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

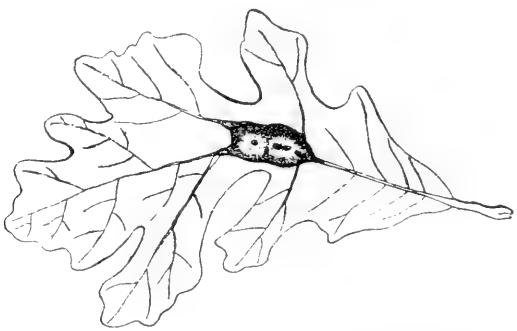

Fig. 1.—Gall produced by *Neuroterus flavipes* Gill on Bur Oak, *Quercus macrocarpa* Michx.

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.

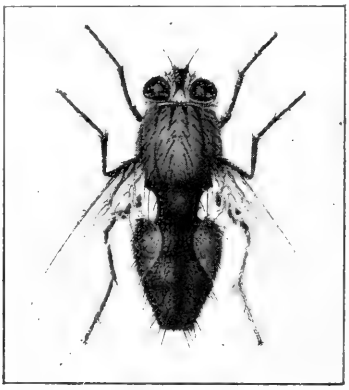

Fig. 2.—Compsilura adult. This excellent parasite of the Gipsy and Brown-tail Moths is now established in Canada. (After the U.S. Bureau of Entomology.)

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

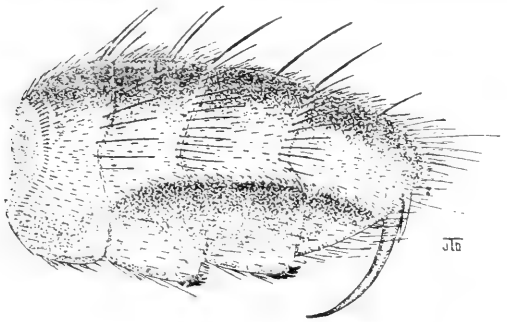

Fig. 3.—Abdomen of female *Compsilura* showing piercing device. The ventral part of segments 2, 3 and 4 is flattened into a keel shaped structure. Note the clusters of spines on segments 2 and 3 that have been developed for holding the caterpillar when using the piercer. (Original.)

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 redpolle'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; anothed 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, superbest 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 José 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

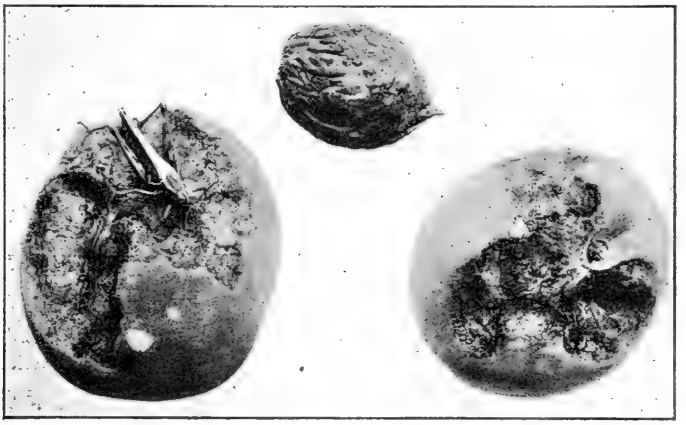

Fig. 6.—Ripening peaches damaged by grasshoppers. Sometimes only the seed remained attached to the tree.

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.

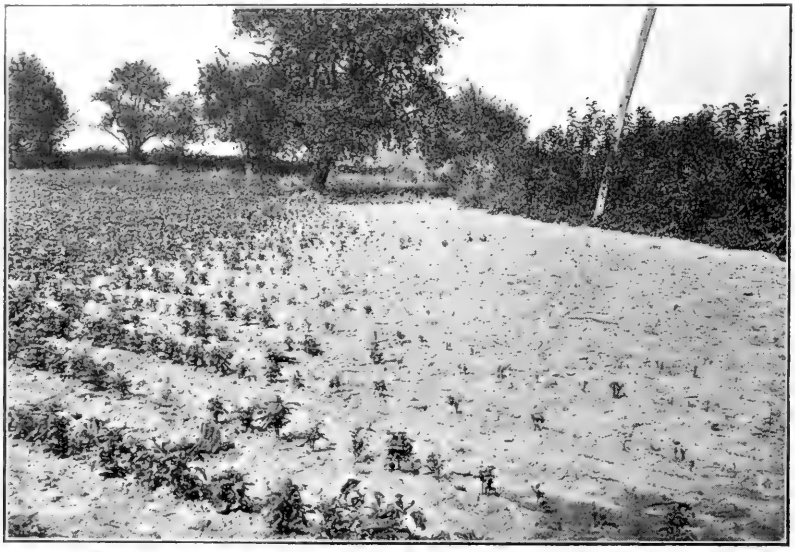

Fig. 7.—Field of navy beans being destroyed by grasshoppers entering from an adjoining field.

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.*

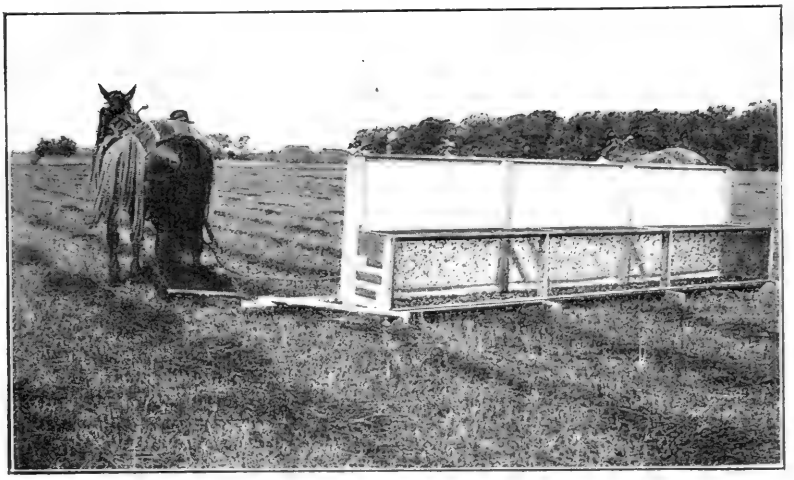

Fig 8.—Grasshopper catcher ready for action.

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.

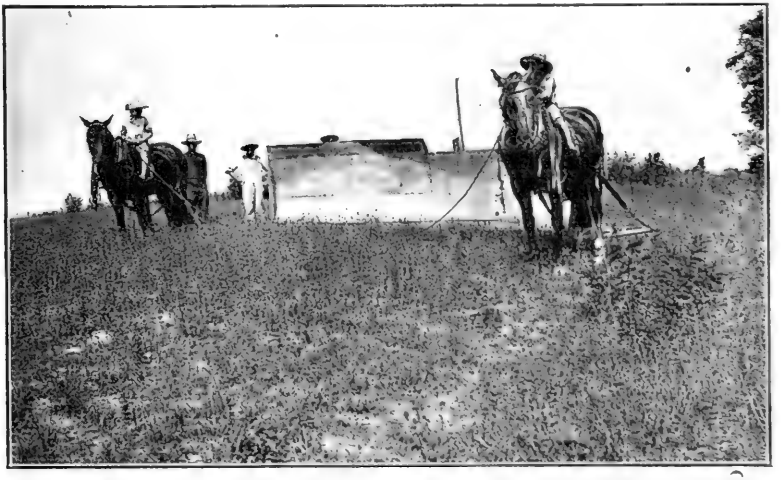

Fig. 9.—Grasshopper catcher in operation.

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 only 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

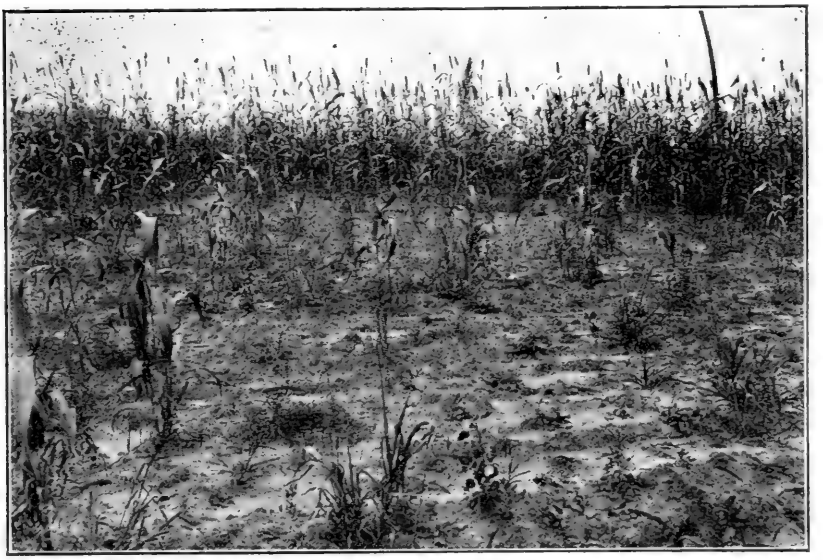

Fig. 10.—Field of cane damaged by White Grubs (*Lachnosterna* spp.)

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 trunck 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.

Studhalter. 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. of 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 insects, 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.

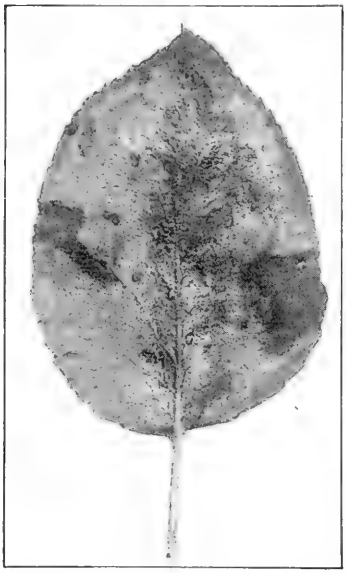

Fig. 14.—Leaf injury caused by pear psylla.

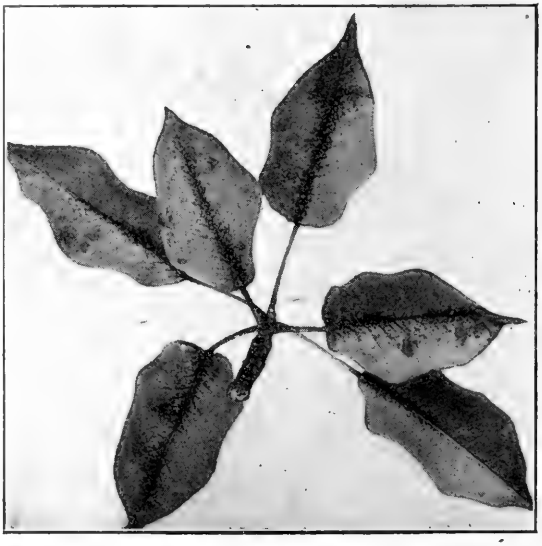

Fig. 15.—Leaves showing honey-dew fungus and nymphs.

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.

Duration of Incubation of 1st Generation Eggs.

Year.	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.

Duration of Incubation of 2nd, 3rd and 4th Generation Eggs.

Year.	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).

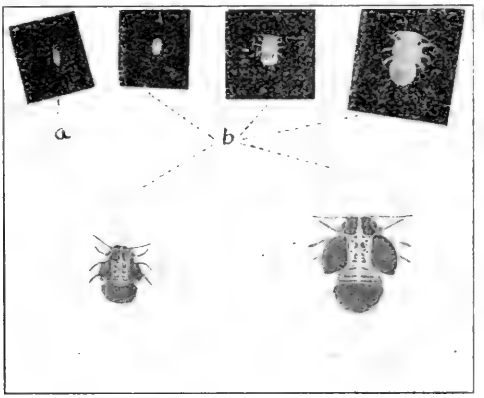

Fig. 18.—"*a*" Egg; "*b*" Various stages of psylla nymphs. (All much enlarged.)

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.

Length of Nymphal Life of Summer Forms.

Year.	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.

Length of Nymphal Life of Overwintering Forms.

Year.	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.)

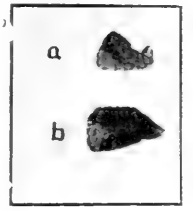

Fig. 20.—Abdomen of "*a*" male, and "*b*" female pear psylla. (Much enlarged.)

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 foliage 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 economies 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 contri-

butions 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*.

2521. *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 conmonus 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.

8477. *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 unisela* 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 cydoniae Fitch. Aweme, Man., Aug. 9, 1918, (N. Criddle); on *Crataegus* 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 betulae 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