible varieties are also dirty. There is very little doubt that with liquid spray he would have succeeded much better.

At Brighton an able fruit grower spent much money on dusting his large orchard and gave more than the regular number of applications, but was much disappointed with the results. Two other equally good growers not far from him treated their orchards with liquid and had beautifully clean fruit, nearly 99 per cent. free from scab. One of these orchards received only three applications in all.

At Whitby about half of the Government demonstration orchard was sprayed with the liquid and the remainder dusted. The results were decidedly in favour of the liquid, though the utmost care was taken to do the dusting well and at the right time, and though extra applications were given in all weather favourable to scab. Dusted Snow trees there had as high as 50 per cent. scab.

Conclusions Regarding the Merits of Dust for Apple Orchards.

In spite of the excellent results I obtained last year and again this year, I fear very greatly that it will be much safer to continue to use the liquid spray at least for a number of years longer until improved dust substitutes or improved machinery or both are available, and until a larger percentage of those who test it can obtain satisfactory results. A duster could, of course, on a large fruit farm help to tide over an emergency where an extra treatment must be given quickly. The great weakness of the dust method in my opinion is its failing to adhere sufficiently long in wet weather to the fruit and foliage.

A Valuable Field Other Than Apple Orchards for the Use of Dust.

Our experiments in two excellent sweet cherry orchards, each consisting of about ninety large trees of several varieties, has shown a very valuable use for dust. Everyone who knows much about sweet cherries knows that it is very difficult, especially in warm, moist weather, to keep the crop from being ruined or nearly ruined by the Brown Rot fungus. The trouble hitherto has been that while liquid spraying either with lime-sulphur or Bordeaux mixture would ward off this disease as long as the mixture remained on the fruit, these substances could not be applied near enough to the time of picking to prevent rot attacking the fruit then, because they would stain the fruit so much that it could not be marketed.

The sulphur dust, however, without any poison in it gets over this difficulty, because it does not stain anything. It may, therefore, be applied even a day or two before picking and unless followed by prolonged heavy showers will protect the fruit until it is marketed.

Having thought of this plan we tested it out on the above-mentioned sweet cherry orchards. The fruit was kept clean up to a few days before picking—in one orchard by three well-timed applications of liquid lime-sulphur and in the other by two of these and one dusting. These were followed in both orchards by a thorough dusting one or two days before picking. As a result in one orchard there was less than 1 per cent. of rotten fruit, in fact my assistant placed it at 1/10 of 1 per cent., though a large check tree in a more exposed situation had over 80 per cent. of infected cherries. Moreover, in spite of the weather this year being very favourable for rot and causing great losses to cherry growers, the owner told me that this was the first time in many years he had been able to harvest the fruit off several of the trees that were specially susceptible to the disease.

The other orchard was a little later in maturing its fruit and was subjected to several very heavy rains before it was all picked. These washed the sulphur off the later fruit. Nevertheless all the earlier varieties yielded a very clean crop and it was only on the later varieties that any appreciable amount of loss occurred, though even here there was not much loss. An extra dusting of these trees would have prevented this.

Since the Brown Rot of cherries attacks also plums, it is clear that the same plan could be used of protecting varieties very subject to this disease.

It takes so few minutes to dust 100 cherry trees that a dozen fruit growers could purchase a duster among them and thus make the cost to each very little. The cost of the material, namely, sulphur with ground talc as a filler, in normal times would be $3.00 or less per 100 pounds, which is less than half the cost when arsenate of lead is added to the sulphur, so that the material would not be very expensive. We feel that the adoption of this method of preventing rot would mean the saving of many thousands of dollars annually to growers of stone fruits.

FATHER LEOPOLD: Have you tried dusting for the control of scab of pears?

PROF. CAESAR: We did not try dusting on any variety of pears subject to scab, and I cannot speak regarding that.

FATHER LEOPOLD: This year for the first time we have sprayed our 65 acres of orchard by dusting instead of with liquid spray. The liquid spray machine we had before was burnt in the fire. For apples we had a marvellous success all along, but we had the worst and most scabby pears I have ever seen in my life. We had good success last year on pears with lime-sulphur wash. I think the leaves are so glossy that the dust will not stay on, and of course this applies to the fruit also. The leaves and fruit of the apple tree are more hairy, and the dust will stick on better. I may say that we had 85 per cent. clean fruit in the 65 acres of orchard, but the MacIntosh was especially good—95 per cent. clean. We had a loss with Wealthy because they were not properly sprayed. None of the Wealthy apples ever had scab before, but of course this has been an exceptionally bad year. With regard to Codling Moth, wherever two sprays were applied we had very good success. Last year we had over 35 per cent. Codling Moth in our orchard, but this year the orchard was clean and free from Codling Moth to the extent of 90 per cent. We made no liquid sprays at all this season.

MR. PETCH: With regard to the value of spraying against dusting, I do not think it matters very much which you use so long as it is done thoroughly and repeatedly. This year was a very bad year for scab and we dusted and sprayed, in order that we might test out both methods. The results were 99 per cent. clean fruit on the sprayed portion and 97 per cent. to 98 per cent. on the dusted portion. The sprayed portion received one more spray, i.e., the dormant spray, otherwise the orchards were sprayed as far as possible on the same day, and there was no division at all in the orchards; it was all done in one orchard, side by side, taking 90 trees in each portion. With regard to dusting I have found that a man who has had a little training in dusting will be apt to have better success than a man with a longer training in liquid spraying. It takes a very good man to spray a tree, whereas a man taught for a very short time with a duster can get good results. I have found that a man spraying for several years will sometimes miss branches of certain portions of the tree with the spray, and on those branches there will be scab, but there will not be even one scabby spot in the dusted portion. We sometimes find that a limb or branch has been overlooked on trees with the heaviest crop of apples, and every apple on these limbs will be affected by scab, and of course this means that the apples are put into class 2 or 3. In the dusted portion the dust settles all over the tree, and does not require the careful attention to reach every branch that the spraying does. Professor Caesar may differ from me in this, but that is my experience, and as regards spraying I may say that we have a very good example in an old orchard badly infested with scab which I think was well known to Macdonald College men last year. The man had the cleanest crop of Fameuse in the Province of Quebec, after spraying thoroughly four times. This year he said: "I am not going to get a large crop anyway, and I am not going to bother very much about spraying." He sprayed the Fameuse once and the others he did not spray at all, with the result that there was 88 per cent. scab. Last year he had 98 per cent. clean fruit in a year which was just as bad as this has been for scab. Last year out of 1,050 barrels packed 1,010 were 2's and 3's, but this year although our crop was not so large we had about 97 per cent. clean fruit. I spoke last night about what can be done by reaching the farmers. Some of these men have sprayed ever since the spray has come into the county, and the Demonstration Orchard men have been sent out to them and have stayed with them for years, and yet this year nearly half, or at any rate a quarter, of their apples were No. 3's.

Father Leopold: What percentage of fillers did you use? We have been using 60 per cent. to 40 per cent. fillers in our orchards.

Mr. Petch: A mixture of 45 per cent. fillers to obtain these results.

Prof. Caesar: I think Professor Brittain made some tests with the dust.

Prof. Brittain: We did make some tests this summer, and our results were so very uneven that I find now I do not know nearly as much about the matter as I thought I did in the spring. We used various strengths of sulphur—40 per cent. to 90 per cent.—through the different orchards. The head of the Botanical Branch and I each took over a small orchard for testing purposes, and I may say that he had the better one—an orchard that has been properly looked after for years, one of the best sprayed orchards in the district, on light sandy land, with splendid air drainage, and with trees well pruned. I took one on heavy clay land, with poor air drainage and poorly pruned trees. He had good results, fruit over 90 per cent. clean, and found with regard to dusting that he had better control with 95 per cent.-90 per cent. than with 50 per cent. With spraying he got slightly better results than with any of the dusts, but on the best dusted fruit the difference was negligible. My orchard had 40 per cent. scab and the worst outbreak of Tussock Moth I have ever known. The Tussock Moth chewed holes in both sprayed and unsprayed portions. My dusted fruits were 90 per cent. scabby, and the check was 100 per cent. scabby. Did Prof. Caesar ever try tobacco dust?

PROF. CAESAR: Not that we could call a fair test and draw conclusions from.

PROF. BRITTAIN: I was very disappointed. A man in New York State assured me that it was a very efficient control for aphids. Green Apple Bugs were present in large numbers and we tried it, with the result that the Green Apple Bugs were chasing themselves around the tree just as lively as ever, and we had only one casualty in the whole tree.

FATHER LEOPOLD: How many times did you apply the dust?

PROF. BRITTAIN: Four times.

PROF. CAESAR: Perhaps Prof. Bunting can tell us something about this.

PROF. BUNTING: No. I may say, however, that I think it would be well for fruit growers to go cautiously at the present time with dust spraying. There seems to be a big difference of opinion amongst men who have been experimenting with both. We know that the liquid spray is very effective and a satisfactory control for most of our orchard pests. Someone has described an ideal spray as one that can be applied with the least inconvenience, in the shortest space of time, will control the largest number of pests for the longest possible season. No doubt dusting machines have done good service, but the fruit grower must have a dust machine and also a liquid machine to spray an orchard at the present time. I think it would be wise for the average orchardist to go cautiously in adopting the dusting machine.

PROF. CAESAR: Where the same man did the work in an orchard at Whitby the liquid spray gave much better results than dusting. I do not advocate the purchase of a dust sprayer for the average fruit grower.

A FEW NOTES ON THE ECOLOGY OF INSECTS.

W. LOCHHEAD, MACDONALD COLLEGE, P.Q.

In its broad aspect the ecology of insects deals with these animals in relation to their environment. It is evident, therefore, that a short paper such as this cannot discuss adequately the whole field of relations between insects and their environment, for this would require volumes. The object of this paper, however, is to touch briefly upon a few aspects of the subject with the hope that more attention may be given to the study of the problems involved to the end that they may help in solving some of the problems relating to the control of injurious insects.

INTER-RELATIONS BETWEEN INSECTS AND PLANTS.

Long continued observations show that there are "all grades of association between plants and insects from most casual contact to mutual dependence, and that there are grades of fitness on both sides." (Needham, *General Biology*.) The important part played by many insects in the fertilization of plants is well known. To this end many beautiful adaptations occur among plants such as in legumes, iris, milkweed, yucca, orchids, mints, figworts, honeysuckles, canna, Smyrna fig, etc., but it should be borne in mind that there has been also much adaptation on the part of the insects.

Another type of inter-relation is the *galls* seen on many plants, produced by certain insects. The chief gall-producing families are the *Cecidomyiidæ Trypetidæ, Aphididæ, Psyllidæ, Cynipidæ* and *Tenthredinidæ*. Mites (*Acarina*) also produce galls. Usually an egg is laid the growing tissue and the larva excites the surrounding tissue to abnormal growth. The transformations occur within the gall, and the adult escapes.

Galls are of various forms, often characteristic of the insects producing them. The nutritive cells lying next to the contained larva contain both sugar and starch and appear to function as feeders for both the larva and the growing cells of the gall, as our fellow-member Dr. Cosens has most admirably shown in his recent studies.

Insectivorous Plants.

Certain plants such as the sundew, Venus's fly-trap, pitcher-plant and bladder-wort entrap small insects and feed upon them. These plants secrete digestive fluids which convert the tissues of the captured insects into liquid food capable of being absorbed.

Bacteria and Fungi.

Many caterpillars die from bacterial diseases. Silk-worms, cabbage worms, army worms, gypsy moth caterpillars, grasshoppers and tent caterpillars are frequently killed by bacteria. Certain fungi also destroy insects. *Cordyceps* destroys white grubs, wireworms and many caterpillars; *Empusa* is often responsible for the destruction of house flies, plant lice, grasshoppers, crickets and caterpillars; and *Sporotrichum* kills many kinds of insects. Attempts have been made to control chinch-bugs and grasshoppers by artificial cultures of *Sporotrichum* and *Coccobacillus,* but only with partial success.

Insects as Carriers of Plant Diseases.

Flea-beetles by eating holes in the leaves of potato permit the entrance of the spores of Early Blight (*Macrosporium solani*) and consequent partial destruction of the leaves. It has also been shown fairly conclusively that certain aphids and other insects* act as carriers of Twig Blight (*Bacillus amylovorus*) of apples and pears, and it is now believed that the Squash-bug (*Anasa tristis*) the Striped Cucumber Beetle (*Diabrotica vittata*), the Twelve-spotted Cucumber Beetle (*D. 12-punctata*), the Cucumber Flea Beetle (*Epitrix cucumeris*), the Melon aphis (*Aphis gossypii*), and the 12-spotted Ladybeetle (*Epilachna borealis*) frequently inoculate the stems of cucurbits with the cucurbit wilt (*Bacillus tracheiphilus*). Again, the punctures made by the Plum curculio in plum, cherry, and peach permit the entrance of the spores of the Brown Rot disease (*Sclerotinia fructigema*). Tree crickets (*Oecanthus* spp.) are said to be responsible for the inoculation of trees and shrubs with canker, of raspberries with the Cane Blight, and probably for the production of other diseases.

Inter-relations of Plants and Insects in Nature.

The idea of inter-relations in Nature was first emphasized by Sprengel, Darwin and Müller, and later ecological studies reveal still more clearly how

*Gossard mentions among others *Aphis avenæ, Empoasca mali, Eccoptogaster rugulosus,* and *Lygus pratensis.* "Any sucking insect can become a carrier, also any insect with the bark-burrowing habit."

all Nature is linked together into a system, one part dependent upon another in an intricate web of life. Disturbances in one portion of the system are followed by disturbances in another. We have already indicated in previous sections some of the relations between insects and plants, between insects and birds, and between insects and their parasites. Numerous other relations might be mentioned but these are sufficient to show that a knowledge of these relations is an important part of the equipment of the economic entomologist who would deal successfully with the problems confronting him.

In a region undisturbed by man the various parts of the system of Nature have practically reached a state of balance through the ceaseless action for long ages of the "struggle for existence." Plant struggles with plant, animal with animal, and both with the environment. With the advent of man, however, the balance has been disturbed by the clearing of the forests, the cultivation and drainage of the land, the growing of crops, and the introduction of foreign plants and animals, since the new set of conditions will be favorable to the increase in numbers of certain plants and animals, including insects, and unfavorable to others. This disturbance is often widespread. Favored insects will multiply rapidly on account of the abundant supply of food furnished by the cultivated crops, faster at first than their parasitic enemies; and insectivorous animals such as snakes, toads, birds and predaceous insects will be deprived of the necessary shelter and hiding places by the clearing of the land, and become less abundant.

On the other hand insects not favored by the destruction of their food plants under the new conditions will diminish in numbers, as will also their parasites, both sometimes no doubt to the verge of extinction. If, however, as is sometimes the case, conditions again favor the insect it will multiply very rapidly because the development of the parasite lags behind its host. Moreover, there is always a limit to the increase of the parasite, otherwise it would exterminate its host, and eventually itself.

Again, the development of insects is sometimes influenced by the soil conditions. For example, sandy or gravelly soils seem to favor the multiplication of such insects as the plum curculio, and the grape root worms. But another factor, namely, the influence of the soil on the plant, must not be overlooked. Plant growth on sandy and gravelly soils is retarded and is to a certain extent abnormal, and the plant is less resistant to attacks of insects. On the other hand, strong rich soils may induce vigorous growth, also to a certain extent abnormal, when the plant is preyed upon by certain insects like plant lice and scale insects which thrive best upon succulent growth.

This relationship of soil insects to climate and soil conditions has been recently discussed in the *Agricultural Gazette* by Dr. A. E. Cameron, of the Entomological Branch, Ottawa, who is attempting to get some definite information out of the chaos of many apparently conflicting observations, a condition due mainly to the imperfect determination of the measure of the operation of many factors. He finds that phytophagous insects of the soil frequent those soils where their food plants thrive, but as these plants depend on the type of soil—its structure, texture and composition, temperature and humidity, it is clear that these insects depend on the type of soil.

Again, predaceous soil forms are dependent on the presence of phytophagous soil forms, and a change in any one of the factors constituting a habitat will have an influence on the fauna.

As a physical index of the varied conditions controlling soil insects it is believed that the evaporating power of air is the most important one, inasmuch as it is an expression of the combined effects of air, temperature, pressure, humidity, wind velocity.

This whole subject requires much additional study.

The inter-relations of plants and insects become more involved when it is known that certain varieties and species of economic plants are more liable to attack by insects than other varieties and species. Treherne in a recent article in the *Agricultural Gazette of Canada* brings forward some instances of this kind. Spring wheat in certain localities in British Columbia is severely troubled with the wheat midge, while fall wheat is seldom attacked. But he notes that the early and late sowings of the spring wheat are not so seriously injured as the mid-season sowing. Again, the grape-blossom midge injures the early varieties of grapes, such as Morris Early, Warden, Champion and Massasoit, more than the Concord. In the serious invasion of the Hessian Fly in Ontario in 1900-01 the writer observed that certain varieties of wheat were injured more than others. The Imperial, Egyptian and Michigan Ambers, Walker's Reliable and General Grant, were but slightly infested, while Dawson's Golden Chaff, Turkey Red, Treadwell and Red Chaff were badly affected. At the same time it was observed that the Dawson's Golden Chaff was not seriously attacked in New York State.

Treherne also notes that the Northern Spy apple is practically immune from the woolly aphis, the Leconte and Kieffer pears from the San José scale, black currants and lettuce from *Peridromia saucia* cut-worm, and the red Dutch cabbages from the cabbage root maggot. In addition, he says: "The forest tent caterpillar (*M. disstria*) attacks sugar maple in preference to the soft maple, the latter being comparatively free from attack. He also records the fact that the spiny elm caterpillar (*Euvanessa antiopa*) rather seriously injures American elms, while Scotch and English elms are not preferred. Similarly, the maple scale (*Pulvinaria innumerabilis*) rarely injures the sugar and Norway maples, but attacks especially the soft maples. Dr. Felt has further rated various shade trees in New York in their order of susceptibility or immunity from attack by insects. The European elm sawfly (*Kaliosysphinga ulmi*) attacks the English and Scotch elms, including the Camperdown variety, in preference to the American elms (Slingerland, Cornell). The elm leaf beetle (*Galerucella luteola*) is reported as most seriously infesting the European elm and when other species of elm were found growing nearby preference seemed to be shown for it (Burgess, Illinois). The European elm scale (*Gossyparia spuria*) attacks the American elms more seriously than the imported English elms. (Doten, Nevada.) The fruit-tree bark beetle (*Euzophera semifuneralis*) clearly prefers the European or imported varieties of plum, but does occur in the native kinds; *Prunus simoni* has, however, thus far been worst affected by it. (Sanderson, Delaware). The white peach scale (*Diaspis pentagona*) a very polyphagous feeder, does not attack the Le Conte and Kieffer pears. (Gossard, Florida). The apple maggot (*Rhagoletis pomonella*) is noted particularly in the sweet and sub-acid summer varieties, while fall and winter sorts, including acid varieties are less infested. (Quaintance, U. S. Bureau.) The brown mite (*Bryobia pratensis*) is seldom observed on quince and apricot, although it attacks a great variety of trees including almonds and peaches. (Weldon, Colorado). The use of resistant vines against the grape phylloxera represents a good example of the value of selection. The wild vines of the Mississippi Valley states which have evolved in company with the *Phylloxera* possess the more resistant forms. The European vine (*V. vinifera*) is the most susceptible of all in California. (Quayle, California.)"

Insects and Birds.

When it is known that about two-thirds of the food of our common birds consists of insects, it becomes evident that the agency of birds in the control of insects is of the highest importance. The seasonal diet of the robin, blue bird, catbird, king-bird, flycatchers, chickadee, wren, swallow, woodpecker, cuckoo, night-hawk, warblers, oriole, and the other birds has been carefully studied in recent years, with the resulting discovery that insects form in most cases their only food, and only at certain seasons are small fruits eaten.

Birds are no doubt of special value to the farmer in nipping incipient scourges in the bud on account of their ability to move rapidly from place to place in search of food, and on account of their varied character and habits. Especially is this true of our winter birds which search every cranny and nook for the hibernating forms of insects at a season when every form destroyed means in most cases the absence of hundreds of thousands of their progeny the following summer.

Insect Behavior Toward Stimuli.

In recent years a large mass of facts regarding the behavior of insects to their environment—both organic and inorganic—has been accumulated, and in a few cases this information has been of service in the control of injurious forms. In general, however, the application of such methods of control is still in its infancy stage, but it gives promise of valuable results in the near future.

As the relations of insects to plants and to other insects have been discussed in previous sections, attention will be confined here to the behavior of insects under the influence of environmental stimuli such as light, heat, moisture, chemical contact, winds, etc.

For some time it has been known that plants show tropistic movements with regard to light, heat, gravity, moisture, contact, etc. Moreover, some progress has been made towards an understanding of the processes. Plants, for example, bend towards the light because the cells on the side away from the light grow faster than those on the side next the light. There is no conscious control of the movement by the plant. Animals, too, exhibit movements under the influence of tropic, or rather, taxic stimuli. In the case of insects, butterflies, bees, house flies, and many moths and caterpillars are positively phototropic or phototactic, and move towards the light, while maggots, bed bugs and cockroaches move away from the light.

Again, most moths move away from sunlight but move towards a lesser light such as electric or oil lamps. Davenport explains this difference by saying that "butterflies are attuned to a high intensity of light, moths to a low intensity." Loeb explains the circling of moths and other insects about a light. The stimulus orients the insect by its more intense action on the muscles next the light, and the insect then moves towards the light.

Loeb states that caterpillars of the Brown-tail Moth as they emerge from hibernation in spring are positively phototaxic, but after they have eaten this response disappears, showing that taxic reactions are sometimes dependent on the state of the body.

"Swaine finds that the destruction of piled logs by the wood-boring larvæ of the sun-loving *Monohammus* can be prevented by forming a dense shade over the logs by means of brush. In his study of the army cut-worm (*Euxoa auxiliaris*) in Alberta, Strickland found that the larvæ are negatively phototropic and hide beneath the soil till about four or five o'clock in the afternoon when they come to the surface to feed. With the weaker light they become positively phototropic and a general migration in a westerly direction takes place. When food is scarce hunger may overcome their aversion to sunshine with the result that the larvæ come above ground, but they still display a modified negative phototropism and migrate in a north-westerly direction. These facts are of practical value in controlling outbreaks of this insect." (Hewitt.)

Insects are very responsive to the stimulus of heat, i.e., they are thermotactic. Some insects respond to the stimulus of touch or contact, and are said to be either positively or negatively thigmotactic. Cockroaches are in the habit of squeezing into narrow crevices, and Loeb mentions the case of a moth (Pyrophila) which also has the same habit.

Chemical substances and foods also act as stimuli influencing the movements of insects. Maggots orient themselves with regard to their food and then move towards it, the orientation being the result of unequal chemical stimulation of the muscles of the two sides of the body. The deposition of eggs by most insects on certain plants is also the result of chemotropism. The house fly and many piercing insects such as the biting flies and mosquitoes are repelled by phenol and other coal tar products.

Wheeler and Loeb give several examples of geotropism among insects. They observed that lady-birds and cockroaches at rest placed themselves on vertical rather than horizontal surfaces.

Observations show that taxic* reactions are very adaptive. Ants and aphids are positively phototaxic when they get wings; and honey bees are periodically phototaxic, thus leading to swarming. Ants, moreover, are strongly thermotaxic, thus securing for their brood the optimum temperature conditions.

Relation of Insects to Temperature and Humidity.

Two important factors influencing the life of insects are temperature and humidity. Their general regulatory action has been known for a long time, but scientific data obtained in recent years enable us to speak more definitely regarding the behavior of insects toward the varying temperature and humidity of their environment.

Pierce in his studies of the Cotton Boll Weevil and other forms says: "A careful study of the records of any species, charting for the time required for each activity and the temperature and then similarly for the humidity will disclose temperature and humidity points of maximum efficiency. With the Boll Weevil these points lie approximately near 83 deg. F. and 65 per cent. relative humidity."

Ewing has found that a constant temperature of 90 deg. F. prevents the development of *Aphis avenæ,* and that the optimum temperature for the production of the wingless agamic forms is about 65 deg. F. The larvæ of the common House Fly are killed at a temperature of 105 deg. F., and the close-packing of manure is sufficient to prevent the breeding of flies.

With regard to changes in humidity insects vary somewhat widely in their reactions. For example, moist air is favorable to most aphids and hastens the development of the larva of the Hessian Fly. On the other hand dry seasons favor the development of the Chinch Bug and the Wheat Midge.

The investigations of Bachmetjew show that humidity is an important factor modifying the effects of temperature, and that the metabolic activities of insects

*The term *taxic* is now more commonly used than *tropic* when applied to the movements of animals under the action of stimuli just referred to.

are related to both temperature and humidity. He says: "Apparently there is a degree of atmospheric humidity which being the most favorable to the maximum speed of insect metabolism should be designated as the optimum; that this optimum varies for each species, for each stage of each species, and for each stage of each individual.

It is a well-known fact that most species of *Thrips* and Red Spiders are more abundant, and hence more injurious, under warm dry conditions.

The Codling Moth is an example of a common insect whose development is greatly influenced by weather conditions. Even within the limits of a single state or province the rate of its development and the time of its stages are influenced by latitude, by early and late seasons, by cool and warm seasons, and by wet and dry seasons. The student will find in the observations of Simpson in Idaho, Pettit in Michigan, Sanderson in New Hampshire, Caesar in Ontario, Headlee in Kansas, Siegler and Simanton in Maine, Brooks and Blakeslee in Virginia, and Forbes in Illinois much valuable data for investigations on the relation of insects to climatic factors.

FRIDAY AFTERNOON, 1.30 O'CLOCK.

A motion picture film on "Field and Parasite Work on the Gipsy and Brown-tail Moths" was shown by Prof. Burgess in the local moving picture theatre.

The use of this film was obtained by courtesy of the U. S. Bureau of Entomology. It was followed immediately by another excellent film illustrating "Orchard Spraying in Nova Scotia," shown by Prof. W. H. Brittain.

THE EFFECT OF STABLE AND HORN FLY ATTACKS ON MILK PRODUCTION.

A. W. Baker, O. A. College, Guelph.

At the annual meeting of the Society in 1916 the writer gave a paper on "Some Repellents for Stable and Horn-Flies on Cattle." At that time the question was raised as to whether or not fly attacks had any effect on milk production. Accordingly during the summer of 1917 a spraying experiment was carried out with milch cows in an endeavor to find the effect of fly attacks on milk production, or rather the benefit to be derived from a prevention of these attacks.

Two lots of five cows were selected. Unfortunately, one cow aborted during the course of the experiment, so that milk records could be kept of only four cows in one lot. From July 17th to July 31st one lot was sprayed once a day and the other lot left unsprayed. From Aug. 1st to Aug. 12th the lots were reversed in spraying and from Aug. 13th to Aug. 25th the lots were again reversed. In taking the milk records the first two or three days of each period were discarded, leaving 10 days in which the effect on yield was considered.

During the first period and part of the second, the cattle were sprayed before the afternoon milking. During the remainder of the second period and the third period spraying was done before the morning milking.

The following table shows the lots of cows, sprayed and unsprayed, with the milk production of each cow for the last ten days of the period and the total milk production of the lot for the same time.

TABLE OF MILK PRODUCTION.

	July 17th—July 31st.				Aug. 1st—Aug. 12th.				Aug. 13th—Aug. 25th.			
	Lot.	Cow.	Milk.	Total Milk.	Lot.	Cow.	Milk.	Total Milk.	Lot.	Cow.	Milk.	Total Milk.
			Lbs.	Lbs.			Lbs.	Lbs.			Lbs.	Lbs.
Sprayed.	A	6	281.3		B	188	299.8		A	6	230.6	
		7	191.1			194	210.7			7	182.7	
		10	127.6	1012.8		193	150.7	911.8		10	82.6	880
		191	263.6			232	250.6			191	247.3	
		185	149.2							185	136.8	
Unsprayed	B	188	312.3		A	6	253.7		B	188	255.6	
		194	244.7			7	186.7			194	196.0	
		193	141.7	972.9		10	85.5	911.5		193	129.1	788.2
		232	274.2			191	241.1			232	207.5	
						185	144.5					

It must be borne in mind in examining these figures that there is a normal loss in milk production from the middle of July to the end of August irrespective of fly attacks. This loss is due of course to drying up of pastures and was especially evident in 1917. Under normal conditions this loss is gradual, so that in three periods such as used in this experiment the middle would represent practically an average of the first and last.

An examination of the table of milk production shows us that such an average production during the middle period was not evidenced where the cattle had been sprayed for part of the time.

Lot A during the first period of ten days, sprayed, gave 1,012.8 lbs. of milk. and in the third period of ten days, also sprayed, gave 880 lbs. of milk. During the second, or unsprayed period, the lot, however, gave 911.5 lbs. of milk, which is 35 lbs. or approximately 4 per cent. *less* than the average of the two sprayed periods.

Lot B during the first period, when unsprayed, gave 972.9 lbs. of milk and in the third period, also unsprayed, gave 788.2 lbs. During the second, or sprayed, period this lot gave 911.8 lbs. of milk, which is 31 lbs., or approximately 3¾ per cent. *more* than the average of the two unsprayed periods.

A comparison of the production of the two lots serves more strikingly to point out the benefit derived from spraying. Lot A containing 5 cows in the first ten days when sprayed produced 40 lbs. more than lot B containing 4 cows unsprayed. In the third period lot A of 5 cows sprayed produced 92 lbs. more than lot B of 4 cows unsprayed. In the second period, however, lot B of 4 cows sprayed produced a fraction of a pound *more* than lot A of 5 cows unsprayed.

This comparison of the two lots also shows the advantage of morning spraying. Lot A in the first period when sprayed in the afternoon gave only 40 lbs. more than lot B unsprayed, whereas the same cows in the third period, when sprayed in the morning, gave 92 lbs. more than the unsprayed lot. The afternoon spraying was less than 50 per cent. efficient as compared with the morning spraying.

due of course to the fact that the cows had poor protection during the heat of the day, when fly attacks were at their height.

We find that the increased milk production through the use of a repellent in certain periods was approximately 4 per cent. in those periods. However, since the afternoon spraying, which was carried on over considerably more than one-third of the time, was less than 50 per cent. as efficient as the morning spraying it follows that the production during the period when morning spraying was practised must have been increased nearly 6 per cent. I should say in this connection that, due to difficulty in securing assistants for summer work on the department, we were forced for a time to use inexperienced and somewhat incompetent help and I feel that there were times when the spraying was not as thoroughly done as was necessary. Accordingly, we feel that another season's work will give even more marked results.

In considering the increase in milk production through protection of cattle from fly attacks by the use of repellents, it must be borne in mind that this increase in production is secured without any increase in plant, stock or equipment. There is also no increase in overhead save the cost of the spray material, as the time required for spraying is so short that no additional help is required. Two men should spray a herd of thirty cows in 25 to 30 minutes.

The repellent used in this work was a home-made spray mixture, a modification of the repellent described in the paper given at the last annual meeting of the Society.

The ingredients are as follows:—

Kerosene	1 gallon
Slightly sour milk	1 "
Fish Oil	1 "
Strong hot soap solution (about ½ cake laundry soap)	1 "
Oil of Citronella	6 ounces

The kerosene and milk are mixed and thoroughly agitated to form an emulsion; the fish oil and hot soap solution are then mixed and thoroughly agitated and the two emulsions are then mixed and the whole very thoroughly agitated. The 6 ozs. of oil of citronella is stirred in when the mixture is cold. This makes quite a stable stock solution. It is advisable, however, to stir up the stock solution thoroughly each time any is taken out. When not in use the stock solution should be kept covered.

The materials for this four gallons of stock solution cost about $1.83. In the work outlined here the repellent was used in the proportion of one part of stock solution to two parts of water. The mixture as applied, therefore, cost 15¼ cents a gallon. In the proportion of 1 to 2 of water 1 gallon as applied should suffice for one spraying for about forty cows. The cost of the spray material used in the experiment was therefore about 55 cents.

The pump used was a small, cheap hand sprayer of the atomizer type, such as is used for spraying small garden patches.

NOTES ON TWO UNUSUAL GARDEN PESTS IN NOVA SCOTIA.

W. H. BRITTAIN, PROVINCIAL ENTOMOLOGIST FOR NOVA SCOTIA.

THE POTATO STEM BORER (*Gortyna micacea* Esp.)

Like so many of our injurious insects this species is evidently introduced from Europe. A short description of the larva is found in Newman's "British Moths." Stainton, in his "Manual of British Butterflies and Moths" Vol. 1, p. 198, states that the larva feeds in the roots of various Cyperaceæ. In "British and European Butterflies and Moths" by Kappel & Kirby, it is said that the larva lives in the roots of *Glyderia spectabilis,* etc. Buckler in his "Larvæ of British Butterflies and Moths" states that the larva feeds on *Equisetum.* He gives the following account of the larva:—

"Larva of *H. micacea*, three-quarters grown, 1 1/16 in. long. The color of the back and sides down to the spiracles was a rather deep purplish red-brown without gloss, and a little paler on the thoracic segments and at the divisions; the sides below the spiracles and belly and the legs were paler and of a dingy flesh color; the head, ochreous brown, the mandibles blackish brown; a polished ochreous brown semi-circular plate on the second segment rather broadly margined in front with blackish brown; a small shining pale ochreous plate on the anal tip, having a terminal border of very small dark warts. At the beginning of July the larva has attained 1⅜ in. long, having meanwhile grown paler on the back and by the tenth of the month the upper and lower surfaces were both alike, of a deep smoky dull flesh color. In this case the larva had fed on Equisetum, but at this date it ceased feeding and excavated a hole in the earth at the side of its pot; in which by the 15th it emerged to a light ochreous brown pupa ¾ in. long from which the moth emerged in August, 1914."

Miss Omerod publishes an account of certain outbreaks of the insect in potato stems in her report on injurious insects for 1898. One outbreak occurred at Fyvie, Aberdeenshire, Scotland, and reports of similar outbreaks were received from Melton Mowbray and from Daleally, Errol, N.B., but in this case no moth was reared. She states that larvæ sent in July 20th pupated the third week in August and moths appeared the middle of September. This fairly closely approximates the life history of the insect as determined for Nova Scotia. In "Entomological Notes" in the Journal of the Board of Agriculture, Vol. 4, p. 519, there is a brief account of the insect and its work. Grünberg, in "Die Süsswasserfauna Deutschlands," published at Jena in 1910, gives a description of the adult of this insect and discusses the food habits of the larvæ, mentioning *Carex, Rumex* and *Iris* as host plants.

The insect was first recorded as occurring in Canada by Mr. Gibson in the 39th Annual Report of this Society, pages 49-51. Mr. Gibson summarizes the literature dealing with the pest and records its discovery at two widely separated points, viz., Westport, N.S., and Tramore, Ont. In both cases the larva was boring in a corn stalk.

The moths have also been taken by Mr. McIntosh at St. John, N.B., who records the insect under the name *Hydroecia medialis,* Smith. The writer records the ravages of the insect in Nova Scotia in a short article published in the Proceedings of the Nova Scotia Entomological Society for 1915, pp. 96 and 97.

No records of complaints of the work of the insect can be found until the summer of 1914, when serious damage was reported to potatoes in gardens at Yarmouth. Specimens of larvæ were obtained and adults reared to maturity from this material. In the same season the rhubarb plantation at the college was visited by a serious attack of this pest which practically destroyed the crop both

1 2 3

4

Potato Stem Borer (*Gortyna micacea*).

1. Eggs in situ on stem.
2. Larva, side view, enlarged about two times.
3. Pupa, dorsal view, enlarged about two times.
4. Adult enlarged about four times.

that and the following year. In the fall the rhubarb was all taken up and the ground plowed and well cultivated. In 1916 it was planted to cabbage and cauliflowers. In 1917 there was no further appearance of the pest though the land was planted out to potatoes.

During the past summer more complaints reached the office regarding this insect than any other one pest. Never a mail arrived during its active season, that did not bring letters of specimens.

Frequent mention was made in the press regarding this "new potato bug" and accounts of its ravages, often exaggerated, gained wide circulation.

We did not have an opportunity of making any detailed study of the insect, but were able to secure the general outlines of its life history and to observe its injuries. The eggs are laid by the female moth during the latter part of August and in September. They are doubtless laid on various weeds, but we have only found them on couch grass (*Agropyrum repens*) where they are very difficult to detect. They are laid loosely and frequently in rather large numbers, attached to the stem, generally being partially surrounded by the leaf sheath. The eggs, which do not appear to have been noted by other workers, are a little less than one millimeter in diameter, circular in outline, faintly ribbed and slightly tinged with pink.

The larvæ emerge in June and bore a tiny entrance hole in the stem through the centre of which they bore, causing it to wilt and die. In the rhubarb they frequently bore through and through the crown of the plant, but in potatoes and corn they confine their attention to the stalk. The injury continues through the latter part of July and into the early part of August, when the insect transforms to a pupa, to emerge late in August or in September, as an adult moth.

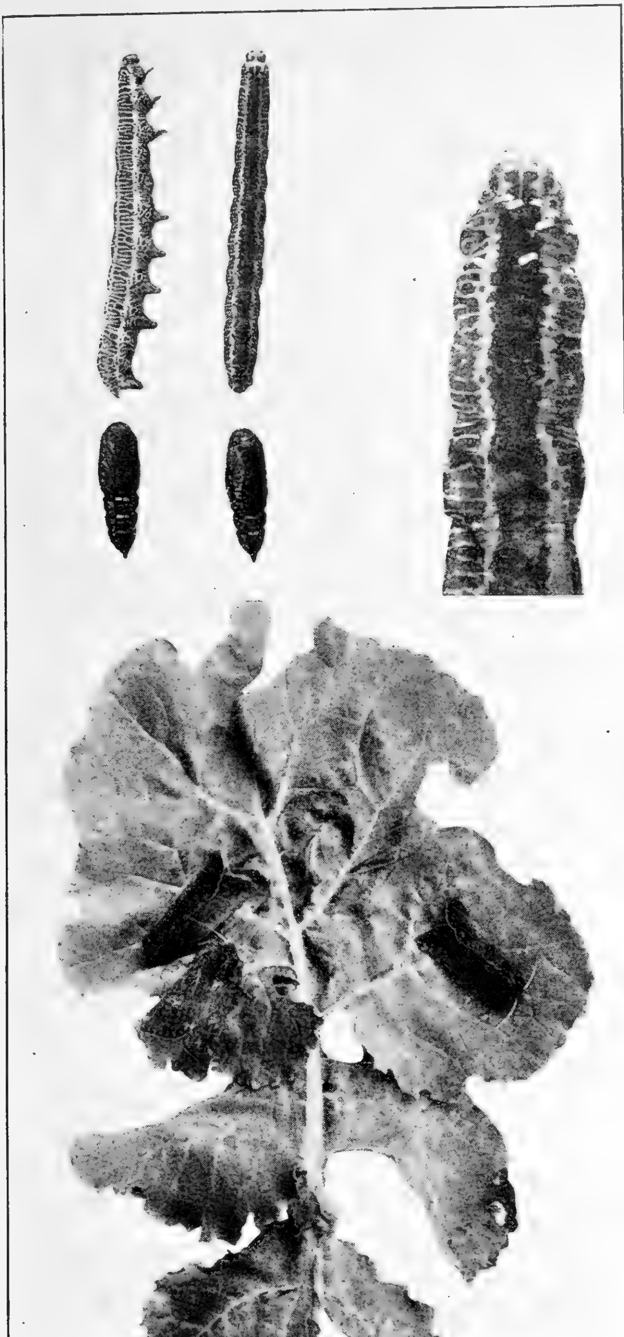
The unusually severe outbreak of this pest during the past year may have been partly due to the great increase in the number of back yard gardens, frequently planted in situations that had formerly been badly overgrown with weeds that would be likely to harbor the pest. The clean cultivation of the plantation during the oviposition period is an obvious step to take. In a permanent plantation, such as rhubarb, this is particularly necessary and in land that is planted continuously in garden crops. Gardens should not be planted on waste land that has been allowed to grow to weeds in previous seasons. Whenever possible such land should be thoroughly plowed and cultivated the previous fall in order to destroy as many eggs as possible. As the insect is chiefly a garden pest, picking the injured stalks and destroying the caterpillars is practicable and should be done to prevent outbreaks in future seasons. It is obviously impossible to attack the insects by means of insecticides.

The Zebra Caterpillar (*Ceramica picta* Harr.)

Unlike the former species, this is a native insect and occurs intermittently over a wide range in the United States and Canada. I have been able to locate about forty-five references to the work of the insect in American literature, consisting for the most part, of brief notes indicating that the pest is not considered to be one of major importance. Neither Chittenden or Sanderson mention it in their text books. O'Kane gives it a few lines stating that it feeds on garden crops of various sorts, especially beets, spinach, celery and peas.

It is apparent from the references to the insect in entomological literature that, while it cannot be considered an unusual pest, serious outbreaks are a somewhat rare occurrence, at least such outbreaks as have been experienced in the Annapolis Valley during the past two years.

1 2

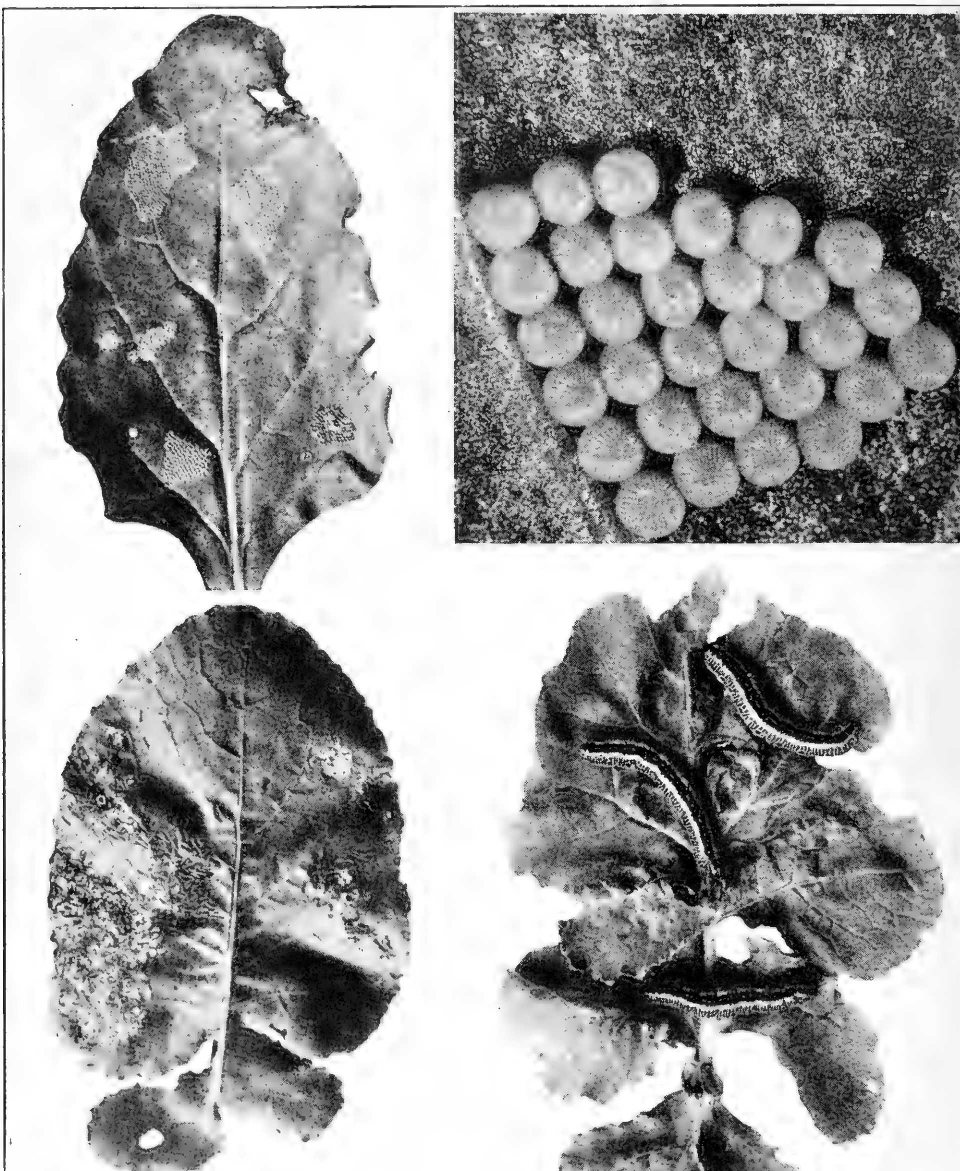


3

Zebra Caterpillar (*Ceramica picta*).

1. Larva, lateral and dorsal view, and pupa, ventral and dorsal view.
2. Larva with egg of tachina parasite near head. Enlarged.
3. Adults at rest on turnip leaf.

1 2



3 4

Zebra Caterpillar (*Ceramica picta*).

1. Turnip leaf with egg masses attached.
2. Eggs greatly enlarged.
3. Newy hatched larvæ on turnip leaf.
4. Mature larvæ on turnip leaf.

In 1915, Zebra caterpillars of the second brood were found to be quite common, though not particularly injurious, in the neighborhood of Kentville, but the next year was the first that any complaint regarding injury, was received. In 1916, there was a very serious outbreak in some localities, mostly in Kings County and numerous turnip fields were stripped of their leaves, the greater damage was being done, as usual, by caterpillars of the second brood. Full grown larvæ collected about Kentville in the fall, were found to be heavily parasited and it was thought that there was little danger of a serious outbreak the next year.

This proved to be true as far as the vicinity of Kentville was concerned, but further west in western Kings and Annapolis counties, and in parts of Digby and Yarmouth counties, there was an equally—if not a more severe outbreak, even the first brood caterpillars being fairly numerous and destructive in some cases. All the farmers, with scarcely an exception, stated that the insect was a new pest—one that they had never seen before. This does not necessarily indicate that the pest was a new one to our province and the nature and distribution of the outbreak would make this possibility extremely unlikely. It does indicate, however, that the period between outbreaks must be comparatively long.

Of the various crops attacked, turnip fields suffered most. Sometimes after the leaves were stripped, the caterpillars would attack the roots themselves and devour a sufficient amount to do considerable damage. On several occasions the larvæ were observed to migrate from one field to another after the manner of the army worm. This occurred when the particular crop upon which they were feeding was entirely devoured. Migrations were observed from turnips to grass and from buckwheat to potatoes.

The insects seem to be quite careless regarding their diet, feeding upon, in addition to those plants already mentioned, beets, mangolds, beans, hydrangeas, sweet peas, pigweed and even apple and plum trees. Eggs of the moth were found deposited on apple leaves twelve feet from the ground.

On a small scale and where cheap labor was available hand-picking the leaves bearing egg masses or nearly hatched caterpillars was the most economical remedy. Where this could not be done, dusting with powdered arsenicals applied by means of a blower, gave very satisfactory results.

THE ENTOMOLOGICAL RECORD, 1917.

ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, DEPARTMENT OF AGRICULTURE, OTTAWA.

Students of insects in Canada have again to acknowledge the many favours received from specialists in the United States and elsewhere for assistance in the determination of species. Dr. L. O. Howard and his colleagues, at Washington, have, as in the past, helped us very materially; Messrs. Barnes and McDunnough, have named many doubtful species of Lepidoptera; Messrs. Casey, Wickham, Liebeck, Leng, Fall, Frost, and Van Dyke have assisted in the Coleoptera; Messrs. Aldrich, Malloch, Johnson, Hine and M. C. Van Duzee, have determined Diptera, and Mr. J. H. Emerton has continued to examine spiders. All of these specialists, as well as others who have assisted us, have our sincere thanks.

Literature.

Among the books, memoirs, etc., (which have appeared during 1917) of interest to Canadian students the following may be mentioned:

Banks, Nathan. Index to the Literature of American Economic Entomology, January 1, 1905, to December 31, 1914: American Association of Economic Entomologists, Melrose Highlands, Mass. This most useful volume of 323 pages is a continuation of the Bibliography of Economic Entomology, which was published by the Bureau of Entomology, Washington, D.C. The insects and other headings are arranged alphabetically; under each are placed the references by author alphabetically.

Barnes William and McDunnough, J.H. Contributions to the Natural History of the Lepidoptera of North America; Vol. IV, No. 1. A Revision of the Genus *Hydriomena* Hbn., Decatur, Ill.: The Review Press, May 23, 1917, pp. 1-38, plates I-X. The results of this study are of particular interest to Canadian lepidopterists. The genus *Hydriomena* is one which has given much trouble and we are glad to have the results of this most recent study of these moths. A number of new species are described, and racial names given to several others. Four of these latter are from British Columbia, and one from Manitoba. Plates I to VI illustrate the various species, etc., many types being figured, and plates VII to X, illustrate male genitalia.

Bethune, C. J. S. Bibliography of Canadian Entomology for the year 1915: Trans. Royal Society of Can., Vol. X, Series III, 1916, pp. 169-187; separate received May 7, 1917. References are given to 175 papers; 71 of these relate to economic entomology; 12 to general entomology; 23 to lepidoptera; 13 to hymenoptera, etc.

Chagnon, G. A preliminary List of the Insects of the Province of Quebec, part III—Coleoptera; published as a supplement to the ninth annual report of the Quebec Society for the Protection of Plants; received Oct. 10, 1917. These lists are very useful. The list of coleoptera comprises 278 pages. Under each species, as in the two previous lists, the various known records are published. The author is to be congratulated on the completion of such a valuable list.

Funkhouser, W. D. Biology of the Membracidæ of the Cayuga Lake Basin; Cornell University Agric. Exp. Stn.; Memoir 11, June, 1917. This interesting memoir is the result of an extended biological study of the species found in the above district. It comprises pp. 181 to 445 and is illustrated with a number of figures and plates. Sixty-one species are discussed.

Garman, Philip. The Zygoptera, or Damsel Flies, of Illinois; Bulletin of the Illinois State Laboratory of Natural History, Article IV, June, 1917; pp. 411-586, plates LVIII-LXXII. Following valuable chapters on morphology, life-history and habits, and history of the Zygoptera, the classification of the species is dealt with. Generic and specific keys are given and descriptions of the nymphs and adults. The plates illustrate structural characters, etc.

Hebard, Morgan. The Blattidæ of North America north of the Mexican boundary: Philadelphia, Pa., Memoirs of the American Ent. Soc., No. 2, received Aug. 14, 1917; 284 pages, 10 plates. In this important contribution forty-three species are recorded as established within the United States and of these ten are probably introduced. Two indigenous forms and two established adventives are known to occur north of the Canadian boundary. Pages 259 to 274 deal more briefly with species found to be adventive but not established in portions of the United States and Canada.

MALLOCH, JOHN R. A preliminary Classification of Diptera exclusive of Pupipara based on Larval and Pupal Characters, with keys to Imagines in certain Families; Part 1: Bulletin of the Illinois State Laboratory of Natural History, Vol. XII, Article III, March, 1917, pp. 161-409, plates XXVIII to LVII. This is indeed an important contribution and one which will be welcomed by both economic and taxonomic entomologists. The plates illustrate, chiefly, larval and pupal characters. The paper deals primarily with Illinois species.

MELANDER, A. L. and SPULER, ANTHONY. The Dipterous Families Sepsidæ and Piophilidæ: Bull. No. 143, April, 1917, Agric. Exp. Sta., Pullman, Wash. The species discussed in this paper are commonly combined as the family Sepsidæ. Economically they are principally scavengers, feeding and breeding in filth, sewage, etc. Descriptions of twenty new species and six new varieties are included. Four are from Canada. The plate at the end illustrates modifications of femora and tibiæ of various species.

PARKER, JOHN BERNARD. A Revision of the Bembicine Wasps of America, north of Mexico: Proc. U.S.N.M., Vol. 53, pp. 1-55; published Feb. 10, 1917. This revision is based upon a study of the specimens in the United States National Museum and other important collections. A number of new species are described, only one of which, however, is from Canada. Interesting biological notes are given on pages 123-141. Eight plates showing structural characters are included.

PARSHLEY, H. M. Fauna of New England, 14; List of the Hemiptera-Heteroptera; Occasional Papers of the Boston Society of Nat. History, VII, Aug., 1917. This useful list will be of special interest to Canadian hemipterists of Eastern Canada, as many of the species herein recorded will undoubtedly be found in Quebec and the Maritime Provinces. Four hundred and nineteen species are listed, definite localities and dates of collection being given.

QUAINTANCE, A. L., and BAKER, A. C. A contribution to our knowledge of the White Flies of the Subfamily Aleyrodinæ (Aleyrodidæ): Proc. U.S.N.M., Vol. 51, pp. 335-445, with plates 32-77; published January 20, 1917. This contribution is in continuance of Parts 1 and 2 of Bull. 27, Tech. Series, U.S. Bureau of Entomology. One new species is described from Canada.

VAN DUZEE, EDWARD P. Catalogue of the Hemiptera of America, north of Mexico, excepting the Aphididæ, Coccidæ, and Aleurodidæ; University of California Publications; Technical Bulletins; Entomology, Vol. 2, pp. 1-902, Nov. 30, 1917. This catalogue undertakes to give a complete enumeration of all the described Hemiptera to and including the Chermidæ, recorded from or known to occur in America north of the southern boundary of the United States. The families Aphididæ, Coccidæ and Aleurodidæ have been omitted, largely because of the fact that Mr. Van Duzee has made no careful study of these groups. The numbering of the species in the catalogue has been made to correspond with that in the Check List published in 1916, by the New York Entomological Society, species published since being interpolated in the catalogue in fractional form. Mr. Van Duzee has been a great help to Canadian hemipterists and we congratulate him on the completion of this most valuable catalogue.

VIERICK, H. L., with the collaboration of A. D. MACGILLIVRAY, C. T. BRUES, W. M. WHEELER and S. A. ROWHER: State of Conn., Bull. 22, Geological and Natural History Survey; Part III, the Hymenoptera, or Wasp-like insects, of Connecticut. This most valuable part of the Guide to the Insects of Connecticut, prepared under the direction of Dr. W. E. Britton, was received in March, 1917. It is a large volume of 824 pages and 10 plates. Keys are included to families, sub-families, and species. Dr. Britton with the various authors are to be congratulated on the completion of this work which will prove indispensable to students of insects generally. The purpose of the volume is primarily, as Dr. Britton states, to present a ready means for determining insects belonging to the hymenoptera, along with such cardinal facts as will leave no doubt as to the desirability of becoming familiar with the order as a whole, and more especially with those forms that are beneficial to us and the few kinds that we call injurious.

WHEELER, WILLIAM MORTON. The Mountain Ants of Western North America: Amer. Academy of Arts and Sciences, Vol. 52, No. 8, Jan., 1917, pp. 457-569. In this valuable contribution many Canadian records are included. One new species, three sub-species and three varieties are described from Western Canada.

NOTES OF CAPTURES.

(Species preceded by an asterisk (*) described during 1917.)

LEPIDOPTERA.

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

Papilionidæ.

6. *Papilio zelicaon* Luc. Nordegg, Alta., July 12-17, 1917, 6,500 feet, (K. Bowman and F. C. Whitehouse).

Pieridæ.

39. *Euchloe creusa* Dbldy. Nordegg, Alta., July 12, 1917, 6,500 feet, (K. Bowman and F. C. Whitehouse).

Satyridæ.

103. *Coenonympha inornata* Edw. Toronto, Ont., (H. S. Parish). Addition to Toronto list.

119. *Cercyonis oetus* Bdv. Nordegg, Alta., Aug. 10, 1916, 5,000 feet, (F. C. Whitehouse).

Nymphalidæ.

198. *Brenthis youngi* Holl. Klutlan Glacier, Yukon, 9,000 feet, June, 1913, (H. F. J. Lambart).

202. *Brenthis astarte* D. & H. Nordegg, Alta., July 14-16, 1917, 6,500 feet, (K. Bowman and F. C. Whitehouse).

Lycaenidæ.

* *Lycaena lygdamus columbia* Skinner. "Vancouver"; Ent. News, XXVIII, 213.

Hesperiidæ.

488. *Hesperia centaureæ* Ramb. Nordegg, Alta., July 12, 1917, 6,500 feet, (K. Bowman and F. C. Whitehouse).

Sphingidæ.

671. *Dolba hylæus* Dru. Quyon, Que., Aug. 23, 1917, (J. I. Beaulne). Only one record in Winn's List of Quebec Lepidoptera, namely, "Dunham Co., VII, (Fyles)."

705. *Smerinthus jamaicensis geminatus* Say. Armstrong, B.C., July 12, 1915, (W. Downes). Only record we have for B.C.

706b. *Smerinthus cerisyi opthalmicus* form *pallidulus* Edw. Victoria, B.C., June 28, 1913, July 14, 1917, bred ex. pupa; new record for B.C.; have seen no other specimens in B.C. collections, (E. H. Blackmore).

Saturniidæ.

794. *Pseudohazis eglanterina* G. & R. Victoria, B.C., July 23, 1917; taken by a schoolboy on the outskirts of the city; first record for Victoria, (E. H. Blackmore).

Arctiidæ.

855. *Lexis bicolor* Grt. Pocahontas, Alta., Aug., 1916; Nordegg, Alta., July, 1917, (K. Bowman).

947. *Neoarctia yarrowi* Stretch. Nordegg, Alta., July 13-16, 6,500 feet, (K. Bowman and F. C. Whitehouse).

988. *Apantesis williamsi determinata* Neum. Murray Bay, Que., (J. G. Holmes). Previously recorded in Quebec Province from St. Agathe.

Noctuidæ.

1080. *Dysocnemis oregonica* Hy. Edw. Armstrong, B.C., May 5, 1907, (W. Downes).

1254. *Euxoa andera* Sm. Armstrong, B.C., July 10, 1915, (W. Downes).

1308. *Euxoa terrena* Sm. Victoria, B.C., Aug. 14, 1917, (E. H. Blackmore).

1313. *Euxoa ontario* Sm. Hymers, Ont. July 30, 1911, (H. Dawson).

1329. *Euxoa tessellata* Harr. Goldstream, B.C., Sept. 1, 1917, (E. H. Blackmore).

1332. *Euxoa esta* Sm. Goldstream, B.C., Sept. 1, 1917, one of the rarest Euxoas in the province, (E. H. Blackmore).

1438. *Agrotis rubifera* Grt. Armstrong, B.C., 1914, (W. Downes).

1475. *Epipsilia monochromatea* Morr. Bridgetown, N.S., May 26, 1914, (G. E. Sanders).

1561. *Abagrotis erratica* Sm. Victoria, B.C., Aug. 11, 1917, (E. H. Blackmore); first record from Vancouver Isl.; previously recorded from Kaslo, (J. W. Cockle) and has been taken at Okanagan Landing (J. A. Munro) and Armstrong (W. Downes)—E. H. B.

1628. *Anarta richardsoni* Curt. Kluthlan Glacier, Yukon, 9,000 feet, June, 1913, (H. F. J. Lambart).

1760. *Polia restora* Sm. Victoria, B.C., Aug. 19, 1916, (E. H. Blackmore); Aug. 25, 1916, (M. Brinkman).

1853. *Eriopyga infidelis* Dyar. Victoria, B.C., Aug. 14, 1917, (E. H. Blackmore).

1938. *Cirphis farcta* Grt. Armstrong, B.C., July 22, 1915, (W. Downes).

2168. *Graptolitha thaxteri* Grt. Montreal, Que., May 12, 1917, (A. F. Winn).

2177. *Xylotype capax* G. & R. Hymers, Ont., Sept. 15, 1911, (H. Dawson).

2178. *Eurotype confragosa acutissima* Grt. Murray Bay, Que., (J. G. Holmes). Addition to the Quebec list.

2187. *Eumichtis ducta* Grt. Smith's Cove, N.S., July 15, 1916, (C. A. Good).

2189. *Eumichtis miniota* Sm. Fort William, Ont., Aug. 19, 1907.

2254. *Septis antennata purpurissata* B. & McD. Victoria, B.C., July 25, 1916; July 21, 1917, (E. H. Blackmore).

2412. *Cerma cuerva* Barnes. Victoria, B.C., Aug. 25, 1916, (E. H. Blackmore). This species has previously been listed under the name of *olivacea* Sm.

Victoria is the only recorded locality in British Columbia for this species, which is rather rare, (E. H. B.).

2465. *Acronycta tritona* Hbn. Hymers, Ont., June 7, 1911, (H. Dawson).

2485. *Acronycta chionochroa* Hamp. Edmonton, Alta., May, 1910, (K. Bowman).

2489. *Acronycta innotata* Gn. Edmonton, Alta., June, 1916, (K. Bowman).

2613. *Menopsimus caducus* Dyar. Waubamic, Parry Sound, Ont., Aug. 4, 5, (H. S. Parish).

* *Xylomoia chagnoni* B. & McD. Rouville Co., Que., June 4; Mt. St. Hilaire, Que., July 4, 6, (G. Chagnon); Cartwright, Man., (E. F. Heath); Can. Ent. XLIX, 320.

2648. *Gortyna obliqua* Harv. Saanich, B.C., Sept. 22, 1916, (W. Downes).

3256. *Autographa nichollæ* Hamp. Rosedale, B.C., June 22, 1917, (E. H. Blackmore). This species occurs sparingly throughout the Lower Fraser Valley and has previously been listed under the name of *Euchalcia putnami* Grt., (E. H. B.).

3274. *Autographa ampla* Wlk. Victoria B.C., July 12, 1917, not previously recorded from this locality, (E. H. Blackmore).

3441. *Mycetophora inexplicata* Wlk. Waubamic, Parry Sound, Ont., July 12, (H. S. Parish); Edmonton, Alta., July 7, 1915, (D. Mackie).

Notodontidæ.

3596. *Datana angusii* G. & R. Jordan, Ont., June 30, 1916, (W. A. Ross).

Drepanidæ.

3757. *Oreta rosea* Wlk. Edmonton, Alta., July 12, 1916, (D. Mackie).

3758. *Oreta irrorata* Pack. Edmonton, Alta., July 12, 1916, (D. Mackie).

3761. *Drepana arcuata siculifer* Pack. Edmonton, Alta., June, 1916, (K. Bowman).

Geometridæ.

3862. *Acidalia frigidaria* Moesch. Edmonton, Alta., July 13, 1915, (D. Mackie).

3865. *Acidalia fuscata* Hlst. Edmonton, Alta., May 29, 1915, (D. Mackie).

3918. *Cosymbia lumenaria* Hbn. Rosedale, B.C., June 20, 1917, (E. H. Blackmore).

3981. *Lygris destinata lugubrata* Moesch. Montfort, Que., June 30, 1916, W. T. M. Forbes).

3982. *Lygris similis harveyata* Tayl. Edmonton, Alta., Aug., 1916, (K. Bowman).

3990. *Thera otisi* Dyar. Pocohontas, Alta., Aug., 1916, (K. Bowman). Mr. E. H. Blackmore, of Victoria, B.C., has informed me that the species recorded in last year's Record, under this name proves to be what he calls *Xanthorhoe incursata,* although it is rather doubtful if the insect is the real *incursata.*

* *Dysstroma mulleolata sobria* Swett. Victoria, B.C., June 22, 1914, (E. H. Blackmore); Can. Ent., XLIX, 69.

* *Dysstroma mulleolata subumbrata* Swett. Victoria, B.C., June 2, 14, 16, 22, 1914; June 24, 26, 1915, (E. H. Blackmore); Can. Ent. XLIX, 70.

* *Dysstroma mulleolata ochrofuscaria* Swett. Victoria, B.C., June 27, 1915, (E. H. Blackmore); Duncan, B.C., June 14, 1910, (A. W. Hanham); Duncan, B.C., Aug. 7, 1908, (G. O. Day); Vancouver Island, July 16, 1905; Can. Ent. XLIX, 70.

4014. *Hydriomena perfracta* Swett. Nordegg and Pocohontas, Alta., June-July, 1917, (K. Bowman). This, I understand, is now considered to be a distinct species and not a variety of *coerulata*.

* *Hydriomena exculpata tribulata* B. & McD. Kaslo, B.C.; Contr. Nat. Hist. Lep. N.A., IV, 14.

* *Hydriomena perfracta exasperata* B. & McD. Departure Bay, Van. Is., B.C., July 13, (G. W. Taylor); Wellington, B.C., June 23, (G. W. Taylor); Contr. Nat. Hist. Lep. N.A., IV, 19.

* *Hydriomena frigidata manitoba* B. & McD. Cartwright, Man., May 25, 28; Contr. Nat. Hist. Lep. N.A., IV, 17.

* *Hydriomena renunciata pernigrata* B. & McD. Skagit Basin, B.C.; Stickeen River, B.C.; Contr. Nat. Hist. Lep. N.A., IV, 25.

* *Hydriomena edenata grandis* B. & McD. Duncan, B.C., March 24-30; Victoria, B.C., April 8, 13, 16; Contr. Nat. Hist. Lep. N.A., IV, 33.

4042. *Xanthorhoe convallaria mephistaria* Swett. Goldstream, B.C., Sept. 3, 1917, (E. H. Blackmore).

4053. *Xanthorhoe congregata* Wlk. Edmonton, Alta., July 13, 1915, (D. Mackie).

4053. *Xanthorhoe salvata* Pears. Edmonton, Alta., July 18, 1915, (D. Mackie).

4092. *Epirrhoe alternata* Mull. Rosedale, B.C., June 22, 1917, (E. H. Blackmore).

4094. *Perizoma basaliata grandis* form *saawichata* Swett. Victoria, B.C., July 12, 1917, (E. H. Blackmore).

4115, 1. *Venusia obsoleta* Swett. Quamichan Lake, near Duncan, B.C., April 18, 1917, (G. O. Day).

4120. *Hydrelia albifera* Wlk. Rosedale, B.C., June 27, 1917. This is the farthest west record of this eastern species, Kaslo being the only other recorded locality in the Province, (E. H. Blackmore).

4158. *Eupithecia columbiata* Dyar. Edmonton, Alta., April 17, 1915, (D. Mackie).

4171. *Eupithecia casloata* Dyar. Rosedale, B.C., June 26, 1917, (E. H. Blackmore).

4218. *Eupithecia stellata* Hulst. Edmonton, Alta., July 23, 1915, (D. Mackie).

4226. *Eupithecia nevadata* Pack. Victoria, B.C., April 3, 1917, (E. H. Blackmore).

4243. *Eupithecia usurpata* Pears. Victoria, B.C., April 12, 1917, (E. H. Blackmore).

4323. *Drepanulatrix litaria* Hulst. Lillooet, B.C., Sept. 22, 1917, (A. W. A. Phair). This is the true *litaria* of which *fumosa* is a synonym. I also have it from Kaslo, B.C., (J. W. Cockle) and Ymir, B.C., (W. H. Danby). The species that Dr. Dyar listed in his Kootenay list as *litaria* is *falcataria* Pack., (E. H. Blackmore).

4332. *Philobia ulsterata* Pears. Cloverdale, B.C., July 9, 1917, (Bevan Hugh). This is one of the rarest of our B.C. geometers, the last previous record I have of this species is Vancouver, B.C., June 7, 1908, A. H. Bush, (E. H. Blackmore).

4341. *Macaria bicolorata* Fabr. Armstrong, B.C., 1913, (W. Downes).

4398. *Hesperumia sulphuraria* form *baltearia* Hulst. Armstrong, B.C., June, 1915, (W. Downes).

4407. *Itame brunneata* Thun. Montfort, Que., June 30, 1916, (W. T. M. Forbes). Addition to Quebec list.

4413. *Itame exauspicata* Wlk. Edmonton, Alta., July 18, 1915, (D. Mackie).
4429. *Itame hulstiaria* Tayl. Edmonton, Alta., May 22, 1915, (D. Mackie).
4478. *Platæa trilinearia* Pack. Lillooet, B.C., (A. W. A. Phair). This is an interesting record as the only previous recorded specimen for British Columbia was taken many years ago by Mr. H. Skinner, at Keremeos Creek, B.C., (E. H. Blackmore).
4488. *Nepytia semiclusaria pellucidaria* Pack. Lillooet, B.C., Sept. 22, 1917, (A. W. A. Phair); Armstrong, B.C., (W. Downes). New record for B.C., (E. H. Blackmore).
4553. *Cleora excelsaria* Stkr. Goldstream, B.C., June 3, 1917, at rest on the charred trunk of a pine tree, first specimen taken for over 12 years, (E. H. Blackmore).
4644. *Sicya macularia crocearia* Pack. Victoria, B.C., July 17, 1917; fairly common at night, has dimorphic females, (E. H. Blackmore).
* *Euchlaena albertanensis* Swett. Calgary, Alta., May 31, 1912, (F. H. Wolley-Dod); Edmonton, Alta., June 16, 1916, (K. Bowman); Edmonton, Alta., (D. Mackie); Can. Ent. XLIX, 351.
4711. *Selenia alciphearia ornata* B. & McD. Victoria, B.C., July 17, 1917, (E. H. Blackmore); Cloverdale, B.C., July 30, 1917, (Bevan Hugh).
4726. *Metanema quercivoraria* Gn. Cloverdale, B.C., June 28, 1917, (E. H. Blackmore); July 12, 1917, (Bevan Hugh).

Pyralidæ.

5098. *Phlyctænia acutella* Wlk. Waubamic, Parry Sound, Ont., July 15, 1916, (H. S. Parish).
5216. *Cataclysta magnificalis* Hbn. Waubamic, Parry Sound, Ont., July 12, (H. S. Parish).
5238. *Scoparia penumbralis* Dyar. Waubamic, Parry Sound, Ont., June 5, July 26, (H. S. Parish).
5254. *Pyralis costiferalis* Wlk. Waubamic, Parry Sound, Ont., July 12, (H. S. Parish).
* *Schœnobius amblyptepennis* Dyar. St. John's, Que., July 11, 1915, (W. Chagnon); Insecutor Inscitiæ Menstruus V, 80.
* *Schœnobius melinellus uniformellus* Dyar. St. Therese Island, Que., July 28, 1915, (W. Chagnon); St. John's Que., July 31, 1915, (W. Chagnon); Winnipeg, Man., (A. W. Hanham); Insecutor Inscitiæ Menstruus, V. 81.
* *Immyrla pasadamia* Dyar. St. John's Que., June 18, 1911, (W. Chagnon); Insecutor Inscitiæ Menstruus, V. 45.

Aegeriidæ.

6686. *Synanthedon corni* Hy. Edw. Waubamic, Parry Sound, Ont., July 12, (H. S. Parish).

Lyonetiidæ.

8135. *Bucculatrix pomifoliella* Clem. Hemmingford, Que., June 13, 1917, (C. E. Petch). Only one record, namely, "Montreal" in Winn's Quebec list.

Nepticulidæ.

* *Nepticula canadensis* Braun. Bear Creek, near Roger's Pass, B.C.; Trans. Amer. Ent. Soc., XLIII, 185.

Micropterygidæ.

8477. *Mnemonica auricyanea* Wlshm. Megantic, Que., July 6, Sherbrooke, Que.—Lake Park—July 5; Montfort, Que., June 30, 1916, (W. T. M. Forbes). Addition to Quebec list.

Hepialidæ.

8488. *Hepialus mathewi* Hy. Edw. Victoria, B.C., Sept. 23, 1917, (E. H. Blackmore). This species has stood under the name of *hyperboreus* Moesch. in B.C. collections for many years. It also occurs at Duncan, B.C., and Vancouver, B.C., (E. H. B.).

8493. *Hepialus montanus* Stretch. Victoria, B.C., May 3, 1915; June 20, 1916, (E. H. Blackmore).

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

(Henshaw's number.)

Cicindelidæ.

36. *Cicindela cinctipennis* Lec. Red Deer, Alta., July 8, 1917, (P. A. Taverner and C. H. Young).

Carabidæ.

77. *Omophron tessellatum* Say. Lanoraie, Que., June, July, 1915, (G. Beaulieu).

177. *Notiophilus semistriatus* Say. Miami, Man., June 28, 1916, (J. B. Wallis).

189. *Nebria gebleri* Dej. Lake Louise, Alta., Aug. 13, 1915, (J. B. Wallis).

231. *Dyschirius longulus* Lec. Husavick, Man., June 22, 1912; Winnipeg, Man., Aug. 16, 1916, (J. B. Wallis). New to Manitoba.

240. *Dyschirius erythrocerus* Lec. Miami, Man., July 6, 1914, (J. B. Wallis). New to Manitoba.

251. *Dyschirius pumilis* Dej. Aweme, Man., June 9, 1916. (N. Criddle). New to Manitoba.

254. *Dyschirius hispidus* Lec. Aweme, Man., June 9, 1916, (N. Criddle).

317. *Bembidium americanum* Dej. Husavick, Man., June 9, 1910, (J. B. Wallis). New to Manitoba.

374. *Bembidium approximatum* Lec. Weyburn, Sask., June 18, 1916, (N. Criddle).

385. *Bembidium æneicolle* Lec. Winnipeg Beach, Man., (J. B. Wallis).

388. *Bembidium intermedium* Kirby. Aweme, Man., July 27, 1916, (N. Criddle).

391. *Bembidium versicolor* Lec. Estevan, Sask., May 21, 1916, (N. Criddle).

398. *Bembidium morulum* Lec. Aweme, Man., June 10, 1909, (E. Criddle). New to Manitoba.

412. *Bembidium connivens* Lec. Ogema, Sask., June 16, 1916, (N. Criddle). New to Saskatchewan.

473. *Patrobus septentrionis* Dej. Gimli, Man., July 19, 1916, (Frances Burridge). New to Manitoba.

Trechus borealis. Husavick, Man., July 8, 1915. (J. B. Wallis). New to Manitoba.

671. *Amara farcta* Lec. Lethbridge, Alta., Aug. 23, 1912, (J. B. Wallis); Calgary, Alta., May 10, 1915, (W. H. T. Tams); Winnipeg, Man., May 3, 1912, (J. B. Wallis). New to Manitoba.

678. *Amara remotestriata* Dej. Lethbridge, Alta., Aug. 21, 1912, (J. B. Wallis); Bird's Hill, Man., Aug. 27, 1916, (J. B. Wallis). New to Manitoba.

898. *Lebia depicta* Horn. Winnipeg, Man., Oct. 4, 1912, (J. B. Wallis). New to Manitoba.

906. *Dromius piceus* Dej. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

1087c. *Harpalus erythropus* Dej. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

Haliplidæ.

Peltodytes sexmaculatus Robts. Bird's Hill, Man., Aug. 27, 1916, (J. B. Wallis); Miami, Man., Oct. 9, 1916, (J. B. Wallis). New to Manitoba.

Dytiscidæ.

* *Laccophilus inconspicuous* Fall. Winnipeg, Man., June 3, 1911, (J. B. Wallis); Edmonton, Alta., (F. S. Carr); Montreal, Que.; Jour. N.Y. Ent. Soc., XXV, 164.

1296. *Coelambus masculinus* Cr. Thornhill, Man., July 1, 1916, (J. B. Wallis); Winnipeg, Man., Sept. 23, 1916, (J. B. Wallis). New to Manitoba.

1298. *Coelambus unguicularis* Cr. Winnipeg, Man., May 11, 1912; Sept. 2, 1916, (J. B. Wallis). New to Manitoba.

1314. *Hydroporus undulatus* Say. Winnipeg, Man., Aug. 16, 1916, (J. B. Wallis). New to Manitoba.

1430. *Agabus congener* Payk. Winnipeg, Man., June 20, 1915, (J. B. Wallis).

1458. *Rhantus flavogriseus* Cr. Winnipeg, Man., Sept. 2, 1916, (J. B. Wallis). New to Manitoba.

Gyrinidæ.

1524. *Gyrinus pectoralis* Lec. Onah, Man., May 24, 1912, (J. B. Wallis); Winnipeg, Man., June 6, 1911, (J. B. Wallis). New to Manitoba.

Hydrophilidæ.

1582. *Hydraena pennsylvanica* Kies. Aweme, Man., July 21, 1903, (N. Criddle). New to Manitoba.

1590. *Tropisternus mixtus* Lec. Selkirk, Man., Sept. 23, 1911, (J. B. Wallis); Winnipeg, Man., Aug. 16, 1916, (J. B. Wallis). New to Manitoba.

1672. *Cercyon melanocephalum* Linn. Aweme, Man., July 4, 1910, (N. Criddle). New to Manitoba.

Pselaphidæ.

1875. *Tyrus humeralis* Aube. Aweme, Man., (N. Criddle).

Staphylinidæ.

2092. *Acylophorus pronus* Er. Husavick, Man., June 22, 1912, (J. B. Wallis).

2106. *Quedius lævigatus* Gyll. Aweme, Man., July 19, 1917, (N. Criddle).

Quedius curtipennis Csy. Aweme, Man., June 27; Sept. 6, 1917, (N. Criddle).

2128. *Staphylinus erythropterus* Linn. Aweme, Man., (N. Criddle).

2189. *Philonthus hudsonicus* Horn. Husavick, Man., June 22, 1912, (J. B. Wallis).

Philonthus protervus Csy. Winnipeg, Man., June 24, 1912, (J. B. Wallis). New to Manitoba.

2204. *Philonthus sordidus* Grav. Peachland, B.C., July 19, 1912, (J. B. Wallis); Winnipeg, Man., May 13, 1911, (J. B. Wallis). New to Manitoba.

2213. *Philonthus brevipennis* Horn. Aweme, Man., June 27; Sept. 6, 1917, (N. Criddle).

2220. *Philonthus punctatellus* Horn. Winnipeg, Man., May 6, 1912, (J. B. Wallis). New to Manitoba.

2221. *Philonthus nigritulus* Grav. Winnipeg, Man., May 30, 1912; Husavick, Man., June 23, 1912, (J. B. Wallis). New to Manitoba.

2251. *Actobius pœderoides* Lec. Winnipeg, Man., April 29, 1911, (J. B. Wallis).

2268. *Xantholinus cephalus* Say. Peachland, B.C., July 19, 1912; Winnipeg, Man., May 18, 1912; Miami, Man., July 2, 1914, (J. B. Wallis). New to Manitoba.

2319. *Stenus femoratus* Say. Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba.

2355. *Stenus corvus* Csy. Winnipeg, Man., June 6, 1916, (J. B. Wallis). New to Manitoba.

2358. *Stenus alpicola* Fauv. Husavick, Man., June 22, 1912, (J. B. Wallis). New to Manitoba.

2377. *Stenus humilis* Er. Onah, Man., May 24, 1912, (J. B. Wallis).

2389. *Stenus vinnulus* Csy. Onah, Man., May 24, 1912, (J. B. Wallis).

Platymedon laticollis Csy. Aweme, Man., May 2, 1916, (N. Criddle). New to Manitoba.

Lathrobium obtusum Csy. Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba.

2512. *Lathrobium punctulatum* Lec. Husavick, Man., July 3, 1910; Winnipeg, Man., Sept. 18, 1912, (J. B. Wallis). New to Manitoba.

2514. *Lathrobium nigrum* Lec. Husavick, Man., Aug., 1914, (J. B. Wallis). New to Manitoba.

2525. *Lathrobium concolor* Lec. Winnipeg, Man., April 17, 1911; Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba.

2526. *Lathrobium simplex* Lec. Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba.

2548. *Pycnorus* (*Scopæus*) *dentiger* Lec. Stony Mountain, Man., April 21, 1916, (J. B. Wallis). New to Manitoba.

2557. *Stilicus biarmatus* Lec. Winnipeg, Man., May 18, 1912, (J. B. Wallis). New to Manitoba.

2562. *Lithocharis obsoleta* Nordm. Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba. Col. Casey refers this to *Pseudomedon thoracicum* Csy., saying that *obsoleta* does not occur in N. A. (H.C.F.)

2578. *Sunius prolixus* Er. Winnipeg, Man., May 13, 1911, (J. B. Wallis). New to Manitoba.

2580. *Sunius brevipennis* Aust. Aweme, Man., June 19, 1917, (N. Criddle).

2626. *Tachinus pallipes* Grav. Winnipeg, Man., May 14, 1912, (J. B. Wallis). New to Manitoba.

2751. *Oxytelus niger* Lec. Winnipeg, Man., April 23, 1916, (J. B. Wallis). New to Manitoba.

9715. *Oxytelus suspectus* Csy. Winnipeg, Man., May 13, 1911; Onah, Man., May 24, 1912, (J. B. Wallis).
2805. *Acidota crenata* Fab. Husavick, Man., July 15, 1912, (J. B. Wallis). New to Manitoba.
2831. *Olophrum rotundicolle* Sahlb. Husavick, Man., June 22, 1913, (J. B. Wallis).
2840. *Homalium lapponicum* Zett. Winnipeg, Man., June 1, 1912, (J. B. Wallis). New to Manitoba.
2851. *Homalium hamatum* Fauv. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

Scaphidiidæ.
2978. *Bæocera concolor* Fab. Aweme, Man., June 27, (N. Criddle).

Phalacridæ.
Phalacrus probatus Csy. Winnipeg, Man., May 13, 1911; Miami, Man., June 27, 1916; Husavick, Man., (J. B. Wallis).

Corylophidæ.
3011. *Sacium lugubre* Lec. Aweme, Man., May 3, 1903, (N. Criddle).
3024. *Gronevus* (*Corylophus*) *truncatus* Lec. Onah, Man., May 24, 1912; in moss in larch swamp, (J. B. Wallis). New to Manitoba.
3025. *Sericoderus flavidus* Lec. Aweme, Man., May 4, 1917; in swarms of *Formica fusca,* (N. Criddle).

Coccinellidæ.
3069. *Harmonia picta* var. *hudsonica.* Victoria Beach, Man., Aug. 7, 1916, (J. B. Wallis). New to Manitoba.
3162. *Scymnus punctatus* Melsh. Aweme, Man., Aug. 7, 1917, (N. Criddle); Thornhill, Man., July 5, 1916, (J. B. Wallis). New to Manitoba.

Endomychidæ.
3179. *Phymaphora pulchella* Newn. Bird's Hill, Man., Sept. 24, 1917, in fungus, (N. Criddle).
3186. *Aphorista vittata* Fab. Aweme, Man., July 7, 1916, (N. Criddle). New to Manitoba.

Cucujidæ.
3327. *Læmophlæus adustus* Lec. Aweme, Man., May 8, 1912, (E. Criddle).
3328. *Læmophlæus testaceus* Fab. Aweme, Man., June 9, 1916, (N. Criddle). New to Manitoba.

Cryptophagidæ.
Agathengis pumilio Csy. Miami, Man., June 26, 1916, (J. B. Wallis); Winnipeg, Man., May 14, (L. H. Roberts).
3380. *Coenoscelis ferruginea* Sahlb. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.
9926. *Atomaria apicalis* Er. Aweme, Man., May 11, 1912, (N. Criddle). New to Manitoba.
3388. *Atomaria ochracea* Zimm. Aweme, Man., July 4, 1916, (N. Criddle).
3389. *Atomaria ephippiata* Zimm. Aweme, Man., April 15, 1905, (N. Criddle).

Mycetophagidæ.
3406. *Litargus tetraspilotus* Lec. Aweme, Man., July 20, 1917, (N. Criddle); Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

3407. *Litargus didesmus* Say. Aweme, Man., June 22, 1910, (N. Criddle). New to Manitoba.

Histeridæ.

3461. *Hololepta fossularis* Say. Dunstan, Man., June 26, 1916, (Miss Jessie Duncan). New to Manitoba.

3464. *Hister planipes* Lec. Winnipeg, Man., June 20, 1915, (L. H. Roberts). New to Manitoba.

3495. *Hister furtivus* Lec. Thornhill, Man., July 5, 1916, (J. B. Wallis). New to Manitoba.

3551. *Dendrophilus punctulatus* Say. Miami, Man., July 4, 1914; Winnipeg, Man., May 31, 1915, (J. B. Wallis). New to Manitoba.

3571. *Saprinus rotundatus* var. *communis* Mars. Winnipeg, Man., June 10, 1914; Onah, Man., July 9, 1916, (J. B. Wallis). New to Manitoba.

3586. *Saprinus oregonensis* var. *sejunctus* Mars. Thornhill, Man., July 1, 1916, (J. B. Wallis). New to Manitoba.

3618. *Saprinus mancus* Say. Victoria Beach, Man., Aug. 7, 1916, (J. B. Wallis). New to Manitoba.

Nitidulidæ.

3711. *Epurœa ovata* Horn. Aweme, Man., Sept. 10, 1916, (N. Criddle).

3730. *Soronia undulata* Say. Aweme, Man., June 16, 1917, (N. Criddle).

3760. *Ips cylindricus* Lec. Aweme, Man., Oct. 24; June 24, 1906-11, (E. & N. Criddle).

Latridiidæ.

9990. *Corticaria fulva* Com. Winnipeg, Man., May 10, 1916, (J. B. Wallis). New to Manitoba.

3779. *Stephostethus liratus* Lec. Winnipeg, Man., Aug. 2, 1916, (J. B. Wallis). New to Manitoba.

Enicmus mimus Fall. Aweme, Man., May 2, 1905, (N. Criddle). New to Manitoba.

Enicmus aterrimus Mots. var *nitens*. Winnipeg, Man., June 10, 1916, on raspberry leaves, (J. B. Wallis).

Cartodere costulata Reitt. Winnipeg, Man., June 24, 1914; Sept. 16, in cellar, (J. B. Wallis).

3796. *Coninomus constrictus* Gyll. Winnipeg, Man., Sept. 14, Oct. 31, 1916; in cellar, (J. B. Wallis). New to Manitoba.

Trogositidæ.

3843. *Tenebrioides americana* Kirby. Ironside, Que., April 19, 1917, (L. M. Stöhr).

3890. *Byrrhus cyclophorus* Kirby. Winnipeg, Man., June 20, 26, 1915, (L. H. Roberts). Previously recorded by Hamilton from Hudson Bay.

3898. *Syncalypta echinata* Lec. Victoria Beach, Man., Aug. 7, 1916; under board on sandy beach, (J. B. Wallis). Previously taken by Hanham, at Brandon, Man.

Parnidæ.

3925. *Elmis vittatus* Melsh. Winnipeg, Man., July 19, 1916, (J. B. Wallis). New to Manitoba.

3930. *Elmis fastiditus* Lec. Aweme, Man., Aug. 28, 1907; in river under stones, (N. Criddle).

3951. *Stenelmis vittipennis* Zimm. Aweme, Man., Aug. 28, 1917; in river under stones, (N. Criddle).

Heteroceridæ.

Heterocerus schwarzi Horn. Aweme, Man., Sept. 3, 1917; in mud, (N. Criddle).

3965. *Heterocerus collaris* Kies. Aweme, Man., Sept. 3, 1917; in mud, (N. Criddle).

3969. *Heterocerus pusillus* Say. Aweme, Man., Sept. 3, 1917; in mud, (N. Criddle).

Dascyllidæ.

3993. *Eucinetus terminalis* Lec. Winnipeg, Man., April 27, 1916, (J. B. Wallis).

Elateridæ.

4153. *Hypnoidus (Cryptohypnus) tumescens* Lec. Winnipeg, Man., June 13, 1914, (Wallis). New to Manitoba.

4220. *Elater pullus* Germ. Husavick, Man., July 6, 1915, (J. B. Wallis). New to Manitoba.

4223. *Elater discoideus* Fab. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

4271. *Ludius attenuatus* Say. Meach Lake, Que., June 21, 1916, (A. Gibson). Addition to Quebec list.

4286. *Agriotes pubescens* Melsh. Headingly, Man., June 13, 1916, (J. B. Wallis).

4380. *Campylus denticornis* Kirby. Aweme, Man., June 22, 1912, (E. Criddle).

4455. *Corymbites angularis* Lec. Vancouver, B.C., May 28, 1915, (R. N. Chrystal).

4456. *Corymbites medianus* Germ. Berens River, Man., July 18, 1916, (Misses Gordon & Lepage).

4487. *Corymbites splendens* Ziegl. Winnipeg, Man., June 13, 1914, (J. B. Wallis).

4495. *Corymbites metallicus* Payk. Onah, Man., July 7, 1916, (J. B. Wallis).

4499. *Oxygonus obesus* Say. Winnipeg, Man., June 4, (L. H. Roberts). New to Manitoba.

Hemicrepidius (Asaphes) brevicollis Cand. Winnipeg, Man., Aug. 1, 1916, (J. B. Wallis).

Buprestidæ.

Dicerca caudata Lec. Victoria Beach, Man., June 17, 1916, (J. B. Wallis). New to Manitoba.

4738. *Agrilus acutipennis* Mann. Thornhill, Man., June 30, 1916, (J. B. Wallis). New to Manitoba.

4742. *Agrilus politus* var. *corylus*. Darlingford, Man., June 10, 1915, (W. R. Metcalfe). New to Manitoba.

4746a. *Agrilus cephalicus* Lec. Onah, Man., July 9, 1916, (J. B. Wallis). New to Manitoba.

Cleridæ.

5178. *Clerus spegeus* Fab. Peachland, B.C., April 28, 1916, (F. Elliott).

5210. *Phyllobænus dislocatus* Say. Aweme, Man., July 2, 1911, (N. Criddle). New to Manitoba.

Ptinidæ.

5329. *Cœnocara scymnoides* Lec. Aweme, Man., June 7, 1912, (N. Criddle).
Cœnocara bicolor Germ. Miami, Man., June 26, 1916, (J. B. Wallis).
Ptilinus pruinosa Csy. Darlingford, Man., July 17, 1916; issuing from dry aspen logs in stable, (W. R. Metcalfe).

Cioidæ.

Octotemnus laevis Csy. Bird's Hill, Man., Sept. 24, 1917, in fungus, (N. Criddle).
5389. *Cis fuscipes* Mellié. Aweme, Man., May 29, 1905, (N. Criddle).
Bracycis brevicollis Csy. Aweme, Man., April 6, 1917, in birch bracket fungus, (E. Criddle).
5404. *Ennearthron thoracicornis* Ziegl. Aweme, Man., Sept. 6, Oct. 10, 1917, in fungus, (N. Criddle).
Xestocis levettei Csy. Aweme, Man., April 23, 1916, (N. Criddle). New to Manitoba.

Sphindidæ.

5410. *Eurysphindus hirtus* Lec. Aweme, Man., (N. Criddle).

Scarabæidæ.

5552. *Aphodius brevicollis* Lec. Darlingford, Man., Oct. 10, 1915, (W. R. Metcalfe). New to Manitoba.

Cerambycidæ.

6179. *Xylotrechus colonus* Fab. Darlingford, Man., July 7, 1915, (W. R. Metcalfe).
6180. *Xylotrechus sagittatus* Germ. Victoria Beach, Man., July 7, 1916, (J. B. Wallis). New to Manitoba.
6253. *Anthophilax malachiticus* Hald. Chelsea, Que., May 28, 1917, (L. M. Stöhr).
6279. *Bellamira scalaris* Say. Hemmingford, Que., Aug. 4, 1917, (C. E. Petch).
6316. *Leptura subargentata* Kirby. Aweme, Man., July 4, 1909, (N. Criddle).
6514. *Tetraopes quinquemaculatus* Hald. Onah, Man., Aug. 26, 1910, (J. B. Wallis).

Chrysomelidæ.

6573. *Lemna trilineata* Oliv. Onah, Man., July 9, 1916, (J. B. Wallis).
6632. *Cryptocephalus insertus* Hald. Stony Mountain, Man., July 31, 1916, (J. B. Wallis). New to Manitoba.
Pachybrachys praeclaris Weise. Aweme, Man., Sept. 10, 1916, (E. Criddle). New to Manitoba.
Pachybrachys carbonarius var. *janus* Fall. Aweme, Man., July 26, 1912, (E. Criddle). New to Manitoba.
Pachybrachis autolycus var. *wahsatchensis* Fall. Aweme, Man., June 24, July 7, 1908-12, (E. Criddle). New to Manitoba.
6681. *Pachybrachys obsoletus* Suffr. Thornhill, Man., June 30; Onah, Man., July 9, 1916, (J. B. Wallis). New to Manitoba.
6690. *Pachybrachys atomarius* Melsh. Thornhill, Man., July 11, 1916; previous records for Manitoba under this name were *peccans,* (Wallis).
Pachybrachys relictus Fall. Darlingford, Man., July 11, 1915, (W. R. Metcalfe). New to Manitoba.
6712. *Diachus catarius* Suffr. Winnipeg, Man., June 1, 17, 1916, (J. B. Wallis). New to Manitoba.

6789. *Leptinotarsa (Doryphora) decemlineata* Say. Red Deer, Alta., 4 adults, Oct. 1, 1917; also reported from Calgary, Alta., (F. C. Whitehouse).

Calligrapha rhoda Knab. Bird's Hill, Man., Aug. 27, 1916, (J. B. Wallis). New to Manitoba.

Calligrapha rowena Knab. Miami, Man., June 20, 1916, (J. B. Wallis). New to Manitoba.

6891a. *Diabrotica fossata* Lec. Aweme, Man., July 29, 1917, (E. Criddle).

6932. *Oedionychis vians* Ill. Ogema, Sask., June 16, 1916, (N. Criddle); Spirit River, Alta., Aug. 20, 1916, (E. H. Strickland).

6932a. *Oedionychis scripticollis* Say. Calgary, Alta., May 10, 1915; Winnipeg, Man., April 24, 1916, (J. B. Wallis). New to Manitoba.

10421. *Haltica vicaria* Horn. Onah, Man., July 7, 1916, (J. B. Wallis). New to Manitoba.

10458. *Phyllotreta pusilla* Horn. Aweme, Man., Sept. 23, 1916, (N. Criddle). New to Manitoba.

7031. *Phyllotreta robusta* Lec. Ogema, Sask., May 29, 1916, (N. Criddle).

10462. *Chætocnema opulenta* Horn. Aweme, Man., June 21, 1917, (N. Criddle).

7053. *Chætocnema pulicaria* Cr. Winnipeg, Man., June 10, 1916, (J. B. Wallis). New to Manitoba.

Tenebrionidæ.

Paratenetus crinitus Fall. Aweme, Man., Sept. 25, 1916, (N. Criddle). New to Manitoba.

Pythidæ.

7713. *Priognathus monilicornis* Rand. Aweme, Man., May 24, 1914, (N. Criddle). New to Manitoba.

Mordellidæ.

7803. *Mordellistena biplagiata* Helm. Miami, Man., June 28, 1916, (J. B. Wallis); Aweme, Man., June 11, 1916, (N. Criddle). New to Manitoba.

Mordellistena cervicalis Lec. Aweme, Man., Sept. 7, 1916, (N. Criddle). New to Manitoba.

7839. *Mordellistena pustulata* Melsh. Darlingford, Man., July 4, 1915, (W. R. Metcalfe); Miami, Man., June 26, 1916, (J. B. Wallis); Husavick, Man., July 26, 1916, (L. H. Roberts). New to Manitoba.

Anthicidæ.

7945. *Anthicus floralis* Linn. Stony Mountain, Man., July 31, 1916, (J. B. Wallis). New to Manitoba.

7956. *Anthicus ephippium* Laf. Husavick, Man., July 24, 26, 1916, (L. H. Roberts). New to Manitoba.

7976. *Anthicus pallens* Lec. Gimli, Man., July 19, 1916, (Frances M. Burridge). New to Manitoba.

Pyrochroidæ.

7993. *Schizotus cervicalis* Newm. Aweme, Man., July 9, 1916, (N. Criddle).

Meloidæ.

8069. *Macrobasis segmentata* Say. Darlingford, Man., June 13, 1915, (W. R. Metcalfe). New to Manitoba.

Rhipiphoridæ.

8171. *Pelecotoma flavipes* Melsh. Darlingford, Man., July 17, 1916; emerging at the same time and place as *P. pruinosus* but from dry peeled aspen poles, *pruinosus* preferring the larger logs, (W. R. Metcalfe); Aweme, Man., July 26, 1906, (E. Criddle).

Curculionidæ.

Apion huron Fall. Aweme, Man., July 3, 1917, (N. Criddle).

8381. *Apion pennsylvanicum* Boh. Aweme, Man., July 3, 1917, (N. Criddle).

8405. *Apion walshii* Smith. Aweme, Man., Aug. 3, 1917, (N. Criddle).

8419. *Apion tenuirostrum* Smith. Aweme, Man., July 6, 1917, (N. Criddle).

8482. *Hypomolyx piceus* DeG. Montreal, Que., (J. H. Menard).

8625. *Magdalis armicollis* Say. Aweme, Man., Aug. 30, 1916, (E. Criddle).

8661. *Pseudanthonomus cratægi* Walsh. Hemmingford, Que., July 31, 1917, (C. E. Petch); only one record, namely, "Montreal Isl." in Quebec list.

11030. *Chelonychus longipes* Dietz. Aweme, Man., Aug. 7, 1917, (E. Criddle).

11041. *Orchestes parvicollis* Lec. Aweme, Man., July 3, 1917, (N. Criddle).

Ceutorhynchus oregonensis Dietz. Aweme, Man., (N. Criddle).

Cryptorhynchus lapathi L. Roberval, Lake St. John, Que., July, 1915, (G. Beaulieu).

8832. *Cœliodes nebulosis* Lec. Aweme, Man., (N. Criddle).

* *Ceutorhynchus omissus* Fall. Aweme, Man., Sept. 23, (N. Criddle); Can. Ent. XLIX, 388.

* *Ceutorhynchus echinatus* Fall. Aweme, Man., Sept. 25, (N. Criddle); Can. Ent., XLIX, 387.

* *Ceutorhynchus invitus* Fall. Aweme, Man., Sept. 23, (N. Criddle); Can. Ent., XLIX, 388.

Ceutorhynchus neglectus Blat. Aweme, Man., July 20, 1917, (N. Criddle).

* *Ceutorhynchus convexipennis* Fall. Aweme, Man., May 31, 1909, (E. Criddle); Aweme, Man., Sept. 8, (N. Criddle); Can. Ent. XLIX, 390.

8863. *Rhinoncus pericarpius* Linn. Aweme, Man., Aug. 7, 1917, (E. Criddle).

11102. *Baris inconspicua* Csy. Aweme, Man., July 9, 1916, (N. Criddle). New to Manitoba.

Ipidæ.

* *Crypturgus borealis* Sw. Winnipeg, Man., (J. B. Wallis); found westward to the coast and south to Colorado, in species of *Picea;* Bull. 14. Ent. Br., Dom. Dept. Agr., p. 7.

* *Phlœosinus canadense* Sw. Ste. Anne de Bellevue, Que., in *Thuya occidentalis*—the species of eastern Canada heretofore confused with *P. dendatus* Say; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 8.

* *Pseudohylesinus tsugæ* Sw. Stanley Park, Vancouver, B.C., in *Tsuga heterophylla,* widely distributed along the B. C. coast; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 11.

* *Pseudohylesinus sitchensis* Sw. Menzies Bay, B.C.; Port Renfrew, B.C., and Stanley Park, Vancouver, B.C.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 12.

* *Pseudohylesinus grandis* Sw. Bull. 14, Ent. Br., Dom. Dept. Agr., p. 13. Mr. Swaine informs me that the types are from Saanichton, B.C.

* *Pseudohylesinus obesus* Sw. Inverness, B.C.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 15.

* *Lesperisinus cinereus* Sw. Hudson, Que., Bull. 14, Ent. Br., Dom. Dept. Agr., p. 15.

9163. *Leperisinus aculeatus* Say. Miami, Man., June 28, 1916, (J. B. Wallis). New to Manitoba.

* *Carphoborus carri* Sw. Edmonton, Alta., in *Picea canadensis,* (F. S. Carr); Aweme, Man., (N. Criddle); Bull. 14, Ent. Br., Dom. Dept. Agr., p. 16.

* *Hylurgops lecontei* Sw. "British Columbia;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 16.

* *Pseudocryphalus brittaini* Sw. Salmon Arm, B.C., (W. H. Brittain); Bull. 14, Ent. Br., Dom. Dept. Agr., p. 20.

* *Pseudocryphalus criddlei* Sw. Aweme, Man., (N. Criddle); Bull. 14, Ent. Br., Dom. Dept. Agr., p. 21.

* *Trypodendron borealis* Sw. Athabasca Landing, Alta.; Prince Albert, Alta., also "northern Saskatchewan;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 21.

* *Trypodendron ponderosæ* Sw. "Southern coast and interior of British Columbia;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 22.

* *Anisandrus populi* Sw. Ste. Anne de Bellevue, Que.; in region about Montreal Island and in the Ottawa valley; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 22.

* *Xyleborus canadensis* Sw. Isle Perrot, Que., Aug. 29, 1910; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 24.

* *Pityophthorus canadensis* Sw. "In twigs of *Pinus* in Ontario and Quebec;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 24.

* *Pityophthorus nitidus* Sw. Tullochgoram, Que.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 25.

* *Pityophthorus rhois* Sw. "Throughout the eastern parts of the United States and Canada;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 26.

* *Pityophthorus confertus* Sw. Adams Lake, B.C., (Tom Wilson); Bull. 14, Ent. Br., Dom. Dept. Agr., p. 27.

* *Pityophthorus granulatus* Sw. Manitoba, Quebec and Nova Scotia; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 28.

* *Pityophthorus ramiperda* Sw. Isle Perrot, Que.; Ste. Anne de Bellevue, Que.; Stoney Creek, Ont.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 28.

* *Pityophthorus intextus* Sw. Athabasca Landing and northern Alberta, and north-eastern British Columbia; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 29.

* *Pityophthorus nudus* Sw. Ontario and Quebec; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 30.

* *Ips englemanni* Sw. Central British Columbia and Alberta; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 30.

* *Ips yohoensis* Sw. Yoho Valley, B.C.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 31.

Ips borealis Sw. Husavick, Man., July 13, 1915, (J. B. Wallis).

* *Eccoptogaster tsugæ* Sw. Cherry Creek Valley, B.C.; Glacier, B.C.; Jasper Park, Alta.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 32.

* *Eccoptogaster monticolæ* Sw. Arrowhead, B.C.; Creighton Valley, B.C.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 32.

Anthribidæ.

9207. *Allandrus bifasciata* Lec. Aweme, Man., Sept. 10, 1916, (E. Criddle). New to Manitoba.

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.

78. *Discobola argus* Say. St. Hilaire, Que., June 22, 1916, (W. T. M. Forbes). Addition to Quebec list.

81. *Elephantomyia westwoodi* O.S. Megantic, Que., July 6, 1916, (W. T. M. Forbes). First definite record from Quebec Province.

86. *Helobia hybrida.* Lake Park, near Sherbrooke, Que., July 5, 1916, (W. T. M. Forbes).

89. *Limnophila areolata* O.S. Megantic, Que., July 6, 7, 1916, (W. T. M. Forbes). Addition to Quebec list.

90. *Limnophila toxoneura* O.S. Lake Park, near Sherbrooke, Que., July 5, 1916, (W. T. M. Forbes). Addition to Quebec list.

* *Tricyphona autumnalis* Alex. Meach Lake, Que., Sept. 2, 1903, (J. Fletcher); Rostrevor, Ont., (not Quebec as in description), Sept. 2, 1907, (A. Gibson); Can. Ent. XLIX, 30.

93. *Amalopis calcar* O.S. In the Entomological Record for 1913, we recorded this species from Meach Lake, Que., and Rostrevor, Ont. On further study Mr. Alexander described the specimens, under the name *Tricyphona autumnalis*, in the Can. Ent. XLIX, 30. A note to this effect should be made in the 1913 Record and also in the Quebec List of Diptera by Winn and Beaulieu, published in 1915.

94. *Cylindrotoma splendens* Doane. Westholme, Van. Isl., B.C., May 17, 1917, (A. E. Cameron). New to Canada.

101. *Tipula caloptera* Loew. St. Hilaire, Que., June 27, 1916, (W. T. M. Forbes). Addition to Quebec list.

Tipula monticola Alex. Ottawa, Ont., June 18, 1916, (W. T. M. Forbes).

105. *Tipula umbrosa* Loew. Megantic, Que., July 6, 1916, (W. T. M. Forbes). Addition to Quebec list.

Culicidæ.

* *Aedes mimensis* Dyar. Kaslo, B.C.; Aweme, Man., June 13, July 10, (N. Criddle); Insecutor Inscitiæ Menstruus, V. 116.

* *Aedes prodotes* Dyar. Banff, Alta., 1908, (N. B. Sanson); Insecutor Inscitiæ Menstruus, V. 118.

* *Aedes acrophilus* Dyar. Lake Louise, Laggan, Alta., Aug. 18, 1916, (Dyar and Caudell); Insecutor Inscitiæ Menstruus, V, 127.

Simulidiidæ.

169. *Prosimulium hirtipes* Fr. Victoria, Vanc. Isl., B.C., April 15, (A. E. Cameron).

Stratiomyidæ.

179. *Sargus nubeculosus* Zett. Outremont, Que., Aug. 30, 1917; Joliette, Que., July 8, 1917, (C. J. Ouellette). Addition to Quebec list.

Nemotelus bonnarius Jhn. Aweme, Man., Aug. 24, 1916, (N. Criddle). First record for Manitoba.

Tabanidæ.

202. *Tabanus cinctus* Fab. Ironside, Que., July 20, 1916, (L. M. Stöhr). Addition to Quebec list.

203. *Tabanus fratellus* Will. Banff, Alta., Aug. 10, 1915, (N. B. Sanson).
206. *Tabanus procyon* O. S. Goldstream, near Victoria, B.C., (E. H. Blackmore); North Bend, B.C., June 6, (S. Hadwen). These are the only records we have for Canada.

Leptidæ.

215. *Leptis ochracea* Loew. Montreal, Que., June 27, 1917, (C. J. Ouellette). Addition to Quebec list.

Bombyliidæ.

232. *Anthrax lateralis* Say. Ironside, Que., Aug., 1916, (L. M. Stöhr).
236. *Bombylius validus* Loew. Ironside, Que., June 14, 1916, (L. M. Stöhr).
238. *Ploas nigripennis* Loew. Goldstream, near Victoria, B.C., July 4, 1916, (E. H. Blackmore).

Asilidæ.

Leptogaster virgatus Coq. St. Eustache, Que., Aug. 22, 1917, (C. J. Ouellette). Dr. Aldrich, who determined the specimen reported, "I believe new to Canada; at least I find no published record."
260. *Cyrtopogon nebulo* O.S. Victoria, B.C., June 5, 10, 16, 1916, (R. C. Treherne).
272. *Laphria pubescens* Will. Banff, Alta., Aug. 11, 1916, (N. B. Sanson).
273. *Laphria xanthippe* Will. Banff, Alta., June 23, 1914, (N. B. Sanson).

Dolichopodidæ.

* *Sympycnus canadensis* Van Duzee. Fort Erie, Ont., June 6; Can. Ent., XLIX, 339.
297. *Scellus exustus* Walk. St. Eustache, Que., Aug. 18, 1917, (C. J. Ouellette). Addition to Quebec list.
299. *Dolichopus batillifer* Loew. Joliette, Que., July 10, 1917, (C. J. Ouellette). Addition to Quebec list.

Phoridæ.

337. *Aphiochæta rufipes* Mg. Banff, Alta., June 21, 1915, (N. B. Sanson).

Syrphidæ.

346. *Microdon globosus* Fab. Joliette, Que., July 15, (C. J. Ouellette). This appears to be the only definite record which we have for Quebec Province.
346. *Microdon tristis* Loew. Ironside, Que., July 20, 1916, (L. M. Stöhr).
353. *Chilosia occidentalis* Will. Lillooet, B.C., 8,000 feet, (A. W. A. Phair).
362. *Leucozona lucorum* L. Ironside, Que., June 17, 1916, (L. M. Stöhr). Previously recorded from Quebec Province from Levis.
Syrphus rectus O. S. Mount Royal, Que., (C. J. Ouellette). Addition to Quebec list. This was considered a synonym of *ribesii* until lately, when Shannon revived it—Proc. Biol. Soc. Wash., 1916, 201—J. M. A.
375. *Rhingia nasica* Say. Aweme, Man., Aug. 21, 1916, (N. Criddle).
375. *Hammerschmidtia ferruginea* Fallen. Ironside, Que., May 31, 1916, (L. M. Stöhr). Addition to Quebec list.
383. *Pyritis montigena* Hunter. Victoria, B.C., April 12, 1917, (A. E. Cameron).
Eumerus strigatus Fall. Montreal, Que., in a greenhouse, Feb. 5, 1917, (J. I. Beaulne). Addition to Quebec list.

396. *Pterallastes perfidiosus* Hunter. Ironside, Que., May 11, 1916, (L. M. Stöhr). Addition to Quebec list.
400. *Chrysochlamys croesus* O. S. Victoria, B.C., June 6, 1916, (R. C. Treherne).
400. *Chrysochlamys dives* O. S. Aweme, Man., July 7, 1916, (N. Criddle).
401. *Brachypalpus frontosus* Loew. Ironside, Que., June 7, 1916, (L. M. Stöhr).
401. *Crioprora alopex* O. S. Victoria, B.C., April 19-30, 1913, (E. H. Blackmore).
402. *Criorhina armillata* O. S. Lillooet, B.C., (A. W. A. Phair).

Tachinidæ.

438. *Leucostoma atra* Twns. St. Eustache, Que., Aug. 10, 1917, (C. J. Ouellette). Addition to Quebec list.
459. *Exorista spinipennis* Coq. Ironside, Que., (L. M. Stöhr). Addition to Quebec list.
476. *Metopia leucocephala* Rossi. Joliette, Que., July 20, 1917; St. Eustache, Que., Aug. 15, 1917, (C. J. Ouellette). Addition to Quebec list.

Sarcophagidæ.

Sarcophaga atlanis Ald. Outremont, Que., Aug. 28, 1917, (C. J. Ouellette). New to Canada.

511. *Sarcophaga cimbicis* Twns. Mt. Royal, Que., Aug. 2, 1917, (C. J. Ouellette). Addition to Quebec list.

Sarcophaga hæmorrhoidalis Mg. Outremont, Que., Sept. 17, 1917, (C. J. Ouellette). Addition to Quebec list.

512. *Sarcophaga hunteri* Hgh. St. Eustache, Que., Aug. 17, 1917, (C. J. Ouellette). New to Canada.

Sarcophaga latisetosa Park. St. Eustache, Que., Aug. 20, 1917, (C. J. Ouellette). Addition to Quebec list.

513. *Sarcophaga pallinervis* Thorn., (*communis* Park). St. Eustache, Que., Aug. 18, 1917; Mt. Royal, Que., Aug. 29, 1917, (C. J. Ouellette). Addition to Quebec list.

Sarcophaga sinuata Mg. St. Eustache, Que., Aug. 18, 1917; Outremont, Que., June 28, 1917, (C. J. Ouellette). Addition to Quebec list.

Muscidæ.

522. *Lucilia sericata* Mg. Outremont, Que., Sept. 10, 1917; Aug. 28, 1917, (C. J. Ouellette). Addition to Quebec list.
523. *Lucilia sylvarum* Mg. St. Eustache, Que., Aug. 18, 1917; Joliette, Que., July 10, 1917; Outremont, Que., Aug. 30, 1917, (C. J. Ouellette). Addition to Quebec list.

Anthomyidæ.

Paralimnophora brunneisquama Mall. , Joliette, Que., July 15, (C. J. Ouellette).

545. *Spilogaster nitens* Stein. Dr. Aldrich in a letter October 12, 1917, informs us that in examining the Hough collection at the Univ. of Chicago, he discovered that the type of this species is from Toronto, Ont., not Massachusetts as Stein's paper gives it. He also remarks that he found the species to be a true *Pogonomyia* and that it has since been described by Malloch as *Pogonomyia flavinervis*.

Scatophagidæ.

Spathiophora fascipes Beck. St. Eustache, Que., Aug. 18, 1917, (C. J. Ouellette). Not hitherto reported from Canada. Dr. Aldrich who determined the specimen states (in litt, Nov. 26, 1917), "*S. fascipes* Becker is a European species that has been found in North America in but two places before that I know of—Hine collected it in some numbers at Cedar Point, near Sandusky, Ohio, and it was identified for him by Coquillett, and I have a specimen from South Haven, Mich." The species was described in Berliner Ent. Zeitsch, XXXIII, 160, 1889.

Sciomyzidæ.

579. *Tetanocera pallida* Loew. Aweme, Man., July 18, 1916, (N. Criddle).
580. *Tetanocera saratogensis* Fitch. Aweme, Man., July 18, 1916, (N. Criddle).
581. *Sepedon armipes* Loew. St. Eustache, Que., Aug. 18, 1917; Mt. Royal Que., Sept. 20, 1917, (J. Ouellet). Mr. Beaulieu has taken the species at Ottawa, Ont.

Sapromyzidæ.

Lonchæa vaginalis Fall. Outremont, Que., Aug. 28, 1917, (C. J. Ouellette). New to Canada.
586. *Sapromyza notata* Fall. Aweme, Man., July 18, 1916, (N. Criddle).

Ortalidæ.

589. *Rivellia flavimanus* Loew. Aweme, Man., July 13, 1916, (N. Criddle).
589. *Rivellia viridulans* Desv. Mt. Royal, Que., June 30, 1917; Joliette, Que., July 20, 1917, (J. Ouellet). Addition to Quebec list.

591. *Tephronota canadensis* Jns. Aweme, Man., July 13, 1916, (N. Criddle).
Stenomyia fasciapennis Cr. Aweme, Man., June 13, 1916, (N. Criddle). Described from Minnesota.

Trypetidæ.

606. *Rhagoletis pomonella* Walsh. Royal Oak, Victoria, Vanc. Isl., B.C., Aug. 15, 1917, (W. Downes).
609. *Eurosta comma* Wied. Maryfield, Sask., Aug. 31, 1916, (N. Criddle).
612. *Euaresta æqualis* Loew. St. Eustache, Que., Aug. 22, 1917, (C. J. Ouellette). Addition to Quebec list.

Sepsidæ.

* *Sepsis violacea hecati* Melan. & Spuler. Keremeos, B.C., (A. L. Melander); Bull. 143, Wash. Agr. Exp. Stn., p. 22.
* *Sepsis signifer* Melan. & Spuler. Nelson, B.C., (A. L. Melander); Bull. 143, Wash. Agr. Exp. Sta., p. 26.
* *Sepsis signifer curvitibia* Melan. & Spuler. Nelson, B.C., (A. L. Melander); Bull. 143, Wash. Agr. Exp. Stn., p. 28.
* *Sepsis neocynipsea* Melan. & Spuler. Waubamic, Parry Sound, Ont., (H. S. Parish); Bull. 143, Wash. Agr. Exp. Stn., p. 29.
* *Themira malformans* Melan. & Spuler. Hudson Bay; Bull. 143, Wash. Agr. Exp. Stn., p. 46.

Ephydridæ.

* *Notiphila olivacea* Cr. Toronto, Ont., July 4, 1913, (M. C. Van Duzee); Trans. Amer. Ent. Soc., XLIII, 52.
628. *Ochthera mantis* DeG. Ironside, Que., April 19, 1912, (L. M. Stöhr). Addition to Quebec list.

Oscinidæ.

Chlorops certima Adams. Aweme, Man., Aug. 24, 1916, (N. Criddle).
633. *Diplotoxa pulchripes* Loew. Ogema, Sask., June 16, 1916, (N. Criddle).

634. *Diplotoxa recurva* Adams. Aweme, Man., Aug. 12, 1916; Maryfield, Sask., (N. Criddle).
634. *Chloropisca variceps* Loew. Aweme, Man., Aug. 24, 1917, (N. Criddle).
635. *Epichlorops exilis* Coq. Aweme, Man., July 30, Aug. 11, 1917, (N. Criddle).
Elachiptera aliena Beck. Aweme, Man., Sept. 11, 1916, (N. Criddle). New to Canada.
636. *Elachiptera eunota* Loew. Aweme, Man., Aug. 24, 1916, (N. Criddle).
Elachiptera planicollis Beck. Aweme, Man., Aug. 24, Sept. 18, 1916, swept from sedges, (N. Criddle).
Oscinis infesta Beck. Aweme, Man., Aug. 24, 1916, (N. Criddle). New to Canada.
Oscinis sulfurihalterata End. Aweme, Man., July 21, Aug. 12, (N. Criddle).

Geomyzidæ.
Diastata 10-guttata Walk. Aweme, Man., Sept. 4, 1916, (N. Criddle).

Agromyzidæ.
Agromyza quadrisetosa Mall. Ogema, Sask., June 16, 1916, (N. Criddle).
Agromyza subangulata Mall. Aweme, Man., May 28, 1916, (N. Criddle).
Agromyza laterella Zett. Aweme, Man., July 18, 1916, (N. Criddle).
648. *Agromyza longipennis* Loew. Aweme, Man., July 29, 1916, (N. Criddle).
Pseudodinia nitida Mall. Aweme, Man., July 18, 29, 1916, (N. Criddle).

Hymenoptera.

Tenthredinidæ.
* *Emphytus mellipes albolabris* Rohwer. Departure Bay, Vanc. Isl., B.C., July 5, 1913, (E. M. Walker); Proc. U.S.N.M., 53, 152.

Braconidæ.
* *Wesmaelia americana* Myers. "Ottawa, Can."; Proc. U.S.N.M., 53, 293.
* *Bracon montrealensis* Morr. Montreal, Que.; Proc. U.S.N.M., 52, 326.

Ichneumonidæ.
* *Pseuderipternus brevicauda* Cushman. "Canada"; Proc. U.S.N.M., 53, 506.
Euceros cooperii Cr. Aweme, Man., July 6, 1917, (N. Criddle).
* *Bathythrix tibialis* Cushman. Vancouver, B.C.; Proc. U.S.N.M., 53, 458.

Pteromalidæ.
* *Eupteromalus tachinæ* Gahan. Guelph, Ont., (A. W. Baker); Proc. U.S.N.M., 53, 211.

Chalcididæ.
* *Lamprostatus canadensis* Girault. Banff, Alta., (E. A. Schwarz); Psyche, XXIV, 96.

Formicidæ.
* *Leptothorax muscorum* var. *septentrionalis* Wheeler. Banff, Alta., (C. G. Hewitt); Emerald Lake, B.C., (W. M. Wheeler); Proc. Amer. Acad. Sc., 52, 511.

* *Leptothorax emersoni* subsp. *hirtipilis* Wheeler. Banff, Alta.; Proc. Amer. Acad. Sc., 52, 515.

* *Lasius flavus* subsp. *claripennis* Wheeler. Banff, Alta.; Proc. Amer. Acad. Sc., 52, 527.

* *Formica fusca* subsp. *pruinosa* Wheeler. Emerald Lake, B.C., Aug. 12-15; Field, B.C.; Banff, Alta.; (W. M. Wheeler); Proc. Amer. Acad. Sc., 52, 548.

* *Formica hewitti* Wheeler. Emerald Lake, B.C.; Field, B.C., Laggan, Alta., (W. M. Wheeler); Proc. Amer. Acad. Sc., 52, 552.

* *Formica truncicola integra* var. *subcaviceps* Wheeler. Dog Lake, Penticton, B.C., (C. G. Hewitt); Proc. Amer. Acad. Sc., 52, 540.

* *Polyergus rufescens* subsp. *breviceps* var. *fusciventris* Wheeler. Treesbank, Man., (C. G. Hewitt); Proc. Amer Acad. Sc., 52, 555.

Eumenidæ.

* *Eumenes crassicornis* Isely. Goldstream, B.C.; Annals Ent. Soc. Amer., X, 362.

Vespidæ.

Vespa austriaca Pz. Ironside, Que., June 18, 1916, two females, (L. M. Stöhr).

Sphecidæ.

Thyreopus argus Pack. Chelsea, Que., July, 1917, males, (L. M. Stöhr).

Thyreopus cingulatus Pack. Aweme, Man., July 21, 1914, male, female, (N. Criddle).

Crabro vierecki H. S. Smith. Lethbridge, Alta.; Nelson, B.C., July, 1916, (F. W. L. Sladen).

Cerceris rufinoda crucis Vier. & Ckll. Not "*crucia*" as in Ent. Rec. for 1917.

Bembicidæ.

* *Bembix comata* Parker. Vancouver, B.C.; Proc. U.S.N.M., 52, 100.

Anthophoridæ.

Anthophora simillima Cr. Lillooet, B.C., May 14, 1916, (E. M. Anderson); Invermere, B.C., April 25, 1915, (G. E. Parham).

Anthophora pacifica Cr. Victoria, B.C., April 25, 1916, (R. C. Treherne).

Anthophora peritomæ Ckll. Lethbridge, Alta., July 22, 1916; Medicine Hat, Alta., August 20, 1917, (F. W. L. Sladen).

* *Tetralonia hirsutissima* Ckll. British Columbia; Ann. Mag. Nat. Hist., June, 1916, p. 428.

Megachilidæ.

Chelynia rubi Ckll. Not "*rubri*" as in Ent. Record for 1917.

Megachile parallela Smith. Not "*parallela* Ckll." as in Ent. Record for 1917.

Megachile (*Xanthosarus*) *perihirta* Ckll. Cochrane, Ont., Aug. 9, 1917; nesting gregariously in a nearly new, bare, gravel railway embankment (F. W. L. Sladen); Athabasca, Alta., Aug. 12, 1915, (E. H. Strickland); this species was found in large numbers actively tripping the flowers of alfalfa at Keremeos, B.C., and Summerland, B.C., in July, 1917. The Athabasca and Cochrane females are darker than the British Columbia specimens, having much black hair on the sixth dorsal segment, (F. W. L. S.).

Bombidæ.

Bombus kirbyellus Frank. Banff, Alta., Aug., 1916, (N. B. Sanson).

Bombus polaris Frank. Banff, Alta., Aug., 1916, (N. B. Sanson).

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.

Hamamelistes spinosus Shimer. Vineland, Ont., June 22, 1914, on *Betula papyrifera*, (W. A. Ross).

Euceraphis betulæ Koch. Bowmanville, Ont., July 21, 1913, (W. A. Ross).

Drepanosiphum platanoides Schr. Guelph, Ont., June 20, 1915, on maple, (W. A. Ross).

Myzocallis bellus Walsh. Ottawa, Ont., Sept. 4, 1917, on *Quercus*, (C. B. Hutchings).

Myzocallis asclepiadis Monell. Ottawa, Ont., Sept. 1, 1917, on milkweed, (C. B. Hutchings).

Nectarosiphum rubicola Oestlund. Bowmanville, Ont., 1913, (W. A. Ross); Ottawa, Ont., July 26, 1917, (C. G. Hewitt).

Macrosiphum tiliæ Monell. Vineland, Ont., Sept. 6, 1917, on basswood, (W. A. Ross).

Rhopalosiphum berberidis Kalt. Bowmanville, Ont., June 17, 1913, on barberry, (W. A. Ross).

Myzus (Ovatus) mespili v.d.G. Vineland Station, Ont., June 8, 1917, on *Pyrus japonica*, (W. A. Ross).

Aleyrodidæ.

* *Aleuroplatus berbericolus* Q. & B. Kaslo, B.C., Jan. 27, 1908, on *Berberis aquifolium*, (J. W. Cockle); Proc. U.S.N.M., 51, 383.

Pentatomidæ.

139. *Cœnus delius* Say. Covey Hill, Que., May 31, 1914, (C. E. Petch).

Aradidæ.

361. *Aradus quadrilineatus* Say. Ironside, Que., (L. M. Stöhr).

Tingididæ.

665. *Physatocheila plexa* Say. Ironside, Que., (L. M. Stöhr).

Miridæ.

1109. *Dicyphus famelicus* Uhl. Ironside, Que., April 18, 1917, (L. M. Stöhr).

* *Lygus vanduzeei* Knight. Parry Sound, Ont., July and August; (H. S. Parish); Truro, N.S., July 8, Sept. 19, Oct. 11; Kentville, N.S., July 2, Aug. 6, 10, Sept. 24, Oct. 5; Smith's Cove, N.S., July 15, Sept. 14, (W. H. Brittain); Cornell Univer. Agric. Exp. St., Bull. 391, 565.

* *Lygus vanduzeei* var. *rubroclarus* Knight. Saguenay River, Que.; Smith's Cove, N.S., May 8 to June 6, June 23, July 15; Kentville, N.S., June 24, Sept. 24, (W. H. Brittain); Cornell Univ. Agr. Exp. St., Bull. 391, 567.

* *Lygus humeralis* Knight. Bear Lake, B.C., July 20; Ainsworth, B.C., July 2; Revelstoke, B.C., July 1, 5, (J. C. Bradley); Cornell Univ. Agric. Exp. St., Bull. 391, 570.

* *Lygus columbiensis* Knight. Fry Creek, B.C., July 23; Cornell Univ. Agr. Exp. St., Bull. 391, 371.

* *Lygus rubicundus* var. *winnipegensis* Knight. Winnipeg, Man., May 7, 1910, (J. B. Wallis); Cornell Univ. Agr. Exp. St., Bull. 391, 591.

* *Lygus alni* Knight. Wolfville, N.S.; Cornell Univ. Agric. Exp. St., Bull. 391, 608.

* *Lygus tiliæ* Knight. Ottawa, Ont., June 29; Cornell Univ. Agric. Exp. St., Bull. 391, 613.

* *Lygus omnivagus* Knight. Parry Sound, Ont., July 24, Aug. 7, (H. S. Parish); Cornell Univ. Agric. Exp. St., 391, 627.

* *Lygus canadensis* Knight. Parry Sound, Ont., July 10, (H. S. Parish); Cornell Univ. Agric. Exp. St., 391, 634.

* *Lygus ostryæ* Knight. Parry Sound, Ont., Aug. 6-8, (H. S. Parish); Cornell Univ. Agri. Exp. St., Bull. 391, 635.

Fulgoridæ.

2466. *Scolops sulcipes* Say. Hemmingford, Que., June 24, 1916, (C. E. Petch).
2549. *Cixius stigmatus* Say. Hemmingford, Que., July 9, 1917, (C. E. Petch).

ODONATA.

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

Coenagrionidæ.

37. *Lestes congener* Hagen. St. Andrews, N.B., Sept. 16, 1917, (A. G. Huntsman).

37. *Lestes disjunctus* Selys. Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman); Le Pas, Man., July 29, 1917; M. 214, H. B. Ry., Man., July 24, 1917, (J. B. Wallis).

39. *Lestes uncatus* Kirby. Neil's Harbour, C.B., July 29, 1917, (A. G. Huntsman).

55. *Enallagma calverti* Morse. Vancouver, B.C., June 14, July 1, 1917, (E. H. Blackmore).

56. *Enallagma civile* (Hagen). Plateau River, Cheticamp, C.B., July 27-Aug. 4, 1917, (A. G. Huntsman). New to Nova Scotia list.

56. *Enallagma clausum* Morse. Dauphin Lake, Man., July-August, 1917, (Mrs. W. W. Hippisley). New to Canada.

57. *Enallagma cyathigerum* (Charp.) Chilcotin, B.C., June 25, 1915, (W. A. N.); Cranbrook Dist., B.C., May 17, 1915; Le Pas, Man., July 7, 1917, (J. B. Wallis).

59. *Enallagma ebrium* (Hagen). Le Pas, Man., July 29, 1917, (J. B. Wallis).

60. *Enallagma hageni* (Walsh.). Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman).

65. *Nehalennia irene* Hagen. Red Deer, Alta., July 1-8, (F. C. Whitehouse). New to Alberta list.

Coenagrion angulatum E. M. Walker. Le Pas, Man., July 1, 1917, (J. B. Wallis).

66. *Coenagrion interrogatum* (Selys.). Nordegg, Alta., July 19, (F. C. Whitehouse). New to Alberta and most westerly record. M. 332, H. B. Ry., July 17, 1917; M. 256, H. B. Ry., Man., July 12, 1917, (J. B. Wallis). New to Manitoba.

66. *Coenagrion resolutum* (Hagen). Le Pas, Man., July 1, 1917; M. 214, H. B. Ry., Man., July 8, 24, 27, 1917; M. 332, H. B. Ry., Man., July 17, (J. B. Wallis); Chilcotin, B.C., June 25, 1915, (W. A. N.). First British Columbia record.

66. *Amphiagrion saucium* (Burm.). Banff, Alta., July 2, 1913, (E. M. Walker).

Aeshnidæ.

76. *Cordulegaster diastatops* (Selys.) De Grassi Point, Ont., June 12, 1917, June 21, 1917, (E. M. Walker).

77. *Cordulegaster maculatus* Selys. De Grassi Point., Ont., June 19-24, 1917, (E. M. Walker); Algonquin Park, Ont., July 17, 1917, (E. M. Walker).

84. *Ophiogomphus colubrinus* Selys. M. 332 and 334, N. B. Ry., Man., July 20, 1917, (J. B. Wallis). New to Manitoba.

91. *Gomphus cornutus* Tough. Carlsbad Springs, Ont., June 20, 1908, (C. H. Young).

109. *Aeshna canadensis* E. M. Walker. Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman).

Aeshna caerulea septentrionalis Burm. Hopedale, Labrador, Aug. 1917, (W. W. Perrett).

110. *Aeshna eremita* Scudd. Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman).

111. *Aeshna interrupta interrupta* E. M. Walker. Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman).

111. *Aeshna juncea* (Linn.) Hopedale, Labrador, Aug. 1917, (W. W. Perrett).

114. *Aeshna sitchensis* Hagen. Hopedale, Labrador, Aug. 1917, (W. W. Perrett); Amherst Id., Magdalen Islands, Que., July 15, 1917, (A. G. Hunstman).

114. *Aeshna subarctica* E. M. Walker. Amherst Id., Magdalen Islands, Que., July 15, 1917, (A. G. Huntsman).

114. *Aeshna umbrosa occidentalis* E. M. Walker. Prospect Lake, B.C., Aug. 30, 1917, (W. Downes).

Libellulidæ.

128. *Williamsonia lintneri* (Hagen). Mer Bleue, near Ottawa, Ont., May 25, 1908, June 4, 1908, (C. H. Young). New to Ontario list.

128. *Cordulia shurtleffi* Scudd. De Grassi Point, Ont., June 14, 1917, (E. M. Walker).

129. *Somatochlora albicincta* (Burm.). Nordegg, Alta., July 12-19, 1917, 4,000-6,500 feet; also nymph believed to be this on circumstantial evidence, previously unknown, (F. C. Whitehouse); Nain, Labrador, Aug. 13, 1917, Aug. 20, (Simon); Hopedale, Labrador, Aug. 1917, (W. W. Perrett).

129. *Somatochlora cingulata* (Selys). Nordegg, Alta., July 15, 17, 1917, 6,500 feet, (F. C. Whitehouse). New to Alberta list. M. 256, H. B. Ry., Man., July 12, 1917; M. 332, H. B. Ry., Man., July 16, 1917, (J. B. Wallis). New to Manitoba list.

130. *Somatochlora forcipata* (Scudd). Hopedale, Labrador, Aug. 1917, (W. W. Perrett). New to Labrador.

130. *Somatochlora franklini* (Selys.). Nordegg, Alta., 6,500 feet, July 11-17, 1917, (F. C. Whitehouse). New to Alberta list. Hopedale, Labrador,

Aug. 1917, (W. W. Perrett); Le Pas, Man., July 1, 1917, M. 214, H. B. Ry., Man., July 7-9, 1917; M. 332, July 14-19, 1917; M. 256, July 12, 1917, (J. B. Wallis).

131. *Somatochlora hudsonica* (Hagen). Sucker River, Thunder Bay District, Ont., July 21, 1917, (Mrs. G. K. Jennings). New to Ontario list. Red Deer, Alta., July 1-9, 1916; July 1, 1917; Nordegg, Alta., July 19, 1917, (F. C. Whitehouse).

131. *Somatochlora minor* Calvert. M. 256, H. B. Ry., Man., July 12, 1917, (J. B. Wallis); De Grassi Point, Ont., (E. M. Walker); Nordegg, Alta., July 11-18, 1917, 4,000-6,500 feet, (F. C. Whitehouse). New to Alberta list.

132. *Somatochlora semicircularis* (Selys.). Nordegg, Alta., July 16, 1917, (F. C. Whitehouse).

132. *Somatochlora septentrionalis* Hagen. Hopedale, Labrador, Aug., 1917, (W. W. Perrett); M. 332, H. B. Ry., Man., July 19, 1917, (J. B. Wallis). New to Manitoba list. Nordegg, Alta., July 18, 1917, 4,000 feet, (F. C. Whitehouse). New to Alberta list.

166. *Leucorrhinia hudsonica* (Selys.). Cranbrook Dist., May 17, 1915, (Coll.?). New to British Columbia list.

167. *Leucorrhinia intacta* Hagen. Saanich Dist., B.C., June 12, July 20, 1917; Elk Lake, Royal Oak, B.C., July 11, 1917, (W. Downes); Vernon Dist., July 6, 1916; Alberni, B.C., July 22, 1915, (W. R. C.). New to British Columbia list.

Collembola.

The following species of Collembola were collected at Arnprior, Ont., in 1917, by Mr. Charles Macnamara, who is making a special study of these insects.

Achorutes packardi Folsom.
Achorutes humi Folsom.
Xenylla maritima Tullberg.
Pseudachorutes complexus MacGillivray.
Neanura muscorum Templeton.
Podura aquatica Linn. (Red colour variety.)
Onychiurus ramosus Folsom.
Onychiurus fimetaria (Linn.) Lubbock.
Isotoma olivacea Tullberg.
Isotoma quadrioculata Tullberg.
Isotoma cinerea Nic.
Tomocerus bidentatus Folsom.
Tomocerus flavescens separatus Folsom.
Papirius pini Folsom.
Sminthurus hortensis Fitch.
Sminthurus hortensis juvenilis Fitch.
Sminthurus spinatus MacGillivray.

Araneida.

(Arranged according to Bank's Catalogue of Nearctic Spiders, U.S.N.M., Bull. 72. The numbers refer to the pages in the catalogue.)

Drassidæ.

* *Pœcilochroa columbiana* Em. Departure Bay, Van. Isl., B.C., 1913, (T. B. Kurata); Can. Ent., XLIX, 269.

9. *Gnaphosa conspersa* Thor. Aweme, Man., (N. Criddle).

Agelenidæ.

15. *Cicurina arcuata* Keys. Aweme, Man., (N. Criddle).

Theridiidæ.

20. *Theridium zelotypum* Em. Truro, N.S., and West River, N.S., (R. Matheson).

* *Arœoncus patellatus* Em. Metlakatla, B.C., (J. H. Keen); Can. Ent., XLIX, 262.

Lophocarum sculptum Em. Metlakatla, B.C., (J. H. Keen); Can. Ent. XLIX, 261.

* *Gonglydium macrochelis* Em. Banff, Alta., (N. B. Sanson); Can. Ent., XLIX, 263.

Gonglydium curvitarsis Em. Sulphur Mt., Banff, Alta., on snow, April, 1917, (N. B. Sanson). Described from Mt. Whiteface, Adirondacks, N.Y.

Linyphiidæ.

* *Diplostyla brevipes* Em. Metlakatla, B.C., (J. H. Keen); Can. Ent., XLIX, 267.

* *Diplostyla keenii* Em. Metlakatla, B.C., (J. H. Keen); Can. Ent., XLIX, 267.

* *Microneta pallida* Em. Departure Bay, Vanc. Isl., B.C., 1913, (T. B. Kurata); Can. Ent., XLIX, 265.

* *Microneta orcina* Em. Inverness, B.C., (J. H. Keen); Can. Ent., XLIX, 266.

Epeiridæ.

39. *Zilla atrica* Koch. Digby, N.S., and Truro, N.S., (R. Matheson).

41. *Epeira cavatica* Keys. Hampton, N.B., and Hillsborough, N.B., (R. Matheson).

Thomisidæ.

* *Philodromus canadensis* Em. "Montreal, Ottawa, and westward to Lake Nipigon and Prince Albert"; Can. Ent., XLIX, 270.

Lycosidæ.

Lycosa wrightii Em. Aweme, Man., (N. Criddle).

60. *Pardosa tachypoda* Thor. Arnprior, Ont., (C. Macnamara).

* *Pardosa metlakatla* Em. Metlakatla, B.C., (J. H. Keen); Mountains north of Vancouver, B.C., (G. W. Taylor); Can. Ent., XLIX, 268.

* *Pardosa vancouveri* Em. Departure Bay, Vanc., Isl., B.C., and Vancouver, B.C., (T. B. Kurata); Can. Ent., XLIX, 269.

Attidæ.

* *Chalcoscirtus carbonarius* Em. Simpson Summit, 7,000 feet, near Banff, Alta.; Can. Ent., XLIX, 271.

INDEX.

Ontario Department of Agriculture

Forty-Ninth Annual Report

OF THE

Entomological Society

OF ONTARIO

1918

PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
1919

Ontario Department of Agriculture

Forty-Ninth Annual Report

OF THE

Entomological Society

OF ONTARIO

1918

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A T. WILGRESS, Printer to the King's Most Excellent Majesty
1919

Printed by
THE RYERSON PRESS

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 1918.

Respectfully submitted,

GEO. S. HENRY,

Minister of Agriculture.

Toronto, 1919.

CONTENTS

Entomological Society of Ontario

OFFICERS FOR 1918-1919

President—PROF. LAWSON CAESAR, Dept. of Entomology, Ontario Agricultural College, Guelph.

Vice-President—MR. ARTHUR GIBSON, Entomological Branch, Dept. of Agriculture, Ottawa.

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

Curator—MR. ERIC HEARLE, *B.S.A., 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. J. M. SWAINE, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, MR. C. E. GRANT, Orillia; Division No. 3, DR. A. COSENS, Toronto; Division No. 4, MR. F. J. A. MORRIS, Peterborough; Division No. 5, MR. J. W. NOBLE, Essex; Division No. 6, MR. J. F. HUDSON, Strathroy; Division No. 7, MR. W. A. ROSS, Vineland Station.

Directors (ex-Presidents of the Society)—REV. PROF. C. J. S. BETHUNE, M.A., D.C.L., F.R.S.C., Guelph; PROF. JOHN DEARNESS, Vice-Principal, Normal School, London; REV. THOMAS W. FYLES, D.C.L., F.L.S., Ottawa; PROF. WM. LOCHHEAD, B.A., M.S., Macdonald College, Que.; JOHN D. EVANS, C.E., Trenton; PROF. E. M. WALKER, B.A., M.B., F.R.S.C., University of Toronto; C. GORDON HEWITT, D.Sc., F.R.S.C., Dominion Entomologist, Ottawa; MR. ALBERT F. WINN, Westmount, Que.

Editor of "The Canadian Entomologist"—PROF. E. M. WALKER, Toronto.

Delegate to the Royal Society of Canada—THE PRESIDENT.

FINANCIAL STATEMENT

For year ending October 31st, 1918.

Receipts.		*Expenditures.*	
Cash on hand, 1916-17	$42 10	Expense	$52 00
Advertisements	15 25	Cork and Pins	51 60
Back Numbers	75 94	Printing	1,316 00
Cork and Pins	74 87	Annual Meeting	101 17
Dues	93 34	Annual Report	25 00
Subscriptions	443 60	Salaries	125 00
Bank Interest	8 95	Insurance	26 00
Government Grant	1,000 00	Cash on hand	57 28
	$1,754 05		$1,754 05

To balance due on printing	$102 59
By cash on hand	57 28
Net deficit	$45 31

Auditors: L. CAESAR.
J. E. HOWITT.

Respectfully submitted,

A. W. BAKER,
Secretary-Treasurer

LIST OF MEMBERS

Ontario

Aitchison, James	Grimsby.
Andrews, H. D.	Toronto.
Baker, A. W.	Guelph.
Beasley, Miss G.	Toronto.
Beaulne, J. I.	Ottawa.
Biggar, W. E.	Hamilton.
Bigelow, N. K.	Toronto.
Blakeley, R. W.	"
Brimley, J. F.	Bloomfield.
Brobst, C. K.	Toronto.
Broderick, F.	"
Burrows, A. F.	Guelph.
Caesar, Prof. L.	"
Calvert, J. F.	London.
Chrystal, R. Neil,	Ottawa.
Cleeves, A. C.	Guelph.
Clemens, W. A.	Toronto.
Cosens, Dr. A.	"
Curran, H.	Guelph.
Dearness, Prof. J.	London.
Detweiler, J.	Toronto.
Doherty, T. K.	Ottawa.
Duff, G. H.	Hamilton.
Dunlop, James	Woodstock.
Ford, Miss N.	Toronto.
Foulds, F.	"
Fouse, C. M.	"
Gibson, Arthur	Ottawa.
Gooderham, C. B.	"
Grant, C. E.	Orillia.
Grant, L. J. M.	"
Hadwen, Dr. S.	Ottawa.
Hahn, Paul	Toronto.
Haight, D. H.	Sudbury.
Hannibal, J.	Toronto.
Hearle, Eric	Guelph.
Hesket, H.	Toronto.
Hewitt, Dr. C. Gordon	Ottawa.
Hudson, H. F.	Strathroy.
Huntsman, Dr. A. G.	Toronto.
Hutchings, C. B.	Ottawa.
James, L. E.	St. Thomas.
Jolly, Miss	Toronto.
Kirkwood, K.	"
Kitto, V.	Ottawa.
Kurata, T. B.	Toronto.
Logier, S.	"
Macnamara, C.	Arnprior.
Martin, Howard	Toronto.
Morris, F. J. A.	Peterborough.
Mossop, Miss B. K. E.	Toronto.
Nash, C. W.	"
Noble, J. W.	Essex.
Petch, C. E.	Ottawa.
Reid, D. E.	Todmorden.
Ross, W. A.	Vineland.
Saxby, J. W.	Toronto.
Shorey, W. P.	Guelph.
Sladen, F. W. L.	Ottawa.
Smith, Arthur	Toronto.
Snazelle, C.	"
Spencer, Capt. G. J.	Guelph.
Strickland, E. H.	Ottawa.
Swaine, J. M.	"
Thompson, J. W.	Toronto.
Tomlinson, A. H.	Guelph.
Walker, Prof. E. M.	Toronto.
Watson, Dr. A. H. R.	Port Hope.
White, Jas.	Snelgrove.
Williams, G. A.	Port Hope.
Wright, B.	Toronto.
Zavitz, E. J.	"

Quebec

Barwick, E. C.	Montreal.
Burgess, Dr. T. J. W.	Verdun.
Chagnon, G.	Montreal.
Chapais, J. C.	St. Denis.
Clayson, G. H.	Montreal.
Corcoran, J. A.	"
Cummings, R. F.	"
Dunlop, G. C.	"
Du Porte, E. M.	Macdonald College.
Germain, Bro.	Three Rivers.
Gibb, L.	Montreal.
Hall, G. H.	"
Huard, Rev. V. A.	Quebec.
Jackson, Dr. F. S.	Montreal.
Kenyon, H. F.	Outremont.
Leopold, Rev. Father	La Trappe.
Letourneau, F.	Oka.
Lochhead, Prof. W.	Macdonald College.
Maheux, G.	Quebec.
Moore, G. A.	Montreal.
Ouellett, J.	Outremont.
Shepherd, A. C.	Montreal.
Southee, G. A.	"
Willey, Dr. A.	"
Winn, A. F.	Westmount.

New Brunswick

Baird, A. B.	Fredericton.
Tothill, J. D.	"

Nova Scotia

Allen, E. C.	Truro.
Brittain, Prof. W. H.	"
Connely, Prof. A. J.	Antigonish.
De Wolfe, L. A.	Truro.
Dustan, A. G.	Annapolis Royal.
Gill, Dr. A.	Truro.
Gilliat, F. C.	Annapolis Royal.
Good, C. A.	Truro.
Kelsall, A.	Annapolis Royal.
Lindsay, Miss H. E.	Truro.
Longley, Miss M.	Paradise.
Mackay, Dr. A. H.	Halifax.
McMahon, E. A.	Annapolis Royal.
Payne, H. G.	Annapolis Royal.
Payne, S. H.	Granville Ferry.
Perrin, Joseph	Halifax
Perry, Prof. H. G.	Wolfville.
Reinhard, E. B.	Halifax.
Saunders, L. G.	Truro.
Spittal, J. P.	"
Wetmore, Ralph	Yarmouth.
Whitehead, W. E.	Truro.
Whitman, C. F. U.	Lawrencetown
Young, Miss E.	Brighton.

Newfoundland

Hills, C. B.	Wabana.

MANITOBA

Brooker, S. H. .... Winnipeg.
Cardhouse, C. G. .... Rathwell.
Criddle, Norman .... Treesbank.
Hippisley, Mrs. W. W. ... Dauphin.
Hunter, Dr. A. J. .... Teulon.
Roberts, L. H. D. .... Winnipeg.
Wallis, J. B. .... "

SASKATCHEWAN

Androchowicz, E. .... Humboldt.
Bentley, Miss L. .... Mellville.
Hutchinson, H. .... Starblanket.
MacBean, G. G. .... Assiniboia.
Neville, S. J. .... Cottonwood.
Rackstraw, S. .... Turtleford.
Willing, Prof. T. N. ..... Saskatoon.

ALBERTA

Antijutti, Miss E. .... Diamond City.
Baird, Thos. .... High River.
Bowman, K. .... Edmonton.
Carr, F. S. .... "
Dod, F. H. Wolley .... Midnapore.
Hinke, Joseph .... Calgary.
Mackie, Donald .... Edmonton.
Whitehouse, F. C. ...... Red Deer.

BRITISH COLUMBIA

Anderson, W. B. .... Victoria.
Blackmore, E. H. .... "
Brown, W. A. .... "
Brinkman, M. .... Victoria
Cameron, Dr. A. E. ...... Agassiz.
Carter, W. R. .... Victoria.
Cockle, J. W. .... Kaslo.
Cunningham, C. .... Victoria.
Day, G. O. .... Duncan's.
Downes, W. .... Victoria.
Eastham, J. W. .... Vancouver.
Eldridge, H. E. .... Victoria.
French, P. E. .... Vernon.
Garrett, C. B. D. .... Cranbrook.
Hanham, A. W. .... Duncan's.
Harris, Miss M. .... Deroche.
Hook, G. .... Cobble Hill.
Hugh, G. W. .... Victoria.
Johnstone, W. B. .... Arrow Lake.
Kermode, F. .... Victoria.
Lallemond, C. A. .... Lytton.
Leach, D. H. .... Salmon River.
Mathers, G. W. .... Vancouver.
Metcalf, W. R. S. .... Peachland.
Phair, A. W. A. .... Lillooet.
Robson, A. C. U. .... Victoria.
Ruhman, M. .... Vernon.
Sherman, R. S. .... Vancouver.
Taylor, L. E. .... Kelowna.
Treherne, R. C. .... Agassiz.
Venables, E. P. .... Vernon.
Ward, W. C. .... Vancouver.
White, E. W. .... Victoria.
Winson, J. W. .... Huntingdon.

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.

MEMBERS OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO ON ACTIVE SERVICE

Bird, M. L. .... Prince Rupert, B.C.
Breun, L. A. .... Victoria, B.C.
Brodie, H. S. .... Dom. Ent. Lab., Agassiz, B.C.
Burrows, A. R. .... O.A.C., Guelph.
*Bush, A. H. .... Vancouver, B.C.
Cleeves, A. C. .... O.A.C., Guelph.
Creese, H. H. .... Kelowna, B.C.
Curran, H. .... Dom. Ent. Lab., Vineland, Ont.
Dickie, C. M. .... Kentville, N.S.
Dod, F. H. Wolley .... Midnapore, Alta.
Good, Lieut. C. A. .... Truro, N.S.
*Harvey, R. V. .... Victoria, B.C.
Hudson, H. F. .... Entomological Br., Ottawa.
*King, V. .... Bureau of Entomology, Washington, D.C.
Martin, A. .... South Vancouver, B.C.
Matheson, J. B. .... Kelowna, B.C.
McCubbing, C. .... Salmon Arm, B.C.
Neville, S. J. .... Cottonwood, Sask.
Prewett, F. J. .... Toronto, Ont.
Rive, Henry .... Victoria, B.C.
Robertson, W. H. .... "
Robson, A. B. V. ...... "
Rowland, H. F. .... O.A.C., Guelph.
Simms, H. M. .... Montreal, P.Q.
Snazelle, Chas. .... Thornloe, New Ontario.
Spencer, Capt. G. J. ... O.A.C., Guelph.
Strickland, E. H. .... Entomological Br., Ottawa.
Venables, E. P. .... Vernon, B.C.
*Walsh, Lieut. F. W. . O.A.C., Guelph.
Williams, C. M. .... Nappan, N.S.
Wilson, Ed. .... Vancouver, B.C.
Wright, Lieut. W. H. . O.A.C., Guelph.

* Killed in action.

Entomological Society of Ontario

ANNUAL MEETING

The Fifty-fifth Annual Meeting of the Entomological Society of Ontario was held at the Ontario Agricultural College, Guelph, on Wednesday and Thursday, December 4th and 5th, 1918. The chair was taken by Prof. Lawson Caesar, the President. The following were present at the meeting: Mr. J. J. Davis, West Lafayette, Ind.; Prof. P. J. Parrott, Geneva, N.Y.; Prof. R. Matheson, Ithaca, N.Y.; Dr. C. Gordon Hewitt; Messrs. Arthur Gibson, C. E. Petch, C. B. Hutchings, F. W. L. Sladen and Dr. S. Hadwen, Ottawa; Prof. E. M. Walker and Dr. W. A. Clemens, Toronto; Mr. James Dunlop, Woodstock; Mr. W. A. Ross, Vineland; Mr. W. E. Biggar, Hamilton; Mr. F. J. A. Morris, Peterborough; Mr. H. F. Hudson, Strathroy; Father Leopold, La Trappe, Que.; Prof. W. Lochhead, Macdonald College, Que.; Mr. F. Letourneau, Oka, Que.; Prof. W. H. Brittain, Truro, N.S.; Mr. John D. Tothill, Fredericton, N.B.; Mr. Norman Criddle, Treesbank, Man.; Professors C. J. S. Bethune, L. Caesar, J. E. Howitt and D. H. Jones; Dr. R. E. Stone; Messrs. A. W. Baker, H. G. Crawford, Eric Hearle, R. M. Aiton, H. C. Huckett and others, Ontario Agricultural College.

By the kindness of Dr. Creelman the visitors were entertained in the College Residence during their stay in Guelph. This arrangement added much to their pleasure by affording many opportunities for social converse, and also saved the time usually spent in travelling to and from the town.

During the morning of Wednesday, Dec. 4th, a meeting of the Council was held, at which various matters of business were brought up and discussed. It was decided that the next place of meeting be Ottawa, the date to be fixed later. A suggestion was made and afterwards adopted at the general meeting, that the *Canadian Entomologist* be issued in ten instead of twelve numbers, but that the quantity of matter remain as heretofore; and also that the size of the page be increased to conform with the majority of scientific publications.

In the afternoon the Society met at 1.30 o'clock. After opening the meeting the President read a letter from Mr. Wolley Dod, from Mesopotamia, which was much appreciated. The following message, proposed by Messrs. Gibson and Tothill, was sent to Dr. Fyles:—

"Entomologists from Canada and the United States now in session at Guelph, extend to you their warmest greetings and regret your inability to attend."

The Reports of the Council, Treasurer, Librarian and Curator were then read and adopted. The Reports of the various Branches, the delegate to the Royal Society of Canada, and the Directors were taken as read.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1917-1918.

The Fifty-fourth Annual Meeting of the Society was held at Macdonald College, P.Q., on Thursday and Friday, November 8th and 9th. The President of the Society, Mr. A. F. Winn, Westmount, P.Q., occupied the chair. There was a very satisfactory attendance of members and visitors; among the latter were Messrs. A. F. Burgess, Melrose Highlands, Mass., and J. H. Emerton, Boston; Drs. T. J. Headlee, New Brunswick, N.J., and W. C. O'Kane, Durham, N.H. A large number of papers of interest and importance were read and discussed, of which the following is a list. Reports on Insects of the year in the various Divisions of the Province by the Directors, Messrs. Gibson, Cosens, Morris, Noble and Ross; "Further Notes on the Imported Onion Maggot and its Control," by Mr. Arthur Gibson; "The Entomological Service of Quebec," by Mr. Georges Maheux; "Some Important Insects of the Season," by Prof. Caesar; "The Apple and Thorn Skeletonizer," by Dr. E. P. Felt; "Some Notodontian Larvæ," by Dr. J. A. Corcoran; "The Problem of Mosquito Control," by Dr. T. J. Headlee; "The Black Cherry Aphis," by Mr. W. A. Ross; "A Comedy of Errors," by Mr. F. J. A. Morris; "Transcanadian Spiders, " by Mr. J. H. Emerton; "A Further Report on the Value of Dusting vs. Spraying," by Prof. L. Caesar; "Notes on the Ecology of Insects," by Prof. W. Lochhead; "Effects of Stable and Horn-fly Attacks on Milk Production," by Mr. A. W. Baker; "Two Unusual Garden Pests in Nova Scotia," by Prof. W. H. Brittain; "The Entomological Record," by Mr. Arthur Gibson. These papers have been published in the Forty-eighth Annual Report of the Society which was issued by the Ontario Department of Agriculture in October last. The following papers were also read but not submitted for publication: "Black Flies in the Dixville Notch," by Dr. W. C. O'Kane; "The Nervous System of Caterpillars and its Relation to Classification," by Mr. J. M. Swaine; "Habits, Behaviour and Tropisms of Insects," by Dr. Arthur Willey. By the courtesy of the U. S. Bureau of Entomology, were exhibited motion pictures of "Field and Parasite Work Against the Gypsy and Brown-tail Moths," through Mr. A. F. Burgess and Dr. C. Gordon Hewitt, and of "Orchard Spraying in Nova Scotia," by Prof. W. H. Brittain. A symposium was held at the close of the evening session on the question of how Canadian Entomologists can help to increase food production, led by Dr. Hewitt and participated in by many of the members.

The Canadian Entomologist, the official organ of the Society, has been regularly issued each month. The fiftieth annual volume will be completed by the issue of the forthcoming December number. The forty-ninth volume, published during 1917 contained 440 pages, illustrated by 21 full page plates and 41 figures in the text. The contributors to its pages numbered 64 and included writers in Ontario, Quebec, Nova Scotia, Manitoba, Alberta and British Columbia, and also in eighteen of the United States. The series of papers on "Popular and Practical Entomology" was continued each month and provided interesting and instructive information for the general reader. In the systematic papers there were described four new genera, 137 new species and 10 new sub-species or varieties. As a result of the publication from year to year of a large number of articles on descriptive and systematic entomology, there is a constant demand for back numbers and volumes.

Twenty-five new members have been added to the rolls of the Society.

It is with deep regret that the Council records the removal by death of one of our oldest and most distinguished members, Mr. William Hague Harrington, who died at his home in Ottawa on the 13th of last March in the 66th year of his age. He was well-known to Entomologists throughout North America by his systematic work in the order Hymenoptera, and was justly regarded as our best

Canadian authority on this department of the insect world. Of late years he had taken up the study of Botany with characteristic energy, and became familiar with the Flora as well as the Fauna of Ottawa and the surrounding country. An appreciative memoir by Mr. Arthur Gibson and an excellent portrait appeared in the June number of the *Canadian Entomologist.*

To the Society's Roll of Honour in the world-wide war, have now to be added the names of Captain R. V. Harvey and Lieut. Vernon King, who have laid down their lives on the battlefield in defence of the Empire and the freedom of mankind. Captain Harvey was for nine years Secretary of the British Columbia Branch of our Society (1902 to 1911) and the success of the Branch during that period was almost entirely due to his enthusiastic work. In the collection and study of insects he devoted himself at first to the Lepidoptera and of late years to the Diptera. At the outbreak of the war he joined the 7th Battalion and was with the first Canadian forces who went to France. In April, 1915, he was severely wounded in a charge and died a few weeks later in a German prison camp. Lieut. King, an Englishman by birth and a graduate of the Ontario Agricultural College, was employed in the Cereal and Forage investigation branch of the U. S. Bureau of Entomology, where he was doing excellent work. He could not, however, resist the call of patriotism and in November, 1914, he returned to Canada and entered the British Army. He served in Egypt and the Dardanelles, and subsequently joined the Flying Corps in France. During an air fight against heavy odds he lost his life on April 11th, 1918.

REPORT OF THE LIBRARIAN.

Owing to the want of funds available for the purpose, the only books purchased for the Library during the year ending October 31st, 1918, are Fabre's "The Life and Love of the Insect," Burmeister's "Manual of Entomology," and Comstock's "The Wings of Insects." Including these works, fourteen bound volumes have been placed upon the shelves, making the total number 2,285. There is a large accumulation of unbound periodicals, bulletins, reports and pamphlets, which, it is to be hoped, may some day be bound and made more readily available for reference.

Respectfully submitted,

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE CURATOR.

The Society's collections have been examined from time to time, and the necessary steps taken to prevent injury from museum pests or other causes. At the present time they are in good condition.

Respectfully submitted,

ERIC HEARLE.

REPORT OF THE MONTREAL BRANCH.

The 376th regular and 45th Annual Meeting of the Montreal Branch was held at the residence of the President, Mr. A. F. Winn, 32 Springfield Ave., Westmount, on Saturday evening, May 11th, 1918.

The report of the Council showed that during the season seven meetings were held with a total attendance of 85, or an average of over 12 per meeting. A public meeting was held in March at the Redpath Museum, McGill University, when Mr. J. M. Swaine came from Ottawa and gave an illustrated lecture on "The Protection of Shade Trees in Cities." At this time the Lyman Entomological Collection was opened for inspection.

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

1. President's Annual Address .... A. F. WINN.
2. An account of insects in vegetable plots .... DR. CORCORAN.
3. Tussock moths .... DR. F. S. JACKSON.
4. A trip to the Provincial Forest Nursery, Berthierville, Q. .... A. F. WINN.
5. A few moths from Bondville, Q., 1917 .... A. F. WINN.
6. Notes on bees .... G. H. HALL.
7. Report of annual meeting of Ent. Soc. of Am. at Pittsburg, Pa. .... DR. CORCORAN.
8. Notes on the Geometrid species of Genus, Acidalia, Guenesia, Cabera .... G. CHAGNON.
9. Hemiptera found in a backyard garden, 1917 .... GEO. A. MOORE.
10. Description of Entomological work in England, 1917 .... LACHLAN GIBB.
11. Chilo comptulatalis Hulst .... A. F. WINN.
12. The protection of shade trees in cities .... J. M. SWAINE.
13. E. P. Van Duzee's catalogue of Hemiptera of America .... GEO. A. MOORE.
14. Collecting in England, 1917 .... LACHLAN GIBB.
15. The Daylight Saving Act, what it will do for Entomologists .... A. F. WINN.
16. Directions for collecting and preserving Orthoptera for the cabinet .... G. CHAGNON.

The Treasurer's Report showed a balance of $150.93.

The following were elected as officers for the coming year:—

President .... A. F. WINN.
Vice-President .... G. CHAGNON.
Secretary-Treasurer .... GEO. A. MOORE.
Librarian .... G. CHAGNON.
Council .... G. A. SOUTHEE, DR. CORCORAN, J. G. HOLMES, G. H. HALL.

Respectfully submitted,

GEO. A. MOORE, *Secretary*.

REPORT OF THE TORONTO BRANCH.

The 217th meeting and 22nd Annual Meeting of the Toronto Branch of the Entomological Society of Ontario, was held in the Biological Building of the University of Toronto, Nov. 21st, 1918, the President, Dr. Clemens, in the chair. The minutes of the previous meeting were read and approved. The report of the Council, the financial statement, and the report of the Librarian were presented and adopted.

The report of the Council showed that during the season of 1917-1918, six regular meetings, one special meeting, and the Annual Meeting were held in the Biological Building of the University of Toronto. The average attendance at the regular meetings, including visitors, was 15 persons. During the season the following papers were read before the Society:—

1917.		
Nov. 22.	Life of Spring Ponds	Dr. E. M. Walker.
Dec. 13.	War Services of Entomologists	Dr. W. A. Clemens.
	Summer Work of New York State Food Commission	John Detweiler.
1918.		
Jan. 24.	The 1917 Collecting Season	Mr. H. V. Andrews.
Feb. 15.	Fruit Flies	Prof. L. Caesar, Guelph.
Mar. 21.	Fossil Insects	Dr. A. Cosens.
Apr. 4.	Injurious Shade Tree Insects and their Control	Mr. J. M. Swaine, Ottawa.
May 9.	Personal Experiences with Tropical Insects	Mr. F. J. Harris.

Seven new members were elected during the year: Messrs. D. E. Reid, B. Wright, Frank Foulds, John Detweiler, R. W. Blakely, F. J. Harris, F. Broderick.

We regret to record the death of two esteemed members, Mr. Samuel T. Wood and Miss Dorothy Fraser. Mr. Wood was well known among nature lovers throughout Canada by his charming writings, particularly the weekly editorials in the *Globe*, on various phases of wild life, and his loss is keenly felt by a large circle of friends, to whom he had endeared himself by his kindly, unassuming personality.

Miss Fraser who was on the staff of the Biological Department of the University of Toronto, graduated from this department in 1917 with the highest honours in Biology. She won the esteem and admiration of all her colleagues by her fine character, her unfailing industry in spite of delicate health, and her unusually keen scientific judgment.

At the meeting of December 13th, 1917, steps were taken toward the formation of a special committee for the purpose of organizing a campaign against the Tussock Moth in Toronto. This committee met five times between January and May. The following programme was drawn up and carried out:—

1. Stirring articles were written by several members of the Society and published in the daily papers. These articles dealt briefly with the destructiveness of the Tussock Moth caterpillars, methods of control, and the responsibility of the citizens in helping to combat the pest.

2. On April 4th a special joint meeting of the Toronto Branch, the City Parks Department, and the Toronto Horticultural Society, was held in the large lecture hall of the Biological Building of the University of Toronto, at which Mr. J. M. Swaine gave a very able and interesting address on "Shade Tree Insects," dealing particularly with the Tussock Moth.

3. An attractive illustrated pamphlet was prepared, and 5,000 copies were printed and distributed to the schools of the city.

4. Through the courtesy of the City Parks Department, four sets of lantern slides were prepared, bearing the same illustrations as the pamphlets, and giving short concise directions for controlling the pest. These were circulated among various motion picture theatres in the city.

Special donations amounting to $35.00 were contributed by the following gentlemen: Major R. J. Christie, Mr. James O'Brien and Mr. Paul Hahn.

The results from the campaign were very gratifying.

The financial statement showed a balance on hand of $19.97.

The report of the librarian shows that a large number of pamphlets and periodicals have been added to the library during the season of 1917-18.

Special arrangements have been made with the Department of Biology, University of Toronto, in regard to filing and shelving space, and by which members of the Department may have access to the literature. Good progress has been made in re-arranging and cataloguing.

The publications received since the last meeting were presented.

The election of officers was then proceeded with, and the results were as follows:

President .... DR. W. A. CLEMENS.
Vice-President .... MR. H. V. ANDREWS.
Secretary-Treasurer .... S. LOGIER.
Librarian .... MISS NORMA FORD.
Council .... DR. E. M. WALKER, DR. A. COSENS, MESSRS. T. B. KURATA, J. HANNIBAL, C. K. BROBST.

The business of the evening finished, the meeting was then left open for short talks by members and for discussion. The following members spoke:

C. K. Brobst on the Tussock Moth work in Toronto in summer of 1918.

Dr. A. Cosens, on "Observations on the Monarch Butterfly."

Mr. H. V. Andrews, on "A trip to Go Home Bay for Oeneis chryxus, var. calais."

Dr. E. M. Walker on "Oeneis chryxus, var. calais."

Mr. S. Logier, on "Observations on parasitized caterpillars."

Those present at the meeting were: President Dr. W. A. Clemens, Dr. Cosens, Dr. Walker, Miss N. Ford, Messrs. Kurata, Andrews, Harris, Reid, Wright, Hannibal, Blakely, Broderick, Brobst, Logier, and five visitors, in all, 19 persons.

Respectfully submitted,

SHELLEY LOGIER, *Sec.-Treas.*

REPORT OF THE BRITISH COLUMBIA BRANCH.

The 17th Annual Meeting of the British Columbia Branch was held in the City of Victoria, B.C., Saturday, February 23rd, 1918. The morning session was called to order by President E. H. Blackmore. Secretary William Hugh handed in his financial statement and read a report of the Society's work during the past year.

The following papers were read and discussed:—

President's Address .... E. H. BLACKMORE.
Notes on the Classification and Bionomics of the Hemiptera .... WM. DOWNES.
Collecting in the Lillooet District—A trip to Mount McLean .. A. W. PHAIR.
Life History of *Perigrapha praeses* Grt .... GEO. O. DAY.
On Parthenogenesis in the Honey Bee .... WILLIAM HUGH.
Insect Notes ofthe Year .... R. C. TREHERNE.

Afternoon Session.

Notes on the Mycetophilidae of B. C.:
A Revision of the B. C. species of the genus Hydriomena based on the character of the male genitalia .... E. H. BLACKMORE.
Notes on the Aeolothripidae .... R. C. TREHERNE.
Natural Control Investigations in B. C.:
Life History of the Leaf-Eating Crane Fly, Cylindrotoma spendens, Doane (Diptera, Tipulidae) .... DR. A. E. CAMERON.

The following were elected to the several offices for the year 1918:—

Hon. President ....F. Kermode, Provincial Museum.
President ....R. S. Sherman, Vancouver, B.C.
Vice-President (Interior) ....J. W. Cockle, Kaslo, B.C.
Vice-President (Coast) ....Wm. Downes, Victoria, B.C.
Hon. Secretary-Treasurer ....William Hugh, Box 20, Cloverdale, B.C.
Advisory Board ....Messrs. E. H. Blackmore, R. C. Treherne, G. O. Day, A. W. Hannam, L. A. Breun.

The Society offered the Vancouver Exhibition Association two prizes for the best collection of types of beneficial and injurious insects put up by school children.

REPORT OF THE NOVA SCOTIA BRANCH.

Since our last report was presented to our parent Society a new number of our "Proceedings" has been issued, comprising approximately 100 pages and including considerable new data on Nova Scotian insects and the problems connected with their control. Another Annual Meeting was held on July 26th of the present year, when a number of papers were read by the members and a successful session was held. The speaker of the occasion was Mr. J. D. Tothill, of the Dominion Entomological Branch, who gave a paper on "The Meaning of Natural Control." The following officers for the year were elected:—

Honorary President ....Dr. A. H. McKay, Halifax.
President ....L. A. DeWolfe, Truro.
Secretary-Treasurer ....W. H. Brittain, Truro.
Asst. Secretary-Treasurer ....E. C. Allen, Truro.
Committee ....A. Kelsall, Annapolis Royal, and Miss Aileen Henderson, Lawrencetown.

Like all other organizations our Society has suffered many inroads in its membership on account of the war. In spite of this we have been able to keep up our members to the pre-war level and are particularly fortunate in the fact that none of our members who have gone overseas have actually lost their lives in the great struggle. With the return of peace time conditions and the removal of all hindrances to our expansion, we are hopeful of healthy, vigorous growth from now on.

W. H. Brittain, *Secretary.*

REPORTS ON INSECTS FOR THE YEAR.

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

The unusual abundance of the Monarch, *Anosia plexippus,* during the past two years, led me to hope that this season I could obtain a series of notes that would be of interest concerning this wide-ranging Canadian butterfly.

In looking over these notes, however, I find only a few of sufficient importance to include in this report. This was owing chiefly to the butterflies not being sufficiently numerous to prevent an ebbtide in the enthusiasm of the early part of the season.

Concerning the first to arrive of the migrants from the south I have made the following note:—

June 15th. "Two specimens of Anosia were seen flitting about a few milkweed plants on the Old Belt Line, near the Humber; one of the butterflies appeared to be ovipositing, but the eggs could not be found."

The above apparently represents, in general, the date of the first appearance in Ontario of this butterfly, since it agrees with that noted by other observers. In 1900, Mr. C. W. Nash, Toronto, states that he saw the Monarch first on June 14th, and in 1901, Mr. J. A. Moffat, London, noted its arrival there on June 12th.

While the middle of June may be taken as the average date of their arrival in this Province, there must be at least isolated butterflies that return much earlier.

With reference to this I find in my notes:—

June 19th. "Mr. Martin saw, on milkweed plants, a nearly full-grown Monarch larva, also a much smaller one."

Later in the day we found the larger larva but did not get the smaller. The one we captured was one and three-fourths inches in length. The egg from

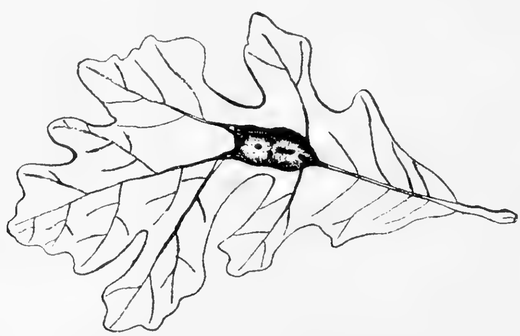


Fig. 1.—Gall produced by *Neuroterus flavipes* Gill on Bur Oak, *Quercus macrocarpa* Michx.

which this larva emerged must have been deposited the end of May or very early in June.

There are notes under two other dates in June.

June 24th. "Anosia butterflies plentiful around the milkweeds at Mimico Creek."

June 27th. "In the same locality as the preceding, caught three males and two female butterflies. These specimens were all much faded and worn, the wing margins were also badly torn. The butterflies were frequently mating at this time."

Nothing of interest appears to have been observed for a month, as the next note reads:—

July 27. "Many Monarch butterflies ovipositing, all the specimens captured were faded and torn. Larvæ were frequently seen, these varied from one-half to full-grown; ten of the latter were collected."

July 30th. "Several of the larvæ taken on the 27th have pupated."

With very little further feeding these larvæ eventually all passed into the chrysalid stage, and all emerged, sometime between the 9th and the 22nd of August, the exact date unknown owing to absence from the city.

Although these butterflies, during the last two seasons, gave ample opportunity, in this locality, of observing their congregating habits, I was not fortunate enough this fall to see a single flock.

I wish also to report the securing of the producers from a gall on Bur Oak, *Quercus macrocarpa.* These producers have been kindly identified by Mr. Wm. Beutenmuller as *Neuroterus flavipes* Gill.

The gall, which is polythalamous, is an elongated, irregular swelling from the midrib of the leaf, but also extending out slightly along the veins. It is somewhat triangular in cross section. Opening on the upper surface of the leaf, from which the gall chiefly projects, are minute canals, one passing to each larval chamber.

Length of gall parallel to the axis of the midrib 10-15 mm.

In all probability a revision of the Cynipidae will place this species in the genus Andricus, as it closely resembles *A. piger* Bassett and *A. petiolicola* Bassett.

The former is a polythalamous gall produced by the swelling of the petiole or midrib of the Scarlet Oak, *Quercus coccinea.* The latter is also located on the petiole or midrib of the leaf, but the host in this case is the White Oak, *Quercus alba.* It is an irregular, spherical swelling drawn out at some place on its surface into a short tapering projection. At the summit of this is an opening surrounded by a dense ring of coarse, brown trichomes.

Division No. 5, Peterborough District—F. Morris, Peterborough.

My report for the present year again deals chiefly with *Cerambycidae.* The first series of observations made relate to the obscure little *Anaglyptus,* Le Conte's *Microclytus* (or rather *Cyrtophorus*) *gibbulus.* This insect had been taken in considerable numbers in 1916 and 1917, feeding on choke-cherry blossom, dogwood and spiked maple, during the first three weeks of June. In the former season the blossom was well out by June 3rd, in the latter by June 10th. This season I made my way out to the place of capture about the middle of May, and found the corner of the wood where the insect had been prevalent already in the act of falling beneath the woodman's axe! It was too early for the blossom and there was no trace of the insect. Before paying the spot another visit, I decided to wait till the end of May. Soon after this decision, however, a hot spell brought the blossoms on with a rush, and I was dismayed on passing a woodyard in the city one day to see a shrub of choke-cherry in full bloom; next day (May 23rd) I hurried out to the "Wood of Desire" and found the shrubs actually shedding their bloom. I had missed the height of the insect's season. The air that day was cold, and I found only a single specimen. It was the more disappointing that I had arranged to go north over the week-end. However, on Tuesday, May 27th, I was back at the hunting ground and had the good fortune to find two or three trees of choke-cherry in a somewhat less exposed position on the margin of the wood; here I secured more than 20 of the insect, including five natural pairs secured from specimens taken home alive and mating in captivity. June proved a very poor blossoming season in our district, and almost no captures were made on dogwood, viburnum and spiked maple. Beyond a single specimen of *M. gibbulus* taken on dogwood on June 1st, I saw no further trace of this elusive little insect. In each of the last three years when it has been captured, the season of its prevalence has been limited to a fortnight and is practically dependent on the blossoming of the choke-cherry clusters; viz., 1916, June 4-18; 1917, June 9-24; 1918, May 20-June 1.

On May 24th, while at Lake Catchacoma, some 30 miles north of Peterborough, I found an extraordinary number and variety of insects drawn in the hot sun to the choke-cherry clusters; besides about 10 species of Longicorn, there were a large number of species of Chrysomelians, Scarabs and Elaters; among these last, three species of *Corymbites* including *C. hamatus* and *C. vernalis;* but the most interesting by far to me of the day's bag was a pair of the very handsome Cantharid, *Pomphopoea aenea.* Only once before had I ever seen this insect, and that was at Port Sydney towards the end of June, when I found a pair on the Nannyberry (*Viburnum lentago*). It is a large insect of a beautiful grey-blue-green shade and of satiny texture; the antennae black, and the legs orange-yellow with black knees and feet. Of the species I am not quite sure; Dr. Bethune who kindly identified the earlier capture thought it *P. sayi,* but according to Blatchley the yellow and black legs belong to *P. aenea.* This had been 1909, for it was just a few weeks before Dr. Brodie's death, with whom I was staying in North Muskoka at the time.

On the first of June I captured two specimens of the so-called Currant-borer (*Psenocerus supernotatus*) settling on a newly fallen poplar stem. On June 10th while ranging about a tamarac swamp for Pyrola and Cypripedium, I had the good fortune to capture a breeding pair of *Tetropium cinnamopterum* resting in the shadow on the underside of a recent windfall of white spruce, the only tree I have ever captured this insect on. On June 15th—rather an early record—while foraging about at the "Wood of Desire," I spied a specimen of *Desmocerus palliatus,* flying from a small clump of the late elder; examination of the shrubs led to the capture of a dozen of these handsome borers; they had evidently just emerged and were crawling up into the sunlight from the stems, a few were already pairing and taken at rest on the underside of the foliage. A specimen of *Goes oculatus* was taken the same day on newly fallen poplar. On June 18th, while exploring a very rich corner of tamarac swamp, I made two finds especially that awoke happy memories; after an interval of 19 years, I found again that local rarity among the orchids, *Orchis rotundifolia,* and on the swamp Valerian—just as three years before near Trenton—I found *Leptura chrysocoma* feeding on pollen. Between June 18th and 20th, I took three specimens of this beetle always among tamaracs. On June 25th, I captured a specimen of *Saperda tridentata* on an elm log, and on a large billet of poplar in a woodpile, a pair of *Pogonochaerus mixtus.*

On June 29th and 30th, during a short stay in Port Hope, I paid a visit to some woods four miles north where a season or two before the woodman's axe had been very busy—far too busy, for every windstorm since has taken heavy toll of the surviving timber. The work of tramping in hot sunshine through bush, and stumbling or slipping on hidden logs and stumps was very exhausting, but a number of interesting captures were made. Among these, one *Leptura zebra* on the sheaf of foliage about an oak stump, five *Neoclytus erythrocephalus* taken running on the trunk and limbs or two fallen trees, a basswood and a butternut, one *Clytus marginicollis* on white pine, three *Physocnemum brevilineum* on fallen elm, three *Leptostylus sex-guttatus* in brush-heaps of white pine, one *Leptostylus macula* on basswood, one *Goes oculatus* and one *Urographis fasciatus,* both resting on the underside of a lodged trunk of maple, three *Hoplosia nubila* on basswood, two *Lepturges symmetricus* and one *Eupogonius subarmatus* on a recent windfall of basswood.

On July 4th a trip from Peterborough to the "Wood of Desire" proved very successful: among other captures, two *Liopus variegatus* on fallen poplar, one *Lepturges querci* on sumac, one *Xylotrechus undulatus* on spruce, two *Desmocerus palliatus* from the same little clump of late elder as had yielded several captures nearly three weeks earlier, two *Oberea tripunctata* and one very small and faintly marked specimen of *Clytanthus ruricola* on raspberry foliage. Next day, on a dead branch of sumac I took a specimen of *Neoclytus erythrocephalus*. On July 6th I took a specimen of *Hoplosia nubila* near Chemong from the same dead limb of basswood as yielded over a score last season. On July 8th, three *Liopus alpha* from dead or dying sumac branches, On July 11th in the heart of a large tamarac swamp on various blossoms including yarrow, daisies and fleabane (feeding on pollen in the hottest of sunshine) 19 *Leptura chrysocoma*, and on the edge of the swamp in milkweed blossom, three *Typocerus velutinus* and two *T. zebratus;* I strongly suspect *L. chrysocoma* to bore in the tamarac, for I have never found it far from that tree. On July 17th, I took fifteen *T. zebratus* on blossom of sumac and milkweed, and one *Leptostylus macula* on a dying branch of sumac.

On July 18th, while with a brother botanist on a corduroy road in a tamarac swamp north of Bethany, I noticed a strange butterfly that at first I took for a fritillary or silver-spot; on capture it proved to be the very beautiful "Baltimore," *Melitaea phaëton.* Investigation in September showed a plentiful growth at the roadside of *Chelone glabra* or Turtlehead, the food plant of this insect's larva.

On July 20th, I paid a farewell visit to the "Wood of Desire" before going north to camp in the Algonquin Park. The day was spent following in the wake of the axe: here were taken, running on white pine logs that lay scorching in the sun, three *Neoclytus muricatulus* (including a mating pair); one *Urographis fasciatus* resting on foliage of a basswood stump; *Lepturges pictus* on a dying branch of basswood; these were all in the open or on the edge of the wood; in the depths among a confusion of felled hemlock, spruce and balsam, I took two *Leptura subhamata* and three *Xylotrechus undulatus* all on spruce.

The active collecting for the season came to an end between July 27th and August 3rd in the Park with the capture of some *Leptura canadensis* and four specimens of *Leptura biforis,* taken in flight about our little camp clearing on Big Island in Cache Lake.

Division No. 6, Essex District—J. W. Noble, Department of Agriculture, Essex, Ont.

Attacking Field Crops. Wireworms, white grubs, cutworms, grasshoppers, crickets. Considerable damage was done in the spring by white grubs to strawberry beds, wireworms to potatoes, cutworms to cabbage and tobacco plants, especially to the latter; a considerable acreage of tobacco had to be replanted on account of the ravages of the cutworm. In July owing to the very hot weather we had more trouble with grasshoppers and crickets than has been experienced in this county for some years. Grasshoppers stripped considerable vegetation but largely confined their energy to cutting binder twine after the sheaves had been tied. Many reports have been received in some instances where crickets and grasshoppers had destroyed binder twine in wholesale quantities. Clover seed midge was reported from a number of fields, but is not believed to be common throughout the county. Hessian fly: some reports of injury during fall of 1918.

Attacking Fruit Trees. Codling Moth very plentiful especially in uncared for orchards; considerable damage done in orchards that had not been sprayed, about three broods reported in many instances.

Plum Curculio very plentiful in plum orchards this season, considerable damage to apples.

San José Scale appears to be considerably winter killed during severe winter of January, 1918, still quite plentiful in uncared for orchards.

Tent caterpillar not common, few nests seen. Fall webworms rather plentiful.

Aphids. Considerable damage to tree fruits, very effectively controlled by tobacco decoction.

Peach tree borer very plentiful especially on trees which winter killed last winter.

Apple Maggot noticeably plentiful in one orchard, very little damage on the whole.

FRUITS AND VEGETABLES. Melon aphid and cucumber aphid again this season accounted for a great loss among the cucumber and melon growers but after the experience of last year a great many fields were saved by early spraying, tobacco decoction being the most popular remedy.

Onion thrips very plentiful in the Pelee marsh, no remedy as yet found satisfactory.

Onion root maggot again very plentiful, considerable acreage lost.

Asparagus beetles plentiful but as the acreage is limited very little reported.

Capsids were considered by Dr. Bethune to have been the cause of white spots appearing on the early tomato crop. Upon careful examination no insects were found and no cause could be located. It occurred in two fields and accounted for considerable loss.

Squash bugs and cucumber beetles. Considerable loss to the pickle growers resulted from these insects. Trapping was tried but with little success, application of a repellant seemed to have only partial results.

Greenhouse Insects. Greenhouse men experienced considerable trouble during the winter of 1917-18 with greenhouse white fly and with aphids. Nematodes were also plentiful. The best growers, however, practised soil sterilization and occasionally fumigated with hydrocyanic gas.

THE PRESIDENT: I shall now ask Father Leopold to read his paper on "Economic Entomology in Quebec."

FATHER LEOPOLD: Mr. President, I was so anxious to secure further information on spraying that I did not prepare a paper but a series of questions which I hope you and other entomologists who have been studying spray mixtures will answer. I believe this will be of more value than my paper would have been. My questions are:—

1. What spray mixtures should I recommend to our people next year for apple orchards?

2. Is it true that Bordeaux mixture causes very great injury by russeting the fruit? If so, which application causes most of the russeting?

3. What recommendations should be made in regard to dusting?

THE PRESIDENT: As neither Mr. Sanders nor Prof. Brittain are here from Nova Scotia I shall ask Dr. Hewitt to tell us something about Mr. Sanders' results and what he intends to recommend this year in Nova Scotia.

DR. HEWITT: I cannot, of course, respond to your request with as much satisfaction to those who are interested in this subject as Mr. Sanders would have been able to give had he been here.

Owing to what appears to be an injurious effect of lime sulphur in reducing the crop of apples in Nova Scotia, Mr. Sanders turned his attention to Bordeaux mixture which had been almost entirely given up in favor of lime sulphur as the fungicide in apple spraying. While it is, of course, not our function to investigate fungicides we were compelled to study them as carriers of insecticides. In Nova Scotia there is not the same demand for a scale destroying spray such as lime sulphur as in Ontario owing to the absence of San José Scale, the existence of which insect was chiefly responsible for the adoption of lime sulphur in other parts of the country.

Coupled with the scalicide properties of lime sulphur was its easy preparation and the powerful advocacy of the manufacturers. We found that when Bordeaux was substituted for lime sulphur in certain of the sprays we obtained better results both from the point of view of production and condition of the foliage; we also found that the trouble of russeting could be obviated by not using Bordeaux in the third spray, that is, the spray when the blossom petals have fallen which is apparently the period when the setting fruit is most susceptible to the Bordeaux injury.

In view of the excellent results that we obtained in our experimental plots and that have been obtained by some of the more prominent fruit growers in Nova Scotia, we are recommending the use of Bordeaux mixture instead of lime sulphur in the first, second and fourth sprays. In the third spray we find that sodium polysulphide has given us the best results. As an insecticide we are recommending in each spray the use of arsenate of lime.

We have felt that far too little is known with regard to the chemistry and bio-chemistry of spraying. Spray mixtures have often been recommended without a careful study of their chemical constitution or of their effect on foliage, fruit or insects. Accordingly, we are now making a very careful study of the chemical nature of the different compounds that result from mixing various insecticides with fungicides and of the effect of such compounds on the trees and on the insects that they are expected to destroy. By these means we hope to secure exact data that will enable us to experiment to better advantage and to secure results of real value.

But after all, I feel that the ultimate test will be made by the fruit grower who will be the best judge as to the sprays giving the best results, and after having carried out our investigations to the best of our ability we shall have to be content to leave the matter in the hands of the grower. If we can demonstrate to him the superiority of one spray over another he is generally willing to be convinced and to act according to our advice. Further, it is a mistake to assume that a spray combination that is the best in one fruit growing section of the country will be the best in another. Spraying systems must be worked out to suit the various localities. The day of the universal spray calendar has long passed and for this reason we are endeavoring to study our spraying problems locally.

Prof. Caesar: I shall briefly answer Father Leopold's questions and then ask Prof. Parrott to give us the benefit of his experiments in New York State.

I myself intend to recommend as usual lime-sulphur for the first spray, that is the one given either before or as the buds are bursting or just after they have burst. For the second spray, the one just before the blossoms burst, I shall recommend either lime-sulphur, 1 gallon to 35 gallons of water, or Bordeaux mixture. 4.4.40, and to each of these either arsenate of lead or arsenate of lime. For the third application, the one just after the blossoms have fallen, I shall recommend lime-sulphur 1 gallon to 40 gallons of water, and the usual amount of arsenate of lead.

At present I do not feel like advising against the substitution of arsenate of lime for arsenate of lead with lime-sulphur, though I am not yet convinced that it is so safe. A warning, however, should be given, that some brands of arsenate of lime are much inferior to others and much less safe.

In a very wet period I should prefer Bordeaux to lime-sulphur for the spray just before bloom, because it will remain on the trees longer and thus keep off scab longer than lime-sulphur. I do not recommend it for the third application because it russets the fruit, some years very badly and every year to some extent.

As to the dropping of fruit which follows later applications of lime-sulphur in Nova Scotia, this has not taken place in Ontario in my own or any other person's experiments that I am aware of. I believe the difference in climate between the two Provinces accounts for the different results obtained.

As to the dust method of treating orchards, I do not intend to recommend it for the present. I have obtained good results from it myself but the fruit growers do not succeed well with it. They also object to the cost. The new spray guns have made them much better satisfied with liquid sprays.

PROF. PARROTT: In our State I believe we have more pests to combat than you have in your fruit growing sections. We have San José Scale, and use lime-sulphur because it is cheap and nearly fool-proof from the standpoint of the farmer. We have the Pear Psylla, which is a very common pest in our pear growing sections, and we rely on lime-sulphur to combat that insect; and we have the various mites which are held in check by sulphur sprays. Considered from the standpoint of the dormant application we have to consider some spray mixture which will handle those particular pests.

Our change from Bordeaux to lime-sulphur was brought about by the attitude of our fruit growers. There was a period in the '90's and ten or fifteen years ago when growers suffered severe injury from Bordeaux mixture. As a result of this injury the farmers swung over to the use of the lime-sulphur, because the fruit presented so much better an appearance from its use. As far as New York is concerned (and I think I am safe in speaking for the men at Cornell as well of those of the New York Experiment Station) we would not dare to recommend Bordeaux to apple growers in our State; it causes too much injury.

I have been very much interested in the question of dropping of fruit. It seems to me it is one of the points which should be looked into. For two years we have carried on comparative experiments with lime-sulphur and arsenate of lead and Bordeaux mixture and arsenate of lead, and in 1917 we had a larger drop on the check trees than on those sprayed with lime-sulphur and arsenate of lead or Bordeaux mixture and arsenate of lead.

We tested nine brands of calcium arsenate this summer and also tested a formula given by our Federal Government for home-made calcium arsenate. In the work on the station grounds we had no injury, not even yellowing, in any plot sprayed with a commercial brand, notwithstanding the fact that we gave all four applications. We had, however, serious yellowing following the second application of the home-made preparation.

A point was made in regard to dusting. There is involved a consideration of the fact that in certain districts of New York the red bugs are a most injurious pest. We have no contact dusting material which favorably controls them. I doubt whether dusting will get very much encouragement the coming season.

INSECTS OF THE SEASON IN ONTARIO.

W. A. Ross, Dominion Entomological Laboratory, Vineland Station, Ont., and L. Caesar, Ontario Agricultural College, Guelph.

Orchard Insects.

San José Scale (*Aspidiotus perniciosus*). The severe winter of 1917-18 destroyed a very high percentage of the scale. Inspectors from all scale districts report less of this insect this year than for many years. In two Woodstock orchards infested for at least the past ten years, it has, so far as the Provincial Inspector could judge, completely disappeared, no live scale being found on fruit or branches in October.

Green Apple Aphis (*Aphis pomi*). During the summer there was a widespread outbreak of the Green Apple Aphis. In most orchards the infestation did not attain serious proportions until about mid-July, and from then on it was somewhat rapidly brought under control by hot, dry weather and by insect enemies, until by the second week of August comparatively few aphids were left on the trees.

In most cases no great damage was caused by the aphis apart from coating the fruit with the sooty honeydew fungus. Fortunately, most of this was washed off before picking time by heavy rains.

White-marked Tussock Moth (*Hemerocampa leucostigma*). In view of the abundance of the tussock moth egg masses on orchard trees last fall, the outbreak of this season came as no surprise. Apple and plum orchards throughout the Niagara District and Western Ontario were badly infested and much damage was done to the fruit.

Fortunately for all concerned, the tussocks were parasitized so heavily by hymenopterous and tachinid parasites that only an insignificant number reached the adult stage. We can safely look forward to next year as a season of comparative immunity from this pest.

Pear and Cherry Slug (*Caliroa cerasi*). During June and July, cherry, pear and plum trees in various parts of the Province were seriously injured by this insect. In many orchards the foliage, particularly of sour cherry trees, was almost wholly destroyed. At picking time much of the fruit on badly infested sour cherry trees was wizened, slug-eaten and unfit for sale.

A very large percentage of the second generation eggs were destroyed by a minute parasite, *Trichogramma minutum* Riley.*

Pear Psylla (*Psylla pyricola*). This pest was again very abundant in various pear orchards from Burlington to the Niagara River. It is worth while recording here that large numbers of trees which had been seriously injured by pear psylla in preceding seasons succumbed to the low temperatures of last winter.

Fruit Tree Leaf-roller (*Tortrix argyrospila*). This insect has apparently almost completely disappeared east of Toronto, but there are some indications that it may be on the increase in the south-western part of the Province. At Simcoe, it caused considerable loss to Greenings. At Ancaster, there are a good many egg masses, indicating that in this locality there will likely be considerable injury from the leaf roller next year.

*Species determined by Mr. A. B. Gahan, U. S. Bureau of Entomology.

Cherry Fruit Flies (*Rhagoletis cingulata* and *fausta*). In the Burlington and Niagara Districts, the crop in some unsprayed orchards of Montmorency and Morello cherries was a complete loss because of the large percentage of wormy fruit.

The severe losses caused by the fruit flies last year induced nearly all the larger growers to spray this season. No sweetening was used, and in many cases a fungicide was added to the poison without detriment to the efficiency of the treatment.

A braconid parasite, *Opius ferruginea* Gahan,* was found in fairly large numbers ovipositing in maggot-infested fruit in an orchard near Jordan, and in another orchard at Burlington. The same species was bred from wormy cherries in late August and early September.

Bud Moth (*Tmetocera ocellana*). East of Toronto and in parts of Western Ontario, the bud moth was very prevalent this spring.

Lesser Apple Leaf-roller (*Alceris minuta*). In September, a farmer of Bruce County wrote for information about a caterpillar that folded apple leaves over and fastened the edges together. Specimens were asked for but when he went to gather them on October 29th, he found the larvæ had deserted the leaves. This fact and the description given of the caterpillar and its work indicate almost without doubt that the species was *Alceris minuta*. The farmer stated that almost every leaf in the orchard was folded. The Lesser Apple Leaf Roller is not common in Ontario.

The Red-humped Apple Worm (*Schizura concinna*), the Yellow-necked Apple Caterpillar (*Datana ministra*), and the Fall Webworm (*Hyphantria cunea*) were prevalent in the Niagara and Burlington districts.

The Pear Thrips (*Taeniothrips inconsequens*). This species, hitherto unrecorded in Ontario, was taken on pear trees last spring in a large orchard near Beamsville. Fortunately, the thrips was present in very small numbers and apparently was not causing any appreciable injury.

It is highly probable that this insect has been present in the Niagara district for a number of years and has not been observed heretofore simply because it has never assumed economic importance.

Insects Injurious to Small Fruits.

Blackberry Leaf-miner (*Metallus bethunei* or *M. rubi*). This miner, though very abundant last year, was even more abundant this year. Practically every leaf in several plantations had from one to fifty mines, and nearly all the older and lower leaves died and fell off in late July and early August. These were replaced by new foliage which in turn became mined in September. All efforts to control the insect failed. In experiments conducted at Burlington large numbers of adults were poisoned by spraying the leaves with sweetened arsenate of lead. It was found, however, that to be effective the spray would have to be applied daily for almost a month because the adults continued to emerge for about that long, and they were found to feed only upon the mixture before it dried, paying no attention to it after this.

In experiments with contact insecticides the sawflies were easily hit but even when drenched with kerosene emulsion, usual summer strength, or with whale oil soap 1 lb. to 4 gals., they recovered as soon as dry and were quite uninjured.

*Species determined by Mr. A. B. Gahan, U. S. Bureau of Entomology.

Last year many parasites were present but this year there were very few cases of parasitism seen.

STRAWBERRY WEEVIL (*Anthonomus signatus*). This species was unusually destructive in Halton County and in the Niagara district. In many strawberry plantations, especially in those adjoining wood-lots, from 30 per cent. to 50 per cent. of the crop was destroyed by this pest.

In a strawberry plantation at Vineland the depredations of the weevil were apparently completely checked by a heavy application of sulphur and arsenate of lead dust (80 parts of sulphur, 10 parts arsenate of lead, 10 parts filler).

STRAWBERRY LEAF-ROLLER (*Ancylis comptana*). At Burlington on July 25th many strawberry leaves were found infested with this roller and numerous moths could be seen flying over the plants late in the evening. All stages of the insect—eggs, larvæ, pupæ and adults—were to be found at that date. Comparatively little injury was done. Growers say that the insect, although common for years, has not caused much loss.

RED SPIDER (*Tetranychus bimaculatus* or *T. telarius*). During the latter part of July raspberry bushes in the Vineland district were seriously injured by the red spider.

INSECTS INJURIOUS TO TRUCK CROPS.

CABBAGE ROOT-MAGGOT (*Chortophila brassicae*). This pest has seldom been more destructive to cabbage, cauliflower and radish than it was this year. Complaints were received concerning it from all parts of the Province. In Carleton County considerable loss was caused on some farms by the maggots attacking and destroying young turnips.

ONION MAGGOT (*Hylemyia antiqua*). This insect, though not so abundant as the cabbage root-maggot, was present in considerable numbers in many localities.

SEED CORN MAGGOT (*Chortophila fusciceps*). Not nearly so many complaints of injury to beans from this maggot were received this year as last. Seed potatoes in the vicinity of Brantford were badly attacked. A few complaints of injury to beans, seed corn, and potatoes were received from other districts.

CABBAGE WORM (*Pontia rapae*). In the Niagara district this pest was unusually abundant.

BEET LEAF-MINER (*Chortophila vicina*). Numerous mines caused by this miner were seen at Guelph and Burlington on beets and a considerable number on mangels. On July 2nd many eggs were to be seen on the under surface of the leaves. Nearly all these eggs or the maggots from them must have perished, for very few mines were observed after that date.

PARSNIP WEBWORM (*Depressaria heracliana*). This species was decidedly destructive to the parsnip seed crop in parts of Western Ontario, and at Guelph and Vineland.

CARROT RUST FLY (*Psila rosae*). Specimens of carrots injured by this fly were received from Guelph, Fergus, Toronto, Shelburne, St. Mary's and Listowel.

CUTWORMS: Corn and garden crops suffered to a considerable extent from cutworm injury.

INSECTS INJURIOUS TO FIELD CROPS.

For the most part, field crops were injured very little by insects.

WHEAT INSECTS. The Wheat Midge (*Thecodiplosis mosellana* Gehin) which caused so much alarm in 1917 was not at all abundant this year. In rearing cages at the Vineland Station Entomological Laboratory, adult midges emerged from June 18th to July 4th, most of them coming out about June 23rd and 24th.

While looking into the wheat midge situation, a slight amount of Hessian Fly (*Mayetiola destructor*) injury was noticed near Ridgeway, Welland County, and in two wheat fields near Beamsville, the Wheat Joint Worm (*Isosoma tritici*) in considerable numbers was found at work.

WIREWORMS. According to Mr. H. F. Hudson, the oat crop in Caradoc, Middlesex, was seriously injured by the wireworm, *Agriotes mancus*.

MISCELLANEOUS PESTS.

WARBLE FLY (*Hypoderma bovis*). Numerous complaints of cattle gadding were received. Farmers who had not previously seen their cattle stampeded in this way and who learned that a fly was the cause, became much alarmed lest the pest should increase.

It looks as if *Hypoderma bovis* were becoming more abundant and more widely distributed through the Province. In some districts, however, it does not seem to be present yet, for stock men in these claim they never saw their cattle gadding.

ROSE MIDGE (*Dasyneura rhodophaga*). This undesirable alien, already well established in a large rose garden near London and in Toronto greenhouses, has invaded another part of Ontario, viz., Port Dover, where it was found this year at work in Messrs. Ivey & Sons' greenhouses.

In order to prevent the further spread of the midge, the following recommendations have been made to florists:—

(1) Whenever possible, growers should propagate their own roses.

(2) New stock should be obtained from non-infested greenhouses.

(3) Rose plants and scions purchased through commission houses or from places not known to be free of midge, should be imported before the end of February. This recommendation is made because such stock, provided it has been planted in November or December, will not have been exposed to infection.

(4) Greenhouse roses brought in later than the end of February should be carefully examined for rose midge injury, and any infested plants should be destroyed. In addition to this, the soil should be washed off the roots of the plants and should then be thrown into the furnace or scalded with hot water or steam.

ROSE LEAF-ROLLER (*Cacoecia rosaceana*). During March this insect was remarkably abundant on roses in a Toronto greenhouse.

NEMATODES. Cyclamen were seriously injured by Nematodes in a Hamilton greenhouse. The species concerned was not determined.

CHERMES. The galls made by *C. abietis* and *C. similis* were more conspicuous on spruce trees this season than they have been for several years.

LADYBIRD BEETLES. *Coccinella 9-notata* and *Adalia bipunctata* were remarkably common this year. The latter species was very frequently found in large numbers this fall in dwelling houses in the Niagara district.

POWDER POST BEETLES (*Lyctus striatus*). This beetle was found infesting and seriously injuring oak floors, base-boards, and an oak cupboard in a Vineland house. Some of the wood in the cupboard was badly worm-eaten. A species of Lyctus was also found injuring woodwork in a church in Hamilton.

PROF. PARROTT: I should like to hear from Mr. Ross regarding the distribution of the pear thrips. We find it both on pears and apples in Western New York. So far, it has only been injurious with us in the Hudson River

Valley. There it is very destructive and is found in varying numbers from season to season.

Mr. Ross: This season I found the thrips only on pear and in only one locality—Beamsville. Next year I am going to look into the question of distribution more thoroughly. I should like to ask Mr. Davis if he can tell us anything about the Rose Midge.

Mr. Davis: I cannot tell you any more than what little I have published.

Mr. Ross: Do you know if it occurs all over the United States?

Mr. Davis: Everywhere east of the Mississippi River. In connection with the control of the midge, what you and others have published is all that is known concerning it.

Mr. Ross: Mr. Sasscer of the U. S. Bureau of Entomology obtained absolute control in a Baltimore greenhouse by fumigating with tobacco smoke and at the same time covering the soil with tobacco dust. He fumigated the house as long as the adults were seen. He also sprayed the sidewalks with kerosene emulsion

---

INSECTS OF THE SEASON IN QUEBEC DISTRICT, 1918.

Geo. Maheux, Quebec.

The summer of 1918 may be considered normal, as regards the insects injurious to cultivated plants. We did not have to register any real plague, and the common insects only appeared in rather small numbers. Only one pest appeared to have increased in numbers, and this one has worked more damage than usual in this district; it is the potato flea beetle, *Epitrix cucumeris* Harr.

On the other hand, the Colorado potato beetle, although well represented, shows a decrease compared with 1917. Certain districts in the northern part of the Province, such as the Lake St. John district, were visited by only a few individuals. It is advisable to note here that if the severe winter we have had has contributed to the partial bankruptcy of the multiplication of pests, it is equally important to emphasize the fact that for two or three years the use of insecticides and sprayers has spread considerably. Moreover, the inquiries we are receiving throughout the summer from farmers, and which are continually increasing, show the importance that the latter now attach to the question of the protection of plants. We consider as a remarkable improvement the fact that at least 80 per cent. of farmers use an efficient insecticide for their potatoes. The sale of sprayers yearly increases in a wonderful manner, and before long the great majority of farmers will own a good spraying machine.

The potato flea beetle, *Epitrix cucumeris* Harr., bored through the leaves of tomato plants as well as potatoes, but the other vegetables only suffered an occasional injury. Poison sprays check them rapidly.

The various Cruciferae of our gardens have had to stand the attacks of numberless cabbage worms (*Pieris rapae* L.). It was, without any doubt, the most injurious pest of the season. Much difficulty was experienced to gather cabbages and cauliflowers that were not infested. The cabbage maggot (*Phorbia brassicae* Bouché) like the cutworms, caused only insignificant damage.

In most of the war gardens, which had been fallow lands for a long time, potatoes were injured by white grubs (*Lachnosterna* sp.); 10 per cent. of the crop was spoiled for this reason.

In a few places, the Zebra caterpillar (*Ceramica picta* Harr.), the corn maggot (*Phorbia fusciceps* Zett.), the pea weevil (*Bruchus pisorum* L.) made themselves known, but without causing any serious loss.

Aside from injurious insects, slugs showed up in large numbers and worked considerable havoc in bean crops, which failed in many districts.

The only insect on fruit shrubs worth mentioning was the imported currant worm (*Pteronus ribesii* Scop.), which destroyed a number of currant and gooseberry bushes. On the other hand, the currant aphis (*Myzus ribis* Linn.), which was very numerous last year, was hardly represented this year.

Satisfactory conditions prevailed in orchards; very few apple aphis, a few caterpillars, *Datana ministra* Dru., *Schizura concinna* S. & A., and *Hemerocampa leucostigma* S. & A., the latter being the most numerous. As regards the rest, conditions were about normal. A good many tussock moth caterpillars were noticed on ornamental trees, as well as a few spiny elm caterpillars (*Vanessa antiopa*).

APHIDS; THEIR HUMAN INTEREST.

A. C. Baker, Washington, D.C.

The aphids, or as they are commonly called, plant lice, are among the most interesting of all insect forms. Their importance from several standpoints only adds to the interest which their peculiar habits arouse and their wide distribution and abundance force them on the attention of all those who are in any way interested in plant growth. Thus the early philosophers were attracted by these curious insects and were at a loss to understand their origin. Some claimed they were engendered of the dew, others that they developed from the waste products of ants.

The galls produced on plants by certain species are among the principal ingredients in the manufacture of inks and dyes. Galls of *Melaphis chinensis* are known on the market as nut galls or Chinese galls, and are used almost exclusively in some of the secret methods of sealskin dyeing. The trade in these galls alone reaches into the millions of dollars annually. The galls of this species were known and used by the Chinese many years before Europe learned of them and a rather extensive account is given in the Pên tsao kang mu. They are gathered, steamed and dried and are then ready for shipment. Galls of certain species of *Pemphigus* have been used for many years in Syria, China, etc., for the preparation of bright colored dyes for the fine silks which we value so highly, and these galls are listed on the market at a high figure. Some of the better known ones have been imported into this country and Europe but a large number of species remain yet unstudied and the uses to which their galls may be put are as yet unknown.

Most species produce in large quantities the substance known as honeydew. This is merely the excrement of the aphids, and not, as is very often supposed, a secretion of the cornicles or so called honey tubes. This substance has been known for many centuries, but its origin was in the early days not understood. Pliny speaks of it as the sweat of heaven or the saliva of the stars, and it was not until fairly recent times that its true nature was made known. The substance was gathered, however, in large quantities. The Arabs used it on their cakes much as we have all used honey in our boyhood days, and it is used in parts of the world as a medicine. In France it has been employed by the peasants in diseases of the chest, and it has also been claimed to cure certain affections of the eyes. In Italy it has been used as a salve for the treatment of wounds and sores.

Honeydew is gathered and stored in large quantities by bees at certain seasons of the year when the nectar flow is low. While this is a disadvantage to the beekeeper in that he can not dispose of it, under the present laws, as pure honey it has the advantage of making available, with little expense,. large quantities of honeydew. At present in this country the honeydew thus secured is nearly all used by our bakers in the making of cakes, etc. It is, however, a source of some of our rare laboratory compounds, and no doubt in the future will be used in the manufacture of products formerly imported at a high price, for it is available in large amounts. It is interesting to note that the cornicles were so long associated with honeydew. Morren[1] even claimed that they were employed in giving nourishment to the newly born young much in the way that the mammary glands supply nourishment to young mammals.

In recent years aphids have been associated with the transmission of important plant diseases. Prof. D. H. Jones[2] early indicated by his experiments that aphids are one of the factors in the transmission of pear blight. In connection with disease like mosaic and spinach-blight apids have been credited with an important role but the study of the relation of these insects to plant diseases is as yet in its infancy.

It is claimed by some workers that large numbers of certain aphid species on forage plants are responsible for the injuring of cattle. In China and other eastern countries, on the other hand, some of the galls have been employed as food and as native medicines. In medicine they are employed chiefly as astringents, although they have also been used in other ways.

The relations between ants and aphids have been a favorite subject of study. In return for the honeydew many ants take great care of aphid colonies, building shelters for them, protecting them from their enemies and transferring them when necessary to new feeding grounds. Some even carry the young above ground during the warm sunny hours in spring and return them to their nests for the night. The writer has supplied ants with several hundred wingless aphids and watched these insects distribute them over the most tender feeding areas of a young tree there to start new colonies.

The peculiar habits of the species afford a field of study paralleled in few other groups. Alternation of hosts is commonly met with, and this habit adds to the difficulty of tracing life cycles. Some species on their primary hosts are remarkably different in structure from the same species on their alternate hosts. The writer has found that if species can be made to live on one host, forms which normally show characters associated with a secondary host will develop the characters, in part at least, of the forms occurring on the primary host. Thus races may be reared which have a definite relation to a given host and quite a definite structure. In some cases these races become more or less fixed after long periods, and it is with the greatest difficulty that they are again established on their original hosts. When this is done they ultimately reassume the characters associated with their original hosts.

The presence of winged and wingless forms has given rise to studies on wing production. This subject has been attacked from several standpoints. The

[1] Morren, Chas.—Ann. des Sciences Nat., 1836.
[2] Jones, D. H.—Bull. Ont. Agr. Coll.

occurrence of definite intermediate forms was pointed out by W. F. Turner[3] and the writer. These forms retain the wings in a more or less rudimentary condition and they tend to lose also the other characters which are associated with the winged form. In some species like *Aphis pomi* DeGeer, it is possible to rear an almost pure apterous line and a line with a high percentage of winged forms. It is noteworthy that in certain aphid groups it is impossible to rear apterous forms while in the more specialized groups the winged forms are often absent for many generations. Sometimes a species may be reared for 100 or more generations without a winged insect appearing. It is thus evident that in the family nature has eliminated the wings to a large extent in the specialized groups.

Search has been made for the controlling factor here and several different ones have been claimed. Ewing[4] worked from the standpoint of temperature and in *Aphis prunifoliae* Fitch (*avenae* of authors) was able to control the winged condition by varying the temperature. This species is one like *pomi* in which both winged and wingless forms are common. Ewing also obtained intermediates (calling them paedogenetic nymphs), adults between the winged and apterous condition. Several factors were not considered in his experiments. The affect of varied temperature on the availability of food and its nature when available was not ascertained and the genealogy of the specimens tested was apparently not considered.

Gregory[5] worked with *Macrosiphum pisi* L., and obtained control by varying the food in the previous generation. With insects from different regions, however, she obtained slightly different results. Her experiments were conducted without a definite temperature control and without considering the descent of her insects.

Shinji[6] has made experiments in feeding different chemicals to aphids and finds that he can define two groups of compounds one of which will result in the development of a high percentage of winged forms and the other of which will prevent wing development. His work follows that of Clark[7] and is very interesting. It is noteworthy, however, that his experiments as recorded were conducted almost altogether during fall, winter or spring, and he gives no records of the ancestry of the specimens whereby we can judge of the percentage of winged or apterous forms which would normally be expected from the individuals treated. The writer has found that in some cases the offspring of an individual will be nearly all winged or apterous at the beginning of the period of reproduction and the reverse toward the end of the period. It is important to remember that Shinji was unable to produce any apterous forms in the aphid groups which have not yet eliminated the wings. That is, the ancestry of these forms was more important than his wing preventing substances. On the other hand, in groups which are nearly all apterous he did not experiment with his wing producing substances. It is curious that tannin is listed as preventing wing development and yet several species develop wings while feeding on galls containing 60 per cent. of tannic acid. On the other hand, sugar is given as a wing producing substance and yet the writer has reared an apterous line of *Eriosoma lanigera* for two years on galls containing an abundance of sugar. That Shinji overlooked some factors is evident for he says "*Macrosiphum rosae* also produced alate forms

[3] Turner & Baker—Proc. Ent. Soc., Wash., XVII, No. 1, 1915.
[4] Ewing, H. E.—Biol. Bull., XXXI, No. 2, 1916.
[5] Gregory, Louise H.—Biol. Bull., XXXIII, No. 4, 1917.
[6] Shinji, George O.—Biol. Bull., XXXV, No. 2, 1918.
[7] Clark, W. T.—Journ. Tech., U. of Cal., I, No. 3, 1903.

even on a relatively younger shoot but it is utterly impossible to raise winged *Myzus persicae* on a similar host without the application of a wing developing substance." The writer has reared very large numbers of *persicae* on just such an host without the application of any such substance, and has repeatedly obtained 90 to 100 per cent. winged. But this was where winged forms would be expected in the line in large numbers.

The peculiar life histories of members of this superfamily have led to studies on the predetermination of sex. Morgan,[8] for example, has shown that in *Phylloxera caryaecaulis* there are two types of males depending on the fate of one of the small sex chromosomes when the polar body is about to be produced. Each of these males thus produces a different type of spermatozöon, one female producing and one male producing. If the sexual egg is fertilized by the female producing spermatozöon the resulting stem mother will give rise to the line which results in the sexual female. If it is fertilized by the male producing spermatozöon the resulting stem mother will give rise to a line which results in the production of the male. It is thus seen why we have two types of stem mothers, one giving the large egg migrants and the other small egg migrants.

The production of plant galls by aphids has given rise to studies on these modifications of plant tissues and attempts to determine the factors at work. In some instances it has been claimed that the agent might be an enzyme present in the saliva for in such galls as those of *Eriosoma lanigera* the normal starch is replaced by sugar. The gall makers, too, have led to observations on the sensory organs of aphids. Those species which inhabit galls as well as many of the subterranean species have larger and more prominent sensoria on the antennae than have other species. These are in striking contrast to the sensoria on the antennae of the solitary and free-living forms. The gall formers and subterranean forms also have a larger number of Hicks organs or olfactory pores on the wings than do the solitary species.

Much interesting work has been done on the relation between aphids and their parasites, both animal and plant, and their predators. It is claimed by some workers that certain lower forms are associated with aphids in a commensalistic relationship and may be even passed from one generation to the next through the egg. Many of the parasites so reduce the numbers of aphids that a species otherwise very destructive need scarcely be considered.

Finally certain aphids are among the most injurious species of insects with which the farmer has to deal. The woolly apple aphis for example, had become so important even in 1832 that the Académie de Rouen offered a gold medal for the working out of its life history. The outbreaks of *Toxoptera graminum* in the grain growing areas of the world have done enormous damage and it is only necessary to watch the exchanges to see the influence this one insect sometimes has in the business world. In one outbreak according to Rondani the swarms of aphids appeared like dark clouds and later their dead bodies covered all the streets of the city.

It is thus seen that aphids have a very vital human interest. They supply materials worth much to the arts. They furnish certain quantities of food. And they have given the clews which have resulted in the working out of important biological problems. On the other hand they contribute some of our worst enemies of agriculture. But in our fight against these species we are aided by natural factors without which many of our important crops would be impossible.

[8] Morgan, T. H.—Journ. Exp. Zool., XIX, No. 3. 1915.

THE PRESIDENT: I am glad Dr. Baker sent us this paper. It is one I am sure all of us will be glad to read over at our leisure. I should like to ask Dr. Matheson if the woolly aphis is of much importance in New York State. In Ontario it is certainly of minor importance.

DR. MATHESON: I hesitate to answer your question for New York State, for I have not done very much on the woolly aphis. I do not think it is a very important factor except in some nurseries on sandy areas.

PROF. PARROTT: Dr. Matheson has expressed the economic status of the insect so far as New York is concerned. Our attention to the work of the woolly aphis is usually called by its presence in young orchards of five, six or seven years' of age which have not received any spraying. This refers to the aerial and not the root form. It is very seldom our attention is called to its work on the roots of nursery trees. From our correspondence it does not appear to attract a great deal of attention.

I think we owe a great deal to the entomologists of Canada for the work which has been done on the cherry aphis. I am referring particularly to the work of Mr. Ross on the ultimate hosts of the insect. This has been a great aid in our studies.

PROF. BRITTAIN: The woolly aphis is of practically no importance in Nova Scotia.

THE PRESIDENT: I think we in Canada and New York State hardly appreciate the advantage we have over States farther south regarding woolly aphis. It is one of the worst pests of the States to the south. I know in Ontario of only one or two cases where the woolly aphis has been found in nurseries attacking the roots.

DR. HEWITT: The woolly aphis has proven to be quite a serious pest in British Columbia, where we get the root form as well as the aerial form. There was one point which Dr. Baker raised in his paper, which leads to an interesting biological phenomenon which it would be well for all of us to bear in mind when we are carrying on our studies, and that is the possibility of the formation of races of insects. During the last year we have found in British Columbia what is evidently a distinct race of the apple maggot on the Snowberry, which is used as an ornamental shrub. Wherever we found this shrub, whether in the south or farther north, we got this infestation by the apple maggot, though apples in the vicinity were not attacked.

SOME INSECT PROBLEMS IN THE PRAIRIE PROVINCES.

NORMAN CRIDDLE, ENTOMOLOGICAL LABORATORY, TREESBANK, MAN.

Conditions in the Prairie Provinces are, as a rule, so totally different from those of Eastern Canada and the problems we have to contend with differ so much in general, that in reality they are often only alike in the broad outlines to which all insect problems must be approached. Take for instance, the general trend of these meetings; the papers and discussions lean decidedly towards the problems of fruit insects and insecticides, whereas in the West you would find fully 75 per cent. related to field crop insects and few indeed to those of fruits or sprays. To us these last are of quite secondary importance, and instead we have to deal far more with poisoned baits and methods of cultivation. Another point, and this has often led to misunderstanding, is that of presuming because an insect occurs across the continent, that it is therefore identical in its life habits throughout its range. As a matter of fact very few are. This was brought prominently to my notice during some recent studies in white grubs (*Lachnosterna* spp). In the east and southward through Indiana, where Mr. J. J. Davis has made such a thorough study of these insects, the life cycle is usually three years, whereas in southern Manitoba it is four years. Now supposing we had studied only the eastern habits and applied them to the west, we should be a year out in our prognostication. It is of interest to note here that I found a similar variation in the life cycle of tiger beetles (*Cicindela*) as compared with habits worked out by Professor Shelford at Chicago. I am also of the opinion that we shall find the habits of some of our wireworms to differ in the same way. Another example may be found in the Hessian Fly, though in this case it is simply a matter of a reduction in the number of generations.

In the past there was a general tendency to supply the habits of old world insects to those of the new and occasionally we find an instance where this is still marring our progress. An example of this occurs in a well known pest of the Prairie Provinces, namely, the Western Wheat-stem Sawfly, *Cephus cinctus*. This insect was originally confused with the European *Cephus pygmæus*, consequently as no further studies seemed necessary at that time, the old remedies were recommended, and are in some instances still, in spite of the fact that every effort has been made to show that they do not apply.

It might be asked, what are the outstanding differences that so alter the habits of identical insects. There are several, but the chief ones are those of climate; greater extremes of temperature, especially on the downward trend in winter, and less precipitation. I have already shown how lack of snow is responsible for the destruction of a large percentage of our Colorado potato beetles. We had another remarkable instance of this last winter, which in the vicinity of my home near Treesbank, Man. was responsible for a total extinction of the species. Thus it will be seen that our frosts are of some value after all. Incidently I may mention that these same invigorating winters have proved an important factor in restricting another invader, namely the brown rat. The chief inclination of our climate, however, is to prolong the life cycle and this seems a general rule where native species are concerned.

The study of climate and meteorological changes in relation to animal life is a most interesting one and also important. Occasionally even a native insect gets caught by abnormal conditions of weather of which we had an instance last spring when a serious lepidopterous tree pest was reduced to quite insignificant proportions through the actions of a belated storm cutting off the food supply. I remember what promised to be another instance some years ago during a severe locust outbreak. The young hoppers had been hatched about two weeks when along came a severe snow storm accompanied by frost. Naturally the prophets predicted a total extermination of the plague, but like some well-known weather prophets their predictions were not verified, in other words, the locusts were in no way affected.

Since we do not grow apples to any appreciable extent, nor are much troubled by other fruit pests, we are able to concentrate largely upon cereal insects and those attacking root or vegetables. The field for this work is a very large one as can well be imagined when it is known that Saskatchewan alone had more than 22,000,000 acres under crop in 1918.

There are many different pests taking toll from these crops, six of which have been especially noteworthy in the past. They are: The Western Wheat-stem Sawfly, *Cephus cinctus;* Grass-stem Maggots (*Oscinidae*); Hessian fly; Wireworms; Locusts and Cutworms. Five of these are native species which before the advent of farming occupied their allotted space in the scheme of nature just as any other harmless creature might do. As usual, however, man upset the balance of things in his attempt to increase production and in doing so provided an unlimited supply of food for these insects. Thus we have the Western Wheat-stem Sawfly spreading from wild grains to cereals and what is almost as important, in most cases, leaving their natural enemies behind them. In their former state they were kept in check by two agencies, namely, lack of flowering stems in which they bred, or parasitic enemies. Under present conditions it would seem as if both these checks had been overcome and there remains, therefore, but one means of keeping them under control, namely, deep, well-turned, packed ploughing done either in the fall or before June of the following year.

The grass-stem maggots embrace many species and include such well known pests as the Greater Wheat-stem Maggot (*Meromyza americana*), Frit Fly (*Oscinis frit*) and many more. There is much variation in the life-history of these flies. Some are very injurious, others become so at times, while yet others actually do good. A few years ago less than a dozen species were known from Canada but within the last three years many more have been discovered including several that are new to science. The life of these flies is extremely variable. Some produce several generations in a season, others but one, while some again, pass the winter in the adult stage, others doing so as larvæ. They are by no means all grass feeders and some prefer decaying matter to living. Thus there is endless variation in their habits and much to be learned concerning them.

The Hessian fly is the only one of those mentioned that is not a native of our country and as is the case with many of our introduced animals it is subjected to inconveniences at times, through our variable climate. We have had seasons when fully 40 per cent. of the crop was injured by this insect, but its attacks, as a rule are few and far between, due chiefly to a lack of humidity at critical periods of the insect's life. In other words moisture is an essential factor in the insect's increase, while dryness reduces it to insignificance. Thus it is only during wet seasons that we have to be on our guard for possible outbreaks. Indeed, we have had but two severe infestations in thirty-five years.

Wireworms are with us always, but as is their habit elsewhere, they perpetuate most freely in grass lands. Several species are involved in our losses, the life habits of which are little known, but the average investigator is not anxious to undertake their study owing to the length of time it takes to rear them through all their stages. I personally have had an individual under observation for three years and it has hardly grown in that time.

One of the greatest scourges we have to contend against is that class of insects known as cutworms. They are always present. Sometimes in one part, at others in another. They come and go, but there are so many species involved that the farmer is often at his wits' end to know what to do. When the outbreaks are excessive large areas are swept off, much as army-worms would clear them. Thus hundreds of miles of territory may be involved. At other times the outbreaks are quite local but we are never wholly free from them and in gardens they are a permanency. There is much variation even in the life of these insects. Some deposit their eggs upon weeds, others in or on the soil. Some hatch from eggs the same season, others do not do so until the following spring. They differ, too, in other ways but in appearance the general colour scheme is so similar that it is not surprising if the farmer fails to differentiate between one kind and another. Even the most experienced are puzzled at times owing to the sudden increase of a previously rare species. I had an example a few months ago when I received a consignment from Alberta. The species involved looked very like an insect to which my colleague Strickland had devoted such profitable attention a few years ago, namely, the army cutworm, but the larvæ seemed too large for the time of year, besides being considerably farther north than usual. However, the fact remains that they were very numerous and that they give every promise of causing injury next spring.

The last on my list is locusts. Probably all have read of the time in the seventies when an old enemy, the Rocky Mountain locust (*M. spretus*), came in millions and devoured all in sight. It was before my time but eye witnesses tell me that not a leaf remained and that the insects suddenly commenced to drop from a clear sky and were soon falling as a severe snowstorm does. The species is not, however, a native of our prairies; consequently, while it may breed for a season or two in millions, the time must come when the climate proves unsuitable and so they perish. Unfortunately we have several native species almost as destructive. One of them the Lesser Migratory Locust (*M. atlanis*) has on more than one occasion caused serious damage, while several others assisted materially in the depredations. A few dry seasons are generally sufficient to increase them to injurious numbers and even when the weather proves unsuitable close at hand they readily fly from elsewhere, consequently an outbreak a hundred miles or more away may easily lead to one close at hand.

I need hardly add in conclusion that there are many other pests requiring attention and we are never sure when others will appear. Army worms, aphids, tree pests and those of live stock all provide their periodic outbreaks and thus while our problems are seldom fruit ones, we have, nevertheless, much to keep us occupied.

THE RECOVERY IN CANADA OF THE BROWN TAIL MOTH PARASITE *COMPSILURA CONCINNATA* (DIPTERA, TACHINIDAE.)

JOHN D. TOTHILL AND LEONARD S. MCLAINE, ENTOMOLOGICAL BRANCH, OTTAWA.

With considerable truth Oliver Wendell Holmes remarks that all boarding houses are the same boarding house. He means by this that there is a monotonous sameness about all of them, and that to know one of them is to know all of them. Until about a decade ago it was thought that tachinid flies resembled boarding houses in the monotonous sameness of their activities and that to know one of them was to know all of them. We were shaken out of this rather comfortable notion chiefly through the work of Pantel in France and Townsend in the United States who showed that these two-winged parasites exhibited among the different species a highly diversified and interesting set of methods for attacking their victims and gaining a livelihood.

One of the species studied by these authors was *Compsilura concinnata* the little fly that forms the subject of the present paper. As to its method of attack it was found that instead of depositing a large egg upon the skin of the victim—the method of the bourgeoisie among the tachinids—it placed a fully developed maggot in the wall of its mid-intestine. This it was enabled to do by reason of a piercing ovipositor, beautifully adapted for the purpose. Moreover, this fly was found to be one of the chief factors in the natural control of the brown-tail and gipsy moths in Europe.

With characteristic energy the United States Government, through Messrs. Howard, Fiske, Townsend and Burgess, took steps to introduce this parasite into the New England States where the gipsy and brown-tail moths were creating such havoc. The story has been told of the collection in Europe of thousands of these parasites and of their liberation in Massachusetts, and of how after several years of anxious waiting the species was finally recovered and known to be breeding on American soil. It has also been related that with almost incredible swiftness the fly increased in numbers so as to take its place in the American fauna as one of the most potent factors in the control of the two insects it was expected to attack.

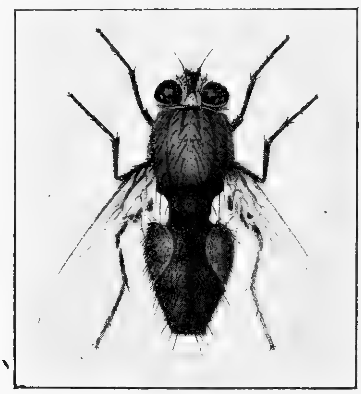


Fig. 2.—Compsilura adult. This excellent parasite of the Gipsy and Brown-tail Moths is now established in Canada. (After the U.S. Bureau of Entomology.)

When the brown-tail moth spread into Canada the country was confronted with a situation demanding immediate action, and the Dominion Entomologist arranged not only for a field campaign against the invader but also for the introduction from Massachusetts of its natural enemies.

The question of what to introduce into the Canadian brown-tail moth area had to be thought over very carefully, because it was realized from the first that our Canadian problem differed in important respects from the New England one. The fine beetle Calosoma was available and was colonized rather as a safeguard against a possible outbreak of the gipsy moth than in the hope of its being of immediate assistance in our brown-tail moth situation; for like most predacious animals it can increase only when the food supply is abundant. An Apanteles which was available had done fairly good work in Massachusetts and was also brought across the international boundary in the hope that it might live in our more rigorous climate and be of equal usefulness. The insect, however, that seemed to warrant almost any amount of effort to introduce was our little friend *Compsilura*.

We needed a parasite that could live upon native hosts as well as on our brown-tail moths—preferably something with two or more generations a year so as to insure a rapid increase. We also needed something that would develop its greatest usefulness against the Brown-tail Moth while that host was still relatively scarce. All these attributes were possessed by *Compsilura* and the work of importation began with hopes running high for the success of the venture. What we did not know, of course, was whether this fly could live under boreal conditions, where the climate is so much more erratic and severe than in France and Massachusetts.

Seven years ago, in 1912, two colonies of *Compsilura* were liberated in New Brunswick strong enough and under good enough conditions to warrant recovery speculations. The next year, however, no *Compsilura* could be recovered from the colony sites and the work of importation had to be continued. At first there was no occasion to worry about the non-recovery of *Compsilura,* for it had taken three years to prove establishment in the United States. However, being human we worried a little and increased our efforts to secure more material for liberation. After four years of colonization, without apparent results, we redoubled our efforts

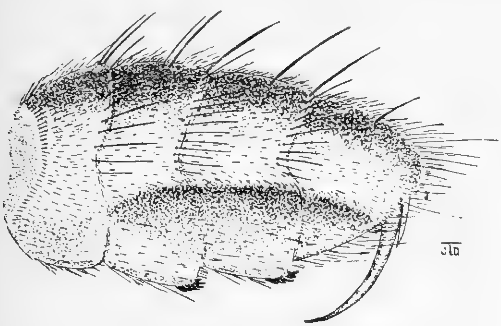


Fig. 3.—Abdomen of female *Compsilura* showing piercing device. The ventral part of segments 2, 3 and 4 is flattened into a keel shaped structure. Note the clusters of spines on segments 2 and 3 that have been developed for holding the caterpillar when using the piercer. (Original.)

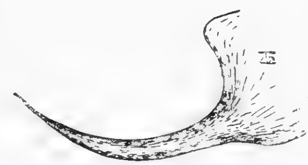


Fig. 4.—Piercing device of female *Compsilura.* With this hollow, sickle-shaped instrument (1 m.m. in length), the female fly punctures the skin of a caterpillar. With her somewhat inconspicuous larvipositor she then places a maggot in the wound after which she flies to another victim. (Original.)

to secure a large number of flies. Host caterpillars were collected in great quantities in Massachusetts and a very large number of the flies were bred out for liberation, as the chart shows, in Nova Scotia, New Brunswick, Quebec and Ontario.

At the close of that year, 1916, it was felt that every opportunity had been given *Compsilura* to become a part of the Canadian fauna—in a period of five years about thirty thousand flies had been liberated—and the work of importation was consequently stopped.

In 1917 a considerable amount of energy wes expended in the attempt to recover this elusive fly, but once again the results were discouraging. This year (1918) the recovery work was continued and the insectary at Fredericton filled with thousands of tussock, datana, and red humped larvæ, collected from likely places in Nova Scotia and New Brunswick. One day Mr. Keenan, who had charge of the tray work, brought in several dozen tachinid puparia bred from tussock larvæ collected at Fredericton. Among these were five little puparia that had the ear marks of *Compsilura.* With the same sort of tender solicitude that worker ants bestow upon larvæ just stolen from a nearby colony, we watched over these five puparia. After a week or two of anxious waiting five flies emerged; three were males and two females and all were *Compsilura concinnata.*

As the last liberations had been made in 1916 it followed that this parasite had successfully hibernated through at least two New Brunswick winters, and that it could now be considered a thoroughly established member of our fauna.

It has taken seven years to bring about the establishment of this parasite. The comparatively low cost of introducing this and other parasites of the brown-tail moth has been largely due to the splendid co-operation offered at all times by the United States Bureau of Entomology, particularly through Dr. Howard and Mr. Burgess who afforded the Entomological Branch every facility for carrying on the work of collecting material in Massachusetts and other parts of New England.

By way of conclusion it may be pointed out that Compsilura is now a national asset of considerable importance. As a parasite of the brown-tail moth it has already proven its worth in Massachusetts—especially in areas where the moth is not very abundant. It is also a splendid parasite of the gipsy moth both in Massachusetts and in Europe, and the cost of introduction would be much more than justified if only as a measure of security against a possible invasion by that despoiler of deciduous trees. In Massachusetts it has also proved to be one of the most, if not the most, effective enemy of the white-marked tussock—an insect now so conspicuous in many Canadian cities. That it is continuing this good work is shown by the fact that our five recovered specimens were all bred from white-marked tussock at Fredericton.

DISTRIBUTION OF THE PARASITE *COMPSILURA CONCINNATA* IN CANADA

NUMBER OF INDIVIDUALS LIBERATED

—	1912	1913	1914	1915	1916
Fredericton, N.B	1238	....	1500	1500	....
Harvey, N.B	....	....	2000	....	....
Keswick, N.B	....	....	....	1800	....
Lower Woodstock, N.B	....	....	....	....	1200
Nerepis, N.B	....	1500	....	....	....
Oromocto, N.B	....	....	....	....	1200
Pokiok, N.B	....	....	....	....	1200
Rosborough, N.B	....	....	....	....	1200
St. Stephen, N.B	1119	1500	....	....	....
Temple, N.B	....	....	....	....	1200
Upper Gagetown, N.B	....	....	....	....	1200
Woodstock, N.B	....	....	1500	....	....
Annapolis Royal, N.S	....	....	....	1500	....
Bear River, N.S	....	1500	....	....	....
Ayer's Cliff, P.Q	....	....	....	....	1200
Coaticook, P.Q	....	....	....	....	1200
Stanstead, P.Q	....	....	....	....	1200
Way's Mills, P.Q	....	....	....	....	1200
Vineland, Ont	....	....	....	....	1200

SUMMARY.

Compsilura concinnata is one of the most important enemies in Europe and Massachusetts of the brown-tail and gipsy moths.

Between 1912 and 1916, inclusive, about 30,000 of these flies were collected in Massachusetts and liberated in the Canadian Brown-tail Moth area.

The parasite was first recovered in Canada in 1918—seven years after the first colony liberated—and can now be considered as established in New Brunswick.

Compsilura is now a national asset of considerable importance. It is a most efficient parasite of the brown-tail moth; affords protection against a possible invasion of the gipsy moth; and is already attacking in Canada the white-marked tussock.

EVENING SESSION.

On Wednesday evening, at 7.30 o'clock, a public meeting was held in Massey Hall, Ontario Agricultural College. Dr. G. C. Creelman, the President of the College, welcomed the members, delegates and visitors to the institution. Mr. F. J. A. Morris then gave an entertaining account of the "Life-history of a Hobby-horse," which was followed by the special address of the evening, on "Some Present-day Problems in Entomology," by Mr. J. J. Davis of West Lafayette, Ind.

At the close of this meeting a smoker was held at Dr. Creelman's residence.

THE LIFE HISTORY OF A HOBBY HORSE.

Francis J. A. Morris, Peterborough, Ont.

Part I (aet. 3-13).

Before I was three years old, so my elders and betters have informed me, I made my escape one day from the nursery and was caught in the garden crawling through a thicket of laurels. On being haled back to captivity by the nurse, I disclosed to her horrified gaze, clutched in one grubby paw, a happy family of "wee beasties" as I called them—an earwig, a "woolly-bear," a centipede and two "slaters" or sow-bugs, which I had collected on this my first entomological trip.

Some two years later, while staying at the seaside near Ailsa Craig, I called one day to an older sister who was hurrying down by me, to know if I might play with a pretty fly I had discovered on the staircase window; she was too busy with some private quest to do more than throw me a careless "yes, certainly," and pass on without turning to examine my playmate. The pretty fly, which was large and banded with yellow and black, so resented my stroking it that it backed down suddenly on the end of my finger, and I was removed howling to the kitchen to have my first wasp sting treated with washing blue.

It was from here or from Stonehaven, south of Aberdeen, where we stayed the following summer, that I brought home a whole chestful of shells gathered on the beach and a scrap book of variously tinted seaweeds. These two visits to the coast made a lasting impression on me, and for many months must have coloured my inland life with the bright hues of romance: for, one day, I rushed into the house from bowling my hoop along the highway, my eyes bulging with excitement, to announce that I had just seen a crab hopping along the Gilmerton Road. As we lived in the heart of Strathearn, 30 miles west of Perth, I presume the crab was a toad.

Children notice very small things, but their looks, I believe, are far from critical. At any rate I had never thought of counting the legs of crabs and frogs, either out of curiosity or from a sense of precaution; though, I well remember how I tried with a brother of mine to count the legs of a centipede after being told what its name meant. But, beyond all question, at the stage when we are ourselves still quadrupeds and creeping face downwards, like reptiles, over the surface of the earth, nothing is too small to be noticed.

It was in these days—i.e., before I had grown up into a biped more or less star-gazing—that I made the acquaintance of certain minute spiders known to those in sexless garments as "soldiers," and the name seemed very appropriate, for they were bright scarlet and bore on their back the distinct impression of a knapsack. "Clocks" and "jumping-jacks" were also among the marvels of what to every child is a new world full of all kinds of wonderful sights and sounds; "jumping-jacks" were a small elater or click-beetle, and "clocks" were weevils with a stupendous power of grasping and clinging in their six pairs of toes. Another mystery we soon got to the heart of was the little blobs of spittle that appeared on the stems of meadow-grass where we played; and at the core of these queer little froth-cocoons we found the tiny atomy that makes them, still spitting for all its life was worth. Quite a formidable monster in this nursery land, I remember, was the "devil's coach-horse," a large black staphylinid or cock-tail beetle, that when cornered would turn at bay threateningly, raising its head and front up from the ground and arching its tail over its back; even snails —as the nursery rhyme reminds the more forgetful of us, with their sudden out-thrustings of long horns, were a fearsome beast not to be approached without due caution.

All this time flowers and ferns and mosses were an equal fascination, and I don't think there was a day when I didn't bring home a handful of these treasures to be told their names; daisies and gowans, buttercups and dandelions, the tiny blue veronica of the hedgerow that we knew and loved as "bird's eyes," the little wild pansy or heart's ease, baby brother to the "Johnny-jump-ups" of our cottage gardens; then, as we went further afield, poppies and cornflowers, dogroses and sweetbrier, the primrose and the periwinkle, ragged-robin and cuckoo flower, wild thyme, eyebright, fox-gloves, bluebells and forget-me-nots. The very names make music in the memory; and it was just the names that we wanted to know. I don't think once heard they were ever forgotten. These names and images cling all through life and gather about them whole clusters of fond associations of time and space. In childhood, perhaps, they are little more than sense impressions, but as the spirit ripens into maturer years, they become informed with emotion, filling our imagination with fragrance and colour: such memories are good wholesome food for manhood's prime and the sweet solace of old age.

About this time my father's hobby of gardening seized hold of me; more, I suspect, for the gardener's sake than the garden's. One's father in those days was the strongest possible proof that giants if not gods still walked the earth in the semblance of men; and to help him water the garden was to be in paradise. I am afraid my help was little more than a hindrance, but I still see myself staggering along behind him with a watering pot; he was so absorbed in his work that the self-constituted under-gardener was often forgotten. I have sometimes since suspected this particular Olympian of being absent-minded.

He was a great smoker and nearly always had his pipe going: for use out of doors he carried a box of "fusees," a wonderful long-headed wooden match that sputtered out a jet of fire capable of lighting pipes in wind or rain; the head was secured to the stick by wire-braid and retained its heat long after being thrown away, as I discovered on a certain memorable occasion when I tried to pick one up. It is told of my eldest sister that once as she toddled after my father in his majestic course down the garden path, one of these newly spent fusees thrown carelessly over his shoulder lodged on her neck and sizzled her into an agony of shrill screams that must have rudely dispelled the smoker's reverie.

My father was very fond of flowers, fonder still of shrubs—lilac, syringa, ribes, laburnum, laurel, cypress, golden yews and silver firs, but fondest of all of rhododendrons: "Roddy dandrums," so the mid Perthshire proverb flew, "Roddy dandrums are the minister's maggot"—All procurable varieties from white to wine-dark crimson flourished in the parsonage garden.

It stands out in my memory as clear as yesterday—so proud a day it must have been—how my father took me along with him one evening for a walk past some nursery gardens. Here he spotted a rhododendron a shade darker than any he had; finding the nurseryman out, he scribbled a note for him and returned with wheelbarrow and spade to the scene of the prize. The shrub was carefully dug up, mounted on the vehicle, and carted exultantly away, the very barrow calling aloud like a guinea fowl at every turn of the wheel; what a triumphal procession that was! I was still too small to help trundle the trophy home, but like the fly on the wheel I thought myself the hero of the day.

To grow these shrubs successfully, my father had cartloads of peat drawn from the neighboring loch of Ochtertyre, and every shrub was lowered into a great pit and filled in with well-pressed peat. One day, I remember, my father came in to lunch from the garden, and behold! the large silver watch was gone from his fob. Most of the afternoon was spent in undoing his morning's work, and it was only after three or four rhododendrons had been dug up and their peat-beds carefully sifted over that the watch was recovered. It still keeps good time, and has been an inmate of my waistcoat pocket for more than thirty years now.

Hitherto, I had been a rather solitary little mortal, but there now came into my life a close companion and bosom friend. This was a brother nearly two years older than I who came home at last from a prolonged visit to the south coast of England, as the rigors of our Scotch climate had been too much for him and he had been sent to the seaside in Sussex. He had stayed there so long that at first coming among us he seemed lost in an alien world and nothing could be found to comfort him. My panacea, to gather "wooden enemies" in the Beech Wood, did seem for the moment to brighten him up, but when he found the "wooden enemies" were only wind-flowers, and a walk to the Beech Wood led up hill through trees to a stone quarry instead of down over sand to the sea, his wrath and disappointment were greater than ever. After some weeks, however, he grew reconciled, and as he made friends very readily, he and I were soon as thick as thieves and always together. Our friendship was all the stronger that we were of somewhat different natures; like twin stars we helped to round each other's lives out to a fuller sphere of wider orbit. An aunt of my father's who stayed with us then, gave us nicknames that stuck for many a long day; she called me "Merry Andrew," and my brother "Slyboots." We were both of a height and could wear each other's clothes quite comfortably. As we were always dressed alike, there were very few outside the family circle who could tell us apart, and the less intimate half of our world supposed we were twins.

Certainly, not even the Siamese twins were more inseparable; we even slept together, in a little attic at the end of a long passage off the kitchen staircase.

Our partnership had not long been formed before we were sent to attend an institution in the town called "Morrison's Academy." Here we took an active part in the school games and made many friends and acquaintances. These were always boys who loved country life, and though none of them ever drew so close to David and Jonathan as to come between us, it often meant that three or even four of us would start out together for a holiday tramp.

Whenever I ponder over this community life of a boys' school, I am filled with wonder at the vast mass of tradition preserved in such a place. It offers a good illustration of the close analogy between children and savages; an immense lore is handed down unconsciously by bigger boys to the small fry from one generation to another. A great deal of this knowledge is forgotten by the individuals as they grow up, but it still survives in the schoolboy community. If as old men we could go back like Mr. Bultitude in "Vice Versa" to our school days we should be reminded of a thousand facts and fancies, primitive beliefs and superstitions, that the young barbarians of to-day have inherited by unbroken tradition from us boys of fifty years ago.

Local names (and even book names) for flowers and insects of wayside and wood, for beasts of the field and fowls of the air; original remarks, shrewd observations and quaint reasonings about their appearance, their habits, their haunts; all these form a common stock of ideas, food for conversation and thought as well as a basis for action, among hundreds of school boys more or less guiltless of the three R's of Reading, Riting and 'Rithmetic.

"Slyboots" and I fell heirs at an early age to a collection of birds' eggs made by our elder brothers when they were at school at Glen Almond. This was quite an extensive collection, ranging in size from a swan's to a golden crested wren's (gold-crowned kinglet's); it represented not only most of our inland birds of Perthshire from game birds and birds of prey to the sparrows and warblers, but sea birds like guillemots, razorbills, herring-gulls, curlews, sea-mews and terns.

Largely through our big brothers' kind offices we soon learned to associate every egg with the name of the bird that laid it; then we made it our daily business to recognize every bird we saw in the countryside by its plumage, flight, song, habits and haunts; we even ferreted out, in the home of a companion, a large work in several volumes on Birds, British and Foreign; we used to pore over its pages, especially the colored illustrations, till we knew the appearance of many birds, even hawks, ducks, and seagulls, far beyond the ken of our county. (120 birds' names.)

We were very tender-hearted for boys, and largely eschewed the society of the rough and tumble urchins who robbed birds' nests. A golden rule impressed on us almost from infancy was never to take more than one or two eggs at most from a nest, and always to leave at least half the clutch, or the birds would desert; indeed, we rarely took eggs at all, if we had any others of the same kind already. My recollection of the neighborhood is that, among the grown-ups at least, bird life was greatly respected. I well remember once with what a thrill of dread it struck me while bending over a "mossie cheeper's" nest by the roadside, to hear a cottager call out as she passed "Eh, laddie, ye'll never thrive, harrying the birds' nests!"

It was certainly a good thing that we had only one collection between us and seldom went in company on these excursions. For with the crowd there was a regular code of law—an immemorial custom; as soon as a nest was spied, "Bags I first!" came the cry, "second!" "third!" and so on; here, bird's nesting was a ruthless pursuit, hardly an egg could escape, and the boys' sharp eyes went everywhere. My brother and I jogged along a much more innocent way, drinking in beauty and pleasure at every turn, and fostering a love of nature that has never left us. That we really were more innocent must have been obvious to the gang of nest-harriers and bird-killers, the bigger boys of the town, who despised us as simpletons and gulled us shamelessly in our chafferings and barters at school. As, for instance, on the flagrant occasion when I was persuaded that a lesser redpoll's egg of mine was only an undersized chaffinch's and agreed to dicker it for a cock's egg, which I was told was of very rare occurrence, as indeed it is.

Among the birds familiar even in childhood were three especially that filled us by their cry with a strange sense of mystery; one was the cuckoo whose influence on his boyhood Wordsworth has immortalized; another was the corn crake or landrail that called from the depths of the meadow grass below our attic window on warm June nights; and the third was the lapwing or crested plover. This last was known to our fraternity as the "peewit" or "peesweep." Like other shore birds, waders and runners (the sandpiper, for instance) this plover has a wonderful instinct for luring enemies away from its brood; when surprised near its nest, it will hobble and flutter and run just ahead of you, trailing a wing on the ground and holding out various signals of distress till it has coaxed you far from the danger zone; then up it soars with loud cries of triumph or derision; in the air it wheels round and round with calls of alarm; naturally, you hunt beneath this magic circle expecting to find the nest; but its circle is really an eccentric one, a sort of horizontal spiral whose centre is continually shifting; and it is safe to say that the nest is never under these movements of the bird, which are simply an ingenious form of camouflage or decoy. Like many of the birds that build little or no nest and breed gregariously, the plover often fails to hatch its young, and addled eggs are not infrequently met with.

I remember one day when my brother and I had found some of these plovers' eggs by going to and fro through a piece of bare pasture, we happened in with a gang of four or five bigger boys. They too had been hunting for peewits' eggs and had met with considerable success. They hailed us, and we drew together for a spell beside a cattle trough filled with water. One of the older boys asked us if we knew the way to tell fresh eggs from bad ones; on our replying in the negative, he showed us how, as he said, the fresh floated while the bad ones all sank; this was a wonderful discovery to us, and when he added to his kindness by exchanging our eggs that sank for some of his that floated we were overjoyed. As we turned to go, a wave of emotion seemed to overcome him—I suppose he was fairly nauseated with our innocence—he seized one of the freshest of the eggs (for it was floating high on the surface of the trough) and threw it full in my face. I was wearing, I remember, a new cricket cap of bright blue flannel; the shell of the bomb exploded on the peak of my cap and I was deluged with the contents of this miniature Chinese stink-pot and very badly gassed.

One memorable summer when I was eight or nine years old, we went to stay in Kent with some relatives in a large country house with extensive gardens and grounds. All kinds of wonders met us here, in the woods, hyacinths and wonderful birds; magpies, jays, green woodpeckers, wrynecks, bottle-tits, goat-suckers; indoors and out, tame things galore; rabbits and hares, rats, mice (white mice, field mice, dormice), doves, canaries, love-birds, toucans, and—most fascinating of all—silkworms.

Our cousins had trays and trays of these grey caterpillars fed with fresh leaves every day from the mulberry tree on the lawn. To watch these creatures feed and grow and moult, to see each one taken when it stopped feeding and put into a paper twirl or "poke"—a miniature cornucopia, to watch them spin their cocoon, and then to assist at the business of tearing away the rough outer scaffolding of yellow strands and fluff, pick out an end from the close-wound cocoon, set the cocoon in a glass of water and reel onto a skein-winder the whole interminable thread of golden silk, the cocoon bobbing about on the surface of the water in the glass, till finally the newly formed pupa sank through the last meshes of its hammock, and was put carefully away in dry bran for the moth to emerge; to see the moth lay its eggs, one after another, side by side, in batches on a sheet of paper spread over the bottom of the box, eggs that soon darkened from creamy color to leaden gray; all this was enchantment and we were soon bound fast under the spell. A whole room was devoted to the work, and its curtains and walls were hung with these inverted paper cones of spinning and pupating caterpillars.

The rage for silkworms travelled back to Perthshire that September on the Scotch express, to spread like influenza; not only did we send next spring to a London dealer in Natural History supplies, for some batches of eggs, but bit some of our particular friends with the mania, so that a silkworm cult was established in the Town of Crieff.

I am afraid the industry never throve; for one thing the mulberry does not grow in Scotland, and although lettuces make a fair substitute, the caterpillars are smaller and less hardy, so that quite a high mortality ensues between egg and adult. But we made, I remember, some interesting discoveries. In the first place, we devised quite an original form of incubator to coax the grub out of the egg a few weeks earlier than the natural season. We began by keeping the eggs on the kitchen mantelpiece just over a good fire that was always going; but presently, too impatient to wait, we tried putting some of the egg hatches into the warm—almost—hot oven; the success of this experiment was almost too great, for the specks of grubs hurried out to feed before the lettuce got up from its bed in the garden to be fed on. It was at this time that we made our second discovery of dandelion leaves as a substitute for lettuce. The supreme result of keeping silkworms, however, was that it decided my brother and me to begin a collection of insects.

Several seasons earlier I had tried rearing some of my favorite woolly-bears, which I found feeding on dockleaves. This had been so far successful that I understood the connection of caterpillars with moths and butterflies, and the mystery of the chrysalis. And after my woolly-bears had been transformed to gorgeous tiger moths, I had gathered from the garden all the caterpillars I could find on cabbages, currant bushes and so on. But I must have been too young to collect systematically, for I don't think it ever occurred to me to keep the imago after its emergence. Two incidents of this earlier experience come back to me; one, how I watched a green caterpillar of the smaller white butterfly, when full grown, spin its little button and sling of silk and contract as though about to pupate. A day or two after when I looked for the chrysalis I found to my amazement that a cluster of tiny yellow-silk cocoons had rent my larva in twain just about amidships. I took the box to my father and asked him, did caterpillars ever have young ones? The phenomenon was as big a puzzle to him, I remember, as to me, but he advised me to keep the brood under their glass lid and see what would happen. I don't think either of us was much wiser for seeing some small winged flies in the box a little later; I know I wasn't. The other incident was even more disappointing. In a lane near the town I found one day a strange chrysalis lying on the ground. It was certainly somewhat hard, but I suspected no guile, and, taking it home carefully, kept it for months in a box of bran; when at last I realized it wasn't going to hatch out, into some gorgeous new butterfly, "like the other chrysalises," I shed tears of disappointment. My chrysalis, in fact, was nothing more or less than a common date stone.

However, all this had been years before when I was quite little. Now I was nearly ten and had a partner almost two years older. Our collection grew apace in its first two seasons, and many notable accessions were made to it; among these, I remember, a large box of tropical butterflies bought at a bazaar; the pupa of a Death's Head Sphinx dug up in the potato garden; a magnificent green caterpillar with purple diagonal stripes on its sides and a horn on its tail found on a weeping willow at the end of the lawn; several rich velvety brown caterpillars of an Emperor moth taken feeding on heather up in the hills; and, superb-est of all, our first Peacock butterfly.

This regal beauty is not found in Perthshire, but one of our next door neighbors, a boy five years my senior, had a fine collection of Lepidoptera and offered one of these gorgeous things as a prize to whichever of us could beat the other in a fight. Now David and Jonathan often fought in the heat of some momentary difference, but to be asked to stand up to one another in cold blood seemed a little too much; still, peradventure, for the sake of a Peacock butterfly! At last we managed to strike a bargain with the stony-hearted judge; whichever threw the other in a wrestling bout should have the butterfly, and we flew together before our chieftain in a close Scotch hug not unworthy of Donald Dinnie at the annual gathering of the Highland games in Strathearn. Whether "Slyboots" had figured it all out beforehand or not I shall never know, but I found it far easier to throw him in the wrestling bout than to pick up his friendship after the fall. The butterfly was mine, when we turned moodily away to go home; it was his ten minutes later when we entered the parsonage gate, deep in friendly converse and of joyful countenance.

If you think for one moment our little lives by now were full to bursting with all this hotch-potch of country fare in the few short months of a Highland summer, you've sadly forgotten the days of your youth. Children are much like dogs, they have a voracious appetite and they cover far more ground in the course of a day's journey than your sober-paced man; they haven't his steadiness of purpose and they hate to stay on the high road; but they're all eyes and ears and full of tireless energy, forever ranging over the surface of things, if never digging deep.

Between you and me and the gatepost, then, I haven't as yet so much as hinted at our really and truly favorite sport of the summer, a sport that at one time grew to a devouring passion and threatened to swallow up all its rivals. This Aaron's rod of our childhood was the rod that according to Dr. Johnson has a worm at one end and a fool at the other, but so long as the worm caught fish we didn't care a button what names you called the fisherman. As long, almost as I can remember, a fishing trip was the greatest holiday treat we could think of. In my case, I am sure, there was never any danger of other interests getting crowded out; for I was never so absorbed in the gentle art that I didn't keep an eye open, to say nothing of my ears, for the rest of nature; everything living was fish to my net, and the contents of my wicker creel went far beyond the finny tribes. "Slyboots" caught more trout, but "Merry Andrew's" basket showed quite as big a catch; among other "queer fish," I brought home, I remember, a young rabbit, a sandpiper, two half grown wood pigeons ("cushie doos"), a bat, a swallow, an owl, a squirrel, a hedge-hog, and once, incredible as it may seem, a pair of full grown weasels. I had spied them playing together near the Forth, but when I hurried up with a collie dog that had made friends with me on the way, they took refuge in a drain-pipe; here I prodded them so with the butt of my rod that they rushed out to be mauled by the dog; whether I could ever have tamed them into pets, remains a moot point, for both died next day, and by the advice of a friend—an old naturalist—were laid out in the shrubbery as a bait for carrion beetles. As for the bat and the swallow, they had both flown at my fly-cast as it went sailing over my head and had actually been hooked in mid air. Many a strange adventure and many a rare sight met us on those fishing trips; once we actually had the luck to see a large otter with a sea-trout in its mouth. The older we got, the further we went; and the further we went, the longer grew our list of the wonders of creation.

Our earliest fishing trips took us to Ochtertyre after perch; the way to this loch led over fields past the corner of a small lake known as the Serpentine; here we caught our first dragon-flies and the little copper butterfly, gathered bullrushes and water-lilies, found our first nests of coots and waterhens, and were given once a swan's egg by one of the game-keepers. Later on, we found from a summer spent (with whooping cough) at the village of Gargunnock near Stirling, that we could catch brook trout; after that still-fishing for perch with a coloured float lost all its charm; even trolling for pike, and the novelty of hauling flounders and bream out of the tidal waters of the Forth paled before the fierce joy of climbing the trout stream, with its linns and grey mare's tails overhung with rowans and birch—the haunt of water-kelpies—up through the wooded glens to the wind-swept heathery moor where the lonely whaup goes crying among the mountain crags. Here with the spirit of solitude dwelt Mystery and Romance, and with beckoning fingers—all unknown but none the less imperiously—drew our boyish lives up to heights far above the welter of mundane things. And well for us both, that this Education of Nature had sped apace; for I was only just thirteen when a bolt from the blue brought the whole palace of delights tumbling about our ears with the sudden death of my father. By the time we had crawled painfully out of the ruins to build up the wreck of our happiness, we found ourselves living in a London suburb.

PRESENT DAY PROBLEMS IN ENTOMOLOGY.

J. J. DAVIS, WEST LAFAYETTE, ILL.

Cereals have always been our most necessary economic crop but the existing war conditions have greatly emphasized their importance and as you are all aware, insect pests are one of the chief causes of crop losses. Within the past year the United States Department of Agriculture has been able to increase crop acreages, especially that of wheat, by efficient publicity methods made possible through the co-operation of the State agricultural authorities and the County agricultural agents. This programme resulting in increased cereal acreages has brought about numerous changes in agricultural practices, such as rotations, an overbalancing due to the increased production of certain crops, and the introduction into certain localities of crops heretofore seldom if ever grown. These changes suggest new entomological possibilities which will become realities and more evident in later years.

At this time I wish to discuss briefly some of these conditions and to follow with a treatment of certain important cereal and forage crop insect enemies which are problems of the moment in the States of Iowa, Wisconsin, Illinois, Michigan, Indiana and Ohio, and which closely approximate conditions occurring in many parts of Canada, more especially in Southern Ontario.

As has been stated the effort for increased production of wheat, has resulted in the disregarding of certain rotations and an increase in the wheat acreage amounting, in Indiana, to 35 per cent. above normal or 50 per cent. above the 1916 crop, which may be considered a typical increase for the area under discussion. Without certain precautions this condition is almost sure to present advantages for the wheat insects, giving them unlimited breeding grounds under most favorable conditions. In some localities where the growing of spring wheat was discontinued a score of years ago on account of the continued ravages of insect enemies, the growing of spring wheat has again become common. It is not unlikely that if we must continue the growing of spring wheat in these areas we will again be confronted with the insect problems which brought about the change in cropping some 20 years ago. In fact, the Hessian fly has already made its appearance in threatening abundance in one locality where wheat was a crop of no consequence until the last year or so.

The problem of the cereal insect investigator differs greatly from problems confronting the entomologist dealing with orchard or garden pests, for the culture of cereals is less intensive and the expense of such practices as spraying is almost out of the question. We must rely almost entirely on general cultural methods although there are exceptions, notably the control of cutworms and grasshoppers by the use of poison baits. The present high prices for foodstuffs increase the possibility of using more intensive methods for controlling pests of general farm crops although here again we are limited because of the shortage of man power.

How we can most effectively assist the farmer to combat the many insect pests is itself a problem of huge proportions. In years past we have issued bulletins which were sent to persons interested or who requested specific information. Experience has taught us that the promiscuous mailing of such bulletins is a waste. At the present time a majority of the counties in the States have what is known as a county agricultural agent, a man who has made a success of farming or who has completed a course in an agricultural college or preferably a man with both qualifications. Such a man cannot be familiar with all phases of farming and he is least likely to have a knowledge of the insect problems. It is evident that we must continue our detailed work and must publish our results, but it is equally evident since the conspicuous advent of the county agent that we should write publications which will appeal and be a help to him. The county agent is a busy man, having calls which keep him almost continuously in the field with little or no time for reading and he must therefore have ready references where he can secure the necessary information without having to read laboriously through pages of unnecessary matter. We have reference books which are well suited for this purpose, but these are usually out of date a few years after they have been published, and have in many instances resulted in recommendations for insect control which had been superseded by more efficient measures, discovered since the publication of the book. I have in mind a type of publication which should be more nearly what is needed to meet the county agent's requirements. Such a publication would discuss a certain class of insects, for instance, the more common corn insects, as a group rather than individual insects, and with it would be synoptic tables enabling the county agent to determine the trouble either from the type of injury or from the insect itself. These would be accompanied by typical illustrations of the insect and injuries. A table showing the seasonal appearance of the different insects would enable one to be on the lookout for certain pests. In such a bulletin the reading matter should be brief and concise and consist principally of methods of control and references to available publications where more detailed information could be obtained. To supplement such a bulletin the county agent should be provided with well illustrated leaflets treating of individual insects which could be handed to the farmer and these should contain just the points required by the farmer and nothing more. Since the advent of the county agent there has been a still further specialization in the form of extension entomologists, horticulturists, animal husbandmen, etc. Their duty is to keep closely in touch with the farmers through the county agents, to demonstrate their respective problems and in other ways to show the farmer by personal contact the better methods of farming. One might surmise that the advent of the State extension entomologist would preclude the need of publications for farmers. While this may to a certain extent limit the need of bulletins, on the other hand it may and does enlarge the value of the published data. For example, as recently given in a letter following a visit to help the farmers in a grasshopper stricken district, and as has been repeatedly stated to us, the farmers are pleased to know that such assistance is theirs for the asking and they become more receptive to bulletins and are more likely to make use of our published data.

I have briefly discussed how we may assist the farmer but we have another problem—how may we assist those who follow our recommendations but whose neighbors continue to disregard the proper methods of control and thus threaten the crops of those about them. Heretofore we have issued the necessary information by means of bulletins, institutes and demonstrations, hoping that farmers would adopt the practices. There are any number of instances, however, where the disregarding of recognized control measures by one has been the means of infesting a neighbor's crops. Two methods seem adaptable. One would consist in furnishing the farmer, from State or County funds, the necessary materials for combating insect outbreaks. Thus in Kansas, Prof. George A. Dean has found it practical for counties to furnish to farmers, poison bait for use in fighting grasshoppers. It seems that this is a step in the right direction for the farmer seeing an impending outbreak, even though skeptical of the value of recommended control measures, will usually follow a practice if the materials are furnished free, or he may feel that since he will pay his share anyway in the form of taxes, he may as well get that which is coming to him. This method of procedure seems adaptable for fighting such insects as grasshoppers where the principal problem is procuring the materials but it does not answer the question of the wheat grower who wishes to protect his crop from Hessian fly by certain cultural practices. This brings us to the second method, namely, control by legal process. For years certain of the States have had laws requiring the spraying of orchards infested with San Josê Scale and other insects and nearly every State has a nursery inspection law requiring inspection of all nursery stock by competent inspectors, to prevent the spread of noxious insects. More recently, Dr. S. A. Forbes has advocated laws requiring a general use of all reasonable and practicable measures for the control of insect pests likely to spread from infested fields to the injury of the property of others, for, as Dr. Forbes has said, "Why should the farmer allow the chinch-bugs he has raised in his wheat to escape into his neighbor's corn any more than he should allow his cattle to break out of their pastures to feed on that neighbor's crops?"* Such a law is now in force in Illinois. The requirement of certain practices to safeguard the community by legal process is not uncommon in certain countries where it has proved an advantage and there seems to be no reason why the same requirements might not be an advantage in our own countries.

The conditions resulting from the war are giving the entomologist a greater opportunity to prove and illustrate the value of his work and are showing to him his shortcomings. With these changing conditions and especially with the coming of the county agent or district agricultural expert the duties of the economic entomologist are changing or, probably better, being advanced. The entomologist of the future must continue to investigate the problems dealing with the life histories of insects and to give practical demonstrations of the control measures and especially to standardize entomological practices. He must in addition delve deeper into the mysteries of insect life in its relation to physical and biological factors, especially meteorological influences and the changing field conditions due to varying crop rotations, more intensive farm practices, and the like. These will lead to another important phase of the future entomologist's activities, namely, the forecasting of insect outbreaks; in fact, we are already able and are making general forecasts of possible insect troubles, especially such insects as the Hessian fly, chinch bug, grasshopper, plant lice, and white grub. Our efforts thus far are quite primitive and not altogether certain but the speaker believes it will be a matter of but comparatively few years until the forecasting of the scarcity or abundance of this or that insect will be a routine, and an important routine, of the entomologist's office.

In a recent article† I had occasion to discuss the relation of entomology to allied agricultural subjects and attempted to point out the importance of co-ordinating our work with that of the agronomist, the horticulturist and others and the work of the entomologist of the near future, as I see it, makes this action not only desirable but imperative. To a like degree is it important for the student specializing in economic entomology to study entomology not as a subject by itself

*The insect, the farmer, the teacher, the citizen and the state. Illinois State Laboratory of Natural History, 1915, p. 12.

†Jour. Econ. Ent. Vol. 11, No. 5, Oct. 1918, p. 406.

as is now so commonly the rule, but in relation to other agricultural subjects; in other words he should use ecology in its broadest and practical sense, which is nothing more than relations between insects and the innumerable conditions affecting themselves and their hosts, and the economic application of these interrelations. The student, whether he is specializing in entomology or along general agricultural lines, should also be encouraged to read more of the general literature dealing directly or indirectly with insect problems. I have in mind one article which to me is a masterful essay, so scientifically accurate and yet so simply stated that it could not but impress the student. I refer to a paper entitled "The Insect, the Farmer, the Teacher, the Citizen, and the State," by Dr. S. A. Forbes. Other papers which I have in mind which should be read by every student in entomology which bear upon the problems discussed this evening are Dr. C. Gordon Hewitt's capable address before the American Association of Economic Entomologists on "Insect Behavior as a Factor in Applied Entomology"; Crosby and Leonard's paper suitably treating "The Farm Bureau as an Agency for Demonstrating the Control of Injurious Insects"; Forbes' address before the Entomological Society of America on "The Ecological Foundations of Applied Entomology," and the timely discussions, one by Cooley on "Economic Entomology in the Service of the Nation," a second by Felt on "Entomological Research and Utility" and the third by Forbes, "Entomology in Time of War." *

These few remarks are given that we may think more of and possibly foresee some of the problems which are to confront us as a consequence of the changing conditions partly resulting from the war, and to emphasize the importance of giving more consideration to our methods of publicity, and are not intended to suggest any specific methods or changes.

The insects of cereal and forage crops which have come to our attention the past few years and which are likely to continue troublesome are not numerous but are of immeasureable importance, and we will briefly discuss the different problems individually.

The Hessian Fly (*Mayetiola destructor*).

The Hessian fly, supposedly introduced into this country by the Hessian soldiers of Prussia, is, as Dr. Forbes has so truly put it, still a Hessian and is without doubt the greatest insect menace to wheat production in the United States. Especially at this time when wheat is so essential does this pest show up as one of the most important, if not the most important and most pro-German insect pest in the States. A year ago the Hessian fly was of little consequence, and again this fall it is not sufficiently abundant to cause undue anxiety but from past observations and the trend of conditions, and especially if we find the parasites

*Forbes, S. A. "The Insect, the Farmer, the Teacher, the Citizen and the State." Illinois State Laboratory of Natural History, 1915.

Hewitt, C. Gordon. "Insect Behavior as a Factor in Applied Entomology." Jour. Econ. Ent., Vol. 10, Feb., 1917, p. 81.

Crosby, C. R., and Leonard, M. D. "The Farm Bureau as an Agency for Demonstrating the Control of Injurious Insects." Jour. Econ. Ent., Vol. 10, Feb., 1917, p. 20.

Forbes, S. A. "The Ecological Foundations of Applied Entomology." Annals of Ent. Soc. America, Vol. 8, Mar., 1915, p. 1.

Cooley, R. A. "Economic Entomology in the Service of the Nation." Jour. Econ. Ent., Vol. 11, Feb., 1918, p. 16.

Felt, E. P. "Entomological Research and Utility." Scientific Monthly, Dec., 1917, p. 551.

Forbes, S. A. "Entomology in Time of War." Circular, Office of Illinois State Entomologist, 1917.

losing hold this fall as anticipated, it will only be a year or two before they are again an item of greatest importance to the wheat grower. The Bureau of Entomology, Division of Cereal and Forage Insects, under the direction of Mr. W. R. Walton, has instituted a series of stations in the principal wheat-growing areas of the United States where detailed studies are being made, in co-operation with the state authorities. Sowing experiments, where wheat is sown on different dates and variously handled, are in progress, in the district covered by the Lafayette Indiana Station, from Michigan to Tennessee. At Centralia, Illinois, in the centre of the southern Illinois wheat belt, we have a substation comprising 18 acres of land in charge of Mr. C. F. Turner and conducted in co-operation with Dr. S. A. Forbes. There intensive studies are made and much stress is laid on the effect of meteorological conditions. For obtaining meteorological data the several instruments giving records which may have a bearing on fly activities are utilized; thus we have in continuous operation not only the hygrothermograph, soil thermograph and rain gauge, but also the atmometer, an instrument which measures the combined effects of temperature, air currents and humidity, terrestrial radiation thermometers, anemometers, etc. This work has been in progress for two years and many valuable data have already been obtained.

The principal remedies advocated at the present time are sowing after the fly-free or safe date and destruction of infested stubble and subsequent volunteer wheat. Since one of these important recommendations is sowing after the so-called "fly-free" or "safe" date and since this date is necessarily not identical year after year, efforts have been made to determine a simple means whereby the county agricultural agent or a group of farmers can determine for their locality the safe sowing date each year. Thus various types of cages are being used to determine which are giving emergence records similar to natural conditions and checks are obtained by making daily records of Hessian fly caught on tanglefoot covered screens erected in the field and by daily egg counts made on specified plants. Sowing at the proper time is not alone a remedy and at most is not a preventive for spring infestation. To be 100 per cent. effective it must be accompanied by the destruction of wheat stubble wherever possible and the elimination of volunteer wheat. Our experiments show that plowing wheat stubble to a depth of 6 or 8 inches and subsequent harrowing destroys at least 92 per cent. of the flies but the practice of sowing clover in wheat makes it difficult to secure the universal practice of this measure and until the sowing of clover with other crops or by itself becomes more general we must continue to depend largely on sowing at the proper date to escape fly injury. Here again the value of proper sowing is dependent to a large extent on another factor, namely co-operation. If all of the farmers in the community do not follow the practice of sowing after the fly-free date, the one or more farmers disregarding the proper sowing date will furnish breeding grounds for the first brood of flies which may, if weather conditions are favorable, mature and infest the later sown wheat or at least the early sown crops will produce a generous supply of flies to infest the wheat in spring. Our laws do not make it possible for us to specify sowing dates and we must depend on the intelligence and honor of the community and much can be done towards securing the co-operation of a community by honor conditions. This is aptly illustrated by an occurrence which happened in southern Indiana a year or so ago when we were conducting a campaign in a particular locality to secure the co-operation of farmers to hold off sowing wheat until advised. One young man asked to learn the penalty if he promised to hold off sowing, but for some reason or other went ahead and sowed before the proper time, and immediately an older man in the back of the room stood up and said "I guess there wont be any penalty but a heap sight of dishonor."

There are of course other considerations in the control of the Hessian fly such as the proper preparation of seed bed and use of fertilizers which enable plants to withstand injury, but it is not my intention here to go into details as I wish only to call your attention to the general subject of our problems. All of the methods of preventing or overcoming Hessian fly injury are what we might term good agricultural practices. Plowing under wheat stubble, except where it bears a good stand of clover, is good practice according to the agronomist, sowing after the fly-free date is, generally speaking, the best date to sow wheat regardless of insects, and the preparation of the seed bed and use of fertilizers are good agronomic practices pure and simple. Progress has been made with so-called fly resistant wheats and one or more of the wheats which are showing promising resistant qualities likewise rank above the average in yields.

Fig. 5.—Three year old apple orchard of 1,500 trees, completely defoliated by grasshoppers. Most of the orchard under cultivation and planted to navy beans which were destroyed previous to the orchard defoliation.

GRASSHOPPERS (*Melanoplus femur-rubrum* et spp.)

The past season we have experienced the most general and serious outbreak of grasshoppers for many years. Two years ago the grasshoppers were noticeably abundant in a few localities and in general the areas of grasshopper abundance were somewhat enlarged last year, while the past season they have appeared quite general and destructive in states where they have heretofore been of but comparatively little importance. There is every reason to believe that they will continue to be abundant next year, although probably not as severe as the past season.

As would be expected, the grasshoppers originated in fields such as timothy, blue grass and clover. The casual observer first noticed injury to clover towards cutting time when he found the plants completely defoliated, nothing remaining but the bare stalks and heads. The hoppers then left the clover for new fields, attacking such crops as were handy, as corn, soy beans, and navy beans; and not infrequently young orchards were defoliated. Thus at New Concord, Ohio, we observed a three-year old apple orchard of 1,500 trees completely defoliated on August 17, and before the grasshoppers attacked the tree foliage they had cleaned up the navy beans which had been planted between the trees over most of the ground covered by the orchard. The insects even girdled the twigs in many places. At the same place we observed a bearing orchard with 20 per cent. of its ripening peaches destroyed, in some cases only the seed being left attached to the tree. It sometimes happens that the grasshoppers remain active until after wheat appears above ground in which case they may keep the wheat plants cut off close to the surface and as might be surmised, it requires but few of the insects to cut off the young tender wheat plants over a considerable area.

Excellent results in combatting grasshoppers have been obtained by the application of two standard remedies, namely, poison bait and the grasshopper catcher. As a general rule we have continued to recommend the standard poison bait formula of bran, molasses, fruits or lemon extract and a poison, preferably Paris green or crude arsenious oxide or white arsenic if neither of the first two mentioned are

Fig. 6.—Ripening peaches damaged by grasshoppers. Sometimes only the seed remained attached to the tree.

available. However, the experiments of the past year, and especially the experiments conducted at Janesville, Wisconsin, by Mr. D. A. Ricker of the Lafayette Laboratory, indicate the non-essentialness of fruits or lemon extract when dealing with mature grasshoppers and that further studies based on age of the insect, meteorological conditions, et cetera, will show the need of important changes in the formula for grasshopper bait. Likewise a half and half mixture of hardwood sawdust, preferably that taken from an ice house, and bran has given results sufficient to warrant its recommendation. Indeed, Mr. E. E. Twing, county agricultural agent of Kalkaska County, Michigan, reports thorough success the past season in his county campaign against grasshoppers, using sawdust alone in place of bran in the poison bait. He used several tons of white arsenic for poison bait for practically all of which sawdust was used as the base. The crude arsenious oxide mentioned is a by-product of the copper smelters of the western states and is obtainable in barrel lots at 8 to 9 cents per pound; and in ordering, a powdered grade should be specified. It has given excellent results the past season wherever we have had an opportunity to observe its use and the results are practically equal to those obtained where Paris green was used. It was tested out in a grasshopper infested section in Michigan, for example, where it gave such good results that the farmers of that section of the state, according to information furnished by Mr. Don B. Whelan, extension entomologist of Michigan, will order a car load in anticipation of grasshopper and cutworm troubles next year.

We find that the poison bait can best be used in fields such as clover about the time they are cut, by first cutting around the field leaving a small central area uncut in which the hoppers will congregate and here they can be slaughtered by the use of a comparatively small amount of poison bait. The bait is likewise of greater value in corn-fields, orchards, and amongst other crops where the grasshopper catcher cannot be used; and in corn fields it is advisable to make the bait more adhesive by an extra amount of water or, better, twice as much molasses, scattering the mixture forcibly amongst the crops so that small particles will adhere to the foilage.

The grasshopper catcher, such as was first recommended by Dr. E. D. Ball and later advocated by Cooley and others, proved highly successful wherever tried.

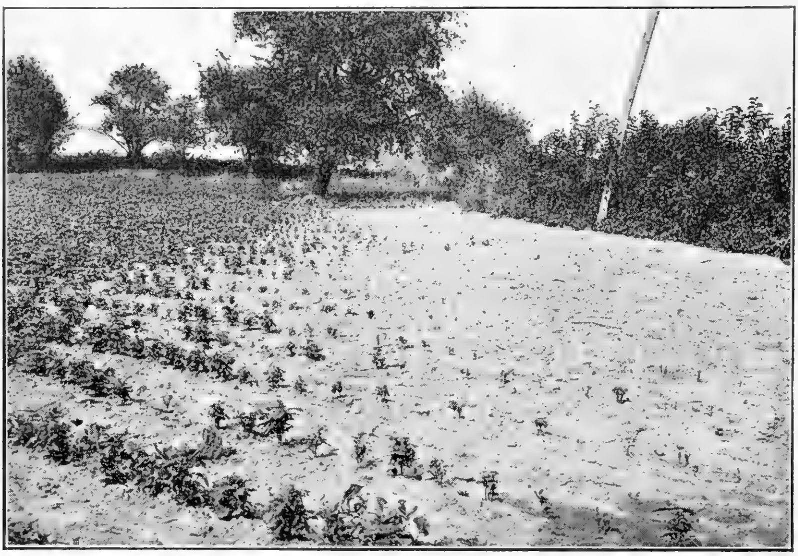


Fig. 7.—Field of navy beans being destroyed by grasshoppers entering from an adjoining field.

This catcher differs from the better known hopperdozer by having a screened box attached to the back (as illustrated), into which the grasshoppers are carried. This has a money value advantage over the hopperdozer in that the insects can be used as poultry feed. After filling the box it is a simple matter to haul the apparatus to the poultry yard where the grasshoppers can gradually escape through the front opening at a rate agreeable to a fair sized flock of chickens, thus giving us an ideal poultry self-feeder. Or, probably better, the insects can be bagged and allowed to die and dry within the bags and laid aside for winter use. Such feed for hens in winter appreciably increases egg production, not a small item these days. We have been able to secure an analysis of mature grasshoppers[1] through the kindness of Mr. E. G. Proulx, State Chemist of Indiana, with the following results.

[1]*Melanoplus femur-rubum.*

Fig 8.—Grasshopper catcher ready for action.

Analysis Based on Live Weight.

Moisture at 100°C with hydrogen	68.40%
Crude fat	1.94%
Crude protein	25.07%
Crude fibre	3.41%
Crude ash	1.24%
Total	100.06%

Calculation of Ash Constituents.

Nitrogen free extract	None
P_2O_5	0.59%
Na_2O	Trace
K_2O	Trace

On this basis dried grasshoppers would contain approximately 75 per cent. of protein.

Fig. 9.—Grasshopper catcher in operation.

Our counts show an average of 500 live adult grasshoppers (*Melanoplus femur-rubrum*) to a pint and about 1,530 to a pound live weight or 4,500 to a pound dry weight. The cost of a grasshopper catcher is from $15 to $25, according to the amount of new materials which must be purchased, and usually it is possible to secure the tin, the largest individual item of cost, as second hand roofing. Considering that such a machine will last for many years, it is easy to see that the cost is repaid in poultry food in a comparatively short time, to say nothing of the value derived by eliminating the insects.

It is not possible to recommend one or the other of these two grasshopper control measures as the more valuable. In some instances, where for example large comparatively level acreages are to be covered and where labour is not scarce, the grasshopper catcher can be used to better advantage and more economically than the poison bait, while in other cases the opposite is true.

Cutworms (*Noctuidae*).

We can expect trouble from cutworms every year, and the past season has not been an exception to the rule. In many sections, more especially in Iowa and Wisconsin, they have been more severe than ordinarily, damaging principally corn and garden crops. The Feltias were most generally common, although in many localities the Euxoas were the principal depredators. In southern Indiana the bottoms of the Wabash river and tributary streams are subject to what are commonly termed overflow worms (*Agrotis ypsilon*). Some injury occurred the past season, but the insects were not nearly so general as the year before. They invariably appear following a late overflow, that is on land which is overflowed and covered with water as late as early June. As the water leaves the ground the moths make their appearance from the higher surrounding land and lay their eggs in the still wet soil; and any crop planted on this ground, which is usually corn, is likely to be damaged if not completely destroyed by the cutworms. It is unusual for a cutworm moth to lay its eggs in moist soil, but this appears to be the usual habit of this species (*Agrotis ypsilon*) and it has already been recorded as a serious pest in the areas overflowed by the Ganges and other rivers in India. Woodhouse and Fletcher * and other authors have given us very interesting accounts of the habits of this species as worked out in India.

You are all familiar with the methods of controlling cutworms. Aside from early fall plowing and certain rotations whereby ground likely to be infested is planted to crops not susceptible to cutworm injury, we have on'y one method of control, which fortunately is quite efficient. Our experience teaches us that poison baits such as are used against grasshoppers are equally effective against cutworms. In the case of the overflow worm it is also possible to escape injury if the ground is cultivated immediately after the water leaves the land and before the moths lay their eggs, but this practice is applicable only for small sections of individual farms, for it is not possible for the individual to cultivate a very large area before the moths appear and begin oviposition.

The So-called "Silk Bugs" (*Diabrotica 12-punctata* and *D. longicornis.*)

An insect, or rather two insects, which have ruined corn crops for many years in the overflow lands of the Ohio river in south-western Indiana but which have

*Woodhouse, E. J., and Fletcher, T. Bainbridge. "The Caterpillar Pest of the Mokameh Tal Lands." Agric. Jour., India, Vol. 8, pt. 4, Od., 1912, pp. 343-354.

been called to our attention only recently, are old and well-known reprobates more familiarly known to us as the southern corn root worm or bud worm (*Diabrotica 12-punctata*), and the northern corn root worm (*D. longicornis*). They are commonly pests of corn plants when in the larval stage, but as the "silk bug" it is the beetle that causes the damage and in an entirely different manner for it appears just as the ears are silking, cutting off the silk before the kernels become fertilized, thus causing the production of barren ears. One would expect the corn plant to be injured by the larvæ of these beetles earlier in its growth but such seems not to be the case, at least the corn shows no apparent injury. The probable reason for this is because the land is overflowed every winter and large amounts of rich humus are deposited, leaving the ground so rich that corn is planted year after year and the plants make such rapid growth that they overcome all injury to the root system inflicted by the larvæ of these two beetles.

We have no remedy for these pests under the conditions just given. As already

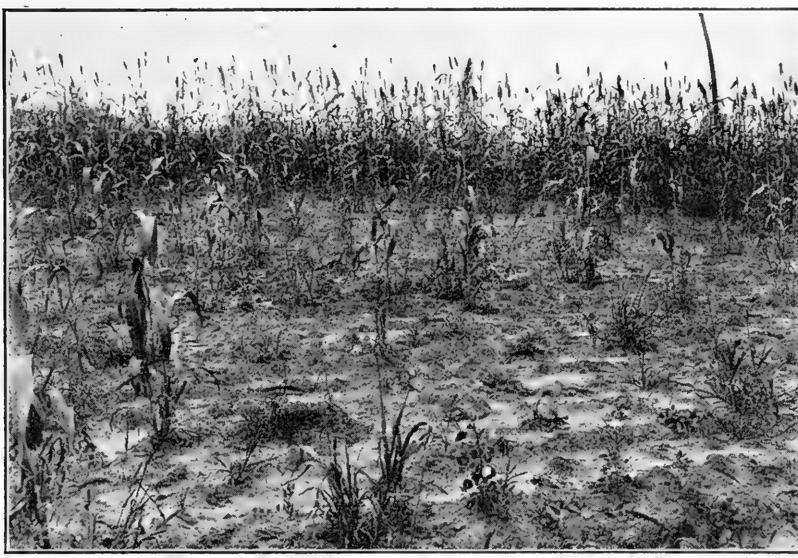


Fig. 10.—Field of cane damaged by White Grubs (*Lachnosterna* spp.)

stated the farmers prefer to grow corn on the ground year after year, giving the one species (*D. longicornis*) at least, ideal conditions for reproducing itself. Poisoning the beetle appears to be out of the question, but there is a likelihood of reaching them by the use of repellant dust sprays. More information on the life history and habits of the species under these conditions, new to us, is necessary before the problem can be intelligently attacked.

The White Grub (*Lachnosterna* spp).

Since the common white grubs have been serious pests in the northern states, this problem has been given considerable attention at the Lafayette Laboratory. The general results bearing on their economic relations have been published, and the natural enemies have been fully discussed in a paper soon to be issued. Many interesting data on their ecological and taxonomic relations have been, and are continuing to be, accumulated through the co-operation of entomologists in Canada and the United States.

As might be expected for an insect having so widespread distribution and involving a life cycle of three years, the white grubs have several definite destructive broods. The important brood which occurs more or less continuously through the northern states from South Dakota to the Atlantic coast and in southern Ontario is present in the beetle stage every three years, 1917 being the last year the May-beetles were numerous. The year following the flight of beetles might be termed the "grub year" since the grubs are then in their most destructive stage. The important brood under discussion evidently began in an accumulative way some score of years ago. By 1909 and especially in 1912, they had become very abundant and destructive over a considerable area. In 1915 the grubs were again as abundant, or more so, as in 1912 but the damage was much less evident because the season was wet, which greatly assisted the corn and pastures to overcome some of the destructive work of the grubs. The past season (1918) grubs were again abundant, although less numerous than for several years past, but fortunately the conditions have been against the pests and comparatively small damage resulted. Parasites, predaceous enemies, and diseases have played a part in this result but certain climatic conditions are in a large measure responsible. In the spring of 1917 May-beetles were apparently as numerous in the soil as in any previous beetle year but the season was late and cold and the beetles came to trees in small numbers until quite late. Only a small percentage of the normal number of eggs were laid and most of these late in the season. As a consequence the grubs were abnormally small when cold weather set in, many of them too small to pass the winter successfully. This year the comparatively few grubs were small when the ground warmed up and they did not reach their destructive developmental stage until late in the year. From general observations it appears certain that the years of maximum abundance are passed and that we may expect fewer grubs of this particular brood for a number of years before conditions will again favor their enormous increase.

The principal methods of combatting white grubs are rotations and utilization of hogs and poultry. In white grub districts rotations should be arranged so that corn and other susceptible crops will not be planted on ground likely to contain grubs the year of their abundance, or better, the use of clover in the rotation, the clover to be followed by corn, since the beetles do not deposit many eggs in ground covered with a stand of clover during the May-beetle flight. The value of hogs to clear land of grubs has been repeatedly demonstrated. Other practices, such as fall plowing and the collection of May-beetles and grubs are only partially successful, but are good practices when supplemented by the measures already mentioned.

I have purposely discussed several of the more important insects of cereal and forage crops which have occupied our attention the past year or two. It is usual and to be expected that the economic entomologist spends much of his time with insects which appear in conspicuous numbers. There are however, hordes of insects of less importance which nevertheless are always present and which constitute a continuous drain on our crops but because of the inconspicuousness and gradualness of the losses they are not recognized seriously. Many of these inconspicuous insects are taking a heavy toll, and I believe we are coming to a time when they will be given their just consideration and it might be added, their just deserts.

Fig. 11.—Field of corn showing typical spotting of field caused by White Grubs (*Lachnosterna* spp.)

Fig. 12.—Trees defoliated by May-beetles (*Lachnosterna* spp.). The trees in centre are bur oak and the tree to right an elm.

Fig. 13.—Hickory woodlot defoliated by May-beetles (*Lachnosterna* spp.). The undefoliated tree to left is an apple.

INSECTS AS AGENTS IN THE DISSEMINATION OF PLANT DISEASES.

Lawson Caesar, O. A. C., Guelph.

The following was delivered as the President's Address:

There are three great classes of plant diseases in the dissemination of which insects play a part. These are:—first, diseases due to fungi; second, diseases due to bacteria; and third, diseases whose cause has not been discovered but which are of a decidedly communicable or infectious character. This last class is often called "Physiological Diseases," or "Diseases of Unknown Origin," the latter term being preferable.

Before discussing the rôle of insects as disseminators it may be well to give a list of the common agents in the spread of plant diseases. They are: wind, rain (especially wind-driven rain), infected seed, infected manure, infected soil, insects, slugs, man with his teams and implements, birds and a few other animals.

Of these various agents every plant pathologist would say that so far as the dissemination of spores of fungi is concerned, wind and rain are, with very few exceptions, such as perhaps Ergot of Rye, vastly more important agents than insects. In the case of diseases that have been introduced recently and that are not yet widely spread, insects may play an important part in long-distance distribution and in the establishment of new centres of infection, especially if the spores of such diseases are of the type that is held together by a gelatinous substance which prevents their distribution by wind alone, though after being dissolved in moisture they may be blown short distances by wind-driven rain.

In the dissemination of plant diseases insects may function in three ways. First, they may serve as mere carriers of the spores or other causal organisms from plant to plant. The amount of disease thus spread compared with that by other agents is probably small. Second, they may cause wounds of various kinds which afford ideal conditions for spores or bacteria to germinate in and establish new infections. This is of course a very important function because many kinds of spores and a large percentage of bacteria seem unable to enter plants in any other way than through wounds. Third, they may serve as direct inoculators, not only bringing the organism with them upon or within their body but actually inserting it, when feeding, into the tissues where it finds favorable conditions for development. This last is on the whole the most important of the three methods.

Insects as Disseminators of Fungus Diseases.

Sucking insects with a few exceptions, such as in the case of the spread of Ergot of Rye by flies and of Downy Mildew of Beans by bees, do not appear to play nearly so important a part in the spread of fungus diseases as do biting insects. This is probably because such sucking insects as feed upon plant tissues have minute, needle-like mandibles and maxillae and in feeding make very small wounds. These wounds do not expose the moist inner tissues or afford much better places for spore entrance and germination than do stomata and lenticels. Moreover, insects with such mouth-parts are not adapted for feeding upon spore masses and so seldom get their mouth-parts contaminated and act as direct inoculators of healthy plants. Biting insects are therefore much more important in the dissemination of fungus diseases of plants.

It is worth noting here that several species of Coleoptera and Orthoptera as well as some Lepidopterous larvæ feed freely upon spore masses, and not only become covered externally with the spores but pass many of them uninjured through their body in the excreta. When this is deposited on healthy leaves or on other parts of the plant it affords an additional source of possible infection, either through the spores germinating and working their way through the uninjured tissues or through their being washed by rains into wounds.

Examples of Fungus Diseases Disseminated by Insects.

Ergot of Rye (*Claviceps purpurea*). This disease of cereals and grasses is said by plant pathologists to be spread in the summer chiefly through insects, especially flies, which are attracted to the sweetish, somewhat milky fluid in which the conidia produced on diseased ovaries of florets float. As this fluid is sticky the flies become contaminated and carry the spores to healthy florets, thus setting up new infections.*

Downy Mildew of Lima Beans (*Phytophthora phaseoli*). Sturgis has shown that this disease is apparently largely distributed by bees. He found that the Mildew failed to appear to any appreciable extent until the flowers began to expand, but that it became well established by the time the blossoms had fallen. He also found that it began regularly in those inner parts of the flower which were touched by the bee when seeking nectar, thus strongly indicating that the bees were the carriers and inoculators.

Chestnut Blight (*Endothia parasitica*). This is a recently introduced disease and therefore its distribution to each new locality is much more important than would be the dissemination from tree to tree of some old, well established fungus. Studhalter, Ruggles, Metcalfe and others have studied the relation of insects to the Blight and have shown that while many insects distribute the spores it is chiefly those insects that cause wounds on the trees that are important as disseminators; because the disease can enter the tree only through wounds in the bark. Ruggles discovered that the Seventeen-year Cicada and a bast-miner were important agents and that the disease in many cases had entered through wounds made by them. The Cerambycid, *Leptostylus macula*, is important as a carrier and possibly also as an inoculator.

White Pine Blister Rust (*Cronartium ribicola*). This is, as everyone knows, another recently introduced disease, and it is not yet established in our northern pine forests. Its spores lend themselves to wind dissemination, but it is thought that insects play an important role in the spread of the disease. Only a few months ago Gravatt and Posey gave an account of their finding tiny Gipsy Moth larvæ feeding greedily upon the spore pustules of the disease on pine trees, and becoming almost yellow with the countless spores that adhered to the hairs of their body. It has been shown that these tiny larvæ can be carried even 20 miles by the wind, so that distant spread of spores of the disease by them would be expected. Gravatt and Posey examined wind-borne larvæ found on Ribes (the alternate host of the disease) and found aeciospores on them. They also found that leaves fed upon by the larvæ contracted the disease. There seems to be no doubt that such larvæ are in the New England States important agents in distributing the White Pine Blister Rust.

Gooseberry Twig Disease (Undetermined fungus). In Burlington I have seen a large, well-cared-for garden of gooseberries in which almost every plant

*Note.—Since writing the above I have been informed by Prof. Howitt that it has recently been demonstrated that wind plays a more important part in distribution of conidia of ergot of rye than was formerly believed possible.

had from one to ten or more twigs dead or dying. Diseased twigs were sent to Geneva and examined by J. G. Grossenbacher, who wrote that the trouble was due to an undetermined fungus which entered through openings made by a Cambium Miner, apparently *Opostega nonstrigella.*. The disease seemed to enter solely through these wounds.

Small Cankers on Apples (*Leptosphaeria coniothyrium*). Parrott, Gloyer and Fulton in their study of Snowy Tree-crickets have shown how the cricket, *Oecanthus niveus*, is the agent in introducing the fungus that causes the small cankers around cricket egg punctures on apple trees. These cankers are found in Ontario as well as New York. This fungus, *Leptosphaeria coniothyrium*, is also the fungus that causes Raspberry Blight and is believed by the plant pathologists of Geneva to enter many raspberry canes through the wounds made by the egg punctures of the Tree-cricket, *Oecanthus nigricornis*.

Heart Rots of Forest and Shade Trees (Several species of fungi). In almost every city may be seen maple trees with unsightly wounds, due to the burrows of the Maple Borer (*Plagionotus speciosus*). These wounds commonly allow the entrance of heart rots, which injure the wood and weaken the trees, often shortening its life. It seems reasonable to assume that similar diseases enter various forest trees, through injuries caused by Cerambycids, Buprestids or Ipids. It is true that most of these attack only sickly, dying or dead trees, but some attack healthy trees. Such gaping wounds as those caused in poplars and willows by the Snout Beetle (*Cryptorhynchus lapathi*) could scarcely fail to admit fungi. The evidence tends to show that this beetle is an important factor in the transmission of the European Poplar Canker (*Dothichiza populea*).

Referring to a species of Scolytus that attacks White Fir, Hopkins says "When the attack is not sufficient to kill the trees, these wounds heal over, but in the meantime a decay often sets in at these injured places, which extends through the heartwood and for several feet above and below the wound, thus rendering the wood worthless for lumber and often for fuel." In the same bulletin he says "It appears that insects contribute more to the spread of fungus of the bark and wood of the main trunk than do such diseases to the spread and ravages of insects."

Brown Rot of Fruits (*Sclerotinia cinerea*). The spores of this disease are readily carried by the wind, but they usually fail to infect peaches and sour cherries in Ontario except through wounds or where fruits touch each other. Some varieties of plums and sweet cherries are very susceptible, even though their surfaces be unwounded. The joint investigations of the Bureaus of Entomology and Plant Pathology of the U. S. Department of Agriculture proved definitely the important part played by the Plum Curculio in the spread of this disease on peaches. Illingworth, Spencer and the writer in their studies of Cherry Fruit Flies found that sour cherries infested by the maggots of these flies were often conspicuously affected by Brown Rot and that where these insects were completely controlled very few cherries rotted even though they were left on the trees until overripe. Moreover, there is no doubt that placing maggoty cherries in baskets along with sound ones favours the development of rot, especially in warm weather; because even though the infected cherries be not rotten, they exude juice from the breathing holes made by the maggots and this gives ideal conditions for rot development.

Lack of space prevents our giving more examples of fungus diseases spread by insects, so we shall now pass on to the bacterial diseases.

Insects as Disseminators of Bacterial Diseases.

Compared with other agents insects play a much more important part in the spread of bacterial than of fungus diseases. This is partly because bacteria do not to any great extent lend themselves to dispersal by the wind, whereas wind is the chief means of fungus spore dispersal. Another reason is that during the growing season,—the time of greatest dissemination,—the bacteria in some plants are wholly concealed within the plants and are only obtained for fresh inoculations by penetration through the surface to them. This insects do. A third reason is that about half of our worst bacterial diseases can enter plants only through wounds and such wounds are made chiefly by insects. It is worth noting that though insects like Aphids or Capsids with very slender, piercing mouth-parts play but little part in the spread of fungus diseases they are often very important in the spread of bacterial diseases. This is because they feed indiscriminately on healthy and diseased portions of plants and thus by penetrating the diseased areas get their mouth parts contaminated; for no set of mandibles and maxillae are too small to carry numerous bacteria if once they reach them. Once the mouth-part is contaminated inoculation of healthy parts is easy. It looks, however, as if White Flies and Red Spiders were exceptions and did not play much part as spreaders. There are also cases like Cucumber Wilt in which it is doubtful whether Aphids can act as inoculators. Further study will doubtless explain such exceptions.

The fact that out of the eight common and important bacterial diseases of plants in Ontario three are disseminated almost exclusively by insects, shows the importance of insects in relation to bacterial diseases.

Examples of Bacterial Diseases Disseminated by Insects.

Cucumber Wilt (*Bacillus tracheiphilus*). It has been definitely proven that the Striped Cucumber Beetle (*Diabrotica vittata*), and to a less extent the 12-Spotted Cucumber Beetle (*Diabrotica 12-punctata*) are the chief and probably almost the sole distributors of this destructive disease and that if they could be exterminated the disease would almost disappear. It is very interesting to learn too that the disease is not only disseminated by these insects but is supposed to be carried over from one year to another by them and not through the soil.

Pear Blight (*Bacillus amylovorus*). This, as is well known, is a very destructive disease of pears, apples and quince, causing an enormous amount of damage some years and a considerable amount every year. It is nearly unanimously agreed that insects are the great factors in its dissemination both in the stage known as "blossom blight" and in the later twig blight stage. If a list were to be compiled of all the insects that had a part in the spread of this disease it would be a long one, for it includes many of the blossom frequenting insects, most sucking insects with piercing mouth-parts found on the apple and pear, and at least one bark beetle. In connection with this disease I may say that we have on several occasions found the gummy exudate at blossom time and have several times found ants feeding upon it. We also know that ants are common frequenters of the nectaries of blossoms. We consider ants therefore as the probable cause of the earliest cases of blossom infection.

Soft Rot of Vegetables (*Bacillus carotovorus*). This fairly common disease of cabbage, turnips, carrots, tomatoes, potatoes and celery is believed to enter solely through wounds, and insects and slugs are believed to be the main carriers of the organism as well as the chief inoculators. There has been a lot of

Soft Rot of Celery this year, for which the Tarnished Plant Bug is blamed. Efforts for control of the disease have been directed towards destroying this insect. The disease appears to winter over in the soil.

BACTERIAL WILT OF CRUCIFERS (*Pseudomonas campestris*). Jones and others have shown that insects and slugs are important and common disseminators, though there are also other agents.

OTHER BACTERIAL DISEASES. Very little is known as to the part played by insects in the spread of the other common bacterial diseases. Bean Bacteriosis (*Pseudomonas campestris*), Black Spot of Plums and Peaches (*Bacterium pruni*), Crown Gall (*Bacterium tumefaciens*) or Potato Wilt (*Bacillus solanisaprus*). We know, however, that the bacteria of the first two of these may enter directly through stomata without the aid of wounds.

INSECTS AS DISSEMINATORS OF PHYSIOLOGICAL DISEASES OR DISEASES OF UNKNOWN ORIGIN.

There are already many well known physiological diseases, and the list is being added to each year. A considerable proportion of our worst plant troubles come under this category. Insects do not play a part in the distribution of all, for instance they seem to have nothing to do with the spread of Peach Yellows and Little Peach. In many cases, however, insects appear to be either the sole agents in distribution or else very important agents. From the evidence available it would appear that most of the insects concerned are of the sucking and piercing types, though there seems no good reason why biting insects cannot also play a part. The infectious principle or virus seems in most cases and probably in all to be taken into the body of the insect and inoculation occurs through feeding.

EXAMPLES OF PHYSIOLOGICAL DISEASES OR DISEASE OF UNKNOWN ORIGIN DISSEMINATED BY INSECTS.

MOSAIC DISEASE OF SWEET PEAS. Most growers of sweet peas are probably familiar with this easily recognized disease which weakens the plants and diminishes the size and beauty of the blossoms. Taubenhaus has shown that it is readily transmitted by aphids, but he says any biting or sucking insect may spread it. Most of the spread will naturally be due to aphids, because they are the most common sweet pea insects.

MOSAIC DISEASE OF TOBACCO. This is a very important disease of Tobacco in the United States and may be identical with Mosaic Disease of Tomatoes, though probably not with Potato Mosaic. Allard has shown that the Peach Aphis (*Myzus persicae*), and also the Aphis (*Macrosiphum tabaci*), are very important spreaders of the disease. White Flies and Red Spiders he thinks do not distribute it.

MOSAIC DISEASE OF CUCUMBERS. This disease causes an annual loss of about $1,000,000 in the United States. I have not seen it in Ontario but believe it has been found in a few localities. Doolittle and Jagger have proven that aphids are carriers and are probably the chief agents in its spread.

CURLY TOP OF SUGAR BEETS. This disease occurs in the South-western States and some years is exceedingly destructive. The Beet Leaf-hopper (*Eutettix tenella*) has time after time been proven to be the distributing agent and so far as known the sole agent.

SPINACH BLIGHT. This blight attacks both spring and fall crops of spinach in Virginia, Ohio and parts of New York. Leaves of affected plants become mottled and malformed and the plants finally die. The disease is a very important one and is said to be spreading. It was formerly thought to be due to malnutrition, but is now known to be a communicable disease, the virus of which is transmitted chiefly by the aphis (*Macrosiphum solanifolii*) but also to a lesser extent by another aphis (*Rhopalosiphum persicae*) and by the Tarnished Plant Bug (*Lygus pratensis*). The most interesting discovery in connection with this disease is that not only do aphids transmit it but also that their offspring down to the fourth generation can do so even though none of these offspring have fed upon diseased plants.

McClintock and Smith who made the above discovery think it very probable that aphids are also responsible for the tiding over in their own body of the disease from spring to fall.

In conclusion we may point out that the plan of controlling such diseases as are spread chiefly by insects by destroying the insects responsible, is in most cases impracticable; because some of the worst offenders, such as the Striped Cucumber Beetle, several species of aphids and the Tarnished Plant Bug, are among the most difficult of insects to combat successfully.

It is also worth while pointing out that it is only during the last few years that any careful study has been made of insects as agents in the dissemination of plant diseases, and that though some very brilliant work has been done, especially during the last four or five years, there still remains great scope for further careful investigation by entomologists and plant pathologists working together in close co-operation.

The More Important Literature Consulted.

Eastham. The part played by insects in the spread of plant diseases. Proc. Ent. Soc. of B.C.

Massee. Textbook of fungi.

Sturgis. Some aspects of vegetable pathology and the conditions which influence the dissemination of plant diseases. Bot. Gaz., Vol. XXV, p. 187, 1898.

Hopkins. Preliminary report on insect enemies of forests in the Northwest. Bul. 21 (n.s.), Bur. Ent., U.S.D.A.

Primm. The European Canker in the vicinity of Philadelphia, Pennsylvania. Jour. Econ. Ent., Vol XI, No. 1, 1918.

Martin. Dissemination of Septoria lycopersici by insects and pickers. Phytopathology, Vol. VIII, No. 7, 1918.

Studhaltfr. Insects as carriers of the Chestnut Blight. Phytopathology, Vol. IV, No. 1, 1914.

Studhalter and Ruggles. Insects as carriers of Chestnut Blight. Bul. 12, Penn. Dept. of Forestry. 1915.

Anderson and Rankin. Endothia Canker of chestnut. Bul. 347, Cornell University. 1914.

Gravatt and Posey. Gipsy Moth larvæ as agents in the dissemination of the White Pine Blister Rust. Jour. Agr. Research, Vol. XII, No. 7, 1918.

Gravatt and Marshall. Arthropods and gasteropods as carriers of Cronartium ribicola. Phytopathology, Vol. VII, No. 5, 1917.

Parrott and Fulton. Tree-crickets injurious to orchard and garden fruits. Bul. 388, N.Y. Agr. Exp. Sta., Geneva. 1914.

Parrott, Gloyer and Fulton. Some studies on the Snowy Tree-cricket with reference to an apple bark disease. Jour. Econ. Ent., Vol. VIII, No. 6, 1915.

Scott and Ayres. The control of peach Brown Rot and Scab. Bul. 174, Bur. Plant Ind., U.S.D.A. 1910.

Scott and Quaintance. Control of Brown Rot of peaches. Circ. 120, Bur. Ent., U.S.D.A. 1910.

Illingworth. Cherry Fruit-flies and how to control them. Bul. 325. Cornell University.

Grossenbacher. Medullary spots, a contribution to the life-history of some Cambium Miners. Tech. Bul. 15, N.Y. Agr. Expt. Sta., Geneva, 1911.

Fulton. The dispersal of spores of fungi by the agency of insects, with special reference to the Phalloidei. Ann. Bot., Vol. III, p. 207, 1889.

Marshall. Microbiology.

Smith. Bacteria in relation to plant diseases.

Rand. Dissemination of Bacterial Wilt of Cucurbits. Jour. Agr. Research, Vol. V, No. 5, 1915.

Rand and Enlows. Transmission and control of Bacterial Wilt of Cucurbits. Jour. Agr. Research, Vol. VI, No. 11, 1916.

Jones. Bacterial Blight of Apple, Pear and Quince. Bul. 176, Ont. Ag. Col., 1909.

Jones. Bacteria, friends and foes. Bul. 265, Ont. Agr. Col., 1918.

Merrill. Aphids and Fire Blight. Jour. Econ. Ent., Vol. VIII, No. 4, 1915.

Burrill. Insect control important in checking Fire Blight. Phytopathology, Vol. V, No. 6, 1915.

Stewart and Leonard. The role of sucking insects in the dissemination of the Fire-Blight bacteria. Phytopathology, Vol. V, No. 2, 1915.

Merrill. Further data on the relationship between Aphids and Fire Blight, Jour. Econ. Ent., Vol. X, No. 1, 1917.

Stewart. The importance of the Tarnished Plant Bug in the dissemination of Fire Blight. Phytopathology, Vol. III, No. 6, 1913.

Stahl and Carsner. Obtaining Beet Leaf-hoppers non-virulent as to Curly-top. Jour. Agr. Research, Vol. XIV, No. 9, p. 393, 1918.

Boncquet and Hartung. The comparative effect upon sugar beets of Eutettix tenella, Baker, from wild plants and from curley-top beets. Phytopathology, Vol. V, No. 6, p. 348, 1916.

Boncquet and Stahl. Wild vegetation as a source of Curly-top infection of sugar beets. Jour. Econ. Ent., Vol. 10, No. 4, 1917.

Taubenhaus. Mosaic disease of sweet peas. Bul. 106, Del. Agr. Expt. Sta., 1914.

Allard. Further studies of the Mosaic disease of tobacco. Jour. Agr. Research, Vol. X, No. 12, 1917.

Doolittle. A new infectious Mosaic disease of cucumber. Phytopathology, Vol. VI, No. 2, 1916.

Jagger. Experiments with cucumber Mosaic disease. Phytopathology, Vol. VI, No. 2, 1916.

McClintock and Smith. True nature of Spinach Blight and relation of insects to its transmission. Jour. Agr. Research, Vol. XIV, No. 1, 1918.

THE CABBAGE ROOT MAGGOT (*CHORTOPHILA BRASSICAE*).

H. C. HUCKETT, O.A.C., GUELPH.

A study of the life-history and control of the Cabbage Maggot (*Chortophila brassicae*) was undertaken this year under Prof. Caesar's guidance. The study is still far from completion but some interesting results from different control methods have been obtained. The most important of these is, that on the whole corrosive sublimate has given better results than discs even where discs have been cleaned after each cultivation. Similar good results have been obtained with corrosive sublimate by the representatives of the Vegetable Branch, Department of Agriculture, Toronto; in fact they made the suggestion that led to our testing it.

Another interesting feature was that round discs, with a round hole in the centre and a slit leading to it, proved equally as effective as the hexagonal discs with the star-shaped centres and slit leading to this. Consequently in the tables both discs have been classed together.

Tests were also made with tobacco dust and lime and also with tobacco dust and sulphur. The results were promising, but much further work will be required to determine accurately their value and best method of using.

TABLE SHOWING RESULTS OF EXPERIMENTS IN CONTROL OF CABBAGE MAGGOT AT BURLINGTON

Method of Treatment.	Total No. Plants.	No. Plants killed by damping off or accident.	No. Plants killed by maggots.	No. Plants that survived.	No. Plants dwarfed.	% living Plants.	% vigorous living Plants.	% killed by other causes than maggots.	% killed by maggots.
Corrosive sublimate....	652	55	13	584	20	89.6	86.5	8.4	2
Check	163	9	78	76	20	46.6	34.4	5.5	47.9
Discs, both round and 6-sided. Earth removed after cultivation...	504	71	31	402	15	79.8	76.8	14.1	6.1
Discs, both round and 6-sided. Earth not removed after cultivation	474	42	161	271	37	57.2	49.4	8.8	34.0
Check	326	50	127	149	31	45.8	36.2	15.3	38.9

TABLE SHOWING RESULTS OF EXPERIMENTS ON CABBAGE MAGGOT AT GUELPH, 1918

Method used.	No. plants.	No. dead from all causes.	No. alive.	No. dwarfed.	% alive.	% vigourous.
Corrosive sublimate	99	0	99	0	100	100
Tarred felt paper discs, round and hexagonal, kept clean............	101	0	101	0	100	100
Tarred felt paper discs, round and hexagonal, not cleaned...........	97	7	90	6	92.8	86.6
Check	99	44	55	15	55.6	40.4

NOTE.—The better results obtained from the tarred felt paper discs at Guelph than at Burlington were apparently due to the plants at Burlington being set deeper in the soil and to the soil being sand, whereas the Guelph soil was clay. The greater amount of shade and the greater difficulty in keeping soil off the plants at Burlington gave the insects a better chance to cause injury. The corrosive sublimate in both cases was used at the strength of 1 part to 1,000 parts of water, or one ounce to 50 pints of water, and was applied with a watering can with a spout in which was inserted a small piece of wood to conduct the liquid directly to the roots without waste. Four applications were given in each case, the first, four days after the plants were set out and the remaining three at intervals of seven days. At each application sufficient liquid was used to wet thoroughly the roots. At Guelph more than was necessary was applied and at first a slight yellowing of the plants occurred, but they soon outgrew this and became just as vigourous as any plants in the plot. At Burlington no yellowing was observed and the plants were very vigourous throughout.

Corrosive sublimate has shown itself to be a very valuable substance in combating this pest, but a great deal of work is yet necessary to determine the best strengths to use, the number of applications necessary, and the best time to make each of these. Tests will also have to be made to determine whether this substance can safely be used with radishes and if so in what way. There is very little doubt that the growers would much more readily use corrosive sublimate than apply the tarred felt paper discs. They seem to have a decided objection to using the latter, though they have been recommended for so many years.

PROF. JONES: In the treatment of cabbage plants for Root Maggot was there any difference observed in the fertility of the soil to which corrosive sublimate had been added as compared with that to which it was not added?

MR. HUCKETT: No observable difference.

PROF. JONES: Corrosive sublimate is one of the strongest of our disinfectants, and in addition to destroying the egg or the larva of the Cabbage Maggot it would have a marked influence on the bacterial content of the soil. It would destroy the nitrogen fixer and the nitrifiers and also the decomposing species of bacteria; and providing there was not plenty of available food material in the soil ready for the plants to use, then on account of the corrosive sublimate I should imagine that synthetic action of the bacteria in the soil as well as decomposition action would be materially interfered with. That would depend upon how long the mercuric chloride was active in the soil after it had killed the maggots. Of course the corrosive sublimate would become inactive within a reasonably short period, its poisonous action being neutralized by its affinity for proteid substances present in the soil, but to what extent its action would interfere with the fertility of the soil I think leaves room for some experimental worker to demonstrate.

SOME CHAPTERS OF THE EARLY HISTORY OF ENTOMOLOGY.

W. Lochhead, Macdonald College, Quebec.

The Beginnings of Entomology.

The beginnings of all sciences are full of interest as they reveal the gropings of earnest seekers after truth. Every natural science has an early stage when the knowledge of nature was extremely limited and clouded with superstition. It has been said that, "All knowledge begins and ends with wonder, but the first wonder is the child of ignorance"; but while wonder and curiosity have been great impulses to the study of that great mysterious world of nature, much of the knowledge of nature has come as the direct result of the experiences of early man in gaining his livelihood. Consequently we must look for the beginnings of Entomology in the practical lore of the hunter, the shepherd and the gardener long before the facts had been collated by the early naturalists.

A few references to insects are made in early writings, locusts, bees and ants being often mentioned by the old Hebrew writers (Exodus 8, Judge 14.14, Proverbs 6, Proverbs 30, Joel 1.4, Joel 2.25, Joel 2.2-10.) and scarabæid beetles sculptured in stone by the old Egyptians. It is very probable that the peoples of some of the ancient civilizations possessed considerable knowledge of natural history, including insects.*

Bee-keeping was a favourite occupation in Palestine, Assyria, Babylon, Carthage, Egypt, Greece and Rome. The Egyptians had even floating apiaries. A hieroglyphic bee has been found sculptured on a Sarcophagus containing the mummy of Mykerinos, King of Lower Egypt, about 3,633 years B.C., no doubt emblematic of the relationship between the King and the people.

Silkworms were cultivated many thousand years ago by the Chinese and the people of India, and the silkworm industry was an agricultural one.

We find also that the Egyptians had a high grade treatise on medicine 1500 years B.C., which must have been based on centuries of observation and practice, and also upon a knowledge of related sciences. However, whatever may have been the accomplishments of these people, no records have been preserved. To the Greeks, therefore, belong the credit of producing the first scientific treatise on natural history.

The first entomologist of whom we have any record was Aristotle (384-322 B.C.) Parts of three of his zoological works viz., *Historia Animalium, De Partibus Animalium,* and *De Generatione Animalium*, have been handed down to us. These reveal the many sided nature of his activities, for he was not only a collector and

*When we reflect that practically all our cultivated plants and domesticated animals are of pre-historic origin, we are obliged to believe that pre-historic man maintained for long ages a high civilization, when skill and labor not only transformed wild life into cultivated fruitfulness and domestic use, but also made progress in the knowledge of the creatures (including insects) that associated with the plants and animals. Recent researches go to show that such an agricultural civilization occupied the Mediterranean Basin from Portugal through Asia Minor and Persia to Korea. Pre-historic cultivation terraces in this district still show how extensive were the plantations in ancient times.

classifier, but also a morphologist and inductive philosopher. He studied the life histories of many insects, he made many dissections and resolved the organs into tissues. His classification of inects, although based largely on external features, remained unimproved for more than 2,000 years, and his generalizations contained the ideas of an evolution from the simplest to the highest organisms in nature.

Concerning his own work Aristotle says: "I found no basis prepared, no models to copy........mine is the first step, and therefore a small one, though worked out with much thought and hard labor. It must be looked at as a first step and judged with indulgence."

Although Aristotle believed in the spontaneous generation of certain insects and other animals that appeared in the processes of putrefaction, his views regarding the generation of the higher animals are expressed in the sentence, "All living creatures, whether they swim, or walk, or fly, and whether they come into the world in the form of an animal, or of an egg, they are engendered in the same way." In fact, Aristotle had very definite even modern views regarding embryology, for he had studied the forming chick in the shell. He might be termed an epigenist, for he believed that "the parts of the future organism do not pre-exist as such, but make their appearance in due order of succession."

It is interesting to note that the methods of Aristotle are those of modern scientific workers, viz., INVESTIGATION BY OBSERVATION AND EXPERIMENT. It required, however, more than 2,000 years for workers to realize the importance of his methods in the study of nature.

Regarding Aristotle's knowledge of insect development and structure it may be said that he knew that there were male and female insects, and that they reproduced sexually. He knew that drone bees develop without fertilization, but he called the "queen" the "king" of the hive. He thought that "nits" do not produce animals, that spiders bring forth live worms instead of eggs, and produce threads of their webs from the external part of their bodies, that caterpillars are produced from cabbages daily, and that many insects rise spontaneously from putrefaction. He believed, too, that all invertebrates were bloodless. He separated the crustacea from insects, and divided the insects into winged and wingless. His sub-divisions were also partly perfectly natural. He considered the larva a prematurely hatched embryo and the pupa as a second egg.

Professor Sundevall estimates that Aristotle indicated and described about 60 species of insects and arachnidans and about 24 species of crustacea and annelids.

Aristotle is said to have written a treatise on bees, but if so, no trace of it has reached us. Columella, however, tells us that the Greeks were proficient bee-keepers. That the Romans practised apiculture is very evident for Virgil devotes the fourth book of the Georgics entirely to a discussion of bees, their habits, economy, and management. Following Aristotle, he calls the queen the king of the hive, and believed that bees originate from decomposing bodies of bullocks (See also Judges 15 for a similar belief).

The Greek poets occasionally refer to insects. For example, Xenarchos says: "Happy is the Cicada, since its wife has no voice."

While Aristotle's knowledge of insects was full of crudities and errors, it must be confessed that he did a large amount of valuable work that has stood the test of time.

After Aristotle, the study of natural history declined and no work appeared until that of Pliny the Elder (23-79 A.D.) the Roman general and historian. His voluminous writings on natural history have been well preserved but they contain nothing new. They are complications of the works of previous writers and include much fable and fancy joined with fact. Pliny's system of classification of animals is inferior to that of Aristotle's, although he adopts the latter's in the case of insects.

After Pliny the study of natural history declined rapidly and no attention was given it for about 1,500 years. Not only during the Dark Ages following the fall of the Roman Empire, but during the Middle Ages the study of nature was thoroughly discouraged as "proceeding from a prying and impious curiosity."

Observation and reason were overthrown by biblical and classical authority and mental activity assumed the form of metaphysical speculation.*

Happily, however, much information was handed down regarding Natural History during these dark centuries in the form of practical lore of the farmer and gardener to which I have already referred, so that when science again showed signs of revival the naturalists had a basis on which to work.

The Revival of Science.

For several centuries bold minds had revolted against the traditional adherence to authority, and in the 15th and 16th centuries, Galileo, Descartes, and Vesalius (1514-1564) working along different branches overthrew the old traditions, and the new movement for the revival of science was fairly launched.

Mention should here be made of some of the investigators of the new era on account of their influence on the pioneer entomologists. Vesalius, a Belgian, studied medicine in Paris and gave much attention to anatomy. His great work "De Humani Corporis Fabrica" is a classic and "created an epoch," as it "overthrew dependence on authority (Galen) and re-established the scientific method of ascertaining truth."

Harvey (1578-1667) was the pioneer physiologist, and his splendid researches on the Circulation of the Blood have earned him a place among the great pioneers of science who questioned and experimented with nature to find out her secrets. Like Aristotle, he considered the larva a prematurely hatched embryo, and the pupa a second egg (*De Generatione Animalium*).

The Great Insect Anatomists.

The impetus given to the study of anatomy by Vesalius produced in the 16th century a large number of workers like Wotton, Gesner, Aldrovandi, and Jonston, who have been called the "encyclopedists" on account of their voluminous writings on many topics.†

---

*This attitude was expressed by Redi about 1668, thus: "Because he's Aristotle, it implies that he must be believed, e'en though he lies."

A curious collection of manuscripts called the "Physiologus" or the "Bestiarius", and produced under theological guidance, formed the main source of information on natural history during these times. The accounts deal with biblical as well as mythical animals, such as the unicorn, dragon, basilisk, and phœnix. Many are represented as symbolical of religious beliefs, and moral reflections are interjected at frequent intervals. Locy says: "The Zoology of the Physiologus was of a much lower grade than any we know about among the ancients."

†Conrad Gesner (1516-1558), a Swiss, was an indefatigable collector, observer and writer. His papers on insects were published after his death by Thomas Moufet, about 1634. Gesner is justly considered as the restorer of natural history. Long lost treasures were again made known and a stimulus was given for further research.

Aldrovandi (1552-1605) described the natural history of insects at great length in seven books. He divided insects into land and water dwellers, and these were subdivided according to the structure of their wings and legs.

The writings of Gesner and Aldrovandi contain many ridiculously improbable statements gathered from ill-attested sources and repeated from the writings of Aristotle and Pliny.

In the 17th century two insect anatomists, Marcello Malpighi (1628-1694) of Italy, and John Swammerdam (1637-1680) of Holland, made large contributions to science. Malpighi's treatise on the *Silkworm,* published in 1669, has become a classic. It was a pioneer work in a new field. The author had the advantage to the new aid to vision, the microscope, which came into use at this time through the ingenuity of Hooke, Malpighi, Swammerdam and Leeuwenhoek. Miall says, "For the first time the dorsal vessel, the tracheal system, the tubular appendages of the stomach, the reproductive organs and the structural changes which accompany transformation were observed." Moreover, he observed and described the nervous system, the urinary tubules (Malpighian) and the silk-forming apparatus.

"This research," says Malpighi, "was extremely laborious and tedious on account of its novelty, as well as the minuteness, fragility and intricacy of the parts which required special manipulation; so that when I had toiled for many months at this incessant and fatiguing task, I was plagued next autumn with fevers and inflammation of the eyes. Nevertheless such was my delight in the work, so many unsuspected wonders of nature revealing themselves to me, that I cannot tell it in words."

Miall says: The last distinct glimpse we got of him is interesting. Dr. Tancred Robinson, writing to John Ray, from Geneva, April 18th, 1684 tells how he met Malpighi at Bologna. They talked of the origin of fossils, and Malpighi could not contain himself about Martin Lister's foolish hypothesis that fossils were sports of nature. "Just as I left Bononia," he continues, "I had a lamentable spectacle of Malpighi's house all in flames, occasioned by the negligence of his old wife. All his pictures, furniture, books, and manuscripts were burnt. I saw him in the very heat of the calamity, and methought I never beheld so much Christian patience and philosophy in any man before; for he comforted his wife, and condoled nothing but the loss of his papers, which are more lamented than the Alexandrian Library, or Bartholine's Bibliothese at Copenhagen."

Swammerdam's researches on the May-Fly and the Honey Bee entitle him to a high place among insect anatomists. He found by dissection that "the queen is the mother of the colony, the drones the males, and the working bees the neuters; but he did not find out that the neuters were only imperfect females" (Miall). Swammerdam's contributions were collected and published after his death by Boerhaave under the title of "Biblia Naturae." The folio edition is a volume of 410 pages of text and 53 plates of excellent drawings. Swammerdam was a more critical observer than Malpighi, as evidenced by his accurate and complete descriptions and anatomical work.

Boerhaave gives us a picture of Swammerdam at work which the reader does not soon forget. "His labors were superhuman. Through the day he observed incessantly, and at night he described and drew what he had seen. By six o'clock in the morning in summer he began to find enough light to enable him to trace the minutiae of natural objects. He was hard at work until noon, in full sunlight, and bareheaded, so as not to obstruct the light; and his head streamed with profuse sweat. His eyes, by reason of the blaze of light and microscopic toil, became so weakened that he could not observe minute objects in the afternoon, though the light was not less bright than in the morning, for his eyes were weary, and could no longer perceive readily" (Miall).

The title of Swammerdam's work is entitled as follows:—

THE BOOK OF NATURE;

OR, THE

HISTORY OF INSECTS:

Reduced to distinct CLASSES, confirmed by particular INSTANCES, Displayed in the Anatomical Analysis of many Species.

and

Illustrated with Copper-Plates

including

The Generation of the Frog, the History of the Ephemerus, the Changes of Flies, Butterflies and Beetles:

with the

Original Discovery of the Milk Vessels of the Cuttlefish, and many other curious Particulars

By John Swammerdam, M.D.

with

The Life of The Author, By Herman Boerhaave, M.D.

Translated from the Dutch and Latin Original Edition,

By Thomas Flloyd.

Revised and Improved by Notes from Réaumur and others,

By John Hill, M.D.

LONDON:

Printed for C. G. Seyfret, Bookseller, in Dean Street, Soho.

MDCCLVIII.

He studied the phenomena of metamorphosis, and showed that the butterfly is contained within the chrysalis, and that the organs of the latter are developed in the caterpillar. He emphasized the point that the various changes do not occur suddenly. He distinguished between metamorphosis and moulting. Moreover, he opposed the idea of spontaneous generation.

The 18th century produced Pierre Lyonnet (1707-1789) of Holland, who surpassed all his predecessors in minute dissection. His memoir on the Goat or Willow Moth, (*Cossus ligniperda*), published in 1750, will always remain a classic of insect anatomy. It contains 18 quarto plates with 137 figures, but the text is mainly a description of the plates. One does not know whether to marvel more at the great patience and manual skill required to make out such detailed dissections, or at his wonderful drawings and plates.

Lyonnet's skill in dissection, however, surpassed his knowledge of anatomy. His great monograph "reveals the lack of insight of a trained anatomist" largely on account of the fact that he did not receive that careful preliminary training in anatomy that his two great predecessors, Malpighi and Swammerdam, received. His contributions to science are confined entirely to matters of anatomy. He showed clearly for the first time what are now known as "imaginal disks" or "histoblosts."

Coming to the 19th century, the names of four anatomists appear on the scroll of fame, viz.: Strauss-Dürckheim, Dufour, Newport and Leydig. The trend of research was gradually changing from a monographic study of a single form to a comparative study of insects, and these with other invertebrate forms, and finally to histological and embryological investigations.

Hercule Strauss-Dürckheim (1790-1865) of France, continued the work of Lyonnet and published in 1828 a most valuable monograph of the Anatomy of the Cockchafer, entitled, "Considérations Générales sur l'Anatomie Comparée des Animaux Articulés, aux quelles on a joint l'Anatomie Descriptive du Melolontha Vulgaris donnée comme example de l'Organization des Coleoptéres." It contained many finely lithographed plates of 109 sketches which compare very favorably with those of Lyonnet. The dissections, however, lack the marvelous details of Lyonnet's work, but his memoir has the merit of broadening the scope of anatomy and of making it comparative.

Leon Dufour, a Frenchman, published between 1831 and 1834 a large number of memoirs on the anatomy and metamorphoses of different families of insects, thus extending the work of Strauss-Dürckheim in the line of comparative anatomy.

Dufour merits attention also because the great Fabre got his inspiration for his life work on reading a volume of Dufour's that came by chance into his hand. It was "the electric impulse that decided his vocation."

Dufour was a disciple of Latreille, and practised as a country doctor. Perhaps his greatest contributions to entomology were along the line of bionomics. He lacked, however, the requisite patience of concentrating his attention for a long period upon a definite object, although he enriched science with a large number of important facts; he was to a large extent unable to interpret them. For example, Legros relates how Fabre had his curiosity aroused when reading Dufour's account of his finding a small metallic Buprestis in the nest of a Cerceris wasp; apparently dead but without any symptoms of decay. To Dufour the Buprestis was dead and he attempted an explanation of the phenomenon. Fabre decided to make observations for himself, and "to his great surprise he discovered how incomplete and insufficiently verified were the observations of the man who was at that time known as the Patriarch of Entomologists."

Newport was the first of the modern type of Entomologists, since he applied for the first time the facts of embryology to insect anatomy. In 1832-34 he published his researches on the modification of the nervous system during the larval, pupal, and adult stages.

Leydig (1821-1908) is thoroughly modern; he broadened the work of Newport by the introduction of histological methods. His great memoir, "The Structure of the Animal Body" was published in 1864.

Great Insect Ecologists

By the term "ecologist" is meant here a student of the habits and life histories of insects. Most of the men whose names have already been mentioned contributed very materially to our knowledge of insect habits, but these contributions were incidental to the study of anatomy.

Francesco Redi, the Florentine scholar, poet, physician and naturalist (1626-1697) did much to shatter the dogma of spontaneous generation which, as we have already seen, had been accepted as the doctrine of the Church, and the scientific world for nearly 2,000 years. Aristotle had accepted the theory to explain the origin of many of the "bloodless" or invertebrate animals, but had excepted the higher animals. Redi proved by experiment that if the flesh of a dead animal were protected carefully from intruding insects no grubs or insects developed in it.

He was not so successful in solving the problem of the generation of parasites and gall insects where he was forced to the conclusion, in spite of contrary convictions, that these insects arose spontaneously. The results of his researches were published in 1668 under the title of "Experiments on the Generation of Insects." His translator says that "The title of the work gives little hint of its varied contents. It is a formal letter grown into a book showing the attitude of seventeenth-century Italians towards their surroundings, and affording a clear insight into their conception of nature. The opinions of priests, philosophers, and poets of the period on natural phenomena of perennial interest, and here set down with grave simplicity, enlivened by occasional humorous comment, and many elaborate quotations from the classics are inserted as proof or refutations of theories advanced."

Among the other interesting topics discussed by Redi are Cherry Fruit Flies, Sheep Bot Flies, and Biting Lice of Birds. Our President, I surmise, will be interested in his description and drawing of the Cherry Fruit Fly. His drawings of the Mallophaga are numerous and suggestive of much close observation. He tells us that he used a microscope furnished with three lenses and made in Rome, and that the drawings were made at his request, by F. Pizzichi.

To the student of the history of biology, the book is a milestone marking the beginning of a great epoch. It records the first, and therefore the most important, statement supported by experimental evidence of that great generalization named by Huxley the Theory of Biogenesis.

It will be noted that Germany lagged behind the other countries of Europe in the study of insects, producing only two writers of any merit. Roesel von Rosenhof (1705-1759), a miniature painter, published "Insecten-Belustigungen" which contains many observations on the habits and metamorphoses of insects. His colored figures and sketches are interesting even at the present time. Frisch, a school teacher, published a number of observations.

Charles Bonnet (1720-1793), acting on the suggestion of Réaumur, demonstrated the sexual reproduction of aphids, but it was Lyonnet who discovered that male aphids appeared towards the end of summer and fertilized the eggs that wintered over.

Francois Huber (1750-1831), the blind Swiss naturalist, has given us much interesting information regarding the habits and economy of the honey-bee. It is said that "out of simple curiosity having undertaken to verify certain experiments of Réaumur's he was so completely fascinated by the subject that it became the object of the rest of his life" (Legros). He made discoveries respecting the impregnation of the queen, the conversion of a worker-larva into a queen by the workers, the origin and elaboration of wax, the nature of propolis, the manner of constructing the cells and combs, and the ventilation of the hives. These discoveries are all the more wonderful when we remember that during the first period of his investigation Huber employed a half-educated assistant to make the necessary observations and experiments. During the middle and later periods of his life his talented wife and his son Pierre acted as his assistants. The latter made contributions of his own on the habits of ants and bees.

One of the first writers to give more attention to general habits and life histories than to structure was Réaumur, (1683-1757). His "Histoire des Insectes" gave a great impetus to the development of the scientific method of research by observation and experiment, and is one of the great entomological classics. Réaumur did not possess the manual skill for dissection or drawing of Lyonnet, Malpighi of Swammerdam, and he had to employ artists to draw for him. He possessed, however, great patience in observation and displayed much ingenuity in his experiments. Besides, his pages show a charm of language which made his volumes popular and gave them a wide reading.

Baron Chas. De Geer (1720-1728) of Sweden, was an anatomist, physiologist, and systematist, and his great memoirs on the "History of Insects" (7 volumes) compare very favorably with those of Réaumur. "A pupil of Linnaeus and a great admirer of Réaumur, he combined the systematic regularity of the one with the experimental skill and patient observation of the other." His works have always been considered a storehouse of important facts, clear descriptions, and enlightened observations. They contain "descriptions of upwards of 1,500 insects, a general history of their manners and metamorphoses and carefully executed engravings filling 238 plates."

Like Réaumur, De Geer was born to wealth, and had immediate command of everything that could help him in his investigations. Compared with Réaumur he was more concise and precise in detailing facts and vastly more methodical. On the other hand he showed less skill in making and recording his observations and experiments.

Great Insect Systematists.

Aristotle, as I have already observed, may be considered the first systematist, and his classification remained practically unchanged until the 17th century, when John Ray (1628-1705) made many important advances, bridging, as it were, the Medievalist and the modern systems. Ray published systematic works on both plants and animals, but his chief contributions were to botany. "He was the first to define the use of the word "species" and to lay emphasis on anatomical characteristics as a basis of classification." In his *Methodus Insectorum* the Arachnida, Crustacea, Myriapoda and Annelida are grouped with the Hexapoda under Insecta.

According to Ray, all similar individuals which show constant characters from generation to generation, or which breed true, form a species.

Carl Linnaeus (1707-1778) was a compatriot of De Geer. He was essentially a systematist. Sachs says: "He might almost be said to have been a classifying, co-ordinating, and subordinating machine." It is hard for us to realize the immense service Linnaeus did for science by the introduction of some system of order among the multitude of living things.

Locy says: "The chief services of Linnaeus to natural science consisted of these three things: bringing into current use the binomial nomenclature, the introduction of terse formulae for descriptions, and fixing attention upon species." The "Species Plantarum" published in 1753 and the tenth edition of the "Systema Naturae" in 1758 are essentially catalogues of the names of the plants and animals arranged in a methodical way. The terms, class, order, genus and species, were established in classification. With the adoption of the binominal methods, "certainty and precision were introduced into the art of description."

Linnaeus' classification of the Insecta is as follows:—

I.—Insects with four wings:	
1. The anterior ones horny.	1. Coleoptera.
2. The anterior ones half horny and half membraneous.	2. Hemiptera.
a. All covered with scales.	
3. The anterior and posterior membranous.	3. Lepidoptera.
b. All naked. The nervures	
* Recticulated.	4. Neuroptera.
** Ramose.	5. Hymenoptera.
II.—Insects with two wings:	6. Diptera.
III.—Insects without wings:	7. Aptera.
1. With six feet, louse, flea and some others.	
2. With more than six feet.	
a. Head connected with thorax (spiders, crabs, etc.).	
b. Head free (centipedes, wood-lice, etc.).	

His *Insecta* corresponds, therefore, to our modern Arthropoda.

De Geer's classification is:—

1.—Insects with wings:
- A.—Gymnoptera.
  - 1. Lepidoptera.
  - 2. Elingula (Ephemerae, etc.).
  - 3. Neuroptera (Libellulae, and other Linnean Neuroptera).
  - 4. Hymenoptera.
  - 5. Siphonata (Aphides and Cicada).
- B.—Vaginata.
  - 6. Dermaptera (bugs and water bugs).
  - 7. Hemiptera (cockroaches and grasshoppers).
  - 8. Coleoptera (beetles).
- C.—Diptera.
  - 9. Halterata (Linnaeus Diptera).
  - 10. Proboscidae (the genus Coccus).

II.—Insects without wings. Aptera:
- D.—Saltatoria.
  - 11. Suctoria (the genus Culex).
- E.—Gressoria.
  - 12. Aucenata (the general Lepisma, Podura, Termes, Pediculus, Recinus).
  - 13. Atrachelia (the spiders and crabs).
  - 14. Crustacea (the Isopoda, Amphipoda, and Myriapoda of Latreille).

Fabricius (1748-1808), a Dane, was born in Schleswig and became a Professor at Kiel. His classification, published in his "Systema Entomologiae" in 1775 followed along a new path, the orders being defined by differences in the mouth-parts. By his system insects far remote were grouped together. His method of using solitary characters did not make for natural grouping.

His classification is as follows:—

I.—Insects with Biting Mouths.

A.—Two pairs of mandibles.	
a. The lower ones having palpi.	
1. Free without covering.	1. Class. Eleutherata (beetles).
2. Covered.	2. " Ulonata (Orthoptera).
3. Connate with labium.	3. " Synistata (Neuroptera).
4. Distended, thin, coriaceous.	4. " Piegata (Hymenoptera).

5. Horny, strongly toothed, labium without palpi.	5. Class. Odonata (Libellulae).
6. All without palpi.	6. " Mitosata (Scolopendra).
B.—A pair of maxillae resembling scissors.	7. " Unogata (scorpions and spiders).
C.—More than two pair of maxillae.	
1. Within the labium.	8. " Polygonata (Isopoda).
2. Outside the lip closing the mouth.	9. " Kleistognatha (short-tailed crabs).
3. Outside the lip but covered by the palpi.	10. " Exochnata (long-tailed crabs).

II.—Insects with Suctorial Mouths.

1. In the mouth a spiral tongue.	11. Class. Glossata (Lepidoptera).
2. In the mouth a horny proboscis, surrounded by jointed sheaths.	12. " Rhyngota (Hemiptera).
3. In the mouths a soft unjointed proboscis.	13. " Antiliata (Diptera).

Summarizing the results briefly one may say that Swammerdam based his classification on *metamorphosis,* Linnaeus on *wings, and* Fabricius on *mouth-parts.*

As already observed the classifications of Linnaeus, De Geer, and Fabricius were based chiefly upon superficial features and not upon deep fundamental characters. The systems were artificial, but convenient for purposes of identification. The natural system was not fully established for another seventy-five years, and was elaborated by Cuvier (1769-1832), Latreille, Lamarck, Leach, Kirby and Spence, Oken and Macleay. The division Aptera had long perplexed systematists. Cuvier proved clearly that the crabs, etc., could not be retained among insects, forming the class Crustacea for them.*

Lamarck removed the spiders, scorpions, etc., constituting the class Arachnida for them, including therein the mites, centipedes, springtails and lice. Latreille,** however, formed the class Myriapoda for the centipedes, the order Thysanura for the springtails and the order Parasita for the lice.

Latreille's ordinal classification is as follows;—

I.—Apiropoda. Condylopes with more than six legs.
- 1. Class. Crustacea.
- 2. " Arachnides.
- 3. " Myriapoda.

II.—Hexapoda. Condylopes with six legs.
- 4. Class. Insecta.

A.—Insects without wings.	
a. Without metamorphosis.	
* With mandibulate organs.	1. Order. Thysanura.
** With suctorial mouths.	2. " Parasita.
b. With perfect metamorphosis.	3. " Siphonaptera.
B.—Insects with wings.	
a. Elytroptera. The anterior wing covers the posterior like a sheath.	
* Mandibulate mouth. Cases horny. Perfect metamorphosis	4. " Coleoptera.
Cases horny, imperfect metamorphosis.	5 " Dermaptera the genus.
Cases coriaceous. Imperfect metamorphosis.	6. " Orthoptera.
** Suctorial mouth.	7. " Hemiptera.
b. Gymnoptera. Wings alike.	
* Four wings.	

---

*It will be recalled that Aristotle separated the Crustacea from the insects as a separate class (Malacostraca).

**Leach first used the term Myriapoda for centipedes and millipedes.

† Mandibulate oral organs at least distinct mandibles.			
Wings with reticulated nervures.	8.	Order.	Neuroptera.
Wings with ramose nervures.	9.	"	Hymenoptera.
†† Suctorial mouth. Mandibles abortive.	10.	"	Lepidoptera.
** Two wings.			
† Two distorted moveable processes on the prothorax.	11.	"	Strepsiptera.
†† Poisers behind the wings.	12.	"	Diptera.

Kirby and Spence's Classification (*Introduction*) is as follows:—

I—Insects with mandibles. Mandibulata.
1. Order. Coleoptera (like Linnaeus and Latreille. Eleutherata, Fab.).
2. " Strepsiptera, Kirb. (Rhiphiptera, Latr.)
3. " Dermaptera, Leach (Family Forficula, Latr.).
4. " Orthoptera (like Latreille, but without Forficula).
5. " Neuroptera (like Linnaeus and Latreille, but without the Trichoptera).
6. " Hymenoptera (like Linnaeus and Latreille).

II.—Insects with suctorial mouths. Haustellata.
7. Order. Hemiptera (like Linnaeus and Latreille).
8. " Trichoptera (Leach).
9. " Lepidoptera (Linnaeus and Latreille).
10. " Diptera (like Linnaeus and Latreille).
11. " Aphaniptera, Kirby (Suctoria, Latr.).
12. " Aptera (all apterous insects breathing through tracheae).
* Hexapoda (Ametabola, Leach, Thysanura, Parasita Latr.).
** Octopoda (Arachnides, Tracheales, Latr.).
*** Polypoda (Myriapoda, Leach, Latr.).

We will note that in the Aptera are included the hexapod spring-tails and lice, the octopod mites, and the polypod centipedes.

McLeay's Classification (*Horae Entomologicae,* 1821) is as follows:—

ANNULOSA:
1. *Crustacea* (according to Latreille).
2. *Arachnida* (according to Latreille).
3. *Ametabola* (Myriapoda, Thysanura, Parasita of Latreille).
4. *Haustellata.*
5. *Mandibulata.*

Ptilota.

Mandibulata	Haustellata.
Larvae with feet, pupae obtectae.	
Trichoptera (Semblodes, Phryganea, etc.)	*Lepidoptera*
Larvae apods, pupae exaratae.	
Hymenoptera	*Diptera*
Larvae varying, pupae free and quiet	
Coleoptera	*Aptera* (Suctoria, Latr.).
Metamorphosis semi-complete, Larvae resembling the imago.	
Orthoptera	*Hemiptera* (Hemip. Heteroptera, Lat.).
Larvae with six feet, metamorphosis varying.	
Neuroptera	*Homoptera* (Hemip. Homopt. Latr.).

THE STUDY OF PARASITISM AND NATURAL METHOD OF CONTROL.

From early times students of insect life have observed that sometimes from caterpillars and their chrysalids there emerge insects that are different from them and that often cause their death. According to Silvestri, Aldrovandi (1602) was the first to observe the exit to the larvæ of *Apanteles glomeratus,* which he thought were eggs, from the common cabbage caterpillar. Later, Redi (1668) recorded the same observation, and others on insects of different species.

Valisnieri (1661-1730) was probably the first to discover the real nature of parasitism. About the nature and work of these parasites he wrote, "If sometimes there are born, (from one insect different ones) they are what I should call false individuals, being born from a different kind of worms which have been deposited there by their mothers, so that they may feed off the real native worm. This is a law ordained in this base world by the Supreme Creator which I have not yet well understood, that the larger always devours the smaller, and is its tyrant, a law which I have constantly observed in all forms of life, winged, four-footed, and aquatic."

Cestoni, a contemporary of Valisnieri, in a letter to him speaks at length about the parasites of *Aphis brassicae, Pieris brassicae,* and finally of Aleyrodes *brassicae.* He calls the insects of this latter species first "butterfly atoms" and then "little cabbage sheep" and their parasites, "wolf-mosquito."

Réaumur, about 1735, and De Geer about 1760, published records of many parasitic forms. About the beginning of the 19th century considerable attention was given to the study of insect parasites by several Zoologists, and many records were published. Ratzeburg's great work on "The Ichneumons of Forest Insects," published about 1850, was for a long time the great classic on the subject. During the last part of the 19th century entomologists of many countries made important contributions so that by the end of the century the literature on the subject was quite voluminous.

Professor Trotter tells us that the first person to divine the importance of parasitism and to apply the principle successfully was Boisgiraud of Poictiers in France. About 1840 he freed the poplars in the suburbs of his town of Gypsy Moth by placing there *Calosoma sycophanta,* and he destroyed forficulids in his own garden by using *Staphylinus oleus.*

These successes seem to have inspired the Milanese in 1843 to offer a medal to be given in 1845 to any person who had in the meantime conducted successful experiments in the artificial breeding of carnivorous insects which may be used advantageously to destroy insects injurious to agriculture. To this appeal Antonio Villa responded in 1844 by a pamphlet entitled: "Carnivorous Insects used to destroy Species Injurious to Agriculture," in which are set forth at length the results of successful experiments carried on by him at Desio in the Province of Milan. In these experiments Carabids and Staphylinids were used. Villa's results were criticized by Bassi, Bellani, and Ratzeburg. The latter said that "Carnivorous insects can be applied to the needs of agriculture only by the beneficent hand of nature and that every effort to assist it must be in vain."

Rondani, a few years later in the sixties, made important studies of insect parasites, chiefly dipterous and hymenoperous forms. In his "Account of Parasitic Insects and their Victims" he shows the importance of these insects in agriculture, and gives a table of parasites known as enemies of injurious insects.

In France, Perris and Decaux carried on valuable experimental work with parasites and predaceous insects in the early seventies.

From that time the U.S. have taken the lead, not only in the study of parasitism but also in economic entomology.

References.

Burmeister, H.	Manual of Entomology, trans. by Shuckard	1836
Greene, E. L.	Carolus Linnaeus, C. Sower & Co.	1912
Henneguy, L. F.	Les Insectes, Masson & Co.........................	1904
Jardine, W.	The Naturalist's Library	1852–3
Kirby and Spence	Introduction to Entomology	1826
Locy, W. A.	Biology and its Makers, Holt & Co.	1908

Miall, L. C. .... The History of Biology, Putnam 1911
Miall and Denny......... The Cockroach, Reeve & Co. 1886
Redi, F. ....Experiments on the Generation of Insects, trans. by M. Bigelow, Open Court Pub. Co. 1909
Swammerdam .... History of Insects, trans. by Thos. Floyd & Hill 1758
Sylvestri, F. .... A Survey of the Actual State of Agricultural Entomology in the United States 1909
Thomson, J. A. .... The Science of Life, Blackie & Son 1899
Westwood, J. O. ....An Introduction to the Modern Classification of Insects, 2 Vols. 1839
Article "Entomology" in Encyclopedia Britannica, XI ed. ....

THE PEAR PSYLLA IN ONTARIO.

W. A. Ross, Dominion Entomological Laboratory, Vineland Station.

The following paper is based largely on insectary and orchard investigations which were conducted at the Dominion Entomological Laboratory at Vineland Station, Ontario, in 1917 and 1918. In the insectary the psylla was bred on pear seedlings grown in flower pots and covered with lantern chimneys.

History and Distribution.

It is believed that the pear psylla (*Psylla pyricola*) was first introduced into North America in 1832 on pear trees imported into Connecticut from Europe. According to Slingerland and Crosby,* the insect is now generally distributed over the Eastern United States as far south as Virginia, and it also occurs in California.

It was first discovered in Canada in 1894 at Freeman, Ont., at which place it was found seriously injuring a block of three hundred Dwarf Duchess pear trees. Since then it has been recorded from other parts of Ontario, from Nova Scotia, and from British Columbia. Professor Lochhead informs me it has never been taken in Quebec.

In British Columbia, according to Mr. R. C. Treherne of the Dominion Entomological Branch, the psylla is present only in the lower Kootenay country where it was first observed in the spring of 1917. As the B.C. form occurs only on apple and as it differs slightly from its Eastern fellow, there is room for doubt, in my mind at least, as to its being *P. pyricola.*

Professor W. H. Brittain, Provincial Entomologist for Nova Scotia, informs me that in that province the pear psylla is injurious in some years and in other years it is very little in evidence.

In Ontario the insect has been taken in the counties bordering Lake Erie and Lake Ontario as far East as Trenton. However, outside of the Niagara and Burlington districts (where it is only too frequently very destructive), it is of comparatively little importance.

Our observations indicate that, in this province at least, the psylla is primarily a pest of the large orchard or of sheltered orchards. For reasons at present not clear to us, conditions in small plantings do not seem to be favorable for its rapid multiplication and in such places it seldom attains destructive proportions.

---

*Manual of Fruit Insects.

Nature of Injury.

The psylla causes injury by extracting with its sucking mouth-parts the sap from the leaves, leaf petioles, fruit stems, and tender wood on which it feeds. On badly infested trees, the continual sapping of the life juices by myriads of insects robs the tree of vitality, dwarfs the fruit, produces brown, dead areas on the leaves (Fig. 14) and, in extreme cases, causes the foliage to drop prematurely. Trees seriously weakened by this pest are especially susceptible to winter injury and in a hard winter like that of 1917-18 readily succumb to low temperatures.

Large quantities of a sweet sticky liquid called honey-dew are excreted by the psyllas, and on attacked trees the foliage, fruit, twigs and branches may be covered with this sticky material and with a sooty fungus which grows in it. (Fig. 15). This coating of honeydew and sooty fungus not only makes the trees and fruit very unsightly but it is very probable that it is also detrimental to the physiological functions of the leaves.

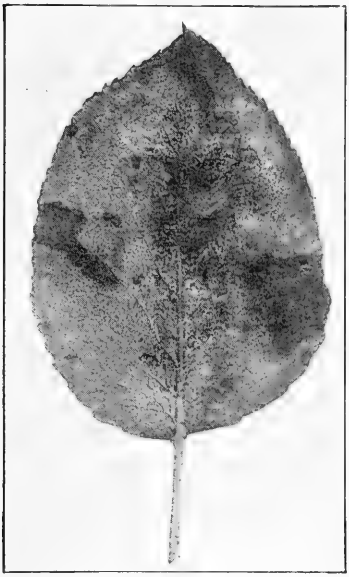


Fig. 14.—Leaf injury caused by pear psylla.

Fig. 15.—Leaves showing honey-dew fungus and nymphs.

Life History.

Summary.

The winter is passed in the adult stage. The adults hibernate under the rough bark on the trunks and main limbs, and under grass, leaves and rubbish near the infested pear trees. In late March or early April the insects leave their winter quarters, congregate on the twigs and fruit spurs and in a short time, provided the weather remains propitious, commence to lay eggs. Oviposition may continue until about the time the petals drop; however, the vast majority of the eggs are laid by the time the fruit buds have burst. The eggs are deposited on the twigs, fruit spurs and smaller branches, chiefly on the under surface. They commence to hatch when the fruit buds are beginning to break, and nearly all have hatched by the time the petals drop. The period of incubation varies, according to the temperature, from 8 to 32 days, the average being about three weeks. The newly hatched nymphs migrate to the opening buds where they feed chiefly on the petioles and blossom stems. They grow rapidly and after moulting five times reach the adult stage in about one month. This first brood is then succeeded by three other broods, and the life cycle is finally completed in the fall by the appearance of the winter adults—the hibernating forms.

The Egg.

Description: The egg (Fig. 18) is sub-oval, blunt at the base and pointed at the apex. In colour it is creamy or pale yellowish with orange at the base. In length it varies from .315 mm. to .340 mm.

The egg is attached to leaf or bark by a short stalk projecting from near the basal end, and at the apex there is a long hair-like filament.

Fig. 16.—Showing eggs along midrib of leaf. (Much enlarged.)

Fig. 17.—First generation eggs laid on bark. (Much enlarged.)

Location of Eggs: The overwintering females deposit their eggs on the twigs, fruit spurs and smaller branches, chiefly on the under surface. (Fig. 16). After the buds have burst, belated females may be found laying their eggs on the young leaves.

The eggs of the summer forms are laid principally on the leaves, singly or in clusters, along the midrib (Fig. 17). They also may be found on the leaf petioles and shoots.

Period of Incubation: In the case of first generation eggs, i.e., eggs laid by overwintering females, the period of incubation was determined in 1917 from a study of 21 batches of eggs deposited at various dates from April 14th to June 9th. The average period was about 20 days, the maximum and minimum being respectively 32 and 8 days. The average duration of the egg stage in April was 26 days, in May 19 days, and in early June 11 days. (See Table No. 1).

TABLE No. 1.

Year.	Duration of Incubation of 1st Generation Eggs.				
	Date of Deposition.	Number of Lots.	Maximum Duration.	Minimum Duration.	Average Duration.
			Days	Days	Days
1917	April 14–22	8	32	23	26
1917	May 2–29	9	28	11	19
1917	June 3–9	4	13	8	11

In experiments with 40 lots of 2nd, 3rd and 4th generation eggs, the average duration of the egg stage proved to be 11½ days in June, 7½ days in July, 10 days in August, and 12½ days in September. (See Table No. 2).

TABLE No. 2.

Year.	Duration of Incubation of 2nd, 3rd and 4th Generation Eggs.					
	Date of Deposition.	Generation.	Number of Lots.	Maximum Duration.	Minimum Duration.	Average Duration.
				Days	Days.	Days
1917	June 19–29	2nd	5	15	8	11
1918	June 8–12	2nd	3	14	10	12
Average	June 8–29	2nd	8	15	8	11½
1917	July 3–31	2nd, 3rd	10	12	4	7
1918	July 9–26	2nd, 3rd	5	10	6	8
Average	July 3–31	2nd, 3rd	15	12	4	7½
1917	Aug. 3–27	2nd, 3rd	10	15	6	10
1918	Aug. 15–26	3rd, 4th	3	11	9	10
Average	Aug. 3–27	2nd, 3rd, 4th	13	15	6	10
1917	Sept. 5	3rd	1	14	12	13
1918	Sept. 1–17	4th	3	23	6	12
Average	Sept. 1–17	3rd, 4th	4	23	6	12½

The Nymph.

Description: 1st instar. Oval and very flat in shape. Antennae translucent with dusky tips. Eyes reddish. Head pale yellow with a narrow median line of cream. Thorax pale yellow. Abdomen yellowish with lunule of deep orange. Legs translucent, dusky tarsi. Length .36 mm.

2nd instar. Similar to the 1st. Length .54 mm.

3rd instar. Similar to the 1st. Wing-pads apparent. Length .72 mm. to 8 mm.

4th instar. Similar to the 5th. Length .9 mm. to 1.08 mm.

5th instar. Oval and very flat in shape. Antennae light brown with dark brown tips. Eyes reddish. Head dark brown with a longitudinal median line of creamy grey. Thorax creamy grey blotched with red, with dark brown markings arranged as in illustration; wing-pads dark brown. Abdomen: anterior third creamy grey with three dark brown transverse bands interrupted in the middle, posterior two-thirds dark brown. Length 1.44 to 1.62 mm. (Fig. 18).

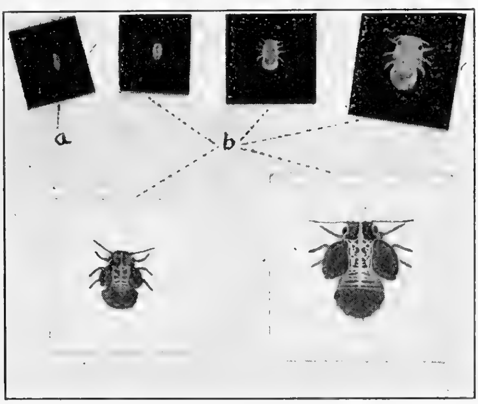


Fig. 18.—"*a*" Egg; "*b*." Various stages of psylla nymphs. (All much enlarged.)

Habits: Upon hatching out in the spring, the nymphs of the first generation migrate to the opening buds where they feed principally on the leaf petioles and blossom stems. The nymphs of the later generations are found chiefly on the upper and under side of the foliage. They also occur to some extent on the tender wood, especially in the fall.

The nymphs secrete copious quantities of honeydew, and, as a general rule, are enveloped by this liquid. According to our observations, the nymphs of the first generation secrete less honeydew than those of the succeeding broods.

Molting: The nymph molts five times, attaining the adult stage after the fifth molt. In experiments with 39 individuals the average duration of each instar was: 1st instar 6 days; 2nd instar 6 days; 3rd instar 6 days; 4th instar 6 days; 5th instar 8 days.

Length of Nymphal Life: In experiments conducted with 192 individuals of the 1st generation, the duration of the nymphal stage varied from 20 to 35 days with an average of 28 days.

Further data on the duration of the nymphal stage of summer and winter forms are presented in Tables No. 3 and 4.

TABLE No. 3.

Year.	Length of Nymphal Life of Summer Forms.					
	Date of Hatching.	Generation.	Number of Individuals.	Duration.		
				Max.	Min.	Aver.
				days	days	days
1917	May 11-31	1st	71	35	24	30
1917	June 5-30	1st, 2nd	40	24	19	21
1918	June 18-24	2nd	10	27	21	25½
Average	June 5-30	1st, 2nd	50	27	19	23
1917	July 3-30	2nd	143	25	11	17
1918	July 26-29	3rd	8	27	12	22½
Average	July 3-30	2nd, 3rd	151	27	11	20
1917	Aug. 4-5	2nd	11	27	19	23

TABLE No. 4.

Year.	Length of Nymphal Life of Overwintering Forms.					
	Date of Hatching.	Generation.	Number of Individuals.	Duration.		
				Max.	Min.	Aver.
				days	days	days
1917	Aug. 19	2nd	6	26	21	23½
1917	Aug. 1-30	3rd	22	55	29	38
1918	Aug. 26-31	4th	11	51	30	43
Average	Aug. 1-31	3rd, 4th	33	55	29	40½
1917	Sept. 1-8	3rd	5	61	51	58

The Summer Adult.

The summer adult commences to appear a short time after the pear blossoms fall, and from then until early autumn it is always present.

Description: The adult (Fig. 18) is a tiny four-winged insect bearing a striking resemblance to a Cicada in miniature. The transparent wings slope roof-like over the abdomen, and the legs are adapted for jumping. The differences in the external appearance of the male and female are shown in Fig. 21. The female is about 2 mm. in length and the male about 1.8 mm.

Colour notes: Predominating colour red. Antennae yellowish brown; 1, 11 reddish; tips black. Head crimson, mesal suture and a spot on either side black. Eyes dark red. Thorax crimson with black markings. Abdomen crimson with five black transverse bands. Legs pale yellowish brown. Front wings faintly clouded with yellow, veins pale yellowish brown, hind wings transparent.

Mating Habits: The female mates several times, and the male is polygamous.

In copulating, the male gets along side the female on her right side, lifts his left wing to some extent, grasps the upper genital plate with his claspers and inserts the penis.

Preoviposition Period of Female: The average preoviposition period of confined females was 4 days in 1917 and 6 days in 1918, the minimum and maximum for both seasons being 3 days and 9 days respectively.

Reproductive Capacity of Female: According to our observations, one female may lay from 1 to 61 eggs per day.

Fig. 19.—Adult pear psylla. (Much enlarged.)

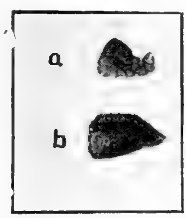


Fig. 20.—Abdomen of "*a*" male, and "*b*" female pear psylla. (Much enlarged.)

In our experiments the maximum production per insect was 695 eggs and the minimum 65 eggs. (See Table No. 5).

TABLE No. 5.

Showing Comparative Reproductive Capacity of Summer and Overwintering Females.

Year.	Generation (Summer).	Number of Couples used.	Egg Laying Period.	Reproductive Capacity of Female.		
				Max.	Min.	Aver.
				Eggs	Eggs	Eggs
1917..................	1st	7	June 19—Aug. 14.	671	427	540
1918..................	1st	5	June 7—July 25.	695	459	625
Average	1st	12	June 7—Aug. 14.	695	427	582
1917..................	2nd	10	July 23—Sept. 4.	684	65	343
1918..................	2nd	5	July 18—Sept. 10.	636	258	456
Average	2nd	15	July 18—Sept. 10.	684	65	399
1918..................	3rd	5	Aug. 15—Oct. 5.	285	86	190
1917..................	Winter	4	April 12—June 13.	448	121	279

Reproductive Period of Female: The average reproductive period of 17 females in 1917 was about 30 days and in 1918 with 15 individuals it was 36 days, the maximum and minimum for both seasons being respectively 63 days and 16 days.

Length of Adult Life: Our observations indicate that the average length of life of the male is about 5 weeks and that of the female a few days longer.

The Overwintering Adult.

Description: The overwintering adult can be readily distinguished from the summer adult by its larger size, darker coloration, and by its transparent front wings. The predominating colour of this form is black or dark brown. The female is about 2.43 mm. in length and the male about 2.16 mm.

Habits: In September, with the coming of autumn, the overwintering forms commence to appear, and their production is continued until the close of the season. They feed to some extent but do not mate or lay eggs. During the winter they hibernate chiefly beneath the rough bark of the trunks and main limbs and also under grass, leaves and rubbish near the infested pear trees. In late March of early April, with the coming of warmer weather, they leave their winter quarters, congregate on the twigs and fruit spurs chiefly in the lower central portions of the trees, and in a short time, provided the weather remains propitious, they mate and commence to lay eggs. They die off rapidly in spring, and by the time the fruit buds have burst comparatively few of them are left on the trees. A few stragglers survive until after the blossoms have fallen.

Egg Laying Period: The females usually commence to oviposit early in April, and, by the time the fruit buds have burst, most of the eggs have been laid. Belated individuals continue to oviposit up to the falling of the petals in late May or early June.

Reproductive Capacity of Female: In an experiment with 4 couples, the egg production per female varied from 121 eggs to 448 eggs, with an average of 279 eggs. Each female laid from 1 egg to 48 eggs per day.

Number of Generations.

In our insectary studies we obtained a maximum of four from the earliest laid eggs and a minimum of two generations from the last laid eggs. This would indicate, at least theoretically, that in the Niagara district there are two complete generations, a very large third generation and a small fourth generation.

Control.

Natural Control.

Several species of insects, notably ladybird beetles, attack the psylla and check its rapid multiplication to some extent. However, undoubtedly the most important control agency afforded by nature is the weather. Our observations indicate that protracted periods of cold, wet weather in spring may be disastrous to the eggs and newly hatched young. Hodgkiss records the destruction of hibernating forms in spring by ice storms, heavy washing rains, and sudden changes in temperature. Professor Brittain, in a letter dated September 23rd 1918, reports a great diminution of the psylla in Nova Scotia, which he thinks was caused by the hard winter of 1917-18. Long spells of hot, dry weather also appear to be fatal to many psyllas chiefly, we think, because such weather renders much of the foliage hard and dry and therefore unsuitable for the development of nymphs.

Artificial Control.

The fact that a combination of the delayed dormant spray of lime sulphur and the post blossom application of nicotine extract will control the psylla was demonstrated this year in a twelve-acre orchard of Bartlett, Duchess, Anjou and Flemish Beauty pears near Beamsville. This orchard had been subject to serious psylla injury for a number of years and last year it was very heavily infested. This spring myriads of hibernating adults were found in it on the twigs and branches and a very large deposition of eggs was made.

The dormant spray of lime sulphur (winter strength) was delayed until shortly before the blossoms opened (Fig. 21) and it was then applied with great thoroughness, care being taken to coat every part of the tree. At this stage, the

Fig. 21.—Showing stage of fruit bud development at the time of first application.

Fig. 22.—Blossoms fallen; time of second application.

vast majority of the eggs had been deposited and many of the earliest laid eggs had hatched. After the blossoms fell (Fig. 22), the trees were again thoroughly sprayed with lime sulphur and arsenate of lead (for scab and codling worm) and Black Leaf 40, ¾ pt. to 80 gals. of spray mixture, the latter of course being added to destroy the psylla nymphs. At this stage an odd winter adult and a very few belated eggs were still present on the trees.

Results: About two weeks after the delayed dormant spray was applied, an examination of the orchard was made and it was observed that although the vast bulk of the eggs and recently hatched nymphs had been destroyed, too many nymphs were still present. In other words, we found that the spray for the eggs would not by itself give us satisfactory control. The orchard was frequently inspected after the post blossom application and up to the time the Flemish Beauty pears were picked the trees were found to be practically free of psylla. Early in July, we examined trees situated in different parts of the orchard and on as much of the tree as could be conveniently looked over, we found from two to nine psyllas per tree. At the end of August, the orchard was still practically free of psylla, the foilage was abundant and healthy green in colour, whereas in our check orchard the trees were heavily infested, all the foliage was spotted with brown and some of it was dead. The last examination of the treated orchard was made in late October and rather to our surprise, we found that the insect had increased to quite an extent and that the winter adults were fairly common.

Conclusions: Our results this year show that although the two applications will not eradicate the psylla, they will reduce it to insignificant proportions. To obtain absolute control, it seems to us in the light of our present knowledge, that it would be necessary to spray with nicotine extract two to three weeks after the calyx application in order to destroy the nymphs derived from belated eggs.

PROF. PARROTT: Pear Psylla is next to Blight the worst pest we have to contend with in the upkeep of our pear plantings, and the experience of Mr. Ross in the control of the insect resembles a great many of our experiences. Control varies with seasonal conditions, and the numbers of females that hang over to take part in the spring oviposition. It takes two sprays to give good commercial control. A great many experiments have been carried on both by the Station and by spraying experts and some years results have been almost perfect and in other years or in other experiments the results have not been so satisfactory.

MR. ROSS: I should like to ask Prof. Parrott if he can explain why the Pear Psylla never seems to be troublesome in small plantings.

PROF. PARROTT: I cannot explain it any more than I can understand why roadside trees are so free from it. I think it likes sheltered, and undisturbed areas in an orchard. As to what influences it I do not know.

CONTROL OF THE APPLE MAGGOT.

L. CAESAR AND W. A. ROSS.

A full account of all our tests of control measures against the Apple Maggot would require too long an article; hence we shall give only the outstanding points of interest and value.

In 1911 and 1912 the destruction of the fallen fruit was tested in a small, isolated, badly infested orchard, and gave fairly satisfactory results, but the labor involved was so great that it was seen that not many fruit growers could or would adopt the method and in many cases live stock could not be used for the purpose.

In 1913 we tried sweetened poison sprays on individual trees or groups of trees in the orchards and found that though the number of infested fruits compared with those on some of the checks was lessened yet the results were not satisfactory.

In 1914 believing that a larger continuous area should be sprayed we gave two applications of arsenate of lead and molasses to a 25 acre orchard at Mountain and left a narrow strip of about 2 acres along the east side as a check. Both check and sprayed portion had been badly infested the previous year and much of the fruit had been left on the ground.

RESULT: In the whole orchard, after an examination in September by both writers, less than a dozen infested apples were found. This no doubt would look like a case of natural control and in no way due to spraying; but such was not the case, because examination of the trees soon after the first application and again during the second showed that, though the flies were not abundant yet sufficient were present to have punctured numerous apples even though the percentage thus injured might not have been high. Moreover, the season was very dry and the owner had sprayed the whole orchard, check and all, very heavily for Codling Moth. Much of this spray was still on the check trees at the time of the first application to the rest of the orchard. This together with the narrow width of the check strip and its closeness to the sprayed trees was sufficient to account for the destruction of the flies on the check.

In 1915 we sprayed a small orchard in Simcoe village, near which were other infested trees. The season was wet and seven applications were given, but in spite of these approximately 60 per cent. of the Tolmans, 20 per cent. of the Snows and 15 per cent of the Spies were punctured. These results showed that one could not hope to control the pest by spraying in a town without treating all trees for many rods on every side; especially would this be true if there were high winds to help in the dispersal of the insects.

We also sprayed in 1915 all of a small, isolated orchard at Villa Nova, which had been badly infested the previous year and most of the fruit of which had been left on the ground.

Result: Though the crop was very light, thus making it harder to protect, and though only two applications were given, which certainly were not sufficient for so wet a season, approximately only 12 per cent. of the fruit was infested; which was very encouraging.

In 1916 we sprayed with the sweetened poison two adjoining orchards on one side of the road at Lyn, near Brockville, and left another orchard about twenty-five rods away as a check. There was a hedge and also a house and barn situated between this orchard and the sprayed ones. On the opposite side of the road we sprayed a third orchard and left a check adjoining it and in the same direction as the other check. Two sprays were given. Many flies were seen in the sprayed orchards after the first spray and some during it.

Result: The two first-mentioned orchards had 95 per cent. or more of the fruit, including such susceptible varieties as Tolman, Wealthy and Snow, free from punctures, though most of the fruit the previous year had been so badly infested it was left on the ground to rot. The orchard on the opposite side of the road was not so clean, some of the Tolmans having as high as 25 per cent. of punctured apples, though most of these apples had only one or two punctures. The check orchards on both sides of the road showed that the Tolman, Snow, Wealthy and St. Lawrence, had from 75 per cent. to 95 per cent. of punctured apples, most of the apples having many punctures.

In 1917 we sprayed these same three orchards again, and to protect the one in which the results had not been quite satisfactory we sprayed a buffer area of about fifteen rods between it and the check.

Result: No punctures were found even on Snow, Alexander or Tolman, in the orchard farthest from the check. In the second orchard on this side of the road punctures were found on only one tree in the extreme north corner. The third orchard, the one on which there had been 25 per cent. of punctured Tolmans the previous year, was this year almost totally free from punctures, less than two score being found in the whole orchard. In the check orchards Snow, Wealthy and St. Lawrence and a heavily laden wild apple tree had almost every apple punctured. There was practically no crop on the Tolmans in the check orchard this year.

In this same year (1917) we also sprayed a small, old orchard north of Trenton, which had been badly infested the previous year. The results here, too, were very satisfactory, only a very few apples being punctured, and nearly all of these on trees situated at some distance from the main orchard and near two trees that had received only one partial spraying.

In the fall of 1917 we found the worst infested apple orchard that we had yet seen. It consisted of nearly three hundred trees, including Snow, Wealthy, Tolman, Belleflower, Ben Davis and half a dozen other varieties. There had been a good crop, which if clean should have been worth $1,000 at least, but every apple that we could find on any variety was punctured by the insect and nearly all of them so badly punctured as to be conspicuously deformed. We therefore decided to make this orchard our final test. In 1918 it was given the regular sprayings for Apple Scab and Codling Moth, and then two extra fairly heavy applications for the Apple Maggot, the first of these being on the 12th and 13th of July and the next the first week in August. Orchards close by were sprayed to act as buffer orchards.

Results: The whole orchard was beautifully free from Scab and Codling Moth, and the effect upon the Apple Maggot was a clear demonstration of the power of poison sprays to control this pest: for instead of 100 per cent. of punctured fruit there was less than 5 per cent. Apple buyers, fruit growers and everybody who visited the orchard this year and had seen it last year were convinced that our method was as nearly perfect as anyone could hope for. There is no doubt at all that without the spraying the crop would have been ruined by the Apple Maggot, for one of the writers visited the orchard every few days from the time the flies began to emerge up to the end of July, and saw that they were very abundant. It was no trouble to capture twenty or more on a single tree in an hour even without a net. Moreover, a neighbouring orchard used as a check but so situated as not to endanger our test orchard was also visited frequently to see how many flies were present. (This orchard had not been badly infested the previous year and the fruit on it had been sold.) Eight or ten flies was the largest number seen on any one day: yet at the end of the season the Snows, Wealthy, Ben Davis and Phoenix in this orchard had 75 per cent. of the fruit infested, in fact so bad was the fruit that the chief apple buyer of the district, who had bought the fruit on the test orchard, absolutely refused to buy the crop on the check, declaring that it was worthless. It may be of value to note that though so many flies were seen in the sprayed orchard yet at no time were they observed copulating or ovipositing, whereas in the check orchard oviposition was observed on several occasions and egg punctures could be readily found before the end of July. No egg punctures were visible in the sprayed orchard at this date or at the time of the second spraying, all having evidently been made much later.

Conclusions.

The results of our field tests conducted in various parts of Ontario and spread over five consecutive years and corroborated by laboratory tests justify us, we believe, in stating confidently that the Apple Maggot can be successfully controlled in apple orchards by spraying.

The first application should be given just before or as the adults begin to emerge, which in the south-western part of the Province is about the last week in June, and in the parts with a somewhat colder climate such as Guelph, Stratford and the district all along Lake Ontario, about the first week of July, and in the still colder parts such as Ottawa and the St. Lawrence River valley about the second week in July.

The second application should be made when the first has begun to disappear or usually in from two to three weeks. In wet seasons like the summer of 1915, a third application about ten days after the second will be necessary. Two years should almost completely destroy the insect in any orchard provided that infested orchards are not situated close by. In such case every effort should be made to have these treated also.

In all orchards every tree whether bearing fruit or not should be sprayed, because the adults often frequent such trees until egg laying begins.

As to the mixture to use, in 1914, 1915, and 1916 we used molasses along with arsenate of lead, but in 1917 and 1918 omitted the molasses and found that the results were equally good. This is fortunate, for molasses tends to cause the spray to wash off more quickly, sometimes burns the foliage, adds to the cost, and may cause complaints from beekeepers, though these complaints are not justified. We therefore recommend the use of from two to three pounds of the paste form or one to one and a half pounds of the powder form of arsenate of lead to forty gallons of water. We believe that heavy rather than light applications of the mixture should be made, especially if only two are given, because adults continue to emerge for a period of six weeks or more, and so the poison must remain on the trees to kill them before they can lay their eggs. Heavy applications remain on longer than light.

OUR GARDEN SLUGS.

Geo. Maheux, Quebec.

It is only during about the past thirty years that the Mollusks of the Province of Quebec have attracted the attention of naturalists and have been the object of their studies. As long as they remained inoffensive, or nearly so, they were objects of interest only to amateurs, on account of their strange forms, some presenting the richest of garments, of admirable color and composition, while others are of a viscous and almost repulsive nakedness. The day these *Mollusca Gasteropoda* came to feed in our vegetable gardens their economical stature changed hastily and the extent of their havoc soon necessitated the interference of zoologists. Of course, the first thing was to acquaint oneself with the species composing this branch of invertebrates; specialists devoted themselves to this study and systematic treatises were soon published; and from this departure, experimentalists endeavored to discover an efficient remedy against these new ravagers.

In 1890, very few text-books bearing on this subject were in existence, except, perhaps, the Manual of Conchology of Tryon, then published by Mr. Pilsbury, of Philadelphia, and a few other works of smaller importance. The following year (1891) our great Canadian naturalist, Abbé Provancher, published a new part of his Canadian Fauna, an illustrated book of over 150 pages, under the title of: "Les Mollusques de la Province de Quebec," Part I; Pteropoda, Cephalopoda and Gasteropoda. Provancher had been, for a long time, collecting specimens of these animals. From his book entitled: "Voyage aux Antilles," we can see that he was taking a great interest in this study and that he then made a large gathering of remarkable shells.

In our days, conchologists are rather numerous and with them the science of mollusks has enormously advanced. However, those who are interested in economic zoology, in the relations of beasts with cultivated plants particularly, still have much to learn as regards their habits, the noxiousness and the destructive work of our garden slugs.

The summer of 1918 seems to have been very propitious to observers and experimentalists. Slugs have increased in number in 12 months and their destructive work has developed. Many "war gardens" in the vicinity of Quebec have had to stand the attacks of these destroyers, usually unknown to average people, in this capacity at least. We might say that we have very often seen considerable damage: amateur gardeners were so much the more puzzled because they could not see the culprit at work. The ordinary species found in our gardens are: *Limax campestris, L. agrestis, L. maximus.*

The three of them seem to operate in the same manner. Everywhere they have injured several kinds of vegetables, never all at a time but rather one after the other. Is this a question of inclination, of caprice, of instinct or hazard? All hypotheses are allowed, and each of these agents probably has some influence upon the work, the choice of the beast.

The following is the order followed by the slugs and the vegetables they successively infested:

1. *Beans.*—The first vegetable infested everywhere, the slug only changing its food when this first plant has become inadequate.

2. *Peas.*—The relationship between beans and peas no doubt explains this transition and the appetite of the ravager.

3. *Turnips.*—After leaving peas, slugs spend most of the summer on turnip leaves, into which they cut large holes, with different contours.

4. *Cabbages and Cauliflowers.*—These crucifers equally attract slugs. At first, they are only seen on turnips, then upon all of them simultaneously.

5. *Pumpkins.*—Towards the end of the season, when the pumpkin has assumed a good round shape and is swelled with juice, the slug penetrates into the pulp and bores holes often as much as two inches deep.

Authors have noted the preference of slugs for cucumbers. For one reason or another, their presence upon this plant has nowhere been noticed by us, although, in most cases, the latter were close neighbors to turnips thoroughly infested by slugs.

The places they like best are gardens with a damp soil, naturally wet or kept in that condition artificially.

The slug does not only eat the plants at night; the weather seems to direct its line of conduct. We have seen slugs at work at night, after its coolness began to be felt; this is evidently the most common habit. The darkness of the night, however, is not indispensable to the coming out of these animals. They willingly show up when it is raining; if the sky is cloudy and the humidity of the air high, they will sometimes be seen upon the leaves. Their presence can even be noticed in the daytime, when the sun is shining brightly, on parts of vegetables that are well shaded and where the moisture will easily be retained, as, for instance, between rows of peas that have grown high and thick. It seems that the only factor essential to their activity is moisture and the absence of a bright light. Moreover, this is very easy to ascertain by a simple experiment; if vegetables are watered at the close of day, they come out almost immediately and much earlier than usual.

The damage done by the slug varies with the various plants on which it feeds, according to their age and consistency. Amongst the vegetables above mentioned, it is obvious that the youngest are the most badly infested.

Thus, beans had only grown three or four leaves when slugs started eating them up; after 8 or 10 days a dried stem was all that was left. It resulted that 50 per cent. of the plants did not bear any crop and 25 per cent. of the remainder only yielded one-third or one-half of the normal crop; one-fourth only was left intact or at least strong enough to bloom normally and yield accordingly. In a field where there were several varieties, the Burpee beans were completely cut down.

The crop of peas has only suffered a small diminution. When slugs launched an attack upon their stems, they were already nearing ripeness and had attained a remarkable degree of resistance. There has been a loss of a few leaves and pods, or a total loss of about 2 per cent.

Of the crucifers, cauliflowers are the only ones that seem to have been injured, and then only when the slugs were successful in penetrating into the fruit. Finally, in the case of pumpkins, there still remained the expedient of removing the injured part, the sides of the hole bored by the slug.

Control.—The following substances were used: Paris green, arsenate of lead, Bordeaux mixture, quicklime (powder).

The first two insecticides only gave poor results; they did not seem to diminish the number of slugs in an appreciable degree.

Bordeaux mixture containing 6 lbs. of lime to 4 lbs. of bluestone makes slugs uneasy, kills a few of them slowly, but does not constitute an efficient means of destruction.

Quicklime has done wonderfully well. It has been dusted on the infested plants, in the following way:

1. At night, before slugs appear; in order that the success be complete, it is important that all issues leading to the plant be closed to the slug, which is not always an easy task.

2. At night, when the slugs are feeding upon the foliage. In this way the best results are achieved. If we can apply lime to come into close contact with the skin of the slug, the latter will die rapidly. The following morning, their inert bodies, reduced by one-half, of a dark green color, are still sticking to the leaves.

3. Applied during the day, lime loses its efficiency, because the coolness of the night lessens its strength.

As a rule, dusted lime retains its destructive power, in whole or in part, as long as it does not rain; it is excellent in a fresh condition. A small particle of lime is then sufficient to kill a slug. We have watched the doings of 12 slugs placed on a board and surrounded by a wall of lime, one-quarter of an inch in height. Not a single one was successful in getting over the obstacle; as soon as they came into contact with lime, they twisted convulsively and died in the space of 2 to 60 minutes, according as the injured part was more or less great or sensible. Secretions very abundant at first, soon become nil, coinciding with the complete absence of movement.

It would be very difficult to find a more energetic remedy and of easier application. By repeating the dusting of lime, particularly at night, these destroyers will soon be controlled.

Several other remedies are, however, to be found. In reading I happened to come across several of them, a few of which are herewith described to bring this study to an end, and thinking that it might interest you.

In his book, "Recettes et Procédés," Tissandier recommends the following mixture, spread on the ground.

Caustic soda	40 gr.
Quicklime	960 gr.

Bellet in "Les meilleures Recettes" say that in order to destroy slugs, it is sufficient to spray the spots visited by these parasites, with a solution of 600 grammes of carbonate of soda dissolved in one litre of water.

Mr. Anadyx surrounds the stem of vegetables with a border of old newspapers and slugs disappear. ("La Nature," 1904.)

Mr. Noel, of the Rouen laboratory of agricultural entomology, after several tests, states that the most efficient destructive agent is copper arsenite. He prepares it in the following manner: He mixes 1 kilogram of coarse wheat bran, 100 grammes of copper arsenite and about 250 cubic centimetres of water. When the whole has assumed the form of a consistent paste, little balls are made and distributed on the ground where slugs are expected to be found. After one week, they will practically all have disappeared. (La Nature, 1910.)

In order to attract slugs, Mr. Hardys covers cabbage leaves with rancid butter and places them here and there in the garden; the next morning they are thoroughly covered with slugs which are then easily destroyed.

Finally, if the chickens are allowed in the garden, they can render valuable services, but they must not be given dead slugs as food; they should be burnt and buried deep.

We did not have the necessary time to try all these remedies; but we place them before you for consideration. No doubt several experimentalists in this assembly will want to give them a trial. The result of their experiments will certainly be both useful and interesting.

THE ENTOMOLOGICAL RECORD, 1918.

Arthur Gibson, Entomological Branch, Department of Agriculture, Ottawa.

The Record for 1918, as will be seen, presents data regarding distribution chiefly in the orders Lepidoptera, Coleoptera, and Diptera. No extensive collections, so far as I know, have recently been made in the less known orders.

During 1918 the insects collected by members of the Canadian Arctic Expedition during the years 1913-1916, have been worked over by various specialists, and it is hoped the results of these studies will soon be available in published form. These reports will make a valuable addition to our knowledge of the insects of Arctic Canada.

As in other years, students of insects in Canada have received much assistance from various specialists, chiefly those resident in the United States. The list of these specialists is every year assuming greater length, and it therefore becomes difficult to specially mention any of our good friends to the South. All who have assisted us in our systematic studies have our grateful thanks.

Literature.

Among the books, memoirs, etc., which have appeared during 1918, of interest to Canadian students, the following may be mentioned:

Barnes, W., and McDunnough, J. Life-histories of North American Species of the genus Catocala; Bull. Amer. Mus. Nat. Hist., XXXVIII, Art. V, pp. 147-177, March 21, 1918. This paper, which was published in anticipation of the "Illustrations of the North American Species of the Genus Catocala," will be valued by those doing life-history work. The ova of a number of the species described were received from Canada, and for this reason the paper is of much interest to our workers.

Barnes, W., and McDunnough, J. Illustrations of the North American Species of the Genus Catocala, by Wm. Beutenmuller, with additional Plates and Text. Memoirs of the Amer. Mus. Nat. History, New Series, Vol. III, Part I, October, 1918. This most excellent memoir was received with much pleasure. We had long known that Mr. Beutenmuller had contemplated such a work and it was fortunate that Messrs. Barnes and McDunnough had his manuscript and some of the plates before them. Pages 1 to 47 are given up to the text. Under each species references to the literature are given, as well as notes on the synonomy and distribution. Under each section and group structural and life-history notes are given. The plates are excellent. I to IX and part of X illustrate adults. Nineteen larval heads are shown on plate X. Plates XI to XIV illustrate mature larvæ. On plate XV there are 25 further figures of head capsuls and 16 drawings of segments. Plates XVI and XVII also show segments. Genetalic drawings are reproduced on plates XVIII to XXII. Plates I to XVII are in colours. Lepidopterists generally will welcome the appearance of this memoir. It is indeed an important contribution.

Barnes, W., and McDunnough, J. H. Contributions to the Natural History of the Lepidoptera of North America, Vol. IV, No. 2—Notes and New Species. This number of the "Contributions," pp. 61-208, plates XI to XXV, is a valuable addition to the literature. Four new species are described from Canada and one new variety. There is a decided improvement in the plates which accompany the number.

CASEY, THOS. L. Memoirs on the Coleoptera, VIII, issued Nov. 12, 1918. The New Era Printing Co., Lancaster, Pa. This large memoir of 427 pages is the result of studies of certain groups, the species in which are closely related. It is divided as follows: I—A Review of the North American Bembidiinæ (pp. 1-223); II—Studies among some of the American Amarinæ and Pterostichinæ (pp. 224-293); III—Observations on the American Pogoninæ, including Trechus (pp. 394-412); IV—Miscellaneous Notes and Corrections (413-416). In the Memoir, 26 new species are described from Canada, all from British Columbia, excepting one from Ontario. In addition a number of Canadian records of previously known species are included.

COMSTOCK, J. H. The Wings of Insects. The Comstock Publishing Co., pp. xviii-423, 9 plates, 427 figs. This important publication is one which has been well received by entomologists generally. Space here forbids us referring at any length to this work. I would refer the reader to a review of the book which was published in the February, 1919, issue of *The Canadian Entomologist*. The price is $3.75.

FELT, EPHRAIM PORTER. Key to American Insect Galls. New York State Museum, Bulletin No. 200. This a most valuable publication of 310 pages, freely illustrated with good text drawings, in addition to which there are sixteen half-tone plates. Entomologists generally will, indeed, be grateful to Dr. Felt for completing this very useful work. With this publication there is an excellent opportunity for Canadian students to add to the known knowledge of these interesting insects.

LOCHHEAD, WILLIAM. Class Book of Economic Entomology, with special reference to the economic insects of the Northern United States and Canada. Philadelphia, P. Blakiston's Son & Co., 436 pp., 257 illustrations; price $2.50. This new book on economic entomology will certainly find a useful place among economic workers. The descriptions are concise and to the point, the illustrations well chosen and the printing excellent. Part I discusses the structure, growth and economics of insects; Part II the identification of insects injurious to farm, garden and orchard crops, etc., Part III, the classification and description of common insects; Part IV, the control of injurious insects.

LUTZ, FRANK E. Field Book of Insects. G. P. Putnam's Sons, New York and London; with about 800 illustrations, many in colour. This field book of a size to fit the pocket is full of useful information. Following introductory remarks, pages 9 to 27 discuss collecting and preserving insects. Then follow chapters on the various orders, under each of which concise information is presented. The volume is one of 509 pages, freely illustrated, many of the figures being coloured.

PETTIT, R. H. and MCDANIEL, EUGENIA. Key to Orthoptera of Michigan with Annotations. Special Bull. No. 83, Mich. Agric. College, Jan., 1918. This publication of 48 pages will prove of interest to collectors and students in Canada. In addition to a key to the families of Michigan Orthoptera, it also contains generic and specific keys. Useful illustrations are included.

PIERS, HARRY. The Orthoptera (Cockroaches, Locusts, Grasshoppers and Crickets) of Nova Scotia, with descriptions of the species and notes on their occurrence and habits. Halifax, N.S., Trans. N.S. Inst. Sci. Vol. XIV, Part 3, pp. 201-356, 4 plates; author's separates published 15 July, 1918. Such provincial contributions are of much interest and will undoubtedly assist in a better knowledge of the species. Descriptions of all the Nova Scotia species are given, with keys to assist in more ready identification. The economic species are discussed at greater length.

Rau, Phil, and Rau, Nellie. Wasp Studies Afield. Introduction by W. M. Wheeler. Princeton University Press; price $2.00. This volume of 368 pages contains most interesting information on the habits of wasps that build their nests in burrows. The chapter headings are: Some Bembicene Wasps; Behaviour of Wasps belonging to the Family Pomphilidæ; Some Fly-catching Wasps; The Bee-killing Wasps; Some Mud-daubing Wasps; The Hunters of Small Orthoptera; The Hunters of Large Orthoptera; The Sand-loving Ammophila; Some Social Wasps—Experiments on the Homing of *Polistes pallipes;* The Mining and other Wasps of the Family Eumenidæ; General Considerations.

Swaine, J. M. Canadian Bark-beetles, Part II, a preliminary classification with an account of the habits and means of control. Bull. No. 14, Ent. Br., Dept. Agriculture, Ottawa, issued Sept. 6, 1918. This bulletin was prepared with the object of assisting students and practical foresters in determining the bark-beetles of Canadian forests. Part I discusses "The Beetles and Their Habits"; Part II "Bark-beetle Injuries and the Means of Control"; Part III "Structural Characters of the Bark-beetles"; and Part IV "Classification—A preliminary Arrangement of the Canadian Bark-beetles." Thirty-one plates and several figures in the text add great value to the publication. This, the most important publication on these insects, will be invaluable to entomologists generally.

Washburn, F. L. Injurious Insects and Useful Birds. Philadelphia and London: J. B. Lippincott Co., 414 illustrations in text and 4 coloured plates. Price $2.00. This volume, although prepared particularly for high schools and agricultural colleges, will be a useful work of reference for amateur entomologists, gardeners, and farmers generally. Chapters I to VI deal with losses due to insects and rodents, etc.; chapters VII to XVIII discuss insects affecting various crops. Chapter XIX, "Our Insect Friends," XX, "The Relation of Birds to Agriculture," and XXI, "Some Four-footed Pests of the Farm," complete the volume.

Wilson, H. F., and Vickery, R. A. A species list of the Aphididæ of the World and their Recorded Food Plants. Reprinted from the Transactions of the Wisconsin Academy of Sciences, Arts and Letters, Vol. XIX, part I; issued Nov. 1918, pp. 22-355. This is divided into two parts; Part I—A species list of the Aphididæ of the world with their recorded food plants; Part II—A list of Aphid food plants and the Aphids said to attack them. Students of aphids will find this publication of great value. It is indeed an important contribution.

NOTES OF CAPTURES.

Lepidoptera.

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

Pieridæ.

35. *Pieris napi pseudonapi* B. & McD. Blairmore, Alta., June, (K. Bowman).
46. *Authocharis sara julia* Edw. Blairmore, Alta., June, (K. Bowman).
64. *Eurymus christina gigantea* Stkr. Mile 214, 332, H. B. Ry., Man., July, 1917, (J. B. Wallis).

68. *Eurymus palaeno chippewa* Edw. Mile 214, 332, H. B. Ry., Man., July, 1917, (J. B. Wallis).

Satyridæ.

122. *Oeneis chryxus calais* Scudd. Mile 332, H. B. Ry., Man. July, 1917, (J. B. Wallis).

Nymphalidæ.

172. *Argynnis edwardsi* Reak. Blairmore, Alta., June, (K. Bowman).
173. *Argynnis platina* Skin. Blairmore, Alta., June, (K. Bowman).
198. *Brenthis youngi* Holl. In the Entomological Record for 1917, this species was recorded from Klutlan Glacier, Y. T. On further study the specimen proves to be *Brenthis frigga* var. *improba* Butl.
200. *Brenthis epithore* Bdv. Blairmore, Alta., June, (K. Bowman).
220. *Euphydryas gilletti* Barnes. Nordegg, Alta., July, (K. Bowman).
226. *Melitaea palla* Bdv. Blairmore, Alta., June, (K. Bowman).
279. *Aglais californica* Bdv. Regarding this species Mr. F. C. Whitehouse sends the following note: "Red Deer, Alta., mid-June, large migratory flight of presumably hibernated insects from B.C.; mid-August, new brood appeared.
313. *Chlorippe clyton* Bdv. & Lec. Pt. Pelee, Ont., Aug. 14, 1909, (P. A. Taverner).

Lycaenidæ.

411. *Heodes cupreus* Edw. Mt. McLean, B.C., 7,000 feet, and at head of Phair Creek, about 30 miles from Lillooet, B.C., (A. W. A. Phair).
427. *Plebeius melissa* Edw. Goldstream, B.C., July 3, 1918, (E. H. Blackmore). Rather rare. This species was not included in the "Check List of B. C. Lepidoptera, 1906," for some unaccountable reason, as it occurs regularly throughout the interior, although it is very common on Vancouver Island (E.H.B.).
432. *Plebeius yukona* Holl. Mile 332, H. B. Ry., Man., July, 1917, (J. B. Wallis).
433. *Plebeius icarioides pembina* Edw. Blairmore, Alta., June, (K. Bowman).

Sphingidæ.

733. *Haemorrhagia gracilis* G. & R. Nipigon, Ont., (J. Fletcher).
741. *Pholus fasciatus* Sulz. Annapolis Royal, N.S., Oct. 31, 1918, (A. Kelsall). This is a beautiful specimen and is now in the Ottawa collection. It is the only Canadian example I have seen, (A. G.).

Arctiidæ.

892. *Clemensia albata* Pack. Edmonton, Alta., Aug. 1917, (D. Mackie).
939. *Dodia albertæ* Dyar. Mile 214, H. B. Ry., Man., July, 1917, (J. B. Wallis).
948b. *Phragmatobia fuliginosa borealis* Staud. Vernon, B.C., April 26, 1918, (M. Ruhmann). I have also a specimen taken at Vancouver, B.C., on April 23, 1907, by the late Captain R. V. Harvey. These are the only two specimens known to me and constitute a new addition to the B.C. List. (E. H. B.).
955. *Diacrisia vagans kasloa* Dyar. Blairmore, Alta., June, (K. Bowman).
956. *Diacrisia rubra* Neum. Edmonton, Alta., June, 1916, (D. Mackie).
962. *Estigmene prima* Slosson. Edmonton, Alta. and Red Deer, Alta., May-June, 1916, (K. Bowman).

Noctuidæ.

1214. *Copablepharon viridisparsa* Dod. Lillooet, B.C., Aug. 24, 1916, (A. W. A. Phair). One specimen a trifle worn. New to B.C., originally described from Lethbridge, Alta., (E.H.B.).

1313. *Euxoa ontario* Sm. Edmonton, Alta., and Pocahontas, Alta., July-August, 1916-1917, (K. Bowman and D. Mackie).

1315. *Euxoa quinquelinea* Sm. Rossland, B.C. No date. (W. H. Danby). New to B.C., (E.H.B.).

1315a. *Euxoa quinquelinea lutulenta* Sm. Okanagan Landing, B.C., August 25, 1915, (J. A. Munro). New to B.C., (E.H.B.).

1353a. *Euxoa divergens abar* Stkr. Duncan, B.C., June 29, 1896, (E. M. Skinner). New to B.C., (E.H.B.).

1357. *Euxoa redimicula* Morr. Atlin, B.C., Aug. 8, 1914, (E. M. Anderson). This is an interesting record as showing the far northern range of this species. (E.H.B.).

1379. *Chorizagrotis thanatologia* Dyar. Ottawa, Ont., June 28, July 7, 1899, (C. H. Young); Ottawa, June 29, 1905, (J. Fletcher); Strathroy, Ont., July 4, 1918, (H. F. Hudson). These specimens are very close to the variety *sordida* Sm., as figured by Dod, but are slightly redder. Wellington, B.C., (G. W. Taylor). This specimen is close to Dod's figure of *boretha* (Can. Ent. XLVIII, p. 4, f. 7).

1445. *Agrotis esurialis* Grt. Duncan, B.C., June 4, 1910, (G. O. Day).

1459. *Agrotis atrata* Morr. Nordegg, Alta., July, 1917, (K. Bowman).

1468. *Pseudorthosia variabilis* Grt. Blairmore, Alta., Sept., (K. Bowman).

1502. *Lycophotia lubricans* Gn. Ottawa, Ont., July 2, 1908, (C. H. Young).

1512. *Aplectoides arufa* Sm. Pocahontas, Alta., Aug., 1916, (K. Bowman).

1513. *Aplectoides condita* Gn. Edmonton, Alta., June, 1916-1917, (D. Mackie and K. Bowman).

1529. *Anytus enthea* Grt. Edmonton, Alta., Sept., 1916, (K. Bowman).

1538. *Anomogyna sincera* H.S. Nordegg, Alta., July, 1917, (K. Bowman).

1539. *Anomogyna laetabilis* Zett. Pocahontas and Nordegg, Alta., July-Aug., (K. Bowman).

1580. *Rhynchagrotis vittifrons* Grt. Penticton, B.C., (L. A. DeWolfe). Lillooet, B.C., Oct. 19, 1917, (A. W. A. Phair). New to B.C., (E.H.B.).

1682. *Polia negussa* Sm. Rossland, B.C., no date, (W. H. Danby). New to B.C., (E.H.B.).

1693. *Polia cristifera* Wlk. Edmonton, Alta., and Pocahontas, Alta., June, 1917, (K. Bowman and D. Mackie).

1697. *Polia rogenhoferi* Moesch. Nordegg, Alta., July, 1917, (K. Bowman).

1702. *Polia variolata* Sm. Victoria, B.C., July 18, 1918, (E. H. Blackmore). Taken at rest on a fence at mid-day. There is one specimen in the Provincial Museum collection taken at Victoria in 1902. Outside of these two specimens I have no further record from B.C., (E.H.B.).

1723. *Polia pulverulenta* Sm. Aweme, Man., June 1, 1918, (N. Criddle); McNab's Island, Halifax, N.S., June 30, 1914, (J. Perrin).

1734. *Polia vicina* Grt. Okanagan Landing, B.C., Aug. 5, 1916, (J. A. Munro). This is the same species which has been previously listed from Kaslo as *pensilis* Grt., the latter species only occurring on Vancouver Island and in the Lower Fraser Valley, (E.H.B.).

2001. *Cucullia omissa* Dod. Ottawa, Ont., June 5, 1906, (C. H. Young).

2018. *Oncocnemis hayesi* Grt. Blairmore, Alta., Sept., (K. Bowman).
2061. *Oncocnemis atrifasciata* Morr. Laterriere, Chicoutimi, Que., Aug. 25, 1878, (V. A. Huard). I recently determined this specimen and am assured it was captured at this place, (A.G.).
2098. *Momophana comstocki* Grt. Near Quebec City, Que., (V. A. Huard).
2125. *Hillia discinigra* Wlk. Edmonton, Alta., Aug., 1916, (D. Mackie).
2168. *Graptolitha thaxteri* Grt. Edmonton, Alta., Sept., 1916-1917, (D. Mackie).
2170. *Xylena mertena* Sm. Lillooet, B.C., (A. W. A. Phair).
2172. *Xylena brillians* Ottol. Edmonton, Alta., Sept., 1917, (D. Mackie).
2185. *Pleroma cinerea* Sm. Lillooet, B.C., May 4, 1916, (E. M. Anderson); Armstrong, B.C., no date, (W. Downes).
2279. *Trachea parcata* Sm. Nordegg, Alta., July, 1917, (K. Bowman).
2315. *Trachea impulsa* Gn. Victoria, B.C., July 6, 1918, (E. H. Blackmore). First record from Vancouver Island, previously recorded from Kaslo, (E.H.B.).
2343. *Oligia includens* Wlk. Edmonton, Alta., July-Sept., 1916-17, (K. Bowman and D. Mackie).
2359. *Eremobia claudens* Wlk. Hymers, Ont., Aug. 16, 30, 1913, (H. Dawson).
2502. *Acronycta lithospila* Grt. Chelsea, Que, June 29, 1917, (J. H. McDunnough).

Xylomœa chagnoni B. & McD. Ottawa, July 13, 1908, (C. H. Young); Trenton, Ont., 1899, (J. D. Evans). In the Ent. Record for 1905, this recently described species is recorded under the name of *Hadena didonea* Sm., the specimens having been reared by Fletcher from larvæ found in the roots of *Phalaris arundinacea*.

2524. *Andropolia aedon* Grt. Duncan, B.C., no date, (E. M. Skinner). New to B.C., (E.H.B.).
2784. *Arzama obliqua* Wlk. Duncan, B.C., June 26, 1906, (E. M. Skinner). One specimen in splendid condition; new to B.C., (E.H.B.).

* *Catocala atala* Cassino. Hymers, Ont., Sept. 18, 1911; Lepidopterist, II, 52.

* *Catocala briseis clarissima* Beut. Cartwright, Man., (Heath); Winnipeg, Man., (J. B. Wallis); Lepidopterist, II, 66.

* *Catocala blandula manitobense* Cassino. Cartwright, Man., July 17; Lepidopterist, II, 81.

3109. *Catocala blandula* Hlst. Red Deer, Alta., August, 1905, (K. Bowman); Ottawa, Ont., July 26, 1906, (C. H. Young).
3207. *Panthea acronyctoides* Wlk. Onah, Man., July 9, 1918, (N. Criddle, J. B. Wallis and L. H. Roberts).
3245. *Autographa v-alba* Ottol. Rossland, B.C., no date, (W. H. Danby). Only B.C., previous record from Kaslo, (E.H.B.).
3272. *Autographa metallica* Grt. Victoria, B.C., June 21, 1918, (E. H. Blackmore). First record from Victoria, B.C., that I know of, (E.H.B.).

* *Syneda hudsonica heathi* B. & McD. Cartwright, Man., June, (E. F. Heath); Cont. Nat. Hist. Lep. N.A., IV, 2, 122.

3434. *Rivula propinqualis* Gn. Edmonton, Alta., July, 1917, (K. Bowman).

Parahypenodes quadralis B & McD. Trenton, Ont., Aug. 30, 1908, (J. D. Evans).

3511. *Zanclognatha lutalba* Sm. Edmonton, Alta., July, 1915-1917, (K. Bowman and D. Mackie).

3580. *Hypena californica* Behr. Edmonton, Alta., Sept., 1917, (D. Mackie).
* *Parahypenodes quadralis* B. & McD. St. Therese Island, St. John's Co., Que., July, (W. Chagnon); Cont. Nat. Hist. Lep. N.A., IV, 2,124.

Notodontidæ.

3669. *Cerura borealis* Bdv. Edmonton, Alta., June-July, 1916-1917, (D. Mackie and K. Bowman).
3670. *Cerura occidentalis* Lint. Nordegg, Alta., and Pocahontas, Alta., July-August, (K. Bowman).

Lymantriidæ.

3704. *Hemerocampa vetusta gulosa* Hy. Edw. Chase, B.C., Aug. 4-6, 1917, (W. B. Anderson).

Geometridæ.

3802. *Synchlora rubrifrontaria* Pack. Edmonton, Alta., July, 1917, (D. Mackie).
3936. *Stamnoctenis morrisata* Hulst. Goldstream, B.C., July 5, 1918—July 8, 1918, two males, (E. H. Blackmore). First record from here; recorded from Duncan, B.C., last year by A. W. Hanham, which was the first record from Vancouver Island, (E.H.B.).
3950. *Acasis viridata* Pack. Edmonton, Alta., May, 1915-1916, (D. Mackie).
3955. *Cladura atroliturata* Wlk. Edmonton, Alta., April-May, 1915-1916, (K. Bowman and D. Mackie).
* *Eustroma fasciata* B. & McD. Cowichan Lake, Vancouver Island, B.C., June; Cont. Lep. N.A., Vol. IV, 2, 137.
3981. *Lygris destinata lugubrata* Moesch. Edmonton, Alta., July-August, 1915-1917, (D. Mackie).
3983. *Lygris explanata cunigerata* Wlk. Edmonton, Alta., July-August, 1915-1917, (D. Mackie).
* *Lygris xylina serrataria* B. & McD. Ottawa, Ont., (C. H. Young).
* *Thera georgii benesignata* B. & McD. Wellington, B.C., July 28, 1905, Sept. 12, 1903; Duncan, B.C.; Cont. Lep. N.A. III, No. 4, 226.
3987a. *Diactinia silaceata albolineata* Pack. Victoria, B.C., April 30, 1918—July 24, 1918, (E. H. Blackmore). First record from Victoria, (E.H.B).
3993. *Dysstroma citrata* L. Pocahontas, Alta., Aug., 1917, (K. Bowman).
3995. *Dysstroma walkerata* Pears. Nordegg, Alta., July, 1917, (K. Bowman).
* *Hydriomena macdunnoughi* Swett. Atlin, B.C., June 11, 1914; Can. Ent. L, 296.
* *Xanthorhoe blackmorei* Swett. Victoria, B.C., May 2, 19, 1915, (E.H. Blackmore); Can. Ent. L, 21.
* *Xanthorhoe macdunnoughi* Swett. Victoria, B.C., May 30, 1915; May 14, 1913; (E. H. Blackmore); Duncan, B.C., (in coll. E.H.B.); Can. Ent. L, 17.
* *Xanthorhoe atlinensis* Swett. Atlin, B.C., June 26, 28, 1914; Can. Ent. L, 20.
4050. *Xanthorhoe iduata* Gn. Edmonton, Alta., June-July, 1915-1916, (D. Mackie).
4060. *Entephria aurata* Pack. Edmonton, Alta., July, 1915, (D. Mackie).
* *Oporinia autumnata henshawi* Swett. London, Ont., (Miss E. Morton and J. A. Moffatt); Lepidopterist, I, 47, (1917).

4077. *Euphyia luctuata* Schiff. Victoria, B.C., June 14, 1917, (W. Downes). First record from Victoria, (E.H.B.).

* *Epirrhoe plebeculata vivida* B. & McD. Wellington and Goldstream, B.C.; Cont. Lep. N.A., III, No. 4, 232.

4094. *Perizoma basaliata grandis* Hlst. Edmonton, Alta., July, 1915-1916, (D. Mackie).

4114. *Venusia cambrica* Curt. Edmonton, Alta., July, 1915, (D. Mackie).

4122. *Edule mendica* Wlk. Edmonton, Alta., June-July, 1915-1917, (K. Bowman and D. Mackie).

4137. *Eupithecia albipunctata* Haw. Edmonton, Alta., July, 1917, (D. Mackie).

4168. *Eupithecia coagulata* Gn. Edmonton, Alta., July, 1917, (D. Mackie).

4172. *Eupithecia niphadophilata* Dyar. Pocahontas, Alta., August, 1917, (K. Bowman).

4185. *Eupithecia scelestata* Tayl. Pocahontas, Alta., June, 1917, (K. Bowman).

4189. *Eupithecia alberta* Tayl. Nordegg, Alta., July, 1917, (K. Bowman).

4199. *Eupithecia terminata* Tayl. Pocahontas, Alta., June, 1917, (K. Bowman).

4274. *Eupithecia fumata* Tayl. Edmonton, Alta., May-June, 1916-1917, (D. Mackie).

* *Horisme vitalbata incana* Swett. Calgary, Alta., June 5, 1914; June 26, 1907; June 26, 1914, (Wolley-Dod); Psyche, XXIV, 190.

4291. *Dasyfidonia avuncularia* Gn. Blairmore, Alta., May, (K. Bowman).

4360a. *Phasiane respersata teucaria* Stkr. Victoria, B.C., May 28, 1918, (E. H. Blackmore).

4372. *Phasiane neptaria* Gn. Blairmore, Alta., May and Sept., (K. Bowman).

4372b. *Phasiane neptaria sinuata* Pack. Victoria, B.C., May 2, 1918, (E. H. Blackmore). This has been previously listed as *neptaria* Gn., but has been found to be conspecific with *sinuata* described by Packard from Vancouver Island. It occurs sparingly throughout the province, (E.H.B.).

* *Phasiane ponderosa* B. & McD. Cartwright, Man., June 14, July 24; Aweme, Man., June 20; Calgary, Alta., June 16; Cont. Lep. N.A., III, No. 4, 235.

* *Phasiane ponderosa demaculata* B. & McD. Calgary, Alta., May 11, July 1, 5; Banff, Alta., July 1; Field, B.C., July 2; Cont. Lep. N.A. III, No. 4, 235.

4421. *Itame bitactata* Wlk. Pocahontas, Alta., July, 1917, (K. Bowman).

4467. *Caripeta angustiorata* Wlk. Blairmore, Alta., July, (K. Bowman).

4565. *Cleora indicataria* Wlk. Edmonton, Alta., June-July, 1915-1917, (K. Bowman and D. Mackie).

4581. *Cleora emasculata* Dyar. Edmonton, Alta., June 1915-1917, (D. Mackie).

* *Cleora satisfacta* B. & McD. Kaslo, B.C., Aug. 15; Cont. Lep. N.A., III, No. 4, 244.

* *Aethaloptera anticaria fumata* B. & McD. Kaslo, B.C., April-May; Cont. Lep. N.A., III, No. 4, 244.

* *Xanthotype urticaria* Swett. "Nova Scotia"; Lepidopterist, fig. 6, pl. VII, Vol. II.

* *Xanthotype manitobensis* Swett. Aweme, Man., (N. Criddle); Lepidopterist, II, 78.

4602. *Glena cognataria* Hbn. McNab's Island, Halifax, N.S., June 14, 1910, (J. Perrin).

4608. *Lycia ursaria* Walk. Rossland, B.C., no date, (W. H. Danby). New to B.C.
* *Plagodis intermediaria* B. & McD. Ottawa, Ont., May 16, (C. H. Young); Cont. Lep. N.A., III, No. 4, 248.
4680. *Nematocampa limbata* Haw. Edmonton, Alta., Aug., 1917, (D. Mackie).
* *Metarranthis septentrionaria* B. & McD. Beulah, Man., June 21; Aweme, Man., May 29, June 18; Winnipeg, Man.; Cont. Lep. N.A., III, No. 4, 257.
4744. *Pero honestarius* Wlk. Edmonton, Alta., May-June, 1915-1917, (K. Bowman and D. Mackie).

Epiplemidæ.

4788. *Callizzia armorata* Pack. Edmonton, Alta., June-July, 1917, (K. Bowman and D. Mackie).

Pyralidæ.

* *Loxostege albertalis* B. & McD. Gleichen, Alta., July, (F. H. Wolley-Dod); Beulah and Miniota, Man.; Cont. Lep. N.A., Vol. IV, 2, 160.
5018. *Loxostege chortalis* Grt. Nordegg, Alta., July, 1917, (K. Bowman).
5093. *Phlyctaenia itysalis* Wlk. Pocahontas, Alta., Aug., 1917, (K. Bowman).
5099. *Phlyctaenia terrealis* Tr. Edmonton, Alta., June-July, 1917, (K. Bowman).
5140. *Pyrausta unifascialis* Pack. Nordegg, Alta., July, (K. Bowman).
5142. *Pyrausta fodinalis* Led. Edmonton, Alta., July, 1917, (K. Bowman).
5151. *Pyrausta borealis* Pack. Nordegg, Alta., July, 1917, (K. Bowman).
5154. *Pyrausta generosa* G. & R. Edmonton, Alta., July, 1917, (K. Bowman).
5155. *Pyrausta ochosalis* Dyar. Red Deer, Alta., June 1917, (K. Bowman).
5166. *Pyrausta nicalis* Grt. Edmonton, Alta., July, 1917, (K. Bowman).
5176. *Pyrausta funebris* Strom. Edmonton, Alta., Red Deer, Alta., June, 1916-1917, (D. Mackie and K. Bowman).
* *Pyrausta pythialis* B. & McD. Cartwright, Man., (E. F. Heath); Aweme, Man., June, (N. Criddle); Cont. Nat. Hist. Lep. N.A., Vol. IV, No. 2, p. 164.

Eucosmidæ.

7114. *Proteopteryx oregonana* Wlshm. Aweme, Man., (N. Criddle).
7129. *Proteopteryx ilicifoliana* Kearf. Vancouver, B.C., July 30, 1917, reared from holly, (R. C. Treherne).

Yponomeutidæ.

* *Swammerdamia cuprescens* Braun. Field, B.C.; Can. Ent., L, 231.

Gracilariidæ.

* *Ornix spiræifoliella* Braun. Field, B.C.; Can. Ent., L, 234.

Hepialidæ.

8486. *Hepialus hyperboreus* Moesch. Pocahontas, Alta., August, 1917, (K. Bowman). Exactly like the type (B. & McD.). *Hyperboreus* appeared in Dod's Alberta list and he so named the species for Mr. Mackie, but this, according to Sir George Hampson, is *H. mathewi* Hy. Edw. (K. B.).
8488. *Hepialus mathewi* Hy. Edw. Edmonton, Alta., Aug.-Sept., 1915-1916, (D. Mackie and K. Bowman).

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

Cicindelidæ.

Cicindela unijuncta Csy. Edmonton, Alta., June 16, 1917, (F. S. Carr).

30. *Cicindela hyperborea* Lec. Edmonton, Alta., June 29, 1917, (F. S. Carr).

Carabidæ.

118. *Carabus chamissonis* Fisch. Edmonton, Alta., June 5, 1917; July 4, 1917, (F. S. Carr).

154. *Elaphrus obliteratus* Mann. Mile 332, Hudson Bay Ry., Man., July 14, 1917, (J. B. Wallis). New to Manitoba.

164. *Blethisa quadricollis* Hald. Husavick, Man., July 4, 1917, (L. H. D. Roberts). New to Manitoba.

172. *Opisthius richardsoni* Kirby. Edmonton, Alta., June 28, 1916, (F. S. Carr).

234. *Dyschirius terminatus* Lec. Edmonton, Alta., April 27, 1917, (F. S. Carr).

323. *Bembidium quadrulum* Lec. Mile 256, Hudson Bay Ry., Man., July 12, 1917, (J. B. Wallis). New to Manitoba.

325. *Bemdidium nigrum* Say. Winnipeg, Man., May 19, 1917. One specimen in my garden on Langside St., (J. B. Wallis). New to Manitoba.

339. *Bembidium nebraskense* Lec. Edmonton, Alta., March 29, 1918, (F. S. Carr).

343. *Bembidium transversale* Dej. Lake Dauphin, Man., March 27, 1918, (Mrs. W. W. Hippisley).

363. *Bembidium grapii* Gyll. Winnipeg, Man., April 9, 1909. This specimen has had a varied career. Prof. Wickham identified it as *dyschirinum*. Mr. Liebeck refused to commit himself. The present determination is Dr. Van Dyke's, (J. B. Wallis).

Bembidium constricticolli Haywd. Winnipeg, Man., April 24, 1916. Not quite typical, (J. B. Wallis). New to Manitoba.

373. *Bembidium obtusangulum* Lec. Leduc, Alta., May 11, 1914, (F. S. Carr).

397. *Bembidium dejectum* Csy. Winnipeg, Man., May 13, 1917. Also in my garden on Langside St., one only, (J. B. Wallis). New to Manitoba.

* *Bembidion brumale* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 22, issued Nov. 12, 1918.

* *Bembidion vacivum* Csy. Skeena River, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 22, issued Nov. 12, 1918.

* *Bembidion blanditum* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 23, issued Nov. 12, 1918.

* *Bembidion impium* Csy. Agassiz, B.C. Memoirs on the Coleoptera, VIII, p. 28, issued Nov. 12, 1918.

* *Bembidion deceptor* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 29, issued Nov. 12, 1918.

* *Bembidion nescium* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 30, issued Nov. 12, 1918.

* *Bembidion viator* Csy. Massett, Q.C.I., B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 31, issued Nov. 12, 1918.

* *Bembidion illex* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 31, issued Nov. 12, 1918.

* *Bembidion haruspex* Csy. Inverness and Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 31, issued Nov, 12, 1918.

* *Bembidion bucolicum* Csy. Stikine River Canon, B.C., (H. F. Wickham); Memoirs on the Coleoptera, VIII, p. 34, issued Nov. 12, 1918.

* *Bembidion insopitans* Csy. Victoria, B.C., (H. F. Wickham); Memoirs on the Coleoptera, VIII, p. 68, issued Nov. 12, 1918.

* *Bembidion vancouveri* Csy. Victoria, B.C., (H. F. Wickham); Memoirs on the Coleoptera, VIII, p. 73, issued Nov. 12, 1918.

* *Bembidion imperitum* Csy. Victoria, B.C.; Memoirs on the Coleoptera, VIII, p. 91, issued Nov. 12, 1918.

* *Bembidion mobile* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 95, issued Nov. 12, 1918.

* *Bembidion imitator* Csy. Kamloops, B.C.; Memoirs on the Coleoptera, VIII, p. 105, issued Nov. 12, 1918.

* *Bembidion tolerans* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 132, issued Nov. 12, 1918.

* *Bembidion gregale* Csy. Agassiz, B.C.; Memoirs on the Coleoptera, VIII, p. 148, issued Nov. 12, 1918.

* *Bembidion peregrinum* Csy. Massett, Q.C.I., B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 159, issued Nov. 12, 1918.

* *Bembidion crassicornis* Csy. Inverness, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 165, issued Nov. 12, 1918.

* *Bembidion keeni* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 166, issued Nov. 12, 1918.

Pogoninæ.

* *Patrobus labradorinus* Csy. W. St. Modest, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 395, issued Nov. 12, 1918.

* *Patrobus minuens* Csy. W. St. Modest, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 396, issued Nov. 12, 1918.

* *Patrobus laeviceps* Csy. W. St. Modest, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 396, issued Nov. 12, 1918.

* *Patrobus insularis* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 397, issued Nov. 12, 1918.

* *Trechus brumalis* Csy. W. St. Modest, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 408, issued Nov. 12, 1918.

Pterostichinæ.

* *Hypherpes innatus* Csy. "Canada (west of the Rocky Mountains)"; Memoirs on the Coleoptera, VIII, p. 329, issued Nov. 12, 1918.

* *Hypherpes responsor* Csy. Victoria, B.C., (H. F. Wickham); Memoirs on the Coleoptera, VIII, p. 330, issued Nov. 12, 1918.

* *Hypherpes anthrax* Csy. "Vancouver Island"; Memoirs on the Coleoptera, VIII, p. 331, issued Nov. 12, 1918.

* *Euferonia quadrifera* Csy. "Ontario"; Memoirs on the Coleoptera, VIII, p. 366, issued Nov. 12, 1918.

* *Cryobius otariidinus* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 374, issued Nov. 12, 1918.

* *Cryobius beringi* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 374, issued Nov. 12, 1918.

* *Cryobius delicatus* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 375, issued Nov. 12, 1918.

* *Cryobius breviusculus* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 375, issued Nov. 12, 1918.

Amarinæ.

* *Curtonotus labradorensis* Csy. Labrador, (W. St. Modest); Memoirs on the Coleoptera, VIII, p. 231, issued Nov. 12, 1918.

* *Curtonotus scrutatus* Csy. Labrador, (W. St. Modest); Memoirs on the Coleoptera, VIII, p. 231, issued Nov. 12, 1918.

* *Bradytus nainensis* Csy. Nain, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 238, issued Nov. 12, 1918.

* *Celia sinuosa* Csy. Aldermere, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 277, issued Nov. 12, 1918.

* *Amara keeni* Csy. Inverness, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 299, issued Nov. 12, 1918.

625. *Amara haematopa* Dej. Mile 214, Hudson Bay Ry., July 9, 1917; Mile 332, July 17, 1917, (J. B. Wallis). Previously recorded from Hudson Bay territory.

651. *Amara angustata* Say. Onah, Man., July 9th, 1916, (J. B. Wallis); Aweme, Man., July 10, 1917, (E. Criddle). Rare in Manitoba.

657. *Amara impuncticollis* Say. Miami, Man., July 2, 1914; Thornhill Man., June 30, 1916; Winnipeg, Man., June 8, 1917, (J. B. Wallis). Previously recorded by Dr. Bell from Oxford House.

658. *Amara littoralis* Mann. Victoria Beach, Man., June 17, 1916, (J. B. Wallis). New to Manitoba.

661. *Amara cupreolata* Putz. Winnipeg, Man., April 24, 1916; Calgary, Alta., April 7, 1915, (Tams). Previously mixed with *protensa,* of which species I have but one really typical specimen, from Aweme, (J. B. Wallis). New to Manitoba.

833. *Platynus gemellus* Lec. Aweme, Man., Oct. 16, 1917, (N. Criddle).

1107. *Harpalus laticeps* Lec. Aweme, Man., May 14, 1904, (N. Criddle).

Dytiscidæ.

1293. *Coelambus sellatus* Lec. Edmonton, Alta., April 9, 1916, (F. S. Carr).

1298. *Coelambus unguicularis* Cr. Edmonton, Alta., April 8, 1916, (F. S. Carr).

1300. *Coelambus fraternus* Lec. Edmonton, Alta., June 12, 1915, (F. S. Carr).

1349. *Hydroporus tartaricus* Lec. Edmonton, Alta., May 8, 1915, (F. S. Carr).

1355. *Hydroporus vitulus* Er. Edmonton, Alta., April 11, 1917, (F. S. Carr).

Gyrinidæ.

1472. *Colymbetes strigatus* Lec. Edmonton, Alta., May 5, 1917, (F. S. Carr).

1505. *Gyrinus minutus* Fab. Edmonton, Alta., Aug. 10, 1917, (F. S. Carr).

1507. *Gyrinus confinis* Lec. Le Pas, Man., June 30, 1917; Mile 214, Hudson Bay Ry., July 6, 1917, (J. B. Wallis). New to Manitoba.

1517. *Gyrinus maculiventris* Lec. Edmonton, Alta., June 12, 1915, (F. S. Carr).

1519. *Gyrinus affinis* Aube. Edmonton, Alta., May 5, 1917, (F. S. Carr).

1524. *Gyrinus pectoralis* Lec. Edmonton, Alta., Sept. 15, 1917, (F. S. Carr).

1525. *Gyrinus impressicollis* Kby. Mile 214, Hudson Bay Ry., Man., (J. B. Wallis). "I feel sure this is the long lost or never recognized *impressicollis* of Kirby, known only by the type in the British Museum" (H. C. Fall).

1528. *Gyrinus lugens* Lec. Mile 214, Hudson Bay Ry., Man., (J. B. Wallis). New to Manitoba.

Hydrophilidæ.

1630. *Philhydrus ochraceus* Mels. Mile 17, Hudson Bay Ry., July 2, 1917, (J. B. Wallis). New to Manitoba.

9335. *Cercyon tristis* Ill. Mile 214, Hudson Bay Ry., July 6, 1917, (J. B. Wallis). New to Manitoba.

Silphidæ.

1727. *Choleva alsiosa* Harv. Mile 214, Hudson Bay Ry., Man., July 10, 1917; under a dead mouse, (J. B. Wallis). New to Manitoba.

Choleva spenciana Kby. Mile 214, Hudson Bay Ry., Man., July 10, 1917; under a dead gopher, (J. B. Wallis). New to Manitoba.

1730. *Choleva clavicornis* Lec. Edmonton, Alta., Aug. 4, 1917, (F. S. Carr).

1732. *Choleva terminans* Lec. Mile 214, Hudson Bay Ry., Man., July 10, 1917; under a dead gopher, (J. B. Wallis). New to Manitoba.

Choleva horniana Blanch. Aweme, Man., July 17, 1918, (N. Criddle and J. B. Wallis). New to Manitoba.

1812. *Clambus gibbulus* Lec. Le Pas, Man., June 30, 1917, (J. B. Wallis). New to Manitoba.

Staphylinidæ.

Quedius aenescens Makl. Aweme, Man., April 22, 1918, (N. Criddle). New to Manitoba.

2011. *Atheta dichroa* Grav. Mile 332, Hudson Bay Ry., July 18, 1917, (J. B. Wallis). New to Manitoba.

Atheta remulsa Csy. Mile 214, Hudson Bay Ry., July 26, 1917, in fungus, (J. B. Wallis). New to Manitoba.

Atheta virginica Bernh. Mile 214, Hudson Bay Ry., July 10, 1917; Mile 332, Hudson Bay Ry., July 18, 1917, (J. B. Wallis). New to Manitoba.

Atheta fungi Groh. Peachland, B.C., Aug. 5, 1912; Winnipeg, Man., May 18, 1912; Miami, Man., June 27, 1916; on bracket fungus, (J. B. Wallis). New to Manitoba.

Atheta dentata Bernh. Onah, Man., July 9, 1916; Winnipeg, Man., Oct. 10, 1916, (J. B. Wallis). New to Manitoba.

Atheta graminicola Gr. Mile 17, Hudson Bay Ry., July 2, 1917, (J. B. Wallis). New to Manitoba.

Atheta irrita Csy. Mile 214, Hudson Bay Ry., July 24-26, 1917; in fungus, (J. B. Wallis). New to Manitoba.

2017. *Atheta recondita* Er. Mile 214, Hudson Bay Ry., July 10, 1917, (J. B. Wallis). New to Manitoba.

2022. *Amischa analis* Thom. Winnipeg, Man., May 10, 1912; April 24, 1916, (J. B. Wallis). New to Manitoba.

Paradilacra densissima Bernh. Winnipeg, Man., Sept. 23, 1916, (J. B. Wallis). New to Manitoba.

Metaxya awemeana Csy. Winnipeg, Man., Sept. 18. 1912; Miami, Man., June 26, 1916, (J. B. Wallis).

9562. *Dasyglossa prospera* Er. Winnipeg, Man., April 15. 1916; St. Norbert, Man., June 24, 1917, (J. B. Wallis). New to Manitoba.

Gymnusa variegata Kiesw. Bird's Hill, Man., May 5. 1917, (J. B. Wallis). New to Manitoba.

2165. *Philonthus basalis* Horn. Mile 332, Hudson Bay Ry., Man., July, 1918. One specimen now in the collection of Dr. H. C. Fall. (J. B. Wallis).

2234. *Philonthus aurulentus* Horn. Mile 214, Hudson Bay Ry., Man., July 6, 1917; Magnus, Man., Sept. 2, 1917, (J. B. Wallis). New to Manitoba.

2432. *Stenus fraternus* Csy. Mile 214, Hudson Bay Ry., Man., July 25, 26, 1917, (J. B. Wallis). New to Manitoba.

2447. *Stenus pollens* Csy. Mile 214, Hudson Bay Ry., Man., July 9-26, 1917, (J. B. Wallis). New to Manitoba.

2463. *Stenus punctatus* Er. Mile 214, Hudson Bay Ry., Man., July 26, 1917, with *pollens* and *fraternus*, (J. B. Wallis). New to Manitoba.

2634. *Tachyporus jocosus* Say. Le Pas, Man., June 30, 1917; Mile 214, Hudson Bay Ry., Man., July 6-26, 1917; Mile 332, Hudson Bay Ry., Man.. July 13, 1917, not taken in Manitoba for a number of years, (J. B. Wallis).

2646. *Conosoma littoreum* Linn. Aweme, Man., Sept. 27, 1918, (N. Criddle).

2671. *Mycetoporus humidus* Say. Winnipeg, Man., April 24, 1916; Mile 214. Hudson Bay Ry., Man., July 6, 1917, (J. B. Wallis). New to Manitoba.

2675. *Mycetoporus flavicollis* Lec. Aweme, Man., July 18, 1918, (N. Criddle).

2833. *Olophrum latum* Mahl. Mile 17, Hudson Bay Ry., Man., July 2, 1917; Mile 214, July 24, 1917, (J. B. Wallis). "Said to be the same as *fuscum* Grav. An example of the latter from the Caucasus . . . . looks a little different," (H. C. Fall). New to Manitoba.

Coccinellidæ.

3053. *Hippodamia americana* Cr. Mile 17, Hudson Bay Ry., Man., July 2, 1917; one only in wash-up of lake, (J. B. Wallis).

3065a. *Coccinella abdominalis* Say. Winnipeg, Man., July 30, 1917, (L. H. Roberts). New to Manitoba.

3122. *Hyperaspis 4-vittata* Lec. Mile 17, Hudson Bay Ry., Man., July 2, 1917, (J. B. Wallis). New to Manitoba.

3156. *Scymnus tenebrosus* Muls. Darlingford, Man., May 28, 1916, (W. R. S. Metcalfe). Rare in Manitoba.

3160. *Stetharus* (*Scymnus*) *punctum* Lec. Aweme, Man., Sept. 9, 1918, (N. Criddle). New to Manitoba.

Colydiidæ.

3290. *Cerylon castaneum* Say. Edmonton, Alta., June 9, 1917, (F. S. Carr).

Cucujidæ.

3349. *Brontes dubius* Fab. Husavick, Man., July, 1914, (J. B. Wallis). New to Manitoba.

Histeridæ.

3486. *Hister foedatus* Lec. Aweme, Man., June 2, 1912; Onah, Man., July 14, 1918, (N. Criddle).

3488. *Hister punctifer* Payk. Edmonton, Alta., Sept. 4, 1915, (F. S. Carr).

3570. *Saprinus comnomus nodifer* Westn. Edmonton, Alta., April 2, 1915, (F. S. Carr).

Nitidulidæ.

3663. *Brachyptum globulosus* Mann. Edmonton, Alta., June 5, 1916, (F. S. Carr).

3737. *Meligethes sævus* Lec. Mile 214, Hudson Bay Ry., Man., July 6, 1917; on *Mertensia paniculata* var. *longisepala*. Occurred along the line of the Hudson Bay Ry., wherever its food plant grew, (J. B. Wallis). New to Manitoba; Edmonton, Alta., May 10, 1915, (F. S. Carr).

Nitidula nigra Schaef. Winnipeg, Man., April 23, 1916; Mile 214, Hudson Bay Ry., July 6, 1917, (J. B. Wallis). New to Manitoba.

3756. *Ips vittatus* Oliv. Lake Dauphin, Man., 1918, (Mrs. W. W. Hippisley).

Latridiidæ.

3798. *Corticaria serricollis* Lec. Mile 214, Hudson Bay Ry., July 26, 1917, (J. B. Wallis). New to Manitoba.

Byrrhidæ.

3890. *Byrrhus cyclophorus* Kirby. Edmonton, Alta., June 23, 1917, (F. S. Carr).

Elateridæ.

4101. *Cardiophorus edwardsii* Horn. Lillooet, B.C., (E. P. Venables).

4217. *Elater pedalis* Germ. Mile 214, June 6, 1917; Mile 332, Hudson Bay Ry., July 13, 1917, (J. B. Wallis). New to Manitoba.

4228. *Elater socer* Lec. Mile 17, Hudson Bay Ry., Man., July 2, 1917, (J. B. Wallis). New to Manitoba.

4257. *Drasterius debilis* Lec. Mile 214, Hudson Bay Ry., Man., July 6-13, 1917, (J. B. Wallis). New to Manitoba.

4414. *Paranomus costalis* Payk. Le Pas, Man., June 30, 1917; Mile 17, Hudson Bay Ry., July 2, 1917; Mile 214, Hudson Bay Ry., July 9, 1917; Mile 256, Hudson Bay Ry., July 12, 1917; Mile 332, Hudson Bay Ry., July 17, 1917, (J. B. Wallis). New to Manitoba.

Buprestidæ.

4628. *Anthraxia æneogaster* Lap. Edmonton, Alta., June 27, 1917, (F. S. Carr).

4728. *Agrilus vittaticollis* Rand. Cawston, B.C., July 2, 1917, (W. R. Metcalfe).

4739. *Agrilus anxius* Gory. Cawston, B.C., June 24, 1917, (W. R. Metcalfe).

Lampyridæ.

4787. *Eros aurora* Hbst. Cawston, B.C., Aug. 5, 1917, (W. R. Metcalfe).

Ptinidæ.

* *Eucrada robusta* Van Dyke. Selkirk Mts., B.C., 1905, (J. C. Bradley); Bull. Brook. Ent. Soc., XIII, 6.

5337. *Endecatomus rugosus* Rand. Edmonton, Alta., June 6, 1916, (F. S. Carr).

Scarabæidæ.

5596. *Geotrupes splendidus* Fab. Ft. Coulonge, Que., June 1, 1918, (J. I. Beaulne). Addition to Quebec list.

5825. *Polyphylla variolosa* Hentz. Ft. Coulonge, Que., July 24, 1917, (J. I. Beaulne).

* *Cremastochilus bifoveatus* Van Dyke. Vernon, B.C., May, (W. H. Brittain); Bull. Brook. Ent. Soc., XIII, 14.

Spondylidæ.

5948. *Spondylis upiformis* Mann. Cawston, B.C., May 9, 1917, (W. R. Metcalfe).

Cerambycidæ.

5967. *Tragosoma harrisii* Lec. Nordegg, Alta., July 17, 1917, (K. Bowman).

5986. *Gonocallus collaris* Kirby. Edmonton, Alta., June 7, 1915, (F. S. Carr).

5988. *Physocnemum brevilineum* Say. Cartwright, Man., (E. F. Heath).

6010. *Callidium cicatricosum* Mann. Edmonton, Alta., April 8, 1916, (F. S. Carr).

6183c. *Xylotrechus undulatus fuscus* Kby. Le Pas, Man., July 3, 1917; Mile 214, Hudson Bay Ry., July 5-26, 1917; Mile 332, Hudson Bay Ry., July 16, 1917, (J. B. Wallis). New to Manitoba.

6184. *Xylotrechus annosus* Say. Cawston, B.C., June 24, 1917, (W. R. Metcalfe).

6267. *Acmæops longicornis* Kby. Cawston, B.C., May 20, June 30, 1917, (W. R. Metcalfe).

6332b. *Leptura cribripennis* Lec. Cawston, B.C., Aug. 5, 1917, (W. R. Metcalfe).

Leptura rufibasis Lec. Mile 17, Hudson Bay Ry., July 2, 1917; called a variety of *subargentata,* (J. B. Wallis). New to Manitoba.

6361. *Leptura mutabilis* Newm. Husavick, Man., July 12, 1917, (L. H. Roberts).

6363. *Leptura aspera* Lec. Winnipeg, Man., May, 1917; Mile 332, Hudson Bay Ry., July 17, 1917. The Mile 332 specimen is the testaceous form, (J. B. Wallis). New to Manitoba.

Pogonocherus salicola Csy. Husavick, Man., July, 1914, (J. B. Wallis). New to Manitoba.

6444. *Graphisurus pusillus* Kirby. Husavick, Man., July 11, 1917, (L. H. Roberts). New to Manitoba.

Chrysomelidæ.

Prasocuris ovalis Blatch. Husavick, Man., July 3, 1917, (L. H. Roberts); seems undoubtedly to be this species. New to Canada (?).

6891a. *Diabrotica fossata* Lec. Winnipeg, Man., Aug. 23, 1916, (J. B. Wallis). New to Manitoba.

6932. *Oedionychis vians* Ill. Ft. Coulonge, Que., June 1, 1918, (J. I. Beaulne). Addition to Quebec list.

6982. *Crepidodera modeeri* Linn. Husavick, Man., July 8, 1917, (L. H. Roberts); Onah, Man., July 9, 1918, (L. H. Roberts, N. Criddle, J. B. Wallis). Swept from herbage in swamp.

7032. *Mantura floridana* Cr. Edmonton, Alta., Aug. 9, 1917, (F. S. Carr).

Bruchidæ.

7159. *Bruchus macrocerus* Horn. Edmonton, Alta., July 13, 1918, (F. S. Carr).

Tenebrionidæ.

7226a. *Phellopsis porcata* Lec. Lillooet, B.C., (E. P. Venables).

7488. *Anaedus brunneus* Ziegl. Husavick, Man., July 12, 1915, (J. B. Wallis). New to Manitoba.

7542. *Boletophagus depressus* Rand. Dauphin, Man., (Mrs. W. W. Hippisley). New to Manitoba.

Cistelidæ.

7626. *Mycetochares basillaris* Say. Miami, Man., July 6, 1914, (J. B. Wallis). New to Manitoba.

Melandryidæ.

7665. *Enchodes sericea* Hald. Dauphin, Man., 1918, (Mrs. W. W. Hippisley).

Pythidæ.

7707. *Crymodes discicollis* Lec. Vernon, B.C., (E. P. Venables).

Mordellidæ.

7766. *Anaspis atra* Lec. Mile 332, Hudson Bay Ry., July 17, 1917, (J. B. Wallis). *Atra* by Smith's table; locality suggests *nigra* (H. C. F.). New to Manitoba.

7778. *Mordella borealis* Lec. Mile 214, Hudson Bay Ry., Man., July 24-26, 1917; on orange-coloured fungous growth on spruce log, (J. B. Wallis). New to Manitoba.

7785. *Mordella serval* Say. Aweme, Man., July 24, 1903, (N. Criddle). New to Manitoba.

7795. *Mordellistena bicinctella* Lec. Aweme, Man., July 20, 1917, (N. Criddle). New to Manitoba.

7805. *Mordellistena vilis* Lec. Aweme, Man., June 19, 1917, (N. Criddle). New to Manitoba.

Mordellistena frosti Lilj. Aweme, Man., July 3, 1917, (N. Criddle). New to Canada.

7807. *Mordellistena decorella* Lec. Aweme, Man., July 7, 1911, (N. Criddle). New to Manitoba.

7819. *Mordellistena tosta* Lec. Aweme, Man., Aug. 2, 1917, (N. Criddle). New to Manitoba.

7833. *Mordellistena nigricans* Melsh. Aweme, Man., Aug. 10, 1917, (N. Criddle).

7840. *Mordellistena convicta* Lec. Aweme, Man., June 19, 1917, (N. Criddle). New to Manitoba.

7843. *Mordellistena morula* Lec. Aweme, Man., July 9, 1917, (E. Criddle). New to Manitoba.

Mordellistena divisa Lec. Aweme, Man., July 29, 1917, (N. Criddle). New to Manitoba.

7858. *Mordellistena æthiops* Smith. Aweme, Man., July 3, 1917, (N. Criddle). New to Manitoba.

Anthicidæ.

7918. *Notoxus talpa* Laf. Onah, Man., July 9, 1918, (Wallis, Roberts, Criddle); Aweme, Man., Aug., (J. Fletcher). New to Manitoba.

Anthicus hastatus Csy. Thornhill, Man., Aug. 19, 1917, (J. B. Wallis). "Does not agree with type in colour," (H. C. F.). New to Manitoba.

Meloidæ.

8103. *Epicauta corvinus* Lec. Husavick, Man., (E. Coates). New to Manitoba.

Rhynchitidæ.

8203. *Auletes congruus* Wlk. Mile 332, Hudson Bay Ry., July 17, 1917, (J. B. Wallis). New to Manitoba.

Otiorhynchidæ.

8245. *Ophryastes sulcirostris* Say. Boissevain, Man., Sept. 20, 1917, (N. Criddle).

Curculionidæ.

8367. *Apion punctinassum* Sm. Miami, Man., July 5, 1916; Onah, Man., July 9, 1916, (J. B. Wallis). New to Manitoba.

Apion nebraskense. Stony Mountain, Man., July 31, 1916, (J. B. Wallis). New to Manitoba.

8177. *Pissodes rotundatus* Lec. Grand Marais, Man., July 26, 1916, (J. B. Wallis). New to Manitoba.

10885. *Dorytomus vagenotatus* Csy. Winnipeg, Man., April 3-15, 1916, (J. B. Wallis); Darlingford, Man., April 23, June 4, 1916, (W. R. Metcalfe). New to Manitoba.

8571. *Endalus limatulus* Gyll. Winnipeg, Man., July 20, 1916, (J. B. Wallis). New to Manitoba.

8576. *Tanysphyrus lemnæ* Fab. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

8637. *Anthonomus scutellatus* Gyll. Winnipeg, Man., Aug. 2, 1916, (J. B. Wallis). Rare in Manitoba.

11006. *Anthonomus squamulatus* Dietz. Onah, Man., July 9, 1916, (J. B. Wallis.

11018. *Pseudanthonomus validus* Dietz. Husavick, Man., Aug., 1913, (J. B. Wallis). New to Manitoba.

8675. *Orchestes minutus* Horn. Onah, Man., July 9, 1918, (N. Criddle). New to Manitoba.

8676. *Orchestes rufipes* Lec. Mile 332, Hudson Bay Ry., July 13, 1917, (J. B. Wallis). New to Manitoba.

11079. *Phytobius griseomicans* Dtz. Miami, Man., July 5, 1916; Grand Marais, Man., July 26, 1916; Stony Mountain, Man., July 31, 1916; Le Pas, Man., June 30, 1917; Mile 17, Hudson Bay Ry., July 2, 1917; Mile 214, Hudson Bay Ry., July 6, 1917; Mile 256, Hudson Bay Ry., July 12, 1917, (J. B. Wallis). Probably equals European *velatus,* (H. C. F.). New to Manitoba.

Ceutorhynchus neglectus Blatchley. Edmonton, Alta., June 28, 1915, (F. S. Carr).

8727. *Conotrachelus posticatus* Boh. Thornhill, Man., July 1, 1916, (J. B. Wallis). New to Manitoba.

8735. *Conotrachelus anaglypticus* Say. Miami, Man., June 28, 1916, (J. B. Wallis). New to Manitoba.

Calandridæ.

Sphenophorus zeæ. Winnipeg, Man., July 1, 1916, (J. B. Wallis). New to Manitoba.

9044. *Rhyncholus brunneus* Mann. Onah, Man., July 9, 1918, (N. Criddle).

Ipidæ.

* *Lesperisinus criddlei* Sw. Aweme, Man., (N. Criddle); St. Hilaire, Que.; Bull. 14, pt. 2, p. 72, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Cryphalus canadensis* Chamberlain. Roger's Pass, B.C., Sept. 28, 1915, (J. M. Swaine); Bull. 14, pt. 2, p. 88, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Pityophthorus pseudotsugæ* Sw. Vernon, B.C., June 29, 1914, (J. M. Swaine); Bull. 14, pt. 2, p. 99, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Pityogenes knechteli* Sw. Jasper Park, Alta., Aug. 30, 1915, (J. M. Swaine); Nechako Valley, B.C., Atlin, B.C., Bull. 14, pt. 2, p. 106, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Ips laticollis* Sw. Near Ottawa, Ont., Bull. 14, pt. 2, p. 116, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Ips dubius* Sw. Roger's Pass, B.C., Sept. 28, 1915, (J. M. Swaine); Selkirks and Rockies, between Glacier, B.C., and Banff, Alta.; Bull. 14. pt. 2, p. 119, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

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.

* *Pachyrhina perdita* Dietz. Aweme, Man., Aug. 7, 1913, (E. Criddle); Trans. Amer. Ent. Soc., XLIV, 116.

* *Pachyrhina opacivittata* Dietz. Aweme, Man., (E. Criddle); Trans. Amer. Ent. Soc., XLIV, 123.

* *Pachyrhina festina* Dietz. Ridgeway, Ont., Aug. 15, 1910, (M. C. Van Duzee); Aweme, Man., (E. Criddle); Trans. Amer. Ent. Soc., XLIV, 126.

* *Pachyrhina obliterata* Dietz. Ottawa, Ont., July 26, 1912, (G. Beaulieu); Trans. Amer. Ent. Soc., XLIV, 133.

* *Tipula macrolaboides* Alex. "Hudson Bay Territory;" Can. Ent., L. 69.

Chironomidæ.

108\. *Johannesomyia* (*Ceratopogon*) *albaria* Coq. St. Louis, Que., Aug. 15, 1918, (J. Ouellet). Addition to Quebec list.

110\. *Palpomyia* (*Ceratopogon*) *subasper* Coq. St. Louis Que., Aug. 8, 17, 19, 1918, (J. Ouellet). Addition to Quebec list.

Mycetophilidæ.

Leia opima Lw. Outremont, Que., Aug. 25, (J. Ouellet). New to Canada. (J. M. A.).

* *Neosciara lobosa* Pettey. Carbonate, Columbia River, B.C., July 7-12, 1908, (J. C. Bradley); An. Ent. Soc. Amer., XI, 333.

* *Neosciara ovata* Pettey. Howser, Selkirk Mountains, B.C., June 22, 1905, (J. C. Bradley); An. Ent. Soc. Amer., XI, 336.

Bibionidæ.

166\. *Bibio nervosus* Lw. Outremont, Que., May 15, 1917, (J. Ouellet). Addition to Quebec list.

166\. *Bibio xanthopus* Wied. Montreal, Que., May 21, 1918, (A. F. Winn). Addition to Quebec list.

167\. *Dilophus obesulus* Lw. Outremont, Que., June 7, 1917; St. Louis, Que., July 8, 1918, (J. Ouellet). Addition to Quebec list.

167\. *Dilophus tibialis* Lw. St. Louis, Que., Aug. 8, 1918, (J. Ouellet). Addition to Quebec list.

Tabanidæ.

197\. *Chrysops mœchus* O. S. Joliette, Que., July 15, 1917, (J. Ouellet). Addition to Quebec list.

198\. *Chrysops striatus* O. S. St. Louis, Que., Aug. 3, 9, 1918, (J. Ouellet). Addition to Quebec list.

198\. *Chrysops univittatus* Macq. Joliette, Que., July 6, 22, 1918, (J. Ouellet). Addition to Quebec list.

Therevidæ.

247. *Psilocephala notata* Wied. Coniston, Ont., July 26, 1915, (H. S. Parish). Mr. J. Ouellet has also taken the species in Quebec Province. Addition to Quebec list.

247. *Psilocephala nigra* Say. Montreal, Que., Aug. 25, 1917; St. Louis, Que., Aug. 3, 1918, (J. Ouellet). Addition to Quebec list.

Mydaidæ.

251. *Mydas clavatus* Dr. Longwood, Ont., July 4, 1918, (G. Blair).

Asilidæ.

Asilus erythrocnemius Hine. Montreal, Que., Aug. 28, 1917; Joliette, Que., Aug. 15, 1917; St. Louis, Que., Aug. 3, 1918, (J. Ouellet). Addition to Quebec list.

283. *Asilus paropus* Walk. St. Louis, Que., Aug. 6, 1918, (J. Ouellet). Addition to Quebec list.

Dolichopodidæ.

297. *Hydrophorus chrysologus* Walk. St. Louis, Que., Aug. 6, 20, 1918, (J. Ouellet). Addition to Quebec list.

Empidæ.

* *Drapetis aliternigra* Mel. "British Columbia;" An. Ent. Soc. Amer., XI, 192.

* *Drapetis infumata* Mel. Nelson, B.C., July 17, 1910; An. Ent. Soc. Amer., XI, 194.

* *Drapetis setulosa* Mel. "British Columbia;" An. Ent. Soc. Amer., XI, 196.

* *Endrapetis facialis* Mel. Medicine Hat, Alta., (J. R. Malloch); An. Ent. Soc. Amer., XI, 200.

Microsania imperfecta Lw. Aweme, Man., Sept. 18, 1915, (N. Criddle).

317. *Syneches pusillus* Lw. Terrebonne, Que., Aug. 20, 1918; St. Louis, Que., Aug. 13, 1918, (J. Ouellet). Addition to Quebec list.

331. *Rhamphomyia irregularis* Lw. Outremont, Que., May 19, 1917, (J. Ouellet). Addition to Quebec list.

Phoridæ.

Aphiochæta evarthæ Mall. Strathroy, Ont., Aug. 14, 1918, (H. F. Hudson).

Syrphidæ.

Pipiza festiva Mg. Mount Royal, Que., May 21, June 2, 1918, (J. Ouellet).

350. *Pipiza pisticoides* Will. Mount Royal, Que., May 23, June 2, 1918, (J. Ouellet). Addition to Quebec list.

363. *Didea laxa* O. S. Outremont, Que., Sept. 19, 1918, (J. Ouellet). Addition to Quebec list.

Syrphus perplexus Osb. Outremont, Que., June 5, Sept. 1, 1918, (J. Ouellet); Rawdon, Que., Aug. 12, 1917. Addition to Quebec list.

377. *Volucella bombylans americana* Jns. Montreal, Que., June 28, 1917, (J. Ouellet). Addition to Quebec list.

393. *Helophilus hamatus* Lw. St. Louis, Que., Aug. 16, 1918, (J. Ouellet). Addition to Quebec list.

393. *Helophilus laetus* Lw. Outremont, Que., June 5, 1917; St. Louis, Que., Aug. 16, 1918, (J. Ouellet). Addition to Quebec list.

399. *Xylota fraudulosa* Lw. Outremont, Que., May 15, June 2, 1918, (J. Ouellet). Addition to Quebec list.

Conopidæ.

412. *Oncomyia modesta* Will. St. Louis, Que., Aug. 15, 1918, (J. Ouellet). Addition to Quebec list.

Tachinidæ.

Viviania lachnosternæ Tns. St. Remi, Que., June 24, 1918, (J. Ouellet). New to Canada, (J. M. A.).

(*Imitomyia*) *Himantostoma sugens* Lw. According to Aldrich *Saskatchewania canadensis*, records of which occur in the Ent. Record for 1915, is evidently the long lost *H. sugens.*

433. *Hypostena barbata* Coq. St. Louis, Que., Aug. 3, 1918, (J. Ouellet). Addition to Quebec list.

440. *Eutrixa exilis* Coq. Outremont, Que., May 19, 1917, (J. Ouellet). Addition to Quebec list.

441. *Xanthomelana flavipes* Coq. Terrebonne, Que., Aug. 19, (J. Ouellet). New to Canada, (J. M. A.).

445. *Metaplagia occidentalis* Coq. Joliette, Que., July 10, 1917, (J. Ouellet). Addition to Quebec list.

Panzeria ampelos Walk. Outremont, Que., May 20, 1917; Sept. 19, 1918: Joliette, Que., July 5, 24, 1918; St. Louis, Que., Aug. 7, 1918, (J. Ouellet). Addition to Quebec list.

Exorista caesar Ald. "I lately got some material for determination which almost convinced me that my *Exorista caesar,* a Canadian fly, is a synonym of *nigripalpis* Tns. The point of difference was the existence of one, or several bristles on the outer front side of the middle tibia: I now think this is sometimes variable, though usually constant." (J. M. A.).

461. *Phorocera erecta* Coq. Mount Royal, Que., May 23, 1918, (J. Ouellet). New to Canada, (J.M.A.).

470. *Tachina robusta* Tns. Newaygo, Argenteuil Co., Que., June 17, 1917. (A. F. Winn). No definite Quebec record in Quebec list.

475. *Phorichaeta sequax* Will. Outremont, Que., July 29, 1917, Sept. 16, Oct. 1, 1918; St. Louis, Que., July 30, 1918, (J. Ouellet). No Quebec records in Quebec list.

488. *Echinomyia decisa* Wlk. Cap a l'Aigle, Que., Aug. 3-17, 1918, (A.F. Winn); Mount Royal, Que., June 15, 1918, (J. Ouellet). Addition to Quebec list.

Dexiidæ.

Thelairodes clemonsi Tns. St. Remi, Que., June 25, (J. Ouellet). New to Canada, (J.M.A.).

Sarcophagidæ.

Sarcophaga latisterna Pk. Outremont, Que., May 20, June 23, Aug. 22. 1918, (J. Ouellet). Addition to Quebec list.

Sarcophaga cooleyi Pk. Allan, Sask., Aug. 11, 1917, (A. E. Cameron).

Sarcophaga marginata Ald. Outremont, Que., Sept. 13, 1918, (J. Ouellet). Addition to Quebec list.

* *Sarcophaga vancouverensis* Pk. Vancouver, B.C., May 12, 19, 1916; June 11, 1916; Savory Island, July 3, 1916; Bd. Bay, May 22, 1915, (R. S. Sherman). Can. Ent., L, 123.

Muscidæ.

Phormia azurea Fall. Outremont, Que., July 28, 1917, (J. Ouellet). Addition to Quebec list.

525. *Pyrellia cyanicolor* Zett. Outremont, Que., May 21, 23, 1917, (J. Ouellet). Addition to Quebec list.

Anthomyidæ.

Hydrotæa houghi Mall. Outremont, Que., Sept. 21, 1917, (J. Ouellet). Addition to Quebec list.

* *Pogonomyia minor* Mall. Farewell Creek, Sask.; Trans. Amer. Ent. Soc., XLIV, 280.

544. *Mydæa duplicata* Mg. Outremont, Que., May 15, Aug. 25, 1917, (J. Ouellet). Addition to Quebec list.

545. *Spilogaster signia* Wlk. Montreal, Que., Oct. 14, 1918, (A. F. Winn). Addition to Quebec list.

Limnophora brunneisquama Mall. St. Remi, Que., June 25, 1918, (J. Ouellet). Addition to Quebec list.

* *Fannia spathiophora* Mall. Gold Rock, Rainy River District, Ont., July 21, 1905, (H. H. Newcombe); Trans. Amer. Ent. Soc., XLIV, 294.

546. *Mydæa uniseta* Stein. Outremont, Que., June 11, Sept. 18, 1918, (J. Ouellet). Addition to Quebec list.

Mydæa rufitibia Stein. Outremont, Que., May 15, 1917, (J. Ouellet). Addition to Quebec list.

Mydæa nitida Stein. Outremont, Que., May 28, (J. Ouellet). Addition to Quebec list. (=*nigripennis* Walk. J.M.A.).

548. *Anthomyia albicincta* Fall. St. Louis, Que., Aug. 15, 1918, (J. Ouellet). Addition to Quebec list.

Hylemyia coenosiæformis St. St. Louis, Que., July 30, Aug. 15, 1918, (J. Ouellet). Addition to Quebec list.

* *Hylemyia pluvialis* Mall. Gold Rock, Ont., July 21, (H. H. Newcombe); Can. Ent. L, 310.

Hylemyia tenax Johannsen. Joliette, Que., July 10, 1918, (J. Ouellet). Addition to Quebec list.

558. *Pegomyia affinis* Stein. St. Louis, Que., Aug. 8, 1918, (J. Ouellet). Addition to Quebec list.

* *Fucellia æstuum* Ald. Vancouver, B.C., Aug. 8, 1917, (Melander); Pender Island, B.C., (Aldrich); Proc. Cal. Acad. Sci., VIII, 157-179.

Cœnosia humilis Mg. Outremont, Que., Sept. 13, 20, 1918, (J. Ouellet). Addition to Quebec list.

561. *Cœnosia hypopygialis* St. St. Remi, Que., June 25, 1918, (J. Ouellet). New to Canada, (J.M.A.).

Lispocephala alma Mg. Mount Royal, Que., April 16, (J. Ouellet). Addition to Quebec list.

Scatophagidæ.

565. *Cordylura latifrons* Lw. St. Louis, Que., Aug. 14, 17, 1918, (J. Ouellet). New to Canada, (J.M.A.).

567. *Hydromyza confluens* Lw. Brome Lake, Que., Aug. 1, 1917, (A. F. Winn). Addition to Quebec list.

567. *Opsiomyia palpalis* Coq. St. Louis, Que., Aug. 16, 1918 (J. Ouellet). New to Canada, (J.M.A.).

Heteroneuridæ.

Clusia czernyi Johnson. Outremont, Que., May 31, 1917, June 15, 20, 1918, (J. Ouellet). Addition to Quebec list.

Helomyzidæ.

Helomyza plumata Lw. Mount Royal, Que., June 15, 1917, (J. Ouellet). Addition to Quebec list.

Leria serrata L. Outremont, Que., May 6, 18, 1917, (J. Ouellet). Addition to Quebec list.

Borboridæ.

Borborus marmoratus Becker. St. Louis, Que., Aug. 13, 1918, (J. Ouellet). Addition to Quebec list.

Sciomyzidæ.

579. *Tetanocera lineata* Day. Mount Royal, Que., Sept. 20, 1917; St. Louis, Que., Aug. 7, 19, 1918, (J. Ouellet). Addition to Quebec list.

Sapromyzidæ.

Sapromyza similata Mall. Mount Royal, Que., June 13, 1917, Aug. 11, 1917, (J. Ouellet). New to Canada, (J.M.A.).

Trypetidæ.

603. *Acidia fratria* Lw. Montreal, Que., June 23, 1917, (J. Ouellet).

Rhagoletis fausta O. S. =*intrudens* Ald. Aweme, Man., reared from fruit of *Prunus pennsylvanica*, (N. Criddle).

Micropezidæ.

617. *Calobata pallipes* Say. St. Louis, Que., July 30, 1918, (J. Ouellet). Addition to Quebec list.

Sepsidæ.

Sepsis signifera curvitibia M. & S. Outremont, Que., Sept. 21, 1917, (J. Ouellet). Addition to Quebec list.

Piophila oriens Mel. Outremont, Que., May 16, 1918, (J. Ouellet). New to Canada, (J.M.A.).

Piophila pusilla Mg. Outremont, Que., Sept. 23, 1918, (J. Ouellet). Addition to Quebec list.

Psilidæ.

621. *Chyliza notata* Lw. Montreal, Que., May 23, 1917, (J. Ouellet). Addition to Quebec list.

Ephydridæ.

Hyadina nitida Macq. Aweme, Man., July 19, 1916, (N. Criddle). An European species, new to Canada.

629. *Parydra limpidipennis* Lw. St. Louis, Que., Aug. 7, 19, 1918, (J. Ouellet). New to Canada, (J.M.A.).

630\. *Scatella oscitans* Wlk. Outremont, Que., June 17, 1917, Sept. 23, 1917; St. Louis, Que., Aug. 14, 1918; St. Remi, Que., June 28, 1918, (J. Ouellet). Addition to Quebec list.

Atissa pygmæa Haliday. Aweme, Man., (N. Criddle). An European species, new to Canada.

Oscinidæ.

633\. *Chlorops crocota* Lw. Aweme, Man., Aug. 11, 1917, (N. Criddle).

634\. *Chlorops rubicunda* Adams. Aweme, Man., (N. Criddle).

Elachiptera melampus Lw. Aweme, Man., (N. Criddle).

Elachiptera nigriceps Lw. Outremont, Que., Sept. 22, 1917, (J. Ouellet). Addition to Quebec list.

Siphonella finalis Beck. Aweme, Man., (N. Criddle).

* *Dicræus incongruus* Ald. Treesbank, Man., (N. Criddle); Can. Ent. L. 340

Oscinis anthracina Lw. Aweme, Man., (N. Criddle).

Osinis incerta Beck. Aweme, Man., (N. Criddle).

Oscinis frontalis Tucker. Aweme, Man., (N. Criddle).

* *Oscinis criddlei* Ald. Treesbank and Aweme, Man., (N. Criddle); Can. Ent. L, 341.

* *Oscinis scabra* Ald. Treesbank, Man., May 6, 1916; Aweme, Man., Sept. 12, Oct. 13, 1916; Estevan, Sask., May 20, 1916, (N. Criddle); Can. Ent. L, 342.

Oscinis frit L. Outremont, Que., (J. Ouellet). Addition to Quebec list.

* *Lasiosina canadensis* Ald. Ogema, Sask.; Estevan, Sask.; Treesbank, Man.; Aweme, Man., (N. Criddle); Can. Ent. L, 337.

Lasiosina similis Mall. Aweme, Man., (N. Criddle).

Geomyzidæ.

Chyromya femorella Fall. Outremont. Que., (J. Ouellet). An European species, new to Canada.

Agromyzidæ.

Agromyza pusilla Mg. St. Louis, Que., Aug. 14, 1918, (J. Ouellet). Addition to Quebec list.

Agromyza posticata Mg. Mount Royal, Que., Sept. 10, 22, 1917; Outremont Que., May 28, 1917, (J. Ouellet). Addition to Quebec list.

Agromyza coquilletti Mall. St. Louis, Que., July 30, 1918; Aug. 13, 1918, (J. Ouellet). Addition to Quebec list.

Agromyza laterella Zett. Terrebonne, Que., Aug. 20, 1918, (J. Ouellet). Addition to Quebec list.

Agromyza vibrissata Mall. Outremont, Quebec., Sept. 19, 1917, (J. Ouellet). Addition to Quebec list.

648\. *Agromyza parvicornis* Lw. Outremont, Que., Sept. 8, 1917, (J. Ouellet). Addition to Quebec list.

Desmometopa latipes Mg. Aweme, Man., (N. Criddle).

HYMENOPTERA.

Vipionidæ.

Opius fuscipennis Gahn. Aweme, Man., July 1, 1918; reared from *Rhagoletis fausta* O. S., (N. Criddle).

Braconidæ.

* *Microbracon cephi* Gahan. Treesbank, Man.; reared from *Cephus cinctus* in stems of *Elymus canadensis*, (N. Criddle). Proc. Ent. Soc. Wash. XX, 19.

Serphidæ.

Serphus caudatus Say. Aweme, Man., Aug. 28, 1915, (N. Criddle).

Formicidæ.

Formica bradleyi Wheeler. Aweme, Man., May 30, 1916, (N. Criddle).

Camponotus abdominalis stercorarius Forel. Lillooet, B.C., found on imported bananas probably from Central or South America; determined by W. M. Wheeler, (A. W. A. Phair).

Audrenidæ.

* *Andrena columbiana* Vier. Mission, B.C., Aug. 8, 1904, (R. V. Harvey); Trans. Amer. Ent. Soc., XLIII, 374.

* *Andrena persimulata* Vier. Montreal Island, Que.; Trans. Amer. Ent. Soc., XLIII, 390.

Apidæ.

Diadasia australis Cr. Lethbridge, Alta., June 28, 1914, on *Opuntia*, (F. W. L. Sladen).

Diadasia diminuta Cr. Salmon Arm, Vernon, B.C., on mallow, (F. W. L. Sladen).

HEMIPTERA.

(Arranged according to a Catalogue of the Hemiptera of America, North of Mexico—excepting the Aphididæ, Coccidæ and Aleurodidæ; by E. P. Van Duzee; University of California Publications, 1917.)

Aphididæ.

* *Symydobius americanus* Baker. Puslinch Lake, near Guelph, Ont., 1909, (A. C. Baker); Can. Ent. L, 318.

Pentatomidæ.

184. *Banasa calva* Say. Jordan, Ont., May 11, 1918, (W. A. Ross).

Coreidæ.

247. *Leptoglossus occidentalis* Heid. Jordan, Ont., June 30, 1917, (W. A. Ross).

348. *Corizus lateralis* Say. Jordan, Ont., Sept. 9, 1918, (W. A. Ross).

Lygaeidæ.

* *Peritrechus saskatchewanensis* Barber. Oxbow, Sask., (F. Knab); Jour. N.Y. Ent. Soc. XXVI, 60

Tingididæ.

639. *Corythucha arcuata* Say. Aweme, Man., June 14, 1918, on *Quercus macrocarpus*, (N. Criddle).

640. *Corythucha pergandei* Heid. Halifax, N.S., 1897, (W. H. Harrington).
Corythucha cydoninae Fitch. Aweme, Man., Aug. 9, 1918, (N. Criddle); on *Cratægus* and *Amalanchier spicata.*
Corythucha immaculata O. & D. Lillooet, B.C., (A. W. A. Phair).
Corythucha heidemanni Drake. Ottawa, Ont., (W. H. Harrington).
Corythucha hewitti Drake. Aweme, Man., July 9, 1918, on *Corylus americana,* (N. Criddle).
Corythucha salicis O. & D. Trenton, Ont., Sept. 1, 1910, (J. D. Evans); Aweme, Man., Aug. 13, 1918, on *Salix discolor,* (N. Criddle).
Corythucha elegans Drake. Hastings Co., Ont., July 27, 1903, (J. D. Evans); Ottawa, Ont., Oct. 13, 1908, on poplar, (H. Groh).
Corythucha betulæ Drake. Ottawa, Ont., (W. H. Harrington).

Anthocoridæ.

847. *Xylocoris sordidus* Reut. Bowmanville, Ont., Aug. 19, 1913, (W. A. Ross).

Miridæ.

1019. *Lygus hirticulus* Van D. Jordan, Ont., July 9, 1915, (W. A. Ross).

Cicadellidæ.

* *Erythroneura ador* McAtee. Halifax, N.S., Aug. 5, 1917, Sept. 1, **1917**; Can. Ent., L, 361.
* *Typhlocyba cimba* McAtee. Halifax, N.S., Sept. 1, 1917; Can. Ent., L, 360.

Odonata.

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

Coenagrionidæ.

54. *Enallagma antennatum* Say. Ironside, Que., (L. M. Stöhr).
60. *Enallagma hageni* Walsh. Red Deer, Alta., June 23, 1918; new to Alberta list, (F. C. Whitehouse).
65. *Nehalennia posita* Hagen. Ironside, Que., (L. M. Stöhr).
67. *Chromagrion conditum* Hagen. Ironside, Que., (L. M. Stöhr).

Aeshnidæ.

82. *Hagenius brevistylus* Selys. Ironside, Que., (L. M. Stöhr). First definite record from Quebec province, (E.M.W.).
83. *Ophiogomphus anomalus* Harvey. Ironside, Que., (L. M. Stöhr). Not previously recorded from Canada; I have, however, seen specimens from L. Nipigon, Ont., (E.M.W.).
97. *Gomphus spicatus* Hagen. Ironside, Que., (L. M. Stöhr). First record from Quebec province, (E.M.W.).
77. *Cordulegaster obliquus* Say. Ironside, Que., (L. M. Stöhr). First undoubted record from Quebec province, Provanchier's specimens being of uncertain identity, (E.M.W.).

Libellulidæ.

* *Sommatochlora kennedyi* E. M. Walk. Mer Bleue, near Ottawa, June 9, 1903, (A. Gibson); Godbout River, Que., July 29, 1918, (Walker); De Grassi Point, Ont., June 19, 1917, (Walker); Can. Ent., L, 371.

138. *Libellula luctuosa* Burm. Ironside, Que., (L. M. Stöhr). New to Quebec province.

PLECOPTERA.

* *Protarcys bradleyi* Smith. Lake Louise, Alta., June 25, 1908; Rogers Pass, B.C. Aug. 7, 1908; Ground Hog Basin, Selkirk Mtns., B.C., July 22—Aug. 7, 1905, (J. C. Bradley); Trans. Amer. Ent. Soc., XLIII, 470.

COLLEMBOLA.

Mr. Charles Macnamara, of Arnprior, Ont. has continued his studies of these insects, and during 1918 he has collected the following around Arnprior. These have not been previously noted.

* *Isotoma macnamarai* Folsom; Can. Ent., L. 291.
Seira buskii Lubbock.
Papirius maculosus Schott.
Sminthurus aquaticus Bourlet.
Sminthurus quadrimaculatus Ryder.
Sminthurus malmgreni elegantulus Reuter.

In addition to the above it is of interest to record *Achorutes harveyi* Folsom, from Aweme, Man., (N. Criddle). In the same locality the same collector has found *Isotoma viridis riparia* Nicolet.

INDEX

Ontario Department of Agriculture

Fiftieth Annual Report

OF THE

Entomological Society

OF ONTARIO

1919

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
1920

Ontario Department of Agriculture

Fiftieth Annual Report

OF THE

Entomological Society

OF ONTARIO

1919

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
1920

Printed by
THE RYERSON PRESS

To His Honour, LIONEL H. CLARKE,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

I have the honour to present herewith for your consideration, the Report of the Entomological Society for 1919.

Respectfully submitted,

MANNING W. DOHERTY,

Minister of Agriculture.

Toronto, 1920.

CONTENTS

Entomological Society of Ontario

OFFICERS FOR 1919-1920

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

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

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

Curator—Captain G. J. Spencer, B.S.A., 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. J. M. Swaine, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, Mr. C. E. Grant, Orillia; Division No. 3, Dr. A. Cosens, Toronto; Division No. 4, Mr. F. J. A. Morris, Peterborough; Division No. 5, Mr. J. W. Noble, Essex; Division No. 6, Mr. J. F. Hudson, Strathroy; Division No. 7, Mr. W. A. Ross, Vineland Station.

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

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

Delegate to the Royal Society of Canada—The President.

FINANCIAL STATEMENT

For the year ending October 31st, 1919

Receipts.		*Expenditures.*	
Cash on hand, 1917-18	$57 28	Expense	$25 50
Advertisements	46 00	Printing	1550 07
Back Numbers	192 10	Annual meeting	105 65
Members' Dues	124 40	Annual Report	25 00
Subscriptions	470 11	Salary	100 00
Bank Interest	2 64	Library	3 50
Government Grant	1000 00	Cash on hand	82 81
	$1892 53		$1892 53

To balance due on printing	$230 81
By cash on hand	82 81
Net Deficit	$148 00

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

Entomological Society of Ontario

ANNUAL MEETING.

The Fifty-sixth Annual Meeting of the Entomological Society of Ontario was held at Ottawa on Thursday and Friday, November 6th and 7th, 1919. The chair was occupied by the President, Prof. L. Caesar.

The following members were present: Prof. W. H. Brittain, Truro, N.S.: Mr. George Sanders, Annapolis Royal, N.S.; Mr. J. D. Tothill, Fredericton, N.B.: Prof. W. Lochhead, Macdonald College, Que.; Mr. A. F. Winn, Westmount, Que.: Dr. J. A. Corcoran and Mr. G. C. Moore, Montreal, Que.; Rev. Father Leopold and Mr. F. Letourneaux, Oka, Que.; Mr. C. E. Petch, Covey Hill, Que.; Dr. C. G. Hewitt and J. McDunn; Messrs. A Gibson, J. M. Swaine, C. B. Hutchings, E. F. Strickland, F. W. L. Sladen, C. B. Gooderham, J. I. Beaulne, L. S. McLaine, V. Kitto and Drs. J. McDunnough and S. Hadwen, Ottawa, Ont.; Mr. F. J. A. Morris, Peterborough, Ont.; Mr. H. F. Hudson, Strathroy, Ont.; Mr. W. A. Ross, Vineland, Ont.; Mr. N. Criddle, Treesbank, Man., and Mr. R. C. Treherne, Vancouver, B.C.

Among the visitors were Mr. C. L. Marlatt, Washington, D.C.; Prof. Cummings, Mass.; Prof. W. A. Macoun and Mr. E. S. Archibald, Ottawa.

Letters of regret at their inability to attend the meeting were received from the following: Dr. W. E. Britton, New Haven, Conn.; Prof. G. C. Crampton, Amherst, Mass.; Dr. E. P. Felt, Albany, N.Y.; Dr. H. T. Fernald, Amherst, Mass.; Dr. T. J. Headlee, New Brunswick, N.J., and Mr. J. J. Davis, Riverton, N.J.

On Thursday morning a meeting of the Council was held at which several matters of importance to the Society were brought up and discussed. In view of the increasing deficit shown by the Treasurer's Report it was decided that the fee to Canadian members of the Society, including members of Branches, be increased to $2.00, and that in lieu of all expenses only the railway fares of the Directors and Officers of the Society be paid.

In the afternoon the general meeting was called to order by the President and the proceedings commenced with the reading of the Report of the Council, followed by those of the Treasurer, Librarian, Curator and of the various Branches of the Society.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1918-1919.

The Fifty-fifth Annual Meeting of the Society was held at the Ontario Agricultural College, Guelph, on Wednesday and Thursday, December 4th and 5th, 1918. Owing to the prevalence of influenza, the meeting was held at a much later date than usual. The chair was occupied by the President, Professor Lawson Caesar, O. A. College. The attendance was very good, including members of the Society from Nova Scotia, New Brunswick, Quebec, Ontario and Manitoba. Mr. J. J. Davis, West Lafayette, Ind., Prof. J. P. Parrott, Geneva, N.Y. and Prof. R. Matheson, Ithaca, N.Y., were welcome visitors.

By the kindness of Dr. Creelman, all those in attendance who came from a distance, were entertained in the College Residence during their stay in Guelph. This arrangement added much to their pleasure and comfort by affording many opportunities for social converse and by saving the time usually spent in travelling to and from the town. This hospitality was greatly appreciated by all present, and a hearty vote of thanks was accorded at the close of the meeting to President Creelman and to the Matron and the Superintendent of the Dining Hall.

At a meeting of the Council, held on Wednesday morning, it was decided to enlarge the pages of *The Canadian Entomologist* in order to be uniform with the standard size of bulletins, and also to issue ten instead of twelve numbers per annum, but at the same time to make no reduction in the amount of reading matter.

During the afternoon of Wednesday and on Thursday, a number of interesting and valuable papers were read and discussed, of which the following is a list:—Reports on insects of the year in their respective districts by Directors, Dr. A. Cosens, Toronto, Mr. F. J. A. Morris, Peterborough and Mr. J. W. Noble, Essex. Insects of the season in Ontario, by Mr. W. A. Ross, Vineland, and of Quebec by Mr. G. Maheux, Quebec; "Aphids; their human interest," by Dr. A. C. Baker, Washington, D.C.; "Insect problems in the Prairie Provinces," by Mr. Norman Criddle, Treesbank, Man.; "The recovery in Canada of the Brown-tail Moth Parasite, Compsilura concinnata," by Messrs. J. D. Tothill and L. S. McLaine; "The Life-history of a Hobby Horse" by Mr. F. J. A. Morris; "Present day problems in Entomology," by Mr. J. J. Davis; "Insects as agents in the dissemination of Plant Diseases," by Prof. Caesar; "The Cabbage-root Maggot," by H. C. Huckett; "Some chapters of the early history of Entomology," by Prof. Lochhead; "The Pear Psylla in Ontario," by Mr. W. A. Ross; "Our Garden Slugs," by Mr. G. Maheux; and "The Entomological Record for 1918," by Mr. Arthur Gibson. The reports of the Montreal, Toronto, Nova Scotia, and British Columbia Branches and of the Librarian and Curator were also presented and read.

The Canadian Entomologist, the official organ of the Society, completed its fiftieth volume in December last; the event was commemorated by a poem from the pen of Mr. F. J. A. Morris, which opened the fifty-first volume. This volume will be completed by the issue of the forthcoming November and December numbers. The semi-centennial volume contained 433 pages, illustrated by 12 full page plates and 21 figures in the text. The contributors to its pages numbered 57 and included writers in Ontario, Quebec, Nova Scotia, Manitoba, Alberta and British Columbia, and also in twelve of the United States. In the systematic articles there were described five new genera, 103 new species and four new varieties of insects. The series of papers published each month on "Popular and Practical Entomology" has continued to form an attractive as well as an instructive feature for the benefit of the general reader.

The number of members of the Society continues to be much the same from year to year. At the end of 1918 there were 179 on the list, including those on military service overseas. During the current year 26 have left us owing to deaths and withdrawals, while the same number of new members has been added to the roll.

It is again the sad duty of the Council to record the loss of one of our ablest and most active Entomologists, Mr. Frederic Hova Wolley Dod, of Midnapore, Alberta, who died of Enteric Fever on the 24th of July, at 49 Hospital, Chanak. His rank was Second Lieutenant in the Yorkshire Light Infantry attached to the

Macedonian Labour Corps. Though beyond the age prescribed for military service, his patriotic spirit compelled him to do what lay in his power for the welfare of the Empire. He accordingly went to England and succeeded in obtaining a commission and being sent out with a Labour Corps to Macedonia. Mr. Wolley Dod devoted himself to the Lepidoptera and became the highest authority in North America on the Noctuid Moths. He published in the *Canadian Entomologist* a long series of papers, extending over many years, on the synonymy and classification of this difficult family.

REPORT OF THE LIBRARIAN.

Owing to the lack of funds available for the purpose, only one book has been bought for the Library during the year now drawn to a close, namely, "Illustrations of the North American species of the genus Catocala" by Drs. Barnes and McDunnough, published by the American Museum of Natural History, New York. Seven bound volumes have been received, making the total number 2,292. A notable gift to the Library has been made by the Rev. Dr. Fyles, a Life-member and Ex-President of the Society. It is a large folio volume, handsomely bound in red leather and entitled "Illustrations in Natural History." It contains 107 water-colour drawings, chiefly of insects, but including a few depicting flowers, birds, reptiles and other creatures. It was presented by the author "as a token of his appreciation of the great pleasure and profit his connection with the Society has afforded him."

The Library continues to receive a large number of periodicals in exchange for *The Canadian Entomologist* and a great variety of bulletins, reports and pamphlets, many of which should be collected into volumes and bound for convenient reference.

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE CURATOR.

Mr. Eric Hearle resigned the position of curator last spring on account of his departure for British Columbia where he has been studying mosquitoes during the summer. In the meantime I have myself, assisted at first by Mr. H. G. Crawford and later by Mr. G. J. Spencer, looked after the collection. They are all in good condition and have been so throughout the year. Very few new insects have been added.

L. CAESAR, *President.*

REPORT OF THE TORONTO BRANCH.

October 9th, 1919.—The 23rd Annual Meeting of the Toronto Branch was held in the Biological Building of the University of Toronto.

The report of the Council showed that seven regular meetings and one annual meeting were held during the year, and that the average attendance was fifteen persons.

The annual meeting held on November 21st, 1918 was an open meeting for general discussion of entomological topics. But at the regular meetings a variety of papers were read, these were as follows:—

Dec. 6th, 1918—"The Natural Control of Insects." By Mr. John D. Tothill, of Fredericton, N.B.
Jan. 9th, 1919—"Insects as Food of Trout." By Dr. W. A. Clemens.
Feb. 6th, 1919—"A Month on the Lower St. Lawrence." By Dr. E. M. Walker.
Feb. 27th, 1919—"Notes on the Biology of Stoneflies." By Mrs. W. A. Clemens.
Mar. 21st, 1919—"Insect Life in British Honduras." By N. K. Bigelow.
April 24th, 1919—"Investigations into the Habits of the Nymphs of the Mayflies of Genus Chirotonetes." By Dr. W. A. Clemens.
Also "Insectivorous Birds in Ontario." By Dr. E. M. Walker.
May 29th, 1919—"The Food and Feeding Habits of some Larval Hymenoptera." By Dr. A Cosens.

The report of the Librarian showed that many publications had been received during the year, and that these had been catalogued and filed.

The financial statement showed a balance on hand of $22.47.

It was owing to the epidemic of influenza in the autumn of 1918 that the annual meeting was not held until November.

Three new members: Mrs. W. A. Clemens, Mr. N. K. Bigelow, and Mr. H. Hesket were elected during the year.

After the reading of the annual report, one new member, Mr. R. W. Hall, was nominated and elected a member of the Toronto Branch.

The election of officers was then proceeded with, the results were as follows:

President, Mr. H. V. Andrews; Vice-President, Mr. S. Logier; Secretary-Treasurer, Miss Norma Ford; Librarian, Mr. N. K. Bigelow; Council, Dr. E. M. Walker, Dr. W. A. Clemens, Dr. A. Cosens, Mr. T. B. Kurata, Mr. J. Hannibal, Mr. C. K. Brobst.

When the annual business was finished the meeting was left open for general discussions in entomology and for notes and observations of the season. Those present at the meeting were: Dr. Clemens, Dr. Walker, Miss Ford, Mr. A. W. Baker of the Parent Society, Messrs. Andrews, Hannibal, Wright, Bigelow, Hall, Logier, and two visitors.

It is with sincere regret that the Toronto Branch record the death of Mr. Chas. M. Snazelle, who had been a member since 1912. During the last two years he had been unable to attend the meetings owing to business obligations in connection with war work. Mr. Snazelle was an enthusiastic student of nature both in entomology and in other branches, and his presence at our meetings will be greatly missed through the coming days.

Shelley Logier, *Sec.-Treasurer.*

REPORT OF THE MONTREAL BRANCH.

The 46th Annual Meeting of the Montreal Branch of the Entomological Society of Ontario was held in the Lyman Entomological Room, Redpath Museum, McGill University, on May 17th, 1919.

During the season 1918-1919 we held eight meetings with a total attendance of seventy or an average of nine per meeting. This was smaller than that of the previous season, which however was the largest on record because of a large public meeting held in 1918. We did not hold such a meeting during the past season, but nevertheless we had successful meetings and the interest was keen.

We have added several recruits to our ranks and hope they will all become ardent entomologists.

We held our regular Victoria Day outing to St. Hilaire and those who were able to go were rewarded as usual from this good collecting ground.

Our Society provided the programme at the Natural History Society's meeting in March.

The Treasurer's Report showed a balance of $158.61 on hand.

The following papers and talks were given during the year:—

1. Annual Address, Subject "Tables" .... A. F. Winn.
2. Collecting in California .... H. F. Simms.
3. Preparation of Hemiptera lists .... Geo. A. Moore.
4. Hemiptera taken at St. Hilaire, May 24th, 1918 .... Geo. A. Moore.
5. Larvæ of Parnidae .... Dr. F. S. Jackson.
6. Notes on the Season 1918—"Hemiptera" .... Geo. A. Moore.
7. Argynus apachana St. and Edwards' Plates of A. nokomis .... A. F. Winn.
8. Economic importance of Samia Cecropia .... Dr. Corcoran.
9. Enodia portlandia Fab. at Oka .... G. Chagnon.
10. Zerene cæsonia Stal. the Dog's Head Butterfly .... A. F. Winn.
11. On which plant to collect Chalæpus nervosa Say .... Brother Ouellet.
12. The Milkweed Bug. Lygæus Kalmii Stal. .... Geo. A. Moore.
13. British Burnets .... Lachlan Gibb.
14. Muscoid larvae found in a human patient .... Dr. F. S. Jackson.
15. The Raspberry Root Borer or Clear Wing Borer, Bembecia marginata Han. .... A. F. Winn.
16. Notes on some localities outside Montreal Island .... Brother Ouellet.
17. The Periodical Cicada .... Geo. A. Moore.
18. Lantern Lecture, Nature Photography .... G. H. Hall.
19. Cercopidæ, Spittle Insects .... Geo. A. Moore.

Geo. A. Moore, *Secretary.*

REPORT OF THE BRITISH COLUMBIA BRANCH.

The 18th Annual Meeting of the British Columbia Branch was held in the biology lecture room at the University of British Columbia, Vancouver, on Saturday, March 15th, 1919. In the absence of the President, Mr. R. S. Sherman, owing to sickness, the chair was taken by the Vice-President for the Coast, Mr. W. Downes.

The Secretary-Treasurer, Mr. Williams Hugh, presented his financial statement and report as librarian. The morning session included the following programme:—

Discussion on Aims and Objects of the Society.
Resolutions.
Notes on Tubuliferous Thysanoptera .... R. C. Treherne.
Stray Notes on B. C. Lepidoptera .... E. H. Blackmore.
Common Tree-hoppers of B. C. .... W. Downes.
Some descriptions of New Species of Mycetophilidae .... R. S. Sherman.

Afternoon Session.

A Swarm of Vanessa californica .... J. W. Cockle.
The Lycaenidae of B. C. .... E. H. Blackmore.
(Illustrated with Specimens)
The Locusts of B. C. .... E. R. Buckell.
Discussion by Thos. MacKenzie, B. C. Commissioner of grazing.
Notes on European Foul Brood in B. C. .... Williams Hugh.
Cutworm Control .... Mr. H. Ruhman.
Life Histories and Control of Our Strawberry Insects .... W. Downes.

Evening Session.

The Onion Maggot .... Mr. H. Ruhman.
Tent Caterpillars, their life-history and control .... A. B. Baird.
The Alfalfa Seed Chalcid .... E. R. Buckell.
Insect notes of the year, leading a discussion on control of injurious insects affecting Agriculture .... R. C. Treherne.

The officers elected for the year 1919 were as follows:—

Hon. President.................................. F. Kermode, Victoria
President .... E. H. Blackmore, Victoria.
Vice-President (Coast) .... R. S. Sherman, Vancouver.
Vice-President. (Interior) .... J. W. Cockle, Kaslo.
Hon. Secretary-Treasurer.................................. W. Downes, Victoria.
Advisory Board.................................. Messrs. Lyne, R. C. Treherne, G. O. Day, John Davidson, L. A. Breun.

Among the resolutions passed was one providing for prizes at the principal fall fairs for the best exhibits of insects collected by students attending the public schools, $100.00 being voted for this purpose from the Society's funds.

The Society at the present time is in a flourishing condition and although interest in the Society's work diminished during the war, in which two valued members lost their lives, we have since been strengthened by the addition of several new members and signs are not wanting that interest in the work of the Society will continue to increase.

W. Downes, *Hon. Secretary-Treasurer.*

REPORT OF THE NOVA SCOTIA BRANCH.

The Fifth Annual Meeting of the Entomological Society of Nova Scotia was held at the College of Agriculture, Truro, on July 31st. The morning session was devoted to a report of the Society's work, financial statement, and the general business of the Society. During the afternoon and evening a number of papers were read by various members.

The following officers for the year were elected:—

Honorary President.................................. Dr. A. H. McKay, Halifax.
President .... W. H. Brittain, Truro.
Vice-President .... J. D. Tothill, Fredericton.
Secretary-Treasurer .... A. Kelsall, Annapolis Royal.
Asst. Secretary-Treasurer .... E. A. McMahon.
Committee .... W. N. Keenan, G. E. Sanders, Miss Dora Baker.

During the year, No. 4 of the Proceedings of the Entomological Society of Nova Scotia was issued, a publication comprising about a hundred pages. Besides including a great deal of new data on the insects of the Maritime Provinces, it contains several articles on comparatively new, or modified, insecticide-fungicide combinations, which are proving to be of considerable economic value.

A. Kelsall, *Secretary.*

REPORTS ON INSECTS FOR THE YEAR.*

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

The frail structure of many insects adapts them only to the warmth and soft breezes of summer, not to the cold and bitter gales of winter. In bridging the period of low temperature the casualties must be heavy among these fairy-like creatures of sunny, dreamy days. Last winter was so uniformly and extremely mild that the hibernating conditions of many groups of insects were no doubt ameliorated, and, as a result, an unusually large number of survivors awakened into activity at the beginning of the season.

This may explain in part the abundance of several species of butterflies. On May 7th, which was a very warm spring day, many specimens of the Red Admiral, *Vanessa atalanta,* emerged from their winter hiding-places. Dozens of them were skimming lazily over the lawns or flitting about among the blossoms of the Norway maples. From that date throughout the whole summer these butterflies were exceedingly numerous, more so than for many years. Later in the season, the Painted Lady, *Vanessa cardui,* also became very plentiful and continued so until nearly the end of August. The Banded Purple, *Basilarchia arthemis* usually a rather scarce butterfly in this locality, was quite frequent along the paths in the parks. Its relative, the Viceroy, *Basilarchia disippus,* never a rare insect here, was this summer, however, uncommonly abundant.

The hibernating habits of these last two species are such as to point to the possibility of a close relation between their unusually large numbers and the mildness of the winter. As soon as the nights begin to become cool, the caterpillars of the butterflies commence the preparation of their winter quarters. The larva selects a suitable leaf on its food plant, and bites off the blade on each side of the midrib, leaving only two flaps at the base. The whole of the leaf remaining is then covered with silk, and the flaps are drawn together so as to form a cosy silk-lined nest. To prevent the leaf from falling some of the threads of silk, that covered its stalk, were passed around a branch of the plant. Into this Esquimaux-like sleeping-bag the caterpillar then crawls, and remains in its snug retreat until the spring sun has burst the buds on its food plants.

Gardeners state that the Cabbage Butterfly, *Pieris rapae,* has been very troublesome this season. It is only seldom that the southern relative of this form comes so far north, but on August 1st, I captured a much-worn female specimen of *Pieris protodice.* The latter species has never proven injurious in Ontario, but is occasionally numerous enough to become destructive in some of the states to the south of us. Throughout the whole of its range, however, this native American butterfly is being gradually driven out by the alien from Europe. The latter, by ovipositing earlier and raising more broods a year, has been able to gain possession of almost all the available, cultivated Cruciferous plants, limiting the former to the wild species only.

---

*For Report of Division No. 6, see p. 83.

August 1st must have been a red-letter day in the entomological calendar as I find in my notes that on that date I captured also the Zebra or Papaw Butterfly, *Iphiclides ajax* var. *ajax*. A strong southern wind that had been blowing for a couple of days may account for these rare stragglers from the south. Speaking of Papilios, it is interesting to note that the Pipe-vine Swallow-tail, *Papilio philenor,* is becoming less rare in this district. This is probably due to the increasing popularity of its favourite food-plant, the Dutchman's Pipe, *Aristolochia macrophylla,* for ornamental purposes.

Although many species of butterflies were exceedingly common this season the Monarch, *Anosia plexippus,* was much less plentiful than usual. I saw only four specimens, and these late in the year—September 7th, 9th and 14th. In a note just received from Mr. C. W. Nash he states that he saw a specimen on each of the dates, September 26th, October 4th and 5th. These butterflies, that have visited us so late are probably members of the rear guard of the migrating columns on their treck to the south from a more northerly summer home.

The Entomological season was opened on April 5th this year by the finding of four specimens of the Ground Beetle, *Calosoma calidum.* In spite of the early date, a pair of these insects were already mated. On two occasions this summer I have seen the larvæ of Ground Beetles attacking earthworms. The beetles were finding their prey rather large, and one at least of the worms escaped.

Some variation in the conditions has proven favourable to the production, this season, of the gall *Andricus operatola* Bassett. On the ground, under several oak trees, infested acorns were plentiful. In previous years it has been rarely that I have found the gall, and never before attached to the acorns. The specimens obtained had dropped from the acorns which had remained on the trees.

This pointed, tooth-shaped gall is enclosed between the cup and the acorn, but originates from the latter. In general the gall projects only slightly above the edge of the cup. Often four or five galls are found irregularly spaced around the base of an acorn. In this locality both red and black oaks act as hosts.

From the galls, that have remained on the ground over winter, producers emerge early the next spring.

Division No. 4, Peterborough District—F. Morris, Peterborough.

One or two items only seem worthy to be reported in this season's collecting. The interruption of school work owing to influenza, in October and November, necessitated the extension of the summer term till the end of June; almost immediately after, your director passed to examination work till late in July. Field observations were very few and not of much value.

Among the collections handed in by pupils at the Peterborough Collegiate was noticed a very rare borer in alder, *Saperda obliqua,* and a member of the staff captured three or four specimens of *Phymatodes dimidiatus* in the latter part of May, the captures being made in his woodshed. A few days after a pupil brought in a specimen of *Saperda puncticollis* just captured on Virginia Creeper. This insect had been taken two or three times by pupils and I was very anxious to make observations. Enquiries had always pointed to Virginia Creeper rather than Poison Ivy as the food plant. The Science teacher accordingly hurried over to examine the vine and captured four or five more specimens, as well as specimens of *Psenocerus supernotatus* emerging from dead stems of the same plant. On learning of the discovery I hurried over to our opposite neighbor's where the low wall is overgrown with the plant in question. I captured over a score of the first insect and three or four of the second. Casual search on four or five other vines of Virginia Creeper at different parts of the city secured further specimens of both insects. The beetle is quite the prettiest of the Saperdas, but small, shy, and easily overlooked. In the hot sun it often climbs out to the surface of the upper leaves, but takes to wing very readily and drops as readily into the heart of its shrubbery. The period of emergence and activity lasts about a fortnight; from May 27th to June 10th. Large numbers of a clearwing moth were observed frequenting blossoms along the edge of a corduroy road through the heart of a tamarac swamp, but so far the insect has not been determined. No other insects of interest have been noted by your observer this season.

Division No. 5, Essex District—J. W. Noble, Department of Agriculture, Essex.

Attacking Field Crops. Hessian Fly has been very conspicuous in its work this year, large acreages of wheat have been cut down in yield 50 per cent. and even some of the later sown wheat planted in the fall of 1918 have been badly attacked. A great deal of injury has already been noticed this fall. It is altogether likely to be as bad in 1920 as this year. Grasshoppers and crickets were quite bad in June owing to extremely dry weather prevailing at that time. Considerable damage was done to cereal grains and some other crops by these insects. Wire-worms and cutworms did a great deal of damage in the spring of 1919. Cut-worms have been quite successfully controlled by the poison bran mixture.

Attacking Fruit Trees. The Codling Moth has possibly never been worse in this county owing to the exceptionally favourable season for its development. Even well-cared-for orchards are heavily infested with this insect. Where the spraying was omitted in the season of the year three weeks after the blossoms have fallen the sideworm injury is especially conspicuous, but in well-cared-for orchards that received the calyx cup spray very little injury has been noticed from the blossom end. A considerable number of specimens at work of Plum Curculio have been submitted for identification, but commercially speaking, the Codling Moth has been much the worst insect on fruit trees.

Fruits and Vegetables. The Onion Marsh at Leamington where about 500 acres were grown this year had considerable trouble from both root maggot and onion thrips. Very little success has been obtained from trying to combat either of these pests.

Aphids were very bad this season on cucumbers but did not seem to do much damage to melons. The general use of Black Leaf 40 and tobacco decoction have been very successful in combating these insects. Tomatoes have been greatly infested this year with Tomato Sphinx, crickets and grasshoppers. Cauliflower plants have suffered considerably from crickets gnawing the stems above the roots. Considerable dame was done, but wet weather checked their depredations before poison solution could be tried.

Tobacco was attacked by the usual pests, the tobacco sphinx being very plentiful this year. Dusting the small plants with arsenate of lead, spraying the partly grown plants with solution and spraying the larger plants with the dust gun when they were too large to allow the spray machine to be used successfully, controls these worms. Wire-worms did an exceptional amount of damage to tobacco plants this year and made the stand very uneven in many cases.

Greenhouse Insects. The usual greenhouse insects have been reported, but where proper methods have been used very little trouble has been reported. Greenhouse white fly, greenhouse aphids and nematodes are among the greenhouse man's worst enemies.

ENTOMOLOGICAL PROGRESS IN BRITISH COLUMBIA.

R. C. Treherne, Entomologist in Charge for British Columbia, Dominion Department of Agriculture.

The products of entomological labors during the past year in British Columbia have been many and varied. In addition to my work as a Federal Officer under the Dominion Entomological Branch, I have undertaken the general direction of the Provincial Entomological work, pending the appointment of a Provincial officer. Under the Dominion Entomological Branch, Messrs. W. Downes and E. P. Venables are engaged, the former on a study of small fruit insects in the Coast sections and the latter on a study of tree fruit insects in the interior of the province. Mr. A. B. Baird is stationed at Agassiz, B.C., working under the general direction of Mr. J. D. Tothill, who has charge of the Federal Natural Control Investigations. His work has been mainly a study of the natural control agencies of the Tent Caterpillar, the Fall Webworm and the Spruce Bud-worm, and these studies begun by Mr. Tothill in 1917 have been continued by Mr. Baird in 1918 and 1919, at Victoria, Vancouver, Agassiz and Lillooet. Mr. Eric Hearle commenced a study of the mosquitoes in the Lower Fraser Valley of British Columbia in March 1919, acting conjointly under the authority of the Dominion Entomologist and under a studentship granted by the Honorary Advisory Council for Scientific and Industrial Research, and he will doubtless not only continue this work in the Lower Fraser Valley but extend it over the province at other important centres. Mr. Ralph Hopping was appointed under Dr. J. M. Swaine, Chief, Dominion Division of Forest Insects, in December, 1919, and he is stationed at Vernon, B.C., engaged on the studies relating to certain forest infesting insects, particularly some *Dendroctonus* beetles affecting commercial pine.

Under the Provincial Entomological Branch, I am fortunate in being associated with Messrs. M. H. Ruhman and E. R. Buckell. The former is engaged in a study of vegetable insects and has made the study of the Root Maggots of the onion and the cabbage his special work during the past two years. Mr. Buckell has taken in hand studies relating to cereal and range insects, the most pressing problem, at the present time, being the control and investigation of locusts on the range.

Vernon, at the north end of Okanagan Lake, has been selected as the headquarters for entomological work in the Province at the present time. Here the central office is located with a reference library and collection of insects for study available to members of the staff, and Riker Mounts and photographic displays of insect pests, in appropriate arrangements, of interest to farmers. Branch laboratories have been established at Victoria, Agassiz and Mission. Another movable laboratory was stationed at Penticton in 1919 but doubtless will be located in the Chilcotins in 1920.

During the past year, 1919, the following investigations have been conducted, excluding the reports of Messrs. Hearle and Baird, who will issue the results of their work independently.

The Peach Twig Borer, *Anarsia lineatella,* was studied at Penticton, making the second consecutive year in which this insect has received attention. We are satisfied that the early application of lime-sulphur, 1-9, as close to, but previous to, the blossoming period as possible, will achieve good commercial results. Applications of arsenate of lead may be made immediately after blossoming with equally good results. The two applications of spray may be made in cases of severe infestation. This insect is known to attack prunes, plums, peaches, apricots, and cherries, and where these fruits are seriously attacked the same procedure for control, as outlined above, may be followed.

Certain studies were undertaken at Vernon this year to breed to maturity the various "worms" affecting fruit. This work was carried out to determine with accuracy the species present in the fruit orchards and to differentiate between the larvæ of the various species for the purpose of assisting in diagnosing outbreaks of Codling Moth. The following species occur: *Tmetocera ocellana, Argyroploce consanguiniana, Cacoecia rosaceana, Mineola tricolorella,* and *Laspeyresia prunivora.*

Insect distributors of fire blight were also the subject of study. Many insects received attention in this connection and while some were incriminated as carriers of both summer and winter blight, it is not believed that their control will either eliminate the disease or control it to the extent expected by many growers.

The Strawberry Root Weevil, *Otiorhynchus ovatus,* is still being subjected to investigation, the main line of work being a demonstration in the principles of crop of rotation. A section of land has been engaged for a period of six years to put into practice the remedies for this weevil which we believe may be successfully held in control by cultural methods. Mr. W. Downes, assistant in charge of this work, has recently shown that the weevils are parthenogenetic and that certain overwintering females may oviposit in the early spring months.

The chief small-fruit insects, with the exception of the Strawberry Root Weevil, which is the most serious, are the following: *Bembecia marginata, Phorbia rubivora, Aristotelia fragariae, Synanthedon rutilans, Epochra canadensis,* and an *Empoasca* of the Loganberry. It is hoped that all these insects will be studied closely during the next few years. With *Epochra canadensis* we have been unable, thus far, to prove any value from the poisoned bait spray and are still recommending growers to rely on cultivation and the use of chickens to rid themselves of this pest.

Among the vegetable insects the Cabbage Root Maggot and the Onion Maggot were each the subject of considerable study. The bulk of the work against the Cabbage Root Maggot is recounted on another page of these proceedings. The work against the Onion Maggot has not resulted, as yet, in our being able to offer definite recommendations for control under field conditions as they pertain to the Okanagan Valley. Our efforts to test the value of the poisoned bait spray have not apparently been rewarded with success. Our inclinations lead us to believe that late thinning and the use of a spring trap crop have considerable value, and in this belief our growers are recommended, at present, to plant a few rows of cull onions, 3-4 inches deep in the soil, in the early spring months, allowing the onions to sprout and thus act as a trap crop for the first generation of the fly. The work with the poisoned bait spray, which is, according to report, giving very good results in Eastern Canada and in the Eastern United States, is being continued. Consequently it is hoped that our recommendations will assume a more definite state in a few years' time.

Among the insects affecting grain and range crops, the locusts situation received considerable attention during the past year. The main species involved were *Camnula pellucida, Melanoplus atlanis* and *M. femur-rubrum.* The paper in this number of the Proceedings by Mr. E. R. Buckell, on some ecological and life history notes of locusts, covers in part, the work accomplished.

Spraying investigations that are being carried on, at present, in the Province, are being maintained by the Provincial Horticultural Division. Their main investigations have been conducted against the Green Apple Aphis, in order to determine the cheapest spray to apply; and against Apple Scab where different mixtures, strengths, and formulae have been used in test against each other. The Codling Moth field work has also been in the hands of the Provincial Horticultural authorities, working in association with the officers of the Entomological Branch. Approximately 223 acres of apple orchards were handled under quarantine in the neighbourhood of Vernon during the past year. 107 acres of this 223 were infested with Codling Moth in the year previous, 116 acres were contiguous to the infested area and were treated as though infested. 11,422 apple trees in this acreage were banded and were sprayed three times, and at the end of the season 19,401 boxes of apples were individually examined for larvæ. Altogether 373 larvæ and pupae of the Codling Moth were taken at Vernon, and as Vernon, during 1919, was the only point in the Okanagan Valley where examples of this moth were taken, the control operations have succeeded to a very creditable degree. A few years ago three distinct and separate outbreaks of the moth occurred in the Okanagan Valley, with as many as 10,000 larvæ being taken in a single year. The record as it stands, therefore, is not only very encouraging but is an indication that incipient outbreaks, in small areas, with proper support by the growers, can be not only reduced but also eradicated. A small new outbreak of this pernicious pest occurred at North Bend this year, which will necessitate action this coming year.

The Tent Caterpillars, *Malacosoma pluvialis* and *M. erosa* were exceedingly common at Vancouver and Victoria in 1919. The outbreak at certain points being exceptionally severe. A memorandum outlining the method for control was submitted to the City Councils of the Cities of Vancouver and Victoria, but with this exception, these insects were studied exclusively by Mr. Baird.

Many sundry insect notes were collected during the course of the year and the more important minor records have been incorporated in a report to the Department of Agriculture, Victoria, B.C. A similar report for the year 1918 was submitted in the same way to the Provincial Department of Agriculture and was published in two sections in the official organ of the Department, the *Agricultural Journal*.

RESULTS OF SOME PRELIMINARY EXPERIMENTS WITH CHLOROPICRIN.

G. J. SPENCER, O. A. COLLEGE, GUELPH.

In 1917, when meditating upon the effects of enemy gas that I had received at Passchendaele it occurred to me that British gas might be turned upon enemies other than Germans.

The opportunity to try this out came in the spring of 1919 when the Khaki University of Canada obtained permission for men of the Canadian forces to study at British Universities. I went to Victoria University, Manchester, where through the courtesy of Prof. S. J. Hickson, I was given the run of the research laboratory and the insectaries at Fallowfield. From the explosives department of the Ministry of Munitions I obtained samples of three of our common battle gases, one of them being chloropicrin, formula tri-chlor-nitrite.

It was decided to try the effects of these gases with a view to greenhouse, flour-mill and domestic fumigation. There was time to carry out only one experiment in Manchester before I was recalled to camp.

Experiment of Chloropicrin on Plants in a Greenhouse..

Capacity of greenhouse, 675 cubic feet approximately. Temperature in the house (June) 90° F. Ten cubic centimetres of gas were used in each of three petri dishes, two in opposite corners of the room on a table, and one on the floor. The nearest dish was right amongst the plants, which were: Recently potted dandelion in flower, Michaelmas daisy, wild vetch and curled dock, a geranium in a pot and cut boughs of willow. Insects present: Thrips, geometrid larvæ, leaf-rollers, Cercopidae, immature Jassidae and some Muscidae flying around the room.

A gas mask was used throughout the experiment in order to observe the action of the gas on the insects.

The leaf-hoppers were the first to show signs of distress by falling off the willow boughs six minutes after the gas was introduced. At the end of 10 minutes and 20 minutes respectively 10 cubic centimetres more of gas were poured out, this time on the floor making a total concentration of 50 c.c. After an exposure of 23 minutes the thrips were apparently all dead, although they had fallen out of the flowers after 11 minutes. At this time the Jassids and the immature Cercopids whose spittle masses had not been disturbed at all were also on the table moving feebly.

The experiment terminated in 38 minutes with the thrips, Jassids and Muscids all dead and the cercopids, the geometrid and leaf rollers very feebly moving. The doors and windows were opened and kept open until the house could be freely entered without discomfort, the gas being dispelled in 5 minutes. Next morning, i.e. after 17 hours those insects which had been feebly moving the day before were all dead. The cercopids alone, in untouched masses of spittle, were apparently unharmed. But all the plants were drooping badly, especially the vetch and michaelmas daisy, and at the same hour the second day, all the plants were dead.

In this experiment the temperature was very high and the relative humidity must have been high also as the floor of the house had been recently watered. But the volume of gas was very low, being for half the experiment only 30 c.c. and at the end of the experiment only 50 c.c. per 675 cubic feet, which amounts to only 3.7 oz. per 1,000 cubic feet.

With these results in mind, the following experiments were carried out at Guelph, the relative humidity being determined in each case:

1. Varying strengths of gas—other factors being equal.
2. Shorter or longer period of exposure.
3. Exposure by night and by day.
4. The killing power of the gas on various insects.

A good supply of Red Spider on salvia and of mealy bugs on coleus was available in the greenhouses of the College and as both these host plants show great susceptibility to killing by hydrocyanic gas, it was considered advisable to try the comparative value of chloropicrin on them.

Experiments were conducted at first in daylight, and proved that exposure to an atmosphere at the rate of 3 pounds of gas per 1,000 cubic feet, relative humidity 87, temperature 55.8° F. kill red spider effectively in 8 minutes—but kill salvia host plants in 5 minutes. And while 40 minutes exposure kills coleus and begonia, it does not kill all the mealy bug; those with their mouth-parts inserted in the stem of the plant seeming to survive those that were moving about. By next day young were issuing freely from the egg masses.

Effect of Gas on Various Insects.

The effect of the gas was tried also on leaf-hoppers and aphis on rose, red spider on salvia, tarnished plant bug and mites on aster and on cutworms. Temperature 66.2° F. Relative humidity 89. Concentration 3 lbs. per 1,000 cubic feet.

Result. Some leaf-hoppers died in 4 minutes, others in 14 minutes; red spiders and aphis seemed to be killed in 8 minutes. The aphis do not remove their beaks from the plant. On the insects being removed from the chamber at the end of 30 minutes, the capsids, cutworms and a few aphis that had been covered under a mass of leaves were still kicking feebly. After being exposed to the air for one hour everything was seen to be dead.

The action of choloropicrin on man is cumulative, and this would seem to be the case with insects also. In most instances, insects that may be kicking feebly when removed from the gas die after a while, even if placed in a current of fresh air.

Effect of rapid concentration. To determine if a sudden rush of gas would prove more effective even in reduced quantity, choloropicrin at the rate of 1½ pounds per 1,000 cubic feet was heated in a retort over a spirit lamp and the gas introduced into the chamber through rubber tubing. Mealy bug on begonia were the insects and plants used. Temperature 68° F. Relative humidity 82. The gas was practically volatilised in 14 minutes. When heating ceased and the plant was left in the chamber for two hours and then removed, on removal a few bugs showed signs of life but these died in three or four hours. Unfortunately the plant was withering at the time of removal.

Experiments at night. Finally, gas was used on red spider and mealy bug at night at a strength of 8.7 oz. per 1,000 cubic feet, temperature 59.0° F., relative humidity 99. Plants used salvia and coleus. Exposure lasted 90 minutes and by this time all red spider and mealy bug were dead; plants apparently normal. Next morning both species of plants were withering.

Inferences from foregoing experiments. It would seem that chloropicrin cannot be used for greenhouse fumigation as it has deadly effects on plants.

Penetration in earth. To test the penetration of the gas in earth, a flower pot about 7 inches deep, of ordinary greenhouse potting soil was used. Earth worms and millipedes were placed at different depths. (1) On the surface, (2) 1½ inches down, (3) 5 inches down. Experiments done at night, concentration at the rate of 8.7 oz. per 1,000 cubic feet. Time of exposure to gas 11 hours and 30 minutes. Temperature 55.4° F., relative humidity 88.

Result. Of those millipedes on the surface, some had crawled off the soil and some into it. Those at 1½ inches depth had gone deeper. At the end of the experiment all the millipedes and worms appeared dead, and while after 5½ hours the largest millipedes showed slight movement, the worms were all dried up. Eight hours afterwards another large millipede was bending slightly, but 12 hours after, all were dead without having moved from their original positions.

Effect of Chloropicrin on House Furnishings.

With a view to finding out if choloropicrin would have any effect on furnishings in houses, the following articles were exposed to its vapors for 12 hours: bright steel, copper, brass, silver, oatmeal wall paper with gilt splashings, several styles of lithographing in colors, cotton material, aluminum and varnished wood (as of cabinets). Relative humidity 88. Temperature 55.6° F.

Result. The gas has a tendency slightly to rust polished steel. Nothing else was affected. Exposure to the gas for 5 or 6 days, even at mild concentrations will rust steel badly. If however, the liquid itself should come into contact with cotton material, it will eat holes into it in a few days' time. Especially is this noticeable after the material has been washed. The gas has little or no action on rubber.

Effects of Chloropicrin on Grain, Meal and Flour Pests.

Into cotton bags containing respectively 2,000 grams of pure wheat flour, and 1,000 grams of a mixture of flour and bran, the following insects were placed in a position about half-way through the contents of the bags: Saw toothed grain beetle (*Silvanus surinamensis*), Meal worm (*Tenebrio molitor*), Drug store beetle (*Sitodrepa panicea*), Confused flour beetle (*Tribolium confusum*), Cadelle larvæ (*Tenebroides mauritanicus*), Granary Weevil (*Calandra granaria*). Temperature 63.5° F. Relative humidity 88 to 84. Concentration 8.7 oz. per 1,000 cubic feet. Time of exposure 25 hours and 15 minutes.

Of these insects, the meal worm larvæ alone moved through the flour either up or down. In both materials, flour and the flour bran mixture, all the adult and larvæ were killed. But 58.3 per cent. of the drug store beetle pupae were still alive when their cases were opened.

Effect of Chloropicrin on Meal Worm Moth Larvæ (*Plodia interpunctella*).

A packet of Quaker Oats, very heavily infested with all stages of meal worm moth was exposed to concentration of 8.7 oz. per 1,000 cubic feet for 24 hours. Temperature 64° F. Relative humidity 86. All stages of the pest were killed.

OUR COMMON CERCOPIDAE.

Geo. A. Moore, Montreal, Que.

As no doubt some here are not familiar with the Cercopidae, or at least do not know these interesting insects by their scientific name, I will begin by telling you their common name and the interesting feature that is characteristic of the family. They are most commonly known as Spittle insects, a term given them because of the habit the nymphs or young have of making a spittle-like froth in which they live.

Many curious explanations have been made to account for this frothy substance seen upon grasses and plants, which is sometimes so thick as to cover and wet a person's boots or clothes when passing through a field or path. Superstitious fear is sometimes felt by the uneducated, who steer clear of it. Some attribute it to frogs, hence the common name "frog spittle" is given, likewise "snake spit" is used in other localities. Negroes of the South claim that horseflies are produced from such masses.

So much now for this peculiar substance, let us now get to know the insect that produces it and afterwards we can learn why it is made and how.

The Cercopidae are a family in the sub-order Homoptera of the great order Hemiptera.

The Hemiptera includes the true bugs: cicadas, treehoppers, spittle insects, lantern flies, plant lice, and scale insects; the sub-order Homoptera all the above except the true bugs.

The Homoptera can be readily divided into two groups; (1) those in which the beak clearly arises from the head and (2) those in which the beak arises apparently from between the front legs or is absent.

Our Cercopidae belong to the first group and have associated with them:

The Cicadidæ —cicadas.
The Flugoridæ—lantern flies, etc.
The Membracidæ —tree-hoppers.
The Cicadelliacæ —leaf-hoppers.

Funkhouser has given their phylogenetic rank, beginning with the lowest, as follows:

1. Cicadidæ.
2. Membracidæ.
3. Jassidæ.
5. Fulgoridœ.
5. Cercopidæ.

The Cercopidae differ from the Jassidae by having only one or two teeth instead of a row of spines on their hind tibiae. They differ from the Membracidae by not having their prothorax prolonged into a horn or point above the abdomen. They differ from the Fulgoridae by having the antennæ inserted in front of and between the eyes instead of being inserted on the sides of the cheeks beneath the eyes.

According to Uhler the Cercopidae have characteristics which mark an important advance in the direction of the higher sub-order Heteroptera. Let us itemize the important features which lead to this decision.

1. The large size of the pronotum or prothorax is in contrast to the small one in the Fulgoridae and is not a phantastic ornament like that in the Membracidae. According to Uhler it is an important regional portion, exercising various important functions.

2. The increased freedom of the anterior coxae thereby approaching a walking insect.

3. The terminal portion of the wing covers being membranous and transparent suggesting the Heteroptera.

4. The hind tibiae having only one or two short stout spines.

In some respects therefore the Cercopidae represent the highest and most specialized forms of the Homoptera, and although most students consider the Fulgoridae to be the highest and most specialized there is evidence in favor of the Cercopidae occupying the position.

So much then for their rank. They are members of a sub-order approaching the higher sub-order and exhibiting interesting links between the two.

I have not yet observed the eggs and have read but few details of what they are like. They are slightly curved and cylindrical and are said to be deposited in the stems of grasses, plants and twigs.

The Cercopidae like other Hemiptera develop gradually, undergoing a series of moults and the young exhibit the characteristics of the adult, becoming more like it at each moult or instar, of which there are five.

They most likely hibernate here both in the adult stage and in the egg.

I have taken adults on May 24th of *Lepyronia quadrangularis,* and on June 20th *Philaenus spumarius.*

It is in the nymphal stage that they live within the frothy mass mentioned above. This substance is manufactured by the newly hatched nymph and they live within it until they emerge as adults. It was formerly supposed that this was made by thrashing about of the oval end of the body in a clear viscid fluid exuded from the posterior end of the body. Prof. E. S. Morse has, however, carefully observed the operation and states that the bubbles are made as follows: the insect exudes a clear viscid fluid from the posterior end of the abdomen, after a short time the posterior end of the abdomen is extended out of the fluid and as it were, grasps a quantity of air and then it is pulled down into the fluid and, the air released, making a bubble. This is continued at the rate of seventy or eighty times a minute. The tail is moved alternately to and fro so that the bubbles are distributed around its body.

Now what is the exudate for? According to most students it is a protective covering which, even if it is conspicuous, apparently serves the creature well. It is said that wasps know that in this juicy covering there is a goodly meal for their young and that they dive in and take the unfortunate nymph to its nest to feed its offspring. However, it would appear that it protects the young Cercopid well, both from the sun and from the ravages of spiders, birds, etc.

Dr. Ball has given some interesting facts upon Cercopidae living in arid regions where many of them do not make spittle masses. He records an interesting case where the nymphs were living in a gall-like sheath in a plant enlarged enough to harbour many of them, and all living in spittle. This was in the Cow Parsnip (*Heracleum lanatum*). In these arid districts others lived on the roots and crowns of Compositae and legumes where they were protected from the hot sun and dry air.

Lintner suggests that the covering is necessary to cover the delicate-skinned nymph from the burning heat of the sun.

The Cercopidae found in Canada are as follows:

Family CERCOPIDÆ (Leach)

SUBFAMILY CERCOPINÆ (Am. and Serv.)

No species.

SUBFAMILY APHROPHORINÆ (Am. and Serv.)

Genus Aphrophora Germ.

1546. *A. quadrinotata* Say. Quebec, Ontario.
1548. *A. parallela* Say. Nova Scotia, Quebec, Ontario.
1549. *A. irrorata* Ball. British Columbia.
1551. *A. saratogensis* Fh. Nova Scotia, Ontario.
1553. *A. signoreti* Fh. Ontario.

Genus *Lepyronia* Am. and Serv.

1555. *L. quadrangularis* Say. Nova Scotia, Quebec, Ontario, Manitoba.

Genus *Philaronia*.

1558. *P. abjecta* Uhl. Manitoba.
1559. *P. bilineata* Say. Quebec, Ontario, N. W. Canada.

Genus *Philænus*.

1560. *P. leucophthalmus* Linn. Quebec, Ontario, Manitoba.
    (a) Var. *falleni* V. D.
    (b) Var. *ustulatus* Fall.
    (c) Var. *lateralis* Linn.
    (d) Var. *leucocephalus* Linn.
    (e) Var. *marginellus* Fabr.
    (f) Var. *fasciatus* Fabr.
    (g) Var. *fabricii* Van D.
    (h) Var. *pallidus* Zett.
1561. *P. lineatus* Linn. Nova Scotia, Quebec, Ontario.

Genus *Clastoptera* Germ.

1562. *C. obtusa* Say. Quebec, Ontario.
 (a) Var. *achatina* Germ.
 (b) Var. *testacea* Fh.
 (c) Var. *tristis* V. D.
1566. *C. proteus* Fh. Quebec, Ontario.
 (a) Var. *proteus* Fh.
 (b) Var. *vittata* Ball.
 (c) Var. *pini* Fh.

The commonest Cercopid in the Province of Quebec is *Philaenus leucophthalmus* Linn. with its hosts of varieties. This insect is found swarming in meadows and Osborn has called it the meadow Froghopper. It feeds upon the common flowers, such as the buttercup, yarrow, thistle, daisy, clover, and particularly the golden-rod.

The egg is moderately elongated, irregularly elliptic, about three times as long as broad, narrowing to one end, slightly flattened. One side straight or slightly incurved, the outer convexly curved, giving the egg a slightly curved appearance. The shell is tough and hard and developed while the eggs are still in the ovariole ducts.

They are deposited in the stalks of their food plants and pass the winter there.

The young hatch out early in the summer, during June, and after passing through five stages emerge as adults throughout July and part of August.

The nymphs are somewhat like the adults even in the earliest stages and gradually become more like it. The fifth instar is to all intents and purposes a pupal stage and in their later stages show colour and have large wing-pads.

As already mentioned this species is extremely variable, running from plain yellow to black and having varied patterns. According to Fallemand in *Genera Insectorum,* there are at least seventeen well-marked varieties, and Van Duzee lists eight as occuring in America, north of Mexico. I have at least six distinct varieties, but there are many others and the intergrading makes it difficult to separate them. Different varieties mate together and it would be interesting to breed them and see what a brood would bring forth.

The second commonest Cercopid is *Philaenus lineatus* Linn., or the Lined Spittle Hopper, or as Osborn calls it, the Grassfeeding Froghopper. This insect belongs to the same genus as does the first mentioned and has a similar life history, but feeds upon grass, timothy and red-top. This is a European species introduced into Canada. It is remarkable in that the former species is very variable, this one is constant in its form and coloring. The male is a little smaller than the female.

Aphrophora quadrinotata Say, or the Four-spotted Spittle Insect, is also common and is often found upon grape vines. They are usually taken in the adult stage during the months of July and August.

Aphrophora parallela Say, or the Parallel Spittle Insect is found quite commonly on pine trees. In reality we should designate it the Pine Froghopper as this tree is its home. There is lives in company with *A. saratogensis* Fh. It does not show the same degree of variation as does *P. leucopthalmus,* but it varies from dark to light forms.

Lepyronia quadrangularis Say, or the Angulated Froghopper is more angular in form than the others and is fairly common. It is said to feed upon grasses, weeds and the blackberry. Little variation is seen in it.

The Genus Clastoptera has two species and they are variable.

The first is *C. obtusa* Germa, or the Alder Spittle insect. This has four varieties and is common. It feeds upon the Alder.

C. proteus has three varieties. It feeds upon the dogwood, cranberry and blueberry.

They are called hoppers because of their remarkable jumping habits. They are generally found on the boughs of trees or standing on the stalks of flowers, especially the golden rod. They are very shy and when approached they slide around to the other side and they keep out of sight.

MY EXPERIENCE THIS YEAR IN DUSTING AND SPRAYING (1919).

FATHER LEOPOLD, O.C.R., OKA, QUE.

Your kind President, Mr. Caesar, insisted that I give you a paper this year, and I thought it would interest you to know of our work at the Oka Agricultural Institute in dusting and spraying during the past season.

THE ORCHARD. The following remarks are limited to one of our orchards only, the most uniform we have to carry on a commercial experience in dusting and spraying: Our Wealthy orchard, situated on a gentle slope with a south-west exposure. It is not the best exposure for our Province, but we seem to get good results with this particular orchard.

I chose 30 rows of this orchard, as you can ascertain in looking over Table I, so as to have a complete row of 11 trees separating each plot which number 6 in all, three plots sprayed and three plots dusted. Remember that the 6 plots are all in the same orchard, on the same site, the trees all the same age, 30 years old, and all the operations made on the same day. We could not get more uniform conditions, considering also that the bloom on each plot was quite uniform.

BLOOM. Looking over Table I, we may see that in plot I, 4 trees only out of 44, did not bloom and 23 were in full bloom; in plot II, 10 trees did not bloom and 18 were in full bloom; in plot III, 11 did not bloom and 16 were in full bloom; in plot IV, 11 also did not bloom and 11 were in full bloom, while 18 had half to three quarter of a full bloom; in plot V, only one tree did not bloom, while 21 were in full bloom; in plot VI, 4 only did not bloom and though three only were in full bloom, 15 had from one half to three quarters of a full bloom.

OBJECT OF EXPERIENCE. I insist somewhat on the fact that the greatest part of each plot had trees in bloom, as the first object I had in view, was to determine the action of liquid Lime-Sulphur on the apples in comparison with the action of liquid Bordeaux mixture on the same. I did not care what were the results as far as scab is considered, Wealthy apples not being very subject to scab.

The second object I was after was to determine just what the cost was in comparison of the dusted plots, per tree, with the sprayed plots. I have carefully gone over this in Table VIII.

I did not intend to tabulate the results of each plot separately in picking and classifying the crop, as this would have entailed too much work, for a commercial experiment. But, by going over the entire orchard, plot by plot, we had a very good idea of the results per plot.

Dusted Plots. Plots II (Table III), IV (Table V), and VI (Table VII), were dusted, with the exception of the first semi-dormant liquid spray on all except the VI's plot.

Taking up Table III we see that we used sulphur, talc and arsenate of lead in this plot, while in Table VII we see that in the last plot we substituted Hydrated Lime to the talc and arsenate of lime to the arsenate of lead and with every sort of satisfaction, thus making the last formula the most economical of all the dusted plots, as arsenate of lead is dearer than arsenate of lime.

Another interesting point was the use, for the first time in our orchards, of anhydrous Bordeaux mixture or dust Bordeaux. The arsenate of lime was used with perfect safety with this bordeaux dust. Having found the commercial copper dust too strong we reduced it by adding more hydrated lime, thus using the following formula, (Table V):

Dry Bordeaux as bought mixed already	46¼ lbs.
Hydrated Lime added to above	46¼ lbs.
Arsenate of Lime	7½ lbs.

Looking over the table of comparative costs, we can see that this new dusting material costs a little over 34½ cents per tree for the four applications, as against 33¾ cents for Sulphur-Talc-Arsenate of Lead Dusting and 17½ cents for the Sulphur-Hydrated Lime-Arsenate of Lime Dusting material

As to results on the crop, the copper dust seems to have good fungicidal value, perhaps a little better than the sulphur dusts, without any russeting to the fruit.

Sprayed Plots. I come now to the first object in view: to determine if Bordeaux mixture, as employed here in our orchards, is a superior spray than the Lime-Sulphur wash we have used since the past 10 years. In a word what the advocates of Bordeaux maintain is that Lime-Sulphur wash, far from being a beneficial spray, sprays the apples of the tree. This has not proven true at all in our orchards. In fact after we were sure that the apples in the plot sprayed with sulphur were sticking just as heavily on each tree, we had to thin each tree in plot III as in any other of the sprayed or dusted plots.

A good many visitors came to see the orchard this summer, and I may mention especially Mr. Petch, Mr. Davis and Mr. Bunting of Macdonald College. These gentlemen went over the orchard very carefully, and were convinced of the fact that Lime-Sulphur is surely a safe spray for our Province at least.

No russeting to speak of was noticed on either of the two Bordeaux mixture plots, plot I and plot V, though more Copper Sulphate was used on plot 1 than on plot V, the old formula of 4-4-40 being maintained on plot I and the new one of 2-10-40 on the other.

Results. Time is lacking to give too many details, but as I have mentioned before, we did not tabulate results, plot per plot, but after looking over the whole orchard, we have found that any of the formulas employed gave satisfactory results, both as to quantity and quality of the fruit. The 6 plots gave 1,500 boxes of fine apples, after they had been all thinned.

In looking over the last table of costs, dusting is certainly a more expensive way of treating an orchard than spraying; but I am going to stick to both, as both have their utility, dusting is a much quicker way to get around the trees in bad weather, and some times no results can be obtained if the applications are not made on time and thoroughly.

TABLE I.

SHOWING A COMPARISON OF THE BLOOM IN THE SIX DIFFERENT PLOTS.

I.		II.		III.		IV.		V.		VI.	
1 2 3 4	5	6 7 8 9	10	11 12 13 14	15	16 17 18 19	20	21 22 23 24	25	26 27 28 29	30
¼ o o ¾		¾ o x o		o o o o		o o o ¼		x ½ ¼ x		¾ ¼ ¼ ¼	
¼ ½ ¼ ¼		x o ¼ ¾		o o o o		¼ o o ¼		x ¼ ½ ½		¼ ¼ ¼ ¼	
¼ x ½ x		¼ ¼ o o		x ½ ¼ ¼		¼ ½ ½ o		¾ ¾ x x		¼ ¼ ¼ ¼	
¾ ¼ ½ ¾		¾ ¾ x x		½ x ¼ o		o x ¾ ¾		x x x ¾		¼ ¾ ¼ ¼	
x x ¼ x		x ½ x ¾		x o ½ ¼		¾ o x ¾		¾ ¾ ¾ ¾		o ½ ¾ o	
x x x x		o x o x		x o ¼ x		x x x x		x o x x		x ¾ ¼ ¼	
x ¼ x x		¾ o x o		x x ¼ ¾		x o o ¾		x x x o		¾ ¾ ¼ o	
x x x x		¾ o x o		x ¾ x x		¾ x o x		x x ¾ x		¾ ¾ o ¼	
x x ¾ x		x x ¼ ¾		¾ ¾ x x		¾ ¾ x ¾		¾ x ¾ ¾		¾ ¾ ¼ ¼	
x x x x		x ¾ x x		x x ½ x		x ¾ ¾ ¾		¾ x x ½		x ¾ ½ x	
o ¾ o x		¾ x x x		x ¼ ¾ x		¾ ¾ ¾ ¾		¾ x ½ ¾		¾ x ¾ ¼	

Explanation of signs: o, no bloom at all; x, full bloom and the fractions mean one-fourth, one-half and three-fourths of a full bloom respectively.

Each plot contains four complete rows of trees, rows 5, 10, 15, 20, 25 and 30 separating each plot.

TABLE II.

PLOT II: 39 TREES—BORDEAUX MIXTURE, 4-4-40.

Date.	Time of Applications.	Temperature.	Material.	Quantity.	Cost Material.	Cost of Labor.	Time.
May 13.	Buds quite open	Fine	Bord. mix. 4–4–40	90 gls.	$0.92¼	0.37½	30
May 26.	Buds showing pink	Fine	Bord. mix. 4–4–40	80 gls.	0.82	0.31¼	25
June 4.	After blossoms have fallen	Rain, night of 5 to 6, 6 to 7 and 7 to 8. Cloudy	Soluble sulphur, 1 lb. to ½ lb. Ars. Lime, Hyd. Lime, 5 lbs,	95 gls.	0.80¾	0.50	40
June 16.	Apples well formed	Fine	Same as above.	90 gls.	0.76½	0.37½	30

TABLE III.

Dusted Plot: Sulphur, Talc, Arsenate of Lead in Powder Form—34 Trees.

Date.	Time of Application.	Temperature.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time taken.
May 15 .	Rain from night of 16 to 18 at night	Leaf buds well open	L.-S. 1.008 semi-dormant	90 gls.	0.59½	0.31¼	25 min.
May 26 .	Buds showing pink	Fine	Sulphur-Talc 60-40	80 lbs.	2.04	0.18¾	15 min.
June 4 ..	After blossoms have fallen	Rainy, nights of 5 to 7. Cloudy, 7 and 8	Sulphur of Talc. Arsenate of lead, 40-50-10	70 lbs.	3.62½	0.18¾	15 min.
June 17 .	Apples well formed	Fine	Same as above	80 lbs.	4.36	0.18¾	15 min.

N.B.—We put on a semi-dormant spray of lime-sulphur wash on the 15th of May.

TABLE IV.

Sprayed Plot: 32 Trees—Lime-Sulphur-Arsenate of Lead (Powder).

Date.	Time of Application.	Temperature.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time taken.
May 16 .	Leaf buds well open	Rain from night of 16 to 18 at night	L.-S. 1.008 semi-dormant	80 gls.	0.53	0.37½	30 min.
May 26 .	Buds showing pink	Fine	L.-Sulphur, 1.007	70 gls.	0.37½	0.25	20 min.
June 4 .	Blossom having fallen	Rainy, nights of 5 to 7. Cloudy, 7 and 8	L.-Sulphur 1.007. Arsenate of lead, 1 lb. in 40	70 gls.	0.97	0.18¾	15 min.
June 16 .	Apples well formed	Fine	L.-S. 1.006, ½ lb. ars. of lead	80 gls.	0.42	0.25	20 min.

TABLE V.

DUSTED PLOT: ANHYDROUS BORDEAUX AND DRY ARSENATE OF CALCIUM.

Date.	Time of Application.	Temperature.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time taken.
May 16 .	Leaf buds well open	Rain from night of 16 to 18 at night	L.-S. 1.008	80 lbs.	0.53	0.37½	30 min.
May 26 .	Buds showing pink	Fine	Bordeaux dust, at 2½% metallic copper	80 lbs.	3.20	0.31¼	25 min.
June 4 .	Blossoms having fallen	Rainy nights of 5 to 7. Cloudy, 7 and 8	Dry Bordeaux, 46¼ lbs. Hydrated Lime, 46¼ Ars. Lime, 7½ lbs.	70 lbs.	3.15	0.31	25 min.
June 17 .	Apples well formed	Fine	Same formula as on June 4th	65 lbs.	2.92½	0.25	20 min.

TABLE VI.

SPRAYED PLOT: BORDEAUX MIXTURE 2-10-40 AND SOLUBLE SULPHUR—41 TREES.

Date.	Time of Application.	Weather.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time taken.
May 16 .	Leaf buds well open	Rain from nights of 16 to 18	Lime-Sul. semi-dorm., 1.008	90 gls.	0.59½	0.43¼	35 min.
May 28 .	Buds showing pink	Fine	B. mixture, 2–10–40. 2 lbs. $CuSo_4$	80 gls.	0.53	0.31¾	25 min.
June 4 .	Blossoms having fallen	Rain nights of 5 to 7. Cloudy, on 7 and 8	1 lb. solution sulphur; ½ lb. ars. of lime to 40 gls.; 5 lbs. H.L.	90 gls.	0.48	0.27½	20 min
June 16 .	Apples well formed	Fine	Same as above, ex. 1 lb. ars. lime	75 gls.	1.01¾	0.27½	20 min.

Do not use arsenate of lead with soluble sulphur. Be sure to add the hydrated lime (H.L.) to the soluble sulphur ars. of lime combination.

TABLE VII.

Dusted Plot: Sulphur, Hydrated Lime, Arsenate of Lime—38 Trees.
There is no semi-dormant spray in this plot. The Oka formula for dusting.

Date.	Time of Application.	Weather.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time needed.
May 26.	Buds showing pink	Fine	Sulphur and Hydrated Lime, 60–40	80 lbs.	2.08	0.25	20 min.
June 4.	Blossoms having fallen	Rain, nights of 5 to 6. Cloudy, 7 to 8	15 lbs. Sulphur, 5 lbs. Ars. Lime, 80 lbs. Hyd. Lime	75 lbs.	1.90¼	0.25	20 min.
June 17.	Apples well formed	Fine	Same formula as on 4th of June	80 lbs.	2.02½	0.18¼	15 min.

We have found the above dusting formulas, omitting the semi-dormant spray in Quebec, to be the most economical dusting sprays.

TABLE VIII.

A Comparison of the Cost of the Dusted and Sprayed Plots.

Plot.	Material.	Labor.	Total Number.	Trees.	Cost per Tree.
I.	$ 3.31¾	$1.56¾	$ 4.87¾	39	$0.12½
II.	10.61	0.87½	11.48½	34	0.3378
III.	2.29½	0.06¼	3.35¾	32	0.1049
IV.	9.80½	1.25	11.05½	32	0.3454
V.	2.62¼	1.30½	3.92¾	41	0.0957
VI.	6.00¾	0.68¾	6.69½	38	0.1762

INSECT OUTBREAKS AND THEIR CAUSES.

JOHN D. TOTHILL, FREDERICTON, N.B.

The Standard Dictionary defines an outbreak as "a sudden and violent breaking forth as of something that has been pent up or restrained." This definition seems peculiarly apt for describing the biological meaning of the word because it implies that all nature is in a condition of restraint and that an outbreak is something abnormal due to the breaking of one or more restraining bonds.

Outbreaks are not confined to species of the insect world and neither are they confined to the animal kingdom. In the vegetable kingdom for instance, there are the familiar cases of the Russian thistle in Western Canada and the California Prickly Pear in Australia. There is also in our own country the case of the Northern Scrub Pine that so often comes up in pure stands after a fire has swept away the original soft wood forest. In the animal kingdom we have among insects such familar cases as the European Gipsy Moth in the New England States, the Forest Tent Caterpillars that greased the tracks and stopped some trains in Canada in 1914; the Army-Worms that at times have spoiled the Western wheat crop; and periodical outbreaks of short-horned grasshoppers. Examples of outbreaks of various species of vertebrates are also quite plentiful; there is the historical case of the European Cotton-tail Rabbit in Australia and there is the present case of the little prairie dog in Alberta. Even man himself has been known to be in a condition of biological outbreak; Caucasian Man in the 17th and 18th centuries doubled his population every twenty-five years on the North American Continent. So that outbreaks of general occurrence may be met with almost anywhere in the realm of living things.

To what causes are these outbreaks due?

As each species is held in equilibrium by the pressures of its environment it is obvious that an outbreak is due to a relaxing of one or more of these pressures.

Let us examine the cases of a few insect outbreaks the causes of which have been studied.

During the first twenty-five years of the Oyster Shell Scale's regime on this continent it increased so abundantly that men like Fitch held fears for the development of an apple industry. With the passage of the time, however, the menace of this scale insect has subsided. In the light of studies made on the present environmental conditions of this insect in Canada it seems probable that the early outbreak was due to an absence of its most effective enemy, a predaceous mite.

Turning to the Gipsy Moth I think we are more or less agreed that the New England outbreak was due more especially to an absence of natural enemies, such as the handsome Calosoma of Europe and the efficient little two-winged fly Compsilura; and also perhaps to a partial release of the food pressure.

In some of our Maritime Province cities there was last year an outbreak of the White-Marked Tussock. Mr. Dustan, who was detailed to make a study of these outbreaks, found that they were due largely to an abundant food supply; to an absence in cities of chickadees and the larger species of woodland ants; and to a relative scarcity of parasitic insects.

There is, at the present time, an outbreak of the Forest Tent insect in Alberta. Studies by Mr. Baird and myself have shown that the outbreak is due at least partially to an almost total absence of its usual insect parasites. It is also influenced perhaps by a relaxing of the food pressure or, in other words, to an increased proportion of trembling poplar.

In New Brunswick our last outbreak of the Forest Tent insect subsided suddenly in 1915. The outbreak seems to have been due to an over abundance of the poplar supply, as a direct result of civilization and forest fires.

In the case of the Spruce Budworm a study of the New Brunswick outbreak has shown the fundamental cause to be a relaxing of the normal food pressure in the form of an increased supply of balsam fir, which is the favored food plant.

This relaxing of the food pressure has been brought about by the hand of man and has been an inevitable result of existing lumbering practices.

Without going into details it can be said that the increase of balsam fir has not only meant an increased food supply, but has also meant a decreased bird supply. For the birds that under conditions of the primeval mixed type of growth keep this insect properly subdued, seldom nest or feed in pure stands of balsam fir.

In New Brunswick we now have an incipient outbreak of the Fall Webworm, and as our studies on this insect have been carried through the best part of a decade, it may be of interest to examine this case a little more closely than the others. In order to show the causes of the present outbreak let us glance for a moment at the situation obtaining toward the end of the last outbreak, and then let us follow the situation through a short term of years until the insect became almost extinct in the Province, and finally let us glance at the conditions of the present incipient outbreak.

In 1912 the Fall Webworm was abundant in New Brunswick and from the fact that the environmental pressures were then in a very nice state of equilibrium I infer that the insect had been a fairly conspicuous member of the fauna for at least a decade.

The food pressure was not very great because the staple diet is Alder and there is an abundance of this shrub along our streams and waterways; the food supply is not great enough to produce menacing millions of the insects but it is sufficient for their maintenance in a condition of mild outbreak.

On the basis of an average egg mass of 260 eggs, there were about 26 that for some reason or other failed to hatch. Of the 234 that did hatch about 42 were attacked in the young caterpillar stage by a four-winged parasite called *Apanteles*. Of the 192 left to tell the tale about 6 were attacked by another little four-winged fly *Meteorus*. Then as the larvæ grew in stature about 22 of those surviving fell prey to a fair-sized Ichneumon that is now known as a *Campoplex*. In spite of these attacks by insect parasites there were still left about 164 half-grown caterpillars. Of these about 85 were parasitized and so removed from the contest by another species of *Campoplex*. The 79 remaining larvæ became about three parts grown when a two-winged fly *Varichaeta* began an attack upon them. This fly victimised about 45 and this attack together with that of another species of minor importance reduced the inmates of our average nest to about 32. About this time the young red-eyed vireos were getting very hungry and the webworm caterpillars fell a prey to them. Of the 32 remaining these birds devoured over 90 per cent. leaving only about two in each nest. The few not attacked by birds were able to pupate, but some of them fell victims to pupal parasites of which an *Exochilum* was the most effective.

As a result of the combined environmental pressures the average number of moths yielded by each egg mass was less than two, so that in the following year there was a measurable decrease in the numbers of the webworm.

This decrease continued very regularly year after year until 1916 when the insect became almost extinct in the Province.

It is interesting to note in passing that as the species became less and less abundant the environmental pressures became so great that it was threatened with extinction. It may also be noted that as the species became rare so did its parasites until finally the red-eyed Vireos were averaging a spoil of 198 caterpillars from each web.

When the Webworm had practically disappeared from the entire Province, as represented by nine observation points, something happened that changed the whole situation. A flight of moths was blown across the Bay of Fundy and the coastal belt from St. John to Moncton was heavily seeded with the insects.

This condition enabled the species to do battle once more on favorable terms with the Vireos, and it began to increase and spread out again over the Province. It has now spread out over more than half the Province and is gaining ground rapidly.

The gain in numbers is also greatly favored because the parasites died out as the host became rare and they have not yet returned to the feast. Moreover they are not likely to return until our present outbreak becomes linked up with territory in which they now occur.

In a word then the causes of our present outbreak are, first an elimination of parasites from New Brunswick, then a flight of moths from new territory.

Having now considered a few insect outbreaks and their causes it may be remarked by way of conclusion that civilization is directly responsible for many of our more notorious outbreaks. We are increasing the food supply of particular insects and thereby making conditions favorable for outbreaks. This is not only true for the insects attacking agricultural crops but is also true for some of our forest insects. In New Brunswick we now have many square miles of forest lands supporting pure stands of poplar and these areas are the nursing grounds of our all too numerous forest tent caterpillar outbreaks. The pure stands of poplar have come in after the fires of civilization have swept away the ancient mixed growth. We also have many square miles of forest now composed of pure stands of balsam fir. In these stands has been nursed the present outbreak of Spruce Budworm—an outbreak that has swept away about three-fourths of the entire crop of merchantable fir in the Province. The overproduction of fir, as already pointed out, is a direct and necessary result of the existing methods of lumbering. In the cases of the Forest Tent insect and the Spruce Budworm civilization has had the effect of removing one of the most powerful of the restraining bonds, namely, that which under natural conditions constitutes a food pressure.

FURTHER NOTES ON THE CONTROL OF PEAR PSYLLA.

W. A. Ross and W. Robinson, Dominion Entomological Laboratory, Vineland Station, Ontario.

With a view of securing some definite data on the susceptibility to common contact insecticides of pear psylla eggs at different stages of incubation, and in order to ascertain what spray material is the most effective ovicide, the following preliminary experiments were conducted this past year (1919).

Experiments Under Greenhouse Conditions.

During the latter part of the winter adult psyllas were taken from their hibernating quarters in the orchards and were brought into the greenhouse. There they were placed on small pear trees—French seedlings—grown in flower pots and were then confined by means of lantern globes. The insects mated readily and deposited their eggs on the seedlings. Large numbers of eggs of known age were in this way readily secured.

Period of Incubation. The duration of incubation of the egg was obtained from the "check" experiments, which will be referred to later, and was found to vary to no considerable extent under the fairly uniform greenhouse temperatures. In fourteen out of sixteen experiments it varied from nine to eleven days. The exceptional periods of incubation were respectively eight days and twelve days.

Experiments with Contact Insecticides.

Batches of eggs, at different stages of development from newly-laid to those on the point of hatching, were sprayed by means of an atomizer with four different dilutions of lime-sulphur wash; soluble sulphur and hydrated lime; lime-sulphur and starch; and lime-sulphur and Black Leaf 40. The results were as follows:

LIME-SULPHUR WASH.

Table I—Effect of Lime-Sulphur, 1-10, 1.027 sp. gr. on Psylla Eggs.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
2	557	Newly laid	64	70.0
2	470	4 days old	74	67.2
3	466	8 ,, ,,	67	68.8
1	414	*9 ,, ,,	74	73.4
Total.. 8	1,907			

Table II—Effect of Lime-Sulphur, 1-9, 1.029, sp. gr. on Psylla Eggs.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
6	843	Newly laid	89	91.3
8	730	4 days old	79	78.6
6	744	8 ,, ,,	77	75.5
2	282	*9 ,, ,,	43	32.3
Total.. 22	2,599			

Table III—Effect of Lime-Sulphur, 1-8, 1.032 sp. gr. on Psylla Eggs.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
10	679	Newly laid	99	99.7
9	593	4 days old	95	99.1
6	609	8 ,, ,,	99	99.3
5	848	9-10 ,, ,,	93	92.1
Total.. 30	2,729			

TABLE IV—EFFECT OF LIME-SULPHUR, 1-7, 1.037 SP. GR. ON PSYLLA EGGS.

No. of tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
2	636	8 days old	100	100
2	635	*9–10 ,, ,,	100	100
Total.. 4	1,271			

* On the Point of Hatching.

As shown in the foregoing tables, lime-sulphur is most effective as an ovicide when used at the strength of 1-7. The tables also show that the newly-laid eggs are on the whole more readily destroyed than those on the point of hatching.

In the experiments with lime-sulphur 1-8 and 1-9 it was observed that frequently a large percentage of the eggs would hatch. However, the spraying mixtures apparently had weakened the embryos or nymphs within the eggs to such an extent that in emerging or immediately after emerging they succumbed.

In the tests where lime-sulphur 1-7 was used 100 per cent. of the eggs invariably collapsed.

LIME-SULPHUR AND STARCH.

An effort to increase the ovicidal value of the weaker lime-sulphur sprays by adding starch to them in order to make them spread and stick better met with success. (See Tables Nos. 5, 6, 7.)

TABLE V—EFFECT OF LIME-SULPHUR 1-10 PLUS 2 LBS. STARCH TO 40 GALS. ON PSYLLA EGGS.

No. of Tests. made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
*1	364	Newly laid	100	100
2	392	4 days old	100	100
2	577	8 ,, ,,	100	100
2	438	9–10 ,, ,,	100	100
Total.. 7	1,771			

TABLE VI—EFFECT OF LIME-SULPHUR 1-9 PLUS 2 LBS. STARCH TO 40 GALS. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
4	588	Newly laid	100	100
*4	471	4 days old	100	100
2	251	8 ,, ,,	100	100
4	581	9–10 ,, ,,	100	100
Total.. 14	1,891			

TABLE VII—EFFECT OF LIME-SULPHUR 1-8 PLUS 2 LBS. STARCH TO 40 GALS. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
5	615	8 days old	99	99.6
*5	867	9–10 ,, ,,	100	100
Total.. 10	1,482			

* In some of the tests a small percentage of eggs hatched, but the nymphs, in the process of emerging or just after emerging, succumbed.

LIME-SULPHUR AND BLACK LEAF 40.

A combination of lime-sulphur 1-9 and Black Leaf 40 also proved 100 per cent. effective.

TABLE VIII—EFFECT OF LIME-SULPHUR 1-9 PLUS BLACK LEAF 40, ⅜ PT. TO 40 GALS. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
2	435	Newly laid	100	100
*1	540	4 days old	100	100
*1	558	8 ,, ,,	100	100
1	485	9 ,, ,,	100	100
Total.. 5	2,018			

* In these cases a small percentage of eggs hatched, but the nymphs, in the process of emerging or just after emerging, succumbed.

SOLUBLE SULPHUR AND HYDRATED LIME.

In using soluble sulphur, hydrated lime was added to the spray primarily to prevent injury to the bursting buds.

TABLE IX—EFFECT OF SOLUBLE SULPHUR, 12½ LBS., HYDRATED LIME, 10 LBS., TO 40 GALS. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were laid.	Average per cent. killed.	Actual per cent. killed.
3	796	Newly laid	100	100
2	700	4 days old	100	100
2	845	8 ,, ,,	100	100
2	500	9 ,, ,,	100	100
Total.. 9	2,841			

CHECKS. Sixteen batches of eggs were left untreated at various times while the foregoing experiments were being conducted. These served as checks. Out of a total of 1,346 eggs, 93 per cent. hatched.

EFFECTS ON NYMPHS. The few tests which were made with lime-sulphur, etc., on recently hatched nymphs were sufficient to show that 1st and 2nd instar nymphs are readily destroyed by lime-sulphur 1-8 and 1-9, with or without starch.

TABLE X—EFFECT OF SPRAY MIXTURES ON RECENTLY HATCHED PSYLLA NYMPHS.

Treatment.	No. of Tests made.	Total No. of Nymphs.	Instar.	Average per cent. killed.	Actual per cent. killed.
Lime-Sulphur, 1-8	2	47	1st	100	100
	2	107	2nd	100	100
Lime-Sulphur, 1-9	3	371	1st	98	95.2
	2	88	2nd	100	100
Lime-Sulphur, 1-9 Starch, 2 lbs. to 40	1	85	1st	100	100
Lime-Sulphur, 1-10	1	85	1st	91	91
Lime-Sulphur, 1 to 10 Starch, 2 lbs. to 40	1	271	1st	96	96
Total	12	1,054			

ORCHARD EXPERIMENTS.

S. M. CULP'S ORCHARD. Our orchard experiments on the control of psylla were conducted at Beamsville in S. M. Culp's thirteen-acre orchard of Bartlett, Duchess, Kieffer, Flemish Beauty, Bosc, Winter Nelis and Anjou pears. The mild winter of 1918-19 was very favorable for the hibernating adults and in the spring they emerged in large numbers and a large deposition of eggs was made.

FIRST APPLICATION. The first application, i.e. the application to destroy the eggs, was put on by means of a spray gun at the usual time,* and the following spray mixtures were used:

(1)	Lime-sulphur	1-7
	Lime-sulphur	1-9
(2)	Starch	2 lbs. to 40 gallons
(3)	Lime-sulphur	1-10
	Starch	2 lbs. to 40 gallons
(4)	Soluble sulphur	12½ lbs.
	Hydrated lime	10 lbs.
	Water	40 gals.

No one spray mixture, so far as we could judge, proved superior to the others. Each destroyed practically all the eggs and exposed nymphs. The nymphs which had hatched out before the sprays were applied and had sought shelter in the leaf buds beneath the bud scales were uninjured. These averaged about 1.5 to a leaf-bud on all varieties other than Kieffer. On the Kieffer trees the infestation was about .18 to a leaf cluster. This difference no doubt was due to the fact that the Kieffer trees were out in leaf when the spray was applied and therefore did not afford the nymphs much protection.

*The Pear Psylla in Ontario—Report of the Ent. Soc. of Ont., 1918, pp. 81-90.

All the spraying mixtures injured the buds and foliage to a slight but not appreciable extent. In comparing the Culp orchard with pear trees which had been sprayed with lime-sulphur 1-20, no difference in the amount of "burning" was noticed.

Spraying for the Nymphs. In order to destroy the nymphs which had escaped the first spray and those which had hatched from the eggs of belated females, a second application was made after the blossoms fell. Black Leaf 40, 3/8 pint to 40 gallons, was added to the regular codling moth spray (Lime-sulphur 1-40, arsenate of lead 2½ lbs. to 40) and this was applied with great thoroughness.

This application gave excellent results. When the orchard was examined a few days later only an old psylla was found. The insect increased very slowly in numbers throughout the season and right up to early September its numbers were very insignificant. The foliage was in beautiful condition all season and the trees bore an excellent crop of pears.

W. F. W. Fisher's Orchard. Part of a large pear orchard at Burlington was sprayed at the usual time for the "egg spray," with lime-sulphur wash 1-9 and starch 2 lbs. to 40 gallons and the other and smaller part was sprayed with lime-sulphur 1-7. In addition to this all the trees received the post-blossom application of Black Leaf 40.

Results. Excellent results were secured—the psylla was reduced to very insignificant proportions, and for the first time in many years caused no damage.

EVENING SESSION.

The Evening Meeting was held at 8 p.m. in the Carnegie Library and was well attended by members and others interested. The chair was occupied by the Deputy Minister of Agriculture, Mr. J. H. Grisdale. The Popular Address was given by Mr. C. L. Marlatt, Chairman of the Federal Horticultural Board, Washington, D.C., his subject being "The Federal Plant Quarantine Act" or "How the United States is Preventing the Introduction of Foreign Insect Pests and Plant Diseases." The address was highly appreciated and felt to be of special value to Canadian Entomologists, as was pointed out by the President of the Society, Prof. Lawson Caesar, while proposing a vote of thanks.

THE FEDERAL PLANT QUARANTINE ACT.

C. L. Marlatt, Chairman, Federal Horticultural Board, Washington, D.C.

[The following discussion covers the subject in a general way as it was presented extemporaneously.]

Most of you undoubtedly are familiar with the Federal Plant Quarantine Act and with the general features of its administration through a Federal Horticultural Board. This Act was the outcome of a long, hard fight which began twenty years ago as a result of a nation-wide conference called in Washington. This conference included state entomologists and inspectors and secretaries of agriculture and horticulture and other persons interested in plant protection. The need of a federal quarantine which should give protection to the whole United

States had long been felt. The San José Scale excitement of that period was, however, the leading element in bringing about the demand for a federal plant law. As a result of the conference in Washington a broad plant law was drafted which was intended to regulate both foreign importation of plants and also interstate traffic. On account of its breadth of field this proposed law aroused a good deal of opposition and failed to get any real standing before Congress. It was re-introduced at different sessions of Congress for a number of years but never received effective support

In 1908 and 1909 the plant import situation became very serious on account of the sudden increase of infestation of nursery stock received from Europe and Japan by gipsy and brown-tail moths. This was about eight years after the original attempt to get federal plant quarantine law. The failure up to that time to get Congress to act had rather dispelled the enthusiasm of most of us, and the passage of any satisfactory law through Congress was generally looked upon as being practically impossible. The securing of legislation, giving new federal powers, is always a difficult matter and especially so where such powers involve an entirely new subject of legislation encroaching in any degree on the police or other powers of the states.

In the face of the great danger which this country was under from the character of nursery stock importations of 1908-09 I secured permission from the Secretary of Agriculture to draft a new plant quarantine law and to have it introduced in Congress. That draft was the original of the present plant quarantine act. It was a very difficult matter to get this legislation through Congress. The bill was revised and re-introduced many times before it was finally passed in August, 1912, and the story of the long fight to get this legislation would be a very interesting one if I had time to relate it.

The Federal Plant Quarantine Act of 1912 is limited to control of entry of foreign plants and plant products, and to the establishment of domestic quarantines within the United States controlling interstate movement of such quarantined or restricted plants or plant products. As to its foreign features, all plants or plant products of whatever kind are subject to restriction. As to the domestic and interstate features, not only plants and plant products may be restricted but any other article which may be the means of conveying insect or disease enemies of plants, a control broad enough to cover, for example, stone and other quarry products, earth, or even manufactured articles. The law does not provide for any general interstate control of plant traffic except in relation to specific quarantines to prevent the spread of dangerous insects or plant diseases, and in this respect is less broad than the law drafted by the original conference at Washington referred to at the outset of this discussion.

This quarantine act has now been in force seven years. There are now in force under it some fifteen foreign quarantines and seven orders restricting or regulating the entry of plants and plant products and some twelve domestic quarantines. With most of this quarantine and control action you are doubtless fairly familiar. I will discuss rather briefly a few of the more important activities of the Board in respect to these quarantines and restrictions on plant movement.

Perhaps the most important activity of the Board at the moment is in relation to the pink bollworm of cotton. This insect is a very important new enemy of cotton which has recently obtained foothold in Mexico and also scant foothold in Texas. To prevent the further entry of this insect into the United States and to effect its control in the limited areas where it is now established we are now receiving from Congress an annual appropriation of upwards of half a million dollars. The work involved covers a very wide range, including extensive clean-up operations in Texas, the enforcement of a quarantine service between Mexico and the United States, the control of all import cotton into the United States and of the cotton mills in this country which make use of such import cotton, and also the control of cottonseed cake and meal and any other product relating to cotton which may be a means of introducing the insect.

Another important quarantine feature under the Board is the white pine blister rust quarantine, which has for its special object the protection of the great pine areas of the western half of the United States from infestation from the eastern half of the United States where this disease has gained wide and probably firm foothold.

One of the later quarantines has relation to the European borer which has recently obtained foothold in the neighborhood of Boston and in a limited area near Albany, N. Y. We are asking Congress for an appropriation of $500,000 for quarantine and other control work in relation to this borer. Inasmuch as this insect is known to infest practically all succulent vegetation, even grasses, and is so concealed as to make its discovery difficult, its extermination is recognized as an impossibility, but if it cannot be exterminated, it certainly can be controlled. I do not believe in being unnecessarily alarmed over the introduction of any new pest, and in the case of this new corn borer, the last year's experience has demonstrated that there are at least four important controlling factors which may later on show this pest to be a comparatively unimportant one, certainly indicating that Canada, for example, need have very little fear on account of it. These hopeful or controlling factors are: (1) for the northern areas of corn culture, single-broodedness with accompanying negligible damage indicated; (2) possibility of cultural control by the elimination of weeds; (3) the immunity now indicated for ordinary field corn, and (4) the possibility of effective egg parasitism.

(The introduction of this insect through the agency of imported broom corn and its probable wide dissemination in the United States was discussed in some detail.)

Another problem that has recently come up to the Board is the potato wart disease, one of the three plant enemies specifically mentioned in the Federal Quarantine Act to be immediately guarded against. This disease was evidently brought into this country in the winter and spring of 1911-12 before the Quarantine Act was passed. The Department of Agriculture through the Federal Horticultural Board is co-operating with the State of Pennsylvania in a thoroughgoing campaign to eradicate this pest. The work of the last season, now concluded, has presented a very much more hopeful outlook also with respect to this potato disease. In other words, the principal commercial varieties of potatoes grown in the United States have developed a substantial immunity to this disease and it looks very possible, therefore, that it can be controlled through the growth of these immune varieties and other varieties, the immunity of which has already been demonstrated in European countries.

These are a few of the important subjects which the Board now has under way. Other subjects are the Oriental fruit or peach moth which came from Japan on ornamental cherry stock and has obtained rather wide foothold in the District of Columbia, Maryland and Virginia and also in New York and a few other places. This pest might have come to this country on any shipment of Japanese ornamental cherry or peach stock, but apparently obtained its first foothold through a shipment of cherry trees made as a gift of the City of Tokio of Japan to the City of Washington. The first lot was of large sized trees and so seriously infested with various insects that the trees were burned. A second sending was later made of young trees and these were apparently in a fairly healthy condition and at least had been so pruned back that any evidences of the work of this insect had been entirely removed. Incidentally, it may be said that it is a very difficult matter to detect an insect about which you know nothing and which you are not anticipating. The inspector does not know where to look for it. In the case of this pest, even with full knowledge of its habits, it is a very difficult insect to detect by inspection, so carefully concealed is it in its hibernating situation. This infestation was not discovered at the time and the trees were planted in Washington's Riverside Park. The local infestation of the District of Columbia and adjacent Maryland and Virginia has undoubtedly originated from this importation of flowering Japanese cherries. The incident illustrates the futility of inspection, even when carefully conducted, as a means of detecting unknown or unfamiliar pests and is one of the strong arguments for the more radical quarantine action which the Board has recently taken in respect to all such ornamental and nursery stock.

Another pest recently imported is the so-called Japanese beetle. It was introduced apparently about eight years ago on iris stock imported by the Dreer nurseries. It now has a very strong foothold in a comparatively small area in New Jersey opposite Philadelphia. This insect lives nine months of the year in the ground out of sight, is a strong flier, feeds miscellaneously on all sorts of vegetation, and there is therefore very little likelihood that it can ever be exterminated. By federal and state appropriation, however, a strong effort is being made to control this insect and to demonstrate the possibilities of exterminating it if such possibilities exist.

One of the last, and perhaps one of the worst, plant pests that has turned up in this country is the "take-all" disease of wheat which has recently been determined in a few fields in southern Illinois and in a similarly small area in Indiana. War conditions and food shortage led to a movement looking to the importation of wheat from Australia into the United States to replace American-grown wheat which was being exported to meet European needs. A knowledge of the risk from such Australian wheat led the Board to declare a federal quarantine and to place such restrictions as to disinfection and use of such wheat as to safeguard its entry. While these steps were in progress this disease was discovered in a small area in southern Illinois and later in a small area in Indiana. The method of entry of this disease is unknown and nothing has been found to indicate that it came with any wheat imported from Australia for commercial purposes. It is probable that its entry was due to some experimental importation of Australian wheat. Very energetic action was undertaken in co-operation with the two states concerned to stamp out the disease in the infected areas, including the prohibition of the further growth of wheat in such areas and the disinfection of the grain and the burning of infected straw and stubble.

These seven or eight quarantine subjects which I have mentioned, together with the nursery stock quarantine, are the big items of work which the Federal Horticultural Board has under way at the present time.

I will close with a brief discussion of the nursery stock, seed and plant quarantine, a subject which has perhaps as great interest for you as any of these others and is one of the oldest of our lines of work. This quarantine has been administered since the passage of the Act in 1912, but has been revised under what is known as Quarantine No. 37. For seven years the Board had been endeavoring to prevent the entry of pests with imported nursery stock and other plants and seeds by a system of foreign inspection and certification with re-inspection of imported goods at destination in this country. Under this system all foreign countries wishing to engage in plant traffic with the United States on a commercial scale have been required to establish an adequate inspection and certification service. Practically all of the important countries of the world have now established such service in response to the demands of the plant quarantine act of the United States. The benefit of this service, as evidenced in the character of the plant shipments to this country, has been tremendous. Whereas, before these inspection and certification measures were compelled by our act, thousands of instances of browntail moth and gipsy moth infestations occurred in a single year in our plant imports, there are now comparatively few instances of these pests being found. Freedom from all kinds of insect pests and plant diseases has been very marked as compared with the old conditions, but, after all, it is only a *marked* improvement, not absolute freedom. These pests still come in. For example, sixty-three instances of browntail and gipsy moth infestations have been discovered by the inspection service in the seven years since the act went into effect, and it is unfortunately not at all certain that all infestations by these insects were discovered in re-inspection at destination in this country. Hundreds of other pests have also been discovered as a result of these inspections. This state of affairs was the important reason leading to the enactment of a new nursery stock, plant and seed quarantine, namely, Quarantine Order No. 37. Before this quarantine was promulgated the subject was given long and careful consideration. A thoroughgoing investigation was inaugurated by the Board, bringing into its scope all the departmental plant experts of its various bureaus. The matter had also been under consideration for several years by state men through their organizations. Finally the whole subject was discussed fully at a hearing at which the producing horticulturists and the state experts of the whole country were brought together. This discussion indicated a practically unanimous support of a quarantine which had been outlined and which was substantially the same in scope as Quarantine No. 37.

Following this hearing the matter was given further study by our experts and some of these experts visited producing horticultural establishments of this country to discuss the needs of this country as to plant importations. Some months later a final conference was called of all the interests concerned and to this conference was submitted a provisional draft of the quarantine. It was eight months after the quarantine had been first broached that it was finally promulgated. The action of the department and the Board, therefore, can certainly not be charged with having been precipitant. The quarantine became effective June 1st, 1919. It has aroused a wide criticism and protest, much of this protest being based on misrepresentation. It has been represented, for example, that the quarantine will prevent the entry into the United States of new plant creations of Europe and other foreign countries and that America will be forever deprived of all such additions to its horticulture and floriculture. There is no foundation for this charge. The quarantine does not really prevent the importation of any plants into the United Satates for which a real need can be shown. Provision is made in the quarantine for the entry for introduction purposes of any new plant creations of Europe or other foreign countries. Furthermore, the quarantine provides for the entry of any reasonable amount of plant material not available in the United

States which is needed for the development of reproduction enterprises to supply home needs. All such special introductions, however, must be made through the Department of Agriculture and will be subject to all the safeguards which the highly developed inspection service of the Department in Washington can give, including, if necessary, detention in quarantine or even the destruction of the imported material if its condition of infestation is such that such destruction is determined as necessary to prevent entry of pests or plant diseases. It is not probable, however, that material offered for entry under this provision of the quarantine will be often so infested as to require such drastic action. As a result of the misrepresentation referred to and other phases of misrepresentation Congress and the Department of Agriculture at Washington have been flooded with letters and petitions in opposition to the quarantine. This opposition has largely come from certain importing interests which will be necessarily restricted in business by the quarantine.

The experts of the Department of Agriculture, and, I think, also the thoughtful horticultural interests of the country, are convinced of the need of such quarantine action. Undoubtedly this quarantine will lead to a development in this country of horticultural productions to take the place of the articles which have hitherto been obtained from foreign sources. In this way it will indirectly be the means of developing American horticulture and floriculture. It is only fair to say to those who go into production enterprises to supply the material the importation of which has been cut off that this quarantine in all probability in its main lines will stand and that such enterprises will therefore fill a permanent place in our horticulture. This does not mean that Quarantine No. 37 is not subject to modification or change, but it does mean that the department and the experts of the country are convinced that it is sound in principle and that its enforcement practically along its present lines will afford a needed protection for the forest, fruit and farm interests of this country. Wherever an error can be shown it will be corrected but changes will not be made for personal, selfish, or commercial interests, however powerful their backing, to the loss of the principle of protection which underlies and is the basis for this quarantine.

HOPKINS' BIOCLIMATIC LAW.

Wm. Lochhead, Macdonald College, Que.

Economic Entomology is ever drawing on other sciences for aid in the solution of its problems. It is indebted to chemistry for help in solving the problem of insecticides, to bacteriology and botany in the effort to work out means of controlling certain insects by bacteria and fungi, to agriculture for the introduction of farm practices that tend to control certain insects, to zoology for a knowledge of the habits of birds and other animals that feed upon insects; to physics for suggestions and explanations regarding the construction of many useful devices, and to Meteorology for the help it has given toward a better understanding of the distribution of organic life and of the factors that influence its seasonal activities. Without a knowledge of these sciences an economic entomologist may make but little headway when brought face to face with a new practical problem.

One of the most recent and most far-reaching contributions to Economic Entomology is the Bioclimatic Law of Dr. Hopkins of the U. S. Bureau of Entomology.

The Science of Phenology. From time immemorial agricultural practice has been guided by meteorological factors. Primitive man, no doubt, soon discovered that his food plants required a limited period to reach maturity and that every growing season had its earliest and latest dates for planting. He soon learned, too, that these dates varied with different regions, with different seasons, and with local weather conditions. In the course of time a mass of observations accumulated, which constituted the basis of farm practice. Naturally much error crept into the observations and false deductions were drawn from certain coincidences, but on the whole the early growers of plants were guided by experience. Their contact with nature was very intimate, perhaps more intimate than that of the farmers of to-day. They knew the times of opening of the buds of the various shrubs and trees, and of the arrival and departure of the birds, and learned to associate certain farm practices with these events as natural guides.

For example, the time of the appearance of the blossoms on the maple was considered by many people a suitable time to begin gardening; the blossoming of blackberries the best time for bean planting; the blooming of the locust trees for the planting of cotton; the mouse-ear size of white oak or maple leaves for the planting of corn; the opening of the elder flowers for the sowing of turnip seed; the ripening of the elder berries for the harvesting of the early onions; and the ripening of the burs of the small cockle-bur for the harvesting of the late crops. In other words, the early farmers associated their farming operations with periodic phenomena connected with some tree, shrub or plant.

In the eighteenth century when plants began to be studied scientifically attention was given to the recording of observations on such periodic phenomena as the opening of the buds, the time of flowering, the ripening of the seeds, etc., which give rise to the science of phenology. At the same time studies were made to determine the geographical distribution of plants and animals.

In the course of these investigations the rates of variation in the dates were partially determined for different latitude, longitude and altitude, but the number of data was not sufficient to permit a definite law of variation to be formulated.

It was early observed that while temperature was the main controlling factor in bringing about variations in periodic phenomena other factors also played an important part. Dr. Merriam's maps of the zonal distribution of plants and animals into Life Zones were largely based on the temperature factor and are very suggestive and helpful in matters of life distribution. These maps, however, do not furnish information regarding the dates of periodic phenomena in different regions and districts so much desired by the economic biologist in the matter of application of methods of control in the different regions.

As an example, the old spraying calendars, based on regional distribution rather than phenological phenomena, have been discarded as unsatisfactory, and instead "some periodic event in the plant to which the spray is to be applied is given as the index to the time to do the work."

Dr. A. D. Hopkins was the first person in America, I believe, who attempted to apply this science of phenology to the solution of entomological problems, especially those relating to certain forest insects in West Virginia. Later it was applied in connection with the control of the Hessian Fly, and as an outcome of the investigations a definite Bioclimatic Law was formulated, which forms a working guide for farm practice and biological research over the entire continent. In connection with this law Dr. Hopkins has prepared a system of maps and com-

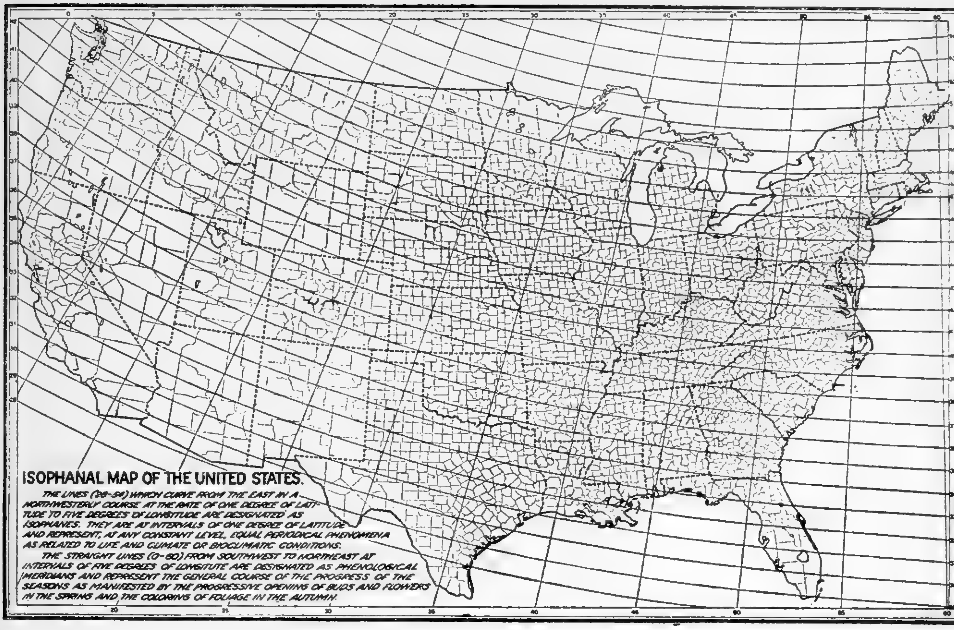


Fig. 1. Isophanal Map of the United States in 1 degree isophanes and 1 x 5 degree quadrangles to illustrate method of expressing the geographical constants of the Law.

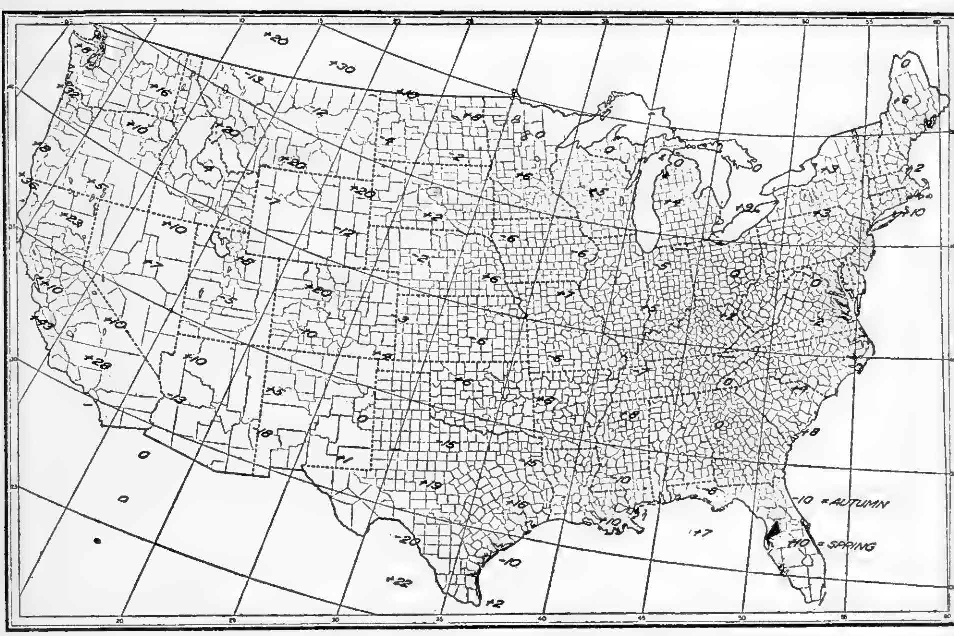


Fig. 2. Isophanal Map of the United States in 5 degree isophanes and 5 x 5 degree quadrangles to illustrate method of designating phenological areas for the study of influences which contribute to time, altitude or latitude departures from the geographical constants. The estimated minus (earlier) and plus (later) departures in days from the computed time constant for spring and autumn events, as given for each quadrangle, are based on a study of more than 40,000 reports on the date wheat harvest begins and on other statistics of planting and harvest dates for wheat, potatoes, etc., and represent averages for the entire quadrangle.

puting calendars and tables which aid very much in the computation of phenological dates.

Dr. Hopkins informs us that the rates of variation in the dates of periodic events were determined earlier by Schubler in 1830 for the distance between Parma, Italy, and Greifswald, Prussia, as 4 days for a difference of about 325 feet of altitude and 1 degree of latitude. Although Quetelet, in 1846, was aware of the influence of longitude, it remained for Fritsch, in 1865, to state that each degree of longitude westward made a variation of 4/10 of a day. In 1893 Ihne found the variation to be about 9/10 of a day. Dr. Hopkins, in 1900, concluded from his investigations in West Virginia that the rate of variation was 4 days to 1 degree of latitude and 400 feet of altitude, and later in 1915 concluded that there was a variation of 4 days to 5 degrees of longitude.

THE BIOCLIMATIC LAW. The Bioclimatic Law may be stated as follows: *The variation in the time in which periodical events occur in the seasonal development and habits of plants and animals at different geographical positions within the range of their distribution is, other things being equal, at the rate of four days for each degree of latitude, five degrees of longitude, or 400 feet of altitude.*

According to this law, lines running from the east toward the north-west at the rate of one degree of latitude to five degrees of longitude represent the same constant or average date of periodical phenomenon for any given level throughout their length. Such lines are called *isophanal lines,* and in accordance with this law Dr. Hopkins has constructed isophanal maps of the United States (Fig. 1). Meridian lines drawn at right angles to the isophanal lines are called *phenological meridians.*

The influence of certain local factors that modify the average dates of the periodic phenomena for each quadrangle, such as topography, lakes, large rivers, rainfall, sunshine, etc., according to their intensity, is marked on each quadrangle as plus (later) or minus (earlier) departures for both spring and autumn (Fig. 2).

Dr. Hopkins believes that the amount of departure of the actual from the computed date for any locality represents the intensity of the action of local factors.

For example, in Florida the departures are ten days earlier than computed time for autumn and ten days later for spring events; for Western Ontario only nine days later for autumn. Such departures were based on a study of more than 40,000 reports on the date wheat harvest begins.

The departure constants were obtained by establishing *phenological bases* or "localities where a sufficient number of observations have been made to establish corrections for local and regional influences, so that the date of any seasonal event recorded there may serve as a reliable basis for the computation of corresponding dates for the same event at any other geographical position within the same or different regions of a country or continent."

Wooster, Ohio, was taken as the base for fall wheat seeding on account of the thorough work done there by Webster in connection with the determination of Hessian fly-free dates, while Minnesota was taken as the base for spring wheat seeding.

In accordance with the law and with the amount of departures for different localities Dr. Hopkins, in 1917, proposed to the U. S. Department of Agriculture to make wheat seeding map-calendars for all the States for the purpose of increasing the wheat yields for 1918 by the control of the Hessian Fly. On account of the limited time, however, posters with maps and instructions were prepared for only New York, Pennsylvania, Illinois, Indiana, Nebraska, New

Jersey, West Virginia, Oklahoma, Virginia, North Carolina, and Tennessee. (Fig. 3.)

Fig. 3 is a calendar of winter wheat seeding date constants for map (Fig. 1) computed for latitude, longitude and altitude. To illustrate its use let us select the Guelph region. This lies in the quadrangle bounded by the phenological meridians 45 and 50 and the isophanes 47 and 48 and at an altitude of 1,000 feet. By referring to Fig. 3 it will be seen that the date for winter wheat seeding is September 10th for an altitude of 1,000 feet. Next, by referring to Fig. 2 we find

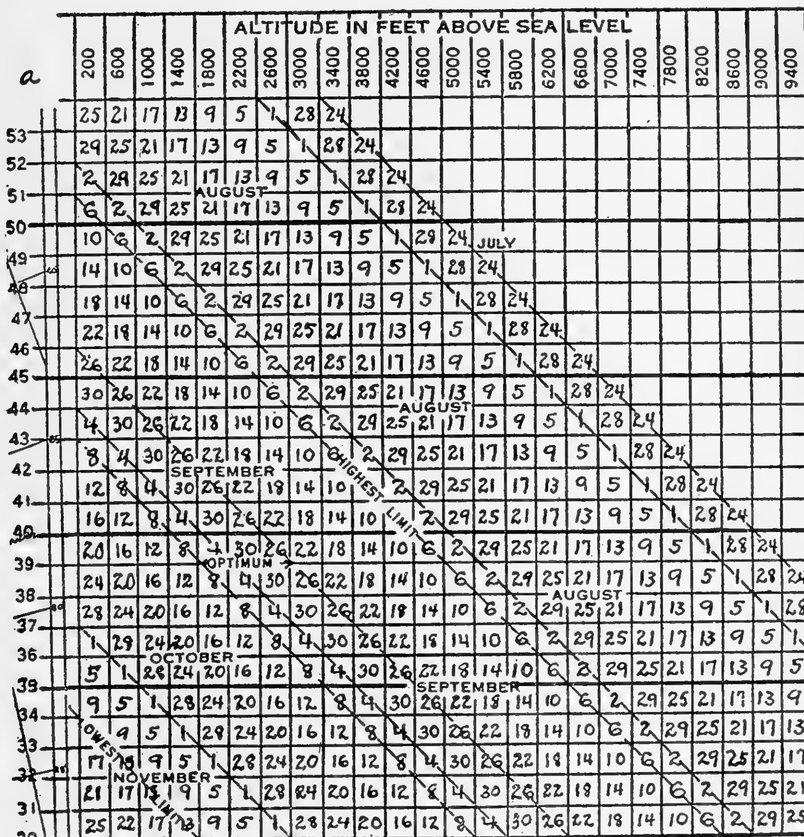


Fig. 3. Calendar of wheat seeding date constants for Isophanal Map, Fig. 1. *a* Isophanes. The dates in this calendar are the computed constants for the given altitudes to be corrected for the 5 x 5 quadrangles of Fig. 2, by adding the + and subtracting the —autumn date which will give the general average date for the average altitude and average season.

the departure constants are 0 for fall events. For this locality, therefore, the best date for winter wheat seeding is September 10th.

It is impossible in the short time allotted me for the presentation of this paper to give in detail the many interesting studies made by Dr. Hopkins in the formulation of his Bioclimatic Law. Such details will be found in *Supplement No. 9 of the Monthly Weather Review,* issued May 1st, 1918, and in an article in the June, 1919, number of the *Scientific Monthly.*

It seems to me that Dr. Hopkins' Bioclimatic Law is an important contribution to service inasmuch as it is based on phenological phenomena which are the best means of determining the influence of all the complex factors that play upon plant and animal life.

I have already referred to the use of the Law in the control of the Hessian Fly. Dr. Hopkins has used it in connection with certain forest insects, viz., the Southern Pine Beetle (*Dendroctonus frontalis*), the Western Pine Beetle (*D. brevicomis*), the Mountain Pine Beetle (*D. monticolae*), and the Pine Bark Louse or Spruce Gall Louse (*Pineus strobi*).

By means of a map-calendar the dates for the beginning and ending of control measures between the autumn and spring flights can be recommended, in the case of the Pine Beetles, and in the case of the Pine Bark Louse the date of hatching and time of moving about.

Dr. Hopkins believes that the Law can be applied with great advantage in farm practice as a means of determining the dates of best seeding and harvesting for the production of maximum crops. While he has shown the application of the Law to winter and spring wheat he is of the opinion that it can be applied equally well to all kinds of crops.

Moreover, it can be used for the making of reliable spray calendars in orchard practice for the control of insect and fungus diseases.

This Law, moreover, is of value in determining the northern limit in the geographical distribution of species of plants and animals. It is, therefore, a valuable supplement to Merriam's work on Life Zones.

Regarding the value of phenology Dr. Hopkins says: "Properly recorded and correctly interpreted there is nothing perhaps to equal the records of the dates of periodical events in plants and animals as indices to the bioclimatic character of a place or local area, because such events are in direct response, not to one or a few, but to all the complex elements and factors of the environment which no artificial instrument or set of instruments yet available will record. In other words, while species and varieties and even individuals of the same species and variety respond in a more or less different degree to the same complex influences, there are certain constant elements in the response of individuals and groups of varieties and species which, if properly interpreted, will serve as a key to the bioclimatic character and conditions which distinguish a particular region, locality, or place from that of other nearby or distant ones.

The Bioclimatic Law in Canada.

Most of the data from which Dr. Hopkins prepared his maps were obtained from the United States, and it will be observed that the departures from the Law constants are practically absent from the Canadian section of his maps. No doubt the reason for this absence was the lack of sufficient data from Canada.

The writer believes, however, that Canada has the data if they can only be compiled. This country has not only a large number of experiment stations scattered from the Atlantic to the Pacific, but also a large number of reports prepared by Federal and Provincial agencies, that could supply the necessary data relating to phenological phenomena. A compilation of such data would be most valuable in extending the practical application of the Bioclimatic Law to the different sections of Canada. The writer expresses the hope that some competent government official may be detailed to gather such data, so that Canada may reap the advantages which may flow from the application of the Law to agricultural practice and to the solution of many entomological and other problems.

FRIDAY MORNING, 9 O'CLOCK.

LOCUSTS IN MANITOBA, WITH SPECIAL REFERENCE TO THE OUTBREAK OF 1919.

NORMAN CRIDDLE, DOMINION ENTOMOLOGICAL LABORATORY, TREESBANK, MAN.

We have had locust plagues in the Prairie Provinces as far back as history will take us; that they occurred long before that time is extremely probable. There were, however, no crops in those days and very few observers, consequently the locust outbreaks were imperfectly recorded and our knowledge of the species involved is extremely dubious. There were at least seven distinct locust outbreaks in the Nineteenth Century most of which extended over two or more years. The first was recorded from Lord Selkirk Red River colony in 1818, another probably occurred about 1830; then we have records for: 1855-57, 1864-66, 1868-70, 1872-75, 1897-98, and 1900 to 1904 of the new century. In other words there were fully 22 locust years in the last hundred. Another significant point is that in almost every instance the infestation lasted two or more years.

Reading from Riley, and from Lugger of Minnesota, one notes that by far the most important injury in all their records was attributed to the Migratory locust, *Melanoplus spretis,* a species which was supposed to have its permanent abode in the foothills of the Rocky Mountains and from that breeding ground to spread far over the surrounding country. In his later reports Lugger also attributes much to the Lesser Migratory locust, *M. atlanis,* and in a smaller extent to the Pellucid locust, *Camnula pellucida.* Judging from more recent occurrences I think it would be safe in concluding that these latter species were present in most of the former outbreaks, especially the Lesser Migratory locust which is, after all, very like *spretis.*

It is evident from this brief summary of the past, that we can expect locusts to become troublesome at intervals of about 15 years though these periodic visits are not, of course, by any means regular. The insect's appearance depends largely upon meteorological conditions among the most important of which are abnormally dry seasons, especially during May and June. There is one other point to bear in mind and that is while we talk of a locust outbreak every 15 years we should remember that such an invasion does not necessarily cover the whole country because, as a rule, it is far from doing so. Indeed most of our outbreaks have been confined to the southern portion of the province.

My personal experience with locusts dates back to 1900, when we had an outbreak in our neighbourhood involving our own farm among the rest. The species concerned was chiefly *atlanis* though there were a fair number of *spretis* among them for the first two years, after which that species disappeared and has not, so far as I am aware, been heard of since. Much crop was destroyed the first season owing to lack of knowledge and proper equipment. The second year, however, we learned the merits of poisoned baits and from that time forward the comparatively small losses were due almost entirely to neglect.

It is fourteen years since the events I have just recorded took place and during the interval we have been free from locusts in the province. The present year, however, has once more brought the insects into prominence.

The new outbreak is a serious one and promises to become still more so. Fully half a million acres are already involved in the southern portion of Manitoba, while there are several areas of lesser extent isolated from the rest.

Strange as it may seem this severe outbreak came to us as a complete surprise, not a report came in of injury the previous year though we know that the insects must have been present in large numbers. This shows how little one can rely upon farmers for such information and indicates how necessary it is to have reliable scouts to be on the watch for just such a plague. The savings from such observers, on this year alone, would have been sufficient to pay the salaries of half a dozen scouts for the next ten years. When information did reach us the young hoppers were already beyond immediate control, and when I arrived at the infested area whole fields had been swept bare; added to this was the fact that we were totally unprepared and in consequence all the necessary supplies were lacking. It was a week before poison could be shipped into the affected territory, and even then it could not be secured in anything like sufficient quantity to cope with the outbreak. The Winnipeg labor strike was partly to blame for this and it also greatly hampered transportation when the supplies were shipped from the east. These are a few of the first difficulties we had to contend against. Next we had to educate the farmers as to the means of control and this in itself was no simple task. Most of the farmers involved had never witnessed a locust outbreak before and when they saw the millions upon millions of tiny hoppers turning the green fields black, many lost heart. Scoffers, too, were numerous, but some enterprising men remained and by their aid examples were provided which added much to our own demonstrations. Dead hoppers, small and hard to find among the grass, were pointed out and as their numbers increased, and the dark areas grew no larger, farmers took heart again; but only temporarily, soon fresh hordes were making their way over the bodies of their dead companions and commenced to eat new inroads into the crop. It was at this time that the human barometer fell very low indeed and but for the former experience of a few men we might have had difficulty in keeping the work going. Some farmers did indeed lose all hope and, later, their crops also. Others of more persistent character continued in their efforts and ultimately had the satisfaction of at least saving part of their crops. As for the dead locusts it is hard to realize the vast numbers that covered the ground. In one instance we found an average of 244 dead to the foot over a large field, that is to say approximately 260 bushels per acre. On one square foot at another place I counted 641 dead locusts, two-thirds of which were adults. I give these instances from many similar ones. Had these locusts been permitted to breed they would have produced at least 6,000 eggs to every square foot of land on the field and these in their turn would have provided locusts enough to destroy fully two thousand acres of crop next year.

Much of the success obtained was due to the Provincial departments supplying the poison free, while the municipalities, as a rule, provided the bran and attractants. There was some delay, however, before these measures were adopted; many farmers in the meantime, procuring their own materials.

Our measures of control did not differ to any marked extent from those in use elsewhere; we relied chiefly upon the Kansas bait partly because it was more easily mixed and also because it seemed more attractive to the grasshoppers than the Criddle mixture. Another point in favor of the former was the difficulty in securing horse droppings in sufficient quantity. However, there were some farmers in nearly every district who spoke very highly of the droppings and used nothing else. Two instances came to my notice where the farmers had used manure spreaders and while this might seem a rather extravagant method of spreading poison, we must take into consideration the cheapness of the material which would permit a far greater quantity to be used in comparison with Kansas bait, at the same cost. The results of this method were, at least, all that could be desired and probably exceeded any other.

Later in the season a large type of hopper catcher was used, this being an improved model of the old hopper-dozer. It was sixteen feet long and some three feet in height, made, apart from the frame, with galvanized iron. With this implement, drawn by two horses, some farmers claimed to have caught as many as fourteen bushels of locusts in one day. Certainly some excellent work was done with them while the enthusiasm lasted, but in spite of the apparent success I am of the opinion that the machines are a poor substitute for poison baits.

There is one feature in the present locust outbreak that makes it different from any other we have experienced in western Canada and that is the fact that we have had to deal with an entirely different kind of locust. Our previous knowledge referred entirely to the genus *Melanoplus* and chiefly to the Migratory and Lesser Migratory species, whereas the present insects involved are largely the Pellucid locust. It was, perhaps fortunate that we visited the infested districts before giving advice and more so that we were able to distinguish the species involved, because the habits of the two genera are different in many respects. For instance the species of *Melanoplus* we have been dealing with, oviposit in and around small openings amid sparse vegetation, or more frequently still, in the stubble fields. Camnula, on the other hand, avoids such places and instead, selects the roadsides and sodded areas, depositing its eggs in the clumps of grass. It thus happened that instead of swarming of the stubble fields, as might have been expected before knowing the species, the insects came from the roadsides. This was how conditions were in most districts, but in a few *Melanoplus* predominated, while in others, all kinds were found together.

It is an interesting sight to see the small hoppers all moving in one direction, as if all were induced by a similar impulse. These movements may be towards the sun or away from it, with or against the wind so that it is difficult to arrive at a reason for the uniformity of movement. One thing is certain: having once located a field they seldom abandon it while food remains available. Moving inward they first steadily work their way towards the centre of the field while the rear guard clean up what is left, or that which re-sprouts. Large masses of these hoppers may also be seen in the morning while the dew is still on the herbage, sunning themselves before partaking of the morning meal. It is then that they sometimes gather along roadsides so thickly that the road looks black with them; on other occasions they have been known to collect on the railway irons in such numbers as to actually stop the trains. The greatest sight of all, however, is to see a migration after the insects have attained the winged stage. At such times they move in regular swarms and drift along with the wind like a thick snow storm. Such a swarm may last for hours or but a few minutes. All depends upon the weather, when the sun comes out bright and hot the insects are on the wing in a moment, should a cloud obscure that orb's surface, the locusts as quickly drop to earth again. The flights, too, seem to be infectious because no sooner do the insects from a distance drift past than those in the vicinity fly up to join them and so add to the moving swarm. To witness such a sight for the first time cannot but prove a joy to the naturalist, but it has a very different effect upon the farmer, who perhaps sees the hard work of months brought to nothing in a few hours. We had instances, at such times, when hundred acre fields of wheat where destroyed in two days by successive swarms of migrating locusts. Other fields, however, were actually freed through the insects moving elsewhere. It was owing to these habits that some farmers who had done little still harvested some crop while other men, working hard to prevent the locusts depredations, lost everything.

The almost daily flights mentioned above, naturally scattered the insects far afield and over much new territory, but while they thus moved in vast numbers their movements were much closer to the ground than are those of the Lesser Migratory locust which often rises far above the area of ordinary vision. *Melanoplus* also takes part in the low flights though less frequently. All species commence to migrate soon after they obtain wings, and continue, on and off, for fully a month and a half. In 1919 they commenced to fly about the middle of July and continued for a considerable time after the insects had begun to oviposit. Indeed there is strong evidence to show that the female frequently deposited one lot of eggs and then moved to other territory to complete her work.

During the wingless stages, and for a time afterwards, the Pellucid locust spreads all through the fields and in this habit resembles the common species of *Melanoplus,* but as the breeding season draws near it returns to the sod land, while the latter remain on the stubble to deposit their eggs. This habit alone usually enables us to distinguish the species involved without seeing it. For instance, should a farmer report extensive cutting of twine we are reasonably safe in referring the injury to species of *Melanoplus* because *Camnula* will be on the sod at the time the grain is cut. The only other insect, therefore, that could be involved would be the larger crickets (*Gryllus assimilis*). Another difference is in the kind of soil preferred, the Lesser Migratory locust inhabits sandy land, *Camnula* the richer soil; though both prefer the dry uplands for egg-laying.

The conditions favoring the increase of any particular species are almost sure to be beneficial to the development of others, consequently there are always others present of lesser importance, and in 1919 we had *Melanoplus minor,* which is the earliest to develop; *M. packardii, gladstoni, dawsoni, bivittatus,* and *femur-rubrum.* The first three are upland species while the last two prefer slightly moister situations. I found a remarkable little outbreak of *M. gladstoni* near Pilot Mound which is, I believe, the first occasion that this species has been recorded as notably injurious.

As I have already mentioned, the eggs of *Camnula* are deposited along roadsides or in pasture fields. Contrary to the general idea the insects, with us, prefer the higher land rather than low spots. Any sodded soil is suitable provided it is comparatively dry. In preparing to oviposit the female selects a low clump of grass in which she forces her abdomen to that the egg mass, that she deposits, is situated among the grasses roots. The eggs, however, are always close to the surface and when the grass clump is a dense one, may actually protrude above ground though, of course, hidden amid the base of the plant. Owing to the peculiarity in selecting egg sites the egg pods, too, are frequently massed together and often actually touching one another in their density. In this connection I have found as many as 84 egg sacks within a square foot, that is to say approximately 2,000 eggs.

It was unfortunate that the seriousness of the 1919 outbreak prevented the few of us engaged in control measures from conducting investigations as to the effectiveness of the various poisons or attractants. When it is considered, however, that the Dominion had but one man in each province and that there was work enough for a dozen, it will be readily understood why we were obliged to devote all our time to the immediate needs of the farmers. In other words, we became, for the time being, demonstrators and encouragers rather than research men. When we view the results, however, we cannot but feel gratified at the thousands of acres that were saved even though much was lost also. We have surely demonstrated what can be done with more effective preparation, and as a result organization is well under way to combat the probable outbreak of next year. We know where the eggs are, having made a careful survey during the autumn months and this knowledge will help us much in locating the young hoppers as soon as they hatch out. We can then attack them immediately rather than wait until they invade the crop.

Deep ploughing has undoubtedly accounted for many eggs, especially in those districts where *Melanoplus* predominated. Unfortunately the sod land is much more difficult to attend to and I fear that it will, in most instances, remain untouched. Experiments conducted at the Treesbank Laboratory, have shown that the eggs, even when incased in their usual covering, cannot withstand a temperature of 90°F. for many hours when the sun is shining and, therefore, exposing them early in the season is an effective means of destroying the eggs. A lesser temperature, however, is not as effective though exposing the eggs to the vicissitudes of autumn, winter and spring may help to prevent their hatching.

Turning to the prospects for next year, we cannot, of course, predict with certainty that there will be an outbreak, as weather conditions may intervene, but judging from the past the chances for this are small, in which case we may expect a worse and more widespread outbreak than the one of 1919. As I said before, I think we shall be prepared. This, however, is a matter that the provinces are chiefly taking in hand. Naturally we have all been working together against the common enemy and for myself, I should like to take this opportunity of expressing my appreciation of the splendid co-operation that has taken place. We have been in the field together and worked together for the common benefit.

LIFE-HISTORY NOTES ON SOME SPECIES OF ACRIDIDAE (*ORTHOPTERA*) FOUND IN BRITISH COLUMBIA.

E. R. Buckell, B.A., Entomological Laboratory, Vernon, B.C.

In presenting some notes on some species of Acrididae occurring in British Columbia I do so with some hesitation for the reason that I have not been able to complete the life-history of many of the species. My hope, however, is that such notes as I have prepared will prove of service to those undertaking any further ecological and life history studies on western species of Acrididae.

My thanks are particularly due to Mr. R. C. Treherne for his encouragement and advice during the past two years in this work, and to Messrs. L. P. Rockwood of the U. S. Federal Entomological Station, Forest Grove, Oregon; and Norman Criddle of the Dominion Entomological Branch, for their kindness in assisting me in the identification of species.

The following species represent the majority of the various Acrididae I have collected in British Columbia during the past two years, and the localities where they were taken.

Acrydiinæ (Tettiginæ)

Acrydium granulatum Kirby. Penticton.

Acrydium ornatum Say. Fairview.

Acridinæ (Tryxalinæ)

Pseudopomala brachyptera (Scudder). Vaseaux Lake. Fairview.

Akentetus unicolor (McNeill). Fairview. Westbank.

Orphulella pelidna (Burm). Fairview.

Chloealtis conspersa Harris. Salmon Arm.

Chloealtis abdominalis Thomas. Salmon Arm. Vernon.

Stirapleura decussata (Scudder). Naramata. Penticton. Fairview. Vaseaux Lake. O. K. Falls. Keremeos.

Ageneotettix scudderi (Burner). Westbank. Fairview.

Aulocara elliotti (Thomas). Westbank. Fairview.

Chorthippus curtipennis (Harris). Penticton. Vernon.

Oedipodinæ

Arphia pseudonietana (Thomas). Salmon Arm. Vernon. Penticton. Fairview.

Camnula pellucida (Scudder). Celesta. Salmon Arm. Vernon. Westbank. Penticton. Fairview. Bridesville.

Hippiscus neglectus (Thomas). Westbank. Penticton. Keremeos. Fairview.

Hippiscus obscurus (Scudder). Westbank. Penticton. Keremeos. Fairview.

Hippiscus vitellinus (Saussure). Penticton. Fairview.

Hippiscus latefasciatus Scudder. Fairview.

Dissosteira carolina (Linnæus). Salmon Arm. Vernon. Penticton. Fairview.

Spharagemon æquale (Say). Vernon. Westbank. Penticton. Fairview.

Mestobregma sp. (probably *kiowa*). Okanagan Landing.

Mestobregma sp. Westbank. Fairview.

Conozoa wallula (Scudder). Vernon. Westbank. Penticton. Fairview.

Circotettix suffusus (Scudder). Celesta. Salmon Arm. Vernon. Westbank. Penticton. Fairview.

Circotettix lobatus Saussure. Fairview.

Trimerotropis cæruleipes (Scudder). Celesta. Salmon Arm. Vernon. Penticton. Fairview.

Trimerotropis vinculata (Scudder). Salmon Arm. Penticton. Fairview.

Locustinæ (Acridiinæ)

Melanoplus atlanis (Riley). Celesta. Salmon Arm. Vernon. Westbank. Penticton. Fairview.

Melanoplus femur-rubrum (DeGeer). Celesta. Salmon Arm. Vernon. Westbank. Penticton. Fairview.

Melanoplus packardii (Scudder). Fairview.

Melanoplus bivittatus (Say). Salmon Arm. Vernon. Penticton. Fairview.

Melanoplus cinereus (Scudder). Fairview.

Acrydiinae.

Two species of the sub-family Acrydiinae were taken during the summer of 1919. Both belong to the Genus *Acrydium.*

Acrydium granulatum Kirby. Large numbers of adults of these insects were taken on April 12th in the meadows at Penticton. During April and May they were common everywhere in damp meadows around Penticton. A few were again taken during the latter part of August. No records of their breeding habits were obtained. The specimens varied greatly in coloration and markings, and all examined were macropterous.

Acrydium ornatum Say. A single male adult of this species was taken on August 7th at Fairview.

ACRIDINAE.

In this sub-family nine species were collected belonging to eight genera.

Pseudopomala brachyptera (Scudder). Two immature insects of this species were taken at Vaseaux Lake, between Penticton and Fairview, on June 14th. No mature specimens were taken this summer.

Akentetus unicolor (McNeill). On June 27th, at Fairview, adults of this species were first seen, and at this date considerable numbers were present on the dry bunch-grass ranges. The nymphs had been observed since the middle of May. By the end of July all were adult and they were found scattered about all over the dry ranges south of Fairview, to the U.S. Boundary Line. A few adults could still be found at the end of August. No observations were obtained as to their breeding habits. These grasshoppers are very active and can jump long distances.

Orphulella pelidna (Burin). These grasshoppers were first taken near Fairview on August 7th (1919) and were found during August fairly commonly near the edges of ponds, and along the banks of the Okanagan River. They were only seen where the grass was still green and were never observed out on the dry ranges. They vary very much in colour, from a dark brown to a bright apple green. They are strong jumpers but do not use their wings much. This is the first time that this insect has been recorded from British Columbia.

Chloealtis abdominalis (Thomas). This species was found in bushy pasture land among dry grass tufts and in burnt-off bush land at Salmon Arm on September 29th. The males were heard stridulating and by approaching them carefully a few were secured.

Only one female was found; it was brachypterous and considerably larger than the males, it was very sluggish and made no attempt to escape but its coloration made it very hard to see among the grass tufts. When the males were at last spotted after a careful stalk they were by no means easy to capture, as they would take one or two big jumps and then burrow down among the leaves and rubbish on the ground, their colour harmonizing closely with their surroundings. When stridulating the males usually crawled up on to a log or stone. These grasshoppers were found again at Vernon on October 4th, on light bush land. The males were stridulating and one or two were secured but I could not find any females. The eggs of this species are laid in rotten logs, fence-posts, etc.

Chloealtis conspersa Harris. One male of this species was taken on September 29th at Salmon Arm while collecting *Chloealtis obdominalis*. These two species are very similar, but *C. conspersa* can be distinguished by having the entire sides of the pronotum and first few segments of the abdomen black, and the lower surface of the last few abdominal segments orange-red.

Stirapleura decussata (Scudder). This species was first observed at Penticton on April 26th on a sheltered stony tract of land from which the snow had gone off early. They were present in considerable numbers but were not very active at this date, not having been out of hibernation very long. A few of them were still in the nymph stage but by far the greater number were adult. As the spring had only opened a short while before and snow was still present on the higher hills, it would have been quite impossible for these to have hatched from eggs this spring and to have grown to adult in this short time. They must, therefore, have hibernated as adults and large nymphs. On May 4th this species was found commonly scattered over the dry range country in the neighborhood of Fairview in the Lower Okanagan Valley. They were most plentiful on stony ground and sage-brush land, although some were seen on the open bunch-grass plains. They were now fully active and the males could be heard stridulating while at rest upon the ground. When disturbed they would hop away but would not readily take wing. They are silent when in flight. On May 19th this species was found to be egg-laying and from the middle of May to the middle of June oviposition was at its height. From this date on, however, they decreased rapidly in numbers and by the end of June no specimens could be found. I do not know when these eggs hatch, and all that I am able to say about their further life history is that up to September 1st, when my observations ended, no specimens of this species were taken. I think, however, that they would soon have appeared as adults again as another species (*Hippiscus neglectus*) with a similar life history was just appearing again on August 28th.

Ageneotettix scudderi (Bruner). This species was first taken on July 20th at Westbank, and on July 23rd they were found to be fairly common on the dry range land around Fairview. They were very similar in habits and distribution to *Aulocara elliotti* and seemed to take their place, for as *Aulocara elliotti* decreased *Ageneotettix scudderi* increased. Both these species when at their height were the most abundant grasshoppers present on the ranges. Although a small species they were easily seen on the ground on account of their white antennae and bright red hind tibiae. They are an active species with great jumping powers. Toward the end of August they began to decrease and were not so frequently taken, and I think that they had deposited their eggs by this time.

Aulocara elliotti (Thomas). This species at the end of June was the most plentiful grasshopper on the dry range country of the Southern Okanagan Valley. I do not know when this species first appears as adults but I should judge that it would be during the second week in June. By the middle of July adults were very plentiful and were evenly distributed over the range country south of Penticton. It was seen egg-laying in the third week in July from which date it decreased in numbers, its place being taken by a very similar but smaller grasshopper *Ageneotettix scudderi*. *Aulocara elliotti* is a powerful jumper but does not make much use of its wings. A few adults could still be found up to the end of August. The females are very much larger than the males and varied considerably in coloration, some having the white markings on the pronotum very distinct, while in others these markings were hardly visible. The males appeared to be far more numerous than the females and were very active, running on the ground with considerable speed. On several occasions from three to five males were observed following a female. In each case the female was hopping while the males were running rapidly behind.

Chorthippus curtipennis (Harris). Adults of these grasshoppers were collected in considerable numbers on September 1st in a damp meadow at Penticton where the grass was long and green. The males could be heard stridulating. I do not know when this species first appears as adult.

Oedipodinae.

In the Oedipodinae fifteen species were collected belonging to ten genera.

Arphia pseudonietana (Thomas). The first adults of these grasshoppers were seen on July 18th at Penticton. It has practically the same distribution in the Okanagan Valley as *Dissosteira carolina* and appears at about the same date. It is rather more common and more evenly distributed over all types of land than is *D. carolina,* which remains together in small flocks on certain dry hill sides, railroad tracks, etc. The disk of the wing in *A. pseudonietana* is dark red. The general body colours do not vary much. The usual colour is dark blackish brown with black speckles; the female being larger and lighter in colour. Some specimens are found with a chalky-white pronotum and two or three white bands across the top of the hind femora. This grasshopper flies with a rather slow zigzag flight and can produce, at will, a slow rattling noise when on the wing. Egg-laying is commenced in the last week in August.

Camnula pellucida (Scudder). This species is probably the most destructive grasshopper that we have in British Columbia and has at various times caused very great loss to stockmen and farmers by increasing in enormous numbers and completely destroying crops and range grasses. This year it has been singularly scarce in the Okanagan Valley although it was plentiful in northern Washington State, crossing the British Columbia Boundary Line into the Bridesville-Rockcreek section where it did considerable damage. The first adults were seen at Fairview on June 12th when small swarms were observed in damp places near the Okanagan River where the vegetation was still green. Mating took place during the middle of August and eggs were being laid during the last week in August and doubtless continued until killing frosts occured in the fall.

Hippiscus neglectus (Thomas). The first specimen of this species was found at Penticton on April 4th when the ground was still frozen in many places, and snow was still present in the bush. This specimen was a nymph and was nearly full grown. On April 26th they were found commonly at Penticton and nearly all were adult. On May 4th at Fairview adults were plentiful. These grasshoppers were found in company with *Stirapleura decussata* and *Hippiscus obscurus* and in similar locations, i.e. stony flats and sage-brush lands and a few were seen out on the open bunch-grass plains of the Okanagan Valley. They are not very active and were never observed to stridulate. On May 19th females were seen with their bodies distended with eggs, and they were observed ovipositing in late June. These grasshoppers vary much in coloration and size and are similar to *H. obscurus* differing from this species by the presence of a distinct tegminal stripe. There are two colour varieties, the first having the disk of the wing red and the hind tibiae yellow, and the other the disk of the wing yellow and the hind tibiae red. From my observations this year it appears that the first variety, with red wings, appears first, preceding the yellow-winged variety by several weeks and is also the first to disappear, and this peculiarity seems to be the case with *H. obscurus* also. Adults resulting from the eggs laid in late May and June were beginning to appear during the last week in August and possibly some eggs may be laid in the Fall but the majority of the adults and nymphs seen in the Fall evidently hibernate and reappear in the spring.

Hippiscus obscurus (Scudder). These grasshoppers appear to have exactly the same life history as *Hippiscus neglectus* and only differ from them in the absence of the tegminal stripe. They have the two colour varieties, with the red wings and yellow hind tibiae, which, as before, are the first to appear; and those with yellow wings and red hind tibiae, which are later in appearing. They were found with *Hippiscus neglectus* and *Stirapleura decussata* at Penticton and Fairview in the spring, and freshly emerged specimens were seen again during the last week in August. I believe that this grasshopper is, by some writers, considered to be a variety of *H. neglectus* and not a distinct species.

Hippiscus vitellinus (Saussure). This grasshopper is very similar to *Hippiscus obscurus* but differs from it by having regularly distributed blotches on the tegmina instead of dark areas tending to form bands. A few were taken at Penticton and Fairview while collecting *H. neglectus* and *H. obscurus.*

Hippiscus latefasciatus (Scudder). Only two adults of this species were seen and both were females. The first was taken on May 4th and the second on May 18th at Fairview. The body of the female taken on May 18th was distended with eggs. Consequently I think that this is another species which hibernates, lays its eggs during May and June, and then reappears in September and October, but further observations are required to determine this. The only other locality where this species has been recorded in British Columbia to my knowledge is from Lillooet, where it was taken by Mr. R. C. Treherne.

Dissosteira carolina (Linnæus). This grasshopper is common along road sides and hard dry places throughout the Okanagan Valley. The first adults were seen at Westbank on July 20th and by the middle of August these grasshoppers were common everywhere. They are very variable in size and colour; some males can be found which measure very little more than an inch in length, while some females measure more than two inches. The general body colour ranges from a pale straw to nearly black passing through various shades of rusty-red and brown. This species is a great lover of dusty roads and may be found in the centre of large towns. By the end of August they were egg-laying. Several were seen in Penticton ovipositing in the earth between the boards of the side-walks. The males of this species have a rather curious "song" during mating time; they jump up into the air until about three feet from the ground and there remain hovering like a hawk in the same spot their wings making a soft rustling sound. After remaining in this position for about half a minute they flutter down to the ground again. There is no dancing up and down and no clicking sounds produced as in the genus *Trimerotropis* or *Circotettix.* This species is found until killed by the frost.

Spharagemon aequale (Say). Adults of this species were seen first at Westbank on July 20th where they were present on the dry range land in considerable numbers. They are active insects often flying long distances before alighting again. When disturbed they fly away in a straight line keeping close to the ground and turning suddenly to one side immediately before alighting, run along the ground for several feet before remaining quiet. This species was frequently seen attacked by a Sarcophagid fly while in flight. During August they were common everywhere on the range lands of the Okanagan Valley and were usually associated with *Trimerotropis vinculata* which they closely resemble. They were seen ovipositing during the latter part of August. A few adults could still be found on the ranges at Vernon on September 15th. The adults of this species were never found together in large numbers but were evenly distributed all over the bunch-grass benches in the valleys and also on some of the higher ranges. There was one very marked variety of this species which was fairly often seen in which the light and dark bands on the tegmina were very clearly defined and the posterior half of the pronotum was white, causing the insect to show up quite conspicuously when resting upon the ground.

Mestobregma (probably *kiowa*). A large number of these grasshoppers were seen on a dry gravelly piece of land adjoining the shore at the north end of the Okanagan Lake, at Okanagan Landing, on September 8th, 1918. I have not taken this species since and they could not be found this year (1919) on the gravelly patch at Okanagan Landing where they were common last year although I searched for them on the same date.

Mestobregma sp. This is an extremely pretty grasshopper when alive; pinned specimens soon lose their colours. Adults of this species were first taken at Fairview on June 27th. During July a few were seen at Westbank and an occasional adult was taken in the neighborhood of Fairview up until the end of August. This species was never found in any numbers, but one or two might be found in a day. They were taken out on the dry bunch-grass flats and were very inactive, often allowing themselves to be caught by hand. No notes were obtained as to their egg-laying habits nor were they ever observed to produce any sound.

Conozoa wallula (Scudder). This was a very common species in certain localities and on certain types of soil. Adults were first observed in large numbers at Westbank on July 20th on a piece of flat sandy ground running out into the Okanagan Lake. This species was seen in many places in the Okanagan Valley, but when observed was always on dry, hot, sandy spots, such as roadsides, waggon tracks across the ranges, on pieces of sandy land in the bend of rivers, or along lake shores. Where they occurred they were usually in large numbers. Although they were all adult by the end of July I noticed no decrease in their numbers at the end of August and I think that they would probably be present until killed by frost. They were very inconspicuous on the ground and very difficult to catch as they were very quick in leaving the ground. When disturbed they only flew a sho"t wav before alighting again. The sexes were pairing during the middle of August. This species seemed to be particularly infested by the red mite *Trombidium locustarum,* and I saw some specimens whose under wings were so covered by these mites that they were unable to fly or even to close their tegmina. There were usually some Tachinids and Sarcophagids flying about among these swarms of grasshoppers. The Sarcophagids were observed to dart at the grasshoppers, while they were in flight, as if to place an egg or living larva upon the bodies of the grasshoppers before they closed their wings on alighting. This same thing was noticed in the case of *Spharagemon aequale* and *Trimerotropis vinculata.*

Circotettix suffusus (Scudder). Adults of this species were first collected at Westbank on July 20th where they were commonly seen along the roads. I do not know when this species first appears but I do not think that those collected on this date had been in the adult state long. I did not see many of these grasshoppers this summer in the Southern Okanagan Valley. This is one of the dominant species at Salmon Arm during August and September and may be found commonly in the orchards and along the roads. On September 29th I found large numbers of them in the orchards in company with *Trimerotropis caeruleipes.* They were depositing eggs in the hard ground around the apple trees and nearly all were in good condition, so that in this locality at any rate, they are one of the chief species present during September. This grasshopper is a strong flier and hard to capture. When approached they leave the ground very rapidly, rising to five or six feet in the air and then zigzag away making a very loud and sharp clicking noise.

Circotettix lobatus (Saussure). These grasshoppers were only taken in one or two localities. They were found in considerable numbers on August 7th near Fairview on a rock slide at the foot of a cliff. The males produce a loud crackling and snapping sound when on the wing. They have a regular "song" at mating time; dancing up and down in the air, producing five or six sharp clicks followed by a shrill rattling sound, very similar to the noise made by a rattle-snake. As these grasshoppers seem to occur almost entirely on rocky slopes at the base of cliffs, which is a favorite haunt of the rattle-snake, I have often found that people mistake their "song" for a rattle-snake which is common in that locality. This species often flies high up on the rocks and rests on the perpendicular face of the cliff and is very hard to capture, its colours harmonizing with the green and grey of the rocks. I do not know where they deposit their eggs.

Trimerotropis caeruleipes (Scudder). This grasshopper does not seem to be at all common in the Okanagan Valley, more especially in the southern half, but is one of the commonest species at Salmon Arm and at more northerly points. It was first taken in the adult form on July 20th at Westbank and a few were collected at Fairview and Penticton during the latter part of August. The only place where this species was seen in any numbers was at Salmon Arm on September 28th. On this date is was seen in large numbers in the orchards and appeared to be at its maximum abundance. They were observed to be pairing and a few were egg-laying. They were found in company with *Trimerotropis vinculata, Circotettix suffusus,* and *Arphia pseudonietana.* The males of this species are much smaller than the females and produce a soft clicking sound when in flight. Frosts of thirteen and ten degrees on September 27th and 28th respectively, caused no visible decrease in the numbers of this species.

Trimerotropis vinculata (Scudder). Adults were first taken at Westbank on July 20th, and from that date on were found in company with *Spharagemon aequale* all over the ranges at Fairview. A few adults were taken at Salmon Arm on September 29th, and had, I think, completed their egg-laying.

Locustinae.

Five species of Locustinae were collected. All belong to the genus *Melanoplus.*

Melanoplus atlanis (Riley). This year there have been remarkably few of any of the genus *Melanoplus* present in British Columbia in the localities where they are usually common. In the southern Okanagan Valley there were very few grasshoppers of this species present. The only place in B.C. to my knowledge, where this species was common was at Celesta on the Shuswap Lake where an outbreak of considerable severity occured. Both this species and *Melanoplus femur-rubrum* have been far more plentiful this year in the humid sections of the Province than they have in the Dry Belt where they are usually most in evidence. They began to hatch about the middle of June, the first of them becoming adult in the latter part of July. Nymphs of this species were still to be found in the beginning of September. Eggs were being deposited during September.

Melanoplus femur-rubrum (DeGeer). These grasshoppers have been fairly numerous this year throughout the Province and I have seen more of this species than I have of *Melanoplus atlanis* which is usually the more abundant species of the two in British Columbia. This grasshopper began hatching about the middle of June and the first adults were taken on July 20th at Westbank. The hatching period of these grasshoppers seems to be very protracted, for nymphs were still found on September 21st in considerable numbers at Vernon. This species was responsible for the outbreak in the Lower Fraser Valley this year. Eggs were being laid during the first week in September and doubtless continued until the frost killed the adults.

Melanoplus packardii (Scudder). This species was only taken on one or two occasions in the Okanagan Valley close to Fairview. It was first seen in a dry gully on June 27th, on which date only a few were adult. On August 22nd this gully was again visited and a considerable number of specimens caught and all were adult. Oviposition began in the third week in August. An odd specimen was found here and there on the open ranges but it was nowhere very plentiful and not more than fifty specimens were seen during the entire summer. The specimens collected belonged to the form *rufipes* (Cockerell).

Melanoplus bivittatus (Say). This grasshopper was not seen very often this year and did not seem to be nearly as common as usual. The first adult taken was at Fairview on June 27th, but from this date until the middle of August no adults were seen. During the last week in August and in the first week in September a considerable number of females were taken while depositing eggs in the earth betwen the planks of the side-walks at Penticton. At the end of September ragged adults could still be found at Vernon and some eggs were still being deposited.

Melanoplus cinereus (Scudder). Adults of this species were first collected at Fairview on August 7th, and were found during August very occasionally in this locality. They are very pale in colour and have bright blue hind tibiae when alive. Only one male of this species was taken and ten females. They were all taken among sage-brush and *Chrysothamnus* bushes. When disturbed they jumped for great distances and using their wings would usually land in one of these bushes, thus making it very difficult to capture them. Several were found by shaking the *Chrysothamnus* bushes in which they seemed to spend a good deal of their time. They were observed to feed on the leaves of the *Chrysothamnus*. Several large nymphs of this species were seen on August 23rd. This is the first record of this species from Canada.

ONE YEAR'S EXPERIMENTS IN THE CONTROL OF THE CABBAGE MAGGOT.

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

Experiments in the control of the cabbage maggot (*Phorbia brassicae* Bouche) were initiated in a small way at Truro in 1917, as a joint project to be carried on co-operatively by the Horticultural and Entomological Departments of the Agricultural College. In 1918 these experiments were continued on a larger scale and the 1919 experiments have grown out of the work of the previous two years, of which they are simply the continuation. Since the records for 1919 reveal nothing inconsistent with the results of the previous seasons, it has been considered sufficient, for the purpose of this paper, to confine our attention entirely to the former. None of the results herein outlined should be considered as final, but we believe that they indicate promising lines for further research, and they form the basis for another season's work. While the utmost care was taken to make the records as accurate as possible and to eliminate possible sources of error, our findings will all be checked up in subsequent seasons before definite recommendations based on our own experiments can be made.

Control Investigations, 1919.

The plots in which the different control experiments were conducted in 1919 were divided into three main series. The first series designated "continuation plots," included trials of those materials found to be of promise in previous years, either in our own experiments or in those of other workers. The second series which were called "field plots," included the three treatments which previous results showed to be most promising, these being applied to later cabbage on a field scale. The last series known as "trial plots" includes methods or material not previously tested by us.

In addition to these there were a number of small miscellaneous experiments conducted with a view to determining the exact method of action of some of the chief materials used.

I. Continuation Plots.

These plots were situated on a piece of ground 275 ft. long by 30 ft. wide. The plants were set out in rows 2 ft. apart and 18 inches apart in the rows, there being 12 rows each containing 240 cabbages of the Early Jersey Wakefield variety. With the exception of tar paper discs and wire screens, 2 applications of each treatment were made, the first on May 21st, the day the adult flies first made their appearance, and again on May 31st.

The different plots were arranged in triplicate and each section removed as far as possible from the corresponding one, to make more certain of securing a uniform infestation. The table lists the different treatments and gives the results obtained from each. The figures given are representative of costs at Truro during the past season and would doubtless vary materially in different localities and in different seasons. Since, however, they indicate the actual set of conditions encountered by us in growing the crop and treating it for the maggot, they are here given. The figure showing cost of production of an acre of cabbage was worked out and furnished us by Mr. James Dickson of the Horticultural Department of the College.

In the following table showing the results of the different treatments the weight of the heads is taken as the main basis for comparison for several reasons, the most important being that, under our conditions of marketing, sales are made by weight. Consequently, it is simplest to make our calculations on that basis. More important is the fact that this is the only really *quantitative* way to record results. Simply to give the number or percentage destroyed is insufficient, since many cabbages may be dwarfed or retarded, though not actually destroyed or rendered unmarketable. It would be impossible to record the number dwarfed as a result of the work of the maggot or to indicate in any way the degree of dwarfing, since there is no method of determining from the appearance of the plants just where it begins or ends. On the other hand, the total weight from each plot indicates this in a very exact manner. It also brings out the fact that certain treatments increase the weight of heads produced, irrespective of their insecticidal value. The weight, therefore, is the best method of expressing results of the different treatments. The actual price obtained for the cabbage from each plot has been recorded, since this is the point that most interests the commercial grower and is the ultimate test of the practicability of any treatment. The average price per pound is also an important item, for certain treatments retard and others accelerate the developments of the head. Those that hasten the heading up process result in a higher price per pound, as the earliest cabbage brings the highest price.

It will be seen that the tar paper discs from which the earth was removed after the first two cultivations, gave the only absolutely perfect stand outside of the wire screens. In weight of heads, in price per pound and in total net profit per acre, this plot is greatly inferior to the one receiving corrosive sublimate 1—1,000, though this plot lost a single plant. Curiously enough double the strength of corrosive sublimate did not increase the efficiency of the material, but rather appeared to reduce it. Either directly or indirectly the use of this material seemed to bring about a great increase in the weight of heads produced.

TABLE I.—CABBAGE MAGGOT CONTROL EXPERIMENTS—CONTINUATION PLOTS, 1919.

Plot No.	Treatment.	No. Plants destroyed.	Per cent. destroyed.	Weight of Cabbages per plot at harvesting.	Average weight of head.	Calculated No. of lbs. per acre.	Average price per lb.	Price received.	Calculated price per acre.	Cost of Treatment per acre.	Net Profit* per acre.
				lbs. ozs.			c.	$ c.	$ c.	$ c.	$ c.
1	Wire screens	....	....	394 8	1.6	22,989.49	4.38	17 30	1,009 17	265 81	568 96
2	Tar paper discs	55	22.9	409 12	2.2	23,878.18	4.39	18 00	1,050 00	42 00	833 60
3	Scotch soot	75	31.25	326 12	2.0	190,413.56	4.37	14 28	833 00	80 90	577 70
4	Check	183	76.25	139 8	2.4	8,041.95	4.69	6 54	381 50	Check	207 10
5	Tobacco dust, Washing soda, Filler } equal parts	67	27.9	384 8	2.2	22,406.74	4.26	16 37	957 92	48 80	731 72
6	Tobacco dust, Soap powder, Filler } equal parts	53	22.1	378 0	2.0	22,027.95	4.17	15 75	918 75	48 80	695 55
7	Tobacco dust, Scotch soot, Soap powder } equal parts	18	7.5	537 0	2.4	31,293.68	4.22	22 65	1,321 25	63 42	1,083 43
8	Tobacco dust, Sulphur } equal parts	60	25	275 4	1.5	16,040.19	5.58	15 29	891 92	58 44	759 08
9	Corrosive sublimate (1–1,000)	1	0.4	638 12	3.0	37,223.16	4.26	27 17	1,584 92	45 82	1,464 70
10	Corrosive sublimate (2–1,000)	3	1.25	587 4	2.5	34,221.99	4.17	24 48	1,428 00	73 54	1,180 06
11	Tar paper discs. Kept free of soil	....	....	503 8	2.0	29,341.46	4.19	21 01	1,225 58	53 20	997 98
12	Tobacco dust and lime } equal parts	69	28.75	305 8	1.7	17,803.04	3.99	12 19	711 08	39 90	496 78

* Cost of raising plants, setting in field, cultivating, cutting and packing, etc., $174.40.

The foregoing treatments are so greatly superior to any of the others that the latter may be disposed of in a few words. The tobacco dust, soap powder and soot mixture is worthy of note as coming next in efficiency to the foregoing and giving a heavy average weight of head. The tar paper discs from which the soil was not removed, were markedly inferior to those where this was done. The screens, while giving perfect control, are too costly and their application too laborious ever to come into general use, and in addition, they seem to have a bad effect upon the plants. The tobacco dust and lime, while inferior to the foregoing in maggot control gave, nevertheless, greatly superior results to those of last season. This is doubtless due to the fact that the material was put on fresh when the flies first appeared and then renewed ten days later. The previous season the material was applied several days before the appearance of the flies, a heavy rain intervening between that time and their appearance. The tobacco dust is apparently only effective when fresh and its usefulness is destroyed by a heavy rain. In conjunction with sulphur, washing soda or soap powder, is apparently more effective than with lime.

It is interesting to note that practically all the substances used in our continuation plots were mentioned by Slingerland in his bulletin on this insect (Bul. 78, Cornell Univ. Agr. Expt. Sta., 1894), though he did not consider them in all the combinations used by us. Among the effective methods he lists screens and tar paper discs; among the ineffective, soot, sulphur and tobacco dust. The two former he did not test himself, but he did some experiments with the latter, which did not turn out entirely satisfactory. The material was applied twice, the first time immediately after planting, the second ten days later. He does not state whether the flies were out at the time of the first application, but says that they were abundant at the time of the second. As a result of the experiments nearly one-half of the treated plants were salable, while only 90 marketable heads were secured out of 600 of the untreated plants.

Particularly interesting is his mention of corrosive sublimate in view of the success that has lately attended the use of this chemical. On this account we reproduce his remarks in full:

"An editorial in 1864 (*Country Gentleman*, p. 65) states that a contemporary recommends 1 oz. of the substance dissolved in 4 gals. of water. A correspondent of a Canadian Journal (*American Cultivator* for April 30, 1881) says all of the London market gardeners secretly use a solution of 1/4 oz. of this substance in 4 gals. of water for these maggots. He has used the solution quite extensively, using enough to saturate the ground. But it is not clear from the account whether it is applied as a preventive or whether it kills the maggots. We have little faith in its effectiveness but it should be further tested."

The foregoing shows that this material was in use many years ago and it seems strange that it never seems to have made headway until recently. The reason for this may have been that the average person takes no notice of the infestation until the plants begin to wilt, when the maggots are well grown and it is too late to apply control measures. All our experiments indicate that to control the maggot a material must be either a repellent, in which case it should be applied at planting or before the flies appear or, it should be one that will destroy the eggs of very young larvæ, a fact that has often been lost sight of in studies of this pest. If the cabbage can be protected for even two weeks after setting out, our experiments indicate that it stands a very good chance of surviving the attacks of the maggot.

II. Field Plots.

Field tests were conducted on 3,200 cabbages (Danish Round-head). These were the treatments showing most promise in the previous years' experiments. The plants were set out on July 19th during the emergence of the 2nd brood flies and while oviposition was actively proceeding. There was some infestation of the plants in the seed bed, which was mostly, but probably not entirely, removed by carefully washing the roots in water. Two applications at intervals of one week were made in the case of corrosive sublimate. One application of the dust was made and the earth was not removed from the discs after cultivation.

Field Teste on Late Cabbages (3,200 Plants).

Plot No.	Materials used.	No. of Plants.	No. destroyed by maggot.	No. with marketable heads.	Per cent. destroyed by maggot.	Per cent. with marketable heads.
1	Tar paper discs	800	42	758	5.25	94.75
2	Tobacco dust, soap powder and soot .... (equal parts.)	800	104	696	13.0	87.0
3	Corrosive sublimate .... (1-1,000.)	800	11	789	1.375	98.625
Check	....	800	350	450	43.75	56.25

Field Tests on Late Cauliflower (280 Plants).

Plot No.	Materials used.	No. of Plants.	No. destroyed by maggot	No. with marketable heads.	Per cent. destroyed by maggot.	Per cent. with marketable heads.
1	Tar paper discs	70	5	65	7.14	92.86
2	Tobacco dust and sulphur ..... (equal parts.)	70	15	55	21.42	78.58
3	Corrosive sublimate .... (1-1,000.)	70	4	66	5.71	94.29
Check	....	70	16	54	22.86	77.14

The accompanying table shows the treatments given and the results. It will be seen that the corrosive sublimate is again superior to the other treatments, the control being almost perfect. While the other two treatments were hardly given a fair chance in comparison with the corrosive sublimate, the lesser cost of the latter and the prospect of still greater reduction in the price of the material, places it definitely ahead as a method of control of the cabbage maggot.

A similar experiment was carried out on a small adjoining block of cauliflowers, using sulphur in conjunction with the tobacco dust, instead of Scotch soot and soap powder. The results, as will be seen from the table, are comparable.

It was originally intended to make further tests using the main crop of late cabbage, but this was not done as our investigations brought to light the fact that July planted cabbage suffer very little from the attacks of the maggot.

CABBAGE MAGGOT CONTROL EXPERIMENTS—TRIAL PLOTS, 1919.

Plot No.	Treatment.	No. Plants destroyed.	Per cent. destroyed.	Weight of Cabbages per plot at harvesting.	Average weight of head.	Calculated No. of lbs. per acre.	Average price per lb.	Price received.	Calculated price per acre.	Cost of Treatment per acre.	Net Profit per acre.
				lbs. ozs.			c.	$ c.	$ c.	$ c.	$ c.
A	Once transplanted stock	66	33	393 12	2.3	21,262.5	2.65	8 05	563 50	Check	389 10
B	Double dosage nitrate of soda	66	33	383 8	2.8	26,845	2.94	11 31	791 70	..	617 30
C	Planted from seed *	35	17.5								
D	Twice transplanted stock	88	44	344 0	3.0	24,080	4.47	11 96	837 20	..	662 80
1	Creosote, 1% Clay, 99%	2	1	712 0	3.5	49,840	3.73	26 61	1,862 70	26 08	1,662 22
2	Dry lime sulphur, 20% Clay, 80%	93	46.5	232 8	2.2	16,275	2.89	6 74	471 80	49 12	248 28
3	Dry lime sulphur, 20% Tobacco dust, 40% Clay, 40%	21	10.5	409 12	2.3	28,682.5	3.35	13 75	962 50	78 16	711 94
4	Anthracene oil, 1% Clay, 99%	3	1.5	574 0	2.9	40,180	3.57	20 50	1,435 00	27 20	1,223 40
5	Tobacco dust, 40% White arsenic, 5% Clay, 55%	4	2	550 8	2.8	38,535	3.73	20 55	1,438 50	52 62	1,211 48
6	Dry lime sulphur, 20% Arsenate of soda, 7% Clay, 73%	137	68.5	134 12	2.1	9,432.5	3.41	4 60	322 00	77 94	69 66
7	Tobacco dust, 40% Corrosive sublimate, 1% Clay, 59%	1	0.5	643 4	3.2	45,027.5	3.74	24 11	1,687 70	78 16	1,425 14
8	Nicotine sulphate, 2% Clay, 98%	25	12.5	430 8	2.5	30,135	3.05	15 09	1,056 30	53 44	828 46
9	Free nicotine (40% solution), 2% Sulphur, 98%	51	25.5	499 4	3.4	34,947.5	3.76	18 77	1,313 90	53 30	1,129 40
10	Salt solution (50% saturated)	48	24	416 4	2.7	29,137.5	3.41	14 22	995 40	61 30	760 10
11	White arsenic, 5% Clay, 95%	68	34	322 4	2–4	22,557.5	2.92	9 44	660 80	33 58	452 82
12	Para-dichlorobenzene, 10% Clay, 90%	12	6	560 8	3.0	29,235	3.67	20 59	1,441 30	52 56	1,214 90
13	Para-dichlorobenzene, 10% Scotch soot, 90%	6	3	659 12	3–4	45,552.5	3.86	25 16	1,761 20	105 90	1,480 90

Cost of raising plants, setting in field, cultivating, cutting, packing, etc., $174.40.
* Complete records not available from this plot.

Trial Plots, 1919.

For trial of treatments not previously tested in our experiments, we had at our disposal a section of land 170 ft. wide by 60 ft. long. With the rows of cabbage 2 ft. apart, there was thus space for 85 rows of cabbage, and with the plants 18 inches apart in the rows, 40 plants for each row. With seventeen different treatments including checks, this gave us 200 plants (Copenhagen Market) for each plot. Instead of having all the 200 plants for each plot together, however, we divided the piece into five sections, one row i.e., 40 plants in each section being devoted to each of the different treatments. We thus had on this piece of ground five repeatings of each treatment, this method tending to equalize variations in intensity of maggot infestation and any in equalities of the soil that might affect the final weight of heads from each plot.

It will be seen that there are four check plots, each receiving a different horticultural treatment, but none protected from the maggot. All the other treatments with the exception of the salt solution were in the form of dry powder and were applied at the rate of 700 lbs. per acre. In the case of the salt, a saturated solution was first made and this then diluted with an equal quantity of water.

Three of the sections were planted May 31st, the remaining two, June 2nd. An exception to this were the plants on Check Plot D, which were planted a week earlier than the others. It was intended to plant them all on the same date, but conditions arose which made this impossible. Normal applications of nitrate of soda, i.e., 250 lbs. per acre, applied in two equal sowings on June 11th and June 28th were made. On Check B, an extra application was applied on July 12th, this plot receiving a total amount equal to an application of 500 lbs. per acre. All the treated plots received two applications of the material used, the first at planting, the second on June 13th. The first brood flies were actively ovipositing at the time of planting.

Discussion of Results.

Had it been possible to set out these plots two weeks earlier, it would naturally have been a more severe test of the different materials, since they would have been exposed for a longer period during the height of the oviposition period. At the same time the number lost in the check rows enables us to make sufficiently striking comparisons.

A consideration of the results from the check plots shows that "A" and "B" are equal as regards the number of plants killed, but the acceleration of the heading process and the greater weight of head, owing to the extra application of nitrate, have given us a much larger price per acre in the case of "B." Obviously, the results of this treatment would depend upon the chemical requirements of the soil. Plot "C" shows a lower rate of infestation, due doubtless to the fact that it escaped the period of most active oviposition. It also missed the high prices obtained for the early crop. Check Plot "D" having been planted earlier than the others, cannot, unfortunately, be compared with them on an equal basis. Exposed during a longer period of active oviposition, more plants succumbed than in the other check plot. Had conditions been different it is not likely that this would have occurred. As it is, the greater average weight of the heads which survived and the earlier heading up of the plants, gives us the largest financial returns of any of the check plots.

It is obvious that some of the treatments are entirely inadequate to control the maggot. A few show a decided advantage over the check plots, but not sufficient to make them worthy of further trial, in view of the very much better results obtained by other materials. In this class may be mentioned nicotine sulphate and clay, nicotine and sulphur, para-dichlorobenzene alone, and salt solution in the strength tested. Others actually appear to have weakened the plants to such an extent that a greater number succumbed to the attacks of the maggot than on the check rows. These include dry lime sulphur, white arsenic, arsenate of soda and combinations of these compounds. No further discussion is necessary regarding these two classes, all the required facts being found in the table.

A consideration of the other treatments shows that Plot VII, (the tobacco dust, corrosive sublimate and clay mixture) gave the smallest number of plants actually destroyed, but Plot I (creosote) is a close second with only one more casualty and with the largest tonnage per acre of any plot, lower cost of treatment and greater profit per acre. Plot IV (anthracene oil) is only slightly behind the foregoing in number of marketable heads produced, but it also falls below Plot XIII (para-dichlorobenzene and soot) in tonnage per acre. This is probably due to another reason than maggot control as will be seen later. The treatment given to No. V (tobacco dust, white arsenic and clay) is apparently next in efficiency, but this plot also falls below No. XIII in tonnage per acre, and even No. XII (para-dichlorobenzene and clay) which lost three times as many plants, has produced a greater weight of head. No. XIII actually comes second in tonnage per acre produced, though behind the plots previously mentioned in the number of plants free from injury. The plants in this plot were noticeably benefited by the treatment, having a deeper green colour of leaf and a healthier general appearance than the other plots. The results from the foregoing treatments are considered promising and will be tested further in the "Continuation Plots" of 1920. Tested out on earliest planted cabbage, the relative merits of these materials as compared with the test in the "Continuation Plots" of 1919, should be clearly indicated.

THE CONTROL OF THE CABBAGE ROOT MAGGOT IN BRITISH COLUMBIA.

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

At the request of Mr. Arthur Gibson, Chief, Division of Field Crop and Garden Insects of the Dominion Entomological Branch, the virtue of the corrosive sublimate treatment for the control of the Cabbage Root Maggot, *Phorbia brassicæ*, was tested in British Columbia during 1919, in comparison with the Tar-paper-disc method of control. At Mr. Gibson's further request the following report is submitted on the record of the experiments performed.

The Plan of Experiment.

The work was conducted altogether in the large commercial vegetable-growing district of Armstrong, B.C., where the Cabbage Root Maggot has for several years exacted a heavy toll. The "block" system of experimentation was adopted in preference to the "row" system. Twelve blocks were employed, with from

70 to 210 plants to a block. Three control untreated blocks were interspaced between the treated blocks and they, with the tar-paper blocks, only received applications of ordinary water on the same occasions as the treatments of corrosive sublimate were made. Six tar-paper-disc blocks, consisting in all of 611 plants were employed in the experiment, interspaced between the other blocks, and three corrosive sublimate blocks on which various strengths were used, at 1 oz. to 6 gallons, 1 oz. to 8 gallons and 1 oz. to 10 gallons of water. The corrosive sublimate blocks were in turn divided into three parts, which received respectively 1, 2 and 3 applications in the season. Observations were made on cabbages and cauliflowers. The following notes deal with cauliflowers in particular and, inasmuch as the cauliflower is more susceptible to injury than the cabbage, it would necessarily follow that what was shown to be the case with the cauliflower would also be so with the cabbage. Cauliflowers were transplanted on May 3rd and set in their permanent positions in the field, and tar-paper discs were placed around the plants at this time. Applications of corrosive sublimate were made on May 7th, May 13th and May 23rd; the first application requiring the use of 1 gallon of diluted mixture, the second application 1½ gallons and the third nearly 2 gallons per 100 plants. One cultivation was given the entire plantation after transplanting between May 3rd and May 23rd.

In checking results a great deal of care was exercised to determine exactly what caused the plants to die or suffer, and observations were made on the vegetative growth and development of the root system. Every plant received a separate number and each was checked weekly throughout the period of the experiment.

Results of Experiment.

The untreated blocks of cauliflowers showed considerable (76.5 per cent.) characteristic injury from maggots and stood out very clearly in the plantation. The tar-paper-disc blocks showed pronounced injury but only 25.3 per cent. of the injury caused was due to maggot attack. Fully 36 per cent. was caused by a "wilt" produced by the presence of the disc. It would be well to mention clearly at this point, that the field chosen for the experiments was a low-lying one with a large quantity of vegetable matter in the soil composition, with a tendency to remain cold for a long time in the spring months. The sun is usually very warm in the Okanagan Valley during May and this last year was no exception in this regard. Consequently with conditions such as these, on cauliflowers, the influence of heat acting on and in association with the subsoil moisture produced a condensation of moisture beneath the disc below the soil surface. This condition was not observed in the case of the cabbages, for the reason that the growth of a cabbage is sufficiently strong to outgrow many adverse conditions. Any check in the growth of cauliflowers is serious in commercial growing, as a process known as "buttoning" takes place. This "wilt" condition was not observed in any case with the plants treated with corrosive sublimate, but some plants were injured by the proximity of fresh manure to the roots, causing the loss "from other causes" shown in the table given below. In fact after three treatments with corrosive sublimate at all three strengths the loss due to maggot attack was less than 2 per cent., and the growth of the plants in "top" and "root" was double the growth on any other block. The results clearly showed that under "bottom" land conditions, with cauliflowers, tar-paper discs were unsatisfactory and that corrosive sublimate in three treatments at 1 oz. to 8 or 10 gallons gave eminently satisfactory and safe results. With cabbages growing in the same field under same conditions as the cauliflowers the loss due to maggot attack varied in different parts of a two-acre field from 18 per cent. to 50 per cent. Where cabbages had tar-paper discs applied as was the case in one acre, the loss averaged rather less than 5 per cent. from maggot attack. This loss from maggot attack, when tar-paper discs were used in previous years, is considered by growers in the locality a fair average annual loss. Where corrosive sublimate was used on cabbages the loss by maggot attack was less than 5 per cent. and the growth of the plant while somewhat better at the commencement of the year, was not appreciably different at the time of marketing the crop. The summarized results are given herewith:

TABLE I.— CAULIFLOWERS—AVERAGES AND SUMMARY.

Form of Treatment.	Percentage.	
	Affected by maggots.	Affected by other causes.
Tar paper discs	25.3	36.4
Corrosive sublimate—		
1 application, 1- 6	68.6	3.9
1- 8	62.0	8.0
1-10	64.0	16.0
2 applications, 1- 6	6.0	4.0
1- 8	62.0	8.0
1-10	64.0	16.0
3 applications, 1- 6	1.8	19.2
1- 8	....	23.4
1-10	1.8	19.0
No control	76.5	21.9

Life-History Notes.

Inasmuch as all previous study given the Cabbage Root Maggot in British Columbia has taken place in the Lower Fraser Valley, this year's work in the Armstrong district adds another locality where this insect has been under observation. The transplanting of the cabbages and cauliflowers was completed by May 3rd in 1919. The first adult flies were captured on May 7th in the field, and on examination of 100 plants on this day, only 3 eggs were taken. Oviposition was heavy previous to May 23rd and on this date small larvæ were found in the root systems of some plants that were showing signs of injury. Two large half-grown maggots were seen on this day also. Twenty-five plants were under more or less continuous observation during the early spring and on the dates May 12th and 13th and June 4th, these plants carried respectively 59, 847 and 1,091 eggs, the eggs on each examination being carefully removed by hand. It was exceedingly interesting to note that the largest plants received the greatest number of eggs and in view of the fact that the corrosive sublimate blocks contained the largest plants the blocks were the greatest attraction areas. The same point is drawn on page 27 of Bulletin No. 12 of the Dominion Entomological Branch, 1916, which details, so far as the bulletin relates to British Columbia, the life-history studies carried on in the Lower Fraser Valley. The sundry other points in the life-history of this maggot in the Armstrong district are so closely allied to the results detailed in Bulletin 12 on this insect that there is no need to take up further space in this paper for their discussion.

FURTHER DATA ON THE CONTROL OF THE CABBAGE ROOT MAGGOT IN THE OTTAWA DISTRICT.

Arthur Gibson, Chief, Division of Field Crop and Garden Insects; Entomological Branch, Department of Agriculture, Ottawa.

Since the publication, in 1912, of our Bulletin on the cabbage root maggot* we have conducted a number of further experiments on the control of this insect, particularly with corrosive sublimate and tobacco dust and lime. The former has received special study during the past four years, and we consider its value to be undoubted and that it has now passed the experimental stage having been used with remarkable success under field conditions. Early references in the literature point to the fact that corrosive sublimate has been known as a remedy for the cabbage root maggot for over 50 years, and it is remarkable that its value has only been appreciated during comparatively recent years. In the years 1916 and 1917 we conducted experiments with corrosive sublimate on a small scale. In 1918, we used in one experiment 800 early cabbage plants. These plants were treated with corrosive sublimate in the strength of one ounce to four gallons of water on four occasions, namely, on May 27th, June 6th, 14th and 23rd. The results from this experiment were very striking, 96 per cent. of the plants treated with the corrosive sublimate being saved. In the same field in which the experiment was conducted the main cabbage plantation was destroyed by the root maggot to the extent of fully 60 per cent. In 1919, over 8,000 cabbage plants were placed at our disposal by Mr. J. I. Farquharson, who resides on the Aylmer Road, near Ottawa. Of this number 2,731 plants of the varieties Jersey Wakefield and Copenhagen Market were used in one experiment. This block of 2,731 cabbage plants was divided into 38 smaller blocks, of which blocks 1 to 18 inclusive, excepting blocks 2, 5, 8, 11, 14, and 17, which were left as checks, were treated with commercial corrosive sublimate mixture in the strengths of 1 oz. in 4 gallons of water, 1 oz. to 6 gallons of water, 1 oz. to 8 gallons of water, and 1 oz. to 10 gallons of water, some blocks having four treatments others only three. The plants were put out in the field on May 12th. The first application was made on the fourth day after planting, the second application six days later and one or two further applications ten days apart, about half a cupful of the mixture being poured around the base of the stem of each plant on each occasion. Each block consisted of 100 plants excepting the checks which varied from 20 to 36 plants each. Blocks 19 to 24 inclusive (100 plants each) excepting checks 20 and 22 (30 plants each) were used for felt-tarred-paper discs of various shapes. Blocks 25 to 23 inclusive (100 plants each) excepting blocks 26, 29, 32, 35, and 38 (20 plants each) were treated with tobacco dust and lime in the proportion of 1 part tobacco dust to 2 parts of lime, 1 part of tobacco dust to 3 parts of lime, and 1 part of tobacco dust to 4 parts of lime, two, three and four applications being made.

The results of this experiment are very striking. Briefly, they are as follows:

Corrosive Sublimate. There was practically no difference in the plots treated with the various strengths of corrosive sublimate. The weakest solution, namely, one ounce in ten gallons of water, gave as good results as did the strongest mixture of one ounce to four gallons of water. Three applications, too, are apparently equal to four applications. The percentage of plants destroyed by the maggot

*Bull, 12, Ent. Br., Dept. Agr., 1916.

in all of these plots ranged from 0 per cent. to 4 per cent., whereas the plants in the check plots were destroyed to the extent of 52 per cent., 57 per cent., 61 per cent., 66 per cent., 70 per cent., and 80 per cent. respectively.

Discs Used. Hexagonal disc (block 19); small square disc (block 21); large square disc (block 24); and round disc (block 23). All gave excellent protection. In blocks 19 and 24 (100 plants in each) 100 per cent. results were obtained; in block 21 of similar size 1 per cent. destruction occurred and in the fourth block (23) 2 per cent. destruction. In the two check blocks, Nos. 20 and 22 (30 plants in each) the loss from maggot was 10 per cent. and 17 per cent. respectively.

Tobacco and Lime. One part tobacco dust and 2 of lime, also in proportions 1-3 and 1-4. Block 25, 1 to 2; Block 27, 1 to 3; Block 28, 1 to 4, (100 plants in each) had 4 applications about ½ to 1 inch of the mixture being placed around the stem of each plant. Block 30, 1-2; Block 31, 1-3; Block 33, 1-4 (100 plants in each) had three applications. Block 34, 1-2 (100 plants); Block 36, 1-3; Block 37, 1-4 (150 plants in each) had two applications. The percentage of plants in these blocks destroyed was also very small, varying from 1 per cent. to 4 per cent., the latter percentage being in Blocks 36 and 37 which received two applications only of the more diluted mixtures. Three applications of the mixture was practically as effective as four applications, and the weakest mixture gave practically as good results as the strongest. Check blocks (20 plants in each) with these series, were destroyed as follows: Block 26, 25 per cent.; Block 29, 20 per cent.; Block 32, 30 per cent.; Block 35, 30 per cent.; Block 38, 30 per cent.

A larger plantation of later cabbages, 3,360 in number, planted May 21st, was used for corrosive sublimate solutions solely. The plantation was divided into 11 blocks, 8 of equal size, each consisting of 378 plants, and the remaining three, which were used as check blocks, contained respectively, 105 plants each and one 21 plants. The corrosive sublimate was used in the same strengths as in previous experiment, namely, 1 oz. to 10 gallons water=1:1,280 (Block A, 4 applications; Block B, 3 applications); 1 oz. to 8 gallons water=1:1,024 (Block D, 4 applications; Block E, 3 applications); 1 oz. to 6 gallons water=1:768 (Block G, 4 applications; Block H, 3 applications); 1 oz. to 4 gallons water=1:512 (Block J, 4 applications; Block K, 3 applications). Blocks C, F, I and L were used as checks. Blocks A, D, G and J were treated on May 27th, June 4th, June 13th, and June 24th: Blocks B, E, H and K, on the first three dates only. In this experiment the time required to treat 3,000 plants was 3½ hours, using a watering can with spout closed slightly with wooden plug. In this experiment no attempt was made to keep a definite record of every plant. The blocks were examined at frequent intervals and from a practical standpoint no injury took place in those treated with corrosive sublimate. Conspicuous injury, however, was apparent in the check plots and the plants in these latter were certainly not as thrifty as those treated.

That the cabbage maggot was abundant in the immediate area of our work in 1919 was well evidenced by the losses which took place on the farms close by. Hundreds of plants of the early varieties were completely killed.

The above experiment following those conducted by us previously, particularly in 1917 and 1918, certainly strengthens the belief that in corrosive sublimate we have a valuable control measure for the cabbage maggot.

Cost of Treatments. In connection with the cost of treating cabbages per acre of plants with corrosive sublimate in comparison with cost of applying discs, it is of interest to record the following:

Corrosive sublimate.—Total cost per acre, including labor and material:	
3 treatments	$24.21
4 "	32.28
Tarred discs.—Total cost per acre, including labor and material	16.75

Effect of Corrosive Sublimate on Soil Bacteria. In order to determine the numbers of bacteria in the soil in the field where our cabbage maggot control work was conducted, bacteriological soil tests were made by an assistant, Mr. J. A. Flock, working under Mr. H. T. Gussow, of (*a*) soil treated with corrosive sublimate and (*b*) untreated soil. These soil samples were taken on August 18th, when most of the crop had been harvested. Briefly, the data resulting from these experiments clearly indicated that the corrosive sublimate treatment showed no deleterious influence either upon the plants or on the relative number of soil organisms present in the treated versus the untreated soil. Under field conditions the applications of the corrosive sublimate mixtures certainly seemed to have a stimulating effect upon the growth of the plants.

In the control measures conducted in 1919, Mr. J. A. Flock and Mr. W. P. Shorey, rendered valuable help.

CABBAGE MAGGOT CONTROL.

L. Caesar and H. C. Huckett.

In neither the Guelph nor Burlington districts did cabbages or cauliflowers suffer any damage worth speaking of in 1919 from the Cabbage Maggot (*Chortophila brassicae*). Only 14 plants out of 7,000 in the plot were killed by the maggots and these 14 were not in any one row but widely distributed over the field.

Fortunately we included in our experiments a plot of radishes, and as radishes were much worse attacked than cabbage some interesting and suggestive results were obtained.

We also devoted considerable time to trying to discover how corrosive sublimate controls the insect.

The results of the work along these two lines is given below:

TABLE SHOWING THE EFFECT OF VARIOUS

PLOT 1—COMPOSED

No. of row.	Date of sowing.	Date plants appeared.	Substance used.	Dates and strength of application.	No. of sound plants.
13	May 3	May 12	Check	Check	4
17	,, 6	,, 13	Check	Check	44
18 19	,, 6	,, 13	Tobacco dust 1 part and soot 2 parts..	May 14 and 26	90
20	,, 6	,, 13	Corrosive sublimate.	May 7—1 to 640 .... May 26—1 to 1,000	128
21	,, 6	,, 13	Corrosive sublimate.	May 7—1 to 640 .... May 26—1 to 1,000	115
22	,, 6	,, 13	Tobacco dust	May 14	55
23	,, 6	,, 13	Tobacco dust	May 14 and 26	34
24	,, 6	,, 13	Tobacco dust	May 14 and 26, and June 10.....	45
25	,, 6	,, 13	Check	Check	42
26	,, 6	,, 13	Soot	May 14 and 26	11
27a	,, 6	,, 13	Salt (dry)	May 26	8
27b	,, 6	,, 13	Salt (solution)	May 26	10
28	,, 6	,, 13	Corrosive sublimate.	May 7—1 to 640 .... May 26—1 to 1,000	75

PLOT 2—MEDIUM

No. of row.	Date of sowing.	Date plants appeared.	Substance used.	Dates and strength of application.	No. of sound plants.
32	May 26	May 30	Check	Check	121
33a	,, 26	,, 30	Corrosive sublimate.	May 31—1 to 240	44
33b	,, 26	,, 30	Corrosive sublimate.	May 31—1 to 480	49
33c	,, 26	,, 30	Corrosive sublimate.	May 31—1 to 720	60
33d	,, 26	,, 30	Corrosive sublimate.	May 31—1 to 1,000	58
34	,, 26	,, 30	Soot	May 31	64
35	,, 26	,, 30	Soot	May 31 and June 7	100
37	,, 26	,, 30	Ammonia	May 31, 1 to 16 of water	....

PLOT 3—LATE

No. of row.	Date of sowing.	Date plants appeared.	Substance used.	Dates and strength of application.	No. of sound plants.
4	July 8	July 16	Corrosive sublimate.	July 8—1 to 500	96
5	,, 8	,, 16	Corrosive sublimate.	July 16—1 to 1,000	78
6	,, 8	,, 16	Corrosive sublimate.	July 8—1 to 500 .... July 26—1 to 1.000	88
7	,, 8	,, 16	Check	Check	48
8	,, 8	,, 16	Corrosive sublimate.	July 8—1 to 500	96
9	,, 8	,, 16	Corrosive sublimate.	July 16—1 to 1,000	62
10	,, 8	,, 16	Corrosive sublimate.	July 8—1 to 500 .... July 16—1 to 1,000	115
11	,, 8	,, 16	Check	Check	28
12	,, 8	,, 16	Tobacco dust, sulphur and arsenate of lead	July 8	24
13	,, 8	,, 16	"	July 8 and 16	37
14	,, 8	,, 16	Carco.............	July 16, 23 and 30	33

SUBSTANCES UPON RADISH MAGGOTS.

OF EARLY RADISHES.

No. of wormy plants.	Per cent. wormy.	Remarks.	No. of row.
38	90.4	Roots not nearly so good as in corrosive sublimate rows.	13
94	68.1	" " " " " " " "	17
201	69.1	Vigorous foliage, long, rough, slender, poor quality roots.	18, 19
17	11.7	Moderate foliage, large, globular, smooth, good quality roots.	20
18	13.5	" " " " " " " "	21
50	47.6	Vigorous foliage, long, slender, rough, poor quality roots.	22
68	67.9	" " " " " " " "	23
70	60.8	" " " " " " " "	24
79	65.2	Roots not nearly so good as on corrosive sublimate rows.	25
50	81.9	Roots like tobacco rows, much inferior to corrosive sublimate.	26
30	78.9	Not a good test.	27a
25	71.4	" " "	27b
37	33.0	Mostly surface injury; good roots for table purposes.	28

EARLY RADISHES.

No. of wormy plants.	Per cent. wormy.	Remarks.	No. of row.
121	50.0	Not so good roots as on corrosive sublimate rows.	32
0	0.0	Good quality of roots, growth of young plants checked at first	33a
0	0.0	" " " " " " " "	33b
3	4.7	" " " " " " " "	33c
1	0.9	" " " " " " " "	33d
82	56.2	Foliage good, roots not so good as corrosive sublimate rows.	34
128	56.1	" " " " " " " "	35
0	0.0	All plants killed; same result later where 1 part to 32 of water was used.	37

RADISHES.

No. of wormy plants.	Per cent. wormy.	Remarks.	No. of row.
20	17.2		4
7	8.2	Note: The later application gave the better results.	5
4	4.3	Note: The two applications gave better results than one.	6
15	23.8		7
27	21.9		8
12	16.2	The later date here again gave better results than row 8.	9
8	6.5	Note: Two applications better than one.	10
12	30.0		11
15	38.4		12
18	32.7		13
9	21.4		14

Inferences from the Above Table and from Observations in the Field.

First. Corrosive sublimate was the only substance used which gave satisfactory or fairly satisfactory results, the results from it being better than the percentages indicate, because nearly all the injuries were on the surface, only a few being deep in the tissues, whereas in the checks a considerable percentage were deep in the tissues. The plants were somewhat older than usual when pulled. This possibly accounts for surface injuries.

Second. Tobacco dust alone, or soft coal soot alone, or a combination of the two, or a combination of tobacco dust, sulphur and arsenate of lead powder, gave no control and in most cases seemed to encourage the presence of the insect.

Third. Under conditions such as we had last year, corrosive sublimate had a decidedly beneficial result upon the size, shape and quality of the radishes causing them to be smooth-skinned and of good size. On the contrary, tobacco and soot both acted as fertilizers and gave excellent foliage but inferior form and size of the enlarged part of the root, this being elongate, slender, rough on the surface and unattractive in appearance.

Fourth. Corrosive sublimate if applied stronger than 1-1,000 to young plants, weakens them and causes a distinct shock, though they soon outgrow this. The same thing happens to cabbages if the roots, when being transplanted, are soaked a couple of minutes in the liquid, yet even then they recover. Too heavy soaking of soil around very young plants in the field, even with 1 to 1,000 may cause a sickly appearance of foliage for a few days.

Fifth. Sufficient tests have not been made yet to allow a reliable conclusion to be formed as to the best time to apply corrosive sublimate to radishes.

Sixth. Corrosive sublimate applied within 24 hours of sowing the seed appears to have no injurious effect upon germination.

How does Corrosive Sublimate Act in the Control of the Cabbage Maggot?

1. Does it Kill the Eggs? Eggs were placed on blotting paper in pill boxes containing soil freshly saturated with corrosive sublimate 1-1,000. The result was that of 80 eggs treated, 64 or 80 per cent. hatched. In the check, out of 134 eggs, 128 hatched or 95 per cent. The above results represent not a single test, but a series with a few eggs at a time. There seems no doubt therefore, that if the eggs hatch under these circumstances, they would hatch in the field in soil treated with corrosive sublimate.

2. Does it Kill the Larvæ? Various methods were employed to test whether corrosive sublimate kills the larvæ in any stage of their growth.

Out of 190 larvæ treated 83 pupated, 4 remained larvæ to the end of the test and 103 or 56.8 per cent. were missing. More would have been missing had they not in some cases been put in retainers from which they could not escape.

In the checks, out of 46 larvæ, 35 pupated and 11 or 23.8 per cent. were missing, 5 of these by accident.

Some of the missing treated larvæ were doubtless killed, especially the very small larvæ, but most of them crawled away and escaped. Where the larvæ were confined so that they could not escape, it was found that, while a good many died, yet many lived. It was observed however, that there was an evident desire both of large and small larvæ to avoid contact with this liquid compared with water. *Our inference* is therefore, that control is not to any large extent brought about by the death of the larvæ from contact with corrosive sublimate, but possibly from its repellent action, which causes the larvæ to wander away from the plant and thus perish. Larvæ, however, once well inside the plant, do not seem to be affected.

3. DOES IT KILL THE PUPAE? Three flower pots filled with fine sandy soil were sunk in the soil this spring and then thoroughly saturated with corrosive sublimate. Pot 1 contained 100 puparia and was saturated with 1-1,000 strength.

Pot 2 contained 100 puparia and was saturated with 1-1,000 strength.

Pot 3 contained 35 puparia and was saturated with 1-240 strength.

Eight other pots containing in all 885 pupae were left untreated and served as checks.

RESULTS.

Pot 1 of the treated puparia gave an emergence of 11 flies.
Pot 2 of the treated puparia gave an emergence of 47 flies.
Pot 3 of the treated puparia gave an emergence of 2 flies.
Total emergence from treated pots 60=25.5 per cent.

From the 885 pupae in the checks 174 flies, or 19.6 per cent. emerged. We can therefore only conclude that corrosive sublimate does not kill the pupae.

Incidentally it may be mentioned that from the 885 untreated pupae, 424 cynipid and 15 staphylinid parasites emerged, and from the 235 treated puparia 20 cynipids and 1 staphylinid.

THE PRESENT STATUS OF MILL-INFESTING PESTS IN CANADA.

E. H. STRICKLAND, ENTOMOLOGICAL BRANCH, OTTAWA.

The Entomological Branch of the Dominion Department of Agriculture is undertaking a series of investigations and experiments upon the control of the insect and other pests of flour mills, bakeries, elevators and warehouses. This has necessitated a preliminary visit to representatives of these various industries throughout the Dominion for the purpose of ascertaining what are the most important pests, and the effectiveness of methods already in operation for their control.

In so far as the flour mills are concerned one pest, namely, the Mediterranean Flour Moth (*Ephestia kuehniella*), so far exceeds all other classes of mill pests in the trouble it causes, that the majority of millers look upon it as the only one meriting serious consideration. One of the favorite breeding places of this pest is inside the legs of conveyors, where the larvæ spin a voluminous mass of silk, which collects large quantities of flour and dust. If no precautions are taken this, in time, entirely clogs the elevator, which must then be dismantled and thoroughly cleaned.

One other group of mill pests—the Flour Beetles (*Tribolium* spp.)—is almost as prolific in Canadian mills as is the moth, but since these beetles do not interfere with the milling process they are, unfortunately, inclined to be tolerated in the various parts of a mill which they inhabit. From the millers' point of view this is readily understood. The moth is a serious menace to the smooth running of the mill. Hence its control is of great, sometimes even of vital, importance to the operation of an infested mill. The beetles on the other hand do not inconvenience the miller, and they are readily sifted out of flour, which apparently leaves the mill in as good condition as if it had never been in contact with them. Suppose, however, one takes a sample of flour which is, to all appearance, in good condition from the mill badly infested with these beetles, and places it in a tightly closed tin, thus assuring that no beetles can obtain entrance for oviposition. An examination of this tin, say in six months' time, will in all probability reveal the presence of a large number of beetles. This is due to the fact that the beetle lays its eggs in such places as the inside of spouts, and in elevator boots. Thus the presence of the beetles results in the contamination of passing flour with eggs. They measure about 1/60 inch in diameter and could never be detected in the flour.

The owner of a badly infested mill rarely experiences any trouble with his flour, since he stores it for a very short time, and when it leaves his warehouse it is, in so far as he knows, a perfectly clean consignment. Should this flour be sold for local consumption it will probably be sterilized by being baked before the newly hatched larvæ have attained a sufficient size to attract the attention of their consumer. If, on the other hand, the flour is exported to some such warm climate as that of the West Indies, the time which must elapse, together with the temperatures at which it will be kept, before it arrives at its destination, offer every opportunity for the completion of at least the greater part of the beetle's life cycle. A further delay in the consumption of this flour may allow the completion of several generations, with the result that the consignment becomes seriously infested. Such conditions may not often occur, but prior to the general adoption of control measures, complaints were more frequently made of infestations developing in consignments of exported flour. Hence, from a national point of view, it is seen that mill pests have a greater significance than merely in so far as they affect the mill in which they live and breed.

Fortunately, we have at our disposal several means of reducing to a minimum, if not in all cases entirely eradicating, these pests, and the majority of millers have shown great energy and enterprise in adapting these remedies to their mills. The most important control measures are: superheating, fumigating and freezing.

Superheating is a method of control based upon the observation that a temperature of about 120° Fah. will destroy any stage of insect life in a very short time. A mill in which the pests are controlled by superheating is usually fitted with sufficient permanent steam pipes to raise its "room temperature" to about 130°F., but similar results can be obtained with the aid of temporary coils, and by utilizing the heat from a drier.

Heating is most conveniently effected over a week-end. When the mill closes down on Saturday night all elevator boots, etc., are opened up to allow a free circulation of air, and the heat is turned on. By the following morning the required temperature is obtained, and by preference it is maintained for over twenty hours. This duration of time is not necessary for the destruction of exposed pests, but it is desirable in order to assure that the heat penetrates into all accessible places. Work can be resumed on the Monday, though the first part of this day is usually occupied in giving the mill a thorough cleaning down. The result of this treatment is that all species of mill pests, in whatever stage they were present, have been destroyed in every part of the mill which was raised to a temperature of 120°, whether such places were accessible to a free circulation of air or not. Superheating is becoming increasingly popular with millers, and it is significant that only those who have never employed it are able to advance serious objections to its use.

Fumigation with hydrocyanic acid gas is a control method which served a very useful purpose before the superheating process was perfected, but it must now be relegated to the "out-of-date" class, since it has the following disadvantages when compared with the rival method: 1. It is dangerous to human life. 2. While the initial expense is less than that of installing an efficient heating system every subsequent operation is far more expensive than that of turning on the steam. 3. The gas fumes are less penetrating than the heat, and since a high concentration is required for the destruction of eggs many of these, which are laid in protected places, may escape. 4. The mill must be idle for a longer period at each operation.

Freezing is a method much in vogue in the Prairie Provinces, where extremely low temperatures can be relied upon at almost any time in the winter. When there is so much of this "natural resource" annually going to waste it would seem to be desirable that it be utilized to the greatest extent possible. We have no records of experimental data as to what low temperature is necessary to destroy the different stages of the various pests, and there is some doubt as to whether the extreme cold experienced in this country will destroy all of the stages. Some of the smaller mills do not run at all in the winter but they never appear to be quite free from pests when they commence operations in the spring. This may, however, be due to an annual re-infestation.

A mill, when it is opened up to freeze for a couple of days, is usually submitted just before or after the operation to a more vigorous cleaning than it receives at any other time in the year. To what extent the evident benefit derived can be ascribed to the cold or to the broom is a debatable point. Adults of the moth and the beetle certainly perish without exception at 25° below zero, but we have no definite data as yet upon the effect on immature stages.

Freezing is, in most cases, acknowledged to be hard on the mill. Steam pipes obviously must be completely drained, and this is not always easy. Some lubricating oils stiffen up at low temperatures, and the mill should not be re-started until it has warmed up to normal temperature. Metal work warms up more slowly than the rest of the mill. This results in sweating, which collects dust and may even cause rust. These difficulties have been overcome in several mills, among them some of the largest in the country, and freezing is practised by them with evident success. The first cold snap of winter is, however, usually rather anxiously awaited in such mills since, by the time it arrives, the moth is often "getting pretty numerous again." This is the main disadvantage to freezing as the sole method of controlling pests. It cannot be applied at any season of the year, and is not available in the summer when the moths are most active. It is, however, to be hoped that an opportunity will be offered this winter for us to obtain some definite data upon the value that low temperatures have in the extermination of mill pests.

These, then, are the chief methods of reducing the pests in our mills, but we are faced with one more problem in this connection, namely, that of re-infestation. This possibly is the main problem, and certainly, had it been solved in the first place, the problems of eradication would have been non-existent, for mill pests are not indigenous to mills. Some of the newest mills in the country have been heavily infested almost as soon as they were put into commission, while some others have remained almost free after many years of running.

Often this infestation, and re-infestation after eradication, is well-nigh unavoidable. A city mill with a local trade stands little chance of immunity.

but a large isolated mill, catering mainly to export trade, should avoid infestation if proper precautions are taken.

In probably 90 per cent. of the mills now infested with moths the pest has been introduced in second-hand bags. These bags are rarely taken into the mill. In most cases they are dumped into the adjacent warehouse to be used for feed stuffs. Sometimes they are cleaned with beaters or by suction, but a few eggs are liable to escape destruction by either treatment. More often the bags are not treated at all. In either case, the warehouse sooner or later becomes infested and it is only a matter of time as to when the pest will appear in the mill itself. The moths are rather unwilling fliers but they are very tame and are readily conveyed from one room to another on the clothes of people passing back and forth.

The remedies which are suggested for this means of infestation are:

(1) To avoid using second hand bags entirely. This, however, is not often practicable, except in the case of manufacturers of special brands of breakfast foods, whose reputation would suffer immeasurably were they to be unfortunate enough to distribute a consignment of "buggy" cereals among an unforgiving public.

(2) To sterilize by heat all second-hand bags before they are allowed to enter the warehouse. The bags should be allowed to accumulate in a small detached building which can be superheated say, once every two weeks; after each operation all of the contained bags should be transferred to the warehouse before more are admitted.

For a new uninfested mill such a method would pay for its small initial cost in a few months. In so far as we are aware, this method is not actually in use as yet in any mill, though it is "under construction" in at least one plant.

(3) To superheat the warehouse as well as the mill. This method would entail too much expense to be practised for most mills, though it would be of great value.

Generally speaking, then, millers throughout the country are keenly alive to the questions relating to the control of pests, but it would seem that a little more attention might be paid to the problem of avoiding re-infestation of a mill once it has been effectively cleared of its present unwelcome guests.

SOME NOTES ON THE LIFE HISTORY OF OUR COMMON JUNE BEETLES.

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

The white grub, the immature form of the May or June beetle, is one of the most important and most injurious of soil-infesting insects, and one of the hardest to control, on the sand and sandy loam soils of Western Ontario. They may occur occasionally in clay soils, but I have never observed or known of any injury by these insects on the heavier types of soil. Since 1914, observations on the life history of these important insects have been under observation, and though the work has had a chequered career, we have been able to breed out from the egg, the complete life history of three species. So far as our collection of beetles is concerned, and that involves many thousands, we have in Middlesex County seven distinct species, but probably only four are really common, although no extensive collections of beetles have been made outside of Caradoc Township. This is somewhat to be regretted as it does not give us a proper idea of the distribution of the different species. The seven species known to exist in Middlesex County are *L. fusca, L. rugosa, L. dubia, L. gibbosa, L. marginalis, L. ilicis*, and *L. inversa*. The three species raised from the egg are *L. dubia, L. rugosa, L. gibbosa*. The year 1914 was an excellent year for the collection of beetles, thousands were present, and ash, willow and butternut trees, were freely stripped of their foliage, while the early blossoms of cherry trees were freely fed on by the beetles. Coming early in May, the time of appearance being governed largely by temperature the beetles soon pair, frequently before they have eaten anything, but from observation eggs are not laid until from two to three weeks after fertilization. The female pairs frequently, at least I have seen the same pairs frequently in copula in their breeding cages. Pairs taken in copula May 16th, 1914, did not lay eggs until June 16th, but this was possibly due to my negligence in omitting to place a piece of sod in the breeding cage for the female to oviposit in. I noticed the day after the sod was introduced eggs were laid. The eggs are small, oval, of a pearly white lustre, each deposited singly in a ball of earth from 2 in. to 6 in. below the surface. After having been laid several days the eggs increase slightly in size, probably due to the absorption of moisture, become spherical in form and change to a reddish colour just prior to hatching. Our breeding cage records show that eggs hatch in from ten days to three weeks with an average of two weeks. This is somewhat difficult to gauge as we have noticed breaking open the little balls of earth to ascertain the egg yield, has undoubtedly a detrimental effect on the vitality of the young grub. The work of 1914 was practically concluded owing to the war, and although an assistant was procured in 1915, the results of the previous year's work amounted to nil. With the appointment of Mr. H. G. Crawford in the spring of 1916 the work obtained a new lease of life and much of the success of this work is due to his untiring and unceasing efforts. Starting with two species the results of that work were carried through to completion in the fall of 1918. On my return in the spring of 1917 the work was enlarged and additional species studied. We have now definitely ascertained the life history of *L. gibbosa, L. rugosa*, and *L. dubia* to be at least three years and in some cases it may be four.

The grubs feed most ravenously during the second and third year of their growth, prepare to pupate the latter part of July or early August of the third year and produce the adult early in September where it lies comfortably in its earthen cell 6 to 8 in. below the surface until the advent of warm spring weather. In 1914 some 8,370 beetles were collected from various trees and shrubs, and a summary of the collection data thus obtained is worthy of mention. *L. gibbosa* is about the earliest species to appear in numbers and is very abundant until the middle of June when its numbers begin to decrease although scattering individuals may be taken until the middle of July. In fact the species comprise 66 per cent. of all beetles collected that year. In point of numbers the males exceed the females in the proportion of 1.74 to 1 or nearly twice as many males as females, the collection from lights and trap lanterns have not been included.

L. rugosa. This species appears about a week later than *gibbosa* and is not an abundant species, it feeds freely on the foliage of most trees. In point of numbers the males exceed the females in the proportion of 1.78 to 1.

L. fusca. Appears about the same time as *gibbosa* but is not so abundant in the early part of the season. Taking the season through it is next to *gibbosa* in order of abundance. The proportion of males to females in this case is reversed, the females predominating in the proportion of 1.47 to 1.

L. dubia. One of the first species to appear in spring but not common. Its season would seem to be shorter than any other species, no specimens having been taken after the 24th June. Females were more abundant than males the former predominating in the ratio of 2.2 to 1.

Notes on Collecting. There are some points of interest in collecting that are worthy of mention. In May and early June the beetle movement is quite regular, and the evening migration takes place usually a few minutes before 8 p.m., and is usually complete in 15 or 20 minutes. They are most abundant on warm nights with a temperature between 65 and 70 degrees, and the best time for collection is between 11.30 p.m. and 1.30 a.m. Likewise the return migration to the ground is similar, and is usually complete by 4 a.m. It seems to be governed by the brightness of the morning and as "West" (8th report Ill. State Ent.) has pointed out, it seems as though the first bird note were a signal for the beetles to fly to their day-time hiding places. Should the temperature be not over 60 degrees, collecting may be safely begun by 9 p.m. as the beetles are not over active at that temperature, but should it be above that it is better to wait a little, until the beetles are less active as they are strongly attracted to lights, and will fly to the light or assemble on the collecting sheets from all directions and from all varieties of trees. The earlier in the evening collections are made the more beating the branches require, while if it is delayed, say until midnight or a little later, the least touch will cause the beetles to fall. It seems as though the cool night air has a stupefying effect, and once dislodged they make no effort to rise again. Collecting from trees inhabited by June beetles does not always indicate that they feed upon that particular plant, as I have ascertained. For instance, on May 18th a soft maple tree was found to be alive with June beetles, and the noise was like the hum of swarms of bees, yet on examination the following morning, no injury of any consequence was observed, except that an occasional outside margin of a leaf had been slightly eaten. Their sole object in thus assembling in this tree was principally for copulation purposes. Their habits in the daytime are equally interesting, leaving their food plants early in the morning, they hide themselves in tufts of grass, or in the soil ½ to 1 in. deep. A heavy rain will keep them in their daytime hiding places, but a light rain will not interfere with their movements. Should a heavy rain come on while they are feeding it has the effect of making them less attractive to lights. Temperature is a very important factor, the lowest temperature I have recorded when collections were made was 47 degrees at 9 p.m. At this temperature beetles are very scarce.

CONTROL MEASURES. We have been rather unfortunate in securing much information on the natural control of these insects. It is a matter of common observation that crows, blackbirds and domestic poultry feed readily on the young grubs, while skunks undoubtedly also relish them. On several occasions we have reared the tachinid *Microphthalma disjuncta* and probably *Pelecinus polyturator*, although the specimen is not perfect. On two occasions in badly infested fields I collected a number of cocoons of a digger wasp, presumably *Tiphia inornata*, but have not been very fortunate in rearing them out. With the scarcity of birds and other natural agencies of control, the question of suppressing an outbreak seems to be one of agricultural rather than entomological procedure. From a careful survey of the crop rotation on several farms in Caradoc Township, it would seem to indicate that arable land should not be in pasture more than two years and a definite system of short crop rotation followed. The following rotation followed on one farm is of particular importance, in that not only is the fertility of the soil increased, but since the adoption, there has been no injury whatever by white grubs or any other insect. First year oats, seeded to clover, hay crop removed, land planted to wheat, seeded to clover again and planted again to potatoes and corn. Here we have two clover crops in four years and no crop longer than one year on the ground. This, of course, is only applicable to arable land, the question of old pastures is still a perplexed problem, except when brought under cultivaton. Trapping the beetles by the use of lanterns is hardly applicable, because fully 75 per cent. of such collections are males. It would appear that short crop rotations, frequent growing of clover, and clean farming will do more to decrease the spread of this insect than any other means.

REPORT OF THE INSECTS OF THE YEAR—DIVISION NO. 6.

H. F. HUDSON, STRATHROY.

Weather conditions in Western Ontario have been both favorable and otherwise to insect life. The spring was cold and very wet, this was followed by a hot and very dry summer. A brief summary of the more important injurious insects is appended below:

CLOVER LEAF WEEVIL (*P. punctatus*). In the low-lying pasture fields south of London, Ont., more especially in and around Delaware Township, clover and timothy fields were most heavily infested with this weevil. They were present literally by millions and probably no such heavy infestation has ever been witnessed in this section before. Every blade of timothy had a grub curled around it and every clover leaf was badly riddled with small holes and over seventy grubs were taken from a single clover plant. Fortunately the extremely wet weather produced a fungus disease amongst them and in less than a week the whole outbreak had subsided.

CUTWORMS. These insects have been responsible for considerable injury and in nearly all cases the culprit has been the "glassy cutworm." In nearly all cases the affected field was an old sod.

POTATO FLEA BEETLE (*Epitrix cucumeris*). Extremely abundant this year but is readily controlled by spraying with arsenate of lead.

POTATO BEETLES (*Leptinotarsa decemlineata*). Probably more abundant this year than usual, but late planted potatoes were scarcely injured; in quite a number of cases potatoes planted in late June were not sprayed at all.

POTATO LEAF-HOPPER (*Empasca mali*). An old pest in a new guise. The potato crop in Western Ontario has been considerably reduced in yield, in some cases I should say at least 25 per cent., due to the ravages of this insect. Classed as a new pest by potato growers adequate means of control were not generally known; consequently the insect had almost its own way. I have had partial success by the use of "Black Leaf 40" and soap, using one tablespoonful of the nicotine solution to one gallon of water plus two ozs. soap.

THE STRAWBERRY ROOT WEEVIL IN BRITISH COLUMBIA.

W. DOWNES, VICTORIA, B.C.

Of the many many insects that trouble the small fruit grower perhaps few equal in destructiveness the Strawberry Root Weevil (*Otiorhynchus ovatus* Linn.). Within the last ten years or so its prevalence in the strawberry-growing sections of the British Columbia mainland and Vancouver Island has been a matter of increasing concern to the planters, and in some of the districts where the industry has been longest established it became a question whether its profitable continuance could be any longer maintained.

In Oregon in 1912 some work was done in the study of the Weevil by Prof. A. L. Lovett[1] and notable work was done in British Columbia in 1913 by Mr. R. C. Treherne[2] who established the main principles for its control. During the last two seasons further studies on this insect have been made by the writer in the Gordon Head district of Vancouver Island and some new information regarding its life-history has been brought to light.

The strawberry-growing sections of Vancouver Island are mainly areas of light sandy soil on which the berries seem to do better than on heavier land, though here and there one finds plantations on stronger soil, usually on the lower levels. Cultivation is on the hill system. The worst infestations were found always on the light land, the reason probably being that such soils provide the best facilities for penetration by the young grubs. The degree of infestation usually varied according to the age of the plantations, one-year-old fields being frequently free or showing an average infestation of one or two weevils to the hill. Two-year-old fields would average three or four times that number, while the highest numbers were nearly always recorded from three-year-old fields. This is, however, not by any means a general rule, as much depends on the proximity of young fields to older plantations and cases were found where one-year-old fields adjacent to an old plantation were badly infested, and in 1918 a two-year-old field of five acres was totally destroyed. This field in 1917 produced 2,000 crates of berries; in 1918 only forty were gathered. In this case the owner had been growing strawberries on his farm for many years until a heavy population of weevils had concentrated there; moreover, the situation was aggravated by the practice of planting strawberries after clover sod, a proceeding calculated to provide the succeeding berry crop with a plentiful supply of weevils, as clover is one of the crops upon which the strawberry root weevil thrives.

At the present time, owing to general appreciation of the principles of control, the strawberry root weevil seems to be decreasing in the Gordon Head district. At Keatings, on the Saanich peninsula, a slight increase is reported, and on the Lower Mainland the situation is very much as it was some years ago with heavy infestations reported from certain points.

Origin and Life History.

Recent investigations show that the strawberry root weevil is undoubtedly indigenous and not introduced. Mr. R. C. Treherne[3] has found the weevil at various altitudes up to 4,000 ft. in the mountains and on isolated rocky islands several hundred yards from the mainland. I myself have found it in spots far removed from cultivated areas, and all the evidence tends to show that it is not an introduced insect but primarily a species infesting grasses and various forms of native vegetation. To the list of wild host plants of the larvæ given by Lovett[1] I am able to add two more, Snowberry (*Symphoricarpus racemosus*) and Oak on both of which I have found the larvæ in Victoria. It is a common pest in gardens and the grubs may be found attacking a great variety of plants.

To the list of cultivated plants attacked by the larvæ Red Clover must be added. I have found them very numerous in clover sod at Gordon Head, even in the spring, on sod that had been ploughed down the previous fall. Thus in any scheme of cultivation in which strawberries have a place it would be obviously unwise to plant them following a crop of clover. A suitable system of rotation will be referred to later.

Oviposition. Observations taken during two seasons at Gordon Head showed that the oviposition period extended from the middle of May to the middle of September. The eggs are laid promiscuously around the plants, sometimes against the crown itself, and often buried a quarter to half an inch below the surface. When a crevice in the soil is available this may be taken advantage of as a spot in which to deposit the eggs. Formerly it was supposed that all the eggs were deposited by those weevils which emerged in the summer, but I have this year conclusive evidence that the over-wintered adults also deposit eggs in large numbers. Commencing on April 1st, collections of over-wintered weevils were made at intervals up to June 13th and kept for observation. That these were true over-wintered individuals there can be no doubt, as the earliest date of the emergence of the summer brood at Gordon Head is during the last week in May, and this year adults were not found in the soil in teneral condition until June 13th. Throwing out of consideration those collected in June, we have four lots of over-wintered adults collected on April 1st, May 1st, May 19th and May 31st. The first lot collected commenced to oviposit on May 18th (probably later than under natural conditions) and those collected on May 19th commenced to oviposit on May 28th. All the lots continued to lay eggs throughout the summer until August 30th when oviposition ceased. The highest average number of eggs per individual was 198, laid by those collected on June 13th, and the next highest 130, laid by those collected on May 19th. The earliest lots collected laid very few eggs, averaging 12 and 28 respectively, this being perhaps due to artificial conditions. In the third week in August the weevils began to die rapidly and by the first week in September nearly all were dead.

Oviposition by Summer Brood. It was intended to make the study of this point more complete this year, but owing to an unfortunate accident to our emergence boxes in the field, sufficient material was not obtained and the data were got from a limited number which were bred in the laboratory. These commenced to deposit eggs on July 20th, probably very much later than would be the case in the field. Under laboratory conditions the weevils are somewhat retarded and do not prove as healthy as those in the field. The vials were examined and the eggs counted every four days. The maximum number of eggs laid by an individual in this experiment was 249 and the minimum 73, while the average was 154, all deposited within a period of six weeks. Thus it will be seen that there are two broods depositing eggs simultaneously. In the case of both broods oviposition ceased at the same time this year but in last year's experiments many weevils continued to lay until the middle of September. Endeavour will be made another season to determine whether the same weevils oviposit twice. In no single instance as yet have I discovered weevils of the summer brood that did not lay eggs and therefore I assume that a proportion of the summer brood does not die but after ovipositing hibernates, and in the spring, after a period spent in feeding and development, oviposits again. If this is not the case, it is difficult to account for the origin of the numerous overwintered individuals.

Parthenogenesis. In all the experiments conducted here no male weevils have been discovered. Although about 200 specimens have been examined and dissected only those have been found possessing the genitalia proper to the female. Also among the large number kept in confinement none were ever found in copulation; neither has it been observed in the field. Consequently the belief has been held by us for some time that *O. ovatus* is parthenogenetic. This impression was strengthened by the recent discovery in France by J. Feytaud[4] that *O. sulcatus,* its near ally, was parthenogenetic, making the fourth Coleopteron known in which the method of reproduction is by parthenogenesis. To test the matter a number of pupae were collected in the field this season and isolated in vials. On reaching adult condition they were placed each in a glass vial loosely stoppered with cotton wrapped round with paper, and fed on strawberry leaves. The vials were kept in my house and examined at intervals of two or three days. At first cotton wool was used for vial stoppers but it was found that the weevils deposited eggs among the wool, making them very difficult to find. When the wool was wrapped in paper the difficulty was surmounted, although the beetles would occasionally deposit eggs in a fold of the paper. Oviposition commenced on July 20th and continued until August 30th. The eggs of each individual were kept separate. On August 24th larvæ were found to have hatched from eggs laid by weevil No. 5 and within a few days larvæ were also found in the other vials. Thus it appears evident that the weevil is parthenogenetic. *O. ovatus* thus makes the fifth coleopteron known to be parthenogenetic the others being *O. turca* Bohem, *O. cribricollis* Gyll, *A. ligustici* Linn., and *O. sulcatus* Fabr. Some individuals produced a larger proportion of infertile eggs than others, and it may be noted that twenty days elapsed between the time when the first food was given and the commencement of oviposition. This is a greater period than would occur in nature and in the experiments conducted by Treherne[2] the minimum period was found to be eight days. I attribute the difference to confinement and artificial conditions of feeding.

Incubation and Fertility. Experiments made to find the period of incubation showed that it varied from sixteen to twenty-two days.

The fertility of the eggs varied from 68 per cent. in the case of those laid by overwintered adults to 80 per cent. in the case of those laid by the summer brood.

Duration of Pupal Stage. This was found to vary from ten to twenty-six days. The adults commenced to harden at the end of twelve hours and are completely chitinized in seven days. One individual came to the surface in four days, but while able to climb was not completely hardened.

Emergence of the adults commenced at the end of May. In 1918 the first were taken in the cages on May 25th and the emergence continued until the end of June with a maximum during the second week in June. In 1919 the emergence was later, the first adults being found in teneral condition on June 13th and these would not normally emerge for another week. The season was colder than the previous one and this would account for the difference as the pupae are retarded by lower temperatures.

Migration. On the advent of warm weather in the spring there is a general movement of hibernated weevils from their winter quarters to their feeding ground. Every conceivable spot may be used by them in which to hibernate and where they are especially numerous, dwellings are frequently invaded by them to the consternation and annoyance of the owners. Piles of stones or logs, and fence lines overgrown with weeds and brush form ideal quarters, but where the winters are mild, as on Vancouver Island, many spend the winter among the crowns of the strawberry plants. The weevils begin to move in March and are fairly active until May when their migratory activities appear to lessen, after which, in June, their numbers are augmented by the newly emerging summer brood and a further movement begins which reaches its climax at midsummer, then lessening until late summer when they seek winter quarters.

Regarding the distance travelled by them in a season no definite evidence was obtained, but one new field at Gordon Head, eighty yards wide, was infested throughout in a single season, the weevils coming from an old patch adjoining. The young patch was bordered on three sides by bush so the weevils could only come from the side adjoining the old patch. On this side the average number of larvæ per hill was 27, in the centre 16, and at the further end 7. I would say, therefore, that the weevils would be likely to travel at least double the width of this patch, or from 160 to 200 yards.

Measures of Control. The observations made during the last two seasons have shown that the main principles of control as formerly laid down are undoubtedly correct. There is no poison or chemical treatment of any kind that we know of that can be applied to the plants without injury and will at the same time control the weevil. The question is a cultural one and the best results are obtained by a suitable rotation of crops, a double object being attained by discouraging the weevil and maintaining soil fertility. At Gordon Head the Provincial Government has leased six acres in a badly infested locality and is endeavouring to demonstrate a system suitable to the district. Briefly outlined this would be as follows: Presuming that we start with an infested field, the plants should be pulled up and burnt at the end of August or beginning of September. Leaving them until this time induces the adult weevils to remain in the field and deposit their eggs there. Then the field may be ploughed and should be kept fallow about a month, the spring-tooth cultivator being frequently used to bring out all strawberry roots that may remain. This proceeding will starve out all the young grubs in the soil. A suitable crop to sow the land to would be fall wheat with vetches or clover. The land may remain in clover two years and should then be fall ploughed and potatoes planted the following year. The next year the field may be planted back to strawberries the land being clean and free from weevils as the potato is one of the crops on which they cannot live.

It is recommended that not more than two crops of strawberries be taken from a field under ordinary conditions. It is not only important not to overcrop the land, but leaving the land in strawberries too long allows the weevils to concentrate there and is inviting disaster. It is also important that judicious applications of barnyard manure be applied to keep the land in good heart. By growing vigorous healthy plants they will be in better condition to stand an attack of weevil and will recover more rapidly. As to the advisability of including clover in the scheme of rotation, we have doubts as to the wisdom of this owing to the danger of maintaining weevil in the land, but we know of nothing that will quite take its place unless it can be shown that it is equally profitable to grow peas or vetches or some other legume and still maintain the fertility of the soil.

The recent light thrown on the oviposition of the weevil emphasizes the necessity of destroying as many adults as possible. It is believed that chickens will prove of the greatest help in this matter and it is suggested that small lots in colony houses should be allowed to run in the plantations. They readily pick up the weevils and the good they do far outbalances the harm done by scratching among the plants. At blossoming time they may be shut up and allowed to run again after the crop is off. The difficulty in closely settled districts of preventing newly set plantations from being re-infested by adjacent old ones is a problem that we are attempting to solve by the aid of wooden barriers with a band of tanglefoot. These have been tried elsewhere and have been found to be partially successful and the results obtained at Gordon Head fully justified us in continuing our experiments. At the present time we have not gone sufficiently far to be able to say that they are commercially practicable but we believe they will prove a useful adjunct in weevil control.

REFERENCES.

(1) Lovett, A. L. Ore. Agr. Exp. Station, Bi. Hort. Rep., 1913.
(2) Treherne, R. C. Dom. Ent. Bul. 18.
(3) Treherne, R. C. Can. Ent., XLIX., No. 8.
(4) Feytaud, J. Comptes Rend. des Séances de l'Acad. des Sci., Vol. 165, No. 22. Paris.

THE STRAWBERRY WEEVIL.

W. A. Ross and C. H. Curran, Dominion Entomological Laboratory, Vineland Station.

The following paper is based largely on field observations made in 1918-19 and on preliminary experiments conducted during the past season in the Niagara and Oakville districts.

History and Distribution in Canada.

The strawberry weevil is a native insect, which, it is believed, bred originally in the buds of the redbud, the wild blackberry and wild strawberry.*

It has been known as a strawberry pest in Canada at least since 1886. In the Dominion Entomologist's Report for 1890, Mr. W. H. Hale, of Sherbrooke,

* Slingerland and Crosby, Man. of Fruit Insects, p. 373.

makes the following statement: "For several years I have been suffering from the ravages of some sort of insect which attacks the buds of all the staminate varieties of strawberries; a small puncture is made through an unopened sepal and an egg is deposited. The stalk is then partially or entirely cut through. . . . In a large field of strawberries in which 80 per cent. of the rows were pistillate varieties not a single bud was touched, while the remaining rows of strawberries were almost entirely denuded of buds. This same trouble was noticed in Staten Island and Hamilton, Ontario, in 1886. . . ."

Further reference is made to strawberry weevil outbreaks in succeeding reports of the Dominion Entomologist, and also in the reports of the Entomological Society of Ontario.

So far as we are aware the weevil is recorded as being injurious in only two provinces in Canada, viz: Ontario and Quebec.

HOST PLANTS AND INJURY. In Ontario the strawberry weevil has been bred from the buds of the strawberry, raspberry and blackberry, and it has also been observed attacking wild strawberries and rambler roses. The dewberry, the red-bud or Judas tree and the yellow flowered cinquefoil, are recorded by Slingerland and Crosby as being additional host plants of this species.

The injury is caused by the female weevil cutting off the flower buds, after depositing her eggs within them.

STRAWBERRY. Occasionally the yield of strawberry plantations in Southern Ontario, especially in the Niagara District and Halton County, is seriously reduced by the weevil, or as it is commonly called, "the cutter." For example, in 1918 from 30 to 75 per cent. of the buds in some strawberry fields near Oakville and Jordan were destroyed by the pest. In a badly infested 3/4 acre plantation at Jordan only nineteen crates, or 513 quarts of berries were harvested.

All the common staminate varieties are subject to attack. Varieties with imperfect or pistillate flowers are practically immune.

RASPBERRY. According to our observations the raspberry crop is never injured to any appreciable extent, chiefly, we believe, because at the time raspberry buds are put forth the overwintering adult weevils are fast dying out. This past season we examined several raspberry plantations adjoining strawberry fields, but even the worst attacked bushes had less than ten per cent. of the buds severed.

BLACKBERRY. A patch of blackberries in the Vineland district was rather seriously injured by the weevil last spring, about 25 per cent. of the buds being destroyed. In the row next to an adjoining field of strawberries about 75 per cent. of the buds were severed. It was noted that frequently the weevil severed the cluster stem and thus, at one stroke, destroyed several buds.

As a general rule, however, weevil injury to the blackberry is negligible.

ROSES. Mr. Bartlett, an Oakville fruit grower, observed the weevil—an insect with which he is very familiar—severing the buds of his rambler roses.

LIFE HISTORY.

SUMMARY. The winter is passed in the adult stage, probably under vegetation and rubbish, in waste and bush lands adjoining the strawberry fields. In spring the insects leave their winter quarters and appear on the strawberry plants about the time the first buds are forming. By means of her slender snout the female weevil punctures the blossom buds, and deposits her eggs singly in the interior of the buds. After depositing an egg she then crawls down the blossom stem and cuts it so that the bud either falls immediately, or is left hanging for a few days, by a thread. Within the severed buds the whitish grubs which hatch out from the eggs, feed on the pollen and other interior parts. They become mature in about two weeks, pupate, and emerge as adults during the latter part of June and throughout July. The new adults feed for a short time on the pollen of various flowers and, then in midsummer, they seek their hibernating quarters. There is only one generation a year.

The Adult.

Description. Oval, robust, brownish-red to blackish, thinly clothed with whitish pubescence, condensed on a medium line of the thorax and scutellum; elytra dark red, the denuded fascia and scutellar space darker. Antennal grooves directed against the eyes, funicle seven-jointed; antennae dull yellow, club darker. Beak longer than the head and thorax, slender, feebly curved, striate and punctate on the sides, carinate above. Thorax wider at the base than long, sides feebly rounded, narrowed towards the apex; disc densely and rather coarsely punctate. Elytra one-fourth wider at the base than the thorax, one-half longer than wide; striae rather deep, their punctures large, close set; intervals convex, finely punctulate. Ventral segments nearly equal, the third longer than the fourth; pygidium convex, not grooved. Front femora with one tooth, hind tibiae with a short spine at the tip, claws armed with an acute tooth. Length, 2-3 mm. (Adapted from Blatchley).

Emergence in Spring and Habits. The weevils appear in strawberry fields in May, about the time the first buds are formed. Last spring they were first observed in the Vineland district on May 14th. At this time the buds of Senator Dunlap were in evidence, but the buds of Williams had not yet been produced.

The insects eat out holes in the buds and feed on the pollen within. Often several punctures are made in a single bud, so that when the blossom opens the petals present the appearance of having been shot full of holes. The weevils also feed on the stamens of open blossoms and occasionally they eat out holes in the foliage.

So far as we could judge strawberry weevil adults are capable of flying only a few feet.

Egg Laying. In ovipositing the female chews a small hole through the bud, inserting the snout to the base. She then turns around, locates the puncture with her ovipositor, and deposits the egg within—usually among the stamens. In observing this process of oviposition we noted that sometimes two holes would be made, but that only one egg would be laid in the bud. After ovipositing the weevil crawls down the stem and cuts it, so that the bud either falls immediately, or, as is more commonly the case, is left hanging by a mere thread for a few days. The stem may be severed at the base of the bud, or further down. Infrequently the stem of the cluster may be severed.

In the field the adults were observed ovipositing first on strawberry, and later on blackberry and raspberry from May 14th to June 26th. However, it should be stated that by the time the raspberry buds appeared most of the adults had died.

The reproductive capacity of the female was not determined.

Effect of Cold Weather on the Weevil. This spring it was observed that during the cold, wet spell of weather prior to May 19th, the weevils were comparatively inactive, and little injury was done to varieties such as Glen Mary, which were in full bud during that period.

The Egg.

The egg is translucent, broadly oval, and is about 1/50" in length. As previously stated, it is deposited within the bud and usually adheres to the stamens or pistils.

Duration of Incubation. In experiments with 100 eggs from May 28th to June 6th the duration of incubation varied from four to eight days, the average being six days.

Mortality. In experiments with 65 eggs from May 28th to May 31st the mortality was 14 or 21.4 per cent.

The Larva.

Description. Length, extended, slightly over 2-mm. Color, whitish-sulphurous, often mottled with blackish. Eyes sub-translucent, yellowish; mouth parts brown, lighter below. Thorax less roughened than the abdomen, of three

Adult of the Strawberry Weevil.

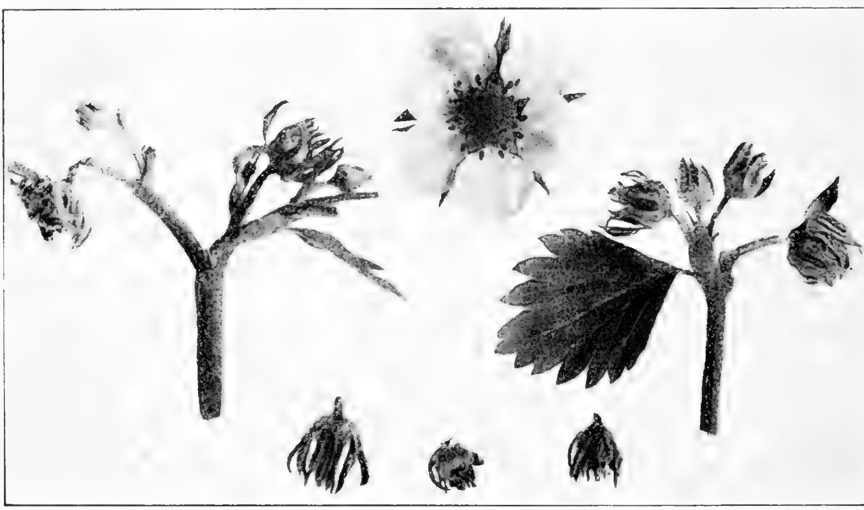
Strawberry bud opened to show egg of the Strawberry Weevil within.

distinct segments; narrow dorsal anterior margin of the first segment brownish. Legs wanting, but represented by six fleshy protuberances, each bearing three bristles, the middle one longer and slightly blackish; between the first pair of protuberances a narrow brownish stripe. Abdomen below more translucent, flattened, the sides produced slightly as a longitudinal fold. Above, the abdomen is deeply rugose; there are eight complete folds commencing at the lateral fold, each bearing two lateral, two sub-lateral and two dorsal hairs; between these, on each side a shorter fold, extending from the lateral fold to one-third the upper curve, and a second dorsal fold, commencing immediately before the dorsal termination of the lateral fold. The dorsal fold bears four hairs, the lateral, two. All the abdominal hairs are without color. Behind the thorax the abdomen is naturally curved beneath, so that the distal end rests below the thorax. Abdomen gradually tapering to the sub-apical segment, which bears the posterior respiratory organs beneath a sub-apical fold. Respiratory organs not at all projecting: a slender, brownish-yellow transverse line runs across them. Last segment tapering, sub-conical, on each side with a very narrow yellow longitudinal line, from the base to near the tip; the extreme tip yellowish.

HABITS. Within the severed bud the larva at first feeds on the pollen. Pollen, however, is not absolutely necessary for its sustenance, as is shown by the fact that we reared a few adults from buds of Sample, a pistillate variety. The grub feeds on the other interior parts of the bud and eventually bores its way into the receptacle, forming here an enclosed cell, the entrance to which is plugged with closely packed excreta.

EFFECT ON LARVA OF DRYING OUT OF BUD. In cases where the buds persist on the plants or dry out on the soil, the majority of the larvæ die. Last season only 11 adults were reared from 180 dried out buds.

DURATION OF LARVAL STAGE. The average duration of the larval stage of 96 grubs was 13 days, the maximum and minimum periods being respectively 16 and 11 days.



Work of Strawberry Weevil. Note the severed buds and punctured petals.

THE PUPA.

Pupation takes place within the bud. The pupa is creamy white, sometimes mottled with black. All the appendages of the adult are apparent.

DURATION OF PUPAL STAGE. In experiments with 90 pupae the maximum, minimum and average periods of pupation were respectively, 18 days, 6 days and 10 days.

FURTHER NOTES ON THE ADULTS.

EMERGENCE FROM BUDS. According to observations made during the past two years the adults commence to emerge from the buds about June 20th, and continue to emerge throughout the greater part of July.

HABITS AND FOOD PLANTS. In the insectary the newly emerged adults fed very freely upon the leaves of strawberries. On some of the plants practically all the foliage was devoured—little more than the bare ribs being left. In the strawberry fields, however, very few beetles were found attacking the foliage, and no case of skeletonizing of the leaves was observed. Prior to July 14th the weevils were noticed only in strawberry patches. On that date, however, large numbers were found feeding on the flowers of milkweed (*Asclepias*) there being from twenty to seventy on each head. Later on the weevils were taken on the leaves of golden rod, and on the bloom of Canada Mint (*Mentha arvensis canadensis*), Catnip (*Nepeta cataria*), and Heal-all (*Prunella vulgaris*).

Slingerland and Crosby state that the weevil feeds on the flowers of wild bergamot (*Monarda fistulosa*); and Dr. Hamilton* mentions that it was taken feeding on the leaves and flowers of basswood (*Tilia*).

HIBERNATION. The beetles apparently go into hibernation in mid-summer. After the second week in August we found no more weevils feeding on flowers, nor did we find out where the insects went. Rubbish and long grass in the neighborhood of strawberry fields were searched, but no weevils were located.

According to Slingerland and Crosby the insects hibernate "under rubbish, particularly in wood lots or hedgerows adjoining strawberry fields." In Minnesota

Strawberry bud cut open to show the Strawberry Weevil grub feeding within.

the weevils have been found snuggled down about the base of strawberry plants, and in New Jersey they have been found in woodlands adjacent to strawberry fields resting upon the upright stems of a common moss.

METHODS OF REARING.

Pill boxes were used for rearing the weevils from the egg to adult stage. A small amount of soil was placed in the box and kept slightly moist. Too much moisture, or too little, resulted in many cases in the death of the larvæ. The buds were secured in the field or from potted plants, and only buds which were observed being cut by the adults were used. In examining the bud, the sepals and petals were carefully raised, so as not to disturb the grub. It was found that this seldom resulted in any apparent injury to the grub, and it did not appear to deter its development. Where only the numbers developing from cut buds was desired, the buds were placed in a flower pot half filled with moist soil and covered with cheesecloth.

* Can. Ent. XXIV., p. 41.

Control.

The excellent results secured in New Jersey in the control of the strawberry weevil by the use of a dust preparation composed or powdered arsenate of lead and finely ground sulphur led us to give this remedy a trial. Two mixtures were tested (1) 100 sulphur, 20 arsenate of lead, and (2) 90 sulphur, 10 arsenate of lead.

Two strawberry fields at Oakville were treated by the junior writer, and one plantation at Vineland was dusted under our supervision. In addition to these a considerable number of strawberry patches in the Oakville and Niagara districts were treated by their owners. The applications were made by means of: (1) a Monarch duster, (2) a home-made twirler,* and some of the growers used cheese-cloth bags.

The dust was applied, weather permitting, as soon as the weevils were found in large numbers. The Bartlett patch at Oakville, and part of the Church patch at Vineland, were dusted twice on account of the first application being washed off by rains, but all the others received only one application.

Results.

W. Bartlett, Oakville. The weevil has been injurious to Mr. Bartlett's strawberries for a number of years and this spring the adults were again very abundant in his patch and threatened to cause serious loss. The two dust mixtures mentioned above were tested and two applications were made.

Results. No more than 5 per cent. of the buds in the whole patch were destroyed and Mr. Bartlett picked the largest crop of berries he had ever harvested. No marked difference was noted between the rows dusted with the 100:20 mixture and those with the 90:10.

As this was the main experimental patch we arranged to leave an adjoining berry patch untreated as a "check." However, Mr. Bartlett found the weevil hard at work in our "check" patch, and decided very suddenly that he was more interested in dollar and cent returns than in experiment results, and he gave what was to have been our "check" patch a heavy coat of dust.

R. Burton, Oakville. Last year (1918) at least 75 per cent. of the buds were destroyed in Mr. Burton's two-acre patch of Glen Mary strawberries. The two dust mixtures were tested this year and only one application was made.

Results. Here again there was no difference in the amount of injury between the rows dusted respectively with 100:20 and 90:10. Throughout the whole of the patch no more than 10 per cent. of the buds were destroyed, and at least half of this injury was done before the dust was applied.

It should be mentioned that in our estimation this particular experiment was of little value because in all cases which came under our observation this year, the variety, Glen Mary, escaped serious injury.

S. Church, Vineland. Last year over 50 per cent. of the buds in Mr. Church's patch were destroyed, and this spring the weevils were present in large numbers. Several rows of early berries were dusted twice. However, the main patch of Williams only received one application. Only the one dust, the 90:10, was used.

*The frame work of the holder was made of a wire ring 9"-10" in diameter and two bent wires crossed at right angles. This was lined with fine wire cloth, twenty or more meshes to the inch. A bent branch was used as a handle.

RESULTS. An insignificant percentage of the buds were destroyed in this patch and a splendid crop of berries was harvested—about 250 crates per acre. In a patch about ¼ mile from Mr. Church's at least 60 per cent. of the buds were destroyed by the weevil and the yield was only 100 crates per acre.

RESULTS IN OTHER STRAWBERRY PATCHES.

In every strawberry field where the dust was put on at the right time excellent control was obtained. All the growers who used the dust remedy expressed themselves as being well satisfied with the results.

INSECTS OF THE SEASON IN ONTARIO.

W. A. ROSS, DOMINION ENTOMOLOGICAL LABORATORY, VINELAND STATION, AND L. CAESAR, ONTARIO AGRICULTURAL COLLEGE, GUELPH.

The past year was a notable one from the entomologist's point of view. The mild winter of 1918-19 and the hot, dry summer were very favourable to insect life, and consequently injurious insects of many kinds were numerous.

Fig. 1.—Young apples deformed by nymphs of the Mullein Leaf Bug (*Campyloma verbasci*).

ORCHARD INSECTS.

It is worth while noting here that the carefully and regularly sprayed apple orchards were practically the only ones which had crops of fruit this year.

CODLING MOTH (*Cydia pomonella*). This well-known pest was very much more abundant than usual and caused great loss in the warmer parts of the Province where the percentage of second brood is largest. Some unsprayed orchards in the Niagara District had almost every apple infested. Orchards, well sprayed this year, but which in preceding years had been neglected or poorly sprayed had as high as 50 per cent. "sideworm injury." On the other hand, orchards in districts that had been well sprayed for several years suffered little injury, thus showing the cumulative effects of good spraying.

CIGAR CASE-BEARER (*Coleophora fletcherella*). This species is usually of comparatively small importance, even in unsprayed orchards, but this year it was present in very large numbers and made the foliage of unsprayed trees very tattered and unsightly.

BUD MOTH (*Eucosma ocellana*). This species was somewhat more abundant than usual, especially in Norfolk County.

PEAR LEAF BLISTER MITE (*Eriophyes pyri*). This well-known pest has for several years been held in check by unknown natural factors, but during the past two years it has increased to a very marked extent in many orchards which have not been receiving the so-called dormant application of lime-sulphur. The present indications are that the blister mite will again have to be reckoned with as a first-class orchard pest.

THE MULLEIN LEAF BUG (*Campyloma verbasci*). A small mirid,* which occurs throughout the Province on mullein, catnip, potatoes and several other plants, was found attacking apples this year in two orchards in Norfolk County. Baldwin, Roxbury Russet and Spy were freely attacked and on a few of the infested trees 75 per cent or more of the apples were more or less injured by the bugs feeding on them. It was not uncommon to see one to seven of the little green nymphs on a single apple.

Fig. 2.—Mullein Leaf Bug injury on mature apples.

Conspicuous brown or sometimes blackish corky warts formed at the spots where the punctures were made. In most cases there was only one or two such scars to an apple; in others a ring of them almost encircled the apple; and in others several, close together on the one side, caused the fruit to be lopsided.

All the puncturing was done by the nymphs while the apples were still small —not more than one-half to two-thirds of an inch in diameter. (According to our observations, the adults do not attack the fruit but they do feed very freely upon the leaves and wood of the new growth, and are specially fond of the water-sprouts.)

The nymphs are light green in color and are very small, being, even in the last instar, only about 2 mm. in length. The adults vary in color from greenish to brown, and average about 3 mm. in length. The life history of this species was not worked out, but from the fact that on June 12th most of the nymphs were in the last instar and a few had transformed into adults it would appear

*Species determined by E. P. Van Duzee.

that these must have hatched from the eggs, at the latest, by the time the blossoms appeared.

At the time of picking it was found that most of the apples had almost completely outgrown the plant-bug injury save for small brown or blackish elevated scars on the surface. Badly punctured apples, however, were greatly deformed by the failure of the injured areas to grow. The percentage of blemished apples could not be determined because the fruit was thinned early in the season and the worst specimens picked off.

THE SAN JOSÉ SCALE (*Aspidiotus perniciosus*) has not yet regained the position it held prior to the winter of 1917-18. Both last year and this year it was difficult to find many badly infested trees. The insect, however, is gradually increasing in its old haunts—neglected orchards.

THE APPLE LEAF SEWER (*Ancylis nubeculana*) was present in most orchards this autumn in moderate numbers. It is usually a rare insect in Ontario.

Fig. 3.—Apple leaves folded by the Apple Leaf Sewer.

Fig. 4.—Pear Slugs skeletonizing cherry leaf.

LESSER APPLE WORM (*Enarmonia prunivora*) was, as last year, very scarce.

PEAR SLUG (*Eriocampoides limacina*). The outbreak of pear slug was repeated this year on an even larger scale than that of 1918. The foliage of thousands of pear and cherry trees throughout a large part of the Province was destroyed, and in the case of early Richmond cherries much of the fruit was rendered worthless. Just as last year, it was the first brood that did nearly all the damage. In a few localities the second brood larvæ were fairly numerous, but in most places they could scarcely be said to have done any injury worth mentioning. The eggs of the second brood were this year, as last, highly parasitized. A few parasites were reared also from the pupae.

ROSE CHAFER (*Macrodactylus subspinosus*). In June hordes of rose chafers appeared in the Simcoe and Fonthill sections and injured apples, grapes and cherries.

TUSSOCK MOTH (*Hemerocampa leucostigma*). As forecasted in last year's report, little or no injury was done by this species.

FALL WEBWORM (*Hyphantria cunea*). The unsightly webs of this species were again very conspicuous throughout the province. However, according to our observations the insect was not so abundant as it was last year.

PLUM CURCULIO (*Conotrachelus nenuphar*). This species was unusually destructive in the Niagara District. It was especially injurious to peaches and was responsible for a large "drop." In a peach orchard at Winona over 50 per cent. of the crop was destroyed by it.

UNSPOTTED TENTIFORM LEAF MINER (*Ornix geminatella*). This unimportant apple insect was common in some orchards in the Niagara District and Norfolk County.

Fig. 5.—Cherry leaves and fruit injured by the Pear Slug. Note the wizened fruit.

SILVER LEAF MITE (*Phyllocoptes schlechtendali*). Practically all the foliage in a block of seedling peaches at the Horticultural Experiment Station, Vineland, was affected with silver leaf. This same disease was quite common in other peach orchards in the Vineland district; and in every case we examined we found it was caused by the mite *Phyllocoptes*. It is of interest to note that according to our observations this mite hibernates under the protection of the bud scales and between the leaf petioles and the base of the bud.

ROSE LEAF-HOPPER (*Empoa rosae*). In late summer and fall myriads of rose leaf-hoppers were present in many apple orchards in the Niagara District and Norfolk County and produced a characteristic mottling of the leaves. In a large infested orchard at Simcoe practically all the foliage became pallid and in the case of Greening trees the appearance of much of the fruit was spoiled by specks of excrement voided by the hoppers.

On October 17th large numbers of females were observed depositing their eggs on apple—in the bark of the smaller branches and twigs.

APPLE APHIDS. Exceptionally large numbers of recently hatched nymphs were observed in the spring in most sections of Ontario. Heavy washing rains and insect enemies, however, destroyed such a large percentage of the plant lice that no serious injury was effected.

PEAR THRIPS (*Taeniothrips inconsequens*). This pest was found only in the orchard in which it was taken last year, and here again it was present in very small numbers.

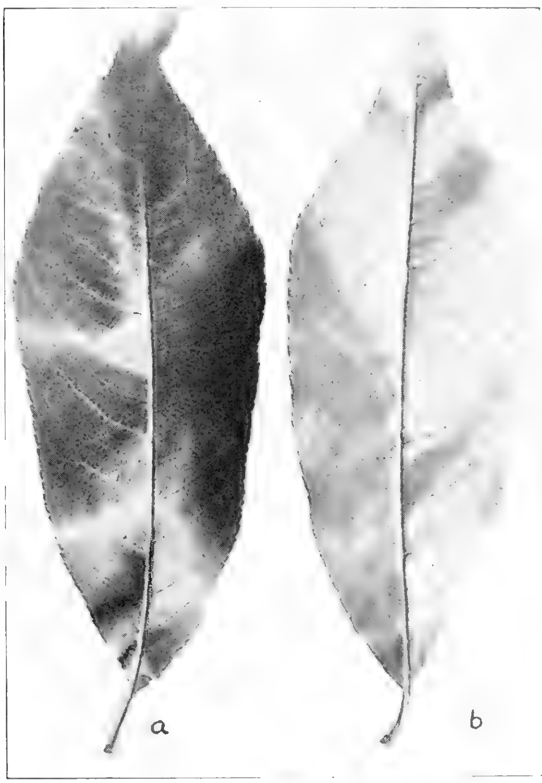


Fig. 6.—(*a*) A normal peach leaf contrasted with (*b*) a leaf injured by the Silver Leaf Mite.

FULGORID ON PEAR (*Ormenis pruinosa*). In a Beamsville pear orchard large numbers of a fulgorid nymph pale green in colour and more or less covered with a white woolly material, were found about mid-July feeding on the water-sprouts. The species was reared and proved to be *Ormenis pruinosa*.

INSECTS ATTACKING GRAPES AND SMALL FRUITS.

GRAPE LEAF-HOPPER (*Erythroneura comes*). In view of the abundance of various species of leaf hoppers, notably the rose leaf-hopper (*Empoa rosae*) and the potato leaf-hopper (*Empoasca mali*) it is of interest to note that the grape leaf-hopper was much less conspicuous than usual in vineyards in the Niaraga District.

Blackberry Leaf-miner (*Metallus bethunei*). This leaf-miner was again very destructive in blackberry plantations in the Burlington and Niagara districts. Egg and larval parasites were much more abundant than last year.

Strawberry Leaf-roller (*Ancylis camptana*). This species was apparently somewhat more general than last year but did comparatively little damage.

Imported Currant Worm (*Pteronus ribesii*). As usual, this sawfly did considerable damage to currants and gooseberries.

Strawberry Root Louse (*Aphis forbesi*). It is worth mentioning that this species, which is so destructive in Illinois and other parts of the United States, was found in small numbers in a strawberry plantation at Bismark.

Imported Currant Borer (*Sesia tipuliformis*). Adults of this species were very abundant about mid-June in some black currant plantations in the Niagara district.

Strawberry Root Borer (*Typophorus canellus*). Adults of this species were common in a strawberry patch at Oakville, but apart from eating out holes in the foliage the insects apparently caused no serious injury.

Raspberry Sawfly (*Monophadnus rubi*). This well-known pest of the raspberry was conspicuous by its absence.

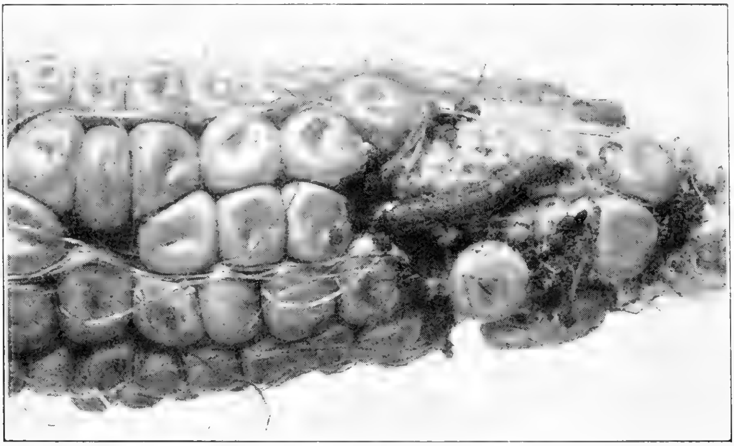


Fig. 7.—Corn Ear Worm and its work.

Insects Attacking Vegetables.

Cabbage Maggot (*Chortophila brassicae*). This insect varied greatly in numbers and destructiveness in the different districts. At Vineland, Burlington, Guelph, London and other parts of southern and western Ontario it did almost no harm except to radishes, but at Ottawa and to a lesser extent in Norfolk County it was abundant and destructive.

Onion Maggot (*Hylemia antiqua*). The onion maggot did much harm at Dixie and in several other localities, but at Burlington and Leamington, as last year, was not of much importance.

Imported Cabbage Worm (*Pieris rapae*). This insect caused much injury in cabbage and cauliflower fields all over the western and southwestern parts of the Province.

Diamond-Back Moth (*Plutella maculipennis*) was very conspicuous in fields of cabbage.

Corn Ear Worm (*Heliothis obsoleta*). This insect attacked the ears of sweet and field corn in many localities this fall. Infested ears were received by the writers from Welland, Lincoln, Wellington and Lambton Counties. Injury was practically confined to late planted corn. In Welland County it was observed that Dent corn was injured more than Flint.

Tomato or Tobacco Worm (*Phlegethontius quinquemaculata*). This species was present in exceptionally large numbers in tomato and tobacco fields in the Leamington district and other parts of western Ontario. It was also common in Norfolk County.

Pea Aphis (*Macrosiphum pisi*). This plant louse was again very destructive to peas grown for the canning factories in Prince Edward County and to a lesser extent in Norfolk County. Field peas were also injured in Lincoln County.

Cutworms. Quite a few complaints were received regarding cutworm injury to cabbage, tomato and corn. What we took to be the dingy cutworm *Feltia ducens* was injurious to cabbage at Vineland about mid-May. The variegated cutworm was moderately abundant throughout the Burlington district and was apparently the cause of most of the holes eaten in tomatoes in September.

Asparagus Beetles (*Crioceris asparagi and C. 12-punctata.*) The two species were very common and injurious in the Niagara district. At Vineland the chalcid parasite (*Tetrastichus asparagi*) was again observed.

Colorado Potato Beetle (*Leptinotarsa decemlineata*). The beetles came through the winter in large numbers and caused much damage early in the year to potatoes and tomatoes. According to reports received, the "Friendly Perillus" was unusually effective as a check.

Cabbage Aphis (*Aphis brassicae*). This louse was very abundant in late summer and fall on cabbage, cauliflower and turnips and caused considerable injury. However, due to the effective work of the parasitic and predaceous enemies, the outbreak did not reach the alarming proportions we anticipated. It is of interest to note that one of the most important insect checks of this species was the larva of *Aphidoletes fulva*.

Red Headed Flea-beetle (*Systena frontalis*). This species was unusually prevalent on beans.

Black Stink-bug (*Cosmopepla bimaculata*) was remarkably abundant this year on grains but so far as we could see caused no injury. Mr. MacLellan, Ontario Vegetable Specialist, reports that during the summer this species killed the tips of asparagus plants in a truck garden at London.

Potato Leaf-hopper (*Empoasca mali*) was remarkably abundant on potatoes and beans throughout the Province. It was generally credited with being responsible for all the leaf burn which was so prevalent on early potatoes. However, we are not at all sure that this claim was wholly correct.

In this connection the following preliminary experiments conducted at the Dominion Entomological Laboratory, Vineland Station, by Mr. Robinson are of interest. Three cheesecloth cages each large enough to cover three plants were put over potatoes growing in the field in June before there were any signs of leaf-burn. Large numbers of leaf-hoppers were introduced into two cages and the third was used as a check. None of the plants were watered. Tip-burn developed on the potatoes in all three cages, and, strange to say, just as rapidly on the check plants as on the infested ones. These experiments were duplicated in the insectary with potted potato plants which were kept well watered. Here the results were quite different: leaf-burn developed on the infested plants whereas the check (one plant) showed no indications of it at all. The interpretation of these results would appear to be that two factors caused the leaf-burn this year, namely the drought (probably the more important) and the leaf-hopper.

ONION THRIPS (*Thrips tabaci*). This pest exacted a very heavy toll this year from the truck gardeners of Ontario. In the counties of Kent and Essex the thrips, aided by the hot, dry weather, reduced the onion crop to one-third of a normal yield.

TARNISHED PLANT BUG (*Lygus pratensis*). This well known bug was present in exceptionally large numbers this year and caused a considerable amount of damage especially in gardens. Asters and dahlias were attacked so freely that in many sections they were a complete failure. At the Dale Estate, Brampton, only about one thousand flowers were cut from twenty thousand plants. At Kingston spinach grown for seed was injured to such an extent that the plants failed to produce any seed. Plant bug injury, in the form of blasted compound leaves was common in potato fields. The black joint disease of celery caused by the bugs feeding at the joints was prevalent throughout the province. It should be mentioned here that Mr. MacLennan, Ontario Vegetable Specialist, is positive that the tarnished plant bug is the chief agent concerned with the spread of bacterial soft rot or black heart of celery.

POTATO FLEA-BEETLE (*Epitrix cucumeris*). In June this species and its work were conspicuous in potato patches in the Niagara district. It was also injurious to tomatoes.

THE THREE-LINED LEAF-BEETLE (*Lema trilineata*) was unusually common on potatoes in the Niagara peninsula.

THE STRIPED CUCUMBER BEETLE (*Diabrotica vittata*) occurred in more than usual numbers in parts of Norfolk County, but around Burlington and in many other localities it was scarce.

INSECTS ATTACKING FIELD CROPS.

CLOVER LEAF WEEVIL (*Phytonomus punctatus*). The larvæ of this pest occurred in exceptionally large numbers in parts of the Niagara peninsula and southwestern Ontario. In Norfolk County a whole field of clover was ruined. However, in most fields serious injury was prevented by the almost complete destruction of the grubs by a fungus disease.

CHINCH BUG (*Blissus leucopterus*). The chinch bug appeared in large numbers this summer in Gainsboro' Township, Lincoln County, and caused a considerable amount of alarm among the farmers. The centre of infestation was at the village of Bismark and the infested area extended, roughly speaking, about two miles around the village. Meadow grasses, particularly timothy, were in some instances killed outright. Oats were injured to a considerable extent. One six-acre field was completely destroyed and in another field a strip about the width of a drill was also killed outright. However, as a general rule the infested oats did not die but ripened prematurely and produced little or no grain. Some damage was also done to corn.

Late in September we found large numbers of the adults destroyed by the chinch bug fungus (*Sporotrichum globuliferum*). The percentage of mortality varied from 25 per cent. to 75 per cent. in the fields examined.

We hope and expect that the wet weather we have had this fall along with the coming winter will reduce the hibernating adults to insignificant proportions.

Crambid Attacking Wheat (*Crambus caliginosellus*).* In the seven-acre field of wheat in Wainfleet Township, Welland County, over 60 per cent. of the wheat was destroyed by a crambid or sod-worm. Because of the very wet spring this particular field was not worked until August and as a result had been covered with weeds and grasses most of the year. One-half of the field was ploughed about August 1st. This part was not seriously injured. The other half was not ploughed until the middle of August and in this the wheat was so badly damaged that it had to be resown.

Clover Seed Chalcis (*Bruchophagus funebris*). Judging from samples of seed sent in last winter from Kent County, this insect must have been very abundant there in 1918. One correspondent claimed that much of the seed produced in Kent County was destroyed by this tiny insect.

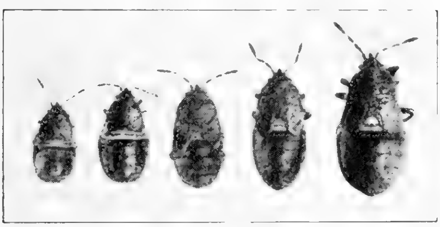


Fig. 8.—Nymphs of Chinch Bug (much enlarged).

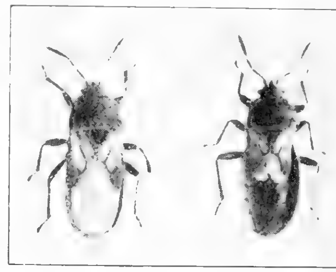


Fig. 9.—Showing the long-winged and short-winged forms of the Chinch Bug adult.

Glassy Cutworm (*Sidemia devastatrix*). This cutworm caused some alarm in Middlesex County in mid-June by cutting off wheat plants. The total loss, however, was not great.

Hessian Fly (*Mayetiola destructor*). So far as observed, this insect did not cause any appreciable injury in any district. In several fields approximately 5 per cent. of the plants were attacked.

Miscellaneous.

Warble Flies (*Hypoderma bovis* and *H. lineatum*) threatened to be very numerous judging by the great numbers of warbles seen on the backs of cattle in the spring. Fortunately the danger so far, at least, as the heel fly was concerned did not materialize, and very few complaints of cattle gadding were received.

Spruce Gall Lice (*Chermes abietis* and *C. similis*). Galls caused by these insects were somewhat more conspicuous than they have been for several years. There are evidently powerful natural factors keeping these insects under control.

Grasshoppers. Few complaints were received regarding grasshoppers or locusts. In the Smithville district, however, these pests were more abundant than they had been for many years. Garden crops, alfalfa and oats were very freely attacked.

Cotton Worm (*Alabama argillacea*). Moths of this species visited many parts of Ontario this autumn and attracted considerable attention.

*Species determined by Dr. McDunnough.

ROSE MIDGE (*Dasyneura rhodophaga*). We regret to report that this destructive midge has made further inroads into Ontario. It is now present in six large greenhouses: three in Toronto, one at Grimsby, one at Port Dover, and in the large Dale Estate at Brampton. In every instance the pest was brought in on rose stock imported from the United States.

Fig. 10.—Injured rose bud opened to show Rose Midge maggots feeding within. (Enlarged three times.)

TRUMPET VINE MIDGE (*Itonida tecomiae*). During the past two years trumpet vines at Guelph have been seriously injured by a white cecidomyiid larva which curls and distorts the leaves. Badly infested leaves turn brown and die and in this way much of the young growth may be destroyed. We reared the adult and the species was determined by Dr. E. P. Felt, as *Itonida tecomiae* Felt.

REMARKS ON THE ANCESTRY OF INSECTS AND THEIR ALLIES.

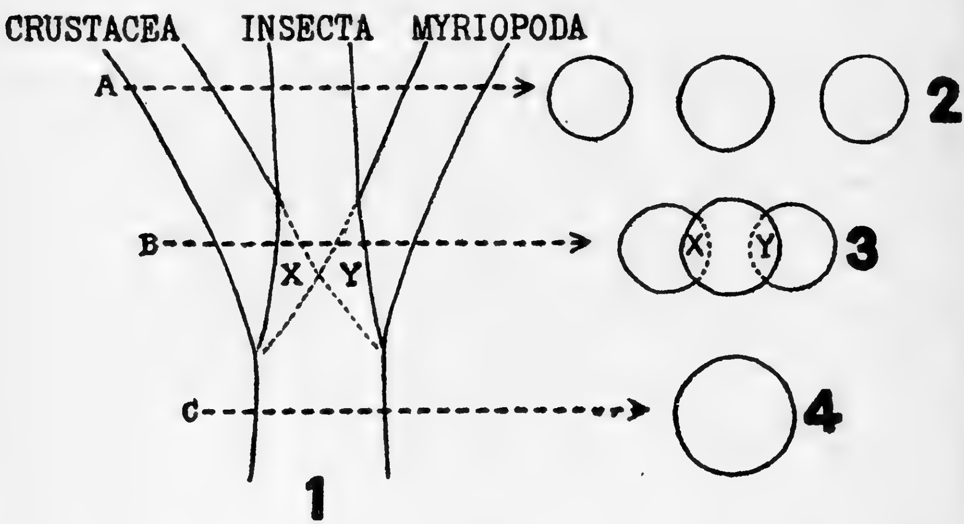
G. C. CRAMPTON, MASSACHUSETTS AGRICULTURAL COLLEGE.

It has been a matter of considerable surprise that so much time and attention have been expended upon the subject of the evolution of mammals, reptiles, and other vertebrates, to the practical exclusion of the consideration of the development of the lines of descent of the insects, Crustacea, "Myriopoda," and other arthropods, especially since the study of the latter forms involves no great outlay in the matter of collecting expeditions, equipment, housing facilities, etc., as is the case with the study of the vertebrate groups. In fact, the arthropods offer unrivaled opportunities for the study of evolution, including, as they do, the greatest number of species of living things, as well as a marvellous range of modifications in adaptation to varied environmental conditions, and a height of development of the psychic faculties (social instincts, etc.) unapproached elsewhere save in the group Mammalia. In addition to these advantages, the ease with which many of them can be obtained, and the fact that no elaborate equipment or technique is necessary for studying their external anatomy brings the group within the reach of practically everyone, and it is most earnestly to be hoped that so fertile a field for research will soon attract a number of investigators commensurate with its great possibilities and its importance from the standpoint of evolution.

Not only has this potentially rich field of research been sadly neglected, but even the meagre investigations which I was able to carry out during the past summer very quickly demonstrated that the prevalent conceptions concerning the meaning of the parts in insects (as interpreted from the standpoint of a comparison with the structures of Crustacea and other arthropods) are in many cases wholly erroneous. Thus the oft repeated statement that the "superlinguae" or "paraglossae" on either side of the hypopharynx of insects represent the first maxillae or "maxillulae" of insects is quite wrong, since the structures in question clearly correspond to the so-called paragnaths or structures on either side of the median ridge (corresponding to the hypopharynx or tongue of insects) in the mouth region of certain Crustacea—and the "superlinguae" or "paraglossae" therefore cannot be regarded as the appendages of a distinct "superlingual" segment in insects, as Folsom has claimed is the case in these forms. The investigations of all embryologists other than Folsom have clearly shown that the "superlinguae" are not appendages of a distinct segment; but practically all recent entomologists have been led astray in a matter which could easily have been righted had they but taken the trouble to examine the corresponding parts in the lower insects and Crustacea. Furthermore, a study of the Crustacea clearly demonstrates that the first maxillae of insects correspond to the first maxillae of Crustacea, while the second maxillae of insects (i.e. the halves of the labium) correspond to the second maxillae of Crustacea, and the head of an insect is therefore comprised of but six (not seven) segments, as embryology has long indicated to be the case.

The statement that the parts of an insect's mandible are comparable to the parts of the maxillae, which has received universal acceptance in the textbooks dealing with the subject, is at once seen to be impossible when one compares a series of crustacean mandibles with those of insects, since such a comparison very clearly shows that the insect's mandible represents the *basal segment alone* of the corresponding appendage in the Crustacea, while the maxillary galea and lacinia represent processes of *two* distinct basal segments of an appendage, whose terminal portion forms the palpus of the maxilla. Furthermore, a comparison with the parts of the Crustacea very clearly shows that the universally accepted opinion that an insect's maxilla represents a "biramous" appendage is wholly false (the galea and lacinia being merely processes of two basal segments of an appendage whose endopodite alone forms the maxillary palpus), and the attempt on the part of several investigators to compare parts of an insect's mandible (as well as the parts of the maxillae) to the endopodite and exopodite of a crustacean appendage would never have been made if they had but taken the trouble to compare a series of crustacean mandibles with those of insects.

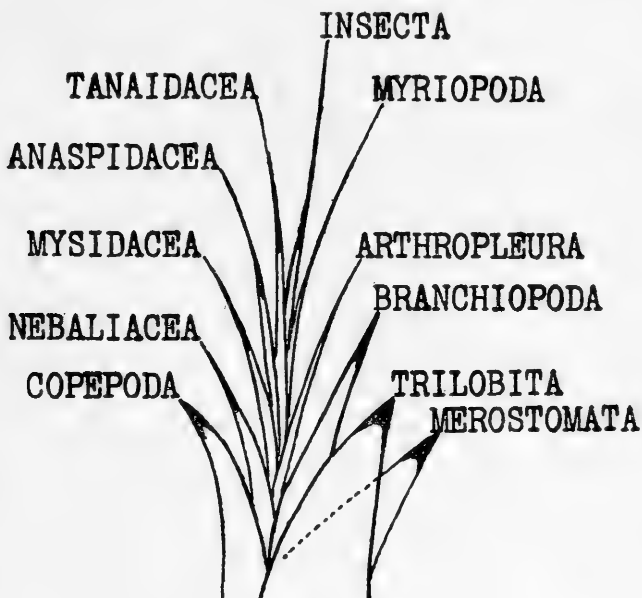
Since the second maxillae of Crustacea are homologous with the second maxillae of insects, which unite to form the labium in the latter forms, it is impossible to homologize the united poison claws of chilopods (which represent the first maxillipedes of Crustacea, and therefore occur behind the second maxillae)



with the second maxillae or labium of insects, as many investigators have sought to do, and the erroneous claim that the underlip (united first maxillae) of diplopods is formed by the fusion of two pairs of appendages, is seen to be untenable when one compares the structures in question with the underlip of certain isopods (which here, however, is formed by the united first maxillipedes) in which the corresponding parts are clearly seen to belong to but *one* pair of appendages, as embryology has shown to be the case all along, although most anatomists have totally disregarded its evidence.

From a comparison with the parts in the Tanaidacea and other Crustacea the cerci of insects are seen to represent one of the rami of the uropods on either side of the telson, and the meaning of the styli attached to the basal segments of the abdominal limbs of the Machilidae and other primitive insects is at once apparent when one examines the reduced abdominal appendages of the Isopoda and other Crustacea. Indeed, the study of the parts in the Crustacea has furnished the key for the interpretation of the corresponding parts in insects in practically every instance, as I am hoping to show in a series of articles soon to be published upon the subject, and these facts are referred to at this point merely to show that a study of this most promising field has been grossly neglected, and even the few observations which have been made are for the most part badly in need of revision!

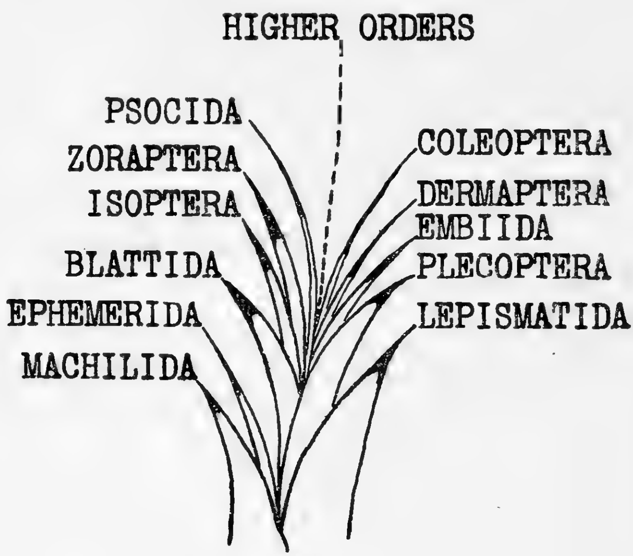
Despite Handlirsch's claim to the contrary (and his opinion has gained a surprisingly wide acceptance among recent writers), a comparison with the Crustacea and "Myriopoda" should convince anyone that the Apterygota rather than the winged insects, are the most primitive representatives of the class Insecta, and by no possible stretch of the imagination can the Apterygota be regarded as degenerate winged forms, as Handlirsch would have us believe! Instead of upholding Handlirsch's fantastic view that winged insects can be directly derived from Trilobites without the intervention of apterygotan forms, and a long series of intermediate stages, a comparison of the parts in insects, "Myriopoda,"



5

Crustacea, Trilobita, and the Merostomata, would clearly indicate that between the type of mouthparts, head capsule, and other structures found in the Trilobita, and those of even the most primitive representatives of the group Insecta, there must have occurred a long series of intermediate stages leading through the lower Crustacea, the lower Malacostraca, and the ancestors of the higher Crustacea (i.e. Isopoda, Tanaidacea, etc.) before the insectan types of structures were developed; and one cannot help but suspect that Handlirsch and his followers are either wholly ignorant of the absolutely obvious and patent evidence afforded by a study of the parts in the Crustacea and their allies, or they have deliberately ignored the tremendous array of facts whose evidence should have convinced them of the error of their contentions.

It is the fashion nowadays to consider the "Myriopoda" as the nearest representatives of the common ancestors of pterygotan and apterygotan insects; but here again, a comparative study of the structures in the Crustacea and certain of the Apterygota such as *Machilis* and *Lepisma* should have been made before such a view was promulgated, for such a study clearly indicates that the lines of development lead from the common ancestors of the isopods, Tanaidacea, Cumacea, and other Crustacea, through those of the Machilidae and Lepismatidae to the ancestors of the most primitive representatives of the winged insects such as the mayflies (Ephemerida) and stoneflies (Plecoptera). The structural resemblance between the mayflies and the Machilidae, or that between the Plecoptera and the Lepismatidae, is most striking, and the lines of descent of the Machilidae and Lepismatidae clearly lead back to Crustacea-like, rather than to "Myriopod"-like ancestors. It must be admitted, however, that certain other apterygotan insects such as the Campodeidae, Protura, etc., are extremely closely related to certain "Myriopoda" such as *Scolopendrella, Pauropus,* etc., but the lines of descent of these forms appear to represent merely side issues of the main trunk which leads to the evolution of the pterygotan insects (unless such insects as



6

Campodea, Japyx, and other insects of the apterygotan order Rhabdura, are near the forms giving rise to the line of development of the pterygotan order Dermaptera, as I formerly held to be the case—but a further study of the insects in question has tended to discredit this view).

Although the main lines of descent of the pterygotan insects appear to avoid the "myriopodan" side of the ancestry of insects and to lead back more directly to Crustacea-like forms through ancestors resembling the Machilidae and Lepismatidae, the dual relationship of apterygotan insects to the "Myriopoda" as well as to the Crustacea, cannot be ignored. This dual relationship is expressed graphically in Fig.1. As is shown in the figure, the lines of descent of the "Myriopoda," Insecta, and higher Crustacea (Isopoda, Tanaidacea, Cumacea, etc.) taken at the level "A," are quite distinct (as is represented by cross sections of these lines of descent shown in Fig. 2); but at the level "B," where the lines of descent begin to converge as they approach their common source, it is evident that the members of the three groups come very close together, and those insects occupying the "hereditary area" labeled "X" in Fig. 1, would naturally be expected to resemble the Crustacea quite closely, since the territory which they occupy is contiguous to that of the higher Crustacea. Similarly, those insects which occupy the "hereditary area" labeled "Y," would greatly resemble the "Myriopoda," since the territory which they occupy is contiguous to that of the "Myriopoda." Cross sections of the three lines of descent at the level "B" would be represented as three intersecting circles (Fig. 3), each of which, taken separately, demarks a distinct group (Crustacea, Insecta and Myriopoda); but the intersecting circles have a certain amount of territory in common, and those insects in the area labeled "X" (Fig. 3) being next to the Crustacea, would naturally have much in common with the Crustacea (left hand circle), while those insects in the area labeled "Y" being next to the "Myriopoda" (right hand circle) would naturally have much in common with the "Myriopoda." If we trace the lines of descent back to the level "C" (Fig. 1) they are seen to merge in a common "crustaceoid" ancestry; and a cross section at this level would represent the circles as completely coinciding (Fig. 4). It is thus readily comprehensible that there may be a dual relationship between the Insecta and higher Crustacea, on the one hand, and between the Insecta and the "Myriopoda" on the other—as we are forced to conclude is the case, from a study of the anatomy and embryology of the forms in question. This may indicate that the group Insecta is a polyphyletic one, and although I have been loath to accept this view, I can see no escape from the conclusion that insects are very closely related to both the higher Crustacea (Isopoda, Tanaidacea, Cumacea, etc.) and the "Myriopoda."

Since it is quite evident that the lines of descent of the higher Crustacea, Insecta, and "Myriopoda" soon merge in a common ancestry, the question naturally arises as to what these common ancestors were like. That these common ancestors were all of one type is out of the question, for they apparently differed among themselves as much as the Mysidacea, Anaspidacea and other "intermediate Malacostraca" (possibly including Arthropleura also) differ among themselves; and these common ancestors probably resembled all of the forms just mentioned (i.e. the Mysidacea, Anaspidacea, etc.), though it is possible that the Cumacea and Tanaidacea are more like the *immediate* ancestors of insects than are the Mysidacea, Anaspidacea, etc., which are more like their *remote* ancestors.

The Anaspidacea, Mysidacea, and other "intermediate Malacostraca" are in turn derived from ancestors resembling the Nabaliacea and other primitive Malacostraca, and the lines of development of the malacostracan Crustacea have undoubtedly accompanied those of the insects and "myriopods" more closely and for a longer distance than any other forms have done. The primitive malacostracan Crustacea such as *Nebalia* and its allies, exhibit undoubted affinities with the Branchiopoda and Copepoda, and to some extent with the Trilobita also, and they have even preserved some ancestral features in common with the Merostomata, although the latter forms lead off toward the lines of development of the Arachnoidea, and away from the lines of development of the higher Crustacea, Insecta, and "Myriopoda."

The question as to which arthropods have departed the least from the common ancestors of the phylum Arthropoda is an extremely difficult one to answer. The Copepoda, Branchiopoda and Trilobita are among the most primitive known arthropods, and it is quite probable that the first representatives of the group combined in themselves characters common to all three. Thus, for example, the earliest arthropods were in all probability not trilobites alone, but were doubtless trilobite-branchiopods, trilobite-copepods, etc., having many features in common with all three of these primitive groups, though in many respects the Trilobita have departed as little as any known forms from the ancestral type. It is thus necessary to make composites combining the primitive characters occurring in all of these primitive groups in order to come to the correct conclusion concerning the character of the ancestral arthropods. The Merostomata have also retained many features which must have been present in the ancestral arthropods; but their lines of descent (which apparently sprang from ancestors resembling the Trilobita) lead off toward the arachnoids, which lie in a side line having no direct bearing on the origin of the insectan and myriopodan type of arthropod. The ancestors of the arthropods themselves were in all probability very much like annelid worms, though other forms such as the Onychophora, etc., have retained many features characteristic of the ancestors of the phylum Arthropoda; but a discussion of these forms has no particular bearing upon the question of the nature of the more immediate ancestors of the higher Crustacea, Insecta, and "Myriopoda," and they need not be further considered here. It may be of some interest, however, to indicate briefly the principle lines of descent of the more primitive representatives of the class Insecta, and I have therefore included a diagram giving the lines of descent of those forms which have departed the least from the types ancestral to the higher groups of insects, although, as is also the case with the diagram of the lines of descent of the arthropodan allies of insects, it has been necessary to omit many important groups in order not to make the diagrams too cumbersome and intricate for practical purposes.

LATER DEVELOPMENTS IN THE EUROPEAN CORN BORER SITUATION.

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

The last two months have witnessed a considerable extension of infested territory, the most significant being the area in Erie and Chautauqua Counties, New York, some twenty-five miles long, extending from Angola to Fredonia and with a known maximum width of ten miles. There is in addition a small infestation at North Girard, Erie County, Pennsylvania, and the probabilities are that the New York and Pennsylvania areas may be connected by a sparse infestation. In fact, the early corn planted on the light soil south of the lake is a suspicious area and it is impossible at the present time to define closely the extent of the infested territory in this section.

Explorations in the vicinity of the Schenectady area tend to confirm in a general way at least the limits established during the summer. The infestation in Massachusetts and New Hampshire has already been described in detail and requires no further comment at the present time.

A most significant development has been the failure of the European corn borer to produce two broods in the infested area in New York State. This means a very material reduction in the possibilities of injury and it is gratifying to state that in the earlier discovered Schenectady area, a section thoroughly cleaned up last spring, the maximum injury has hardly overrun one per cent. in a few very restricted areas, possibly amounting to five per cent. It is considered advisable for the present to content ourselves with the statement that but one generation developed last year since there is a possibility, perhaps very remote, that two generations may occur in this area during certain seasons and this condition may, after all, prove to be the normal.

The decidedly disturbing feature is the very sparse, inconspicuous character of the infestation in the western part of the state, a section where the insect has bred in a few localities at least for two seasons. The infestation was brought to the attention of Cornell University authorities through the accidental discovery of a few borers in a stalk, although a farmer in that vicinity had noted the injury the preceding season but had failed to appreciate its significance. In most of the territory, however, a very close examination is necessary to find the borer and these conditions suggest the comparative inefficiency of publicity measures and the great difficulty of organizing a sufficiently thorough scout of the corn fields of America to determine with a reasonable degree of accuracy the limits of the present infested areas.

We have yet to find unquestioned evidence as to the agencies producing these isolated infestations. It looks very much as though railway lines were an important factor, possibly in carrying the moths, since both the eastern and western areas in New York State have good railway connections with the older infested area in Massachusetts.

The occurrence of but one brood in the cooler corn-producing areas of New York State, even if this be normal, cannot be construed as being true of our great southern and warmer corn belt. The sparsely infested areas must be regarded as a real menace to much of the corn crop of America. The most practical method of handling the situation appears to be pushing the publicity campaign as far as practical, systematic scouting of the more suspicious areas so far as they can be determined and a comprehensive campaign of control designed specially to check spread until the economic status of the borer can be determined in this country.

THE ENTOMOLOGICAL RECORD, 1919.

Arthur Gibson and Norman Criddle, Entomological Branch, Dominion Department of Agriculture.

The collecting season of 1919 does not appear to have provided any marked variation from the preceding year. In the Middle West a continuation of the drought in southern sections was especially favourable to the development of dry-loving insects, more notably Orthoptera, which in some parts increased to injurious numbers. Somewhat similar conditions prevailed in British Columbia and probably to a lesser extent in Ontario. Collecting, generally, was reported to have been good during the first part of the season but later became less so. It is gratifying to report that more attention is being devoted to hitherto neglected orders; as a result a far broader knowledge of the distribution of Canadian insects is being obtained.

During 1919, students of insects in Canada, have, as in previous years, been much assisted in their studies by various specialists, particularly those resident in the United States. To all who have assisted us, we extend our grateful thanks.

Literature.

Among the publications which have appeared during 1919, the following are of interest to Canadian students.

Bowman, Kenneth. Annotated Check List of the Macrolepidoptera of Alberta. Published by the Alberta Natural History Society, Red Deer, Alta., 16 pp., February, 1919. In the preparation of this list the author has "endeavoured to provide an epitome of what has been accomplished by students of this order within the province to date, as an aid, not only to present workers but those who will follow after." We were very glad indeed to receive this list. It is a very useful contribution.

Canadian Arctic Expedition (1913-1918) Insect Reports. These reports on the insects of the various orders collected by members of the expedition were published in 1919, with the exception of the one on the Lepidoptera which was issued early in January, 1920. They comprise Vol. III of the Report of the Canadian Arctic Expedition. Ottawa: J. de Labroquerie Tache, Printer to the King's Most Excellent Majesty.

Part A: Collembola, by Justus W. Folsom, 29 pp., 8 plates. Twelve species are discussed, three of which are described as new. The plates illustrate structural characters.

Part B: Neuropteroid Insects, by Nathan Banks, 5 pages, 1 plate. Five species are definitely determined, two of which are described as new. Two additional generic determinations are given. The plate illustrates genitalia of the two new species and views of other male characters.

Part C: Diptera, 90 pp. Crane flies, by C. P. Alexander; Mosquitoes by H. G. Dyar, and other Diptera by J. R. Malloch. In the first portion on the Tipulidae, sixteen species are reported upon. Of these, thirteen are new. The six plates accompanying the section, illustrate wings, antennae and other structures. The mosquitoes represented three species one of which only is definitely determined and this is described as new. The third section reporting upon other Diptera collected, comprises pages 34 to 90, (10 plates). The number of species listed is ninety-three.

representing fifty-five genera. Thirty-two new species are described and one new variety. The plates show various structural characters.

Part D: MALLOPHAGA, 12 pp., by A. W. Baker; ANOPLURA, by G. F. Ferris and G. H. F. Nuttall. Sixteen species are recognized in the former paper. One plate illustrates four species. In the latter contribution three species are listed.

Part E: COLEOPTERA, 27 pp. Forest Insects, including Ipidae, Cerambycidae and Buprestidae, by J. M. Swaine; Carabidae and Silphidae, by H. C. Fall; Coccinellidae, Elateridae, Chrysomelidae and Rhynchophora (excluding Ipidae), by C. W. Leng; Dytiscidae, by J. D. Sherman, Jr. In this part sixty species are determined, four of which are described as new. Three plates showing ipid beetles and their work, illustrate Dr. Swaine's section.

Part F: HEMIPTERA, 5 pp., by Edward P. Van Duzee. Six species are definitely recognized, one of which is described as new. Generic determinations of five other species are given.

Part G: HYMENOPTERA and PLANT GALLS, 38 pp. Sawflies—Tenthredinoidea, by Alex. D. MacGillivray; Parasitic Hymenoptera, Chas. T. Brues; Wasps and Bees, F. W. L. Sladen; Plant Galls, E. P. Felt. In this part, records of thirty-five species are included; others have been determined generically. Of the thirty-five species, twenty-one, mostly sawflies, are described as new. Two plates illustrate the eighth ventral segment in the males of four species of *Bombus.*

Part H: SPIDERS, by J. H. Emerton; ACARINA, by N. Banks; CHILOPODA, by Ralph V. Chamberlin; 22 pp. Twelve species of spiders are recorded, three of which are described as new. Two plates show structural characters. The Acarina collected include seventeen species, all but one previously known. Only two species of Chilopods were represented in the material secured by the expedition. A new species of *Ethpolys* from Washington and Oregon States, as well as a sub-species of this new species, the former from Alaska, are also described by Mr. Chamberlin.

Part I: LEPIDOPTERA, by Arthur Gibson, 58 pp., 6 plates. In this report is also included notes on other species collected in Arctic America, not met with by members of the expedition, all of which material is in the National Collection of Insects at Ottawa. Altogether notes and records of ninety-seven species are included, nine of which are described as new species. In addition, two new varieties are recognized. Plate i shows genitalia of species of Oeneis; ii, undersides of nine examples and underside of one, of species of the same genus. Plates iii, iv and v, the latter two coloured, illustrate a number of the rarer and new species collected by the expedition, of the genera *Pieris, Erebia, Brenthis, Eurymus, Oeneis,* etc.

EMERTON, J. H. Catalogue of the Spiders of Canada, known to the year 1919. Trans. Royal Canadian Institute, Toronto, 1919. This catalogue which contains the names of 342 species of spiders which have been found in Canada will be of considerable interest and value to those persons who are collecting these creatures in Canada.

FALL, H.C. The North American Species of Coelambus. Published by John D. Sherman, Jr., 1919. This pamphlet of 20 pp. includes several Canadian records. Twelve new species are described, three of which are from Western Canada.

HART, CHARLES ARTHUR. The Pentatomoidea of Illinois with keys to the Nearctic Genera. Division of Natural History Survey, Vol. XIII, Article VII, pp. 157-223. This contribution will undoubtedly be of value to our students of Hemiptera. Keys to families, sub-families, tribes, genera and species are given, Notes and distribution records are included of each species. Five plates illustrate structural differences, and one plate shows typical Pentatomoidea.

LOCHHEAD, WM. Class Book of Economic Entomology, with special reference to the economic insects of the Northern United States and Canada. Philadelphia: P. Blakeston's Son & Co., 436 pp., 257 illustrations, price $2.50. This volume is a companion to Reese's book on Economic Zoology. It is divided into four parts: Part I discusses the structure, growth and economics of insects; Part II the identification of insects injurious to farm, garden and orchard crops, etc.; Part III the classification and description of common insects; Part IV the control of injurious insects. This new volume will certainly find a useful place among economic workers.

WASHBURN, F. L. Injurious Insects and Useful Birds. J. B. Lippincott Company, Philadelphia; 414 illustrations in text and four coloured plates. A useful work of reference, the result of 21 years of work in entomology on the part of the author. Chapters I to VI deal with the losses to agriculture due to insects and rodents, etc.; Chapters VII to XVIII discuss insects affecting the various crops; chapter XIX, "Our Insect Friends"; XX, "The Relation of Birds to Agriculture" and XXI, "Some Four-footed Pests of the Farm," completes the volume.

NOTES OF CAPTURES.

Species preceded by an asterisk (*) described during 1919.

LEPIDOPTERA.

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

Pieridæ.

33. *Pieris occidentalis* calyce Edw. Edmonton, Alta.; Pocahontas, Alta.; April (K. Bowman). Addition to the Alberta list.

57. *Eurymus hecla glacialis* McLach. Nordegg, Alta.; June, (K. Bowman). Addition to the Alberta list.

59. *Eurymus eriphyle autumnalis* Ckll. Edmonton, Alta.; Banff, Alta.; Nordegg, Alta.; Red Deer, Alta.; (K. Bowman). Addition to Alberta list.

64. *Eurymus christina pallida* Ckll. Nordegg, Alta.; Red Deer, Alta.; (K. Bowman). Addition to Alberta list.

64. *Eurymus christina gigantea* Stkr. Edmonton, Alta.; Nordegg, Alta.; Red Deer, Alta.; (K. Bowman). Addition to Alberta list.

Satyridæ.

* *Oeneis semidea arctica* Gibson. Bernard Harbour, N.W.T., July, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18; Vol. III, Part I, Lepidoptera, p. 13.

* *Oeneis simulans* Gibson. Bernard Harbour, N.W.T., July, 1915, (F. Johansen); Rep. Can. Arctic Exp. 1913-18; Vol. III, Part I, Lepidoptera, p. 14.

* *Oeneis cairnesi* Gibson. White River District, Y.T., lat. 61° 55′, long. 141°, July 16, 1913, (D. D. Cairnes); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 15.

* *Oeneis brucei yukonensis* Gibson. Klutlan Glacier, Y.T., June 13-15, 1913, (E. W. Nesham); elevations 8,200-8,500 feet; Rep. Can. Arctic Exp. 1913-18, Vol. III, part I, Lepidoptera, p. 15.

Nymphalidæ.

151. *Euptoieta claudia* Cram. Fort Steele, B.C., (W. B. Anderson). First record we have for British Columbia.

157. *Argynnis leto* Behr. Blairmore, Alta., July, (K. Bowman). Addition to Alberta list.

* *Brenthis natazhati* Gibson. 141st Meridian, north of Mount Natazhat, 8,600 feet, June 15, 1913, (E. W. Nesham); Bernard Harbour, N.W.T., July 14, 1916, (F. Johansen); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 21.

* *Brenthis distincta* Gibson. Harrington Creek, Y.T., lat. 65° 05′, July 30, 1912, (D. D. Cairnes); Eduni Mt., 6,000 ft., Gravel River, N.W.T., July 8, 1908, (J. Keele); Tindir Creek, Yukon Territory, lat. 65° 20′ international boundary; July 25, 1912, (D. D. Cairnes); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 25.

211. *Euphydryas nubigena beani* Skin. Pocahontas, Alta., July, (K. Bowman). Addition to Alberta list.

283. *Vanessa virginiensis* Dru. Edmonton, Alta., July, (D. Mackie). Addition to Alberta list.

Lycaenidæ.

352. *Strymon melinus* Hbn. Onah, Man., Aug. 20, 1914, (E. Criddle).

* *Plebeius incariodes blackmorei* B. & McD. Goldstream, V. I., B.C., May 31, (E. H. Blackmore); Can. Ent. LI, 92.

427. *Plebeius melissa* Edw. In the note regarding this species published in the *Ent. Record* for 1918, the word "common" should be corrected to read "uncommon."

Sphingidæ.

753. *Proserpinus flavofasciata* Wlk. Mile 214, H. B. Ry., Man., July 17, (J. B. Wallis).

Saturniidæ.

794. *Pseudohazis eglanterina* Bdv. Blairmore, Alta., (K. Bowman). Addition to Alberta list.

Arctiidæ.

851. *Roeselia minuscula* Zell. Miami Man., July 4, 1914, (J. B. Wallis).

Noctuidæ.

1076 *Melaporphyria immortua* Grt. Edmonton, Alta., May, (K. Bowman). Addition to Alberta list.

* *Parabarrovia keelei* Gibson. Mountain below Twitza River, near Gravel River, N.W.T., July 2, 1908, (J. Keele); Rep Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 33.

1275 *Euxoa infracta* Morr. Blairmore, Alta., Aug., (K. Bowman). Addition to Alberta list.

1332. *Euxoa esta* Sm. Wellington, B.C., Aug., 19, 1903, (T. Bryant); Victoria, B.C., Sept. 3, 1916, (E. H. Blackmore). Listed in 1906 B.C. list under the name *velleripennis*, (E.H.B.).

1339. *Euxoa campestris* Grt. Edmonton, Alta., August, (D. Mackie). Addition to Alberta list.

1379. *Chorizagrotis thanatologia perfida* Dod. Peachland, B.C., July 30, 1919, (J. B. Wallis).

1455. *Agrotis cinereicollis* Grt. Lillooet, B.C., July 3, 1918, (A. W. A. Phair). Peachland, B.C., Aug. 8, 1915, (J. B. Wallis). New to British Columbia, (J. B. Wallis).

1507. *Aplectoides occidens* Hamps. Sicamous, B.C., Aug. 12, 1915, (J. B. Wallis).

1596. *Rhynchagrotis gilvipennis* Grt. Maillardville, B.C., July 18, 1919, (L. E. Marmont).

* *Anarta subfumosa* Gibson. Armstrong Point, Victoria Island, N.W.T., July, 1916, (J. Hadley); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 34.

1871. *Stretchia plusiæformis* Hy. Edw. Among some specimens determined for Canon V. A. Huard, of Quebec, Que., was one of this species, which was described from Nevada. As I had never seen this species from Eastern Canada, I questioned its occurrence in Quebec Province, but Canon Huard assured me that it was captured at Chicoutimi in 1881. (A.G.).

1900. *Perigrapha algula* Sm. Sahtlam, Van. Isl., B.C., May 10, 1918, (G. O. Day).

1986. *Rancora brucei* Sm. Nordegg, Alta., June, (K. Bowman). Addition to Alberta list.

2060. *Oncocnemis umbrifascia* Sm. Lillooet, B.C., Sept. 5, 1918, (A. W. A. Phair). New to British Columbia, (E.H.B).

2137. *Graptolitha ferrealis* Grt. Edmonton, Alta., April (D. Mackie). Addition to Alberta list.

2174. *Xylena thoracica* Put.-Cram. Okanagan Falls, B.C., April 7, 1913, (E. M. Anderson); Rossland, B.C., (W. H. Danby). New to British Columbia. It may be mentioned here that the species going under the name of *cineritia* Grt., in B.C. collections is in reality *mertena* Sm., (E.H.B.).

2178. *Eurotype confragosa* Morr. Tahu River, B.C., Sept. 30, 1906, (T. Bryant). This is the first authentic record for B.C. *Medialis* Grt., which is a synonym of *confragosa* Morr. is recorded from Wellington, B.C., in the 1906 check list but upon a recent examination of the specimen I find it to be *E. contadina* Sm. (E.H.B.).

* *Homoglaea murrayi* Gibson. Bernard Harbour, N.W.T., July 10, 1916. (F. Johansen); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 36.

2316. *Trachea mixta* Grt. Winnipeg, Man., June 24, 1911, (J. B. Wallis).

2380. *Luperina passer conspicua* Morr. Edmonton, Alta., (D. Mackie). Addition to Alberta list.

2513. *Meroloncha ursina* Sm. Nordegg, Alta., June, (K. Bowman). Addition to Alberta list. Wellington, B.C., June 6, 1904, (T. Bryant). This name is new to B.C., but I suspect it is the same insect which has been previously recorded under the name *lupini* Grt. Very rare in B.C. collections, (E.H.B).

2636. *Helotropha reniformis atra* Grt. Victoria, B.C., Aug. 2, 1916, (E. H. Blackmore); Duncan, B.C., (E. M. Skinner). First record of the form *atra* from B.C., (E.H.B.).

2837. *Eutricopis nexilis* Morr. Reared from larvæ found on *Antennaria* at Aylmer, Que., emerged in office Jan. 10, 1920, (J. McDunnough).

3012. *Sarrothripus revayana cinereana* N. & D. Vancouver, B. C., May 6, 1902; Mission, B.C., Aug. 8, 1904, (R. V. Harvey). New record for B.C., (E.H.B.).

* *Autographa rectangula nargenta* Ottol. Vancouver Island, (A. W. Hanham); Kalso, B.C., (J. W. Cockle); Jour. N. Y. Ent. Soc., XXVII, 122.

* *Autographa interalia* Ottol. Nordegg, Alta., (K. Bowman); Banff, Alta., (R. Ottolengui); Jour. N. Y. Ent. Soc., XXVII, 122.

* *Autographa diversigna* Ottol. Nordegg, Alta., (K. Bowman); Laggan, Alta., (T. Bean); Jour. N.Y. Ent. Soc. XXVII, 121.

* *Autographa magnifica* Ottol. Ucluelet, B.C., (C. H. Young); Jour. N.Y. Ent. Soc. XXVII, 124.

3241. *Autographa ottolenguii* Dyar. Dawson, Y.T., 1909, (A. Day).

Autographa pulchrina Haw. Dawson, Y.T., 1909, (A. Day). This record was received from Mr. G. O. Day, of Duncan, B.C., with the statement "Dr. Ottolengui gave me to understand that this is the first record for the North American Continent."

3313. *Melipotis versabilis* Harv. Quamichan, Van. Isl., B.C., May 31, 1908, (G. O. Day); Cawston, B.C., July 24, 1917, (W. R. S. Metcalfe).

3333. *Syneda alleni saxea* Hy. Edw. Blairmore, Alta., June, (K. Bowman). Addition to Alberta list.

3487. *Epizeuxis scobialis* Grt. Kingsmere, Que., July 23, 1919, (R. N. Chrystal).

3501. *Zanclognatha minoralis* Sm. Quebec, Que., July 27, 1918, (V. A. Huard). Addition to Quebec list.

Notodontidæ.

3640. *Heterocampa umbrata* Wlk. Aylmer, Que., June 2, 1919, (C. B. Hutchings). Addition to Quebec list.

Lymantriidæ.

* *Olene dorsipennata* B. & McD. Chelsea, Que., July 8-14; Aylmer, Que., (J. McDunnough); Can. Ent. LI, 102.

3712. *Olene vagans willingi* B. & McD. Edmonton, Alta., July, (D. Mackie). Addition to Alberta list.

3712. *Olene vagans grisea* B. & McD. Quamichan, Vancouver Island, B.C., July 22, 1916, (G. O. Day).

Geometridæ.

3972. *Coryphista meadi* Pack. Blairmore, Alta., June-July, (K. Bowman). Addition to Alberta list.

3990. *Thera otisi* Dyar. Mt. Arrowsmith, Vancouver Island, B.C., (T. Bryant).

3999. *Dysstroma cervinifascia* Wlk. Nordegg, Alta., July, (K. Bowman). Addition to Alberta list.

4017. *Hydriomena renunciata* Wlk. "Province of Quebec" (V. A. Huard). Addition to Quebec list. Edmonton, Alta., May-June, (K. Bowman). Addition to Alberta list.

4208. *Eupithecia albicapitata* Pack. Edmonton, Alta., July, (K. Bowman). Addition to Alberta list.

* *Eupithecia probata* S. & C. Duncan, B.C., (C. Livingstone); Victoria, B.C., March 30, 1916; April 3, 1916, (E. H. Blackmore); Lepidopterist iii, 105.

* *Eupithecia moirata* S. & C. Penticton, B.C., April, 1913, (E. H. Blackmore); Lepidopterist, iii, 107.

4325. *Drepanulatrix liberaria* Wlk. Aylmer, Que., Sept. 3, 1919, (C. B. Hutchings).

4332. *Philobia ulsterata* Pears. Edmonton, Alta., June, (K. Bowman). Addition to Alberta list.
4349. *Macaria purcellata* Tayl. Nordegg, Alta., July, (K. Bowman). Addition to Alberta list.
4465. *Caripeta divisata* Wlk. Edmonton, Alta., July, (K. Bowman). Addition to Alberta list.
4489. *Pygmæna simplex* Dyar. Nordegg, Alta., July, (K. Bowman). Addition to Alberta list.

Pyralidæ.

4974. *Diaphania nitidalis* Stoll. Meach Lake, Que., Sept. 16, 1903, (C. H. Young). Addition to Quebec list.
5032. *Loxostege commixtalis* Wlk. Banff, Alta.; Nordegg, Alta., June-July, (K. Bowman). Addition to Alberta list.
* *Diasemia alaskalis* Gibson. Collinson Point, Alaska, July 10, 1914, (F. Johansen); W. of Konganevik (Camden Bay) Alaska, July, 1914, (F. Johansen); Rep. Can. Arctic Exp., Vol. III, Part I, Lepidoptera, p. 45.
5051. *Diasemia plumbosignalis* Fern. Nordegg, Alta., July, (K. Bowman). Addition to Alberta list.
5088. *Phlyctænia ferrugalis* Hbn. Edmonton, Alta., June, (K. Bowman). Addition to Alberta list.
* *Pyrausta ainsliei* Heinrich. St. John's, Que., (W. Chagnon). Jour. Agr. Research, XVIII, 3, 175.
5135. *Pyrausta fumoferalis* Hlst. Edmonton, Alta., June, (K. Bowman). Addition to Alberta list.
5548. *Mineola tricolorella* Grt. Reared from larvæ found in apples in Okanagan Valley, B.C., (E. P. Venables).
* *Pyla arctiella* Gibson. Collinson Point, Alaska, July 17, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part I, Lepidoptera, p. 46.

Pterophoridæ.

5915. *Pterophorus sulphureodactylus* Pack. Pointe Aux Alouelles, Ste. Catherine Bay, opp. Tadousac, Que., July 28, 1919, (V. A. Huard). Addition to Quebec list.

Gelechiidæ.

* *Aristotelia fragariæ* Busck. Victoria, B.C., (W. Downes); Proc. Ent. Soc. of Wash., XXI, 52.
6166. *Paralechia pinifoliella* Cham. Ottawa, Ont., July 1, 1907, (C. H. Young).
6200. *Anacampsis tristrigella* Wlshm. Aylmer, Que., June 21, 1919, (J. McDunnough). Addition to Quebec list.
6283. *Gelechia conclusella* Wlk. Ottawa, Ont., June 24, 1906, (C. H. Young).
6288. *Gelechia panella* Busck. Maple Bay, B.C., Aug. 3, 1914, (A. W. Hanham).
6290. *Gelechia fuscotæniaella* Cham. Aweme, Man., Sept. 5, 1915, (N. Criddle).

Tortricidæ.

* *Tortricodes fragariana* Busck. Victoria, B.C., (W. Downes); Proc. Ent. Soc., Wash., XXI, 52.

Gracilariidæ.

7925. *Lithocolletis affinis* F. & B. Aylmer, Que., July 24, 1919; mines in *Lonicera*, (J. McDunnough).

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

Carabidæ.

* *Bembidium lengi* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII. 98.

* *Pterostichus laevilatus* Notman. Golden, B.C., (Leng. col.); Jour. N.Y. Ent. Soc., XXVII, 231.

680. *Celia gibba* Lec. Aweme, Man., March 29, 1918; Maryfield, Sask., Aug. 30, 1916, (N. Criddle).

Celia brumalis Casey. Aweme, Man., Sept. 2, 1916, (E. Criddle). New to Canada.

* *Asaphidion yukonense* Wickham. Yukon Crossing, Y.T., May 21, 1911, (J. M. Jessup); Proc. Ent. Soc., Wash., XXI, 180.

Dytiscidæ.

1292. *Coelambus suturalis* Lec. Winnipeg, Man., Thornhill, Man., Miami, Man., Mile 214 to 332, H.B.R., Man., (J. B. Wallis). New to Manitoba.

* *Coelambus canadensis* Fall. Winnipeg, Man., Stony Mountain, Man., Miami, Man., (J. B. Wallis); N. A. species of *Coelambus,* published by J. D. Sherman, New York, 1919.

* *Coelambus tumidiventris* Fall. Stony Mountain, Man., April 15, 1912; Winnipeg, Man.; Stonewall, Man., (J. B. Wallis); Edmonton, Alta., April 8, 1916, (F. S. Carr); N.A. species of *Coelambus,* published by J. D. Sherman, New York, 1919.

* *Coelambus hudsonicus* Fall. Ungava Bay, H.B.T., (L. M. Turner); N.A. species of Coelambus published by J. D. Sherman, New York, 1919.

Coelambus punctilineatus Fall. Stony Mountain, Man., April 13, 1912, (J. B. Wallis).

1441. *Agabus lecontei* Cr. Peachland, B.C., Aug. 7, 1919, (W. R. Metcalfe and J. B. Wallis).

Silphidæ.

* *Colon elongatum* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII, 98.

Pselaphidæ.

1899. *Batrisus fontalis* Lec. Aweme, Man., April 18, 1919; in swarm of ants, (*Acanthomyops*), (S. Criddle).

Staphylinidæ.

Atheta (*Acrostoma*) *blanchardi* Ful. Stonewall, Man., July 18, 1918, in rotten fungus, (J. B. Wallis).

Atheta comitata Csy. Stonewall, Man., Aug. 18, 1918, in fungus. (J. B. Wallis). New to Manitoba.

Atheta (*Datomicra*) *celata* Er. Onah, Man., July 13, 1918; in larch swamp, (J. B. Wallis). New to Manitoba.

Atheta (*Demetrota*) *subrugosa* Kiew. Onah, Man., July 12, 1918, in moss, (J. B. Wallis). New to Manitoba.

Aleochara (*Polychara*) *deflecta* Say. Stonewall, Man., Aug. 18, 1918, (J. B. Wallis). New to Manitoba.

Aleochara (*Euryodma*) *pleuralis* Csy. Treesbank, Man., July 18, 1918, (J. B. Wallis). New to Manitoba.

Silusa modica Csy. Stonewall, Man., in rotten fungus, (J. B. Wallis). New to Manitoba.

Anomognathus cuspidata Er. Winnipeg, Man., Aug. 27, 1918; under bark of rotten *Negundo,* (J. B. Wallis). New to Manitoba. Apparently introduced from Europe, (A.F.).

Homalota plana Gyll. Winnipeg, Man., July 30-Aug. 14, 1918; under bark of rotten *Negundo,* (J. B. Wallis). New to Manitoba. Apparently introduced from Europe, (A.F.).

Gnypeta manitobæ Csy. Stonewall, Man., Aug. 18, 1918, (J. B. Wallis).

Gyrophaena nana Payk. Winnipeg, Man., Aug. 27, 1918, in fungus, (J. B. Wallis). New to Manitoba.

Gyrophaena pulchella Heer. Stonewall, Man., Aug. 18, 1918; Winnipeg, Man., Aug. 27, 1918; in fresh whitish fungi, among the gills. (J. B. Wallis). Apparently an introduction from Europe, (A.F.). New to Manitoba.

* *Lathrobium tenebrosum* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII, 99.

* *Lathrobium humile* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII, 100.

* *Scopæus linearis* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII, 100.

Endomychidæ.

3180. *Phymaphora californica* Horn. Duncan, B.C., (A. W. Hanham).

Erotylidæ.

3239. *Tritoma flavicollis* Lec. Duncan, B.C., (A. W. Hanham).

Colydiidæ.

3271. *Lasconotus pusillus* Lec. Aweme, Man., Onah, Man., July, 1919, (N. Criddle).

Histeridæ.

* *Saprinus rugosifrons* Fall. Aweme, Man., (N. Criddle); Can. Ent., LI, 213.

* *Saprinus castanipennis* Fall. Aweme, Man., June 21, 1918, (N. Criddle); Can. Ent., LI, 214.

* *Saprinus iris* Fall. Aweme, Man., May 31, 1909, July 1, 1915, (N. Criddle); Can. Ent., LI, 214.

Nitidulidæ.

3713. *Epuræa aestiva* Linn. Aweme, Man., 1919, (N. Criddle).

* *Epuræa ornatula* Notman. Cochrane, Ont., Aug., 1918, (H. Notman); Jour. N.Y. Ent. Soc., XXVII, 102.

Dascyllidæ.

3991. *Eucinetus punctulatus* Lec. Stonewall, Man., Aug. 18, 1918; in rotten fungus, (J. B. Wallis).

Elateridæ.

4390. *Anthous cucullatus* Say. Husavick, Man., July 27, 1912, (J. B. Wallis). New to Manitoba.

4403. *Anthous vittiger* Lec. Winnipeg, Man., (J. B. Wallis). New to Manitoba.

Ptinidæ.

Ptilinus lobatus Csy. Aweme, Man., June 24, 1919, (N. Criddle); Husavick, Man., July 6, 1917, (L. H. D. Roberts). New to Manitoba.

5359. *Dinoderus substriatus* Payk. Mile 214, H.B.R., Man., Winnipeg, Man., June, July; Peachland, B.C., (J. B. Wallis).

Cisidæ.

* *Dolichocis manitoba* Dury. Aweme, Man., Oct., 1918, (N. and T. Criddle); Can. Ent., LI, 158.

* *Cis criddlei* Dury. Aweme, Man., Oct., 1915-1918, (E. and N. Criddle); Can. Ent., LI, 158.

Scarabæidæ.

5426. *Canthon ebenus* Say. Lyleton, Man., Aug. 27, 1919; Boissevain, Man., (N. Criddle).

5551. *Aphodius haldemani* Horn. Rosebank, Man., Aug. 10, 1917, (J. B. Wallis). New to Manitoba.

* *Serica cucullata* Dawson. Montreal, Que., May 6, 1905, (A. F. Winn); Ottawa, Ont.; Winnipeg, Man., (J. B. Wallis); Aweme, Man., (N. Criddle); Kentville, N.S.; British Columbia; Jour. N.Y. Ent. Soc., XXVII, 34.

Cerambycidæ.

* *Callidium subopacum* Sw. South of Rampart House, Y.T., (D. H. Nelles); Rep. Can. Arctic Exp., 1913-1918, Part E, Coleoptera, p. 12.

6250. *Pachyta rugipennis* Newm. Winnipeg, Man., May 18, 1919, (L. H. D. Roberts). New to Manitoba.

6385. *Monohammus minor* Lec. Winnipeg, Man., July 15, 1918, (J. B. Wallis). New to Manitoba.

Chrysomelidæ.

6558. *Syneta carinata* Mann. Mt. Prevost, near Duncan, B.C., 2,500 feet, (A. W. Hanham).

6721. *Xanthonia villosula* Melsh. Bird's Hill, Man., Sept. 23, 1917, (J. B. Wallis). New to Manitoba.

10407. *Monoxia debilis* Lec. Melita, Man., July 1, 1919; collected on *Grindelia squarrosa,* (N. Criddle).

7001a. *Systena ligata* Lec. Husavick, Man., Aug. 3, 1914, on Canada thistle; Winnipeg, Man., Aug. 14, 1918, (J. B. Wallis). New to Manitoba.

Tenebrionidæ.

7528. *Scaphidema aenolum* Lec. Stonewall, Man., Aug. 7, 1918; under bark of dead aspen, (J. B. Wallis).

Melandryidæ.

7656. *Phryganophilus collaris* Lec. Duncan, B.C., (A. W. Hanham).

7695. *Canifa pallipes* Melsh. Winnipeg, Man., May 28, 1911; Victoria Beach, Man., July 1, 1918; Miami, Man., June 27, 1916; Aweme, Man., July 15, 1918, (J. B. Wallis).

Œdemeridæ.

7733. *Nacerdes melanura* Linn. Vancouver, B.C., July 15, 1919, (A. W. Hanham).

Meloidæ.

8025. *Nemognatha apicalis* Lec. Lillooet, B.C., July 13, (A. W. Hanham).

Curculionidæ.

* *Trichalophus stefanssoni* Leng. Bernard Harbour, N.W.T., Sept. 26, 1914; May 22, July 6, 7, 1915; June, July and Sept., 1916, (F. Johansen); Cape Krusenstern, N.W.T., July, 1916, (D. Jenness); Kogluktualuk river, Coronation Gulf, N.W.T., July, 1915, (J. J. O'Neill); Langton Bay, N.W.T., 1911, (V. Stefansson); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part E, Coleoptera, p. 20.

8381. *Apion pennsylvanicum* Boh. Magnus, Man., Sept. 2, 1917, (J. B. Wallis).

Apion commodum Fall. Stony Mountain, Man., Aug. 8, 1918, on *Psoralea esculenta,* (J. B. Wallis).

Apion finitimum Fall. Magnus, Man., Sept. 2, 1917, (J. B. Wallis).

Apion nasutum Fall. Onah, Man., July 12, 1918, (J. B. Wallis). New to Canada.

10823. *Macrops ulkei* Dietz. Aweme, Man., May 7, 1919, (N. Criddle).

8576. *Tanysphyrus lemnæ* Fab. Miami, Man., June 27, 1916; Treesbank, Man., July 18, 1918, (J. B. Wallis). New to Manitoba.

8619. *Magdalis subtincta* Lec. St. Norbert, Man., June 24, 1917; Aweme, Man., July 15, 1918, (J. B. Wallis).

8620. *Magdalis hispoides* Lec. Onah, Man., July 8-12, 1918, (J. B. Wallis). New to Manitoba.

8627. *Magdalis alutacea* Lec. Victoria Beach, Man., July 1, 1918, (J. B. Wallis). New to Canada.

10958. *Promecotarsus densus* Csy. Aweme, Man., July 15, 1918, (J. B. Wallis). New to Manitoba.

8669. *Anthonomus canus* Lec. Onah, Man., July 13, 1918, (J. B. Wallis). New to Manitoba.

Ceutorhynchus solitarius Fall. St. Norbert, Man., June 24, 1917, (J. B. Wallis). New to Manitoba.

Calandridæ.

Sphenophorus aequalis. Stonewall, Man., July 5, 1918, (J. B. Wallis). New to Manitoba.

Ipidæ.

* *Dendroctonus johanseni* Sw. Sandstone rapids, Coppermine river, N.W.T., Feb., 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part E, Coleoptera, p. 5.

* *Carphoborus andersoni* Sw. Sandstone rapids, Coppermine river, N.W.T., Feb. 15, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part E, Coleoptera, p. 6.

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.

* *Dicranomyia alascaensis* Alex. Nome, Alaska, Aug. 24, 25, 1916. (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 5.

80. *Limnobia sciophila* O.S. Lillooet, B.C., June 21, 1917, (M. H. Ruhmann); Gordon Head, B.C., April 30, 1918, (W. Downes).
81. *Limnobia solitaria* O.S. Lillooet, B.C., June 25, 1919, (M. H. Ruhmann).
97. *Xiphura topazina* O.S. Vineland, Ont., May 5, 1915, (W. A. Ross).
* *Nephrotoma arcticola* Alex. Bernard Harbour, N.W.T., July 1-14, 1916; July-Aug., 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 10.
98. *Nephrotoma ferruginea* Fab. Bowmanville, Ont., June, 1913, (W. A. Ross).
* *Nephrotoma euceroides* Alex. Perth, N.B., June 15, 1915, (F. M. McKenzie); Can. Ent., LI, 172.
* *Erioptera angustipennis* Alex. Bernard Harbour, Dolphin and Union Strait, N.W.T., Aug. 1-7, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 5.
* *Tipula nebulipennis* Alex. Battle Harbour, Labrador, Aug. 1, 1912, (G. P. Engelhardt); Can. Ent., LI, 170.
* *Tipula trypetophora* Dietz. Victoria, B.C., July 6, 1912; An. Ent. Soc. Amer., XII, 89.
* *Tipula johanseni* Alex. Bernard Harbour, N.W.T., July 10, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 11.
* *Tipula diflava* Alex. Bernard Harbour, N.W.T., July 12, 1915; Herschel Island, Y.T., July, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 12.
* *Tipula hewitti* Alex. Bernard Harbour, N.W.T., July 1-14, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 14.
* *Tipula subpolaris* Alex. Bernard Harbour, N.W.T., July-Aug., (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 14.
* *Tipula besselsoides* Alex. Bernard Harbour, N.W.T., July 1-14, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 15.
* *Tipula subarctica* Alex. W. of Kongenevik, Camden bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., Part C, Diptera, p. 15.
* *Tricyphona frigida* Alex. Ketchikan, Alaska, Sept. 10, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 7.
* *Tricyphona brevifurcata* Alex. W. of Konganevik, Camden bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 6.
* *Limnophila rhicnoptiloides* Alex. Bernard Harbour, N.W.T., July 15, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 6.
* *Stygeropis parrioides* Alex. W. of Konganevik, Camden bay, Alaska, June 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 9.
100. *Tipula angustnpennis* Loew. Vernon, B.C., April 2, 1915, (M. H. Ruhmann).
101. *Tipula cognata* Doane. Vernon, B.C., April 2, 1915, (M. H. Ruhmann).
102. *Tipula dorsolineata* Doane. Vernon, B.C., (M. H. Ruhmann); Victoria, B.C., (W. Downes).
102. *Tipula eluta* Loew. Vineland, Ont., Aug. 18, 1914, (W. A. Ross).
* *Tipula noveboracensis* Alex. Beaver Dam, N.B., June 23, 1914, (J. D. Tothill); Can. Ent., LI, 167.

Chironomidæ.

* *Tanypus alaskensis* Mall.; Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 35.

* *Diamesa arctica* Mall. Colville Mts., Wollaston peninsula, Victoria Island, July 22-29, 1915, (D. Jenness). Angmaloktok, Colville mountains, Wollaston peninsula, Victoria Island, July 29, 1915, (D. Jenness); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 37.

Culicidæ.

* *Ædes pionips* Dyar. White River, Ont., June 17-25, 1918; Prince Albert, Sask., Aug. 14-18, 1918; Red Deer, Alta., July 30-Aug. 3, 1918; Nepigon, Ont., June 26, 1918; Lochearn, Alta, Aug. 5-7, 1918; Lamoral, Alta., Aug. 6, 1918; Lake Louise, Alta., July 11-17, 1918, (H. G. Dyar); White River, Ont., June 24, 1907, (Knab); Kenogami river, Ont., June 30, 1903, (W. J. Wilson); Insecutor Inscitiæ Menstruus, VII, 19.

* *Ædes intrudens* Dyar. White River, Ont., June 12-25, 1918; Nepigon, Ont., June 26, 1918; Dryden, Ont., June 29-30, 1918; Winnipeg Beach, Man., July, 1918; Lake Minnewanka, Alta, July 22, 1918; Banff, Alta., July 7-25, 1918; Laggan, Alta, July 11, 1918, (H. G. Dyar). With the description the following statement appears: "Eastern records are found in the monograph under *impiger* (page 757). They are correct, except that 'Ottawa, Ontario (J. Fletcher)' should be transferred to *lazarensis*;" Insecutor Inscitiæ Menstruus, VII, 24.

* *Ædes nearcticus* Dyar. Bernard Harbour, N.W.T., July 9, 1915; June 21-July 1, 1916, (F. Johansen); Collinson Point, Alaska, June 23, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 32.

Bibionidæ.

166. *Bibio nervosus* Loew. Vernon, B.C., (M. H. Ruhmann); Saanich, B.C., (W. Downes).

Simuliidæ.

* *Simulium similis* Mall. Hood river, Arctic sound, N.W.T., Aug. 28, 1915, (R. M. Anderson); Bathurst inlet, N.W.T., Sept 1, 1915, (R. M. Anderson); Rep. Can. Arctic Exp., 1913-18; Vol. III, Part C, Diptera, p. 42.

* *Prosimulium borealis* Mall. Wollaston peninsula, Victoria island, 1915, (D. Jenness); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 41.

Stratiomyidæ.

179\. *Sargus decorus* Say. Lillooet, B.C., June 20, 1917, (M. H. Ruhmann).

180\. *Sargus viridis* Say. Kelowna, B.C., June 18, 1918, (R. C. Treherne).

182\. *Stratiomyia discalis* Loew. Vernon, B.C., May 17, 1917, (M. H. Ruhmann).

183\. *Stratiomyia norma* Wied. Kelowna, B.C., June 26, 1918, (R. C. Treherne).

183\. *Stratiomyia meigenii* Wied. Vernon, B.C., June 21, 1917, (R. C. Treherne).

183\. *Stratiomyia maculosa* Loew. Lillooet, B.C., June 25, 1917, (M. H. Ruhmann).

189\. *Nemotelus arator* Mel. Walhachin, B.C., July 11, 1918, (E. R. Buckell).

Tabanidæ.

195\. *Chrysops obsoletus* Wied. Vineland, Ont., June 20, 1919, (W. A. Ross).

204\. *Tabanus insuetus* O.S. Vernon, B.C., April 15, 1915, (M. H. Ruhmann).

205. *Tabanus maculifer* Bigot. Lillooet, B.C., July 24, 1917, (R. C. Theherne).
206. *Tabanus procyon* O.S. Vernon, B.C., June 8, 1918, (R. C. Treherne).
207. *Tabanus rhombicus* O.S. Vernon, B.C., April 15, 1915, (M. H. Ruhmann).
208. *Tabanus stygius* Say. Vineland, Ont., July 8, 1919, (C. H. Curran).

Bombyliidæ.

231. *Anthrax hypomelas* Macq. Penticton, B.C., (R. C. Treherne); Walhachin, B.C., (E. R. Buckell).
234. *Anthrax sinuosa* Wied. Lillooet, B.C., July 23, 1917, (R. C. Treherne).
236. *Bombylius lancifer* O.S. Lillooet, B.C., Oyama, B.C., (M. H. Ruhmann).
* *Villa webberi* Jhn. Montreal, Que., June 11, (G. Chagnon), Ottawa, Ont., June 14, (Bro. Germain); Psyche, XXVI, 11.
* *Ploas atratula* Loew. Goldstream, B.C., June 2, 1918, (W. Downes).

Therevidæ.

247. *Psilocephala lævigata* Loew. Walhachin, B.C., July 11, 1918, (E. R. Buckell).
248. *Thereva egressa* Coq. Vernon, B.C., June 10, 1918, (R. C. Treherne).

Asilidæ.

256. *Stenopogon californiæ* Wlk. Vernon, B.C., July 8, 1918, (R. C. Treherne).
259. *Cyrtopogon callipedilus* Loew. Vernon, B.C., May 5, 1915, (M. H. Ruhmann).
260. *Cyrtopogon longimanus* Loew. Lillooet, B.C., July 16, 1917, (M. H. Ruhmann.
271. *Laphria pubescens* Will. Duncan, B.C., July 28, 1918, (W. Downes).
* *Erax harveyi* Hine. Vernon, B.C., Aug. 11-15, 1904, (R. V. Harvey); An. Ent. Soc. Amer., XII, 115.

Dolichopodidæ.

* *Medeterus frontalis* Van Duzee. Joliette, Que., July 13, (J. Ouillet); Proc. Cal. Acad. Sci., Aug., 1919, p. 266.
* *Medeterus vittatus* Van. Duzee. Kearney, Ont., July 26; Toronto, Ont., Sept. 2; Niagara Falls, Ont., July 20, (M. C. Van Duzee); Proc. Cal. Acad. Sci., Aug., 1919, p. 268.
* *Hydrophorus pilitarsis* Mall. Teller, Alaska, July 29, 1913; Aug. 6, 1913, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 51.
303. *Dolichopus pachynemus* Loew. Outremont, Que., June 20, (J. Ouillett); Chatham, Ont., June 17, 1915. (M. C. Van Duzee). Addition to Quebec list.
* *Dolichopus dasyops* Mall. Bernard Harbour, N.W.T., July 10, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 49.
309. *Pelastoneurus laetus* Loew. St. Louis, Que., Aug. 14, (J. Ouillet). Addition to Quebec list.

Empidæ.

* *Rhamphomyia erinacioides* Mall. W. of Konganevik, Camden bay, Alaska, July 4, 1914, (F. Johansen); Barter island, Arctic coast of Alaska, July 11, 1914, (D. Jenness); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 45.

* *Rhamphomyia ursina* Mall. Bernard Harbour, N.W.T., July 19, 1915, (F. Jonhansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 46.

* *Rhamphomyia similata* Mall. Bernard Harbour, N.W.T., July 18, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 46.

* *Rhamphomyia herschelli* Mall. Herschel island, Y.T., July 29, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 47.

* *Rhamphomyia conservativa* Mall. W. of Bernard Harbour, N.W.T., July 14, 1916; Herschel Is., Y.T., July 29, 1916; Bernard Harbour, N.W.T., July 10, 18, 19, and Aug. 1-7, 1915; Young Point, N.W.T., July 18, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 48.

Lonchopteridæ.

333. *Lonchoptera lutea* Panz. Vernon, B.C., Aug. 31, 1917, (M. H. Ruhmann).

Phoridæ.

* *Aphiochaeta platychira* Mall. Nome, Alaska, Aug. 21, 24, 25, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 52.

* *Aphiochaeta alaskensis* Mall. Nome, Alaska, Aug. 24, 25, 1916, (F. Johansen). Rep. Can. Arctic Exp. 1913-1918, Vol. III, Part C, Diptera, p. 52.

Syrphidæ.

350. *Pipiza fraudulenta* Loew. Vineland, Ont., June 8, 1919, (C. H. Curran).

354. *Myiolepta strigilata* Loew. Vineland, Ont., June 10, 1919, (C. H. Curran).

354. *Myiolepta nigra* Loew. Vineland, Ont., June 16, 1919, (C. H. Curran).

362. *Didea fasciata fuscipes* Loew. Lillooet, B.C., July 24, 1917, (R. C. Treherne); Vineland, Ont., June 6, Sept. 20, 1919, (C. H. Curran).

366. *Syrphus genualis* Will. Walhachin, B.C., July 30, 1918, (E. R. Buckell).

Syrphus knabi Shan. Vineland, Ont., Sept. 9, 1919, (C. H. Curran).

* *Syrphus sodalis interruptus* Mall. W. of Kongenevik, Camden Bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 55.

368. *Syrphus xanthostoma* Will. Vernon, B.C., May 13, 1917, (M. H. Ruhmann).

370. *Mesogramma boscii* Macq. Saanich, B.C., May 10, 1918, (W. Downes).

371. *Mesogramma geminata* Say. Saanich, B.C., June 10, 1918, (W. Downes).

384. *Eristalis aeneus* Fab. Vineland, Ont., July 3-9, 1919, (C. H. Curran). First record we have for Canada.

387. *Eristalis inornatus* Loew. Vernon, B.C., May 31, 1917, (M. H. Ruhmann).

392. *Helophilus chrysostoma* Wied. Kelowna, B.C., June 26, 1918, (R. C. Treherne).

393. *Helophilus lactus* Loew. Vineland, Ont., June 4, July 7, 1919, (C. H. Curran).

394. *Asemosyrphus mexicanus* Macq. Kelowna, B.C., July 9, 1918, (R. C. Treherne).

Eumerus strigatus Fall. Aweme, Man., May 17, 1919, (N. Criddle); Vineland, Ont., June-Sept., (C. H. Curran).

398. *Xylota flavitibia* Bigot. Vernon, B.C., Aug. 10, 1915, (M. H. Ruhmann).
402. *Criorhina analis* Macq. Vineland, Ont., June 10, 1919, (C. H. Curran).
404. *Spilomyia longicornis* Loew. London, Ont., Aug. 25; Vineland, Ont., Sept. 8, 1919, (C. H. Curran).

Conopidæ.

412. *Myopa clausa* Loew. Kelowna, B.C., May 17, 1917, (M. H. Ruhmann).
413. *Myopia vicaria* Walk. Nelson, B.C., April 29, 1918, (R. C. Treherne).

Oestridæ.

419. *Cuterebra tenebrosa* Coq. Vernon, B.C., July, 1916, (M. H. Ruhmann).

Tachinidæ.

423. *Phorantha occidentis* Walk. Walhachin, B.C., July 16, 1918, (E. R. Buckell).
447. *Senotainia rubriventris* Macq. Vernon, B.C., (M. H. Ruhmann); Walhachin, B.C., July, (E. R. Buckell).
448. *Senotainia trilineata* Van der Wulp. Walhachin, B.C., July, (E. R. Buckell); Vernon, B.C., (M. H. Ruhmann).
* *Peleteria arctica* Mall. Cockburn Point, N.W.T., Sept. 5, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 57.

Sarcophagidæ.

* *Meloposarcophaga tothilli* Parker. British Columbia, Savary Island, June 13-31, 1917, (R. S. Sherman); Can. Ent. LI., 155.
Sarcophaga communis Park. Walhachin, B.C., (E. R. Buckell).
512. *Sarcophaga helicis* Towns. Kelowna, B.C., June 13, 1918, (R. C. Treherne).
Sarcophaga planifrons Ald. Walhachin, B.C., (E. R. Buckell).

Muscidæ.

* *Phormia caerulea* Mall. Bernard Harbour, N.W.T., May 24, 1915; June-July, 1915-1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 58.
Pyrellia cyanicolor Zett. Vernon, B.C., May 30, 1917, (M. H. Ruhmann).

Anthomyidæ.

* *Phaonia imitatrix* Mall. Bernard Harbour, N.W.T., July, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 61.
* *Phaonia minima* Mall. Nome, Alaska, Aug. 21, 24, 25, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 61.
* *Mydaeina obscura* Mall. Bernard Harbour, N.W.T., Aug. 4, 1915, June, 1916, (F. Johansen); Colville Mts., Wollaston Peninsula, Victoria Island, July 22, 1915, (D. Jenness); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C., Diptera, p. 62.
* *Aricia borealis* Mall. Bernard Harbour, N.W.T., July, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C. Diptera, p. 64.
* *Alliopsis obesa* Mall. Bernard Harbour, N.W.T., June, 1915-16, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 70.

547. *Limnophora narona* Walk. Walhachin, B.C., July 17, 1918, (E. R. Buckell).
548. *Anthomyia albicincta* Fall. Vernon, B.C., Aug. 1, 1917, (M. H. Ruhmann).
* *Helina fletcheri* Mall. Radisson, Sask., July 30, 1907, (J. Fletcher); Can. Ent. LI. 274.
* *Helina tuberculata* Mall. Rigolet, Labrador, July 18, 1906; Can. Ent. LI. 277.
550. *Anthomyia pratincola* Panzer. Vernon, B.C., Aug. 1, 1917, (M. H. Ruhmann).
* *Hydrophoria arctica* Mall. Cockburn Point, Sept. 5, 1914, (F. Johansen); Bernard Harbour, N.W.T., June, 1915, (F. Johansen); Rep. Can. Arctic Exp. 1913-1918, Vol. III, Part C, Diptera, p. 69.
* *Hylemyia acrostichalis* Mall. Nome, Alaska, Aug. 21, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 72.
* *Hylemyia quintilis* Mall. Godbout, Que., July 25, 1918, (E. M. Walker); Can. Ent. LI. 274.
* *Hylemyia pedestris* Mall. Godbout, Que., July 25, 1918, (E. M. Walker); Can. Ent. LI. 274.
* *Hylemyia spinosissima* Mall. Port Hope, Ont., June 13, 1897, (W. R. Metcalfe); Can. Ent. LI. 95.
* *Phorbia brevitarsata* Mall. W. of Konganevik, Camden Bay, Alaska, June, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 73.
558. *Pegomyia ruficeps* Stein. Vernon, B.C., (R. C. Treherne).
* *Pogonomyia quadrisetosa* Mall. W. of Bernard Harbour, N.W.T., July 14, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 66.
* *Pogonomyioides atrata* Mall. Bernard Harbour, N.W.T., July 7, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 67.
* *Coenosia fuscifrons* Mall. Brockville, Ont., Aug. 12, 1903, (W. R. Metcalfe); Ottawa, Ont., Aug. 17, 1907, (J. Fletcher); Port Hope, Ont., May 14, 1897, (W. R. Metcalfe); Can. Ent. LI. 96.
563. *Schoenomyza chrysostoma* Loew. Vernon, B.C., Aug. 19, 1917, (M. H. Ruhmann).

Scatophagidæ.

* *Gonatherus atricornis* Mall. Bernard Harbour, N.W.T. and Cape Krusenstern, July 3, 1919, (F. Johansen); Rep. Can. Arctic Exp. 1913-1918, Vol. III, Part C, Diptera, p. 77.
* *Cordylurella subvittata* Mall. Bernard Harbour, N.W.T., July 18-19, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 78.
* *Dasypleuron tibialis* Mall. Collinson Point, Alaska, June 20, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 79.
* *Allomyia unguiculata* Mall. Chantry Island, Bernard Harbour, N.W.T., July 17, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 80.

Helomyzidæ.

* *Neoleria rotundicornis* Mall. Nome, Alaska, Aug. 24-25, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 83.

* *Oecothea aristata* Mall. Bernard Harbour, N.W.T., Aug. 1-7, 14, Sept., 1915; July 10, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 82.

573\. *Tephrochlamys rufiventris* Mg. Vernon, B.C., April 12, 1915, (M. H. Ruhmann).

Borboridæ.

* *Leptocera transversalis* Mall. Collinson Point, Alaska, June 13, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 53.

Sciomyzidæ.

580\. *Tetanocera plumosa* Loew. Lillooet, B.C.; Vernon, B.C., (M. H. Ruhmann).

Sapromyzidæ.

582\. *Palloptera jucunda* Loew. Creston, B.C., Sept. 19, 1918, (R. C. Treherne).

Ortalidæ.

592\. *Anacampta latiuscula* Loew. Vernon, B.C., (R. C. Treherne).

595\. *Chrysomyza demandata* Fab. Vernon, B.C., July 5, 1918, (M. H. Ruhmann).

598\. *Seoptera vibrans* Linn. Vernon, B.C., July 1, 1918, (R. C. Treherne).

Trypetidæ.

604\. *Spilographa setosa* Doane. Vernon, B.C., July 17, 1919, (M. H. Ruhmann).

Piophilidæ.

* *Piophila borealis* Mall. W. of Konganevik, Camden Bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 84.

HYMENOPTERA.

The following new species of saw-flies appear in the Report of the Canadian Arctic Expedition, 1913-1918, issued Nov. 3, 1919, Vol. III, Part G.

Tenthredinoidea.

* *Rhogogastera reliqua* MacG. Nome, Alaska, Aug. 21-25, 1916, (F. Johansen).

* *Euura abortiva* MacG. Herschel Island, Y.T., adults from galls on leaves of *Salix reticulata* L., July, 1915, (F. Johansen).

* *Euura arctica* MacG. Bernard Harbour and Cape Krusenstern, N.W.T, July 6, 1916, (F. Johansen).

* *Pontania atrata* MacG. Herschel Island, Y.T., July, 1915, (F. Johansen).

* *Pontania lorata* MacG. Herschel Island, Y.T., adults from galls on *Salix arctica,* July, 1915, (F. Johansen).

* *Pontania delicatula* MacG. Herschel Island, Y.T., adults from galls on leaves of *Salix reticulata,* July, 1915, (F. Johansen).

* *Pontania deminuta* MacG. Bernard Harbour, N.W.T., Aug. 16, 1915, (F. Johansen).

* *Pontania quadrifasciata* MacG. Sandstone Rapids, Coppermine River, N.W.T., July, 1915, (F. Johansen).

* *Pontania subpallida* MacG. Bernard Harbour, N.W.T., July 12, 1915, (F. Johansen).

* *Pontania trifasciata* MacG. Bernard Harbour, N.W.T., July 15, 1915 (F. Johansen).

* *Amauronematus completus* MacG. Collinson Point, Alaska, June 20, 1914, (F. Johansen).

* *Amauronematus indicatus* MacG. West of Konganevik, Camden Bay, Alaska, July 4, 1914, (F. Johansen).

* *Amauronematus digestus* MacG. West of Konganevik, Camden Bay, Alaska, July 4, 1914, (F. Johansen).

* *Amauronematus cogitatus* MacG. Demarcation Point, Alaska, June 23, 1914, (F. Johansen).

* *Amauronematus varianus* MacG. West of Konganevik, Camden Bay, Alaska, June 27, 1914, (F. Johansen).

* *Amauronematus aulatus* MacG. Barter Island, Alaskan Arctic Coast, June 16, 1914, (D. Jenness).

* *Amauronematus magnus* MacG. Bernard Harbour, N.W.T., July 15, 1915, (F. Johansen).

Braconidæ.

* *Opius downesi* Gahan. Victoria, B.C., host *Rhagoletis pomonella* (W. Downes); Proc. Ent. Soc. Wash., XXI, 164.

Ichneumonidæ.

* *Dioctes modestus* Brues. Bernard Harbour, N.W.T., Aug. 7, 12, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part G, p. 23.

* *Polyblastus arcticus* Brues. Ketchikan, Southern Alaska, Sept. 10, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part G, p. 22.

* *Aptesis nivarius* Brues. Collinson Point, Alaska, June 20, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part G, Hymenoptera, p. 21.

Formicidæ.

Solenopsis molesta Say. Found generally at points south of Penticton in Okanagan Valley, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Tapinoma sessile Say. Found generally at points south of Penticton, in Okanagan Valley, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Pogonomyrmex occidentalis Cresson. Found in Lower Okanagan, B.C., fairly common at points south of Fairview, but not common at points north of Fairview. Also found at Summerland, B.C., (R. C. Treherne and E. R. Buckell. Determined by Dr. W. M. Wheeler, who reported "first record of any species of *Pogonomyrmex* from British America."

Formica subpolita Mayr. var. *camponoticeps* Wheeler. Found at points south of Penticton, in Lower Okanagan Valley, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Formica fusca L. var. *argentea* Walker. Fairview, B.C., Vaseaux Lake, B.C., Rock Creek, B.C., Naramata, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Formica sanguinea Latr. subsp. *subintegra* Emery. Fairview, B.C., Vaseaux Lake, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Formica neogagates Em. Fairview, B.C., Okanagan Falls, B.C., Kaleden. B.C., Vaseaux Lake, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Camponotus laevigatus F. Smith. Osoyoos, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Psammocharidæ.

* *Pompiloides canadensis* Banks. Truro, N.S., Aug. 12, (R. Matheson); Val Morin, Que., July 29, 30, (J. Ouellet); Can. Ent. LI., 82.

Apidæ.

* *Bombus neoboreus* Sladen. Bernard Harbour, N.W.T., Aug 17, 18, 1915; July 10, 1916; June 6, 21, 25; July 2, 9, 30; Aug. 7, 8, 17, 18, 1915; June 16, July 3, 1916; July 19, Aug. 10, 14, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part G, p. 28.

Philanthidæ.

Philanthus (Anthophilus) psyche Dunn. Aweme, Man., August, 1914, (N. Criddle); Medicine Hat, Alta., July, August, 1917, (F. W. L. Sladen).

Philanthus (Anthophilus) inversus Patt. Medicine Hat, Alta., August, 1916, 1917, (F. W. L. Sladen). (What I believe to be the males of this rare species were taken by me at Medicine Hat, July, August, 1916, 1917 —F.W.L.S.).

Philanthus (Pseuanthophilus) frontalis Cr. Summerland, B.C., July, August, 1916, 1917; Medicine Hat, Alta., July, August, 1916, 1917, (F. W. L. Sladen).

Philanthus (Anthophilus) multimaculatus Cam. Vernon, Summerland, Keremeos, B.C., July, 1916, (F. W. L. Sladen).

Prosopidæ.

Prosopis ziziae Rob. Ottawa, June, 1913, (F. W. L. Sladen).

Prosopis modestus Say. Kaslo, B.C., June, July, 1906, (J. W. Cockle); Ottawa, June, July, August, 1913; Kazubazua, Que., August, 1913, (F. W. L. Sladen).

Prosopis elliptica Kirby. Kaslo, B.C., June, 1906, (J. W. Cockle);

Prosopis varifrons Cr. Ottawa, June, 1913, (F. W. L. Sladen).

Prosopis cressoni Ckll. Ottawa, June, July, August, 1913, (F. W. L. Sladen).

Colletidæ.

Colletes lacustris Swenk. Toronto, August, 1887, (W. Brodie); Ottawa, June, July, 1913, (F. W. L. Sladen).

Colletes brevicornis Rob. Aweme, Man., June, 1913, (N. Criddle).

Colletes compactus hesperius Swenk. Similkameen, Okanagan, B.C., Sept. 1913, (T. Wilson).

Colletes armatus Patton. Toronto, August, September, 1885, 1890, 1893, (W. Brodie); Rostrevor, Ont., September, 1907, (A. Gibson); Kazubazua, Que., August, 1913; Hull, Que., August, 1913, on *Solidago;* Ottawa, August, September, 1913, (F. W. L. Sladen).

Colletes fulgidus Swenk. Peachland, B.C., July, 1909, (J. B. Wallis).

Colletes americanus Cr. Toronto, August, 1885, (W. Brodie); Kazubazua, Que., August, September, 1913; Ottawa, October, 1913, (F. W. L. Sladen).

Colletes similis Rob. Aweme, Man., August, 1913, (N. Criddle).

Colletes hyalinus Prov. Toronto, July to September, 1882 to 1893, (W. Brodie); Ottawa, June, July, 1913; Kirk's Ferry, Que., July, 1913; Kazubazua, Que., July, 1913, (F. W. L. Sladen).

Colletes mesocopus Swenk. Toronto, June, July, August, 1887-1893; Port Sidney, Ont., June, 1897, (W. Brodie); Kazubazua, Que., July, 1913, (F. W. L. Sladen).

Colletes eulophi Rob. Toronto, June, July, August, 1885-1893, (W. Brodie); Ottawa, June, July, 1913; Kirk's Ferry, Que., July, 1913; Kazubazua, Que., July, 1913, (F. W. L. Sladen).

Colletes phaceliae Ckll. (*Salicicola geranii* Ckll.). Teulon, Man.; Pincher, Alta., July 10, 1904, (T. N. Willing).

ODONATA.

Coenagrionidæ.

* *Enallagma vesperum* Calvert. Toronto, Ont., Aug. 16, 1907, (E. M. Walker); Trans. Amer. Ent. Soc., XLV, 380.

HEMIPTERA.

Cicadellidæ.

* *Euscelis hyperboreus* Van Duzee. West of Kongenevik, Camden Bay, Alaska, June 27, 1914; Bernard Harbour, N.W.T., July 15, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part F, p. 4.

NEUROPTEROID INSECTS.

Psocidæ.

Atropos pulsatoria Linn. Montreal, Que., Sept. 24, 1919, (E. H. Strickland).

Perlidæ.

* *Capnia nearctica* Banks. Bernard Harbour, N.W.T., June 25, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part B, p. 3.

Trichoptera.

* *Analobia emarginata* Banks. Teller, Alaska, July 29, 1913, (F. Johansen). Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part B, p. 4.

DERMOPTERA.

Forficulidæ.

Forficula auricularia Linn. Vancouver, B.C., in house, (R. C. Treherne).

ORTHOPTERA.

Acridiidæ.

Orphulella pelidna Burm. Fairview, B.C., Aug. 7, 1919, (E. R. Buckell). New to British Columbia.

Chloealtis abdominalis Brun. Salmon Arm, B.C., Sept. 29, 1919, (E. R. Buckell).

Xanthippus (*Hippiscus*) *vitellinus* Sauss. Fairview, B.C., (E. R. Buckell); Osoyoos, B.C., (W. B. Anderson).

Melanoplus cinereus Scud. Fairview, B.C., Aug. 7, 1919, (E. R. Buckell). New to Canada.

* *Asemoplus somesi* Hebard. Banff, Alta., (N. B. Sanson); Lake Louise, Alta, (Mrs. Schaeffer); Kitchener Glacier on Mt. Kokanee, B.C., (A. N. Caudell); Trans. Amer. Ent. Soc. XLV, 274.

Locustidæ.

Amblycorypha oblongifolia De. G. Pt. Pelee, Ont., Sept., 1905, (P. A. Taverner).

Collembola.

* *Achorutes sensilis* Folsom. Bernard Harbour, N.W.T., July 5, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part A, p. 5.

* *Onychiurus duodecimpunctatus* Folsom. Bernard Harbour, N.W.T., July 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part A, p. 6.

* *Entomobrya comparata* Folsom. Bernard Harbour, N.W.T., May, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part A, p. 13.

Thysanoptera.

Apterothrips subreticulatus Bagnall. This species was described in the Trans. Nat. Hist. Soc. of Northumberland, Vol. III, pt. 1, p. 185. The type locality is Massett, Q.C.I., collected most probably by J. H. Keen. I have also taken the species at Lillooet, B.C., July, 1918. The type is in the British Museum, (R. C. Treherne).

* *Ælothrips auricestus* Treherne. Vernon, B.C., Kelowna, B.C., July, 1917, (R. C. Treherne); Can. Ent. LI., 184.

* *Euthrips cameroni* Bagnall. Seamans, Sask., Aug. 4, 1917, (A. E. Cameron); An. Mag. Nat. Hist. IV, ninth series, 271.

* *Frankliniella varicorne* Bagnall. Seamans, Sask., Aug. 4, 1917, (A. E. Cameron); An. Mag. Nat. Hist., IV, ninth series, 269.

Acarina.

Cheyletidæ.

Cheyletus eruditus (Schrank). Montreal, Que., Sept. 24, 1919, (E. H. Strickland). First Canadian record, (E.H.S.).

Tetranychidæ.

* *Stigmaeus arcticus* Banks. Bernard Harbour, N.W.T., June 18, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part H, p. 11.

Araneida.

(Arranged according to Bank's Catalogue of Nearctic Spiders, U.S.N.M., Bull. 72. The numbers refer to the pages in the catalogue.)

Clubionidæ.

14\. *Clubiona riparia* Koch. Klondike Valley, Y.T., 1919, (W. E. Cockfield).

Linyphiidæ.

* *Microneta maritima* Emer. Cockburn Point, Dolphin and Union Strait, N.W.T., Sept., 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part H, p. 4.

* *Tmeticus alatus* Emer. Cockburn Point, N.W.T., Sept. 26, 1914; Bernard Harbour, N.W.T., June 27, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part H, p. 3.

Tmeticus conicus Emer. Klondike Valley, Y.T., 1919, (W. E. Cockfield).

Epeiridæ.

41. *Epeira carbonaria* Koch. Klondike Valley, Y.T., 1919, (W. E. Cockfield).
42. *Epeira diadema* Clerck. St. John's, Nfld., (A. English).

Thomisidæ.

48. *Xysticus limbatus* Keys. Klondike Valley, Y.T., 1919, (W. E. Cockfield).
49. *Coriarachne brunneipes* Banks. Klondike Valley, Y.T., 1919, (W. E. Cockfield).
51. *Tibellus oblongus* Wal. Klondike Valley, Y.T., 1919, (W. E. Cockfield).
52. *Philodromus pacificus* Banks. Klondike Valley, Y.T., 1919, (W. E. Cockfield). First Canadian record.

Lycosidæ.

* *Lycosa asivak* Emer. Bernard Harbour, N.W.T., June to September; Camden Bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part H, p. 5.

Pardosa albiceps Emer. Klondike Valley, Y. T., 1919, (W. E. Cockfield).

59. *Pardosa uncata* Thor. Klondike Valley, near Dawson, Y.T., 1919, (W. E. Cockfield).

INDEX

[illegible]