

TWENTY-FIFTH ANNUAL REPORT
OF THE
ENTOMOLOGICAL SOCIETY
OF
ONTARIO
1894.

(PUBLISHED BY ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.)

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.



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Common names
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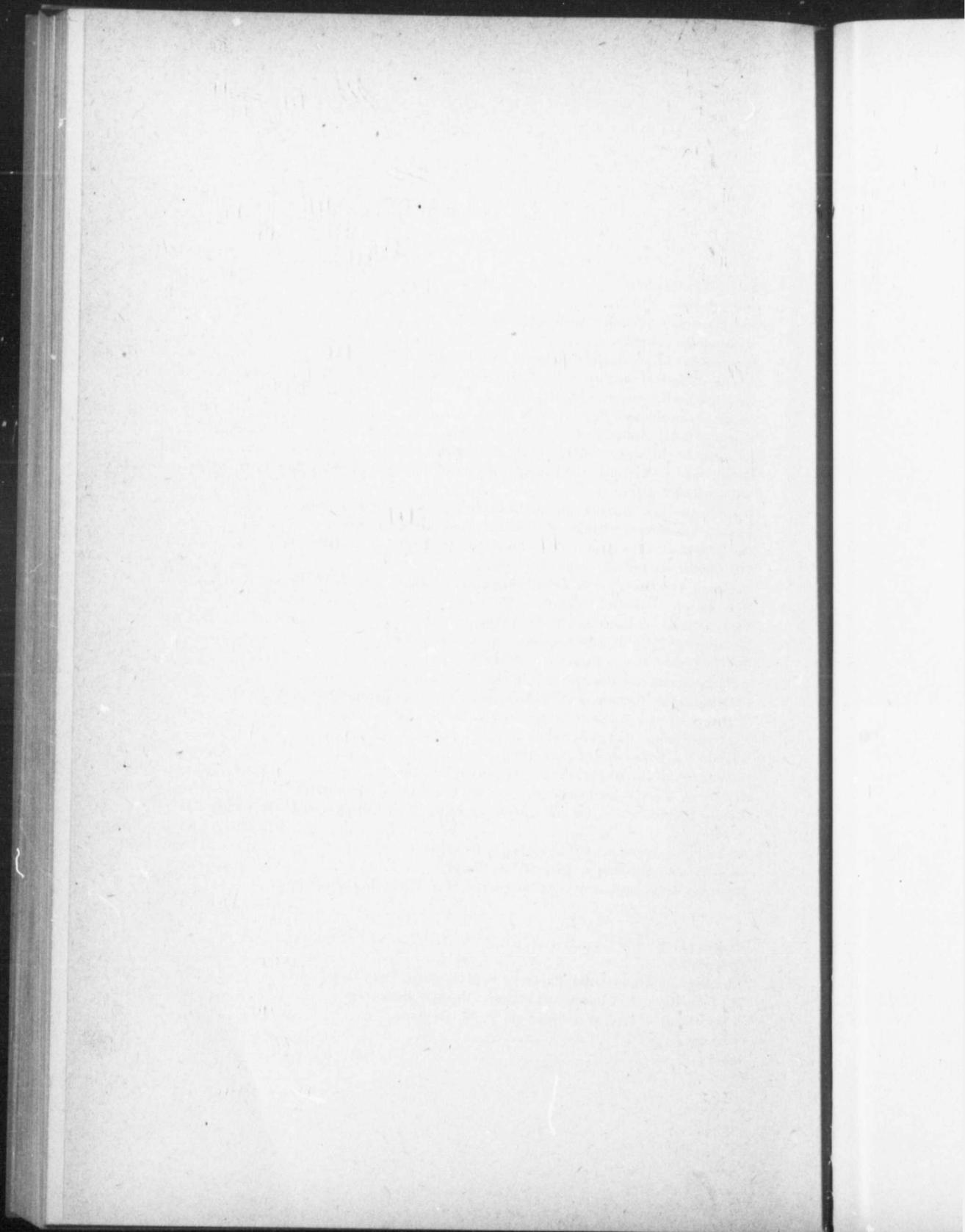
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Miscellaneous
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Obituary
Index . . .

CONTENTS.

	PAGE.
LETTER OF TRANSMISSION	1
LIST OF OFFICERS	2
ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY.....	3
Report of the Council	6
Report of the Librarian and Curator: J. A. MOFFAT.....	7
Annual Address of the President: W. H. HARRINGTON.....	9
Report of the Treasurer: J. A. BALKWILL	19
Report of the Montreal Branch: A. F. WINN	19
Report of the Geological Section: S. WOOLVERTON	20
Report of the Botanical Section: W. F. McCLEMENT	21
Report from the Entomological Society to the Royal Society of Canada: Rev. T. W. FYLES.....	22
Election of Officers.....	23
Insects collected in Bermuda during the winter of 1894: GAMBLE GEDDES.....	25
Common names for Butterflies—shall we have them: H. H. LYMAN.....	27
The Butterflies of the Eastern Provinces of Canada: Rev. C. J. S. BETHUNE.....	29
The Pitcher-plant Moth: JAMES FLETCHER	44
Catastega Aceriella Clemens, Semasia Signatana Clemens: Rev. T. W. FYLES	46
Notes on a few Canadian Coleoptera: W. H. HARRINGTON	47
Food, Feeders and Fed: Rev. T. W. FYLES	49
An Attack of Ephestia Interpunctella: H. A. STEVENSON	57
The Economic Value of Parasitism: F. M. WEBSTER.....	58
A Reappearance of Pieris Protodice, Boisduval: J. A. MOFFAT	61
Remarks on the structure of the undeveloped wings of the Saturniidae: J. A. MOFFAT	63
Bordeaux Mixture as a deterrent against Flea Beetles: L. R. JONES.....	66
The Gypsy Moth: JAMES FLETCHER	67
The San José Scale: JAMES FLETCHER	73
Injurious Fruit Insects of the year 1894: JAMES FLETCHER	76
SIXTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.....	82
A brief account of the rise and present condition of official Economic Entomology: L. O. HOWARD.....	82
Bisulphide of Carbon as an Insecticide: J. B. SMITH	102
Spraying with Arsenites vs. Bees: F. M. WEBSTER	104
Economic Entomological Work in the Parks of New York: E. B. SOUTHWICK	106
—————	
Professor C. V. Rile	112
Book Notices	113
Miscellaneous Entomological Papers by F. M. Webster, Feb., 1894	118
The Inter-Relation of Insects and Flowers: CHARLES ROBERTSON	119
A Pen Sketch of Prof. Wm. Saunders: F. W. GODING.....	120
Obituary	122
Index	125







PROFESSOR WILLIAM SAUNDERS, F.R.S.C.

Director of the Experimental Farm of the Dominion of Canada. President of the Entomological Society of Ontario, 1875-86. Editor of "The Canadian Entomologist," 1874-86.





AUGUSTUS RADCLIFFE GROTE, A.M.,

Honorary Member of the Entomological Society of Ontario (Elected Nov. 10, 1868); Vice-President of the American Association for the Advancement of Science, (1878), etc., etc.

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To the Honor

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TWENTY-FIFTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO

1894.

To the Honorable the Minister of Agriculture :

SIR,—I have the honor to submit for your approval the twenty-fifth annual report of the Entomological Society of Ontario. The Council feels a pardonable pride in drawing your attention to the fact that they have now completed a quarter of a century's work in the investigation of the life histories of insects and their relation to agriculture and horticulture, and have embodied the results of their researches in twenty-five annual reports and twenty-six volumes of the *Canadian Entomologist*. This somewhat uncommon success in the case of a voluntary scientific society is, they feel, largely due to the support which has been received from the Legislature of Ontario, and for which they desire to record their grateful thanks.

The President's address and the various papers on economic and general entomology which are contained in the accompanying report will be found, it is trusted, as interesting and as useful as on previous occasions.

I have the honor to be, Sir,

Your obedient servant,

W. E. SAUNDERS,

Secretary.

OFFICERS FOR 1895.

<i>President</i>	W. H. HARRINGTON	Ottawa.
<i>Vice-President</i>	J. W. DEARNESS	London.
<i>Secretary</i>	W. E. SAUNDERS	do
<i>Treasurer</i>	J. A. BALKWILL	do
 <i>Directors :</i>		
Division No. 1	JAMES FLETCHER	Ottawa.
“ 2	REV. C. J. S. BETHUNE	Port Hope.
“ 3	GAMBLE GEDDES	Toronto.
“ 4	A. H. KILMAN	Ridgeway.
“ 5	R. W. RENNIE	London.
 <i>Librarian and Curator</i>	 J. A. MOFFAT	 do
 <i>Auditors</i>	 { J. H. BOWMAN J. M. DENTON	 do do
 <i>Editor of the “Canadian Entomologist”</i>	 { REV. C. J. S. BETHUNE	 Port Hope.
 <i>Editing Committee</i>	 { J. FLETCHER H. H. LYMAN REV. T. W. FYLES J. M. DENTON J. H. BOWMAN	 Ottawa. Montreal. South Quebec. London. do
 <i>Delegate to the Royal Society</i>	 REV. T. W. FYLES	 South Quebec.
 <i>Committee on Field Days</i>	 { DR. WOOLVERTON, MESSRS. McCLEMENT, ELLIOTT AND STEVENSON	 London.

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ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY.

The thirty-second annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday and Thursday, November 7th and 8th, 1894, the President, Mr. W. H. HARRINGTON, F.R.S.C, of Ottawa, occupying the chair.

The meeting was called to order at 3 o'clock p.m. on Wednesday, when the following members were present: Rev. T. W. Fyles, South Quebec; Mr. H. H. Lyman, Montreal; Mr. James Fletcher, Ottawa; Rev. C. J. S. Bethune, Port Hope; Capt. Gamble Geddes, Toronto; Messrs. J. M. Denton, J. A. Balkwill, W. E. Saunders, J. A. Moffat, J. W. Dearness, W. Stevenson and H. P. Bock, London. A letter of apology was read from Mr. J. D. Evans, of Trenton, regretting his inability to attend the meeting.

After discussing the question of obtaining more suitable and commodious rooms for the society, which was also considered at the evening session, the first paper on the list was read by Capt. Geddes on "Some of the Insects of Bermuda collected during the Winter of 1893-4." The writer brought a number of interesting specimens to illustrate his remarks. Observations were made upon the paper by Dr. Bethune, who had visited the islands during the two previous winters and had found very few insects of any kind; the only butterflies he saw were *Danais Archippus* and *Junonia Coenia*, a few Geometer moths and Plusias flying about the lantana blossoms at dusk, and some beetles of the family Scarabaeidae. As Capt. Geddes's visit had extended over four months his opportunities were very much greater and he had succeeded in making a very interesting collection.

Capt. Geddes gave an account of a remarkably late brood of the Camberwell Beauty butterfly, *Vanessa Antiopa*. He found the larvæ feeding on the yellow and partly faded leaves of a young elm tree in his garden, which they nearly stripped of its foliage; many of the caterpillars fell to the ground with the falling leaves on which they fed. The butterflies from this brood came out in the house on the 6th and 7th of November.

Mr. Lyman gave an account of his observations of the various broods of *Vanessa Milberti*. Hibernated specimens of the butterfly appear in early spring; the first brood from these was flying on the first of July, and colonies of larvæ were found feeding on nettles early in the month. Very young larvæ were found again on the mountain at Montreal on the 20th of August; these became full grown on the 13th of September and changed to pupæ on the 18th. Late in October the full colors of the butterfly were showing through the chrysalis case, but when he left home on the 5th of November, the butterflies had not emerged. Mr. Scudder, in his work on butterflies, states that this species has three broods in the New England States. Mr. Lyman thought that those now in the pupa state were the third brood at Montreal.

Dr. Bethune exhibited some specimens of rare Lepidoptera that he had taken this summer. Among them were *Limenitis Proserpina*, captured at Roach's Point, Lake Simcoe, on the 22nd of August; *Sphinx luscitiosa*, attracted by light at Port Hope, in June; a variety of *Catocala ilia* taken at sugar in July; *Plusia venusta*, Walk. (*striatella* Grote), attracted by light; an immaculate specimen of *Pieris rapæ*, etc. Mr. Fletcher stated that *L. Proserpina*, though excessively rare, had been taken at Rideau Hall, Ottawa.

Mr. Lyman read an interesting paper on "Common Names for Butterflies, Shall We Use Them?" In the discussion that followed Mr. Fletcher stated that common names would be given for all the Canadian species of butterflies in the handbook that he and Dr. Bethune were preparing for publication. The general opinion of those present was that it is highly desirable that ordinary English names should be used as far as practicable in order to promote the study and observation of insects.

Dr. Bethune then read "A List of the Butterflies of the Eastern Provinces of Canada," which contained no less than 116 species, of which the localities and in most cases the food plants and times of flight were given. The paper was commented on by Capt. Geddes, Messrs. Fletcher, Fyles and Lyman, who contributed much interesting information regarding a number of the species.

Mr. Fletcher exhibited specimens and gave an account of the remarkable habits of the moth *Ecxyra Rolandiana*, the larva of which feeds upon the leaves of the pitcher plant, *Sarracenia purpurea*. He also exhibited an interesting collection of butterflies sent by Mr. Green, of British Columbia, and gave an account of a visit he made to Sudbury in May last, when, notwithstanding a snow storm that prevailed, he procured the larva of *Pamphila metacomet*, which fed on carex, and which he succeeded in rearing. He made some interesting remarks upon *Colias elis*, *nastes* and *interior*, and gave an account of a rearing of *Colias eurytheme*, the eggs of which he had obtained at Nepigon in June. When the chrysalids were beginning to show the color of the butterfly he retarded their development for some weeks by placing them in a refrigerator, while emergence was hastened by exposure to electric light. He also showed some specimens of *Papilio Bairdii* and *P. Oregonia* received from Mr. Edwards, who had this year added yet another to his laurels by proving that these very dissimilar butterflies were really dimorphic forms of one species. Mr. Edwards had gone to Colorado and with great care had bred broods of larvæ from eggs laid by both forms and had obtained from each brood some of both kinds of the butterflies named. This, the speaker said, he considered one of the greatest triumphs of this wonderful man. He had had the great pleasure of meeting Mr. Edwards in his own beautiful home amongst the mountains of West Virginia, where he hoped he would long be spared to carry on his useful studies with his characteristic energy, perseverance and accuracy.

Mr. Fletcher next exhibited specimens of *Pamphila metacomet* in all stages, egg, larva, pupa and cocoon and perfect butterfly, as well as an egg parasite, which had been named by Mr. Ashmead *Telenomus pamphila*, n.s. It was agreed at the last annual meeting that each member should try to work out the life history of at least one insect in time for this meeting: he had devoted his attention to *P. metacomet*, which is as a rule rarely taken at Ottawa. This fact, however, he thinks has been due to a want of knowledge as to its habits. He had previously taken the butterfly only in open glades in a wood, but the larvæ feed on carices growing on exposed rocks. The food plant of this species as well as that of *P. mystic*, which he had also bred this year, was, he thought, not grasses, but sedges (carex), although in confinement they would eat grasses. The eggs are laid in July and the caterpillar passes two or sometimes three moults the same autumn and then hibernates in a case made by spinning three or four of the leaves of the food plant together. The larva is pale green, closely lined all over with broken white lines and covered with minute black piliferous tubercles. The most remarkable part of the larva is the head which is ornamented differently from that of any other species of the genus he was acquainted with. On the front, at the apex, is a large, velvety black area edged with white, and down either side of the face run two white lines with a dark area between them; behind these lines the head is black. The thoracic shield is ribbon-like, double, white in front, black behind. Just previous to pupation two large, white patches were plainly visible through the skin beneath segments 11 and 12. When ready to pupate the larva spins a close cocoon, similar to that of *Acronycta obliqua*, the end of which is stopped up with a silvery white, flakey powder which is emitted through the skin (apparently) from the two white patches mentioned. In three or four instances the pupa worked its way out of the cocoons and fell to the ground. It is piceous, when cleaned of the white silvery powder, slender and much elongated. The tongue case protrudes beyond the wing cases as in *Pamphila cerne*, etc. The abdomen beneath is closely covered with tawny bristles which are thickest at the cremastral end. The end of the body is furnished with about six short blunt spikes and on each side two larger ones. A more detailed account of the stages will appear later in the *Canadian Entomologist*.

The Rev. T. W. Fyles read a short paper on "*Catastega aceriella-Semasia signatana*." In answer to an enquiry whether *Nematus Erichsoni*, the Larch saw-fly, was

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still at work, he stated that it was still operating in the Province of Quebec, but in greatly reduced numbers. A tree here and there had been stripped this summer; in some cases part of the tree only had been affected. The insects were now attacking young trees—those from about ten to twenty or more feet in height. They seemed on their first arrival to pass by these, he supposed because the foliage of the more mature trees was more palatable to them. Some trees near Quebec that had been badly attacked and that he once thought would die, seemed to have made a struggle for life and had sent out numbers of small twigs on the stems and main branches, so as to present a very scrubby appearance. He had not been able to visit the large swamps in the Townships, but he believed the state of things there to be such as he had described in the society's Reports. He had been surprised to find in parts of the Gomin swamp affected by drainage numbers of small tamaracks from six inches to several feet high, where a few years ago none were to be seen. Mr. Harrington stated that in Cape Breton also he found young tamaracks growing up.

Mr. Fyles next gave an account of a strange food for the larvæ of *Pyralis farinalis*. He said that in the society's Report for 1893, page 42, he gave a description of a *Lithocolletis* larva that he found feeding in blisters on the leaves of the white hazel, and which he hoped to rear. When full fed the larva spun a cocoon inside the blister, but his hope of obtaining the perfect insect was defeated in a strange manner. One the 3rd of March he examined the glass jar in which he had stored the blistered nut leaves, and over which he had tied a muslin cover. To his great surprise he found a number of Pyralid larvæ feeding upon the leaves. He described them as follows: Length, when extended, nine-tenths of an inch; head and prothoracic and anal plates, nut brown; the rest of the body, lead color; dorsal line, black. The appearance of the larvæ seemed familiar to him, but he let them be. They ate up the nut leaves, leaving only a tangle of the ribs and veins. In due time they produced a number of fine specimens of the moth *Pyralis farinalis*, Linn.

Mr. Fyles stated that he wished to rectify a mistake. In the list of captures on page 41 of the annual Report for 1893 occurs the name *Anisota senatoria*; it should be *Anisota virginensis*, Drury.

Mr. Harrington exhibited a collection of beetles from Japan, many of which were very beautiful and remarkable.

Mr. Lyman showed a box of specimens collected by Mr. Bean, at Laggan, Alberta, among which was a series of the moth *Nemophila petrosa*. An excellent photograph of these had been made, and it was resolved, on motion of Mr. Fletcher, seconded by Dr. Bethune, that Mr. Lyman be requested to have a plate prepared for publication in the *Canadian Entomologist*.

Mr. Fletcher exhibited a small collection of diurnals which had been sent down for identification by Mr. A. W. Hanham, of Winnipeg. Attention was drawn to specimens of *Thymelicus Garita*, this being probably the most eastern record; *Lycæna Melissa*, *Thecla Acadica* and three specimens of *Thecla strigosa*, all of which showed the large fulvous spots similar to the specimen figured by Boisduval and Leconte as *T. Liparops*. This form was very rare at Ottawa, the speaker having taken only two specimens in many years.

While on his feet Mr. Fletcher said he wished to mention that a good deal of work had been done during the past season in collecting insects in distant places in Canada.

Mr. A. P. Low, of the Geological Survey, had made a collection of diurnal Lepidoptera and Coleoptera in his journey across Labrador, specimens of *Pyrgus centaureæ*, *Chionobas jutta* and *Colias Scudderii* were exhibited. Dr. G. M. Dawson and Mr. J. McEvoy had collected in the mountains about Ashcroft, B.C.; Messrs. C. de B. Green and Edmund Reynolds had made large and valuable collections of Lepidoptera in the mountains at Osoyoos, B.C., just north of the boundary of Washington State. Specimens were exhibited of *Papilio Daunus*, *Oregonia*, *Rutulus var. Arizonensis*, *Tarucus*, *Satyrus Etus*, *S. Ariane*, *Lycæna sagittigera*, *L. Heteronea*, *Pieris Beckerii*, *Colias Emilia*, *Anthocaris Sara*, *A. creusa*, *Thecla dumetorum*, *Pterogon Clarkii* and many other

rarities. Mr. Fletcher was glad to be able to announce that Mr. Green intended next year to collect as a business. His address for the present is Osoyoos, B.C., and intending purchasers would do well to correspond with him at once. Mr. Green and Mr. Reynolds had both added new species this year to the Canadian list. At Calgary Mr. C. Wolley-Dod had done good work in collecting and providing Mr. W. H. Edwards with eggs of *Chionobas Alberta*, the larvæ from which had been successfully taken through all their stages. At Olds, 40 miles from Calgary, Mr. T. N. Willing had also done good work, and had taken, among other rarities, *Erebia discoidalis* and *Argynnis Edwardsii*. Prof. John Macoun had this year collected at Crane Lake, in the same district, and had added *Hipparchia Ridingsii* to the Canadian list. In Alaska collections of insects had been made by Messrs. Otto Klotz and W. Ogilvey, of the Boundary Survey, as well as by some of the other members of the party. This material was chiefly diptera, coleoptera and hymenoptera. It had not as yet been worked up. In the Rocky Mountains Mr. T. E. Bean continued his studies. Through his kindness eggs had been received by the speaker of *Colias Elis*, of which bred specimens of the larvæ and imago were exhibited, *Colias nastes* and other rare species. Some beautifully blown larvæ prepared by Mr. Bean were shown. Mr. W. McInnes and Mr. J. C. Guillim, of the Geological Survey, had collected east of Port Arthur, the latter gentleman taking *Euptoieta Claudia* at Wabigoon, on the C. P. Ry. In Manitoba collections had been made by Mr. Hanham at Winnipeg, and a very remarkable collection by Mr. E. F. Heath, near Cartwright, Man., some most surprising captures had been made as *Vanessa Californica*, *Nathalis Iole*, and a *Thecla* which is probably undescribed. Mr. Heath has also sent the cocoons of some splendid specimens of *Samia Columbia* which were exhibited, and compared with specimens found at Ottawa on tamarack. The northwestern food of this species is *Elcagnus argentea*, and the moths are always distinguishable by their much redder hue.

Mr. Harrington gave some interesting "Notes on Canadian Coleoptera," relating how he had obtained a hair-snake from a *Coccinella*, and found the larvæ of a beetle, *Brachyacantha ursina*, feeding upon plant lice in an ant's nest, with other noteworthy matters, which will be found detailed in his paper.

The meeting adjourned at 6 o'clock p.m.

EVENING SESSION.

In the evening the society held a public meeting in its rooms in Victoria Hall, at which there was a largely increased attendance of members, between thirty and forty being present. Besides those already mentioned at the afternoon meeting, the following were noticed: Messrs. R. W. Rennie, J. G. Wilson, J. H. Bowman, Dr. S. Woolverton, J. H. Pearce, W. T. McClement, W. Scarrow, etc.

The chair was taken by the President, Mr. Harrington, at 8 o'clock. After apologizing for the absence of Mr. Kilman and Mr. Evans, the Chairman called upon the Secretary to read the

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario beg to present the following report of their proceedings during the past year:

They are happy to congratulate the members of the society upon the steady increase in numbers which continues to take place, and the hearty interest that is maintained in the various departments of work.

The twenty-fourth annual report on Economic and General Entomology was presented to the Minister of Agriculture in November last, and was printed and distributed at the beginning of January. It consisted of one hundred and eleven pages, a much larger number than usual, and was illustrated with thirty-nine wood cuts and a portrait of the Editor, who was for several years President of the society. Among the more important and interesting papers may be mentioned Mr. Fletcher's account of "The Injurious

Insects of the Authors," by Mr. McLaughlin in their annual meeting the principal

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Insects of the Year 1893"; the President's Address; "Entomological Mistakes of Authors," by the Rev. T. W. Fyles; "Mosquitoes," by Mr. Moffat; "Dragon Flies," by Mr. McLaughlin; "A Contrasted Summary of the Main External Characters of Butterflies in Their Different Stages of Life," by Mr. S. H. Scudder, and a report of the fifth annual meeting of the Association of Economic Entomologists, together with a number of the principal papers.

The *Canadian Entomologist*, the monthly magazine published by the society, has been regularly issued at the beginning of each month, and completed its twenty-fifth volume in December last. It consisted of 334 pages, being the largest number yet published. Of the twenty-sixth volume eleven numbers have already been issued; the increase in the number of pages has been more than maintained, 328 having been already published. No less than fifty-two wood cuts have been used to illustrate papers, a large proportion of them being new and original. Among the many valuable and interesting papers that have been published, mention may especially be made of the series of illustrated articles on the "Coleoptera of Ontario and Quebec," by Mr. Wickham, which are intended especially to assist beginners in naming their specimens, and to lead them on to a more thorough study of the order. The list of contributors includes the names of the most eminent entomologists in North America, as well as several in Europe.

The collections of specimens belonging to the society have been increased during the past year by the addition of a number of coleoptera new to the Canadian lists by Mr. A. H. Kilman, of Ridgeway, and a collection of insects from San Domingo. Improvements are also being steadily made by the substitution of fresh specimens for those that are faded or imperfect in the cabinets.

The geological, microscopical and botanical sections of the society have held regular meetings during the past season and have done much good work, as is shown by their respective reports. It is to be regretted that the ornithological section has not been so active as in former years, but it is trusted that interest in this department will speedily be revived.

The treasurer's report is highly satisfactory. The expenditure on the *Canadian Entomologist* has necessarily been increased by its enlargement, but this has been fairly met by the steady growth in the number of subscribers and by the sale of back volumes. The balance on hand at the close of the financial year is \$360.50. This will be entirely absorbed by the necessary expenses of the remaining months of the year. The Council take this opportunity of recording their appreciation of Mr. Balkwill's services as treasurer and the satisfactory mode in which his accounts are kept.

The society was represented at the annual meeting in Ottawa of the Royal Society of Canada, in May last, by the Rev. T. W. Fyles. We have much pleasure in recording that two of our members were elected fellows, namely, our President, Mr. W. H. Harrington, and the Rev. G. W. Taylor, of Nanaimo, B.C.

All of which is respectfully submitted.

W. E. SAUNDERS,
Secretary.

REPORT OF THE LIBRARIAN AND CURATOR.

Mr. J. A. Moffat presented and read his report as follows:

I beg leave to submit my report for the year ending 31st of August, 1894.

Seventy-seven volumes have been added to the Library during the year; these include bound volumes received from public institutions and scientific societies, exchanges collected and bound, also books obtained by purchase.

The more important of the bound volumes received are, The Reports of the Missouri Botanical Garden for the years 1891 and 1893.

Annual Report of the Ontario Department of Agriculture for 1892.

The Smithsonian Report for 1891.

Report of the New York State Entomologist for the years 1891 and 1892.

Report of the New York Agricultural Experiment Station for 1892.

Reports of the New York State Museum for the years 1892 and 1893.

Proceedings and Transactions of the Royal Society of Canada for 1893.

Iron-bearing Rocks of Minnesota.

Added by purchase: A popular handbook of the Ornithology of the United States and Canada, based on Nuttall's Manual: by Montague Chamberlain, 2 volumes. All the Entomological writings, up to date, of J. W. Tutt, F. E. S., England, editor of "The Entomological Record and Journal of Variation." Also his instructive and amusing book entitled, "Random Recollections of Woodland, Fen and Hill"; seven volumes in all. These were obtained in exchange for back volumes of the *Canadian Entomologist*.

There are now four hundred and eighty-five pamphlets in the Library, bound in twenty-seven volumes. These volumes are labelled "Pamphlets," and numbered consecutively from 1 to 27, but have their number in the Register according to the time they were bound and placed in the Library. The pamphlets are numbered in order, and catalogued in a book by themselves, giving the Library number as in the Register, the number of the pamphlet volume, the pamphlet number, with the author's name, the subjects, and the date of issue where obtainable.

The whole number of volumes on the Register is now 1,361. The number of volumes issued to local members during the year was forty-four.

Additions are still being made to the Society's collection of native lepidoptera by the capture of species hitherto unrepresented therein; twenty named forms being added during the year, which had not before been published as Canadian. There are now 1,077 named forms in this department, as against 930 in 1892. A steady improvement in the quality of the collection is also being made by the replacing of such as are not in perfect condition, with fresh material obtained by capture or exchange.

The first important addition to the Society's collection of native Coleoptera for several years was made by Mr. A. H. Kilman, of Ridgeway, Ont., in a donation of a hundred and fifty species.

A small but highly interesting collection of Santo Domingo insects was presented to the Society by a friend, the captures of his sister, Miss Davida Rougoie, who is at present a resident of that island. The most noticeable feature of it being three specimens of *Mantis* of strikingly different form, color and ornamentation, indicating that it is an abundant family in that locality.

Through the kindness of Mr. A. P. Morse, of Wellesley College, Mass., the Society has been put in possession of representative specimens of three species of New England *Spharagemon*, also his paper, historical and descriptive, of the same.

All of which is respectfully submitted.

J. ALSTON MOFFAT,
Librarian and Curator.

The President then read his annual address, which was listened to with great interest and attention:

GENTLEMEN,
I sincerely thank you for the presence of the President at the meeting. The Annual Report is now before you, and I trust you will find it interesting and profitable to listen to it.

My good wishes are for the success of the Society, and for the progress of the science of entomology, and for the welfare of our country.

The Report of the Society is now before you, and I trust you will find it interesting and profitable to read it. It contains many interesting facts, and I trust you will find it well worth your attention.

After calling your attention to the Report, I will now read a paper on the "Canadian Entomologist," and I trust you will find it well worth your attention. It contains many interesting facts, and I trust you will find it well worth your attention. We need not compare it with the *Canadian Entomologist*, but my presence here is as a record of the vast extent of our work. We need not compare it with the *Canadian Entomologist*, but my presence here is as a record of the vast extent of our work.

It is with pleasure that I have been able to present to you the Report of the Society, and I trust you will find it well worth your attention. The Society is now in a position to appear in the world, and I trust you will find it well worth your attention. Among the descriptions of the interesting and beautiful insects, I trust you will find many that are new to you.

ANNUAL ADDRESS OF THE PRESIDENT.

BY W. HAGUE HARRINGTON, F.R.S.C., OTTAWA.

"An ant slow-burrowing in the earthy gloom,
A spider bathing in the dew at morn,
Or a brown bee in wayward fancy borne
From hidden bloom to bloom."

—Lampman.

GENTLEMEN,—My first duty to the members of the Entomological Society is to sincerely thank them for the honor which they conferred upon me in re-electing me to be their President, notwithstanding my inability to be present with them at the last annual meeting. Those among you who may afterwards have read my address, as printed in the Annual Report, may perhaps have congratulated yourselves that I did not appear at the meeting and read it to you in extenso. You need not, however, be alarmed lest you have to listen to such an over-lengthy document on this occasion.

My good friend, Mr. Fletcher, has kindly consented to address you on the injurious insects of the past season, and thus I am relieved of a task for which he is more competent, and for which his official duties so fully qualify him. You shall, I rest assured, find his remarks to be most interesting and profitable to you, both as regards economic and scientific questions.

The Report prepared by the Council will inform you as to the work performed by the Society during the year, and as to its present financial standing and prospects, so that, with regard to these points, I need merely express my sense of a lively satisfaction in the knowledge that continued prosperity and success crown the efforts which you are making to advance an interest in, and a truer knowledge of the attractive and deeply interesting science of entomology, for the study of which you have been banded together for so many years.

After careful consideration of several topics which occurred to me as worthy of your attention, I decided that a brief review of the results of the past twenty-five years might not be unprofitable. I shall base my remarks upon the volumes of the *Canadian Entomologist*, and shall afterwards endeavor to indicate the direction in which future work may be advantageously undertaken. The splendid series of twenty-five volumes of the *Canadian Entomologist*, which have already been completed, constitute a veritable treasure-house of information regarding the insects of North America. The value of their pages has been greatly increased by the constant contributions from the leading entomologists of the neighbouring Republic, and by frequent articles from European correspondents. The valuable papers received from these sources have dealt largely with the Canadian fauna, and have often been based upon the captures of our members in Canada, but my present remarks will be confined to a discussion of the work of our home members as recorded by themselves. These laborers have ever been few in proportion to the vast extent of country of which it is our privilege and duty to investigate the insect life. We need not be surprised, therefore, because the investigated districts are very limited in comparison with the still unexplored fields which are waiting to yield up their treasures to the careful investigator. The areas in which systematic and sustained work has been done are, in fact, so few and so limited in extent, that on a map they appear almost as mere starting-points.

It is worthy of note that the labors of editing the twenty-five volumes of the *Entomologist* have devolved equally upon Prof. Saunders and Dr. Bethune; each of these gentlemen having edited twelve volumes and shared in the editing of volume eighteen. The Society has owed much to the zeal and work of these gentlemen, whose contributions appear in nearly every volume, and much exceed the efforts of any other member. Among their contributions are many valuable papers on our lepidoptera, containing descriptions of their earlier stages, and also of some new species. Another series of very interesting and valuable papers was that "On Some of our Common Insects," designed to arouse the interest of some of those who might be taking up the study of entomology,

and to stimulate them to become earnest workers. We are glad to know that these learned friends, who have, in the past, done so much for our Society and for the study of entomology, are still connected with us in the work which we are carrying on. Dr. Bethune continues to be our efficient editor, and under his wise and careful direction our publication continues steadily to improve, and to hold a foremost place in entomological literature. Prof. Saunders, although called to a position making great demands upon his time and strength, still keeps up his interest in our special line of scientific work. A few years ago he embodied his researches in that excellent treatise on "Insects Injurious to Fruits," which, since its appearance, has been a standard work, and has had a very large circulation throughout North America.

One of the most useful and important features of the earlier volumes was the compilation by Dr. Bethune, from Kirby's *Fauna Boreali-Americana*, of the "Insects of the Northern Parts of British North America" (afterwards republished as a separate volume), which placed the descriptions of a great many of our insects in the hands of students who might not otherwise have been able to obtain them, the original publication being very rare.

Before commencing this address I made a list of some fifty Canadian contributors, the majority of whom still continue to send in valuable papers. Several, however, have passed to the "Happy Hunting Ground" beyond the "Great Divide," while others have either removed from the Dominion, or through pressure of business and new occupations, have ceased to contribute; though in some cases still keeping up their collections and their interest in the study and work of the Society. My intention is not to go at length into the writings of individual members, nor can I make any reference to the many valuable papers specially prepared for the Annual Reports furnished to the Ontario Government. But I shall try to bring my subject before you in two ways: first, from a geographical standpoint, that you may see in what districts our insects have been studied; secondly, from a systematic point of view, that you may see which orders have received attention, and which have been, in whole or in great part, neglected.

As our Society is provincial, in so far as regards its name and the liberal support which it annually receives from the enlightened Legislature of Ontario, so the larger portion of the work accomplished by it has naturally related to the insects of the Province in which it was organized and by which it is sustained. A good starting-point for our proposed tour of inspection will be London—the beautiful city in which we are now met, and which, as the headquarters of the Society, has been for many years the Entomological Mecca to which we annually resort to renew our strength and zeal in the good work, and to arrange our plan of campaign for the coming year.

Here Prof. Saunders toiled for many years, and, with the later assistance of his sons, made most extensive collections. His papers do not, however, include any lists of the species which he collected in the various orders, and the same remark may apply to Messrs. Denton, E. Baynes Reed, Williams and others whose captures have so largely enriched the collections of the Society. The London members, however, had for many years almost the entire management of affairs of the Society, and the preparation of the Annual Reports, the arrangement of the collections, the care of the library, etc., occupied much time that might otherwise have been devoted to special lines of research.

At Grimsby Mr. J. Pettit, in the earlier years of the Society, was a very skilful and assiduous collector, and his list of the coleoptera taken in that neighborhood, which he commenced in the first volume, is one of the most complete local catalogues yet published in Canada. The Hamilton district has been investigated by such competent collectors as Messrs. Moffat, Murray, Johnston and Hanham. The first of these gentlemen has made many valuable contributions to our publications, and is now continuing his good work in London, where he has the charge of the collections and library. Mr. Geo. Norman, of St. Catharines, published a very interesting list of the Noctuidæ captured there by him. At Ridgeway we find a member of our Council, Mr. A. H. Kilman, who has made extensive collections in what seems to be a very rich district; but while he has added largely to the knowledge of our insects, he has not yet published as much regarding them as we should like him to do.

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Toronto, as the chief City in Ontario and the seat of various and important institutions of learning, should furnish us many capable investigators, but I find that the workers there have never been numerous; nor do the local natural history societies appear to have done much to develop them. I must mention, however, our first President, Prof. Croft, with Mr. W. Brodie and Capt. Gamble Geddes. Mr. Brodie has accumulated large collections, and he has published a few interesting articles in our magazine (and more recently in the "Biological Review of Ontario,") upon various gall-forming insects. Capt. Geddes has been a most enthusiastic gatherer of lepidoptera, amassing a collection of butterflies unequalled in Canada, and which has since been purchased by the Geological Survey of Canada. His interesting papers upon Canadian butterflies appear in several volumes of the *Entomologist*.

Port Hope has been the home of Dr. Bethune, so we may rest assured that the country round about has been well investigated. I have not yet had the pleasure of seeing his fine collections, and as regards the extent and value of his writings upon our insects I have already spoken. At Belleville we have had such well-known collectors as Prof. J. J. Bell and Prof. Macoun. The former paid much attention to the smaller forms of coleoptera, and was a frequent contributor to the *Entomologist*. As for Prof. Macoun, he is now a naturalist of world-wide reputation, who has been most assiduous in making known the fauna and flora of the Dominion, and although the great demands upon his time do not permit him to continue the study of entomology, he still continues, I am glad to say, the collection of insects as opportunity permits. In the neighboring town of Trenton very careful work has been done by Mr. J. D. Evans, one of the most thorough collectors with whom I have corresponded, and whose collections are models of neatness and skill, in mounting and arrangement.

A branch of the Society formerly existed at Kingston, but I do not find the record of any work except by Mr. R. V. Rogers, from whom we have had several interesting papers. With such a well-known university as Queen's located in the city, there should be more activity in the development of the natural history of the locality. Ottawa in the early days of the Society was the residence of one of our most noted collectors, the late Mr. B. Billings, who was a contributor to Vol. I. His collections were extensive and were very carefully and skillfully prepared, but death cut short his labors, and his collections were mostly destroyed through want of proper care on the part of the Society into whose hands they passed. Of recent years there has been an active, if not large, body of investigators, who have striven to develop a full knowledge of the local fauna, and who have been able to do some useful work in other directions. Prof. Saunders is now there, as Director of the Experimental Farms, in connection with which our good friend, Mr. Fletcher, holds the position of Entomologist and Botanist. The value and authority of his official work, and his enthusiasm in all entomological matters, are recognized by every entomologist. Your out-going President is also to be found in the Capital, when at home, but it would not be quite the correct thing to give any opinion on his work, as you might think me a prejudiced judge. The Ottawa Field-Naturalists' Club, organized in 1879, has always had an Entomological Branch, and several other of its members are doing fair work, among whom I may cite Mr. T. J. MacLaughlin, one of the few collectors of odonata in Canada. Several entomological lists, with numerous reports and papers have been published in the *Transactions of the Club* (now the *Ottawa Naturalist*), and Mr. Fletcher has now ready for publication a complete catalogue of the Ottawa butterflies.

Occasional workers have been stationed at other points, as, for instance, Rev. V. Clementi at North Drury, Mr. N. H. Cowdry at Stratford and Mr. B. Gott at Arkona. In the Lake Superior region the only sustained work has been by Mr. Evans at Sudbury, where he made a most interesting, and fairly complete, collection in several orders. Many rare insects have been captured by him and it is much to be regretted that he has not yet found time to publish the lists which he has had in preparation. Nipigon has several times been visited by Mr. Fletcher, and in one of the annual reports can be found an interesting account of the work done there. Dr. Bethune has also published observations made during a trip to Lakes Huron and Superior.

In the adjoining Province of Quebec we find the work of the Ottawa members naturally extending across the Ottawa river to a country which within a few miles is diversified by outlying spurs of the Laurentians, with some consequent change in the flora and fauna. A strong branch of our society is located in Montreal where much effective work has been done by the resident entomologists. It is only a few years since the branch sustained a great loss in the death of their former President, Mr. Bowles, who had made a study of the lepidoptera of the Island of Montreal, and had written frequent papers on the species collected. Mr. Lyman, who I am glad to see with us today, has for several years been the President and has shown great interest in its success, and in the continuance of its meetings. He has made a careful study of the lepidoptera, and has accumulated a splendid collection, while his contributions to the *Entomologist* have been numerous and of unusual interest. The late Mr. Caulfield was an industrious collector, and careful observer, who contributed severable valuable lists and other papers, relating chiefly to the insects of the Island of Montreal. Another member who resided there was the late Mr. W. Couper (also of Quebec and Ottawa) a frequent contributor to our earlier volumes. Among other Montreal workers may be mentioned Messrs. Jack, Winn, Hausen, Gibb, Wintle, etc. The Natural History Society has always taken some interest in entomology, and on its annual field-day encourages by suitable prizes the collection of insects by the young people. The *Canadian Naturalist and Geologist* and its successor the *Canadian Record of Science* have from time to time published entomological papers, such as the late Mr. Ritchie's list of local coleoptera, Mr. Caulfield's paper on Canadian orthoptera, and Mr. Hausen's list of coleoptera collected at St. Jerome.

Going down the St. Lawrence we reach Quebec, the scene for many years of the labors of the late Abbe Provancher, whose Faune Entomologique is a monument to his industry and perseverance in the collection and study of our insects, under more than usual difficulties and discouragements. Mr. Bowles and Mr. Hanham also formerly resided in Quebec, and at present we are well represented there by the Rev. T. W. Fyles, a very industrious observer, who has frequently charmed us by the scholarly papers read at these meetings, to be present at which he does not hesitate to take the long journey from the Ancient Capital. The late Mr. Couper made collecting trips to Anticosti and the shores of the Lower St. Lawrence, the results of which appeared in our earlier volumes.

In the Maritime Provinces our only contributors appear to have been Mrs. Caroline E. Heustis of St. John, N.B., and Mr. J. Matthew Jones of Halifax, N.S. The catalogues of the British Museum and other scattered entomological literature show that considerable collections have been made in those provinces, chiefly by officers of the army and navy, and it is matter of regret that there are no resident entomologists, to make a closer study of the insect life, which my own occasional observations prove to be very interesting in many particulars.

Turning westward again to that immense country which stretches from our fair province to the far Pacific, the localities which have been investigated are almost lost in the vast expanse of yet unexplored territory. Mr. Hanham, who formerly collected in Ottawa, Hamilton, Paris and Quebec, has recently removed to Winnipeg, and intends to devote every opportunity to making known its insect life. Capt. Geddes a few years ago made most valuable collecting trips across the prairies and to the Rocky Mountains, and at Laggan, Alta., Mr. Bean is industriously collecting, and adding to our knowledge of the mountain fauna. Both of these gentlemen have, however, devoted themselves chiefly to the study of the lepidoptera, and we have yet to wait for resident entomologists, stationed at moderate distances apart, to gain an adequate idea of the general distribution of the insects of all orders.

On the Pacific coast the Canadian gleaners are also few, although a rich and abundant insect life rewards the labors of the collector. Our chief worker has been the Rev. G. W. Taylor, who has made large collections of lepidoptera, hymenoptera and coleoptera, including many species new to science. These collections were chiefly made in the vicinity of Victoria, V.I., but Mr. Taylor has recently removed to Nanaimo, and

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has thus a new field of investigation open to him. Mr. W. H. Danby of Victoria is also an energetic collector, and our former associate in the Council, Mr. E. Baynes Reed, now resides at Esquimalt, a few miles from Victoria, and although he has not yet sent to us any account of his work, I know that he is making collections. The recent organization of a Natural History Society in Victoria may stimulate a further interest in Entomology, indeed I believe that a catalogue of the butterflies of Vancouver Island has already been published in the transactions of the Society. Several hundred miles to the north, at Masset in the Queen Charlotte Islands, there is a very careful and competent collector, the Rev. J. H. Keen, who in this farthest outpost has made most interesting discoveries, especially in coleoptera.

A considerable knowledge of the insects of the remoter regions of the Dominion has resulted from the collections made by various members of the staff of the Geological Survey; prominent among whom may be mentioned Dr. Dawson, Dr. Bell and Prof. Macoun. There has not yet been any regular entomological work done in connection with the Survey, and it cannot be expected that the collections of insects, which are made in addition to the regular field work, should be very large or comprehensive. But our thanks are no less due to the gentlemen who have aided; for even a few specimens brought in occasionally, from the distant points reached by these explorers, may do much to help in ascertaining the geographical range and distribution of species. Reference to Volume XXII of the *Entomologist* will show that quite a long and useful list of coleoptera was obtained by collating the various short lists published in the Survey Reports. When the Dominion Museum is housed in correspondence with the value of its great collections, and room is afforded for the display of the natural history specimens collected, the explorers will feel a greater interest in the securing of specimens, and a department of entomology will probably soon be installed.

Having now made a rapid, and necessarily imperfect, survey of the districts which our members have explored in the past, or which they are still investigating, let us change our point of view, and, for a few moments, consider what attention has been bestowed upon the several orders, into which it has pleased systematic entomologists to separate the great and almost inexhaustible complex of minute forms, which are known to us under the general term Insects. From the twenty-five volumes of the *Entomologist*, I have made a list of the papers which seemed to me to be of most importance in helping us to a knowledge of the position of our workers in regard to the investigation of the several orders. The list (appended) is by no means a complete one, as numerous short papers, notes on the occurrence of species, and interesting correspondence have been omitted; my object not being to make an index of papers.

It is found that the contributions dealing with lepidoptera probably equal, in number and volume, those relating to all the remaining groups. This, however, is not surprising, for to this order belong the most beautiful examples of all terrestrial life; flowers of the air, their wings decked with all the hues that blossom or gem can show; as they wing their brilliant flight through the glad summer days, or hover radiantly over the fragrant blooms, they naturally appeal to every heart which is warmed by the least vestige of artistic or poetic taste. Dull and debased indeed in feeling, and most sincerely to be pitied, must he be who sees not some beauty, feels not something of inward pleasure, in beholding these wonderful atoms of grace and brightness.

"The dreamy butterflies

With dazzling colours powdered and soft glooms,
White, black and crimson stripes, and peacock eyes,
Or on chance flowers sit,
With idle effort plundering one by one,
The nectaries of deepest throated blooms."

—Robert Bridges.

Apart also from their beauty of form and richness of ornament in the winged state, the lepidoptera furnish the most interesting and attractive examples for the study of the development and life of the insect, from the egg to the imago. In the larval stage they also play a most important part in the economy of nature, and make man pay tribute in varied and large measure. Yet even in this favorite order there remains plenty of work

for our entomologists, and far from discouraging those who are engaged in such attractive studies, I would urge them to perfect their knowledge by careful observations on the early stages of our lepidopterous friends and foes, so that they may make their light to shine for the guidance of their fellow students.

Next to the butterflies, the beetles have ever been the favorite prey of the budding entomologist. Very numerous, varied in form and habits, yet easy to collect and preserve, they yield themselves most readily to the formation of an attractive and easily cared for collection. The coleoptera have for these reasons been so thoroughly collected in northern countries, that there remains, even in Canada, a very small percentage of species not already known to entomologists. Even microscopic species from most remote localities, with few exceptions, prove to have received a name and character—even if the character may occasionally not be a good one, or sufficient to qualify the beetle for the position in which it has been placed. Yet there remains abundance of work for our coleopterists in the more careful collecting of the smaller species, and the preparation of accurate local lists, and especially in the study of the early stages of our beetles, since the complete life history of comparatively few species is known.

“Among the yellow pumpkin blooms, that lean
Their crumpled rims beneath the heavy heat,
The striped bees in lazy labor glean
From bell to bell with golden-feathered feet.”

—Lampman.

Of recent years more attention has been directed to the study of the hymenoptera, and interest in these insects has been stimulated by the publication of several fine works. The publication by Cresson of a synopsis of the families and genera, and a catalogue of the described N. A. species has much facilitated the determination and arrangement of collections, but species are being so rapidly discovered and described, that a new edition will soon be necessary to make it conform to the present knowledge of the order. To our younger members, who have not yet settled upon any special line of investigation, I would strongly recommend the consideration of this order, to which my own attention has been chiefly given for several years. The species are very numerous, more so even than the beetles, and the habits of its members are of wonderful variety and interest. From the bees, wasps and ants, with their well developed mental faculties and their highly organized family communities, we pass to microscopical forms of which a score may develop in a single butterfly-egg. The study of these insects is most absorbing, and inexhaustible fields of enquiry are open. It would be very encouraging to see more students attracted to this order; taking up special families, and by sustained and serious researches aiding in the elucidation of many perplexing problems.

“Mist of grey gnats that cloud the river shore
Sweet even choruses, that dance and spin
Soft tangles in the sunset.”

—Lampman.

Apart from the three orders to which reference has been made, there has been but a meagre investigation of our insects, notwithstanding their claims to a due share of attention. The diptera are numerous in species and individuals, of much diversity of habit, and of great influence upon the bodily and temporal welfare of man. The order is difficult to study for the very reason that so few have devoted their attention thereto, but it affords scope for much original work, which cannot fail to be of great importance. There are probably hundreds of species now in the collections of our members waiting for some student to make them known to us.

The neuroptera and pseudoneuroptera are less rich in species, but include some of our largest and most striking insects, such as the dragon-flies.

“To-day I saw the dragon-fly
Come from the wells where he did lie.
An inner impulse rent the veil
Of his old husk; from head to tail
Came out clear plates of sapphire mail.
He dried his wings; like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew.”

—Tennyson.

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The early stages of many forms can be advantageously studied in aquaria, for the life histories of but few of the American species have been published. Here is another inviting and almost unoccupied field for students seeking a special line of work.

The same may be said of the orthoptera, our species of which are not numerous, but of moderate size and frequently present in great abundance. They are among the most destructive insect enemies of plant life, but atone, in some measure, for their ravages, by the animation of their movements, and their almost ceaseless stridulation breaking agreeably the silence of the fields.

" In intervals of dreams I hear
The cricket from the droughty ground ;
The grasshoppers spin into mine ear
A small innumerable sound."

—Lampman.

The hemiptera consist of two very large and important groups, which contain many species exceedingly injurious to the crops which man raises, with so much labor, for his sustenance, and even from merely material motives the "bugs" are deserving of careful study. Nor are these insects all unattractive in their forms and habits; many of them, in fact, are very prettily ornamented. It is fully time that some attention was bestowed upon them by our members.

Even yet the avenues of study have not been exhausted; when all the six-footed insects have been examined there still remain for observation the spiders, skilful weavers of the silken films that glisten in the morning dew; the mites, so small and yet so grievously afflicting man and beast and plant; with other allied arthropods of considerable variety of form and habit, which fall within the scope of entomological research.

The volumes of the *Canadian Entomologist* contain many important papers by our numerous and hard-working entomological friends in the United States, upon the orders and groups which have been so much neglected by our own correspondents. These papers indicate the interest and value which is attached to their study, and in these contributions it is often observed that the species under discussion have been derived from Canadian sources. This indicates that our collectors are not working up the material that they obtain with so much care and patient searching. It is certainly easier to send specimens to specialists abroad than it is to determine them with the scanty library and cabinet resources at the command of most of us. But one should not rest satisfied merely with such determinations, but by subsequent study of his insects increase his knowledge regarding them. He will thus be able, at least, to publish correct local lists which may be of great value in the more complete study of the fauna of larger regions, and as data for establishing the distribution of species.

There is a great temptation to amass large collections, which in themselves are very desirable and important, but whose care and incident correspondence and exchange may so engross one's time that profitable lines of investigation are neglected, and one becomes merely an insect curator instead of an entomologist. The finest collection may be suddenly destroyed, or its possessor incapacitated for further labor, and the knowledge which he has accumulated by many years of patient toil is then lost to science, if it has not been published. There are rare instances of writers who seem unable to restrain themselves from any topic, but the majority of entomologists doubtless find, as I do myself, that it is far more pleasant to collect, examine and arrange their specimens than to sit down and write about them. Yet we should try to do our duty in this respect also, knowing that, if we have made discoveries or valuable observations, we owe it to our fellow-workers to make them participants therein through the pages of the *Canadian Entomologist*.

If gentlemen, you have found my paper dry, I may but hope that it has been dry enough to kindle fresh entomological fires, or add fuel to those already existing; fires that shall emit not merely flashes of passing enthusiasm, but which shall burn brightly and steadily, casting light where the shadows now deepen, and by genial warmth stimulating to renewed attack upon the myriad problems which await your solution in the almost limitless and ever-attractive domain of Insect Life.

APPENDIX A.—LIST OF FIFTY CONTRIBUTORS, WITH THE NUMBER OF VOLUMES TO WHICH THEY CONTRIBUTED

	No.		No.
Bean, Thos. E., Laggan	2	Hausen, J. F., Montreal	2
Bell, Prof. J. J., Belleville	2	Heustis, Mrs. Caroline E., St. Joh., N.B.	5
Bell, J. T., "	4	Jack, John G., Chateaugay Basin	5
Bethune, A. M., Port Hope	1	Johnston, James, Hamilton	1
Bethune, Rev. C. J. S., Port Hope ..	22	Jones, J. Matthew, Halifax	1
Billings B., Ottawa	1	Keen, Rev. J. H., Masset, B.C.	1
Bowles, G. J., Quebec, Montreal	12	Kilman, A. H., Ridgeway	3
Brodie, W., Toronto	5	Lyman, H. H., Montreal	12
Caulfield, F. B., Montreal	14	Macoun, John, Belleville	1
Clementi, Rev. V., North Douro	4	Moffat, J. Alston, Hamilton	16
Couper, W., Montreal	9	Murray, Wm., "	2
Cowdry, N. H., Stratford	1	Norman, Geo., St. Catharines	2
Croft, Prof. H., Toronto	2	Pearson, C. W., Montreal	3
Danby, W. H., Victoria	2	Pettit, J., Grimsby	5
Dawson, Percy M., Montreal	1	Provancher, Abbe, Cap Rouge	2
Denton, J. M., London	1	Reed, E. Baynes, London	13
Evars, J. D., Trenton	1	Rogers, R. V., Kingston	5
Fletcher, J., Ottawa	13	Saunders, H. S., London	1
Fyles, T. W., S. Quebec	12	" Prof. W., "	19
Geddes, Gamble, Toronto	7	" W. E., "	2
Gibb, Lachlan, Montreal	1	Taylor, Rev. G. W., Victoria	4
Gott, B., Arkona	1	White J., Edmonton, Ont.	1
Guignard, J. A., Ottawa	2	Williams, J., London	1
Hanham, A. W., Hamilton	2	Winn, A. F., Montreal	2
Harrington, W. H., Ottawa	14	Wintle, Ernest D., Montreal	1

APPENDIX B.—LIST OF CONTRIBUTIONS (NOT COMPLETE) BY THE WRITERS MENTIONED IN APPENDIX A.

Lepidoptera.

	Vol.
Entomological Notes (a series of papers), Saunders	I.
Notes on Canadian Lepidoptera (a series of papers), Bethune	I.
List of Diurnal Lepidoptera observed in the neighborhood of Ottawa, during the season of 1868, Billings	I.
Larva infesting the Parsnip (<i>Depressaria Ontariella</i> n. sp.), Bethune	II.
On a supposed new Arctian, Saunders	II.
Description of larva of <i>Catocala Polygama</i> , Guen., Reed	II.
Notes on <i>Hadena Xylinoides</i> , Saunders	II.
On the larva of <i>Thecla inorata</i> , G. R. Saunders	II.
A new species of <i>Anarta</i> , Bethune	II.
Note on <i>Amphipyra Tragoponis</i> , Bethune	II.
On the larvæ of some Lepidoptera, Saunders	II.
List of Lepidoptera taken at Quebec, Bowles	II.
Accentuated list of Canadian Lepidoptera, Reed	II.
On <i>Neonympha Eurythris</i> , Fab., Saunders	II.
Notes on Lepidopterous Larvæ (series of papers) Saunders	III.
Notes on <i>Samia Columbia</i> , Bowles	III.
Lepidoptera of Anticosti and North Shore of the St. Lawrence, Couper	IV.
Captures of Noctuidæ at St. Catharines, Ont., Norman	VII.
List of Diurnal Lepidoptera of the Island of Montreal, Caulfield	VII.

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VOLUMES TO	No.		
.....	2	List of Sphingidæ and Zygaenidæ occurring on the Island of Montreal, Caulfield.	VII.
.....	5	Captures of Noctuidæ near Orillia, Norman	VIII.
.....	5	List of Bombycidæ occurring on Island of Montreal, Caulfield and Pearson	IX.
.....	1	Sphinx Eremitis, Fyles	XI.
.....	1	Observations on Linnenitis Arthemis, Mrs. Heustis	XV.
.....	1	List of Geometridæ taken at Quebec and Montreal, Bowles	XV.
.....	1	List of Diurnal Lepidoptera collected in the Northwest Territories and the Rocky Mountains, Geddes	XV.
.....	1	Notes on Colias Christina, Lyman	XVI.
.....	1	Thecla Niphon, Fletcher	XVI.
.....	1	Remarks on the Family Bombycidæ, Bowles	XVI.
.....	3	Rocky Mountain Butterflies, Geddes	XVII.
.....	12	Additions to the list of Canadian Lepidoptera (a series of papers), Moffat	XVIII.
.....	1	Additions to the list of Montreal Lepidoptera, Bowles	XIX.
.....	16	The North American Callimorphas (with plate), Lyman	XIX.
.....	3	Notes on the Genus Argynnis while alive in the Imago state, Geddes	XIX.
.....	2	Notes on the Genus Colias, Lyman	XX.
.....	3	Description of the preparatory stages of Chionobas Jutta, Fyles	XX.
.....	5	Notes for collectors visiting the Prairies and Rocky Mountains, Geddes	XXI.
.....	2	Notes on the preparatory stages of Carterocephalus Mandan, Fletcher	XXI.
.....	13	The N. Am. Callimorphas—a reply to critics, Lyman	XXI.
.....	5	The Mediterranean Flour Moth, Fletcher	XXII.
.....	1	The Butterflies of Laggan, N. W. T., account of certain species inhabiting the Rocky Mountains in lat. 51°, 25', Bean	XXII.
.....	19	Food plant of Melitea Taylori, Edw. Danby	XXII.
.....	2	Notes on Argynnis Freya, Chariclea and Montinus, Lyman	XXII.
.....	4	Gelechia Gallædiplopappi, n. sp., Fyles	XXII.
.....	1	Note on the occurrence of Lepisesia Flavofasciata, Barnston, Lyman	XXIII.
.....	1	List of Lepidoptera taken at Little Metis, Que., Winn	XXIII.
.....	2	Hybernia Defoliaria, Linn. in Vancouver Island, Taylor	XXIII.
.....	1	Some rare Lepidoptera taken near Montreal, Winn	XXIII.
.....	1	Vanessa Californica in Vancouver Island, Danby	XXIII.
.....	1	Pamphila Manitoba, Scud., and its varieties, Lyman	XXIV.
.....	1	Descriptions of the preparatory stages of Nemeophilus Scudderi, and its varieties, Lyman	XXV.
.....	1	Notes on the occurrence of Hepialus Thule, Strecker, at Montreal, Lyman	XXV.

MENTIONED

.....	Vol. I.	<i>Coleoptera.</i>	
.....	I.	A luminous larva, Bethune	Vol. I.
.....	I.	Coleoptera taken in the neighborhood of London, Ont., during the season of 1868, Reed	I.
.....	I.	List of Coleoptera taken at Grimsby, Pettit	I.
.....	II.	Description of the Wheat Wire-worm, Pettit	IV.
.....	II.	Anticosti Coleoptera, 1873 (determined by Leconte), Couper	VI.
.....	II.	Additions to Canadian lists of Coleoptera, Harrington	XVI.
.....	II.	Phytonomus punctatus, Kilman	XVI.
.....	II.	List of Staphylinidæ taken at Belleville, Bell	XVII.
.....	II.	The Entomology of Vancouver Island. Notes on 76 species of Cicindelidæ and Carabidæ collected near Victoria, Taylor	XVII.
.....	II.	On Physonota unipunctata, Say and its supposed varieties, Caulfield	XVII.
.....	II.	Coleoptera at the electric light, H. S. Saunders	XIX.
.....	II.	Additions to the list of Canadian Coleoptera, Kilman	XXI.
.....	III.	On the lists on Coleoptera published by the Geological Survey of Canada, 1842-1888, Harrington	XXII.
.....	IV.	Notes on a few Canadian Rhyncophora, Harrington	XXIII.
.....	VII.	Some British Columbia Coleoptera, Keen	XXIII.
.....	VII.	On the occurrence of two species of Coleoptera new to Montreal, Hausen	XXIII.

Hymenoptera.

The Grape seed insect, <i>Isosoma vitis</i> , n. sp., Saunders	Vol. II.
Remarks on the History and Architecture of the Wood Paper-making Wasps, Couper	II.
Notes on the Humble Bees, Bowles	XI.
The Entomology of Vancouver Island. Notes on 80 species of Hymenoptera collected near Victoria, V. I., in 1882, Taylor	XVI.
A new Tenthredinid, Provancher	XVII.
Notes on the occurrence of some species of Uroceridae, Harrington	XVII.
Additions to North American Hymenoptera, Provancher	XVIII.
Notes on Tenthredinidae, 1885, Harrington	XVIII.
Notes on Hymenoptera collected near Ottawa, Guignard	XVIII.
<i>Oryssus Sayi</i> , Harrington	XIX.
The Nuptials of <i>Thalessa</i> , Harrington	XIX.
New species of Canadian Tenthredinidae, Harrington	XXI.
<i>Ibalia maculipennis</i> , Haldeman, Harrington	XXI.
Tenthredinidae collected at Ottawa, 1889, Harrington	XXII.
<i>Nematus pallidiventris</i> , Fallen—a fresh importation, Fyles	XXIII.
Two new species of Canadian Pimpline, Harrington	XXIII.
Canadian Galls and their occupants, Brodie	XXIV.
Notes on <i>Zarea Americana</i> , Fyles	XXIV.
Canadian Hymenoptera (series of papers), Harrington	XXIV.
<i>Typhon flavifrons</i> , n. sp., Fyles	XXV.

Diptera, Hemiptera, Neuroptera and Orthoptera.

List of Neuroptera (collected at Grimsby), Pettit	Vol. VI.
List of Canadian Diptera (compiled from Brit. Mus. Catalogue), Couper	IX.
Description of a dipterous parasite of <i>Phylloxera vastatrix</i> , Fyles	XIV.
List of Diptera taken in the vicinity of Montreal, Que., Caulfield	XVI.
Notes on <i>Ceresa bubalus</i> , Jack	XVIII.
Notes on Ant-lions, Moffat	XVIII.
List of Orthoptera taken in the vicinity of Montreal, Caulfield	XVIII.

General Papers.

Entomological notes during a trip to the Saguenay, Saunders	Vol. I.
Insects of the northern parts of British America compiled from Kirby's Fauna Boreali Americana, Bethune	II.
Quebec Currant Worms, Bowles	III.
Entomological notes during a trip to Lakes Huron and Superior, Bethune	III.
Hints to Fruit Growers (series of papers), Saunders	III.
On some of our Common Insects (a series of papers by Saunders, Bethune, Geddes, Rogers, etc., commenced)	V.
Entomology for Beginners (a series of papers by Saunders, Bethune, Fletcher, Harrington, etc., commenced)	XI.
Entomological notes, Jack	XVII.

A vote of thanks to Mr. Harrington for his valuable and very interesting address was moved by the Rev. Dr. Bethune, who remarked in doing so that he hoped all the members of the Society would be stimulated by the historical record their President had given them to fresh efforts in their investigations and renewed zeal in contributing their observations to the *Canadian Entomologist* and the Annual Report. Mr. Fletcher, in

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seconding the motion, gave an account of the admirable work that Mr. Harrington has been doing for many years past in collecting and studying the coleoptera and hymenoptera of Ottawa and its neighborhood; in the latter order especially he had accomplished very much, and described a number of new species. The motion was very cordially received by the meeting, and the vote of thanks was accorded with much acclamation.

The reports of the different sections of the Society were then presented and read by their respective Secretaries

The Treasurer, J. A. Balkwill, read the following report of Receipts and Expenditure for the year ending August 31st, 1894 :

REPORT OF THE TREASURER.

RECEIPTS, 1893-4.		EXPENDITURE, 1893-4.	
Balance on hand Sept. 1st, 1893..	\$ 457 54	Printing.....	\$ 631 33
Members' fees	291 08	Report and meeting expenses.....	157 70
Sales of Entomologist	73 90	Library	82 05
" pins, cork, etc.	62 79	Expense, postage, etc.....	116 82
" duplicates	5 25	Rent and fuel.....	159 97
Government grant.....	1,000 00	Insurance	28 00
Advertisements.....	13 50	Salaries	350 00
Interest	14 24	Pins, cork, etc	31 83
Total.....	\$1,918 30	Balance on hand Aug. 31st, 1894.	360 60
		Total.....	\$1,918 30

We, the Auditors of the Entomological Society of Ontario, certify that we have examined the books of the Treasurer, compared them with vouchers, and find them correct, and that the above is a true statement.

JOHN M. DENTON, }
JAS. H. BOWMAN, } Auditors.

REPORT OF THE MONTREAL BRANCH

Mr. H. H. Lyman read the following report.

Annual Meeting of the Montreal Branch of the Entomological Society of Ontario :

The 21st annual meeting of the Montreal Branch was held at the residence of Mr. H. H. Lyman, 74 McTavish street, on Tuesday evening, May 8th, at 8 o'clock.

Members present, Messrs. H. H. Lyman, President; J. F. Hausen, W. C. Adams, A. F. Winn. Rev. E. C. Trenholme, a former member was also present.

The President presented the following report of the Council :

21st Annual Report.

The Council beg to present the following report for the year 1893-94 :

From a variety of causes we have had less meetings than usual during the past winter, but the four that were held were well attended, and the following papers have been read :

I.—Common names for butterflies. Shall we have them? H. H. Lyman.

II.—A Trip to Gomin Swamp, Quebec. H. H. Lyman.

III.—Trypeta solidaginis and its parasites. Rev. T. W. Fyles.

One new member has been added to our roll, Mr. O. C. Hart, but the resignation of Mr. H. B. Cushing has lost us one.

The Council would urge the members to contribute more papers at the meetings, giving accounts of some of their collecting trips, or experience in raising species from the egg or larva as well as to bring more specimens with them.

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The present season has opened unusually early, and there seems to be a prospect of a particularly good year for insects, and it is hoped that a lot of good work will be done by our entomologists.

The Treasurer's report showed the balance at our credit to be growing slowly.
Respectfully submitted on behalf of the Council.

(Signed), H. H. LYMAN,
President.

The following officers were elected for the ensuing year :

President—H. H. LYMAN.
Vice-President—LACHLAN GIBB
Secretary-Treasurer—W. C. ADAM.
Council—J. F. HAUSEN, A. F. WINN.

Mr. Winn read a paper entitled "An Hour at Hochelaga," illustrated by the specimens taken.

The meeting then adjourned.

A. F. WINN,
Secretary.

REPORT OF THE GEOLOGICAL SECTION.

Mr. President and Members :

I regret that the chairman of our section for the past year is not with us to night. I refer to the Rev. Chas. Andras, who, you will remember, was with us a year ago at our last annual meeting, but has now gone to reside in the North West. We expected with his assistance to have presented a full and comprehensive report of the proceedings of our Society for the past season. We have had no more active member in our section than he since its organization. All his spare moments were devoted to making a collection of the minerals and fossils of this region, most of which were exhibited to the class from time to time, adding very much to the interest as well as profit, and giving us some idea of what might be obtained at our own doors. He made a very large private collection during the time he was with us. Together we visited most of the outlying towns in search of specimens for our cabinets, and have travelled on foot many a mile in these holiday outings.

Among other places we have visited St. Marys, Dorchester, Kilworth, Byron, Komoka, Kettle Point (Lake Huron), Ilderton, Thedford, Beachville and Woodstock.

Occasionally we had some of our fellow workers to bear us company and assist in our undertakings and researches.

I can only mention a few of my observations along the geological line. The work undertaken by this section has been greater and more successful than in any previous year, not only as regards the material that has been collected, but also in the interest the members have shown by regular attendance at our weekly meetings, and taking an active part in the discussions that have arisen from the objects laid before them.

We have also been favored with several interesting lectures and papers on various geological subjects as follows :

By the Rev. Prof. Andras :

- I.—Earthquakes.
- II.—Talk on British Coal Fields.
- III.—Sketches of his North West Travels.

By Prof. J. H. Andras :

- I.—Papers on Cephalopoda.
- II.— " " Arcidae.

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By Dr. I. G. Wilson :

I.—Paper on Silica.

II.— “ “ Glacial Drift.

By Mr. I. Goodburn :

I.—Lecture on the Six Days' Work of Creation.

By S. Woolverton :

I.—Paper on Trilobites.

It is proposed to print some of them for circulation, or if thought worthy in the Journal of this society. Several of these addresses were given at the home of the vice-chairman, where an available collection is to be found, the better to illustrate the subject of the lecture.

Another observation perhaps worthy of mention, is the finding of a great number of Indian relics in this vicinity during the past summer. A number of mounds have been dug over and many rare specimens have been obtained of the North American Indian, notably—skinning-stones, pipes, bone needles, bones of the animals eaten by early inhabitants, in a perfect state of preservation, with pottery in great abundance.

The remains were all found in ash heaps, kitchen middens so called, showing conclusively that this was once a favorite resort and hunting-ground of a race of people that have faded away over three hundred years ago.

From this source sufficient material has already been collected to stock a department in a public museum.

S. WOOLVERTON,
Vice-Chairman.

REPORT OF THE BOTANICAL SECTION OF THE ENTOMOLOGICAL SOCIETY.

The Botanical Section beg to offer the following report for the summer of 1894.

The first meeting was held on April 21st, and from that date until September 24th regular meetings were held, except for a part of August.

At all the meetings the attendance has been fair, and a number of young business and professional men have become enthusiastic workers. The principal work undertaken was the collection, identification and recording of the phaenogamous plants of this district.

Field days in various directions were very fruitful, especially to Komoka on May 24th, when 77 species of plants were identified, all in bloom. At Mud Lake, south of Dorchester station, the beautiful and extremely sweet scented *Habenaria blephariglottis* was found abundant on July 2nd.

Probably the most important collections of the season were : *Collinsia verna*, taken by Mr. Robert Elliott near Plover Mills, London township, Middlesex, May 26th, now first recorded in Canada ; and *Utricularia resupinata*, collected by Mr. J. H. Bowman, near Bala, Muskoka, not before identified and recorded to our knowledge.

A specimen of the notorious Russian Thistle was found by Mr. Dearness, near Tilbury Centre in Kent county.

All of which is respectfully submitted.

W. F. McCLEMENT,
Secretary.

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

BY REV. THOMAS W. FYLES, F. L. S., DELEGATE.

I have the honor to report that the Entomological Society of Ontario continues, with zeal and success, its researches into all such subjects as naturally fall under, or in any way have a bearing upon Scientific and Economic Entomology.

The membership of the Society during the past year has greatly increased, especially by additions from the Province of Ontario. This fact betokens both a growing interest in the subject of entomology, and also an increasing confidence in the Society as a guide and helper in its pursuit.

The Society was established in 1863. Of its founders but few now remain; most of them have been lost to us through death, or departure to distant places of residence. By the members of the present day their memory is held in grateful respect. The Society, however, still enjoys the benefit of the experience and scholarship of the Rev. C. J. S. Bethune, and the business talent of Mr. J. M. Denton. The names of these gentlemen appeared in the first list of officers published by the Society, and they are found also in the list published for the present year.

The Society enjoys the confidence of the many able entomologists who have been appointed to positions in the colleges and experimental stations of the United States of America; and numerous articles from these gentlemen have appeared in the Society's publications. It also numbers among its correspondents leading entomologists in England and Germany.

It is largely due to the wise and liberal support of the Ontario Government that the Society has been enabled to attain its present eminent position of usefulness.

The report of Mr. J. A. Balkwill, Treasurer of the Society, shows that its finances are in a highly satisfactory state—all expenses having been met, important purchases for increasing the advantages of the Society having been made, and a sufficient balance remaining for carrying on the immediate work of the Society.

Seventy volumes have been added to the Society's library in the course of the year, by donation and purchase. Among them are: the "Tenth Volume of the Proceedings and Transactions of the Royal Society of Canada," "The Report of the Ontario Game and Fish Commission," "The Report of the Smithsonian Institution," "The Report of the New York State Museum," "The Mammals of Minnesota," "The Hawks and Owls of the United States," "The Seventeenth Report of the Geology and Natural History of Indiana." The number of books in the library is now 1,284. Very important additions have also been made to the Society's collections of natural objects.

Valuable work has been done by the Ornithological, the Botanical, the Microscopical and the Geological Sections of the Society, and a report from each of them was read at the annual meeting. With a view to bringing the knowledge and experience of the members of these sections to bear more frequently for the good of the Society at large, a Committee on Field Days, consisting of Dr. Woolverton, Messrs. McClement, Elliott and Stevenson, and one representative from each section, was appointed at the annual meeting.

The Montreal Branch of the Society held eight meetings during the year, at which interesting papers were read, and much profitable conversation upon entomological subjects generally was held. The branch numbers among its members men well acquainted with the entomology of the Montreal Island: Messrs. L. Gibb, A. F. Winn, F. Hausen and H. B. Cushing; and the hospitality of Mr. H. H. Lyman, the president of the branch, and the access he has afforded to his extensive collections of lepidoptera have made the meetings of the branch exceedingly pleasant and profitable.

The Annual Report of the Society, printed by order of the Legislative Assembly of Ontario, contains: a record of the proceedings of the annual meeting held October 11th

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and 12th; reports from the council and the various officers and sections of the Society; the opening address of Mr. James Fletcher (given in the absence of the president), and telling of the injurious insects of the year and the various modes of dealing with them; and the annual address of the president, Mr. W. Hague Harrington, likewise containing much valuable information on these subjects. These are followed by contributions from members of the Society, viz.:

"The Entomological Mistakes of Authors," by Rev. Thomas W. Fyles, South Quebec.

"The Season of 1895," by the same.

"Mosquitoes," by J. Alston Moffatt, London, Ont.

"Canadian Uroceridae," by W. Hague Harrington, Ottawa.

"Additional Notes on Japanese Insects," by the same.

"Notes and Queries," by Rev. W. J. Holland, Ph.D., Allegheny, Pa.

"The Dragon Fly," by T. J. MacLaughlin, Ottawa.

"The Song of Thyreonotus," by William T. Davis, Staten Island, N.Y.

"Notes on some of the more important Entomological Exhibits at the Chicago Exhibition," by James Fletcher, Ottawa.

Then comes a full report of the annual meeting of the Association of Economic Entomologists, furnished by Mr. L. O. Howard, of the Division of Entomology, Department of Agriculture, Washington, D.C., together with some of the most generally interesting papers read at the meeting. Some of these are by the most eminent and practical entomologists of the United States, and all of them are valuable. The closing pages of the report are devoted to book notices, obituaries, etc.

The *Canadian Entomologist*, the Society's monthly organ, completed at the end of the year its 25th volume. This volume contains descriptions of no less than 162 new species of insects. The contributors to its pages number 56. Among them are men of world-wide reputation.

That the Society may be of service to the community at large, by teaching our farmers, gardeners and fruit growers the life histories of their insect friends and insect foes, and by showing them how the injurious attacks of the latter are carried on, and what steps should be taken to meet and nullify them is, we believe, the earnest desire of every one of its numerous members.

Appended will be found a list of the officers of the Society.

The whole is respectfully submitted.

THOMAS W. FYLES, F.L.S., Delegate.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year:

President—W. HAGUE HARRINGTON, F.R.S.C., Ottawa.

Vice-President—J. DEARNESS, London.

Secretary—W. E. SAUNDERS, London.

Treasurer—J. A. BALKWILL, London.

Directors—Division 1, JAMES FLETCHER, F.L.S., F.R.S.C., Ottawa.

Division 2, REV. C. J. S. BETHUNE, F.R.S.C., Port Hope.

Division 3, GAMBLE GEDDES, Toronto.

Division 4, A. H. KILMAN, Ridgeway.

Division 5, R. W. RENNIE, London.

Librarian and Curator—J. ALSTON MOFFAT, London.

Editor of the "Canadian Entomologist"—REV. C. J. S. BETHUNE, M.A., D.C.L., Port Hope.

Editing Committee—J. FLETCHER, Ottawa ; H. H. LYMAN, Montreal ; REV. T. W. FYLES, South Quebec ; J. M. DENTON and J. H. BOWMAN, London.

Delegate to the Royal Society—REV. T. W. FYLES, South Quebec.

Committee on Field Days—DR. WOOLVERTON, MESSRS. McCLEMENT, ELLIOTT and STEVENSON, London.

Auditors—J. H. BOWMAN and J. M. DENTON, London.

Dr. Woolverton exhibited a very perfect and beautiful trilobite, *Phacops bufo*, from the Devonian rocks in the neighborhood, and made some interesting remarks upon the geology of the district.

Mr. Bowman made a verbal report upon the proceedings of the Microscopical Section during the past season.

Mr. W. Scarrow suggested that the Council should be instructed to find more suitable quarters for the Society, as the present room was entirely inadequate for the purpose. The matter was discussed at some length by several of the members, and it was finally decided that the officers of the Society resident in London should be empowered to look for satisfactory accommodation, and take whatever steps might be necessary to secure it.

A very entertaining and interesting paper was then read by the Rev. T. W. Fyles on "Food, Feeders and Fed," which was highly appreciated by the audience.

The meeting adjourned at 10.30 p.m.

THURSDAY, NOVEMBER 8TH.

MORNING SESSION.

The meeting was called to order by the President at 10 o'clock a.m.

The first paper read was by Mr. H. A. Stevenson describing an attack by the moth, *Ephestia interpunctella*, in a warehouse in London, and the successful manner in which it had been dealt with.

Dr. Bethune then read an interesting paper on "The Economic Value of Parasitism," by Prof. F. M. Webster, of Wooster, Ohio. Mr. Harrington, in commenting on the paper, stated that the canker worms which had been so injuriously abundant about Ottawa for two or three years, were this season almost exterminated by their parasites.

Mr. Moffat presented papers on "*Allophila homalana* *Har.*" and "Remarks on the Structure of the Undeveloped Wings of the Saturniadae."

A paper by Prof. L. R. Jones, of the Agricultural Experiment Station at Burlington, Vermont, on "Bordeaux Mixture as a Deterrent Against Flea-beetles," was presented by Mr. Fletcher.

[All the papers read at the different sessions are printed *in extenso* in the following pages of this Report.]

Resolutions regarding the binding of periodicals and the case of members in arrears with their subscriptions, were brought forward and discussed, and action taken upon them.

The remainder of the morning was spent in examining and determining specimens which had been brought to the meeting by various members. At twelve o'clock the proceedings were brought to a close, all who had taken part in them having much enjoyed their annual gathering and the many interesting papers brought before them.

INSECTS

The paper treat especial of many of the beginning in inspection, w our Canadian

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INSECTS COLLECTED IN BERMUDA DURING THE WINTER OF 1894.

BY GAMBLE GEDDES, TORONTO.

The paper I propose to read before the members of the Society, will not, I fear, treat especially upon insects, for I have experienced great difficulty in securing the names of many of the species captured by me in Bermuda during the four months of last winter beginning in January. I can, however, place a number of examples before you for inspection, which may prove interesting in that they correspond so closely to many of our Canadian insects.

I shall, in the course of the paper, touch upon a few of the food-plants which came under my notice and read a list of the insects named in the only book that I could find on the subject in the Public Library. This list will not, I can assure you, occupy much of your time, as it was published thirty years ago, and very little collecting has been done since.

In considering the diurnal lepidoptera of the Islands, I shall begin first with *Danais Archippus*, which species was flying about freely in February and March. I fancy it must be an all-the-year-round insect as I took eggs and larvæ upon a lovely asclepias (*A. Curassavica*) at the same time that I captured apparently perfect imagos.

Of this asclepias I have raised from seed several healthy plants, and was in hopes that I could produce one in bloom.

Mr Oswald A. Reade, (now a pharmaceutical chemist in London, England), has made his mark as a botanist in Bermuda and elsewhere, and has written a book entitled, "Plants of Bermuda, or Somers's Islands."

In his description of this asclepias (or Butterfly weed) he states that it is a perennial plant, growing from two to four feet high, half shrubby at the base, the stems being cylindrical and downy. The pods are ovate, smooth and seeds embedded in glossy, silky hairs. Distribution, West Indies. Habitat, waste places. He also says flowers showy, scarlet and orange, frequent, July to November.

I presume when he states those particular months he means that these plants are in their "prime" at this time of the year, for I found full grown larvæ, and also, very diminutive larvæ, also eggs, upon asclepias during the months of February and March.

I did not find any of the larvæ on the other asclepias, viz., *A. Linaria*.

The commonest and only other diurnal I captured was *Junonia Cœnia*, and the larvæ of this insect fed freely upon the leaves of the common sage bush, (*Lantana Odorata*.) This shrub forms the principal undergrowth of all the Islands from one end to the other of the group. It has been grown to great perfection in many of our hothouses.

J. Cœnia in its flight reminds me very much of the *Vanessidæ* and is quite difficult to catch on a sunny day, but easy to net in damp and foggy weather.

These two species are the only ones taken in winter, but a list was printed in "The Naturalist in Bermuda," by Jno. Matthew Jones and Major Wedderburn, (late 42nd Highlanders) and J. L. Hurdis, Esq., in 1863—thirty-one years ago—which reads as follows:

<i>Danais Archippus</i>	Food plant, asclepias, common.
do. <i>Berenice</i>	do. rare.
<i>Vanessa Atalanta</i>	April to November.
<i>Cynthia Cardui</i>	Early November, abundant 1852.
<i>Vanessa Antiopa</i>	Rare.
<i>Junonia Cœnia</i>	Called Musk Butterfly, common.
<i>Terias Lisa</i>	September, October and November.
Unknown (1853, September).....	Brimstone yellow, tinged with a greenish hue large as English Brimstone Butterfly, taken on potato patches.

These eight varieties of butterflies appear to be all known at that time whilst none of the Skippers or Lycaenidae appear to have been captured. This seems a curious fact as it is well known that both families are abundantly represented in the southern States and in all the West Indian Islands.

Sphinx (Phlegethontius) Cingulata is very common in season, the larva is taken on the Papaw (*Asimina Triloba*) has a thick caudal horn and pupates in the ground as most of the Sphingidae do. (See Grote's check list of the Hawk moths of North America.)

The other *Sphinx* taken by myself was *Cherocampa (Deilonche, Grote) Tersa*. Larva feeds on Button-weed (*Spermacoce Glabra*) Mr. Grote, in his remarks upon this insect says, rare in Canada and Eastern States, more common in the south; it has at least two congeners: *Deilonche Robinsonii* (Grote) in Cuba, and *D. Falco* (Walker) in Mexico; comparative studies must be made with other forms referred by Butler to *Cherocampa*, a genus with European types.

I was also informed in Bermuda that *D. Lineata* had been taken, but I saw no traces of it in the few collections I came across, nor did I take a specimen myself.

I now come to the most interesting part of the collection I made, viz.: the various families of moths outside of the Sphingidae. I am indebted to Mr. Moffat for his kindness in naming a few that are identical with the Canadian species. I was unfortunate in not meeting Mr. Neumogen, of New York, on my way back, as in these matters he has always been most willing to assist me.

I am not aware of seeing any specimens in the following families, viz.: *Egeriadae*, *Thyridae*, *Zygaenidae*, *Bombycidae*; but of *Noctuidae*, *Geometridae*, *Pyrallidae* and *Tortricidae* there is evidently a large field open for collectors even in the winter months. In the *Noctuidae* the *Drasterias* and *Plusias* largely predominate and the undetermined species which I have with me will clearly indicate what a wealth of them exists on these islands.

I shall endeavor to get a correct list of all the *Noctuids*, as well as the other groups, and give a list of those which have occurred in Canada, that are identical with the Bermudian insects. This list I should be pleased to have published in the "Entomologist" for future reference by those who may be interested.

In *Pyrallidae* I have taken in numbers, *Eudiotis hyalinata* of Linneus, *Nomophila noctuella*, *Botis adipaloides* and many others not yet identified.

The majority of these moths have been taken in the bright sunshine, mostly during the time of day known in Bermuda as "between the showers" and rarely at dusk.

The favorite flower of the *Plusias* was *Sinapis nigra* in appearance like a white mustard flower; also a species of Golden Rod, (*Solidago sempervirens*.)

I have also taken a number of *Pyrallidae* on the common "Sowthistle," (*Sonchus Oloraceus*) and a few *Coleoptera* on the same plant.

A few of the micros appeared to gather their food from a beautiful little plant resembling a dicentra, viz.: *Fumaria Deusiflora*; and *Parthenium Hysterophorus*, a bunch aster, was full of all kinds of insects.

Upon the vetch (*Vicia Saliva* I think) I took numerous Hymenoptera, notably the Bermuda wasp, *Polistes pallipes*.

Upon the flower of the orange Lantana, (*L. Cruxea*), most of the *Diptera* were caught, and this lovely shrub grows everywhere, so freely that one was seldom at a loss to look for a bush of it.

Coleoptera. Very few *Coleoptera* are known in Bermuda, as far as I can ascertain, my total catch for over three months being 15 specimens—6 of which evidently are one species taken from the centre of full-blown roses.

Of *Diptera* I took about 50 specimens, including our own pet housefly. This was by no means uncommon during winter as the domestics had to drive them out of the rooms two or three times a day in fine weather and keep the house quite dark. Another favorite, (the mosquito,) was only too common, and for variety in size and the nature of

its bite, I could only be busy in looking for their food and their food is "beneficial"

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its bite, I consider them unequalled. These unwelcome intruders kept me so continually busy in looking after my own interests that I came to the conclusion I would not study their food plants—nor would I recommend them to any of my Bermudian friends as a "beneficial insect" (to mankind at least.)

Of Hemiptera about 6 varieties were captured, principally about the Loquat tree and upon the tree known as The Pride of India.

The Loquat is a favorite fruit with not only the natives but nearly every visitor who tastes it. The botanical name is *Cydonia Japonica*, and as its name implies is a native of Japan, and thrives in sheltered places.

The Pride of India, (*Melia Azedarach*) is a grand tree and lines the boulevards of the principal streets in Hamilton. I have water-color sketches of these trees, one in fruit the other in flower.

There is one other fruit tree the product of which seems most palatable to the natives, viz.: The Surinam Cherry. I am at fault about the scientific name, but also produce a water-color sketch of the fruit at its best. Upon the blossoms the Plusiadae and bees are to be taken, frequently in February and March. I have no doubt in the summer months the second crop would attract many more examples, for the trees fruit twice a year, I have been told by old residents.

Referring to this tree I have taken a few katydids and grasshoppers, (Orthoptera,) amongst them doubtless *Conocaphalus Basiger*, although I must confess I prefer the song of his green colored cousin *Phylloptera Oblongifolia*, hailing from our midst and which is found drowned so often on the shores of our lakes in Upper Canada after a heavy gale of wind.

The spiders would give entertainment to any enthusiast for months, for their name is legion.

In conclusion I may add that the Neuroptera were very scarce during the winter-time, although I saw several varieties in some of the local collections which were unnamed. Evidently they were abundant about the marshes during the summer months.

COMMON NAMES FOR BUTTERFLIES.—SHALL WE HAVE THEM?

By H. H. LYMAN, MONTREAL.

Read before the Montreal Branch 14th November, 1893.

This is a question upon which the entomologists of this continent have been as much divided as upon any of the deeper scientific problems which have engaged their attention.

The great majority of the working entomologists have been strongly opposed to their introduction, some even fiercely so, but there have been a few entomologists, some of them of the first rank, who have espoused their cause with at least some measure of success.

Of course there are many objections to these names, the chief being their purely arbitrary and unscientific application, the impossibility of securing uniformity in their use and the difficulty of obtaining suitable and sufficiently concise names for more than a very limited fauna.

The opponents of popular names assert that it should be as easy to remember the scientific as the common names and that if it is not, we should not encourage laziness by adopting them.

I used to be as strongly opposed to these names as anyone, but latterly have sometimes thought that if their adoption would result in popularizing the study of this science the gain would be worth the sacrifice.

In this paper, therefore, I propose to discuss this subject which has recently been brought again into view by Mrs. Slosson's interesting paper in the first number of the journal of the New York Entomological Society, and shall try to do so in a calm and judicial manner. Of course Mrs. Slosson would not suggest that the names which commend themselves to her proteges should be generally adopted, but why should we not have common names scientifically applied?

It is all very well to say that it should be as easy to remember the scientific as the popular name, but it isn't. It ought to be, of course, just as it ought to be just as easy for children to be good as to be naughty.

I have often been asked the name of a moth and when I had given it, it has been greeted with a laugh of derision, for the general public scoff at these scientific names, and one doesn't wonder when one looks over a catalogue and sees the terrible names, such as *nezahualcoyotl*, which have been given to beautiful and inoffensive creatures.

It does not degrade Botany to have the *Cypripedium* called the Lady's Slipper, the *Ranunculus* the Buttercup, or *Lonicera* the Honeysuckle, nor does Ornithology suffer because *Hirundo Horreorum* is better known as the Barn Swallow, and *Tyrannus Carolinensis* as the Kingbird, and why should there be an outcry at calling the lovely *Idalia* the Regal Fritillary, or *Grapta Gracilis* the Hoary Comma?

I believe that if we could have common names for our butterflies and a cheap, but good, book with a recognizable colored illustration of each species, such as England has in Coleman's *British Butterflies*, we should have at least ten persons interested in entomology for every one that we have to day.

If it be urged that it is impossible to secure absolute uniformity in the use of these names the same is true of the scientific names, as we all have to remember in reading Mr. Scudder's works that what he calls *Jasoniades Glaucus* is what the rest of us call *Papilio Turnus*.

It seems to me that one of the chief objections to the adoption of these popular names is their arbitrary application totally regardless of scientific relationship. For instance, they have in England two butterflies, known respectively as the White Admiral and the Red Admiral. Naturally one would suppose that these belonged to the same genus, instead of which they belong to entirely distinct genera, which in Kirby's world-wide catalogue are separated by fifty-seven other genera, while on the other hand the nearest ally in England of the Red Admiral is called the Painted Lady, which is surely an opprobrious name.

When I began collecting as a child, upwards of thirty years ago, and wanted to know the names of my treasures, I was told that *Cardui* was the Thistle butterfly. Shortly afterwards I captured a specimen of *Atalanta*, and fairly gloating over the pre-eminent beauty of its under surface I named it the Queen Thistle, for child though I was, I at once recognized its close relationship to the other. But in the common names which have been proposed by various authors, the generic relationship has frequently been lost sight of. A very marked example of this occurs among Scudder's names in two cases adopted from Gosse, for some of the *Pierinae*; thus *Eubule* is the Cloudless Sulphur; *Philodice* is the Clouded Sulphur; *Lisa* is the Little Sulphur. Then in the genus *Argynnis*, *Atlantis* is the Mountain Silver Spot while *Aphrodite* is the Silver Spot Fritillary, the latter certainly a most indefinite name considering the number of silver spot fritillaries we have on this continent. On the other hand some of Gosse's names were so well chosen that we can recognize the species intended even when linked to wrong scientific names. This is strikingly the case in the *Graptas*, for which his names were particularly appropriate and have in all but one case been adopted by Scudder.

The Violet Tip was his name for *Interrogationis*; the Green Comma, though doubtfully linked with the name *Progne*, must have been intended for *Faunus*, not at that time described, while the Orange Comma and the Gray Comma well indicate *G. Comma* and *G. Progne*. It is doubtless true that in English works the popular name is frequently given undue prominence, being printed in large type at the beginning of a description,

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while the scientific name is given in italics, or in brackets at the end of the description, and the same prominence was, I found, given to popular names in the beautiful economic exhibit from the Entomological Division of the Department of Agriculture in the U. S. Government building at the World's Fair; but it is not necessary to follow this custom, and we could very well print the scientific name first in large type and the popular name second in smaller type as is done by Mr. Scudder in his "Butterflies of New England."

But if it be agreed that the adoption of popular names is on the whole desirable, is it practicable? No doubt it is for a limited fauna like that of England or New England, but is it for the whole of North America?

- Who will undertake to invent suitable popular names for the upwards of sixty species of *Argynnis*, the nearly forty species of *Melitæa*, the fifty species of *Thecla*, the equal number of species of *Lycaena*, or the upwards of ninety species now grouped under the generic name *Pamphila*!

I confess the idea appears to me utterly hopeless and impracticable.

THE BUTTERFLIES OF THE EASTERN PROVINCES OF CANADA.

BY REV. C. J. S. BETHUNE, PORT HOPE, ONTARIO.

The following list of the butterflies of the Eastern Provinces of Canada has been prepared in order to bring together in convenient form all the localities that have been published as well as those that have come under my own observation. The list is as complete as I can at present make it, but no doubt there are many collectors in different parts of the country who could add largely to the localities given, and possibly add a few more species to those here recorded. The time of flight and the food-plants are given in most instances.

The question of nomenclature and arrangement has been a difficult one to decide. It will be observed that I have followed the order of families and genera given in Dr. J. B. Smith's "List of Lepidoptera of Boreal America," (Philadelphia, 1891), and have for the most part adopted the nomenclature of Mr. W. H. Edwards's "Revised Catalogue of the Diurnal Lepidoptera of America North of Mexico," (Philadelphia, 1884). For the sake of convenience I have added in brackets Mr. Scudder's name for the species whenever it differs from that which I have employed. I have also followed Mr. Edwards in beginning the specific names with a capital letter as they are nearly all proper names and seldom adjectives.

In the preparation of this list the records of the following authors and observers have been gone over for localities in the Province of Ontario: Messrs. D. W. Beadle, St. Catharines; J. M. Denton, London; J. D. Evans, Sudbury; G. Geddes, Toronto; Rev. W. Kirby, ("Fauna Boreali-Americana: Insecta"); Theodore L. Mead, Oviedo, Florida; Prof. J. Macoun, Geological Survey of Canada, Ottawa; J. Alston Moffat, London; J. Pettit, Grimsby; E. Baynes Reed, London. For both the provinces of Ontario and Quebec: Messrs. B. Billings, Ottawa; W. H. Edwards ("Butterflies of North America, etc."); J. Fletcher, Ottawa; Prof. W. Saunders, Ottawa; S. H. Scudder ("Butterflies of the New England States and Canada"). For the Province of Quebec alone: Dr. R. Bell, Geological Survey of Canada, Ottawa; J. G. Bowles, Montreal; F. B. Caulfield, Montreal; W. Couper, Montreal; W. S. M. D'Urban, Montreal; Rev. T. W. Fyles, South Quebec; P. H. Gosse, Compton, ("Canadian Naturalist"); J. G. Jack, Chateauguay Basin; H. H. Lyman, Montreal; A. F. Winn, Montreal. For Nova Scotia and New Brunswick: Mrs. Heustis, St. John; J. Matthew Jones, Halifax. For Newfoundland: Capt. Brown and Mr. P. H. Gosse. For Labrador and Hudson Strait: W. Couper and Lieut. Payne. For Prince Edward Island: Prof. John Macoun.

LEPIDOPTERA.

RHOPALOCERA.

Family NYMPHALIDÆ. *US spec.*Sub-family *Euploecinae.* *358*

1. *DANAIS ARCHIPPUS*, Fabr. (*Anosia plexippus*). Abundant throughout Southern and Eastern Ontario; taken also on the shores of Georgian Bay, at Sault Ste. Marie and Nepigon; rare in the Province of Quebec, taken at Montreal, Sorel, Quebec, River Rouge district, Little Metis; rare in Nova Scotia. Earliest dates, May 24, June 4, 6, 7, 12, 14; very common in July; especially abundant in August and September; latest dates, October 23, 27. Food plant, *Asclepias*. Fig. 1, represents the butterfly; Fig. 2, the caterpillar; Fig. 3, the successive changes to chrysalis; Fig. 4, the chrysalis.

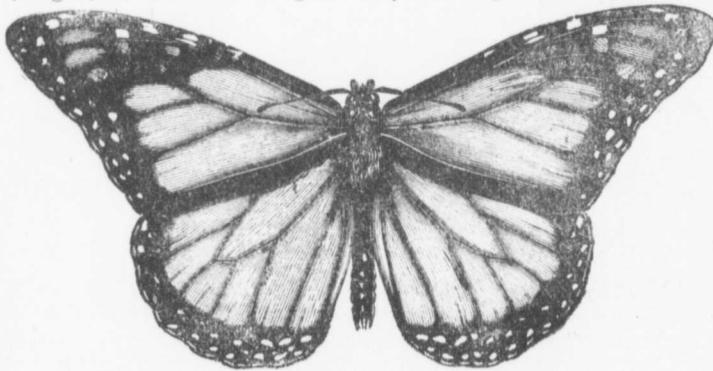


Fig. 1.

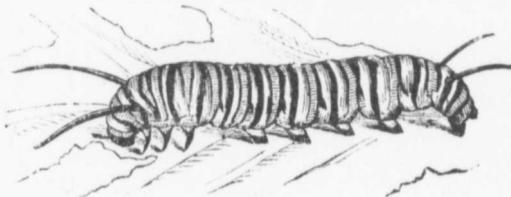


Fig. 2.

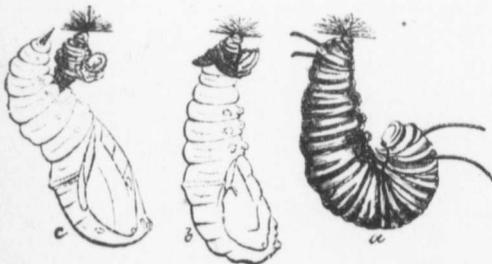


Fig. 3.



Fig. 4.

Sub-family *Nymphalinae.*

2. *EUPTOIETA CLAUDIA*, Cram. Very rare. Has been taken at Wabigoon, Ont. (J. C. Guillim), London, St. Catharines, Chateauguay Basin, Montreal (Aug. 15, 1874); also in Manitoba and North-West Territories. Food plants—Violet, Passion Flower, Sedum, Portulaca, Desmodium, Podophyllum.

pp. 30-44

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 3. ARGYNNIS CYBELE, *Fabr.* Common throughout Ontario and Quebec. Taken at Nepigon, Sault Ste. Marie, Georgian bay, Cameron lake, Amherstburg, Point Pelee, London, West Flamboro', Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, Eastern Townships, Quebec, Little Metis; also in Cape Breton and Prince Edward Island. Flies during July, August and September. Food plant of this and the other species of *Argynnis* is the various species of Violets.

4. ARGYNNIS APHRODITE, *Fabr.* Taken throughout Ontario and Quebec. Nepigon, Sault Ste. Marie, north of Lake Huron, Sudbury, Cameron lake, London, Hamilton, West Flamboro', Credit, Toronto, Cobourg, Ottawa; Montreal, Sorel, Quebec, Lower St. Lawrence and Bay of Chaleur; Restigouche river, New Brunswick; Nova Scotia; Prince Edward Island; Moose Factory, James's bay. Flies during July and August.

5. ARGYNNIS ATLANTIS, *Edw.* Common throughout Northern Ontario and Eastern Quebec. Moose Factory, Nepigon, Fort William, Sault Ste. Marie, Ottawa (rare); Montreal (very rare), Co. Missisquoi, P. Q., Little Metis, Godbout river, Cacouna, Lower St. Lawrence; Anticosti, Labrador, New Brunswick, Nova Scotia, Cape Breton, Newfoundland, Prince Edward Island. Flies during July and August.

6. ARGYNNIS ELECTA, *Edw.* Nepigon (Macoun, Fletcher, Bethune).

7. ARGYNNIS CIPRIS, *Edw.* Nepigon (Bethune and Fletcher). Sudbury (Fletcher and Evans), August.

8. ARGYNNIS MYRINA, *Cram.* (*Brenthis Myrina*). Common throughout the eastern Provinces of Canada. Nepigon, Fort William, Sault Ste. Marie, Sudbury, London, Hamilton, St. Catharines, Grimsby, Credit, Toronto, Cobourg, Rice lake, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Cacouna, Little Metis, Godbout river, Lower St. Lawrence; Metapedia river, Dalhousie, N.B., Nova Scotia, Cape Breton, Prince Edward Island. Flies during June, July and August. Taken at Montreal in May and at Ottawa in September.

9. ARGYNNIS CHARICLEA, *Ochs.* (*Brenthis Chariclea*). Port Arthur, Spanish river, Nepigon, Georgian bay (Lyman), July. Labrador, May 30 and June (Couper). Mingan, July 22. Hudson bay.

10. ARGYNNIS FREIJA, *Thunb.* (*Brenthis Freija*). Port Arthur, Fort William; Quebec, Gomin Swamp; Labrador, Hudson's straits, Cumberland House, Lat. 54° (Kirby), taken in August and September. *Ottawa, Stewart's Bay 1 sp. May 27*

11. ARGYNNIS BELLONA, *Fabr.* (*Brenthis Bellona*). Common in Ontario and Quebec. Nepigon, Fort William, Sudbury, London, Credit, Hamilton, Cobourg, Ottawa Lake Temiscamingue, P. Q., Chateauguay Basin, River Rouge district, Quebec, Little Metis, Godbout river, Lower St. Lawrence, Dalhousie, N. B., Moose Factory. Flies in June, July, and August. *J.F.*

12. ARGYNNIS TRICLARIS, *Hüb.* Ottawa, Mer Bleue (June 16, 1893); Labrador (Couper, Low).

13. MELITEA PHAETON, *Drury.* (*Euphydryas Phaeton*). Widely distributed, but rarely seen. Flies only about swamps and the damp margins of rivers. Has been taken at Ottawa, London, Toronto, Montreal, Quebec, Nova Scotia, New Brunswick. Flies during the latter part of June and first half of July. Food plants—*Chelone glabra*, *Lonicera* and *Viburnum*.

14. MELITEA HARRISII, *Scud.* (*Cinclidia Harrisii*). Very rare, though widely distributed. Sudbury, Montreal, Quebec, St. Henri, Levis, Saguenay, Gaspé; New Brunswick, Nova Scotia, Newfoundland. Taken at the end of June and up to the middle of July. Food plants—Double-bristled Aster, *Diplopappus umbellatus*.

15. PHYCIODES NYCTEIS, *Doubl.-Hew.* (*Charidryas Nycteis*). Taken throughout Ontario and in Quebec; not common. Nepigon, Port Arthur, Sault Ste. Marie, Sudbury, London, Hamilton, Toronto, Ottawa; Montreal, Quebec, Saguenay. Flies in June and July. Food plants—*Helianthus* (Sunflower), *Actinomeris*.

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 River Rouge
 , 7, 12, 14;
 latest dates,
 Fig. 2, the



Fig. 4.

bigoon, Ont.
 g. 15, 1874);
 sion Flower,

16. *PHYCIODES CARLOTA*, Reak. Very rare. Taken at London, (Saunders), Scarborough near Toronto, (Geddes); Nova Scotia, (Jones) "South of Lat. 40° from Atlantic to Rocky Mountains," Scudder.

17. *PHYCIODES BATESII*, Reak. Only recorded from Hamilton (Johnson) and Godbout river, P. Q. "Common in July."

18. *PHYCIODES THAROS*, Drury. (Forms *MARCIA*, Edw.; *MORPHEUS*, Fabr.) Abundant throughout Ontario, Quebec and the Maritime Provinces. Nepigon, Port Arthur, Sault Ste. Marie, Sudbury, Amherstburg, County of Essex, Point Pelee, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Rice lake, Ottawa; Montreal, River Ronge district, Eastern Townships, Quebec, Cacouna, Saguenay, Little Metis, Lower St. Lawrence, Anticosti, Labrador, New Brunswick, Nova Scotia, Cape Breton, Prince Edward Island, Newfoundland, Moose Factory. Flies during June, July and August; occasionally seen in May and September. Food plants—*Chelone glabra*, *Aster*, *Actinomeris helianthoides*.

19. *GRAPTA INTERROGATIONIS*, Fabr. (*Polygonia Interrogationis*). Taken throughout Ontario; rare in Quebec and Nova Scotia. Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, Compton, Quebec. Form *UMBROSA*, Lint. taken June 3 to 20, July 17, August 7. Form *FABRICII*, Edw. taken in August and September, occasionally in October. Food plants—Hop, Elm, Nettle, Linden, *Celtis occidentalis*.

20. *GRAPTA COMMA*, Harr. (Summer form *DRYAS*, Edw.; Winter form, *HARRISII*, Edw. *Polygonia Comma*). Common throughout Ontario; taken also in Quebec and Nova Scotia. Nepigon, Cameron lake, London, Hamilton, Port Hope, Cobourg, Ottawa; Montreal, Chateauguay Basin, River Rouge district, Compton, Quebec, Anticosti; Moose Factory; Dalhousie, N.B. June, July and August. Food plant—Hop, Elm, Nettle.

21. *GRAPTA SATYRUS*, Edw. (*MARSYAS*, Edw.; *Polygonia Satyrus*). Very rare. Taken in Ontario at Cameron lake, near London, and at Ottawa. In Quebec at Chateauguay Basin and Brome. Also in Prince Edward Island. Food plant—Nettle.

22. *GRAPTA FAUNUS*, Edw. (*Polygonia Faunus*). Taken throughout the Eastern Provinces of Canada. Nepigon, North of Lake Huron, Hamilton, Cobourg, Ottawa; Montreal, Brome, Missisquoi county, Quebec, Little Metis, Gulf of St. Lawrence, Nova Scotia, Newfoundland, Moose Factory. Has been taken in each month from May to October. Food plants—Green Alder, Willow, Birch, Currant, Gooseberry.

23. *GRAPTA PROGNE*, Cram. (*Polygonia Progne*). Fig 5. Common throughout the Eastern Provinces of Canada. Nepigon, Fort William, Sault Ste. Marie, Vermilion lake (Lake Huron), Sudbury, Cameron lake, Amherstburg, London, Hamilton, Credit, Port Hope, Cobourg, Peterborough, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Little Metis, Godbout river, Lower St. Lawrence and Bay of Chaleur, Anticosti, Restigouche river, N.B., Nova Scotia. Lat. 54° (Kirby). Flies from May to October; earliest date May 14, latest October 20. Food plants—Currant, Gooseberry, *Betula papyrifera*, Elm.

24. *GRAPTA GRACILIS*, Grote and Rob. (*Polygonia Gracilis*). Taken in northern Ontario and in Quebec. Nepigon, Sudbury, Quebec, Levis, Little Metis. Flies in July, August and September. Food plant—Currant.

25. *GRAPTA J-ALBUM*, Boisdu-Roc. (*Eugonia J-Album*). Common throughout the Eastern Provinces of Canada. Sault Ste. Marie, Bruce Mines, north of Lake Huron, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Lake Simcoe, Ottawa; Montreal, River Rouge district, County of Grenville, Eastern Townships, Sorel, Quebec, Little Metis, Godbout river, Bay of Chaleur, Labrador, Nova Scotia. Flies during August and September; hibernating specimens are often found during the winter in houses and



Fig. 5.

appear on the autumn brood

26. VAN... Eastern Provi... bury. Lake Si... Montreal, Eas... Godbout river... Hibernated sp... out the whole... and individual

27. VAN... ceding species... Toronto, Port... ships, Quebec... foundland, Ca... March and Ap... October as lat

28. PYR... Eastern Provi... ton, Credit, T... Sorel, Quebec... scotia, Princ... abundant in J... plants—Nettl

29. PYR... Sault Ste. M... Montreal, Riv... Grand Metis... foundland, Pr... months till S... Hollyhock, B

30. PYR... so abundant a... Hamilton, O... Orleans, Litt... August and S

31. JUN... in Canada... Stanley, Lon... Ontario. F... Plantago, Lin

32. LIM... (*Arthemis*). A... vices of Ca... Sault Ste. Ma... Port Hope, C... Montreal, Ri... Sorel, Quebec... river, N.B.,... June, July a... and Yellow I

33. LIM... Specimens ha... Rideau Hall... S (EN

appear on the wing on warm days in March and April; taken also in May and July; autumn brood appears in September and October. Food plant—White birch.

26. VANESSA ANTIOPA, *Linn.* (*Euvanessa Antiopa*). Abundant throughout the Eastern Provinces of Canada. Nepigon, Sault Ste. Marie, north of Lake Huron, Sudbury, Lake Simcoe, London, Credit, Toronto, Hamilton, Port Hope, Cobourg, Ottawa; Montreal, Eastern Townships, River Rouge district, Quebec, Little Metis, Rimouski, Godbout river, Anticosti, Labrador, Newfoundland, Nova Scotia, Prince Edward Island. Hibernated specimens appear at the end of March and early in April; common throughout the whole summer, the second brood appearing in August; common in September, and individuals are found till the end of October. Food plants—Willow, Elm, Poplar.

27. VANESSA MILBERTI, *Godt.* (*Aglaia Milberti*). As widely distributed as the preceding species. Nepigon, Sault Ste. Marie, Amberstburg, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Isle of Orleans, Little Metis, Godbout river, Saguenay, Labrador; Newfoundland, Cape Breton, Nova Scotia, Moose Factory. Hibernated specimens appear in March and April; more or less abundant throughout the summer; individuals seen in October as late as the 18th. Food plant—Nettle.

28. PYRAMEIS ATALANTA, *Linn.* (*Vanessa Atalanta*.) Abundant throughout the Eastern Provinces of Canada. Nepigon, Sault Ste. Marie, London, Point Pelee, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, River Rouge district, Sorel, Quebec, Little Metis, Godbout River, Anticosti, Labrador, Newfoundland, Nova Scotia, Prince Edward Island, Moose Factory. Taken from May to August; very abundant in June when the lilacs are in blossom; occasionally seen in October. Food plants—Nettle, Hop.

29. PYRAMEIS CARDUI, *Linn.* (*Vanessa Cardui*). Abundant everywhere. Nepigon, Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Cacouna, Little Metis, Grand Metis, Godbout river, Anticosti; Dalhousie and St. John, N. B., Nova Scotia, Newfoundland, Prince Edward Island. Flies at the end of May and throughout the summer months till September; occasionally seen in October. Food plants—Thistle, Mallow, Hollyhock, Burdock, Wild Sunflower.

30. PYRAMEIS HUNTERA, *Fabr.* (*Vanessa Huntera*). Widely distributed, but not so abundant as the preceding species. Nepigon, Sault Ste. Marie, Point Pelee, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, Quebec, Isle of Orleans, Little Metis, Godbout river, St. John, N. B., Nova Scotia. Flies in July, August and September. Food plants—Gnaphalium, Thistle, Myosotis.

31. JUNONIA CENIA, *Hüb.* Fig. 6. Very rare in Canada. Has been taken at Chatham, Port Stanley, London, Stratford and Ridgeway in Ontario. Food plants—Gerardia, Antirrhinum, Plantago, Linaria Canadensis.

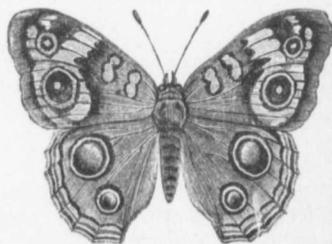


Fig. 6.

32. LIMENITIS ARTEMIS, *Drury.* (*Basilarchia Arthemis*). Abundant throughout the Eastern Provinces of Canada. Lake of the Woods, Nepigon, Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Lakefield, Belleville, Ottawa, Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Sherbrooke, Little Metis, Godbout river, Lower St. Lawrence, Tobique river, N. B., Nova Scotia, Cape Breton, Newfoundland, Moose Factory. Flies in June, July and August, often seen in immense numbers. Food plants—Willow, Black and Yellow Birch, Poplar, Thorn, Plum, Cherry, Amelanchier.

33. LIMENITIS PROSERPINA, *Edw.* (*Basilarchia Proserpina*). Excessively rare. Specimens have been taken at Hamilton, Roachs' Point, Lake Simcoe (August 22, 1894), Rideau Hall, Ottawa, and Halifax, N. S.

♂ (EN.)

34. LIMENITIS URSULA, *Fabr.* (*Basilarchia Ursula.*) Very rare in Canada. Has been taken at Port Stanley, London, and in Essex county, Ontario. Plentiful at London 1893 (Moffat). Food plants—Cherry, Currant, Oak, Willow, Vaccinium, Apple, Quince, Hawthorn, Plum.

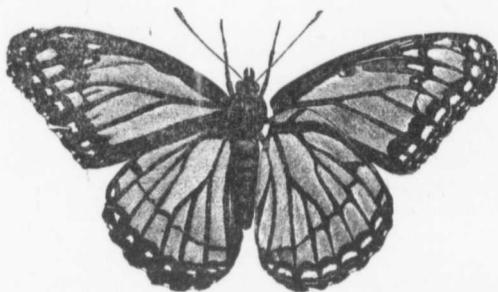


Fig. 7.

35. LIMENITIS DISIPPUS, *Godt.* (*Basilarchia Archippus.*) Widely distributed, but not very abundant. Amherstburg, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Rice lake, Ottawa, Montreal, L'Orignal, Little Metis, St. John, N.B., Nova Scotia. Flies in June, July and August; occasionally seen in September and October.

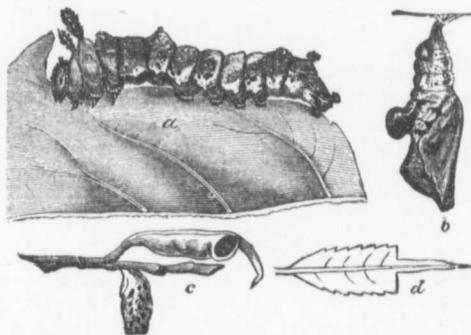


Fig. 8.

Food plants—Willow, Poplar, Plum, Apple, Oak. Fig. 7 the butterfly; fig. 8, *a*, the larva, *b*, the chrysalis, *c* and *d*, the larva case.

Sub-family Satyrine.

36. DEBIS PORTLANDIA, *Fabr.* (*Enodia Portlandia.*) Very rare. In Ontario it has only been taken at Ottawa. In Quebec at Hull and Kirk's Ferry, Montreal, Chateauguay Basin, River Rouge district, Eastern Townships, Compton, Quebec; Nova Scotia. Flies in July and August. Food plants—Grasses.

37. NEONYMPHA CANTHUS, *Boisd-Lec.* (*Satyrodus Eurydice*, Linn; *Neonympha Boisduvallii*, Harris.) Not very abundant. Has been taken at Sault Ste. Marie, Essex county, London, Hamilton, Toronto, Grafton and Ottawa (common) in Ontario; at Montreal, Compton and Quebec; Mingan Islands, Nova Scotia. Flies in June, July and August. Fig. 9. Food plants—Grasses and Sedges.

38. NEONYMPHA EURYTRIS, *Fabr.* (*Cissia Eurytris.*) Widely distributed, and not uncommon. Sudbury, Essex county, London, Hamilton, Credit, Toronto, Port

Hope, Cobourg,
in June and Ju



39. CENON
Point (Macoun)

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in July, 1868.

Hope, Cobourg, Rice lake, Ottawa, Montreal, Eastern Townships, Quebec. Flies in June and July. Fig. 10. Food plant—Grasses.

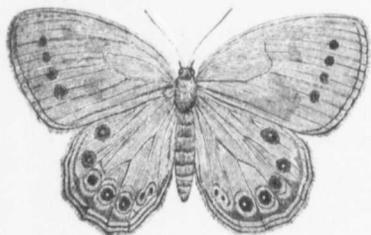


Fig. 9.

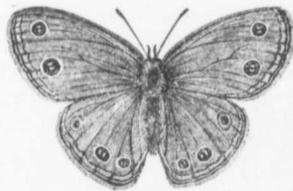


Fig. 10.

39. *CENONYMPHA INORNATA*, *Edw.* A very rare butterfly. Taken at Massasauga Point (Macoun), Lake Winnipeg, Sault Ste. Marie, and in Newfoundland and Labrador.

40. *EREBIA DISCOIDALIS*, *Kirby.* The only Eastern Canadian record is its capture at Sudbury by Mr. J. D. Evans, May 12, 1889.

41. *SATYRUS NEPHELE*, *Kirby.* (*Cercyonis Nephela.*) Abundant throughout the Eastern Provinces of Canada, County of Essex, London, St. Catharines, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, River Rouge district, Quebec, Little Metis, New Brunswick, Nova Scotia, Prince Edward Island. Flies throughout July and August; taken from June 10 to 20, in Essex county, Ontario. Food plant—Grasses.

42. *SATYRUS ALOPE*, *Fabr.* (*Cercyonis Alope.*) This more southern form has been taken at St. John, N.B., and in Nova Scotia and Prince Edward Island.

43. *CHIONOBAS MACOUNII*, *Edw.* (*Oeneis Macounii.*) This rare butterfly has only been taken at Nepigon, from June 28 to July 13. Food plant—Sedges.

44. *CHIONOBAS JUTTA*, *Hubn.* (*Oeneis Jutta.*) A very rare and local sub-arctic species. Has been taken at Nepigon, Ottawa, the Gomin Swamp, Quebec, Bergerville, P.Q., and in Labrador. Food plant—Carices.

Sub-family *Libytheinae.* 1 sp.

45. *LIBYTHEA BACHMANI*, *Kirtl.* (*Hypatus Bachmani.*) Fig 11. Very rare in Canada. Has been taken at Port Stanley, London and Hamilton in August. Food plant—Celtis.

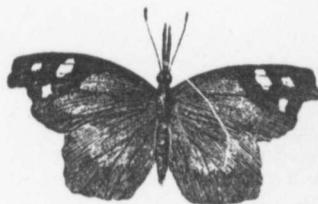


Fig. 11.

Family LYCENIDE. 23 sp.

Sub-family *Lyceninae.*

46. *THECLA ACADICA*, *Edw.* Rare. Has been taken at London, Hamilton, Ottawa, Montreal and St. Rose, P.Q. Flies in July. Food plant—Willow.

47. *THECLA MELINUS*, *Hubn.* (*Uranotes Melinus.*) Very rare in Canada. Has been taken at London, Hamilton, Montreal. Flies in July. Food plants—Hops, Beans, Cynoglossum, Crataegus.

48. *THECLA EDWARDSII*, *Saund.* (*Falacer*, Harris.) Very rare. Has been taken at London, Hamilton, Credit and Ottawa (rare), in July. Food plant—Oak.

49. *THECLA CALANUS*, *Hubn.* (*Inorata*, Grote-Rob; *Falacer*, Godt.) Usually rare, but sometimes abundant. Has been taken at London, Hamilton, Ottawa and Montreal, in July and August. Food plants—Oak, Butternut, Hickory.

50. *THECLA ONTARIO*, *Edw.* Taken only at Port Stanley, Ont., by Mr. E. B. Reed, in July, 1868.

51. *THECLA STRIGOSA*, Harr. (*Liparops*, Seud.) Rare. Taken at Cameron Lake, London, Ottawa and Montreal, July. Food plants—Thorn, Shadbush (*Amelanchier*), Blueberry (*Vaccinium*), Plum.

52. *THECLA SMILACIS*, Boisd.-Lec. (*Mitura Damon*, Cram.) Has been taken only at Point Pelee, Ont., by Mr. Saunders. Food plant—Red Cedar. *Pielon, Mh. 77.*

53. *THECLA AUGUSTUS*, Kirby. (*Incisalia Augustus*.) Has been taken at London and Ottawa, Montreal, Bergerville and Quebec, and at Halifax, N.S.

54. *THECLA IRUS*, Godt. (*Incisalia Irus*) This very rare butterfly has been taken at Nepigon by Mr. Macoun, and at Montreal by Mr. Bowles. Food plant—Wild Plum.

55. *THECLA NIPHON*, Hubn. (*Incisalia Niphon*.) Rare. Has been taken at London and Ottawa, Montreal, Chelsea, Sorel, P.Q., Halifax, N.S. Flies in May. Food plant—Pine.

56. *THECLA LETA*, Edw. (*Erora Leta*.) Very rare. Taken at London and York Mills, Ont., Beloeil Mountain, St. Joachim, St. Hilaire and Quebec. Flies during the latter part of May.

57. *THECLA TITUS*, Fabr. (*Mopsus*, Hubn.; *Strymon Titus*.) Widely distributed, but rather rare in Canada. Nepigon, Sudbury, London, Hamilton, Credit, Toronto, Ottawa, Montreal, Oka, Eastern Townships, Quebec. Flies in July and August. Food plants—Wild Cherry, Oak.

58. *FENISECA TARQUINIUS*, Fabr. Widely distributed, but not common. Sudbury, London, Hamilton, Credit, Toronto, Stony Lake, Ottawa, Montreal, Cowansville, Township of Stanbridge, Island of Orleans, P.Q.; Halifax, N.S. Has been taken from May 24th, through the summer to September. Larva feeds upon plant lice (Aphides).

59. *CHRYSOPHANUS THOE*, Boisd.-Lec. Taken in Ontario and Quebec, but very locally on the margin of rivers or lakes. Nepigon, London, Hamilton, Port Hope, Cobourg, Ottawa, Montreal, Lachine, Quebec, Eastern Townships. Flies in August and earlier part of September. Figs. 12 and 13. Food plants—Rumex and Polygonum.



Fig. 12.



Fig. 13.

60. *CHRYSOPHANUS FLORUS*, Edw. (Five specimens of this rare butterfly were taken at Nepigon by Prof. Macoun. It has also been taken by Capt. Brown in Newfoundland.)

61. *CHRYSOPHANUS DORCAS*, Kirby. Kirby's record is lat. 54°. It is reported from Labrador in July.

62. *CHRYSOPHANUS EPIXANTHE*, Boisd.-Lec. (*Epidemia Epixanthe*.) Rarely seen, but very widely distributed; frequents the borders of swamps and peaty meadows. Has been taken at London, Toronto, Ottawa, Montreal, the Gomin Swamp, Quebec, Cape Breton, Newfoundland. Flies in July. Food plant unknown.

63. *CHRYSOPHANUS HYPOPHLEAS*, Boisd. [*C. Americana D'Urban*] (*Heodes Hypophleas*.) Very common throughout Ontario and Quebec. Nepigon, Sault Ste. Marie, Sudbury, county of Essex, London, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Cacouna, Little Metis, Prince Edward Island, Moose Factory. Flies from the end of May to September. Food plant—Sheep's Sorrel (*Rumex acetosella*).

64. *LYCENA PEMBINA*, Edw. Has been taken at Cacouna, P.Q., by Mr. Saunders in July, 1866 (*Can. Ent.*, Vol. I., p. 12). = 5

65. *LYCENA* Ont.; Heights of Labrador, Newfoundland.

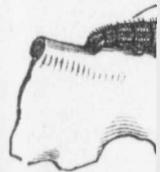
66. *LYCENA* taken at Nepigon costis, Labrador, August. Food

67. *LYCENA* Edw.: summer form Nepigon, Sudbury, Ottawa, Montreal, Godbout river. 54° (Kirby) May (forms *Lycena* form *Neglecta* plants—Cornus, other plants (vi

68. *LYCENA* at Nepigon, Sudbury Basin. Flies in pedeza, Desmond



69. *PIERIS* rarely seen. S.



Cobourg, Lachine and other crucif

65. *LYCENA COUPERII*, *Grote*. Rare. Has been taken at Nepigon and Brantford, Ont.; Heights of Levis, Cacouna, Little Metis and Godbout river, P. Q., Anticosti, Labrador, Newfoundland.

66. *LYCENA SCUDDERII*, *Edw.* (*Rusticus Scudderii*). Locally abundant. Has been taken at Nepigon, London, Toronto, Cobourg, north shore of the St. Lawrence, Anticosti, Labrador, Hudson bay. Cape Breton. Flies at the end of May, in June and August. Food plant—Lupin.

67. *LYCENA PSEUDARGIOLUS*, *Boisd-Lec.* (Winter forms *LUCIA*, *Kirby*; *VIOLACEA*, *Edw.*; summer form *NEGLECTA*, *Edw.*—*Cyaniris Pseudargiolus*). Very widely distributed. Nepigon, Sudbury, London, Hamilton, St. Catharines, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Eastern Townships, River Rouge district, Quebec, Riviere du Loup, Godbout river, Anticosti, lower St. Lawrence, Labrador, Prince Edward Island. Lat. 54° (*Kirby*). Appears very early in the spring, and may be found in April and May (forms *Lucia* and *Violacea*); in June and July in the more northern localities; the form *Neglecta* is found during June, July and August, and into September. Food plants—Cornus, Actinomeris, Viburnum, Acer spicatum, Willow, and a great variety of other plants (vide *Scudder's Butterflies of the Eastern United States and Canada*, p. 938).

68. *LYCENA COMYNTAS*, *Godt.* (*Everes Comyntas*). Not uncommon. Has been taken at Nepigon, Sudbury, London, Hamilton and Ottawa; Montreal, Lachine, Chateauguay Basin. Flies in May, June, July and August. Food plants—Leguminous plants, Lespedeza, Desmodium, Clover, Lathyrus.

Family PAPILIONIDÆ. 18 97

Sub-family *Pierinae*.

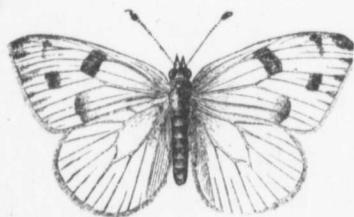


Fig. 14.

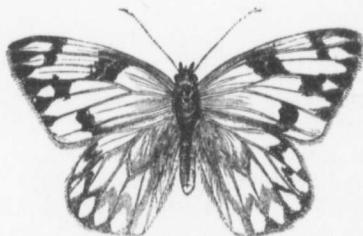


Fig. 15.

69. *PIERIS PROTODICE*, *Boisd-Lec.* (*Pontia Protodice*). Formerly common, but now rarely seen. Sault Ste. Marie, Amherstburg, Port Stanley, London, Hamilton, Toronto,

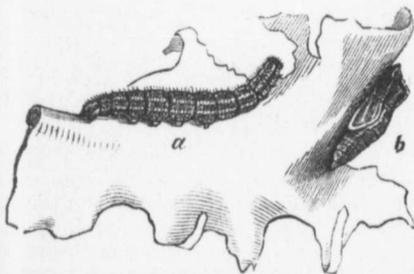


Fig. 16.

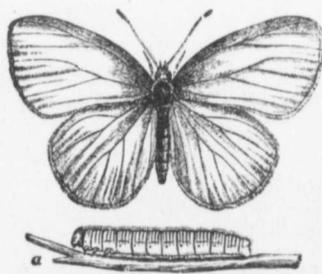


Fig. 17.



Fig. 18.

Cobourg, Lachine, P.Q. Has been taken from May to October. Food plants—Cabbage and other cruciferous plants. Fig. 14, male; fig. 15, female; fig. 16—a larva, b chrysalis.

70. *PIERIS NAPI*, *Esper.* (Forms *OLERACEA-HIEMALIS*, *Harr.*; *BOREALIS*, *Grote*; *FRIGIDA*, *Scud.*; *VIRGINIENSIS*, *Edw.*; *OLERACEA-ÆSTIVA*, *Harris*). Taken throughout the Eastern Provinces of Canada. Formerly very abundant, but since the wide-spread introduction of *P. rapæ*, this and the preceding species have become quite rare. Recorded from Nepigon, Sault Ste. Marie, Bruce Mines, north of Lake Huron, Sudbury, Collingwood, Amherstburg, London, Hamilton, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Cowansville, River Rouge district, Quebec, Little Metis, Lower St. Lawrence, Anticosti, Labrador, Newfoundland, Cape Breton. Lat. 65° (Kirby). Hudson Bay. The form *Borealis* has been taken at Godbout river, P.Q.; *Frigida* at Mingan, Anticosti and the south and east coasts of Labrador; the aberrant form *Virginienensis* at Hamilton and Fort William. Food plants—Turnips and other cruciferous plants. Fig. 17 butterfly, and *a* the larva; fig. 18 chrysalis.

71. *PIERIS RAPÆ*, *Linn.* and aberrant form *var NOVÆ ANGLIÆ*, *Scud.* Since its introduction to this country at Quebec, in 1858, it has spread over a large portion of the continent, and is everywhere one of the commonest butterflies. Flies from April to

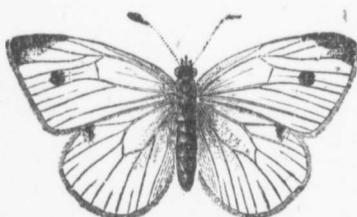


Fig. 19.

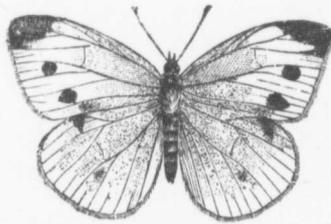


Fig. 20.



Fig. 21.

October. Food plants—Cabbage and other cruciferous plants, mignonette, stocks. Fig. 19, male butterfly; fig. 20, female; fig. 21—*a* larva, *b* chrysalis.

72. *COLIAS CÆSONIA*, *Stoll.* (*Zerene Cæsonia*). Mr. Scudder gives "Southern Ontario" as one of its localities, but I can find no recorded place of capture. Mr. Moffat tells me that it was taken at Long Point, Lake Erie. Food plants—Clover, *Amorpha*.

73. *COLIAS EURYTHEME*, *Boisd.* [Forms *KEEWAYDIN*, *Edw.*; *ERIPHYLE*, *Edw.*] (*Eurymus Eurytheme*). Abundant north of Lakes Superior and Huron; occasionally taken in more southern localities. Nepigon, Fort William, Port Arthur, Bruce Mines, Sault Ste. Marie, London, St. Catharines, Port Hope (Oct. 15), Ottawa, Hull, Montreal, Missisquoi county, Quebec. Food plant—White Clover.

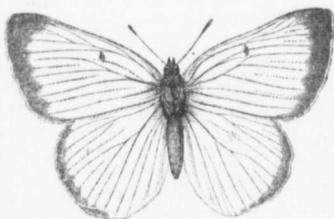


Fig. 22.

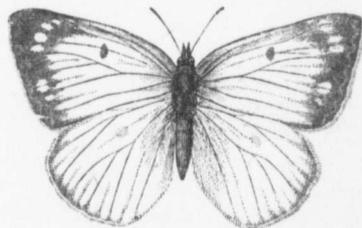


Fig. 23.

74. *COLIAS PHILODICE*, *Godt.* (*Eurymus Philodice*). One of the commonest butterflies throughout the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island. Abundant from the middle of May to September; occasionally taken as early as April 9th, and as late as October 19th. Food plants—Clover, Pea, Lupin. Fig. 22, male; fig. 23, female.

75. *COLIAS* and Huron; Spanish river Heights of I

76. *COLIAS* field, July, 18 foundland, P

77. *TERESIA* been once tal

TERESIA June 29, 188

78. *TERESIA* 29, 1882, Sa 23, 1882.)

79. *PANORAMA* ally taken in Essex, Point Papaw.

80. *PANORAMA* inces of Ont Newfoundla of May, thro sometimes plants — A Willow, Cl Black and V wood, Am butterfly; I

81. *PANORAMA* Fig. 26. S

75. *COLIAS INTERIOR*, Scud. (*Eurymus Interior*). Abundant north of Lakes Superior and Huron; occasionally taken further east. Nepigon, Port Arthur, Fort William, Spanish river, Georgian bay, Sudbury, Ottawa, Montreal, Owl's Head Mountain, Quebec, Heights of Levis, Moose Factory. Flies in July and August. Food plant—Willow.

76. *COLIAS INTERIOR*, var *LAURENTINA* Scud. Is recorded from Montreal (Caulfield, July, 1874); Quebec (Fyles); Godbout river, Anticosti, Mingan, Labrador, Newfoundland, Prince Edward Island, Cape Breton.

77. *TERIAS NICIPPE*, Cram. (*Xanthidia Nicippe*.) This southern butterfly has been once taken at Point Pelee, Ont. Food plant—Cassia.

TERIAS MEXICANA, Boisd. has also been taken at Point Pelee, by Mr. Saunders, June 29, 1882.

78. *TERIAS LISA*, Boisd-Lec. (*Eurema Lisa*) Has been taken at Point Pelee (June 29, 1882, Saunders); Port Stanley (August, 1861); London, Hamilton (Moffat, June 23, 1882.) Food plants—Clover, Cassia. *Ottawa*

Sub-Family, *Papilioninae*.

79. *PAPILIO AJAX*, Linn. [Form *MARCELLUS*, Boisd.] (*Iphiclides Ajax*.) Occasionally taken in June in the extreme southern parts of Ontario, North Ridge, county of Essex, Point Pelee, Long Point, Ridgeway, Komoka, near London. Food plant—Pawpaw.



Fig. 24.

80. *PAPILIO TURNUS*, Linn. (*Jasoniades Glaucus*.) Abundant throughout the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island; also in Newfoundland. Flies during the latter part of May, throughout June and part of July, sometimes in enormous numbers. Food plants—Apple, Thorn, Aspen, Poplar, Willow, Cherry, Alder, Busswood, Oak, Black and White Ash, Birch, Aspen, Tulip wood, Amelanchier Canadensis. Fig. 24, butterfly; Fig. 25, caterpillar.



Fig. 25.

81. *PAPILIO ORESFONTES*, Cram. (*Papilio Thoas*, Boisd.; *Heraclides Cresphonte*) Fig. 26. Spreading gradually through southwestern Ontario. Has been taken in the

county of Essex, at Amherstburg, Sandwich, Windsor, Belle Isle, Chatham, Point Pelee, St. Thomas, Long Point, Theford, Dunnville, London, Dundas, Hamilton, Ridgeway,

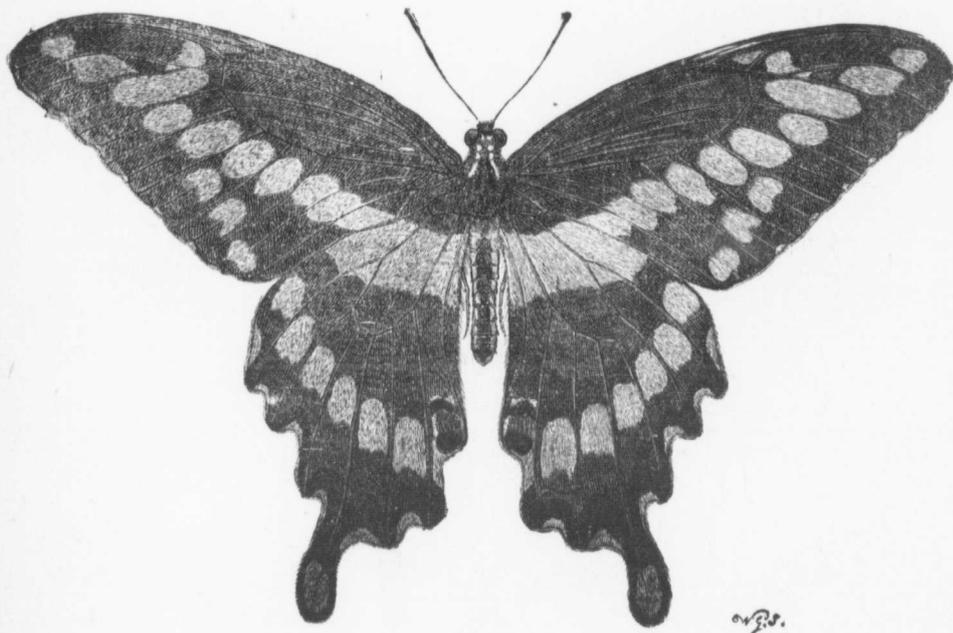


Fig. 26.

Toronto, Roach's Point, Lake Simcoe, Sparrow lake. In Quebec at Chateauguay Basin and at St. John, N. B. Flies in June, July and August. Food plants—The Citrus family, Rutaceae, Prickly Ash, Hop-tree (*Ptelea trifoliata*) *Dictamnus fraxinella*, *Ruta graveolens*.

82. *PAPILIO BREVICAUDA*, *Saunders*. Taken only in the extreme east; Godbout River, Anticosti, Labrador, Newfoundland, Gaspé and Dalhousie, N. B. Food plants—*Ligusticum*, *Pastinaca*.



Fig. 27.

83. *PAPILIO ASTERIAS*, *Fabr. Papilio, Polyxenes.*) Fig. 27. Abundant throughout the western peninsula and eastern parts of Ontario; not common in the Province of

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Quebec. County of Essex, Amherstburg, London, West Flamboro, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, "150 miles east and west of Quebec" (Bowles), Lorette, Cacouna, Little Metis, Labrador, New Brunswick, Newfoundland. Flies at the end of May and through June, July and August; most abundant during the last-named month. Food plants—Celery, Carrot, Parsley and other umbelliferous plants.

84. *PAPILIO TROILUS*, Linn. (*Euphœades Troilus*.) Confined to the western peninsula of Ontario, where it is common. County of Essex, Point Pelee, Dunnville, London, West Flamboro, Hamilton, St. Catharines, Credit. Flies during June, July and August. Food plants—Spice bush, Sassafras.

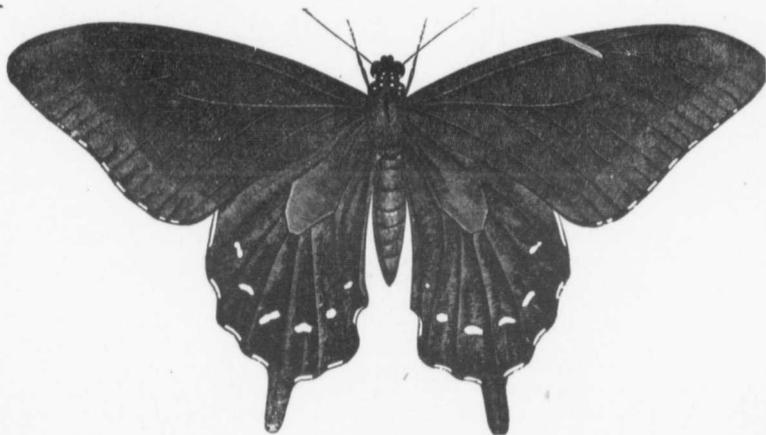


Fig. 28.

85. *PAPILIO PHILENOR*, Linn. (*Laertias Philenor*.) An occasional visitor to southwestern Ontario. Long Point, Ridgeway, Woodstock, West Flamboro, Hamilton, Grimsby, Humber Plains, Toronto. Only seen in the month of June. Food plant—Dutchman's Pipe (*Aristolochia siphon*.) Fig. 28, butterfly; Fig. 29 *a* and *b*, chrysalis; Fig. 30, caterpillar.

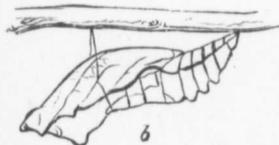


Fig. 29.

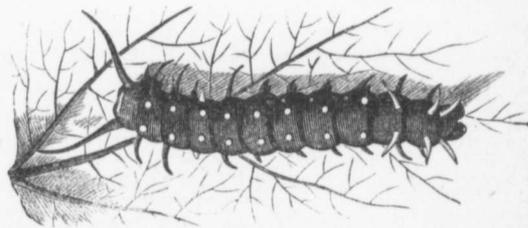


Fig. 30.

Family *Hesperidae*. 32 sp.

86. *CARTEROCEPHALUS MANDAN*, Edw. Taken in the northern parts of Ontario and in Quebec. Nepigon, Sault Ste. Marie, St. Joseph's Island, Lake Huron, Sudbury, Bobcaygeon, Ottawa, Lake Mistassini, Lachine, Compton, Bergerville, Levis, Quebec, Godbout river, Anticosti, Labrador. Flies in June and July. Food plant—Grass.

87. *ANCYLOXYPHA NUMITOR*, Fabr. (*Heteropterus Marginatus*, Harris.) Widely distributed but extremely local. Point Pelee, London, Hamilton, Grimsby, St. Cathar-

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Ridgeway,

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Province of

ines, Township of Shefford, River Yamaska, P. Q. Has been taken in June, August and September. Frequents low marshy places. Food plant—Grass.

88. PAMPHILA MASSASOIT, *Scud.* (*Poanes Massasoit.*) Only recorded by Mr. Scudder as from "Ontario (Saunders)."

89. PAMPHILA ZABULON, *Boisd.-Lec.* [Forms HOBOMOK, *Harris*; POCOHONTAS, *Scud.*] (*Atrytone Zabulon*). Not uncommon in one or other of its forms throughout Ontario and Quebec. Taken at Nepigon, Sudbury, county of Essex, London, Hamilton, Credit, Toronto, Ottawa, Montreal, Chateauguay Basin, Compton, Quebec, Dalhousie, N. B., Nova Scotia. Flies in June and July. Food plant—Grass.

90. PAMPHILA MANITOBA, *Scud.* (*Erynnis Manitoba.*) Inhabits northern Ontario and Quebec. Nepigon, Sudbury, Kirk's Ferry, Quebec, Levis, Cacouna, Riviere du Loup, Little Metis, Gaspé. Taken in July, August and September.

91. PAMPHILA LEONARDUS, *Harris.* (*Anthomaster Leonardus.*) Taken sparingly in Ontario and Quebec. London, Hamilton, Credit, Toronto, Port Hope, Chelsea, Hull, Montreal, Chateauguay Basin. Flies in July and September. Food plant—Grass.

92. PAMPHILA OTHO, *Sm.-Abb.* [Variety EGEREMET, *Scud.*], (*Etna, Scud.*) Very rare. Has been taken at Hamilton, London, Prescott, and in the Eastern Townships, P. Q. (Fyles).

93. PAMPHILA PECKIUS, *Kirby.* [WAMSUTTA, *Harris*] (*Polites Peckius.*) Common and very widely distributed. Nepigon, Sudbury, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Quebec, Little Metis, New Brunswick, Nova Scotia, Cape Breton, Moose Factory, Prince Edward Island. Flies in June, July, and occasionally in August. Food plant—Grass.

94. PAMPHILA MYSTIC, *Scud.* (*Thymelicus Mystic.*) Frequents the same localities as the preceding. Nepigon, Sudbury, London, Hamilton, Port Hope, Ottawa, Montreal, Chateauguay Basin, Quebec, Cacouna, Ha! Ha! bay; Nova Scotia, New Brunswick and Prince Edward Island. Flies in June, July and August. Food plant—Carex.

95. PAMPHILA CERNES, *Boisd.-Lec.* [AHATON, *Harris.*] (*Limochores Taumas, Fabr.*) Very abundant throughout eastern Canada. Nepigon, London, Hamilton, Credit, Toronto, Port Hope, Ottawa, Montreal, Chateauguay Basin, Eastern Townships, Quebec, Nova Scotia, Cape Breton, Prince Edward Island. Flies in June and July. Food plant—Grass.

96. PAMPHILA MANATAAQUA, *Scud.* (*Limochores Manataaqua.*) The only Canadian localities I have found are "Canada West" (British Museum Catalogue); Prince Edward Island (Macoun.)

97. PAMPHILA METACOMET, *Harris.* (*Euphyes Metacomet.*) Not common. Has been taken at Nepigon, Sudbury, London, Hamilton, Ottawa, Montreal, Heights of Levis. In July. Food plant—Carex.

98. PAMPHILA PONTIAC, *Edwards.* (*Limochores Pontiac.*) The only Canadian locality is Montreal (Caulfield, teste Strecker.)

99. PAMPHILA DION, *Edw.* (*Limochores Palatka, Edw.*) Taken only at Hamilton by Mr. Moffat.

100. PAMPHILA VIATOR, *Edw.* (*Phycanassa Viator.*) This southern butterfly has been taken at Hamilton by Mr. Moffat, and on the Humber Plains near Toronto by Mr. Geddes.

101. PAMPHILA VITELLIUS, *Sm.-Abb.* [*Delaware, Edw.*; *Logan, Edw.*] Taken only at London by Mr. Saunders.

102. AMBLYSCIPTES VIALIS, *Edw.* Rare. Has been taken at Nepigon, Sudbury, London, Ottawa, Chelsea, Montreal and Eastern Townships. In June and July. Food plant—Grass.

103. AMBLYSCIPTES SAMOSET, *Scud.* Occurs even more rarely than the preceding. Has been taken at Ottawa, May 27, 29; Eastern Townships and Levis, P.Q., Nova Scotia. Flies in the end of May and in June.

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104. PYRGUS TESSELLATA, *Scud.* (*Hesperia Montivaga*, *Reak.*). A southern and western species which has only been reported from Essex county, Ontario. (Lowe, Can. Ent., vii, p. 140.)

105. PYRGUS CENTAURÆ, *Ramb.* (*Hesperia Centaureæ*). A northern circumpolar species. It has been taken at Wabigoon, on the C. P. R. (about 200 miles west of Fort William), and in Labrador (Low).

106. NISONIADES BRIZO, *Boisd.-Lec.* (*Thanaos Brizo*). Widely distributed, but not very common. Sudbury, London, Hamilton, Toronto, Ottawa, Montreal, Quebec, Nova Scotia, Prince Edward Island. Flies in June. Food plant—Scrub Oak.

107. NISONIADES ICELUS, *Lint.* (*Thanaos Icelus*). Abundant locally, but not common. Nepigon, Sudbury, Hamilton, Ottawa, Montreal, Quebec, Nova Scotia. Flies in June and July. Food plants—Aspen, Willow, Witch-hazel.

108. NISONIADES LUCILIUS, *Lint.* (*Thanaos Lucilius*). Only recorded in Ontario from London and Ottawa. Flies in May, July and August. "In 1893 so abundant at Ottawa as to be noticeably injurious to garden Columbines" (Fletcher). Food plant—Wild Columbine (*Aquilegia Canadensis*).

109. NISONIADES PERSIUS, *Scud.* (*Thanaos Persius*). Has been sparingly taken in the county of Essex, London, Hamilton, Toronto, Ottawa and at Saguenay, P. Q. Flies in May and June. Food plants—Willow, Poplar.

110. NISONIADES MARTIALIS, *Scud.* (*Thanaos Martialis*). A southern species, which has been taken at London, Hamilton and Toronto.

111. NISONIADES JUVENALIS, *Fabr.* (*Thanaos Juvenalis*). Not common. Has been taken at London, Hamilton, Toronto, Cobourg, Ottawa (rare). Flies in May and early June. Food plants—Oak and various leguminous plants.

112. PHOLISORA CATULLUS, *Fabr.* Not common. Has been taken in the county of Essex, Point Pelee, London, Hamilton, Toronto, Eastern Townships and Quebec. Flies in June. Food plants—Chenopodium, Aramantus. *Nepigon (Barus)*

113. EUDAMUS ELECTRA, *Lint.* (*Thorybes Electra*). This butterfly has only been taken by Mr. Moffat at Hamilton. The only specimen, a female, is in the possession of Dr. Holland, of Pittsburg, Penn.

114. EUDAMUS PYLADES, *Scud.* (*Thorybes Pylades*). Common in certain localities. Has been taken at Nepigon, Sudbury, London, Hamilton, Ottawa, Montreal, Chateauguay Basin. Flies in May, June and July. Food plants—Clover, Lespedeza and other leguminous plants.

115. EUDAMUS BATHYLLUS, *Sm.-Abb.* (*Thorybes Bathyllus*). This southern species has been taken in the county of Essex, at London, Hamilton, Toronto, Rice lake, ~~Ottawa~~. Flies in June and July.

116. EUDAMUS TITYRUS, *Fab.* (*Epargyreus Tityrus*). Very widely distributed throughout Ontario and Quebec; common, but not numerous. County of Essex, Point Pelee, London, Hamilton, St. Catharines, Credit, Toronto, Port Hope, Ottawa, Montreal, Chateauguay Basin, Quebec. Flies in May, June and July. Food plant—Locust, Acacia, *Lathyrus palustris*, *Apios tuberosa*.

POSTSCRIPT.—Since this list was prepared I have learnt that the following species has been taken within our limits:

117. LYCENA AQUILUS, *Boisd.* [*Franklinii*, *Curtis*]. This northern species was taken at Nepigon by Mr. Fletcher, July 7, 1894. It is also reported from Labrador, Hudson straits, Newfoundland (Gosse).

The following species do not come strictly within the limits that we have adopted, but may be mentioned as possible additions to our fauna:

ARGYNNIS POLARIS, *Boisd.* Hudson straits (Payne and Bell).

CHIONOBAS CALAIS, *Scud.* Rupert House, Hudson bay; Newfoundland.

Sokoma Bay, Ont. E.M. Walker, 190

- CHIONOBAS TAYGETE, *Hubner*. Hudson straits (Payne).
 CHIONOBAS SEMIDEA, *Say*. Labrador, Hudson straits, Newfoundland.
 CHIONOBAS CRAMBIS, *Frey*. Hudson straits (Payne).
 CHIONOBAS CENO, *Boisd.* Labrador (Couper).
 CHIONOBAS BORE, *Esp.* Labrador (Couper).
 LYCENA ASTER, *Edw.* Newfoundland (Gosse, Mead).
 LYCENA LYGDAMUS, *Doubl.* Labrador (Couper).
 PAPILIO MACHAON, *Linn.* Rupert House, Hudson bay (Payne).
 COLIAS BOOTHII, *Curt., var. CHIONE, Curt.* Hudson straits (Payne, Geddes, Can. Ent., xxi., 59).
 COLIAS HECLA, *Lef.* Hudson Straits (Payne).
 COLIAS EDWARDSII, *Behr.* Fort William (Geddes).
 COLIAS NASTES, *Boisd.* Labrador ; Hudson straits (Payne).
 COLIAS LABRADORENSIS, *Scud.* Labrador. =
 COLIAS SCUDDERII, *Reak.* Labrador, Hudson bay.

THE PITCHER-PLANT MOTH.

(*Exyra Rolandiana*, Grt.)

By JAMES FLETCHER, OTTAWA.

There are few of our native plants of so much interest as our native pitcher-plant, *Sarracenia purpurea*, from its peculiar beauty and the curious shape of its leaves and flowers, and there are few insects more interesting than the pretty little moth *Exyra Rolandiana*, of which the caterpillars or cocoons may generally be found by making a close search inside the leaves of the pitcher-plant during the month of June or early in July.

This moth was first described by Mr. A. R. Grote in *Psyche*, vol. ii., 1877, page 38, from specimens reared by Mr. Roland Thaxter, at Newton, Mass. It is a small, thick-set insect, about three-eighths of an inch in length, of a dark, metallic, purplish hue which on the forewings is relieved by a yellowish discal patch. The base of the wings is deep red. The dark color on the wings of the females is much blacker than in the other sex. The hind wings in both sexes are black. When at rest the wings are sloped like those of a *Plusia*.

In the *Canadian Entomologist* for 1874, vol. vi., page 207, Prof. Riley contributed an article "On the Insects More Particularly Associated with *Sarracenia variolaris*," and in this article he treats of the closely allied moth, *Xanthoptera semicrocea*, in a most entertaining manner, giving figures of all its stages. The insect-catching power of the pitcher-plants is well known and has been frequently referred to. By an examination of the decaying remains, which may be at any time found in the leaves, it will be seen that insects of almost all orders fall a prey to these treacherous death traps. Ants, however, seem to far outnumber all other kinds of insects, and Prof. Riley suggests that the acidulous properties which their decomposing bodies give to the liquid, with which the lower portion of the pitcher is always filled, render it all the more potent as a solvent of the bodies of the entrapped insects, from which doubtless the plants derive benefit, if indeed they be not, as some believe, truly insectivorous. The leaf of the pitcher plant, from its shape, namely that of a hollow tube tapering to a point at the base, swollen a little above the middle and contracted at the mouth, forms a trap from which it is very difficult for any insects to escape when they have once entered. In addition to the shape of the leaf there are other characters which add to the difficulty of egress. Above the

mouth of the the opening, the danger ly the direction most insects : Once inside, water, and s down to the is almost im few kinds of is a large fles revelling in When full-g surrounded I have studie

My first June, 1890. the cocoons.

Mr. Rol smaller leave is off the gro then of a d warmer, they nated, betake hole near the The larva rea long, of a du The cocoon is after spinnin the color of t extreme mea it resembles disturbed, an wings is very when crawl

I have r most of then detected by t which showe as not, had s the bottom h sions when tl regained thei was eaten at left intact. grown, when the pitcher o and its own o to keep out q by the larva. taken here by which did no

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mouth of the pitcher is a wide expanded hood with stiff bristles pointing down towards the opening, and any insect settling upon this expansion is unconsciously directed toward the danger lying beneath, by finding it, when attempting to walk, much easier to go in the direction of the bristles. The orifice of the pitcher is highly polished and difficult for most insects to find a footing upon; experience shows that a great many fall into the trap. Once inside, they are met with new dangers; the lower third of the pitcher is filled with water, and should they succeed in crawling out of this, the upper portion of the tubes down to the swollen part is thickly beset with fine bristles pointing downward, so that it is almost impossible for luckless captives to regain their liberty. There are, however, a few kinds of insects which are able to brave these dangers with impunity. One of these is a large flesh fly, of which the white maggots may generally be found during the summer revelling in the decomposing remains of other insects at the bottom of the pitcher. When full-grown, they bore their way out through the walls of the leaf and pupate in the surrounding moss. Another species is the pretty little moth referred to above, of which I have studied a few specimens every summer for the last three years.

My first acquaintance with this insect was upon finding the moth inside a pitcher in June, 1890. Since that time I have collected similarly located larvæ of various sizes and the cocoons. I have also bred the larvæ from after the third moult in confinement.

Mr. Roland Thaxter says: "The larvæ of *Exyra Rolandiana* may be found in the smaller leaves of *Sarracenia purpurea* in this vicinity (Newton, Mass.) as soon as the snow is off the ground early in spring, apparently having moulted two or three times; they are then of a dull reddish brown and about 6 mm. long. As soon as the weather grows warmer, they increase in size rapidly, and, having eaten the leaf in which they have hibernated, betake themselves to the larger leaves, which they begin to eat after having made a hole near the base to let the water out and after having spun a close web over the mouth. The larva reaches its full growth about the first of May and later, when it is about 20 mm. long, of a dull carmine or brown color, lighter, sometimes white, between the segments. The cocoon is spun in the leaf of loose white silk, the larva changing to a pupa a few days after spinning. The imago appears early in June. There is a good deal of variation in the color of the females, some being much brighter than others. The following are the extreme measurements of both sexes: males, 26-20 mm., females 21-16 mm. In its habits it resembles *E. semicrocea*, generally backing down towards the bottom of the leaf when disturbed, and using its wings in ascending. I notice that the frenulum at the base of the wings is very long in this species, and, as well as I could see, the moth seems to use it when crawling up the leaf. This species is very delicate and difficult to rear."

I have never found the larva at Ottawa before the beginning of June, and they had most of them at that time moved to a new leaf, but their presence on a plant was easily detected by the brown dead patch on the leaf where they had fed the year before and which showed plainly on the outside. The leaves containing the larvæ, moreover, as often as not, had some water in them. This, of course, may have resulted from the *débris* at the bottom having stopped up the hole observed by Mr. Thaxter. On one or two occasions when the larvæ were shaken off into the water, they floated on the top and easily regained their places on the sides of the pitcher. In all instances the surface of the leaf was eaten at one place only, generally near the top inside the leaf, the outside skin being left intact. The larva is sluggish and seldom moves from its feeding ground until full grown, when it spins a loose cocoon of very fine cobwebby silk, either against the side of the pitcher or, in two instances, beneath the surface of the mass of decomposed insects and its own excreta. The web over the mouth of the pitcher, although very fine, seems to keep out quite effectually all other insects after the leaf has been taken possession of by the larva. The time of appearance of this moth is rather extended. Moths have been taken here by the first week in June, and at the same time a very small larva was found which did not give the perfect insect until the 12th of July.

The following is a description of this caterpillar when full-grown: Length, when extended, three-quarters of an inch; spindle-shaped; distinctly segmented; general outline closely resembling the larva of *Xanthoptera semicrocea*, figured by Prof. Riley on page 208 of the *Canadian Entomologist*, vol. vi., but lacking the fleshy processes of the

abdominal segments; head and first segments small; segments 2-7 gradually enlarging to 3 mm., and then tapering to the posterior extremity; each segment velvety claret color, the velvety hairs only in the central part of the segments; the intrasegmental sutures smooth, pale, in some specimens almost white; head white, marked symmetrically on each side with three black marks, the uppermost almost round, the middle one crescent-shaped, and the lowest, above the ocelli, comma-shaped; spiracles brown, ringed with black; on each segment about six small black tubercles bearing slender tawny bristles; thoracic feet and pro-legs darkened externally. When walking this caterpillar has the same half-looper appearance as the caterpillars of the *Plusias*, due to the fact that like them it has only two pairs of abdominal pro-legs. At the same time the fore part of the body is moved from side to side with a wavering motion.

Before spinning its cocoon the caterpillar ceases feeding for about a day and then spins its flimsy cocoon through which the chrysalis can be easily seen. The pupal stage lasts between 15 and 19 days. The moth when it emerges crawls up the sides of the pitcher and easily forces its way through the gossamer-like covering.

CATASTEGA ACERIELLA Clemens, SEMASIA SIGNATANA Clemens.

BY THE REV. T. W. FYLES, SOUTH QUEBEC.

In my notes on "The Season of 1893," published in the Society's last Report, I described the *Catastega* larva and pupa. In telling of the habits of the larva I said, "Then it bites away portions of the inner skin of the leaf and proceeds to make itself a case" This, without addition may be somewhat misleading.—*It makes its case of its excrementa*. The larva vacates its case, or rather tube, and drops from the tree about the 15th of September. The perfect insect appears in the middle of April next ensuing. The following is a description of it:

Length of body one-fourth of an inch. Expanse of wings five-eighths of an inch. Colors, grey and brown. Antennæ, filiform, grey; palpi, large and pale grey; face, clothed with long, pale grey, feathery scales; eyes, protuberant, pale grey; thorax, grey; abdomen, brownish grey; legs, feathered throughout, pale grey—the tarsi barred with brown on the upper side, as are also the tibiæ of the middle and foremost pairs; primaries, pale grey, having numerous, dark-brown lines, running from the costa with a backward curve for about one-third of the width of the wing; having also three conspicuous patches of dark brown, one—somewhat triangular—in the centre with an angle touching the costa, and one on each side of this, running from the inner margin about half-way across the wing—the base and outer angle of the wing are clouded with brown; secondaries, brownish grey, darkening towards the hind margin; fringes of all the wings grey.

On April 17th I sent specimens of the moth to Professor Fernald, and said:—"I dare say the moth is known under another name. If this be the case, which name will stand good?" To this he very kindly replied. "I am in receipt of your letter enclosing specimens of *C. aceriella* Clem. which prove to be *Semasia signatana* Clem. and this last name will hold, because it was given to an imago which was properly described, and the type is still preserved in the collections of the Am. Ent. Soc. in Phil., and because the former name and description were for the early stages of some unknown insect."

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NOTES ON A FEW CANADIAN COLEOPTERA.

By W. HAGUE HARRINGTON, F.R.S.C., OTTAWA.

Punque signata
Hippodamia 5, signata, Kirby.—Fig. 31 (much enlarged) In the summer of 1893 I collected in a swampy meadow some coccinellids with the hope of obtaining hymenopterous parasites from them. In this I was not successful, but from a specimen of the species named there emerged two individuals of a small, white hair snake (*Gordius*?) about two inches long.

Brachyacantha ursina, (Fab) This beetle has been very abundant at Ottawa the past two seasons, although formerly I had only found occasional individuals. During July and August it occurred commonly upon milk-weeds. About the end of April last year, in examining colonies of ants under stones, I discovered in a colony of the small brown ant (*Lasius alienus*) four larvæ which were devouring plant-lice, which were feeding upon the roots of grass after having been wintered by the ants. These larvæ were whitish and powdery, like the aphides themselves, and were 6 mm. long and 2 mm. wide tapering only slightly toward the extremities. Recognizing them as coccinellid larvæ, I secured them and placed one in alcohol. The remaining three were kept in a small jar with a few of the aphides, but they did not appear to eat any more, and a day or two later had gathered in a group and formed for themselves almost globular cocoons of white flocculent secretions, in which they pupated. The imagos emerged between the 15th and 20th June, and proved to be *B. ursina*, whose larval habits have not been described so far as I can ascertain with the literature at hand.



Fig. 31.

Antherophagus ochraceus, Melsh. This beetle is found sparingly upon flowers, such as the spiked-maple, goldenrod, etc. On one occasion I observed a humble bee (*Bombus terricola*), upon a currant bush, and evidently in trouble. Closer observation showed that some small insect had seized her by the end of her tongue, and was retaining its hold in spite of the bee's frantic exertions to dislodge it with her front legs. I secured the bee in my cyanide bottle and when she was dead found that her assailant was still attached to her tongue, and was a specimen of *A. ochraceus*. They are still together in my cabinet. Dr. Riley has, I think, mentioned this species as occurring in the nests of *Bombus*, but I cannot find the reference at present. Had the beetle in this instance merely attached itself to the bee by accident, or was it intent on getting free transportation to the bee's nest? If the latter were the case it probably intended to attach itself to the leg, and seized the tongue in mistake.

Oestodes tenuicollis, (Rand. This rather pretty elater has been one of the beetles which I had always been expecting to turn up at Ottawa, but which I had never found until this summer, when several were taken upon goldenrods on an island below the city, and one also in a field in the suburbs.

Poecilnota cyanipes, (Say.) This fine little buprestid is rare, and only occasionally found upon willows and poplars, upon the former of which one specimen was taken during the past season.

Anthaxia aeneogaster, Lap., (*inornata*, Rand.) The habits of this pretty little species appear to be somewhat different to those of our other species of *Anthaxia*, which are generally obtained by beating trees during the summer, whereas this species usually is found earlier in the season, and nearly always on flowers, such as trilliums, etc. Three were taken on the 20th June last in the flowers of *Cypripedium pubescens*, the Yellow Ladies' Slipper.

Hydnocera difficilis, Lec. Last spring I collected a number of the small, round, flat spider nests, which may be commonly found adhering to stones. They are of a tough consistence, and somewhat glistening surface, but I do not know the name of the species which constructs them. They are frequently infested by a *Pezomachus*, the oblong cocoon of which can easily be seen when the spider's cocoon is held up to the light. From one of the cocoons which I supposed to contain a *Pezomachus* there came forth a beetle of this species. The hole cut by it was more irregular than the orifice by which the hymenopterous parasite issues, and exposed to view within the exuviae of the beetle.

Cupes concolor, Westw. Some years ago I captured one of these beetles when beating shrubbery on the edge of a small lake, but it did not turn up again until this year, when one was found in my bed-room on the evening of July 28th. It had apparently flown in the window, attracted by the electric lamp.

Saperda lateralis, Fab. On June 24th I captured near Hull a beautiful example of this elegant longicorn. My only previous capture of the species was made with a paddle as I was crossing the Ottawa. My canoe was in mid-stream when I saw a rather uncommon looking beetle flying by, and I could just reach it with the paddle, to the wet surface of which it stuck; such are the accidental captures which do not throw much light on the localities to search for further specimens.

Chlamys polycocca, Lac. This beetle was more than usually abundant the past season, and did considerable damage to blackberries, the foliage of which was often so badly riddled as to be virtually destroyed. The beetle is readily recognized by its almost globular, bronzed and corrugated body, and the grubs can be easily found, as they live in black ob-conical cases which are quite conspicuous upon the riddled leaves and stems. A number of the larval cases were collected and kept in breeding jars with a hope of securing parasites, but only beetles were obtained. From one pupa case, however, there sprouted a small slightly club-shaped fungus about 4 mm. long.

Phyllodecta vulgatissima (Linn.) This beetle occurred in great abundance upon willows on an island below the city, and during the months of July and August the beetles and their larvæ almost entirely destroyed the foliage of some low-growing species. The beetle had never previously been observed in such numbers near Ottawa.

Diabrotica longicornis, (Say) This insect was described in 1824 from specimens found near the Rocky Mountains, and is a common species in several of the United States, especially in Illinois, Iowa and Missouri. It has been frequently a very serious pest to corn, in the roots of which the grubs burrow. A very complete account of its life-history and ravages may be found in a report by Prof. Forbes (10th Rept. of State Entomologist, Illinois), which contains good illustrations of the various life stages of the insect. I do not find that it has ever been recorded from Canada, nor can I find any mention of the northerly and easterly limit of its distribution. It will therefore, I think, be of considerable interest to record the occurrence of this pretty little greenish beetle at such a far easterly point as the head of the Bay of Fundy. On Sept. 8th, 1890, I found it quite abundantly on the Big Tantramah Marsh near Aulac, New Brunswick, which is almost on the boundary line between that province and Nova Scotia. It may be added that these and similar dyked lands are always spoken of as the "marsh." The beetles were found upon the flower-heads of the common large thistle (*Cnicus lanceolatus*), apparently feeding upon the pollen. Thirty or more were easily secured upon a small patch of the thistles. But little corn is grown in the neighborhood, nor am I aware of the occurrence there of ragweed, in which the beetle has also been stated to breed, and it seems probable that it must find a living in the roots of some of the larger grasses.

Nacerdes melanura, Linn. This beetle, introduced from Europe, is, according to Dr. Hamilton, rather rare in America. Some years ago I captured one on a wharf in Sydney, N.S., and on June 26th last I found another on a building in this city.

Corphyra Newmani, Lec. Four or five springs ago I noticed a curious behavior on the part of this beetle. Specimens were twice found mounted upon *Meloe niger*, but for what purpose was not apparent, unless they were attracted by the oil exuded by the blister-beetle. The specimen which I have in my cabinet is dated May 22nd. It is a male, as is also the *Meloe* upon which it was captured. The species is not uncommon here on flowers.

Meloe sps.? Frequently when collecting hymenoptera I find upon some of the smaller bees, such as *Halictus*, the minute triungulin larvæ of *Meloe*. They generally are attached to the posterior femora or to the hairs at the base of the abdomen, and several are sometimes found on one bee. One day last season I saw what seemed to me a new species of bee with a red metathorax, but to my disappointment, when I had carefully netted it, I found it to be only the very common *Prosopis affinis*, upon which more than half a dozen

Hylaeus modestus (Say)

of the triungulin species of these occur most frequently. I have also found so as to be common.

Barynotus p. 21, as occurring in September, at a place was also much itely settled to

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of the triungulins had clustered, so as to entirely cover the metathorax. At least two species of these triungulins are common, one being yellowish, the other brownish. They occur most frequently on *Ceratina dupla* and *Halictus discus*? during the month of June. I have also found them upon the catkins of willows waiting for the visits of these bees, so as to be carried to their nests.

Barynotus Schaefferi, Zett. This European weevil, which I recorded in Vol. 23, p. 21, as occurring at Sydney, N. S., in 1884, was again found there by me last September, at a point some distance from the shore where I formerly took it. The specimen was also much fresher in appearance, and there can be no doubt that the species is definitely settled there.

Otiorynchus sulcatus, Fab., and *Otiorynchus ovatus*, (Linn.), also occur somewhat commonly at Sydney, but are very much less common than the next species to be mentioned.

Otiorynchus rugifrons, Gyll. In a dry rocky pasture where I collected one morning, this beetle was found in great abundance. Under nearly every stone several would occur, either clinging to the under surface, or upon the roots of the grasses, etc. Great quantities of the ejectamenta of toads were seen, and the pellets were composed almost entirely of the remains of this beetle, with an occasional specimen of the preceding species. Thousands must have so perished, as fifty or more were required for one meal by the toad, and I imagine that even then he got very little nourishment, in proportion to the mass of indigestible matter swallowed.

Hypomyza piceus, De G. This fine northern weevil does not appear in our label list, although under the synonyms *H. pinicola*, Couper, and *H. pineti*, Fab., it is recorded from several points in Canada. Last year I took a dead specimen in the leaf of a pitcher-plant some 30 miles from the city (near Casselman), but to-day (17th Nov.), in searching for *Staphylinus erythropterus* I found four fine fresh specimens at the base of a larch tree, just under the moss. From the condition of the beetles and their being all on the same tree, it seems evident that they had been bred in it; the only conifers near by were larches and cedars.

Conotrachelus anaglypticus, Say. This handsome little weevil was an addition to my Ottawa list this season; six specimens having been taken on goldenrods, upon the island previously mentioned, on August 18th and 25th.

FOOD, FEEDERS, AND FED.

BY REV. THOMAS W. FYLES, F.L.S., SOUTH QUEBEC.

On the cover of that interesting magazine "Science Gossip," are represented incidents in the feud that seems to have known no truce since the beginning of created things. A fish has made a spring from the water to catch a fly, but has itself been seized, at one end by a kingfisher and at the other by a pike. Underneath, a water-insect is making every effort to escape from a dytiscus, whilst a perch is in eager chase of the pursuer, unmindful of the monster that with open mouth is close at its own tail. The consummation of such a series of efforts is described in another publication, which, with half the title of that just mentioned, makes a larger claim, viz., "Science." Dr. Charles C. Abbott tells us that he found a bull-frog (*Rana Catesbyana*) with enormously distended sides, and that on examining the contents of its stomach, he found a garter-snake (*Eutamias sirtalis*) eighteen inches long, and a field-mouse (*Arvicola riparia*). Close examination shewed that the snake was in the very act of swallowing the mouse when the bull-frog made a meal of both of them. SCIENCE, Vol. III, p. 67.

SNAKES.

I once saw a large garter-snake swallow a full-grown toad. This toad had held possession of a flower-bed in my garden. In it no doubt it had done me good service by catching various insect intruders. When I came upon the scene the snake held the toad

by one of its hind legs. There was no attempt at resistance. The toad, charmed, or overcome by terror, quietly submitted, and the snake drew in both legs of its unfortunate prey as far as the haunches. At this stage of the proceedings, regardless of the toad's services, I interfered, and disturbed the snake by poking it with my walking-stick. It glided away; and I supposed, of course the toad would make off too. But no, it drew itself together and sat, as stolid as Mark Twain's celebrated frog. After a few minutes the snake came sidling back again. It rubbed its head on the ground, first on one side and then on the other, with the fawning motions of a kitten, and so approached the toad which remained apparently quite apathetic. It seized it by the hind legs as before. The gorging process went on smoothly until the trunk of the toad was reached—then came the strain! I could see the upper jaw of the snake cautiously raised and slightly protruded. Then fresh hold was taken, and the bite with effort secured. As this process was continued, the forward part of the toad's body was more and more distended with the displaced viscera and compressed air. By and by the fore-legs of the toad stuck out angularly, one on each side, and seemed to offer insurmountable difficulties—but no, they in turn were engulfed; and the last motion I saw of the unfortunate victim, as its face was drawn in, was a solemn wink, which seemed to say, "It's all right, my good Sir; it will be worse for the snake than for me. I'll give him a horrible fit of indigestion!" The whole process occupied exactly two hours. How long the toad would live in the snake's inside it is impossible to say. Two naturalists, out on a collecting tour, captured a snake a little more than a yard long, which had a peculiar lump in the middle. Whilst carrying the snake homeward by the tail, they noticed that the lump gradually approached the head. They hung the reptile to a tree still with its head downwards, and awaited developments. The mouth slowly opened, and a large toad covered with a greenish slime dropped out. After some minutes the toad recovered, "and was seemingly little the worse for its imprisonment." SCIENCE GOSSIP, 1874, p. 68.

The snake is not always a conqueror, it is sometimes, as we have already seen, a victim. I have seen a pigeon-hawk (*Falco columbarius*) pounce down upon and fly off with a garter snake; and, stranger still, I have seen a hen shake out a red-bellied snake (*Storeria occipitomaculata*, Baird and Girard,) as one would snap a whip, and then gobble it up—beating back her chickens with her wings meanwhile. The air of complacency, befitting one who had done a virtuous action, with which she afterwards strutted off with her brood, was a thing to be remembered.

Besides the snakes above-mentioned we have in the province of Quebec two others that are frequently met with—the riband snake and the water snake, and two which seem to be local and rare—the milk snake and the grass snake.

The milk snake (*Coronella eximius*, De Kay) is found on the hills bordering upon Vermont. I have taken it on Shufelt's Hill which overlooks the village of Sweetsburg. It is an exceedingly beautiful creature. Its body-color is fawn, softening down to white underneath. All along the back and sides are irregular blotches of rich warm brown bordered with very dark brown.

The grass snake (*Cyclophis vernalis*, De Kay) I have met with only in the neighborhood of Quebec. Two years ago I found a dead specimen in the road near the English Church at New Liverpool; and last summer I captured the living snake on the Island of Orleans. The circumstances of the capture were these: I had drawn down a branch of a young ash-tree to examine it for larvae, and I was conscious of the fall of a rather heavy body. I glanced down, and at my feet was the snake just making off. I took it with my net, and examined it closely. It was about one foot eight inches long. In form it was very elegant; and its color was a delicate pea-green, without spots or markings of any sort. Underneath the hue was somewhat paler, much like that of the down on the body of the Luna moth. The eye of the snake was black, and its glance was as mild and innocent as that of a canary bird. While I was debating in my mind how I should carry it home—for I had no box with me large enough to hold it—it found a hole in the bottom of my net, escaped through it, and glided into a clump of young thorn-bushes and I saw it again no more. It frequents the trees to catch young birds and insects.

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P. Linnæus

But it is when we come to interview the insect tribes that we find the most astounding series of gastronomical accommodations. One insect fattened upon another is destined to become food for a third, which in turn must fall a prey to a fourth. Consider the

SPIDERS.

We have been taught to look upon the spider as an embodiment of successful villainy—of cold-blooded calculation. We hold in abhorrence its stealthy steps to entrap the innocent and unwary.

“Will you walk into my parlor?
Said the spider to the fly;
'Tis the prettiest little parlor
That ever you did spy;
You only have to pop your head
Just inside of the door,
And you'll see so many curious things
You never saw before.”

Oh, the old reprobate! How much satisfaction it affords us to think that the black-headed Tit (*Parus atricapellus*) and other birds snap up without hesitation this betrayer of the innocent. But birds are not the only avengers upon its footsteps. Numerous insects make it their prey. Even that monster spider *Mygale Hentzi* (Fig. 32) of California finds a Nemesis in the “Tarantula Killer,” as it is called, the *Pompilus formosus* of Say. (See the “American Entomologist,” Vol. I, p. 129).

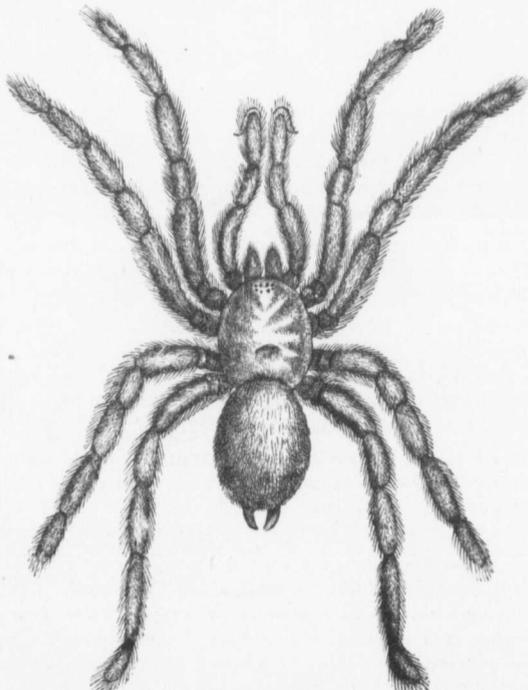


Fig. 32.

Compton P. G.

Some years ago I paid a visit to the Compton Ladies' College, which was then under the care of its public-spirited founder, the Rev. J. Dinzey and his excellent wife. I found in the cupola of the building a number of cells of a species of mud-daubing wasp, probably *Pelopæus cemetarius*, Linn. The insects had vacated their quarters, but there remained in the cells the skins of the spiders on which they, in their larval stage, had fed. Now nature abhors waste, and on these skins a number of small beetles of the species *Plinus fur* Linn, were battenng.

P. Linné 60.

The mother mud wasp after building a cell crammed into it a number of spiders which she had paralyzed with her sting. Having provisioned her nest she laid an egg in it. The business of the larva that hatched from this egg was simply to make a long feast on the fresh food stored up for its use. But Walsh tells us that the larva is not in every case left undisturbed in this pleasing occupation. An ichneumon-fly (*Cryptus juncus*, Cress) sometimes pierces the wall of a cell and ejects an egg, the larva from which proceeds to dispose of the rightful occupant. Commenting upon this Walsh says: "Thus the spider preys upon flies, the mud-dauber upon the spider, and the ichneumon-fly upon the mud-dauber. 'Kill and be killed; eat and be eaten.'" This is the great universal law of nature." "American Entomologist," Vol. 1, p. 137.

I do not like to dismiss our friend *Ptinus fur* without further notice. He is small but he likes high living. He is a fellow of wonderful appetite! I think he outdoes in that respect the famous ostrich which indulged in ten-penny nails and broken bottles, or the African chief who despoiled a party of travellers of their supplies and was seen to eat up a pot of blister salve. It affects the dried specimens in our cabinets seasoned with oxalic acid and verdigris. Curtis found it eating an old coat; and it has been known to thrive on such gentle stimulants as *Nux vomica* and capsicums.

Not only are spiders exposed to dangers from without,—sometimes they suffer from "terrors within." The hair-snakes have been known to make use of them as hosts.

HAIR-SNAKES

are plentiful in the Province of Quebec. The most common of them is *Gordius varius*.

The Rev. E. A. W. King, of Waterville, obtained a worm of this species, and placed it in a dish of water, that he might observe its motions. In a short time it commenced to lay its eggs. They were in the form of a white thread, many inches long, which was gathered into a loose tangle, and through and about which the worm entwined itself, as if to hold it in safety. He did not wait for the eggs to separate and hatch, but consigned the string and the mother worm to a bottle of alcohol.

I have obtained a male *Gordius* from a larva of *Zarcea Americana*, and a White Hair-snake 10 inches long from a Lepidopterous larva, that in length, was but an inch and a quarter. The creature lay closely curled—like the spring of a bird-trap—under the skin of its victim.

Hair-snakes are often met with in strange places. A lady in Montreal, feeling thirsty in the night, took a glass and filled it from a tap in the bath-room. While drinking she felt a tingling sensation on her lip. She paused—struck a light—and to her disgust found one of these creatures in the tumbler. (Moral: Look before you drink).

I lately heard an advanced version of the old myth of the horse-hair in the water. A gentlemen accompanied a hunter on an excursion in search of moose. The hunter looked carefully into every stream they came to, and, at length, discovering Gordii, exclaimed joyfully, "Yes, moose have been here—here are hairs from them turned into snakes."

The history of the hair-snake is not yet completed. The adult worm—its form and structure—its nervous, muscular and reproductive systems, have been fully described. Its mouth is said to open upon a gullet which spreads out upon the upper end of the cellular tissue which extends through the whole length of the worm (Dr. Meissner, quoted by Dr. Leidy, "American Entomologist," Vol. II, p. 195.) Its food, which has (it should be remembered) already gone through the digestive organs of its host, is passed "by endosmosis from cell to cell" and is completely assimilated.

The eggs, the embryos, and the newly developed Gordii have all been described. The last have been seen to enter the bodies of the larvæ of Ephemera, and have been found in them encysted. But, between the notice of them in that condition and the record of the perfect worm, there is a gap in the history. It remains for some careful Helminthologist to fill up the hiatus. It is believed that the *Gordius* is one of those creatures that have to pass from one host to another (like the *Trichinæ*) before they can

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reach their perfect state. We can understand how it could pass in the May-fly to predacious insects, such as the spider and the ground-beetle, but not so readily how it could find a second host in a vegetable devourer, such as the locust or the caterpillar. It may be that the encysted worm is cast off with the pseud-imago skin of the fly, or that it survives the decay of the fly itself, and, being caught in the herbage, is taken in by some hungry herbivorous insect. The chances against it, in this case, seem to be very great. Still, when we remember the vast number of eggs laid by one female Gordius—they have been estimated at more than six millions and a half—we must allow that there is a very broad margin for failures; and that if only a small percentage of the brood arrives at perfection, there must be a very great number, indeed, of hair-snakes that run the full length of days allotted to their kind. In the case of the tape-worm, *Tenia solium*, we know that the ova survive the decomposition of the ejected proglottides or divisions of the worm, and are swallowed by hogs and sheep as they feed upon the vegetation.

Another kind of creatures that affords us much food for reflection is the

APHIDES.

One day in July of this year I found two patches of these "plant-lice" on the broad Windsor beans growing in my garden. My first impulse was to destroy the intruding insects, but entomological curiosity overcame horticultural prudence, and I made up my mind to allow the insects to run their course. By the end of August there was not a stalk in the double row of beans (which was 12 yards long) that was not black with aphides. The insects clustered especially on the topmost leaves, and among the flowers, and along the edges of the pods. The winged brood of the species appeared in the middle of September.

The number of familiars and foes that resorted to this colony of aphides was truly amazing. First there were the ants busy about their "milch cows"—as the old naturalists called them. It was amusing to see a cunning ant approach an aphid and caress her daintily till she—either indignant at the liberties taken with her, or tickled to death with the fun—ejected the precious drops that the ant was longing for—for the love of the ant for the Aphis is simply cupboard love.

At least four kinds of lady-birds employed themselves in lessening the numbers of the aphides:—The Thirteen spotted, Fig 33, (*Hippodamia tredecim-punctata* Linn.) the nine-spotted, Fig. 34, the beetle, fig. 35 larva, (*Coccinella novem-notata*, Kirby), the five-

South Quebec
Hbst



Fig. 33.



Fig. 34.



Fig. 35.



Fig. 36.

spotted, fig. 36, (much magnified,) (*C. quinque-notata*, Kirby,) and the two-spotted, (*Adalia bipunctata*, Linn.) The handsome larvæ of these species might be seen driving their snouts into the ill-fated aphides, and after a while casting them off "flaccid and drained." The coccinellide are among the gardener's most useful insect friends, but they are not always duly appreciated. A gentleman saw a gardener busily employed in picking off the Lady-birds from his plants and treading them under foot. "What are you doing that for?" he asked. "Well, sir," was the reply, "you see these nasty red things—them's the old uns; you see these little green things—them's the young uns just hatched. I'm killing the old uns fust, and I'll tackle the young uns arterwards."

Attracted, by the aphides, and the honey-dew which they ejected, innumerable two-winged flies buzzed daily about my beans. On one occasion I counted fifteen different sorts. Conspicuous amongst them were, *Eristalis tenax*, Linn, the Drone Fly (so called from its resemblance to the male of the honey bee); a pretty black and yellow Syrphus Fly, *Eristalis transversus*, Wiedeman; *Volucella erecta*, Walker, easily distinguished by the brown patch in its wings; *Tachina vivida*, Harris, a bustling showy insect with a large orange-red abdomen set with black bristles; the Flesh Fly, *Sarcophaga*

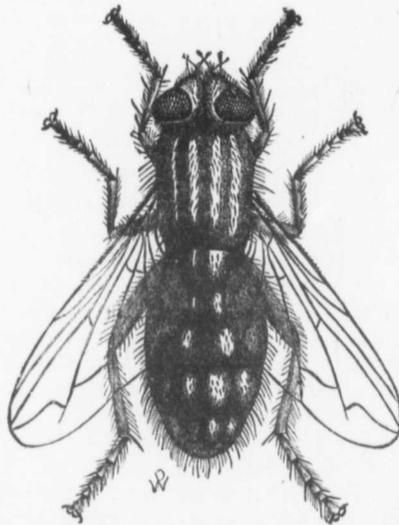


Fig. 37.

carnaria Linn, Fig. 37, (highly magnified,) large, red-eyed, with striped thorax and mottled abdomen—grey and black; the Green-bottle Fly, *Musca Cæsar*, Linn; the Blue-bottle Fly, *M. vomitoria* Linn, and a species of *Scatophaga*.

Less abundant as regards individuals, but more numerous in point of species were the Hymenopterous insects that frequented that row of beans. The following is a list of twenty different kinds of them captured during the month of September with the cyanide bottle only:

<i>Edynerus tigris</i> , Saussure.	<i>I. jucundus</i> , Brulle.
<i>Philanthus bilunatus</i> , Say.	<i>I. creperus</i> , Cress.
<i>Crabro singularis</i> , Pack.	<i>I. paratus</i> , Say.
<i>Monedula ventralis</i> , Say.	<i>Trogus Copei</i> , Cress.
<i>Aphilanthrops frigidus</i> , Smith.	<i>Amblyteles indistinctus</i> , Prov.
<i>Pompilus atrox</i> , Dahlbom.	<i>Opion purgatum</i> , Say.
<i>Hedychrum violaceum</i> , Lepell.	<i>Ophelotes glaucopterus</i> , Linn.
<i>Ichneumon comes</i> , Cresson.	<i>Bassus leatorius</i> , Fab.
<i>I. lætus</i> , Brulle.	<i>Pimpla pedalis</i> , Cress.
<i>I. flavizonatus</i> , Cress.	<i>Sampronota Americana</i> , Cress.

A few words on

INTERNAL PARASITES.

The lowest types of these with which we are acquainted are the Gregarinidæ which are found in earth worms and other annulids. The gregarina of the earth-worm consists of a transparent capsule filled with a colorless, semi-fluid, granulated mass, in one part of which a well-defined nucleus appears. The creature has no digestive apparatus—it lives by absorption of fluids through the capsule. When two

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Gregarinae meet they adhere one to the other, and then surround themselves with a cyst. The partition between them disappears; the nuclei also disappear and then the case becomes filled with spindle-shaped bodies called "pseudonavicellæ," which in due time escape from the cyst into the surrounding medium. Their after history is not yet told.

It is said that when a gregarina finds itself left in a state of single blessedness it does not give itself over to despair, but proceeds to encyst itself, and to produce pseudonavicellæ on its own account.

The internal insect-parasites of insects are of two kinds: (1) Those that complete their metamorphoses within their victims; and (2) Those that leave their hosts on the completion of the larval stage.

Of the former, *Rhagoletis intermedius*, Cress, affords us an example. It assails the larvæ of *Apateta hastulifera* Abbot and Smith, which feeds upon the alder *Aldus incana*, Willdenow.

The parasitized *Apateta* larva may be found in the autumn attached to the leaves and stems of the plant. In them the ichneumon grubs, having attained their growth, form their thin, brown, closely-woven cocoons, which are arranged at an angle of about forty-five degrees, and usually in four rows. I have drawn out with a setting-needle no less than thirty-five pupæ from one caterpillar. They were all placed with the head upward. Very regular rows of round holes show how the adult ichneumons escape from their nurseries. As I have found the flies at large in the middle of October I presume that some of them, at any rate, pass the winter in the perfect state.

There are much larger insects that undergo all their changes within their hosts such as *Ophion macrurum*, Linn, Fig 38, in the Saturniæ, *Opheteles glaucopterus*, Linn, in Cimber. The eggs of these are laid singly or in pairs.



Fig. 38.

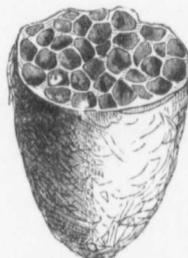


Fig. 39.

Of parasites that leave their hosts when full fed and before undergoing the pupal change *Apanteles longicornus*, Prov, is an example. The fluffy, yellow masses of the cocoons of this species may often be seen attached to the remains of noctuid larvæ, under the rails of fences, etc.

What entomological neophyte has not experienced the disappointment of finding, on a sudden, a carefully tended Sphinx caterpillar in a state of collapse, and bristling with the larvæ of some microgaster, that have extruded themselves from it, and that proceed to spin their cocoons about its remains.

But surely the most economical of all the internal insect parasites is the well-known *Cryptus extrematus*, Cress. The larvæ of this insect find themselves, they know not how, in the inside of a caterpillar of *Platysamia Cecropia*, Linn, and forthwith commence the herculean task of reversing the state of things in which they find themselves, and of environing their environment—putting the outside grub into their insides—beginning with the fatty portions of it. Numbers and perseverance accomplish the task, but not

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before the caterpillar has spun its wonderful cocoon. When this is finished the *Cryptus* larvæ, finding no more fat in preparation, hold a grand carnival on the vitals and frame of their host, and then spin their own cocoons within the snug winter quarters prepared by their unhappy victim. In them they lie through the winter as snugly packed, Fig. 39, as herrings in a barrel or sardines in a box.

CANNIBALS.

Among insect feeders upon insects the "Cannibals" must not be passed by. Of English caterpillars that have a bad reputation as such, *Thyatira derasa*, *Characlea Delphinii* and *Cosmia trapezina* are well-known examples. With *Mantis Carolina* Linn, the nuptial embrace has been known to end in the death grip, and the female to make a wedding breakfast of her spouse.

But the most startling story of all was told by J. F. Stephens, author of "Illustrations of British Entomology." He said that having turned the tail of a dragon-fly round to the head he saw the insect make a meal of four joints of its own abdomen. (See *Ent. Mag.* 1., p. 518). If this story had not come from so good a source, we should have thought it of like kind to that told of the Irishman, who, having disturbed a mud-turtle, "saw the baste swallow its own head."

There remains one other sort of devourers of insects that I wish to notice before concluding my paper—it is

FUNGI.

We are accustomed to the idea of insects feeding upon vegetables, but that of vegetables feeding upon insects is not so familiar to us.

A fungus that has excited much interest amongst naturalists is the *Sphaeria Robertiana*, which grows in, and out from, the caterpillar of a New Zealand Ghost-moth, *Hepialus virescens*. This caterpillar undergoes its pupal change in the soil. But it often happens that a spore from the *Sphaeria* finds a lodgment upon the body of a *Hepialus* caterpillar—usually between the head and the segment following—and, vegetating there, penetrates to the creature's inside. The animal contents of the caterpillar are by degrees exhausted by the fungus, and the skin—which retains its perfect form—becomes filled with vegetable tissues. At the same time one or more sprouts from the fungus rise through the soil, and into the open air. Fig. 40. The sporules are formed round the top of this shoot, which is sometimes ten inches long. The parasitized larva is called by the Maories "Hotete." It is sought for by them and greedily eaten. It is said to have a nutty taste.

There is a fungus of somewhat similar habits that affects the larvæ of the May-beetle, *Lachnosterna fusca*, Fröhl. It is found at Quebec.

In my paper entitled "A Day in the Woods," published in the Society's twenty-first Report, I told of a fungus *Entomophthora grylli* var. *aulica*, Fres, that was destroying the caterpillars of Arctians of different kinds. This fungus is still destructive. It affects particularly the larvæ of *Leucarcia Acraea* Drury and *Spilosoma Virginica*, Fabr.

It may be that our meadows have been preserved from depredations, such as those described by Harris, under the head of "The Salt Marsh Caterpillar,"—"Insects Injurious to Vegetation," p. 351, by the agency of this fungus.

Time would fail to do justice to my theme—a volume might be written on every division of it; but I trust that I have said enough to awaken interest, and to stimulate research.

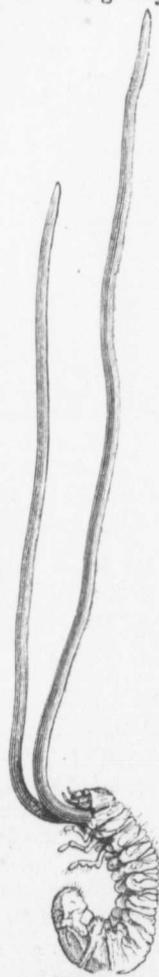


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AN ATTACK OF EPHESTIA INTERPUNCTELLA. *Hbn*

BY H. A. STEVENSON, LONDON.

Attack.—Slender white or pinkish cylindrical caterpillars from one-half to three-quarter inches in length, with reddish-brown heads; a dark brown stripe runs along the side. The caterpillars were found feeding on raisins, prunes, rice, currants, dried apples, and wherever found they could be traced by whitish silk threads or webs. The caterpillars, when full-grown, spin close whitish or greyish-white cocoons about a half-inch long and one-sixteenth of an inch in diameter. When the caterpillars emerge from the cocoons they are a narrow rolled-up-like moth, and are a brownish-grey color with a golden lustre. A more complete report of this insect is contained on page 77 of Mr. Fletcher's report in the Experimental Farm Reports for the year 1889.

On August 17th I was called to a wholesale warehouse in this city (London), where they said they were troubled for the last three days with a small moth, which was increasing very rapidly. When I went down there these small moths were flying all over the warehouse in great abundance, from the cellar to attic; they were even on the outside of the front door, and they had originally started at the back door. I asked them where they came from, and they replied that they did not know where they came from, as the first were observed only three days before, so, after looking over the place I came across a shipment of Sultana raisins behind the back door and alongside the elevator. There were about 500 boxes, and the boxes were almost covered with the caterpillars and the moths. The moths were flying about in great abundance. A great number of the caterpillars had fallen down the elevator into the cellar, and some had also climbed up the supports of the elevator into the upper stories. The caterpillars had also penetrated into the adjoining rooms, and were swarming over the tea chests in great numbers—in fact, were into everything.

The raisins had been imported from Smyrna by Liverpool and Montreal, on October 20th, 1893, and had remained in the warehouse since then.

In three days from the time they were first noticed they had swarmed all over the warehouse.

Remedies.—I recommended that the raisins and the tea chests, which were swarming with the caterpillars and moths should be placed in some large boxes which were airtight, and in which some bisulphide of carbon had been exposed in open dishes and left for a time. The moths and caterpillars on the tea chests soon fell off, as they had not penetrated into the interior. But the raisins were left over night in the boxes and the pests were soon destroyed. The firm tried spraying the place with the bisulphide, but it dissolved all the rubber atomizers used.

At night some bisulphide of carbon was exposed through the different parts of the warehouse, and the proprietor collected the keys from the different employees and cautioned them about the use of lights, as the bisulphide of carbon is very inflammable, and the whole warehouse was swept thoroughly through with a good stiff broom.

The raisins were unpacked and picked over and thoroughly cleaned and reboxed again as good as new. I have been in the warehouse several times since, and have not noticed the recurrence of the insect.

Thanks are due to Mr. Moffat, who at once identified the insect and compared it with the specimens in the Society's collection. And thanks are also due to Mr. J. Fletcher, of Ottawa, to whom specimens were sent, which he identified as *Ephestia interpunctella*, and also for his immediate reply concerning the destruction of the pest.

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THE ECONOMIC VALUE OF PARASITISM.

BY F. M. WEBSTER.

In the term parasitism, as here used, is included the preying of one organism upon another, whereby the latter is largely kept within normal, numerical bounds, or is reduced to such conditions when it rises beyond them. Or, in other words, the preying of certain so-called beneficial insects upon others called destructive, and the action of fungoid growths upon such destructive species. Parasitism, in its broadest sense, has been aptly termed the balance wheel of nature, because of its similarity in effect to the mechanical contrivance bearing that name, which is instrumental in equalizing the irregularities of motion, in the machinery of which it is a part, and hence dependant upon the same source for its motive power.

The effect of vegetable devouring insects is to prevent the encroaching of one vegetable upon another, lest the latter should be exterminated: and the insect and fungoid enemies of such vegetable-feeding insects prey upon them in order that they do not themselves carry their work to such an extent as to exterminate the plant they are only designed to restrict. Thus we have a plant being fed upon by a species of insect, which insect is being kept from exterminating this plant by its own or primary parasites, and these in turn are kept from destroying all of the plant-feeding insects by still other parasites, known as secondary parasites, and these also have their parasites, known as tertiary parasites, and besides are more or less influenced by meteorological environment. To make the matter still clearer, it is as if a number of men were sent to prune an orchard, and a superintendent sent with them to see that the task was not over-done, he too, being amenable to still other authority.

Now, both plants and insects are capable of reproducing far beyond the number of young ordinarily required to keep these elements in equilibrium; but when, from any cause, one of them becomes abnormally reduced, this reserve reproductive force is brought into play, and the weakened element is thus soon able to regain its normal numerical power, but is restrained from going beyond. We thus have a huge piece of natural mechanism, self-regulating and self-adjusting, the balance wheel of which is parasitism.

Under perfectly natural conditions and uninfluenced by man, all of these natural organisms work in unison, as above indicated, and a temporary disarrangement of any one element, due to outside causes, such as the weather, is soon readjusted with little more disturbance to the others than would result to the Gulf of Mexico from the dropping of a pebble into the middle of the Atlantic ocean. In some cases a few plants might be killed throughout the local areas, but these would soon be replaced by others. But the husbandman now appears and upsets this equilibrium by destroying hundreds of species of plants over an area of millions of acres, and in their stead replacing but one. He causes a thousand apple trees to grow where nature intended but ten should exist. He causes the ground to produce a thousand grain plants, where nature intended but one to grow, and to produce seed far in excess of nature's requirements. The result is that the insect enemies of these cultivated plants, or such insects as can feed upon them, are greatly increased in numbers, because more of the young find a sufficient amount of food to develop them, and because they are needed by nature to counteract the influence of man. Later, the parasites, both primary, secondary and tertiary, increase for precisely similar reasons, and in obedience to the same laws, though, of course, they follow more or less distantly the movements of their hosts. From the fact that their movements do follow more or less distantly the ebb and flow of their respective hosts, the question of the economic importance of their influence has remained unsettled, and, by some, has even been doubted. When we come to consider that but an exceedingly small percentage of the movements of these insects ever reaches the eyes of even the most observing entomologist, and of the interactions of these organisms we really know but very little, it will be observed that to estimate the economic value of their influences is a very difficult task, if one expects to be just and secure the actual facts. A millionaire, in one of our larger cities, may replenish his purse at the bank each morning and go about among the poor, supplying to the needy a coat here, a pair of shoes there, a break-

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fast in one place and a supper in another; medicine for one sick mortal and medical attention for another; and go on in this way for years without being known outside of his own city, especially if he does not choose to advertise his generosity. But let him once fall into the clutches of a dissolute woman whom he may have, out of pity, befriended, and he will be publicly introduced from one side of the continent to the other, and the student of human nature will, indeed, have to be exceedingly guarded in his conclusions if he expects to get an unbiased estimate of this man's character, based only on the facts thus placed in his possession. Yet it seems to me that he is in as proper position to do so, as is even the working entomologist to pass upon the value of parasites in overcoming an invasion before more or less financial loss has accrued, basing his judgment upon the failures to do so that have come under his observation, and necessarily leaving what he does not see out of consideration. I do not believe anyone, be he ever so good an observer, can, within the space of one life time, collect data sufficient upon which to base the statement that "they usually appear in force only after the damage is done." Twenty years of close observation of insects, in the fields, leads me to make this statement; and I venture to say that in ninety-nine cases out of one hundred, an invasion of an injurious insect will attract the attention of an ordinary entomologist only when its parasites fail to overcome it before it has caused monetary loss. If the entomologist does not see them, how much more likely is the ordinary farmer to note these conflicts between parasites and hosts? It is the failures that usually first attract our attention, while the successes are more often unobserved, and, such being the case, how can we, with justice, weigh evidence we do not possess, and of the magnitude of which we can have little conception.

Now, I will give a few personal observations relative to this matter, which illustrate the fact that thousands of similar cases might pass unnoticed, even by those possessing fair abilities for seeing such things.

Ten years ago, in Indiana, I was studying wheat insects, and found the Wheat Midge larvæ, *Diplosis tritici*, exceedingly abundant in a number of fields; enough so to threaten serious injury to the crop. Soon after I observed these, considerable numbers of *Coccinellidæ* and *Telephoridæ* were running about over the heads of the wheat, thrusting their own heads down among the bracts, and feeding among the maggots of the *Diplosis*. Some of the *Telephoridæ* were venturesome enough to thrust their heads among the bracts in order to secure such of their prey as were exposed by the bending of the head as it swayed in the wind and were caught by the wheat head suddenly returning to an upright position, and if a breeze did not soon release them, paid the penalty of their temerity with their lives. Thousand of these carnivorous beetles were present, and they must have destroyed millions of the *Diplosis* larvæ, in the ten days to two weeks they were observed at work, and no perceivable injury resulted from the invasion of the midge.

A few years later a couple of coniferous trees on the campus of a western University were attacked by a scale insect, *Mytilaspis pinifolia*, if I recollect correctly, and by mid-summer the leaves had a decidedly whitish tinge, as if sprayed with a dilute whitewash, and besides, took on a sickly look. In the meantime a colony of *Chilocorus bivulnerus*, or Twice Stabbed Lady Beetles, (Fig. 41), as they are commonly called, took up their abode on the trees, deposited their eggs and with the larvæ from these (Fig. 42) began to destroy the scales. All through the autumn the contest was waged, and with the coming of cold weather all the beetles, which had long before escaped from their pupa cases, went into winter quarters. With the coming of spring they were observed to return to the trees, and again began the contest in turn giving way to their larvæ, and these emerging as adults. In early summer the ends of the branches began to show leaves free from scales, and by the coming of winter again the outbreak of the pest had apparently been entirely overcome, and the fall rains washed off all vestige of the conquered hosts. The invasion had been overcome, and I doubt if another person besides myself had been aware of the two years' conflict.

Later, the maples along one of the principal residence avenues of Columbus, Ohio, were threatened with an invasion of the Maple Bark Louse, *Pulvinaria innumerabilis*, (Fig. 43), and the trees would certainly have been overrun the following year, had not this same Lady Beetle appeared in numbers, and with their larvæ so reduced the pest in numbers as to render injury impossible.

The appearance of the GrainAphis, *Siphonophora avenae*, in such enormous numbers, during some seasons and the almost total absence of them during others, are matters of continued observation, but the causes therefor are not well understood. The present season, there was, quite early, indication of an outbreak of this species, but later it largely disappeared, while the cause for its doing so is obscure. Now, with all the light on the subject that I have been able to gain from several years' study of this insect, I am about convinced that the secret lies in the condition of the weather during spring; that



Fig. 41.



Fig. 42.



Fig. 43.

cold, wet weather, at that season retards the development of their Hymenopterous parasites, by which they are largely held in check, but does not retard their own development to the same extent, thus giving them an advantage, early in the season, which is sometimes not overcome until much later and after the aphid has worked some injury. One other observation and I am done, though if space would allow, and time permitted me to go over my note books, I could multiply the number by at least fifty.

Late in April and early in May of the present year, there was considerable consternation among the farmers over a large portion of the State of Ohio, caused by the appearance of enormous numbers of the larvæ of the Clover Leaf Weevil, *Phytonomus punctatus*, in the clover fields. These larvæ were literally swarming and eating the plants to the ground, which, together with the drouth prevailing at the time over the northern portion of the State, gave matters anything but a favorable appearance, and it seemed that many fields could not escape ruin. In fact, an occasional farmer was frightened into plowing up his fields. But just here a fungous disease, *Entomophthora sphaerosperma*, Fresn., appeared and the effect was astounding. Farmers who had about given up all hope of a hay crop, wrote to say that the worms were all dead or dying and they could not find a live one. One farmer, who came in to consult me about breaking up his field, came a few days later to say that all the worms were dead or dying, and I found a close search was necessary to find a healthy one of any size, and but few of even the youngest. Now, I do not believe a million dollars would cover the saving to the hay crop of Ohio, by this minute fungus, the present year. But this is not all. Soon after, rains occurred and the effect of the worms resulted only in retarding the blooming of the clover, precisely the effect of mowing or pasturing when done to prevent the depredations of the Clover-seed Midge, *Cecidomyia leguminicola*, and whether the result was the same or not, the farmers over the area covered by this Leaf Weevil, harvested a good crop of clover seed.

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As previously stated, I do not even pretend to have observed a one-thousandth part of similar instances that have been going on in every locality each year. And I repeat again, it is the cases where parasites fail to overcome a destructive insect, before it occasions financial loss, that are the exceptional ones, and the nature of these failures is such that we see and recognize them far more readily than where the reverse is the case. It is the damage that we see, and this being the case, how can we see it before it exists? Not only this, but I believe the great fundamental principle involved in the use of insecticides is to assist parasites in doing their work; and as we get to applying them more and more intelligently, we shall watch for the exceptional cases where parasites are weak in numbers, and by artificial methods, seek to offer a substitute for the lack of numerical strength.

A RE-APPEARANCE OF PIERIS PROTODICE BOISD.

BY J. ALSTON MOFFAT, LONDON, ONT.

Prot. & hae.

On the 18th day of October, 1894, I received a *P. protodice* from Mr. C. Anderson, a young collector of London, who has done some excellent work during the past summer, by sugaring in his father's garden. A few days previously he had called on me to say that he had seen on the street a white butterfly that was new to him. Failing to recognize his description of it, I showed him the drawer containing the *Pieris*, when he at once pointed to the female of *protodice* (see fig. 15) as like what he had seen. I gave him some information about the peculiar history of that butterfly which excited his interest, and he determined to make an effort to obtain some of them. With that end in view, he went on the 17th to a locality which he thought was the one most likely for them to be found in, with the result that he secured a pair of them, and when he showed them to me on the 18th they were yet alive. This is the first living pair of that butterfly that I have seen since the autumn of 1872, when *Pieris rapae*, the imported cabbage butterfly appeared on the stage to act its part, whilst the native one retired from view.

In 1887, Mr. S. H. Scudder, of Boston, published a most interesting account of the introduction and spread of *Pieris rapae* from 1860, the year in which Mr. Couper captured a few specimens at Quebec, where it is supposed to have been landed, and the first reported to have been seen on this continent, to 1886, when it had reached the Rocky Mountains. This history of the introduction and spread of *P. rapae* is full of interest and importance to the cultivators of some of the most valuable products of the field and garden; but the fact, that as the imported *rapae* advanced the native *protodice* disappeared, has ever seemed to me to be one of the most singular and interesting events in natural history that has come under my observation.

I have seen the statement made by various writers, that *Pieris oleracea*, also native, has disappeared from their locality on the advent of *rapae*. This does not accord with my experience. *Oleracea* I always found to be confined to certain locations, periodical in its appearance and never very plentiful; and so it has continued to be. But *protodice* used to be more or less abundant every autumn until *rapae* came, when it totally disappeared from my field of observation.

Mr. Scudder in tracing *rapae*'s gradual spread westward, says: "In 1873, as before stated, it reached Port Hope, and 'F. C. L.' reports taking his first specimen at Dunn in Haldimand county, Ontario, (Can. Ent. vi. 60), and some were taken at Hamilton (J. A. Moffat), where one would have looked for it the preceding year from its presence then at Toronto."

I have always felt quite certain that *rapae* was present at Hamilton during the fall of 1872, although I did not notice it. My attention was arrested that season by the unusual abundance of cabbage butterflies, which I set down without examination as

protodice. Not being informed about the advance of *rapæ*, I did not suspect its presence until the following winter, when upon a visit to Dundas I saw specimens of it in Mr. Kyle's collection which he had captured in his own garden the previous summer without suspecting that they were other than a variation of the native *protodice*. So that if I had examined closely, I have not the slightest doubt but I would have found *rapæ* helping to swell the numbers that so attracted my attention during the autumn collecting; confirming Mr. Scudder's expectations. Moreover, I found *rapæ* in the spring of 1873, indicating that it must have been present the previous fall. From that onward, I saw no more *protodice*, their place being taken by *rapæ*. And this I believe corresponds with the experience of Canadian collectors.

I have never seen this sudden and total disappearance of *Pieris protodice* satisfactorily accounted for. When I have seen the subject touched upon, it has usually been dismissed with a reference to "the struggle for existence and the survival of the fittest," which does not seem to me to apply in this case at all. The breeding habits of the two differ considerably; the native *protodice* was quite content to make use of the natural products of the soil for its purpose, whilst the imported *rapæ* attacks first, and in preference to all others the cultivated ones. So there need have been no "struggle" between the two on that point, as there was plenty for both, and as the larvæ of *rapæ* had an abundance of vegetable food to its liking, it would not devour that of the other even if it had met with it on the same plant. As that theory does not account for the disappearance of *protodice*, I have to look for one that will meet the requirements of the case.

It is a well-known principle in biology, that there are races of animals of the same species, that are possessed of different constitutions and dispositions, and that there are in nature, external influences at work which, acting upon the living organism will produce such differences. That in some instances, such differences manifest themselves geographically, and are spoken of as geologic and climatic, or as pertaining to the soil and climate. That races may differ in strength of constitution and character according to the part of the globe to which they belong. And that a strong race commingling with a feeble one, will impress its peculiarities upon the results of such a union and make its controlling power manifest.

Now it is generally admitted, that the life of Europe is of a more vigorous, tenacious and aggressive character than that indigenous to this continent; therefore I come to the conclusion that *protodice* and *rapæ* are but different races of the one species, and that when they met and commingled, the stronger constitution and proclivities of *rapæ* prevailed, and the outcome of the union were all stamped unmistakably *rapæ*, the characteristics of *protodice* being completely absorbed and obliterated. This seems to me to be quite sufficient to satisfactorily account for all that has occurred in connection with these two butterflies, and if it is correct then the probability amounts almost to a certainty, that, sooner or later *protodice* will return. This is not a prophecy, but a simple deduction from the well-known laws of nature; for the external influences that produced the typical *protodice* and brought it into harmony with its environment at first are still at work, and working in the same direction. Therefore, when these external influences have had sufficient time to work their utmost upon *rapæ*, and no fresh importations take place, a reversion to the original type will be brought about as a matter of course.

In seasons of its greatest abundance, *protodice* never caused any serious injury to cabbage, in this northern portion of the continent at least. Its larva was quite content to feed upon the loose outside leaves of the plants, and so did but little harm; but the larvæ of *rapæ* will eat their way into the solid heart of the largest heads, injuring them greatly, if not ruining them utterly. If then *protodice* should return with its original disposition unimpaired and supplant *rapæ*, it will be a welcome transformation to the cultivators of that useful vegetable.

REMARKS O

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REMARKS ON THE STRUCTURE OF THE UNDEVELOPED WINGS OF THE SATURNIIDÆ.

BY J. ALSTON MOFFAT.

I have had an opportunity of making further microscopical examination into the condition of the undeveloped wings of one of the large Saturniideæ.

During the winter of 1893 and 1894, I secured a large number of the cocoons of *Attacus promethea* and *Telea polyphemus*. In the early spring of 1894 I watched them closely, so as to secure, if possible, some of the moths on their escape from the cocoon, before expansion had commenced.

I was fortunate on being present at the moment of emergence of a fine large specimen of *T. polyphemus*, which I killed at once before growth had started. After removing the front winglet from its socket in the thorax, I found that the crimpling of the heavy nervures on the costal margin had relaxed, yet, even with that addition to its size, it measured only five-eighths of an inch in length and about three-eighths at its widest part; which might have expanded to three and a half inches in length, and one and a half at its widest part.

I did not discover anything new about the structure of the nervures, but I paid especial attention to them in relation to some suggestions that were made in connection with my former observations, to see how far they might be correct or otherwise.

One was, that the nervures might be constructed spirally, and that the extension of the membrane of the wing might be produced by, as it were, the relaxing of a compressed spring. I could see nothing to confirm such a view. The prominent rings of each segment made a complete circle. The extension of the nervure is in a straight line, something after the manner of the drawing out of a telescope, only, the one section not merely draws out of the other, but the small end of the one section draws out with it the inside of the large end, and keeps on extending until the nervure is all brought to a uniform thickness, with a slight reduction to the outer end.

It has been claimed by some, that the fluid enters the nervures and assists in the extension of the membrane. This, I am satisfied, is not the case. I examined the large nervures of an expanded wing, and found some parts of them hollow, and quite empty, which would not have been so if fluid had entered them. Moreover, the parts of the nervures where the segments unite seem to be solid, somewhat resembling the joints of a bamboo-cane, which would make the passing of the fluid through them almost, if not quite, impossible. My impression is, that the nervures do not in any measure contribute toward the extension of the wing, but depend for their own extension upon the pressure derived from the fluid flowing between the membranes.

The amount of fluid stored up in a newly emerged imago to be used in expanding the wing, must be very great. One of my *A. cecropia* in coming out of the cocoon, had in some way got a piece torn off a front winglet. Whilst expanding, fluid began to show at the break, and by the time the wing was fully extended, large drops hung all along the broken edge. This wing expanded as perfectly as the unbroken one; showing that there was enough fluid to do the work and some to spare.

I thought by maceration and manipulation to draw out the winglet to some extent; but was disappointed and not a little surprised to find that I could make little or no impression upon it in that direction. I afterwards thought that I discovered the reason of my failure.

I succeeded in cutting out a longitudinal section from between the heavy costal nervures of the winglet. Placing it on one of its cut edges under the microscope, I found that I had got a beautiful and intensely interesting object of contemplation. The gatherings of the membrane on the upper surface of the winglet, lay before me in a uniformly symmetrical row of elongated loops, with a row of tiny scales on the crest of each. The loops were nearly closed at their base, widest a little above their centre, making a narrow curve at their apex, open and quite empty. I looked for, and expected to find in the

membrane of the underside, loops or gatherings, corresponding in some measure to those of the upper side, but could see none or anything resembling them. The membrane appeared only roughened and wrinkled. It was extremely thin and very frail, and the base of the loops seemed to be attached to its inner surface. The thought occurred to me that this would account for my inability to draw out the membrane of the winglet, and will in a measure explain the reason for the comparative slowness of their expansion as compared with butterflies. That is, supposing the wings of butterflies are constructed upon a different principle; but this is a point which will require much more careful investigation than I have given to it.

The extent to which the fluid of the insect gives color to the scales is a very interesting subject for consideration. The fluid differs in color in different species. The color of the fluid decides the color of the membrane in the expanded wing; but to what extent it affects the color of the scales is not so easily determined.

Prof. V. L. Kellogg, in his able and interesting paper, "The Taxonomic Value of the Scales of the Lepidoptera," which appeared in the Kansas University Quarterly, for July, 1894, on page 49 says: "The scales are attached to the wings by means of their short pedicels fitting into minute pouches or cups on the surface of the wing membrane. . . . The cups sink but slightly into the wing-membrane, the outer open end being at the surface of the membrane, and the inner closed end or bottom of the pocket, being only slightly below the surface. . . . Thus the cups are more truly little pockets on the surface of the wing, than pits or cavities in it." On page 50 he says: "The pedicels of the scales are of slightly varying shapes and of different lengths, corresponding with the pockets into which they fit. Those which enter insertion-cups which are expanded at the base, or at some point between the base and the mouth, present at the tip or between the tip and the point of merging into the blade of the scale, respectively, a slight expansion, so that they are pretty firmly held in the cup by a sort of ball and socket attachment."

These quotations convey no intimation that there is any opening at the top of the scale, or that the tip passes through the inner surface of the membrane, whereby the fluid could enter the scales whilst flowing between the upper and under membranes of the wings. And yet I think we have positive proof that in some instances the fluid does enter the scales and influences to some extent their color.

When commencing his description of the structure of scales, the Professor, on page 51, says: "The scales are flattened sacs, composed of two membranes, enclosing sometimes only air, sometimes pigment granules attached to the inner face of one of the membranes, and sometimes (as observed in cabinet specimens) the dry remains of what may have been during life an internal pulp." Here in a foot note, Prof. Kellogg refers to Minot and Burgess, who, in their description of the anatomy of *Aletia*, declare that in all of the scales examined by them there was always an internal pulp which contained coloring matter. Then on page 69 Prof. Kellogg states that: "The colors of scales are produced by two causes: (1) The presence of pigment; (2) The overlapping, lamination and striation of the scales which produce those familiar but striking optical phenomena due to the interference of the waves of light. Combinations of these causes are usually present, so that the resulting color effects are practically incapable of analysis."

But there is a third cause of coloring. The long, slender scales on the winglets of a newly emerged *luna* are as pure a white as those upon the abdomen; when the wings are expanded these same scales are tinged with yellow. Whence did they obtain it? It is a well-known fact in the coloring of materials that a small quantity of green entering a pure white, a yellow is the natural result. Therefore the conclusion to me is irresistible, that a portion of the green fluid passing between the membranes of the expanding wings entered the scales—not enough to make them green, but sufficient to make them yellow. And there may be other lepidopterus insects which have the color of their scales modified in a similar way, but which will have to be detected by observing and comparing them in their unexpanded state with those on the expanded wing. The scales on an undeveloped wing are as much compressed, in proportion to their size, as the wing itself. As it

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requires the action of the fluid to expand the wing, the natural inference is, that similar causes are required to produce similar results in the scale; but whether there is an opening in the scale corresponding to that at the base of the wing, to admit the fluid, or whether it enters by cell absorption, has yet to be demonstrated. In the great majority of cases the scales have their colors decided in the chrysalis, by internal pigments probably. What change takes place, if any, during expansion, I have not been able to ascertain, except a perceptible brightening of the colors.

After my paper was written I received from Mr. Balkwill a chrysalid of *D. archippus*, which had matured up to the point of emerging, then died before accomplishing it. I removed a winglet and proceeded to investigate. I failed to extend this winglet as completely as I did that of *Polyphemus*. It was much more elastic, and I could draw it out about half its own length, but it would go back again, and it was easier drawn out laterally than longitudinally. I found it impossible to remove the scales by any means at my disposal, and was becoming hopeless of seeing the structure of the membrane. I removed the costal nervure, and when examining the cut edge with a lens I perceived in one place that the edges of the membranes had parted. By many efforts and steady directing I succeeded in getting the point of a pin between them, when I found that the winglet was like an empty sac. The two membranes were not in the least attached; even at the edges there was no pressure required to separate them, and the only thing that showed any symptom of holding them together was the fringes; so I separated the two membranes clean from base to apex without an effort, when the whole structure of the winglet was exposed to view. The nervures are in the upper membrane, with a groove in the lower, opposite, into which they fit. Both membranes are structurally alike, but the gatherings are perceptibly finer in the lower as compared with the upper. The surface, under the microscope, presented the appearance of a multitude of light grey transverse lines with dark spaces between. The gray lines are the under edge of the gatherings, whilst the dark spaces are the openings into the loops, on the crest of which the scales are situated. The transverse lines are not solid lines, but seemed to be made up of minute elongated dots. Near the base of the winglet some of the lines had the appearance of being composed of wide-spread W's. Elsewhere the lines of the W's were erect and closely packed. This gives quite a different view of the wing structure from that obtained in my former observations of the upper surface of the membrane. Here we see all the material that is required for producing a wing two inches in length by one inch at its widest part, compressed into a space less than three-fourths of an inch long and three-eighths wide. We also see that there is nothing to prevent its rapid, or even instantaneous expansion when the fluid from the living insect enters between the membranes in sufficient quantity and force; but that is required for the purpose, and nothing else seems capable of producing the wing extension; but why the fluid does not escape at the edges I do not know, and yet all the butterflies that I have observed burst their chrysalis always let fall some drops of fluid, and it may be that this is whence they come, and which would also account for the general external moistness of the imago at that time.

But to return to a consideration of the moths. I am now convinced that there must be an actual growth of the lower membrane during the progress of their wing expansion. There is nothing in its structure resembling the gatherings observed in the lower membrane of this butterfly. There is an appearance of looseness in its texture, but it has none of the elasticity of the other; it would tear rather than yield. Then again, when small moths are expanding their wings, the edges invariably curl under, as if the upper surface was extending more rapidly than the lower, which no doubt is the case, and is the cause of the curling, and as they press the two upper surfaces together it assists in extending the lower membrane and straightens out the curls. Here the question arises, are the wings of all moths constructed on the same principle? And are those of butterflies all constructed upon the other? The further one travels along such a road the greater appears the distance to the end.

BORDEAUX MIXTURE AS A DETERRENT AGAINST FLEA BEETLES.

By L. R. JONES, BURLINGTON, VT.

Bordeaux mixture is a remarkable compound. After many comparative tests, experimenters have decided that no other mixture or solution yet discovered is equal to it as a general fungicide. Furthermore, those who have studied its action upon plants are agreed that it exerts upon them some beneficial influence entirely apart from its fungicidal effects.*

So far as I know, however, Bordeaux mixture has never before been experimentally shown to have value as a remedy against insects. Some experiments in this line made at the Vermont Experiment Station during 1893 and 1894 will therefore have so general an interest that I present the results before this Society.

Potato plants in Vermont suffer from the attacks of the cucumber flea beetle (*Crepidodera Cucumeris*, Harris). I cannot estimate the amount of the damage to the entire potato crop of the State from these insects, but I am convinced that it is most serious, especially during a dry summer, such as we have just experienced. In confirmation, I will pass around for your inspection, some leaves taken from our experimental potato plot at Burlington. You will perceive that many of them are completely riddled with the small holes eaten by these flea beetles. These leaves do not exaggerate the condition of the entire plants in many portions of our field. Leaves punctured and even skeletonized, as some of these are, suffer much from the loss of so considerable a portion of their leaf tissue. Moreover, leaves thus mutilated are most disastrously exposed to the effects of drouth during dry weather, and to the inroads of fungi and other parasites during wet weather. Indeed, these secondary injuries follow so closely after the attacks of the flea beetle, and the beetles themselves are so small and shy, that the great majority of potato growers attribute the entire trouble to these secondary agencies.

Entomologists have tried many remedies against these flea beetles. The one commonly recommended by them for use on potatoes is the standard insecticide, Paris green, mixed with land plaster and dusted upon the plants. As will be seen from our results below this poison has been of comparatively slight value with us. Certain fungicidal compounds, however, proved of decided worth in our experiments of 1893. These fungicides were originally applied to check the fungous diseases to which potatoes in Vermont are especially liable. Noticing that these sprayed rows were less badly eaten by the flea beetles, a careful count was made of the number of holes in fifty leaflets from each row of one plot under treatment. The results were as follows:†

In 50 leaflets sprayed with	very weak Bordeaux mixture,	1,794 holes
“ “ “ “	. . . . ammoniacal copper carbonate,	1,587 “
“ “ “ “	. . . . modified eau celeste,	1,376 “
“ “ “ “	. . . . weak Bordeaux mixture,	1,295 “
“ “ “ “	. . . . strong Bordeaux mixture,	1,194 “
“ “ “ “	. . . . strong Bordeaux mixture and soap,	945 “

These plants had been sprayed but once, August 1st. The examination was made August 12th. From our observations during the present summer (1894), we are convinced that most of the holes in the leaves sprayed with Bordeaux mixture had been made before the plants were sprayed at all, *i.e.*, before August 1st. The present season observations upon these insects were begun earlier. The beetles were first seen about June 1st. By June 12th some of our early potatoes were badly eaten. This attack lasted but a short time, however, and during the latter part of June and first two weeks of July but few beetles were seen. Suddenly, about July 20th, they again appeared in large numbers, and during the next ten days did great damage to unprotected potato plants. Previous to this time portions of our plants had been sprayed with various fungicides, and all the plants sprayed with the stronger copper compounds, especially with the Bordeaux mixture, have remained practically free from the flea beetle injuries up to date.

*U. S. Dept. Agric., Div. Veg. Path., Bul. 7, p. 31.

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It has been unusually dry with us, and in consequence our field is free from fungus troubles, yet the contrast between the sprayed and unsprayed rows is most striking. On the unsprayed rows every leaflet has from 50 to 500 flea beetle punctures, the plants are pale and sickly, and are already beginning to shrivel from the drought. The rows sprayed with Bordeaux mixture are practically free from the flea beetle mutilations, vigorous and thrifty. I have brought for your examination two entire potato plants taken from adjoining rows, the one sprayed with Bordeaux mixture, the other not, which fairly represents these differences. A few days ago two leaves were taken from each hill of these two rows and carefully examined. An average of twelve flea beetle punctures per leaflet was found on the row sprayed with Bordeaux mixture. On the adjoining row which had received no Bordeaux mixture, but had been freely dusted with Paris green (1 pound Paris green in 50 pounds land plaster) there was an average of 262 holes per leaflet.

We therefore feel justified in advising the use of Bordeaux mixture on potatoes for a new purpose, namely: As a deterrent against flea beetles. The use of Bordeaux mixture as a fungicide has proved especially profitable with us during wet seasons. This newly discovered virtue will warrant its use during the driest seasons also, since the flea beetles are most troublesome then. Judging from our experience this season, in Vermont two applications of the mixture will suffice to hold these beetles in check, and upon late potatoes one application will probably prove sufficient. The first application should be made upon early potatoes during the first week of June, and another about July 15th. This latter application is also well timed for the prevention of the fungus diseases of the potato. Upon later potatoes the earlier application just mentioned is not necessary. We may, therefore, say that practical immunity from flea beetle injuries to potatoes may be secured at the cost of but a single application of Bordeaux mixture in addition to those already recommended for the fungus diseases.

Regarding the value of other fungicides tested, modified Eau Celeste has proved nearly as effective a deterrent against these beetles as has Bordeaux mixture. All of the other copper solutions tested have had similar deterrent effects roughly in proportion to the amounts of copper contained. The inference, therefore, is that the copper salt is the element especially distasteful to the beetles. Soap, when mixed with these fungicides adds slightly to their value as deterrents, but not enough to justify its addition for general use.

THE GYPSY MOTH (*Ocneria dispar*, L.).

BY JAMES FLETCHER, OTTAWA.

Of the many injurious insects introduced at various times from the old world, not one has, in as short a time, attracted so much attention, been so great a cause of anxiety, or been so systematically fought as the Gypsy moth, since it appeared in vast numbers in the State of Massachusetts in 1889. As a practical object lesson of the value of scientifically directed effort to overcome an insect enemy which had been allowed to increase unnoticed until it had assumed almost overwhelming proportions, the campaign which has been so successfully carried on for the last four years by the Gypsy Moth Department of the State Board of Agriculture of Massachusetts is of very great interest to all economic entomologists.

Having recently passed through part of the infested region, my attention was attracted to the trees bearing bands of burlap or marked with the various signs used by the inspectors to denote that they had examined the trees. Since my return to Canada, I have been favoured with a full series of the excellent reports of the Commission, together with much other information as to the methods of work, which have been kindly furnished by Prof. E. H. Forbush, the director of field work. On the whole, I think all must acknowledge that, up to the present time, the efforts of the Commission have been very successful; but whether the enemy is entirely exterminated must depend upon whether the work is continued in the same careful manner for at least a few years longer.

+For further details see Vt. Exp. Sta., Bul. 40, p. 25.

Mr. L. O. Howard, the United States Entomologist, one of the best qualified to express an opinion, says, in his recent address as President of the Association of Economic Entomologists, as follows: "The work upon the Gypsy moth which has been done by the State of Massachusetts since 1889, is one of the most remarkable pieces of work, judging by results, which has yet been done in Economic Entomology. The operations have been carried on by a Committee of the State Board of Agriculture, and the means have been furnished by large appropriations by the State Legislature. Three hundred and twenty-five thousand dollars have already been appropriated. A territory comprising something over 100 square miles was infested by the insects, which occurred in such extraordinary numbers as to destroy many trees, and almost to threaten the ultimate extinction of living vegetation, not only within the infested territory, but in all localities to which it might spread. . . . The infested territory has been reduced by one-half, and within the districts in which the Gypsy moth at present exists, it is, practically speaking, a comparatively rare species. The future of the insect is, however, problematical. The continuance of sufficiently large appropriations from the State Legislature to enable the work to be carried on, on its present scale, is doubtful, and yet those in charge believe that still larger appropriations are necessary to bring about extermination. They are confident, however, that with sufficient means, the insect can be absolutely exterminated from the State of Massachusetts."

It will be instructive to consider how it was that this pest became so numerous before it was noticed, what measures were taken to control it, and lastly, what can be learned from the efforts of the Commission.

Prof. O. H. Fernald, the eminent Entomologist of the State, and Prof. Forbush have given, in the reports, most careful accounts of the introduction, habits and best methods of fighting this pest. There seems to be little doubt that the species was introduced into America in 1868, by a Mr. L. Trouvelot, then living near Glenwood, Medford, Mass., where he was carrying on experiments with various caterpillars as producers of silk. Having brought from Europe a cluster of the eggs of the Gypsy moth, he took them out of the box and laid them on the sill of an open window, whence they were blown away and lost. From this centre the moth scattered in every direction until, in 1891, it was found to have spread, during the twenty-three years, over thirty townships.

The chief causes of its increase are "the prolificness of the females, the hardness of the species, and the fact that it feeds upon almost every plant wild or cultivated; the caterpillars also seem much less susceptible to injury from the ordinary poisonous insecticides than most of our native caterpillars and being an introduced insect, of which all the members of the present devastating hordes were derived from one nest of healthy eggs, the species is not attended by the natural parasites which in Europe keep, as a rule, its numbers within reasonable bounds.

It seems strange that so voracious a creature as the Gypsy moth caterpillar could have increased so largely as is described in several letters from correspondents which are published in the 1894 report, without having attracted sufficient notice for some one to have sent specimens to the official Entomologist of the State sooner than 1889. Mrs. Belcher, of Medford, Mass., writes: "Mr. Trouvelot, who is said to have introduced the Gypsy moth into this country, was a next door neighbour of ours. The caterpillars troubled us for six or eight years before they attained to their greatest destructiveness. This was in 1889. They were all over the outside of the house, as well as the trees. All the foliage was eaten off our trees, the apples being attacked first, and the pears next. They ate nearly every green thing in my yard, killing my rose bushes and doing much damage to the vegetables. No one who did not see them at that time, can form any idea of what a pest they were. We killed many with boiling hot water, and would then dig a hole and bury them so as to prevent a stench. Mr. Belcher was poisoned by them. While he was killing them upon the trees, they would get upon his neck and poison it. It was impossible to stay long in the garden, for they would crawl all over one. We fought them for two or three years before the Commission took hold. When they hatched out in the spring, our fence would be one living mass, and while they were small it was almost impossible to keep them off one's person."

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Mr. J. P. Dill, of Medford, also gives a graphic account descriptive of the great numbers and annoyance due to this scourge: "The caterpillars first appeared in May and were at their worst in July. They ate all the leaves off the trees until it seemed as though fire had run through them, trees finally becoming as leafless as in midwinter. After eating the apple tree leaves, they completely stripped a Bartlett pear tree. We got no fruit from either the pear tree or the apple trees that year. That summer we could have got the caterpillars out of the holes in the trees by pecks. After the caterpillars had eaten all the leaves off the trees, they went down into the grass where they swarmed. When the plague was at its worst, that summer, I do not exaggerate when I say that there was not a place on the outside of the house, where you could put your hand without touching caterpillars. At the time the caterpillars were the thickest on the trees, we could plainly hear the noise of their nibbling at night. It sounded like the pattering of very fine rain drops. If we walked under the trees, we got nothing less than a shower bath of caterpillars, which spun down from the trees by hundreds, even when they were of large size."

There are several letters in the same tenor, bearing evidence to the enormous numbers of this pest at the time when the assistance of the State Entomologist was sought in 1889. We find that immediately following this, vigorous steps were taken to make known the gravity of the occurrence, and the Legislature was induced to make appropriations and appoint the Commission, which, by its energetic and successful efforts, has attracted the attention and admiration of the whole world.

Undoubtedly, one of the reasons that this insect made such headway without being noticed generally, was the culpable and unpardonable ignorance which prevails everywhere and in all countries, even among sensible people, concerning the habits of the injurious insects which yearly destroy such vast quantities of produce of all kinds. This ignorance on the part of the public is unpardonable, because it is in a large measure unnecessary; not only have efficient remedies been found out by officers paid by themselves through the State treasury, but the results of the work of these officials are in most cases at the disposal of anyone who will ask for them. Another reason that the pest did not sooner

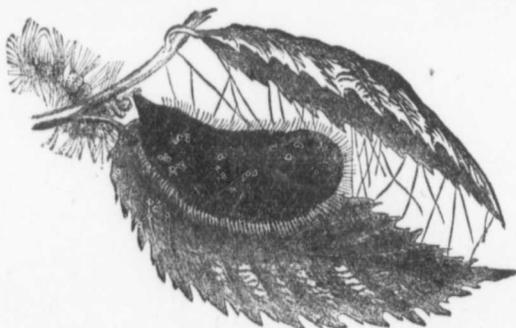


Fig. 44.—Gypsy moth, chrysalis.

attract attention, was probably that the caterpillars feed normally at night, and during the day hide in cracks and crevices of the bark, or rest on the trunks of trees, where by reason of their colouring they are not easily detected. It is only when their numbers become excessive and the food supply is diminished, that they feed at all times of the day and night, and wander from place to place. A feature of the work of the Commission has been the making known, as widely as possible, the appearance of this insect in all its stages. Not only were beautifully coloured plates published in all the reports, but show cases were made up and distributed to schools and public institutions, illustrating by actual specimens the appearance of the eggs, caterpillars, chrysalis, and perfect moths.

The eggs are laid from July to September in oval or rounded clusters, containing from four to five hundred eggs, covered with the yellowish hair from the body of the female. These clusters of eggs are placed indiscriminately on any object near to where

the female emerges from the chrysalis (Fig. 44), on trees, fences, stone walls, etc. They are mostly laid about the middle of July, and do not hatch until the following spring. Both the egg-laying and the hatching of the young caterpillars are very irregular, so that the insect may be found active throughout the season. The caterpillars (Fig. 45), although extremely voracious, take a long time to complete their growth. When full-grown, they are nearly two inches in length, and although gaudily marked when examined closely, they are nevertheless inconspicuous when at rest on trees. "The general colour of the body is creamy white, thickly sprinkled with black. The ground colour shows in the dorsal and lateral lines which are somewhat broken. The tubercles on each side of the dorsal line from the second to the sixth inclusive are blue and give rise to short black

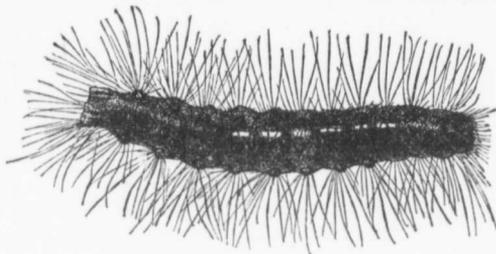


Fig. 45.—Gypsy moth, caterpillar.

spines. On each side of the remaining segments, except the last, the tubercles are dark crimson. On the top of the tenth and eleventh segments, on the dorsal line is a small cylindrical fleshy tubercle without hair or spines, the top of which is slightly inverted. It is uncertain what is the function of these organs, but it is quite possible they are scent organs."

"On the posterior edge of the last segment are four bluish-white tubercles giving rise to black spine-like hairs. The spiracles are oval, pale yellow, and encircled with black. The legs are dark crimson and the pro-legs flesh-coloured and streaked with reddish-brown."—(Fernald.)

There are other but less conspicuous markings, which it is not necessary to mention here. When full-grown, the caterpillars spin a small quantity of silk and change to the chrysalis condition. This usually occurs in July or August, and in Massachusetts the insect remains in this state from eight to twelve days.

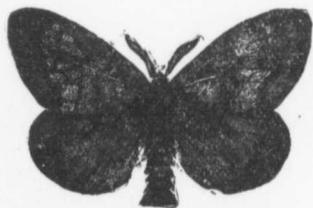


Fig. 46.—Gypsy moth, male.



Fig. 47.—Gypsy moth, female.

The male (Fig. 46) and female (Fig. 47) moths are very dissimilar in appearance. The former measure from one and a half to two inches across the expanded wings. The ground colour of all the wings is brownish-yellow, varying in intensity in different examples. The head, thorax and antennæ are grayish-brown. The wings are crossed by about four waved black lines which are darkest on the costal edge of the wings. The terminal space is also darker than the rest of the wing, and the fringe is cut with dark brown between the veins. The males fly easily, in which they differ from the females, which can only fly down from an elevation.

The female the tips of the tip above, which black, but in s been kindly l the two sexes

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The meth effected by sa For the caterp which they w lime," was pla brush was cle form hiding pl were enclosed shade trees, o known that t infested cent to clear thro obtain an acc in his 1894 r results and ha thorough long infested local towns that it upon to assur destroyed; lo all cavities w for at least tv

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The females are larger, varying from one and a half to two and a half inches between the tips of the wings; the entire body is white, except the abdomen beneath and the tip above, which are yellow. The markings on the fore wings are dark brown, or nearly black, but in some specimens are almost obliterated. The figures shown herewith have been kindly lent by Prof. Forbush, and give the general appearance of the markings of the two sexes, the chrysalis and the caterpillar.

The methods which have been adopted in the prosecution of such extensive operations as have been necessary, have been changed from time to time according to circumstances and experience, and many valuable data have been recorded which will be of great assistance for reference in future work. For carrying on this warfare, it was necessary to train all the inspectors and the many men required to cover the ground, and to attend to the many details connected with the destruction of the insect in its various stages, and the prevention of its spread into other districts. This involved an immense amount of careful work, which naturally took much time and money. A small hand-book, entitled "Laws, Rules and Regulations relating to the extermination of the Gypsy Moth," was printed for the use of the employees, giving a copy of the Act of 1891, authorizing the work, "Rules and Regulations for the Public," most complete "Rules and Regulations for the Agents" employed, and finally a very complete but concise account of the life history and habits of the Gypsy moth.

The methods employed were briefly as follows: The destruction of the egg was effected by saturating the clusters with creosote oil, dilute nitric and carbolic acids. For the caterpillars, trees were banded with burlap, which provided a hiding place in which they were afterwards destroyed; or a material called "raupenleim" or "insect lime," was placed upon the bands to prevent the caterpillars from climbing trees. Underbrush was cleared out wherever possible, and useless and hollow trees which would form hiding places, were cut down and burnt. Traps were also devised in which females were enclosed for the attraction of the males, which were successful. Wherever possible, shade trees, orchards and woodlands were sprayed with poisonous mixtures. As it was known that the moths were disseminated mainly by vehicles driving beneath trees in infested centres, efforts were made to inspect all vehicles going out of such districts and to clear thoroughly all trees along the roads. Great care seems to have been taken to obtain an accurate knowledge of the extent of the infested territory. Prof. Forbush, in his 1894 report, says: "The means, which though expensive, have given the best results and have finally exterminated the moth from localities and towns, consist of a thorough long-continued and repeated search by competent men, not only of all known infested localities, but of entire towns. The moth is now so rare in most of the infested towns that it is only by such search that it can be found, and this search must be relied upon to assure extermination. When a colony is found, all forms of the moth must be destroyed; loose bark must be scraped from the trees, the undergrowth cut and burnt, all cavities which may serve for hiding places filled, and the locality carefully watched for at least two years."

Among the good results of this investigation is the discovery of the value of Arsenate of Lead as an insecticide. The experiments with insecticides made under Prof. Fernald's direction, prove that the arsenites as commonly used for spraying foliage are comparatively ineffectual against the Gypsy moth. It was found that the caterpillars will feed for days without apparent injury, upon trees which have been sprayed with Paris green or London purple, in a mixture so strong as to somewhat burn the leaves. In fact, the committee, in the spraying they are carrying on at present, have found it necessary to use arsenate of lead in as strong proportion as 10 pounds to 150 gallons of water. The great value of arsenate of lead is that it can be used freely upon foliage without danger of injury to the plant, as is the case with the generally used arsenites, Paris green and London purple. The greatest success in clearing the infested districts seems to have been secured by destroying the eggs late in the summer and in early fall, as soon as possible after they are deposited. If they are not disposed of at this time, some of the egg-clusters may be broken, and the eggs scattered by man, animals, or the elements. The treatment with acids is preferable to collecting, as there is less danger of breaking up the clusters and dropping

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the eggs. For the destruction of the caterpillars, Prof. Forbush reports that "the method of banding the trees with burlap is the most effective one yet devised to dispose of this form of the moth. The burlap offers them a convenient shelter, and if it is put on all infested trees, and frequently examined, many caterpillars will be caught that would otherwise escape notice. One hundred and fifty thousand yards of this material were purchased. It was cut into strips and applied to the trees in infested localities. It is necessary to examine the burlap bands once each day, or at least once in two days, to be sure of securing all the caterpillars which gather beneath them."

In view of the great difficulties which the commission had to face in solving the problem of the extermination of the Gypsy moth, the immensity of the work, the impossibility of forming a true estimate of the extent of the infested country or of the money required and, as it turned out, of the habits of the insects and the best remedies, too great credit cannot, I think, be given to those who have so wisely and ably directed the efforts to stamp out this dire enemy.

It will, indeed, be short-sighted policy, if the Legislature of Massachusetts does not now provide the funds necessary to finish up this good work. For nothing is more certain than that, if the amount estimated by the director with all the experience of the past three years, as absolutely necessary, be not forthcoming, not only will all the good work already accomplished be nullified, but at some time in the future it, and much more, will have to be done over again at a far greater expense. In concluding his last report, Prof. Forbush says: "The statute under which the committee is appointed, calls for extermination. The cost of extermination is great. It certainly costs more to search for the last egg-cluster, caterpillar or moth, than it would to destroy the majority of them and thus prevent both dissemination and damage for the time being. But if larger sums of money than those already appropriated can be secured and the extermination of the moth can be accomplished, an expense will be stopped, which must otherwise be continually increasing and which must be borne annually for an indefinite period, either by the State or by all residents of the country over which the moth would extend its constantly widening range. Encouraging progress towards extermination has already been made with manifestly insufficient funds and in the face of many obstacles. The numbers of the moth have been so reduced that no material damage has been done by it during the past two years. It has been exterminated first from single trees, then from orchards, woodlands and entire towns. More than 800 infested localities have been entirely freed of its presence. This work was begun on the borders of the infested region, and has progressed toward the centre until the moth appears now to have been exterminated from more than one-third of the region infested in 1891."

This was written in February, 1894. In Prof. Fernald's report, published in the same volume, are statements from six of our most prominent official entomologists, all of whom testify to the admirable way in which the work has been carried out. Prof. Packard says: "It seems to me that the work is practical and thorough throughout." Prof. Weed, of New Hampshire, says: "I have never seen a series of similar experiments carried on in so large a scale or in so thoroughly scientific a manner." Dr. Fernald, of Pennsylvania, says: "A careful consideration of the methods used and of the results already obtained, has convinced me that the extermination of the Gypsy Moth is not only possible but certain, if the work be prosecuted for a sufficient length of time." Prof. John B. Smith says: "The force has accomplished wonders, and I feel that there is very good reason for the belief that the Gypsy moth can be exterminated, provided the means are furnished." Dr. Lintner, of New York, says: "How a work of such magnitude, extending over so large a territory, could have been accomplished was a wonder and an enigma to me, until I became acquainted with the means by which it had been brought about."

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THE SAN JOSÉ SCALE. (*Aspidiotus perniciosus*, Comstock).

BY JAMES FLETCHER, OTTAWA.

The unexpected discovery, in the Eastern United States and British Columbia, of this scourge of the Pacific Coast orchards, makes it all-important to draw the attention of Ontario fruit-growers to the subject, so that they may become familiar with its appearance and be prepared to adopt active measures to eradicate it, should it, as it is more than probable, appear in our province.

In August, 1893, the first eastern specimens of the San José scale were brought to the notice of the United States Entomologist, and he at once took active measures to find out all that was to be learned concerning its distribution and injuries, with the object of stamping out such a formidable enemy. In April, 1894, Mr. Howard issued a circular under the caption, "An Important Enemy to Fruit Trees," in which he gave a short history of the insect and the most approved remedies. He has been kind enough to lend Fig. 48 from that bulletin, which will be of great service in giving an idea of the appearance of the insect.

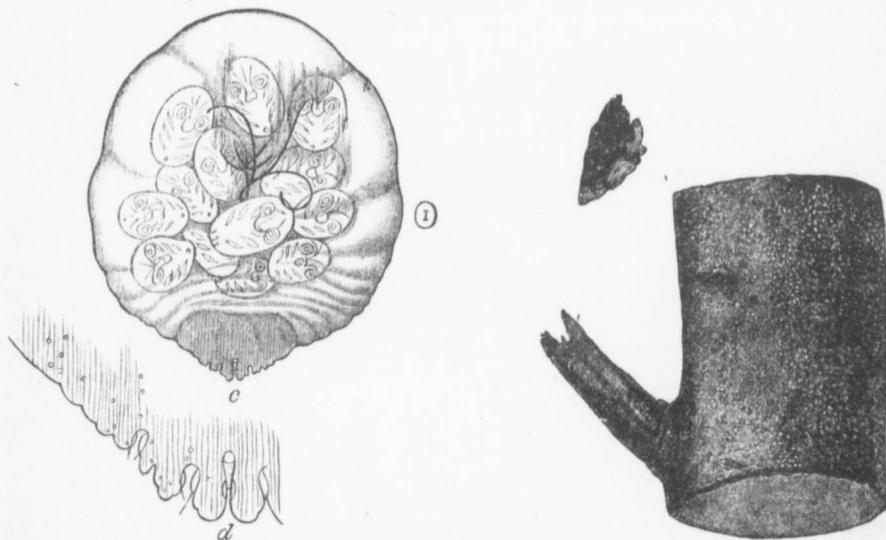


Fig. 48.—San José Scale, female enlarged and part of infested branch (life size).

The San José Scale was first brought to California it is thought, from Chile about 1870, and it was first noticed as injuriously abundant at San José in 1873, and called the San José Scale. "It does not seem to have been named scientifically until 1880, when Prof. Comstock described it in his annual report to the United States Department of Agriculture—he designated it *perniciosus*, because he considered it the most pernicious scale insect known in the country. It swarmed in countless numbers upon the trees in certain orchards, and infested all the deciduous fruits grown in California, except the apricot and Black Tartarian cherry. In the course of twelve years, the insect spread through all the fruit-growing regions of California, through Oregon, and into the State of Washington. It is known as the worst insect pest of deciduous fruit trees on the Pacific coast, and has caused great pecuniary loss. Many crops of fruit have been ruined, and thousands of trees have been killed." (L. O. Howard, Circular 3.)

In 1892 the insect was found in New Mexico on apple, pear, plum, peach, quince and rose. It had been brought into New Mexico upon young trees from California. Nearly all the other instances of infestation east of the Rocky Mountains can be traced to two nurseries in New Jersey, where the pest had been introduced in 1886 or 1887 on

trees of the Japanese plum "Kelsey," which had been procured from the San Jose district in California. Idaho pear trees had also been frequently imported from California which were most probably infested. In 1891 and 1892 several blocks of young apple trees were badly infested. It is on pear trees chiefly that this pernicious scale has been distributed through the state of New Jersey. Prof. J. B. Smith says (*Insect Life*, VII., p. 166): "The Idaho pear has been the most dangerous because it came infested whenever imported direct, and after it came in close order, Madame von Siebold, Garber, Lawson, Seckel, Lawrence and Bartlett. Other varieties are also infested, but less frequently, and the scales do not do so well. Kieffers alone are absolutely exempt, and closely following comes the Leconte, which is rarely infested in the nursery, and never in the orchard, in my experience. One tree grafted with Lawson and Kieffer had the Lawson branch and fruit covered with scales, while the Kieffer branch was entirely free. Currants, black and red, became rapidly infested, and the scales were certainly distributed on these plants."

Mr. Howard says that this insect spreads rapidly for a scale insect, and is the most dangerous scale known. It is, too, inconspicuous and would be overlooked by many. Specimens of infested apple boughs received from British Columbia were entirely incrustated with the scales so as to give them the appearance of having been dusted with ashes. Mr. Howard gives the following description of the scale in his circular above referred to: "The San Jose Scale belongs to the same group of scale insects—the Diaspinæ, or armoured scales—to which the Oyster-shell Bark-louse of the apple belongs. It differs from this species, and in fact from all other eastern species found upon deciduous fruit trees, in that the scale is perfectly round, or at most very slightly elongated or irregular. It is flat, pressed close to the bark, resembles the bark of the twigs in colour, and when fully grown is about one-eighth of an inch in diameter. At or near the middle of each scale is a small, round, slightly-elongated, black point; or this point may sometimes appear yellowish. When occurring upon the bark of the twigs or leaves, and in large numbers, the scales lie close to each other, frequently overlapping, and are at such times difficult to distinguish without a magnifying glass. The general appearance which they present is of a grayish, very slightly roughened scurfy deposit."

The natural rich reddish colour of the limbs of the peach and apple is quite obscured when these trees are thickly infested, and they have then every appearance of being coated with lime or ashes. When the scales are crushed by scraping, a yellowish oily liquid will appear, resulting from the crushing of the soft yellow insects beneath the scales, and this will at once indicate to one who is not familiar with their appearance the existence of healthy living scales on the trees. During winter the insect is to be found in the half-grown or nearly full-grown condition. The young begin to hatch and to crawl from under the female scales shortly after the trees leaf out, and from this time through the summer there is a constant succession of generations. The insect affects not only the young twigs and limbs, and with young trees, the entire plant, but is also found upon the leaves and upon the fruit. When abundant, the fruit is destroyed. One of the most characteristic points in the appearance of the insect upon fruit, is the purple discoloration around the edge of each scale.

The above description will enable fruit-growers to recognize this enemy, should they be unfortunate enough to get their orchards infested with it.

REMEDIES.

With regard to remedies, we have the advantage of all the experience of Californian experimenters and the careful work of the Division of Entomology at Washington, as well as of Prof. J. B. Smith of New Jersey during the past year. There are three methods which have proved effective in fighting the San Jose Scale. In cases of severe attack it is recommended to cut down the infested trees and burn them. The other methods are, spraying with insecticidal washes, or fumigating the trees with poisonous gases. The insecticidal washes may be divided into summer washes, which can be applied while the trees are in leaf, and winter washes of a

stronger nature during the effect of desiccation. An emulsion (Ricinus) of 10 per cent. strength is recommended by Howard, and the susceptibility of the plants to its volatiles is very great. The young scales are viviparous in winter and it was found that kerosene emulsion is very important, since it will last for three or four weeks with the regular application readily carried out.

In Prof. Howard's *Insect Life*, VII., p. 166, it is stated that in an orchard of over 100 trees the scale was found in 10 times to most of the trees. The treatment has been as follows:

For winter treatment: The stock kept in the water, and the following proportions: Resin 1 lb., Sulphur 1 lb., Water 100 lbs.

"The mixture is mixed in 100 lbs.; water 100 lbs.; during the growth of the lime area of the kettle. The scales are removed from the surface and will finally be found being ordinary. The lime and the water of lime are mixed. This should be done on account of the bottom unless the

The thickness of the scales has been examined. Necessary arrangements for the tree are necessary. The fumes of potassium, which are kept on the ground, are given off.

What is the result? In summing up the work against the scale at intervals

stronger nature, which would injure the foliage but will do no harm to the trees during the winter, when they are in a dormant condition, and yet will have the effect of destroying the scale insect. Of the *summer washes*, the ordinary kerosene emulsion (Riley-Hubbard formula) and a resin wash [resin 20 lbs., caustic soda (70 per cent. strength) 5 lbs., fish oil 3 pints, water 100 gallons] were recommended by Mr. Howard, and used with success during the past summer. On peach trees, owing to the susceptibility of the foliage to injury, the stock kerosene emulsion was diluted with fifteen times its volume of water, instead of nine times, the usual strength advised for most other plants. It was found advisable to repeat the sprayings at intervals of about a week. The young scale insects were noticed on May 19th at Riverside, Md., and the females, viviparous in habit, gave birth to young for a full month. This was upon peach trees, and it was found that the resin wash killed the scales more quickly than the very diluted kerosene emulsion, and, as Mr. Howard points out, this rapidity of the work is important, since where a full-grown female is sprayed with kerosene emulsion, she may live for three or four days, during which time she brings forth young; whereas if sprayed with the resin wash, fewer young scales are produced. The resin wash, however, is readily carried off by the rains, while the kerosene is more resistant.

In Professor J. B. Smith's investigations in Pennsylvania, it is recorded (Insect Life, VII, p. 159) that, "he has visited the locality at Atglen, Pa., and found that in an orchard of over 7,000 trees, all of certain varieties, and a few of others, were infested by the scale. As a result of his recommendations, kerosene emulsion has been applied three times to most of the trees at intervals of ten days, up to the first week in June. The treatment has been absolutely successful."

For *winter washes* the kerosene emulsion and resin washes may be made stronger. The stock kerosene emulsion has been used diluted with only four and a half parts of water, and for the resin wash the same ingredients were used in the following proportions: Resin, 30 lbs.; caustic soda, 9 lbs.; fish oil, 4½ pints; water, 100 gallons.

"The most favored winter remedy in California, however, is the lime, salt, and sulphur mixture. This consists of unslaked lime, 10 lbs.; sulphur, 5 lbs.; stock salt, 5 lbs.; water to make 15 gallons. This wash will do great damage to the trees if applied during the growing season, and should be used only in winter. All the sulphur and half the lime are placed in a kettle and 8½ gallons of water added, after which the contents of the kettle are boiled briskly for about an hour. The solution which at first is yellow from the sulphur, will turn very dark brown, assuming more or less of a reddish tint, and will finally change from a thick batter to a thoroughly liquid condition, the product being ordinary sulphide of lime. All the salt is added to the remaining 5 pounds of lime and the latter slaked, after which the slaked lime and salt are added to the sulphide of lime already obtained, the whole being then diluted with water to make 15 gallons. This should be strained before application, as it does not form a perfect liquid solution on account of the considerable quantity of undissolved lime, which will soon sink to the bottom unless the solution is constantly stirred while being sprayed."

The third method of fighting scale insects is known as the Gas Treatment. This has been extensively used in California but is an expensive operation, and the materials necessary are very poisonous and dangerous to have about. It consists, briefly, of covering the tree to be treated with an air-tight tent and then filling the tent with the poisonous fumes of hydrocyanic acid gas, which is generated by placing 1 oz. of cyanide of potassium, 1 fluid oz. of sulphuric acid, and 3 fluid oz. of water in an earthenware vessel beneath the tent. The gas is very light and rises to the top of the tent, and if this be kept on the tree for half an hour, every scale will be destroyed. The quantity of ingredients given above is sufficient for a tent enclosing 150 cubic feet.

What is wanted, however, is to know *the best remedy*, and it is satisfactory to learn that on the whole the standard remedy for scale insects, kerosene emulsion, is the best. In summing up his experience of the year, Mr. Howard says as follows: "Remedial work against this insect is onerous, but our experience has shown that three sprayings at intervals of ten days during the latter part of May and June, will practically destroy

the insect, whether the spraying be conducted with very considerably diluted kerosene emulsion or with a resin wash, while during the winter a single application of either of the three winter washes will greatly reduce the numbers of the insect. Among the winter washes our experience leads us to give the preference to strong kerosene emulsion; next, to the winter resin wash; and finally, to the lime, salt, and sulphur mixture.

The kerosene emulsion is now well-known to most Canadian fruit-growers; but it may be well to give it here.

Kerosene (coal oil)	2 gallons.
Common soap or whale oil soap	$\frac{1}{2}$ pound.
Water	1 gallon.

Cut up the soap and boil in the water till all is dissolved, then add it boiling hot to the coal oil; churn the whole briskly for five minutes with a syringe or force pump. When the emulsion is perfect, it will adhere without oiliness to the surface of glass, and when cooling forms a jelly-like mass, which can be kept indefinitely if stored in a cool place and covered from dust.

When required for use, for a summer wash dilute one part of the stock made as above with nine or fifteen parts of water. To make the stock dissolve easily, take first three parts of hot water to one of the emulsion, and then, when all is thoroughly mixed, add sufficient cold water to make the nine or fifteen parts required; for a winter wash mix with four and a half or nine parts of water.

INJURIOUS FRUIT INSECTS OF THE YEAR 1894.

By J. FLETCHER, OTTAWA.

The season of 1894 has been a busy one for the practical entomologist. Not only have the usual complaints come in of injury by the canker worm, codling moth, curculio, cut worm, etc., but beside these there have been special developments of some well-known species, and some new invaders have appeared within our borders. Of these last the most notable are the Pear-tree Psylla, which occurred in large numbers in an orchard at Freeman, Ont., and the San Jose scale, of which undoubted specimens were sent in from British Columbia. The attention paid generally to the remedies advised by entomologists is decidedly much greater to-day than it has ever been before. This is largely due to the satisfactory results which have been obtained by new methods in treating insect enemies, and also by the even more remarkable successes of botanists in controlling fungous diseases. The combined application of fungicides and insecticides is still being carefully studied and the practice of adding Paris green or some other arsenite to the Bordeaux mixture for the treatment of fruit trees, has now been widely adopted by the best fruit-growers. The late action of the British Columbian Government in condemning and destroying shipments of fruits which on arrival were found to be infested by injurious insects illustrates the vigorous policy which has been adopted by the Provincial Board of Agriculture to protect their important fruit industry. This action will also doubtless have the effect of turning the attention of careless and improvident fruit-growers to the subject, and of inducing them to adopt the simple and cheap remedies which entomologists have been advocating for the last ten years and which must certainly result not only in increased wealth to themselves and the province, but gradually in reducing very materially the amount of injurious insect-presence in the Dominion.

The insect which was the cause of the condemnation of the shipments of apples in British Columbia, was the codling moth (Fig. 49 shews the work of the grub in the fruit) which, remarkable as it may seem, has not as yet been authentically recorded as breeding in British Columbia, although it is perhaps to-day the worst enemy of the apple in Eastern Ontario. If it be true that the codling moth is not already established in British Columbia, the wisdom of the Government of that Province in using every reasonable means of keeping it out, must commend itself to everybody.

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Two of the worst enemies of the fruit grower are the codling moth (*Carpocapsa pomonella*) and the plum curculio (*Conotrachelus nenuphar*). [Fig. 50 represents all stages of the insect.] After a great many experiments under varying circumstances, spraying the trees with Paris green (one pound of Paris green, one pound of fresh lime and 200 gallons of water) still remains the best remedy; I believe that whether these insects are known to be present or not, it will well repay fruit growers to spray their orchards at least once every spring as a regular operation. Numerous instances have been reported to me of astonishingly successful results from following this course, and hardly any failures; so I can repeat what I said last year, that "where this work is done carefully and intelligently, it is practically all-sufficient." The occasional cases of failure which are sometimes heard of, and these are very rare, are almost invariably due to careless work. In the January number of the *Canadian Horticulturist*, I published an open letter requesting fruit-growers who had failed to obtain paying results from spraying plum or apple trees, to write to me on the subject. After nearly a whole year, I have not

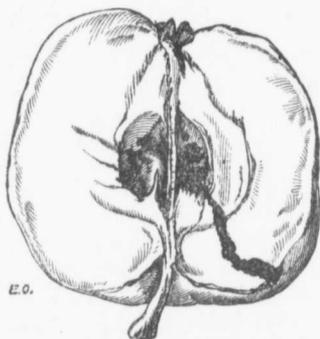


Fig. 49.—Codling moth larva in apple.

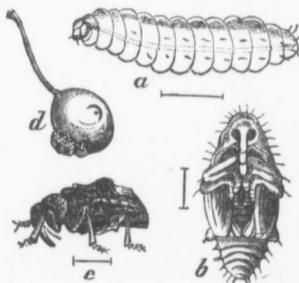


Fig. 50.—Plum curculio.

received a single unsatisfactory reply; furthermore, at the last annual meeting of the Fruit Growers' Association of Ontario, held at Peterboro', the question of spraying apple trees for the codling moth and plum trees for the curculio, came up for discussion. During this meeting which I had the pleasure of attending, I requested those present who had sprayed with Paris green against those insects, to give the results of their experience. Some convincing instances were given by leading members of the Association, which proved the efficacy of the treatment recommended.

SCALE INSECTS.—Considerable injury is undoubtedly due throughout the whole Dominion to the operations of the inconspicuous but very pernicious scale insects; the most redoubtable of these is the Oyster-shell bark-louse (*Mytilaspis pomorum*, Bouche), and it competes every year with the codling moth for the honour of being the worst enemy of the apple tree. The life history, in this species as well as in most others, gives us a suggestion as to the best time to apply a remedy. The scales (Fig. 51) may be found upon the twigs and branches of apple trees, black currant bushes, mountain ash, ash and many other trees during the winter. From these during June emerge minute, white mite-like insects with six legs (Fig. 52), which for a few days crawl about the trees seeking for a suitable spot for them to attach themselves. This is generally on the young wood of the previous year. It is only during these few days that they are able to move, for having chosen a spot they pierce the bark with their needle-like beaks and remain fixed for the rest of their lives. Each gradually secretes a waxy mantle (Fig. 52, 3), and by August has transformed into a scale (Fig. 52, 7), in the case of the females, covering a cluster of eggs. The scales of the males are much smaller than those of the females and of a different shape. The eggs do not hatch until the following June. While the young are in the active state they are very much more susceptible to injury than after the scales are formed. The time of hatching varies somewhat in different localities, but by examining the trees this date can be easily ascertained, and if the trees are then sprayed with a

diluted mixture of kerosene emulsion the insects will be destroyed. A good time also to spray the trees, is early in spring before the buds burst. It is a matter of surprise to some how these insects which pass their lives for the most part attached firmly to the bark can spread so rapidly through an orchard, as they frequently do. This has been explained by the suggestion that at the time the young lice first hatch, they are very active and crawl

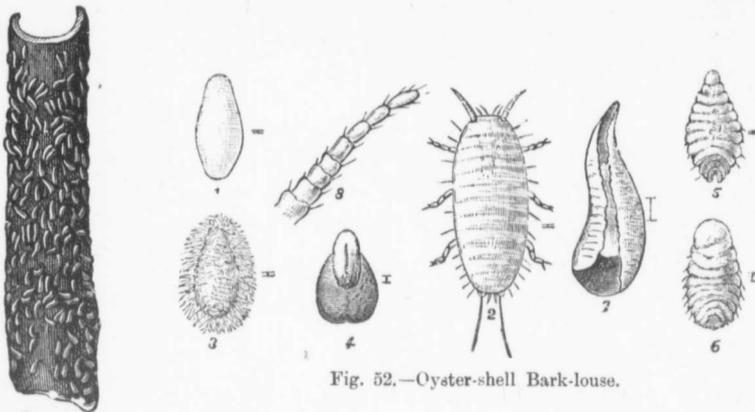


Fig. 51.

Fig. 52.—Oyster-shell Bark-lice.

with great agility. At this time of the year, the trees are much frequented by birds and other insects, upon which the lice crawl and are then carried from tree to tree by these larger winged creatures.

Belonging to this same class of scale insects, is the pernicious San Jose scale which on account of its importance, is treated of in a separate article.

Another enemy of fruit trees which has this year for the first time appeared in the Dominion, is the Pear-tree Flea-lice, (*Psylla pyricola*, Förster), specimens of which were sent in from Freeman, Ont., by Mr. J. S. Freeman, who writes: "I have a block of 300 dwarf Duchess pear trees mixed with apple trees, which are so badly affected with the insects which I am sending you, that from the appearance of the trees at present, the whole crop will be destroyed. I do not think that the pear trees have been troubled before this season. They are more or less over the pear trees of different kinds in my nine-acre orchard. From inquiries of other fruit-growers in this section, I think it likely that this pest occurs in other orchards too." At the time of receiving the specimens the insect was in the pupal form and just about to assume the perfect state. Mr. Freeman was written to as to the nature of the insect, and he was recommended to spray his trees with kerosene emulsion at the time, and to repeat the application early next spring when the buds burst, that being the season when the young hatch from eggs laid by females which are now hibernating on the trees. This has been found to be the most successful treatment.

The Pear-tree Flea-lice belongs to the same class of insects as the aphids or plant lice, with which they form the second section of the *Homoptera*, known as *Dimera*, or those with two-jointed feet. In this section we find small insects with antennæ longer than the head and in the winged individuals four wings, ordinarily all of the same membranous texture. The *Psyllidæ* or flea-lice are small insects found on leaves and in some species, as the Hackberry flea-lice, give rise to galls. They have long slender antennæ terminated by two bristles. The beak is short and tri-articulate, and the eyes are lateral and prominent as in the *Cicadæ*. In fact, these little flea-lice, although seldom much more than one line in length, very much resemble *Cicadæ* in miniature. On the front of the face are three ocelli placed in a triangle, the posterior ones quite close to the eyes. Unlike the *Aphides* or plant lice, the flea-lice have the power of leaping, from which they take their English name.

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The Pear-tree Flea-louse is an introduced insect which was first recorded as injurious in America in 1833, according to Dr. Harris. It seems to be widely distributed in the Eastern United States and occasionally has developed into a serious pest. It has been treated of at various times by Dr. Lintner, Dr. J. B. Smith and the Washington Entomologists. The most important articles are those by Prof. Lintner in his Ninth Report and Prof. Slingerland in Bulletin 44, Cornell Univ. Agr. Exp. St., October, 1892, where a complete account is given of its life history and habits.

The presence of this insect is easily detected by the copious secretion of honey dew with which the leaves of the infested trees are covered and which soon becomes covered with the dirty looking black fungus (*Fumago salicina*), and also, after a time, by the falling of the foliage. The insect itself is about one-tenth of an inch in length, of reddish brown colour, with broad black bands across the abdomen, with transparent wings, the fore wings bearing one large vein which is divided into three forks, which again are bifurcated at the extremities. The immature insect, when first hatched, is a curious flattened oval creature, semi-translucent, yellow and very inconspicuous, only one-eightieth of an inch in length. It grows rapidly and in about a month passes through the five nymph stages, the last two of which are called the pupal stages and have black wing pads and blotches of the same colour on the body. Dr. Lintner records at least four broods during the season. An encouraging feature noticeable in all the accounts of this insect is the irregularity of its appearance, its occurrence in large numbers one year very seldom indicating that it will be as abundant the next.

Another very troublesome enemy of the fruit-grower is the Cigar Case-bearer of the apple (*Goleophora Fletcherella*, Fernald), which has been sent in from several places in Ontario and the Maritime Provinces. The first specimens were from Mr. Edwin Worden, of Oshawa, Ont., who in March sent twigs of apple trees thickly infested with the hibernating larvæ of the case-bearer, and the cocoons of the interesting little moth *Micropteryx pomivorella*, Pack. Specimens of the former came also from the Grimsby district, where it was stated that Greenings suffered most. Later in the year I had a visit from Mr. Harold Jones, of Maitland, Ont., who has suffered much from this small but very troublesome insect. He estimates his loss at fully the average fruit of one hundred trees. This has proved an extremely difficult insect to control. The life history is as follows:

The eggs are laid by the tiny moths during July. The young larvæ hatch in about a fortnight, and burrowing into the leaves, feed upon the parenchyma for a short time. They then cut out from both surfaces of the leaf oval pieces of the epidermis, with which they form their curious cases. Mr. Jones observed the young larvæ beneath the leaves about the 10th of August, and by the 1st of September they were clustered on the twigs. Here they remain all the winter with their curved cases, fastened securely to the twigs with white silk. As soon as the buds open in spring, they crawl out on the twigs and attack the unfolding leaves and flowers. As the leaves get larger, they confine themselves to the leaves, feeding chiefly on the undersides, where they bore a circular hole through the epidermis and extending their bodies into the cavity between the upper and lower surfaces, make large blotch-mines. They also do much harm by attacking the stems of the flowers and forming fruit. About the third week in June the larvæ crawl to the upper surface of the leaves, and, having fastened their cases down, change to pupæ inside them; the very small dark brown moths, a quarter of an inch in length, appearing from the second week to the end of July.

The remedy, which has been tried for this insect with the greatest success, is spraying with kerosene emulsion early in spring. Dr. Young, of Adolphustown, who suffered much from this insect, writes me on July 3rd last: "On the large block of Duchess apple trees, where we sprayed with Paris green in 1891 and '92, when the case-bearers were so numerous, there is now only an odd worm to be seen; but in other parts of the orchard, where they had scarcely reached at first, they were numerous this spring. The kerosene emulsion, either warm or cold, used in the winter had no effect; but when used cold in the spring, after the worms began to move about, was very effectual. It more completely cleaned the trees of the case-bearers than did the Paris green. Still the Paris green did well, and took most of them off. We sprayed with both the same day." It is

rather remarkable that this insect, in Nova Scotia and Prince Edward Island, attacks the plum and pear as well as the apple; but at Oshawa, Mr. Worden reports that, although he has plum and pear trees side by side with his apple trees, the latter alone are attacked.

An insect which has caused considerable damage to fruit growers is the Oblique-banded Leaf-roller (*Cacocia rosaceana*, Harris). Fig. 53 represents the moth with open wings; fig. 54, with wings closed; fig. 55, caterpillar and chrysalis. It is frequently a troublesome pest on apple trees and currant bushes. This year it was sent to me as an enemy of the birch, apple, pear, gooseberry, black currant, garden geranium, and a rare



Fig. 53.



Fig. 54.

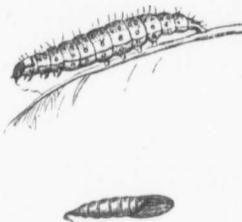


Fig. 55.

Oblique-banded Leaf-roller.

interesting attack was noted in which it was destroying the seeds only of the silver maple. In fact this insect seems to be a pest upon a large number of shrubs and trees, upon any one of which it may develop injuriously under special circumstances. The general practice of spraying fruit trees with the arsenites, for the codling moth and the leaf-eating insects, will certainly reduce largely the occurrence of the Oblique-banded Leaf-roller.

The peach orchards in the Niagara district have, during the past two years, suffered seriously from the Peach Bark-beetle (*Pithoeus liminaris*, Harris). Careful experiments have been begun in the extensive orchards of Mr. C. E. Fisher and Captain J. Sheppard, at Queenston; and it is hoped that before long a practical remedy will be discovered. It has usually been stated that this insect attacks only injured or dying trees; this, however, is certainly not the case, for it was found in perfectly healthy and thrifty young two-year-old peach trees; although very much more abundantly in older trees with rough bark. Its ravages are chiefly confined to the peach; but, at Queenston, specimens were found in both cherry and plum. There are at least two broods in the year. The perfect beetles hibernate in shallow galleries in the bark; they are active very early in the spring, and on warm days, even in February and March, come out of their burrows. Mr. Fisher wrote me on March 13th last: "I examined the trunks of the trees, as you suggested, on a sunshiny day, and found beetles crawling with their wings set for flying. As you know, ordinarily they do not appear as if they had wings; but these had them out ready for use. The presence of this insect is conspicuously evident in wet weather, when enormous quantities of gum ooze from the trunks and fall to the ground. The work of both the larvæ and the perfect beetles seems to be confined, at Queenston at any rate, to the bark. Not a single instance of penetration of the wood could be found, although this latter attack is recorded by some observers."

The remedies which have been tried are, washing the trunks with kerosene emulsion, linseed oil, and whitewash containing Paris green. The results have been rather conflicting, but there is every reason to think that before long a sure means of prevention will be found.

Another insect, which was received from the Queenston district, and also from Fenwick, Ont., is the Otiorhynchid beetle (*Anametus grisea*, Lec.).¹⁶ Mr. Fisher found specimens upon his peach trees, but was under the impression they did not do him much harm. Mr. E. S. Atkins, of Fenwick, however, suffered more severely; he writes: "Last year they killed 130 young peach trees for me, and ate out four rows of strawberries extending

across a six-acre trees when first by eating the potato beetle, and in warm cealed at the r is nothing to s mixture." As attack them, a of the various beetles occur, stock, a strip ground around for cut-worms.

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across a six-acre field. They only attack the very first leaf-buds and the bark of the young trees when first set out; or when a young tree is budded and cut off near the ground, by eating the bud they destroy the tree. In many of their habits they resemble the potato beetle, such as letting themselves drop to the ground and lying apparently dead; and in warm sunny days they move about and eat, and on cold or wet ones they lie concealed at the root of the tree in the earth. When the beetles are most destructive, there is nothing to spray, as the top is cut off, and it is a mere switch with nothing to hold the mixture." As these beetles are wingless, and have to climb up the stems of trees to attack them, any mechanical means of prevention, such as a band of cotton batting or one of the various kinds of tree protectors, placed around the trunks at the time the perfect beetles occur, would prevent injury by the mature insects. In the case of young budded stock, a strip of tin bent into a ring about four inches in diameter, and pressed into the ground around the base of the stem, similar to those now so generally used by gardeners for cut-worms, might be serviceable.

I am informed by Dr. J. Hamilton that he has bred this beetle in Pennsylvania from the stems of the Rag-weed, *Ambrosia trifida*, where the larva had lived as a borer; but I think it must have some other larval habit in Canada, as this plant is only an accidental weed in a few places in Ontario.

The Spotted Paria (*Paria sexnotata* (Say)) is another beetle which requires mention as a serious pest of the raspberry. It has given great trouble on some of the fruit farms in the neighbourhood of Grimsby and St. Catharines for several years past. It was first brought to my notice by Mr. Martin Burrell, of St. Catharines, and was so difficult to control that he eventually ploughed out the whole of the infested patch. He wrote in 1892: "My old enemy, *P. sexnotata*, has revisited me this spring in greater numbers than ever. I sprayed with Paris green, 4 ounces to 30 gallons, but the foe still 'bobbed up serenely.' Of a quarter of an acre of my raspberries not a score of canes have leafed out. I am not the only victim this year, as several of my neighbours have been severely injured by the beetles."

Mr. John Craig, Horticulturist, of the Central Experimental Farm, found this insect also very abundant early in May, in raspberry plantations on the road between Hamilton and Grimsby; and Mr. Linus Woolverton, the energetic secretary of the Fruit Growers' Association of Ontario, sent me last spring specimens, with the report that they were doing much harm about Grimsby by eating out the fruit buds of raspberries, and thus destroying the crop. The following answer was sent to him: "The beetles you send are the Spotted Paria. This is a most injurious insect, and has done much damage in the way you describe, at St. Catharines. It seems to be very difficult to kill. I would suggest your dusting the raspberry bushes at once with Paris green and slaked lime, 1 pound of Paris green to 25 of lime. This mixture is easiest applied by putting it in a bag of cheese-cloth and shaking or tapping it over the bushes. Of course, if you can get a morning when there is a dew on them, so much the better. The beetles may also be killed in large numbers by beating or shaking them off the canes into an open pan containing water, with a little coal oil on the top. A good plan for collecting them is to hold an open and inverted umbrella beneath the canes when beating them, and then brush the insects out into the coal oil pan."

The Spotted Paria does not confine its attacks to the raspberry alone, but is occasionally troublesome to strawberries. In 1874, Mr. John McGrady, of Gatineau Point, Que., suffered a disastrous attack upon his strawberry beds. He found that hellebore was quite useless against the enemy; and my experience is that much stronger poisons are necessary for this beetle than for many others.

There have been, of course, many of the well-known fruit pests complained of from various parts of the province, but, with perhaps the exception of the Bud Moth in the Grimsby and London districts, and *Bucculatrix pomifoliella*, in western Ontario, no others demand special mention here.

SIXTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.*

The Association met at 10 a. m. in Room 12 of the Packer Institute, Brooklyn, N. Y., August 14th, 1894. The following officers and members were present :

President, L. O. Howard, Washington, D. C. ; Vice-President, J. B. Smith, New Brunswick, N. J. ; Acting Secretary, C. L. Marlatt, Washington, D. C.

Messrs. William H. Ashmead, Washington, D. C. ; Geo. F. Atkinson, Ithaca, N. Y. ; Nathan Banks, Sea Cliff, N. Y. ; D. W. Coquillett, Washington, D. C. ; Geo. C. Davis, Agricultural College, Mich. ; A. D. Hopkins, Morgantown, W. Va. ; Geo. H. Hudson, Plattsburg, N. Y. ; J. A. Lintner, Albany, N. Y. ; V. H. Lowe, Jamaica, N. Y. ; F. W. Raine, Morgantown, W. Va. ; William Saunders, Ottawa, Canada ; E. B. Southwick, Central Park, New York City ; F. A. Serrine, Jamaica, N. Y. There were also in attendance upon the meetings visitors and members of other scientific societies, the average attendance being twenty-five persons.

The meeting was called to order by the President, and in the absence of the Secretary, Mr. Gillette, Mr. C. L. Marlatt was elected Secretary for the meeting.

The President, Mr. Howard, then delivered his annual address as follows :

A BRIEF ACCOUNT OF THE RISE AND PRESENT CONDITION OF OFFICIAL ECONOMIC ENTOMOLOGY.

By L. O. HOWARD, WASHINGTON, D. C.

When this Association was founded, in 1889, the name adopted was "The Association of Official Economic Entomologists," and its objects as outlined had evidently especial reference to the work of those economic entomologists who hold official positions. At the first annual meeting, held in Washington in November of the same year, Dr. Lintner, with the evident idea of broadening the scope of the Association, introduced an amendment to drop the word "official" from the title, and this amendment was adopted at the meeting at Champaign, Ill., the following year. Notwithstanding this fact, the membership of the Association is to-day largely official ; out of 73 members 60 hold official positions, while the active work is all done by those with whom economic entomology is a means of subsistence. At the last meeting, held in Madison, Wis., in August, 1893, every member registered belonged to the official class.

The organization meeting at Toronto on the 30th of August, 1889, presented a strange contrast to this. It was held, as may not generally be known, upon a wooded knoll at a landing called Scarborough Heights, overlooking the waters of Lake Ontario. The beach below and the woods around were being scoured by industrious collectors of the old section F, of the American Association for the Advancement of Science. Professor Cook, who presided, occupied a dignified position astride a fallen log. Dr. Smith, who acted as secretary, had climbed with difficulty to the top of a tall stump and took his minutes on his knee. Dr. Bethune, Mr. Fletcher, Mr. E. Baynes Reed, Mr. H. H. Lyman, Prof. C. W. Hargitt, Mr. E. P. Thompson, and the writer, reclined with more or less grace, according to their physical conformation, upon the ground or sat cross-legged upon convenient ant-hills. This group, which made the Association "official" in name, was composed of four official entomologists and five who were simply interested workers.

*Through the kindness of Mr. L. O. Howard, Entomologist of the Department of Agriculture, Washington, D. C., and Mr. C. L. Marlatt, Acting Secretary of the meeting, who prepared an abstract of the proceedings for the *Canadian Entomologist*, we are enabled to give the following account of this interesting meeting as well as some of the papers in full.—Ed.

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This brief historical paragraph is introduced for the purpose of showing the interesting paradox that this Association was originally made official by non-officials, that it was subsequently made non-official by officials, and that since it was made non-official it has become more official than before.

It is in part for this reason that I have chosen to bring together for presentation at this meeting some account of the rise and present condition of official economic entomology, but more largely for the other reasons that few of us probably have been able to take a comprehensive view of the status of our application of entomology the world over, and that a review of what has been done can not but justify our existence as a class and as an association and afford the strongest of arguments for the increase of our numbers and for increase of means and facilities.

The ravages of insects on cultivated plants were doubtless coetaneous with the beginning of the cultivation of plants. Thus a necessity for economic entomologists existed at a very early time. The condition of the ancient husbandman with reference to injurious insects is voiced by the prophet Joel, when he says :

That which the palmer-worm hath left, hath the locust eaten ; and that which the locust hath left hath the canker-worm eaten ; and that which the canker-worm hath left hath the caterpillar eaten. * * * He hath laid my vine waste and barked my fig tree ; he hath made it clean bare and cast it away ; the branches thereof are made white * * * The field is wasted, the land mourneth. * * * Be ye ashamed, O, ye husbandmen ; howl, O, ye vinedressers, for the wheat and for the barley, because the harvest of the field is perished.

In 1881 Dr. Hagen published in the columns of the *New Yorker Belletristisches Journal* (August 16) an interesting article entitled "Heuschrecken-Kommissionen im Mittelalter und heute," in which he showed that grasshopper invasions have taken place since time immemorial, and that man's efforts to combat them have always ended in his discomfiture. It is not surprising, therefore, says Dr. Hagen, that the helpless multitude called on the intervention of the law and of God to deliver them from such pests ; and the legislators on one side and the priests on the other were forced to carry out the will of the people. But since written laws and legislative decrees against elemental plagues would have been ridiculous without a surrounding of imposing, legally regulated forms, the development of these formalities gradually reached a high degree of perfection. Legislation for defense against injurious animals reached its highest development in the Middle Ages. Legal procedures against all sorts of noxious animals were frequent, and the famous Burgundian legal light, Bartholomæus Chassaneus, wrote a book setting forth the rules according to which a suit against grasshoppers should be entered. After a court had been called together by written request, a judge was appointed and two lawyers were elected, one to plead the cause of the people and one the cause of the accused grasshoppers. The former commenced by formulating the charge, and concluded by requesting that the grasshoppers be burned. The defendant's lawyer replied that such a request was illegal before the grasshoppers had been requested in due form to leave the country. When, however, they had not left the country after a stated term, they could be excommunicated. Many years afterward, another jurist, Hiob Ludolph, wrote a pamphlet antagonizing Chassaneus's work, setting forth the lamentable legal ignorance displayed by the latter. The accused grasshoppers, said Ludolph, must be summoned four times before the court, and if they do not appear, then they should be dragged by force before the court. Then only can the suit proceed. Other interested parties, however, shall be heard, namely, the birds that feed on the grasshoppers. Further, it would be a great injustice to banish the grasshoppers into adjacent territories. Finally, the code proposed by Chassaneus can never be brought into accordance with the laws and rules of the Church, because there is absolutely nothing in those laws about suits against grasshoppers.

Several suits against injurious insects were brought before the courts, and the rulings have been preserved. In one case (1479) a suit was brought against injurious worms, apparently cut-worms, in the canton of Berne, Switzerland. The worms, although ably defended, lost the suit, and were excommunicated by the archbishop and banished. Regarding the effect of this awful punishment, the chronicler who relates the story adds : "No effect whatever resulted, evidently on account of the great depravity of the people."

In various other law suits the chroniclers fail to mention the final outcome; but, says Hagen, it is safe to surmise that in the whole history of jurisprudence there was never a greater disregard for the rulings of the courts on the part of the guilty parties than during the time of the mediæval insect commissions.

To attempt to enumerate the different commissions which have been established, particularly by European countries, against particular outbreaks of injurious insects, and especially against locusts, which have entered Europe from the south and from the west at intervals for many hundreds of years, would be impossible, and even if possible, would extend this paper far beyond its proper length. I shall be obliged, therefore, to neglect this phase of the subject and confine myself rather to the history of the more prominent organizations of wider scope, and these I shall treat geographically and chronologically, beginning with our own country.

THE UNITED STATES.

MASSACHUSETTS. Dr. Thaddeus William Harris was probably the first American entomologist to receive public compensation for his labors, and in this sense he may be called the first of the official entomologists in this country. In 1831 he prepared a catalogue of insects, appended to Hitchcock's Massachusetts Geological Report. "In the condition of American science at that day," says Scudder, "it was a work of inestimable value, though his only material compensation was one copy of the report and several copies of the appendix." At a later period he was appointed by the State as one of a commission for a more thorough geological and botanical survey. In this capacity he prepared his now classic report on insects injurious to vegetation, first published in full in 1841, the portion upon beetles having appeared in 1838. He reprinted the work under the name "Treatise" instead of "Report" in 1842, and again, in revised form, in 1852. The whole sum received by him from the State for this labor was \$175. After his death the work was reprinted by the State in its present beautiful form, with wood engravings which themselves marked an epoch in that art. It is largely upon this work that Harris's scientific reputation will rest, and, although prepared more than half a century ago, it is to-day perhaps above all other works the *vade mecum* of the working entomologist who resides in the northeastern section of the country.

From 1852 to 1870 Massachusetts did little or nothing in economic entomology. In the latter year, however, Dr. A. S. Packard, jr., then of Salem, was appointed entomologist to the State Board of Agriculture—without compensation, however, as he informs me. Dr. Packard published three reports covering the years 1871, 1872 and 1873. They were short pamphlets, but were ably prepared, and were undoubtedly productive of very considerable good.

With the founding of the State Agricultural Experiment Station under the Hatch Act, Prof. C. H. Fernald, professor of zoology at the Massachusetts Agricultural College at Amherst, was appointed entomologist to the station. Prof. Fernald's work has been practically like that of most other station entomologists, and he has published several important bulletins. The ones for which there has been the greatest demand are No. 5 on household pests, which was the outgrowth of original studies which Prof. Fernald had made in this direction, and No. 12 containing the work upon the bud moth, spittle insects, and several other injurious species, all based upon original observation. The most important portion of his work has not yet been published. It comprehends the scientific results of his observations as entomological adviser to the gypsy moth committee of the State board of agriculture. That these results will prove of great value the writer is in full position to assert, as he has had the pleasure of seeing many of Prof. Fernald's experiments in the course of procedure, and has been greatly impressed by the ability and care with which they are being carried on. Prof. Fernald has also for some years held the position of entomologist to the State Board of Agriculture.

The work upon the gypsy moth, by the way, which has been done by the State of Massachusetts since 1889 is one of the most remarkable pieces of work, judging by results, which has yet been done in economic entomology. The operations have been carried on by a committee of the State Board of Agriculture and the means have been furnished by

large annual appropriations of thousands of dollars. The State has expended over 100 square miles of territory as to destruction, not only of the insects themselves, but of the property they have spread. It is undoubtedly true that the main credit is due to the State, but the districts in which the insects were most destructive were relatively rare specimens of sufficiently large areas. The work was carried on on it with appropriations that with sufficient Massachusetts methods of the small appropriation like that in force the committee would have done, they will be of the destruction which the insect has caused in the case of unproductive land. Between the two, however, there is a wide over the country will take its place. Some variations have become little more than European nature that the gypsy moth is a prime pest. The State has drawn to climatic draw. The gypsy moth has been sprayed with kerosene to burn the leaves. In the present, have found that it is worth 150 pounds to 150 gallons of European injurious insects. The fact that it is its forerunners. and well-directed in the extreme, it will or can ever be done. NEW YORK. entomologist. The State has expended in the course of procedure, during the course of procedure, of insects, especially suitable person. New York State Agricultural Society, held at the State Board of Agriculture. The work was passed: Resolved, That the State Board of Agriculture be furnished with such of the society; and that the State Board of Agriculture be instructed to prepare instructions for

large annual appropriations by the State legislature. Three hundred and twenty-five thousand dollars have already been appropriated. A territory comprising something over 100 square miles was infested by the insect, which occurred in such extraordinary numbers as to destroy many trees and almost to threaten the ultimate extinction of living vegetation, not only within the infested territory, but in all localities to which it might spread. It is unnecessary to detail the steps by which relief was brought about. Mistakes were undoubtedly made at first, and it is to the work of the present committee that the main credit is due. The infested territory has been reduced by one-half, and within the districts in which the gypsy moth at present exists it is, practically speaking, a comparatively rare species. The future of the insect is, however, problematical. The continuance of sufficiently large appropriations from the State legislature to enable the work to be carried on on its present scale is doubtful, yet those in charge believe that still larger appropriations are necessary to bring about extermination. They are confident, however, that with sufficient means the insect can be absolutely exterminated from the State of Massachusetts. With the legislature disinclined to continue the large appropriations, the methods of the committee at present pursued will have to be seriously altered. Given a small appropriation of say \$25,000 annually, it will become necessary to adopt some law, like that in force in California, whereby much less frequent inspection may be made, and the committee will have to rely in part upon voluntary observers for information. Moreover, they will be unable to conduct spraying operations upon a large scale, and the expense of the destruction of insects will have to be assessed upon the owners of the property upon which the insects are found, provided such owners will not themselves undertake the destruction of the insects. There will be many disadvantages from such a course, and in the case of unproductive lands the expense will be so great that the owner will prefer confiscation. Between some such course as this and the continuance of the present methods, however, there seems to be little choice, since if the appropriation were taken away the insect will not only speedily reach its former destructive height, but will spread far and wide over the country. It may be urged that it will be only a few years before the insect will take its place as a naturalized member of our fauna and will become subject to the same variations of increase and decrease as our native species, and that it will, in fact, become little more to be feared than species already existing with us, particularly if its European natural enemies are introduced. Against this view, however, it must be urged that the gypsy moth seems an exceptionally hardy species and that even in Europe it is a prime pest. The caterpillar is tough and rugged and seems little subject to disease and to climatic drawbacks and is wonderfully resistant to the action of ordinary insecticides. The gypsy moth larva will feed for days without apparent injury upon trees which have been sprayed with Paris green or London purple in a solution so strong as to somewhat burn the leaves. In fact, the committee, in the spraying which they are carrying on at present, have found it necessary to use arsenate of lead in as strong proportion as 10 pounds to 150 gallons of water. The well-known vitality of previously introduced European injurious insects is apparently increased to a striking degree with this species, while the fact that it feeds on nearly all plants renders it a much more serious pest than any of its forerunners. Under these circumstances, therefore, any course other than an energetic and well-directed effort to keep the insect within its present boundary will be shortsighted in the extreme, although it is very doubtful to my mind whether absolute extermination will or can ever be brought about.

NEW YORK. It is rather a stretch of the facts to classify Dr. Harris as an official entomologist. The first scientific man to receive a true official commission for the investigation of injurious insects was Dr. Asa Fitch, of New York. The New York State legislature, during the season of 1853-54, made an appropriation of \$1,000 for an examination of insects, especially of those injurious to vegetation, and authorized the appointment of a suitable person to perform the work. The matter was placed in the hands of the New York State Agricultural Society, and at a meeting of the executive committee of the society, held at the Astor House, in New York City, May 4, 1854, the following resolution was passed:

Resolved, That Asa Fitch, M.D., of Washington County, be appointed to perform the work; that he be furnished with such accommodations as he may desire in the rooms appointed for the laboratory in charge of the society; and that the president and Mr. Johnson, the corresponding secretary, be a committee to prepare instructions for such entomological examinations.

Mr. William Kelly, at that time president of the New York State Agricultural Society, and Mr. B. F. Johnson, its corresponding secretary, performed their duties in the preparation of these instructions in the most admirable manner. In fact, so well were they performed that we imagine Dr. Fitch himself may have drafted the report which was signed by these gentlemen. So far as we are aware, no subsequent appointment of an official entomologist has ever been accompanied by such a full, explicit, and able paper, and for this reason we quote it in full :

As our State has had a thorough examination made of all branches of its natural history except its insects, it is of the highest importance that the remaining branch—not less in importance than the others—should receive attention. The committee feel assured that in the selection of Dr. Fitch they have secured a person every way competent to discharge the duties imposed in a manner creditable to the society and the State.

In carrying out this examination it is desirable that equal prominence be given to economical as well as to scientific entomology, that being the part of this science which is specially important to the community at large. It has been objected to the volumes of the Natural History of the State that they are too purely scientific in their character to be of special value to the great mass of our citizens, and in the work now to be performed it is obvious that it will be of very little consequence to know that a particular kind of moth or fly is an inhabitant of this State unless we are also informed of its history and habits, and whether it is a depredator upon any substance which is of value to man. The habits and instincts of our insects are a proper subject of inquiry as much as their names and marks by which they are distinguished from each other. The whole history of every noxious species should at least be traced out as fully as circumstances will permit.

The examiner is therefore directed, in the first place, to make for the present season the insects which infest our fruit trees the leading object of examination. Those infesting our forest trees, our grain and other crops, our garden vegetables, our animals, etc., will remain to be studied hereafter. The examiner is desired in his examinations to search out every insect which is a depredator upon our apple, plum, pear, cherry, peach and other fruit trees, and study out all the facts in the history of each species, both in its larva and in its perfect state, as far as he shall have opportunity to do so. In this way a broad foundation will be laid, to which additions can be made which future observations may show to be necessary.

Should any important insect depredator appear the present season in any other situation than upon the fruit trees, the opportunity for studying it should not be neglected, for the same species may not appear again in many years under circumstances as favorable for becoming acquainted with its real history.

Secondly, what time is not necessarily occupied in examining the insects infesting our fruit trees should be devoted to collecting and classifying the insects of the State, and to naming and describing such species as have not been described.

A report to be prepared at the end of the season, to be submitted to the legislature, showing what has been accomplished during the season, to be divided into two parts. The first, upon economical entomology, giving an account of all that has been ascertained respecting the insects infesting our fruit trees, and any other injurious species that may have been obtained. The second, upon scientific entomology, giving a systematically arranged catalogue of all the insects of the State, so far as they are known, with a brief description of such new and undescribed as may be discovered.

The work should be pursued with a view of eventually securing to the State as full and complete accounts of all the insects of this State as far as to place this important science (which is at the present so greatly in the background, and so partially and imperfectly explored on this side of the Atlantic) in as perfect a position and as favorable a situation for being acquired as its nature will admit of. Should there be time, in addition to the above, to perform other labor, it is desired :

Thirdly, that a commencement should be made in writing out full descriptions of the species pertaining to some particular order, with observations upon the time of appearing, habits, etc., with a view of future publication, so as to secure a complete account of all the insects of the State pertaining to that order.

Lastly, suits of specimens to fully illustrate both the economical and scientific entomology of the State should be gathered in connection with the other parts of this work, to be placed in the Cabinet of Natural History; and in the Agricultural Museum specimens of the wood, leaves and fruits; and other substances depredated upon by each and every species of our noxious insects, showing the galls or other excrescences which they occasion, the holes or burrows which they excavate, the webs or other coverings for themselves which they construct, with preserved specimens of the worms, caterpillars, etc., by which each of these deformities is produced.

Such further examination as Dr. Fitch may deem necessary to carry out fully the objects desired to be accomplished, as from time to time may be deemed advisable, the committee desire may be made.

WILLIAM KELLY,
B. F. JOHNSON,
Committee.

Dr. Fitch, while not officially designated as State entomologist of New York, was always given this title by courtesy, and continued in office until 1871 or 1872, when his fourteenth report was published, and when the infirmities of age affected him to such an extent that he could no longer continue his investigations. The reports were published in the Transactions of the State Agricultural Society from 1854 to 1870, skipping the years 1859, 1865 and 1868. The first eleven have been published separately, as well as

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in the transactions of the society. In 1873, through an appropriation by the State legislature, provision was made for the revision and republication of the reports, and the revision was completed by Dr. Fitch. The resolution for printing, however, failed of the concurrence of the senate, and since that time the manuscript has been lost.

The value of Dr. Fitch's labors has been very great. In his fourteen reports the great majority of the injurious insects of the State of New York received more or less detailed consideration, and in the majority of cases the life histories of the insects treated were worked out with great care and detail. The remedial measures suggested by Dr. Fitch have, however, been largely improved upon, and the practical value of these reports to day rests almost entirely upon the life-history side.

From the time of the publication of Dr. Fitch's last report, in 1872, the State of New York did nothing for the encouragement of economic entomology until 1881, when the legislature, on April 14, passed an act to provide for the appointment of a state entomologist. The law reads as follows :

No. 316.]

SENATE OF NEW YORK,

In Senate, April 14, 1881.

Introduced by Mr. Fowler ; read twice and referred to the committee on finance ; reported favorably from said committee and committed to the committee of the whole.

AN ACT to provide for the appointment of a state entomologist and fixing his compensation.

The people of the State of New York, represented in Senate and Assembly do enact as follows :

SECTION 1. There shall be appointed, by the governor, a state entomologist, who shall be charged with the study of insects injurious to agriculture and of methods for controlling and preventing their depredations.

P. 2. The salary of the entomologist shall be two thousand dollars, and he shall render an annual report of his labors and investigations to the legislature and shall arrange for the state museum of natural history a collection of insects taken in the course of his investigations.

P. 3. This act shall take effect immediately.

(Senate No. 316).

(I. 520, G. O. 391).

(Chap. 377 of the Laws of 1881. Passed May 26, 1881, three-fifths being present.)

The movement which resulted in the passing of this law was started by the regents of the University of the State of New York at their annual meeting in 1877, and the person appointed to fill the office was Dr. J. A. Lintner, a well-known worker in entomology, who, up to that time, had been connected with the State Laboratory of Natural History. Dr. Lintner has held office continuously since 1881. He brought to bear upon his duties a ripe experience and a mind trained in scientific methods. He has published nine reports, the last one covering the year 1892, and only recently distributed. These reports are in many respects models. The great care and thoroughness of the author have hardly been equalled by any other writer upon economic entomology. The form of the reports is most admirable, and the account of each insect forms almost invariably a complete compendium of our knowledge concerning it down to the date of publication. His accounts are also arranged in the most convenient form for reference, a full bibliography precedes the consideration of each species, and the frequent subheadings enable the most practical use of the report. The reports are replete with sound and ingenious practical suggestions, and are written in a straightforward, simple style, which possesses great literary merit. They abound in illustrations, and are made available by most complete indices and tables of contents. Aside from these reports, Dr. Lintner has published a great deal in the newspapers, particularly the "Country Gentleman," on the subject of economic entomology, and another valuable feature of his reports is the comprehensive list which he publishes each year of his unofficial writings.

The Cornell University Agricultural Experiment Station was established by the authorities of the university in 1879, and its first annual report contained a series of miscellaneous entomological observations by the acting professor of entomology Dr. W. S. Barnard. The second report, issued in 1883, contained an elaborate monograph of the Diapsinæ by Prof. J. H. Comstock, and an important article on the Tineidæ infesting apple trees by Mr. A. E. Brunn, a student of the Department of Entomology. With the establishment

of the agricultural experiment stations under the Hatch bill, in 1888, this experiment station became governmental in its character, and Prof. Comstock was naturally made entomologist. Since that date he, or his assistants, have published a number of very important bulletins, the first one, on "A Sawfly Borer of Wheat," by Prof. Comstock; the second on Wireworms, by Prof. Comstock and his assistant, Mr. M. V. Slingerland, and the later ones mainly by Mr. Slingerland. These are among the best and most practical of the experiment station bulletins that we have. They are characterized by almost a superabundance of detail and plainly by great care. The illustrations are very nearly all original, and are excellent.

THE U. S. DEPARTMENT OF AGRICULTURE. Almost simultaneously with the appointment of Dr. Fitch to do entomological work for the State of New York, came the appointment of an entomological expert under the General Government. On June 14, 1854, Mr. Townsend Glover was appointed by the Commissioner of Patents to collect statistics and other information on seeds, fruits and insects in the United States, under the Bureau of Agriculture of the Patent Office. Mr. Glover was one of the most eccentric individuals who have ever done important work on North America insects. He had led a roving and eventful life as a boy in Brazil, as a clerk in a draper's shop in England, as an artist in Germany, as a roving traveller and naturalist in all parts of the United States, and finally as a landed proprietor with horticultural tastes on the banks of the Hudson in New York. Pomological interests brought him to Washington shortly before the time when he received his appointment. His first report was published in the Report of the Commissioner of Patents for 1854, was illustrated by six plates engraved on stone by the author and comprised some consideration of the insects injurious to the cotton plant, wheat, and the grapevine, and on the plum curculio, codling moth, and peach borer, closing with some account of the more common species of beneficial insects. His second report, in 1855, continued the consideration of the cotton insects, together with some accounts of orange insects. The reports for 1856 and 1857 contained nothing from him, but that for 1858 contains a rather full report on the insects frequenting orange trees in Florida, published over the initials D. J. B., which were those of the then chief clerk of the Bureau, with whom Mr. Glover had many serious disagreements, largely on the matter of credit, which resulted in his resignation the following year. In 1862 the Department of Agriculture was established as a separate institution, under the commissionership of the Hon. Isaac Newton, and in 1863 Mr. Glover was appointed entomologist to the Department. His annual reports follow consecutively from 1863 to 1877, and are storehouses of interesting and important facts which are too little used by the working entomologist of to-day. Their value for ready reference, however, is detracted from by a lack of systematic arrangement and poor paper and presswork, but many observations are to be found in the pages written by Glover which have subsequently been announced by others as original and important discoveries. There is, however, in Mr. Glover's reports, a lack of consecutive and full treatment of any one topic, and the subject of remedies seems seldom to have received original treatment or thought with him. This is largely due to the fact that his reports were matters of secondary importance to him, his main energies being devoted to the building up of a museum for the Department and to the preparation of his most elaborate series of illustrations of North American insects, a work upon which he expended enormous labor, and which unfortunately, up to the present time, has added to his fame nothing but the good opinion of a few of his scientific contemporaries.

In 1877 Mr. Glover's health suddenly failed him. His report for that year was largely prepared by his able assistant, Mr. Charles Richards Dodge, who, by the way, is the author of the charmingly written account of Mr. Glover's life, published as Bulletin 18 of the Division of Entomology of the Department of Agriculture. Mr. Glover lived for several years afterwards, but was unable to do further work. He died in Baltimore in 1883, and the writer and Profs. Uhler and Riley were the only entomologists present at the funeral services of this, in many respects, remarkable man.

The year 1878 marked a new era in the governmental entomological work. Prof. C. V. Riley, a comparatively young man, who had already become famous by the admirable work which he had done as entomologist of the State of Missouri, and as chief of the

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U. S. Entomological Commission, was that year appointed successor to Mr. Glover by the Hon. William G. Le Duc, then Commissioner of Agriculture. Prof. Riley took hold of his work with his accustomed vigor, and, during the nine months that he remained in office at that time, accomplished a great deal. His report for the year 1878, though short, is by far the most practical one which the Department had published up to that time. On account of a misunderstanding with the Commissioner, Prof. Riley resigned his commission in May, 1879, and Prof. J. H. Comstock, of Cornell University, was appointed in his stead. Prof. Comstock remained in office until May, 1881. He completed the investigation of the cotton worm, begun by Prof. Riley, and published a thoroughly practical and useful volume entitled "Report upon Cotton Insects," early in 1880. In addition to this report he published extensive annual reports covering the years 1879 and 1880, which rival in thoroughness and practicality the Missouri reports of Prof. Riley and those which were issued by the Department after his resignation. The report for 1880 is marked by the publication of the results of a preliminary investigation of the insects affecting the orange, and more especially by an elaborate report upon scale insects, which formed the basis of the study of this important and very destructive group of insects in this country. Upon the change of administration in 1881, Prof. Comstock was retired, with a year's commission as investigator, and Prof. Riley resumed charge of the governmental entomological work. From that time until June, 1894, Prof. Riley remained consecutively in office. The work which he has accomplished has been of the highest order, and has been largely instrumental in placing the science of economic entomology in this country upon its present sound footing. During the course of his administration of the office he has published 12 annual reports, 31 bulletins, 2 special reports, 6 volumes of the periodical bulletin "Insect Life," and a large number of circulars of information. He has developed not only the scientific side of the work, but also the practical side. Under his direction advances have been made both in insecticides and insecticide machinery, which are of the most far-reaching importance. The earlier work of Prof. Riley will be mentioned in another place, but it will be appropriate to state here that no other name in the annals of North American economic entomology stands out with the same prominence as his. His work has been called epoch making, and this expression may be considered justified. His voluntary resignation at this time would be greatly to be deplored, were it not for the fact that, with the restoration of his health, which is confidently to be anticipated, he will resume his labors—in another capacity, it is true, but along entomological lines and with undiminished vigor.

Aside from the work of the Division of Entomology, the General Government has, upon one occasion only, provided for work in economic entomology, as have so many other governments, by the appointment of a special commission. The U. S. Entomological Commission was founded, by authorization of an act of Congress approved March 3, 1877, specifically to report upon the depredations of the Rocky Mountain locust in the Western States and Territories and the best practical methods of preventing its recurrence, or guarding against its invasions. The commission was attached to the U. S. Geological and Geographical Survey of the Territories under the charge of Prof. F. V. Hayden, and the office of chief was filled by the appointment of Prof. O. V. Riley by the Hon. Carl Schurz, then Secretary of the Interior. The other members of the commission, also appointed by the honorable Secretary of the Interior, upon consultation with Prof. Riley, were Dr. A. S. Packard, jr., of Massachusetts, secretary, and Prof. Cyrus Thomas, of Illinois. The commission remained in existence, supported by annual appropriations by Congress of varying amounts, until 1881. It published 5 reports and 7 bulletins. The first two of the annual reports related to the Rocky Mountain locust and allied migratory locusts, and form together probably the most complete monograph of any one insect ever published. The practical end was kept constantly in view, and the reports are thoroughly practical, as well as thoroughly scientific. In the appropriations for the year 1879 the commission was instructed to report upon cotton insects, and the results of the investigation thus brought about are published in the fourth report of the commission on the cotton worm and boll worm—another elaborate volume which cannot be too highly praised from all standpoints. The third report treats of a variety of topics and includes two important monographs, one upon the army worm and the other upon canker worms, while the fifth

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report contains a full and comparatively exhaustive treatment of the subject of the insects injurious to forest and shade trees. The first, second and third reports are published under the joint authorship of the three commissioners, the fourth under the sole authorship of Prof. Riley, and the fifth under the sole authorship of Dr. Packard.

ILLINOIS. During the regular session of the legislature of Illinois, in the winter of 1866-'67, a law was passed enacting that a State entomologist shall, "by and with the consent of the senate, be appointed by the governor with a salary of \$2,000 per annum, for a period of two years, or until his successor is appointed and qualified." This legislation was the result of a petition from the State Horticultural Society, and on May 21, 1867, the society passed the following resolution:

That the president of the society be authorized to engage B. D. Walsh to immediately commence entomological investigations in relation to horticulture, and be empowered to pay out for that purpose a sum not exceeding \$500 from the legislative appropriation. This action is taken in case of failure to appoint.

At a special session of the legislature held in June, 1867, the governor sent in the name of Mr. Walsh for confirmation, but the senate postponed action upon it until the next regular biennial session in the winter of 1868-'69. Hence it follows that Mr. Walsh's first and only report was published as acting State entomologist, his untimely death occurring before his second report was prepared, its preparation having been delayed by a long period of ill-health which preceded the railway accident which was the immediate cause of his demise. Mr. Walsh was a retired farmer and lumber dealer of English university training, who for a number of years prior to his appointment had been industriously studying entomology and had written largely for the agricultural press upon the subject of injurious insects. Although not a naturalist by training, his work showed extraordinary powers of observation, and his published writings, as well as the statements of his contemporaries, indicate that he possessed a remarkable mind. In this connection, however, we have occasion to speak only of his official work as indicated in his one report. In this report, which is now unfortunately very rare, he treated particularly of the insects affecting the grape, the apple and the plum, and to this added, under the head of "Insects affecting garden crops generally," a chapter on the so-called "hateful grasshopper," or migratory locust, (*Caloptenus spretus*). His treatment of the other insects is very thorough and his work in a large part remains standard to-day.

Mr. Walsh's successor, Dr. William LeBaron, a practising physician of Geneva, Ill., well known for his writings on injurious insects in the agricultural journals of the time, and an able and conscientious entomologist, published four reports as appendices to the Transactions of the State Horticultural Society, from 1871 to 1874. The first three treated of miscellaneous insects, mainly those injurious to fruit and fruit-trees, while his fourth report, and part of his third, consisted of the beginnings of a work entitled Outlines of Entomology, of which he completed only the order Coleoptera. This portion however, was executed in the most scientific manner, and was fully illustrated, largely by original drawings by Prof. Riley. It has since been used to some extent in the class room, and has undoubtedly been the means of interesting many students in the subject of entomology. Dr. LeBaron's treatment of insects from the economic standpoint was careful and practical. He records in his first report the first successful experiment in the transportation of parasites of an injurious species from one locality to another, and in his second report recommended the use of Paris green against the canker-worm on apple trees, the legitimate outcome from which has been the extensive use of the same substance against the codling moth, which may safely be called one of the great discoveries in economic entomology of late years.

Dr. LeBaron died in harness, I believe, and was succeeded in office by the Rev. Cyrus Thomas, of Carbondale, who published a series of six reports, extending over the years 1875 to 1880. Mr. Thomas at the time of his appointment was a well-known entomologist, who had written extensively for the "Prairie Farmer" and other agricultural newspapers on the subject of economic entomology, and who had published an elaborate monograph of the Acridiidae of the United States as one of the special volumes of the Hayden survey of the Territories. He started with his first report, a manual

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of economic entomology for the State of Illinois, including in this report the portion relating to the Coleoptera. In his second report his assistant, Mr. G. H. French, treated of the Lepidoptera, and in his third report Mr. Thomas treated the Hemiptera, monographing the Aphididae. His fourth report included a consideration of one family of the Orthoptera, namely, the Acridiidae, and the fifth a paper on the larvae of Lepidoptera, by his assistant, Mr. D. W. Coquillett, while in his sixth he was obliged, from the force of circumstances to abandon the scheme. The manual of economic entomology of Illinois remains, therefore, unfinished. In the course of the six reports a very large number of insects are treated from the economic standpoint. Mr. Thomas was able to employ several excellent assistants, and the six reports as a whole are very creditable to the State. The last of the six reports shows rather plainly the falling off in Mr. Thomas's interests in the subject of entomology. Its publication was coincident with the close of the work of the U. S. Entomological Commission, and it consists entirely of reports by Mr. D. W. Coquillett and Prof. G. H. French. After its publication Mr. Thomas transferred his labors to the field of ethnology, in which he had long been interested, and he is at the present time one of the able workers in the U. S. Bureau of Ethnology.

Upon Mr. Thomas's withdrawal from office, Prof. S. A. Forbes, director of the State Laboratory of Natural History, at Normal, Illinois, was appointed State entomologist, his commission dating July 3, 1882. Prof. Forbes's attention had for some time been more or less engaged by questions relating to economic entomology. He has held office continuously since that time, and has published six reports, the first one covering the remainder of the year 1882, the second the year 1883, the third the year 1884, the fourth the years 1885 and 1886, the fifth the years 1887 and 1888, and the sixth the years 1889 and 1890. Prof. Forbes's reports are among the best which have been published. They are characterized by extreme care and by an originality of treatment which has seldom been equalled. The practical end is the one which he has kept mainly in view. His experiments with the arsenites against the codling moth and the plum curculio were the first careful scientific experiments in this direction which were made, and his investigations of the bacterial diseases of insects have placed him in the front rank of investigators in this line. His monographic treatment of the insects affecting the strawberry plant is a model of its kind, and the same may be said of his work upon the corn bill-bugs and of his studies of the chinch bug. In fact, whatever insect or group of insects has been the subject of his investigations, he has attacked the problem in a thoroughly original and eminently scientific and practical manner. Prof. Forbes has been able to command the services of a very able corps of assistants, including Messrs. C. M. Weed, H. Garman, F. M. Webster, John Marten, and C. A. Hart.

MISSOURI. In the session of 1867-'68 the legislature of Missouri passed an act establishing the office of State entomologist, and directed that the reports of this officer should be made to the State Board of Agriculture. The first and only appointee to this position was Prof. C. V. Riley, who had at that time become prominent as an entomologist through his writings in the "Prairie Farmer," of Chicago, with which paper he had been for some time connected, and through his editorship, in association with Mr. B. D. Walsh, of the "American Entomologist," of which one volume had then been published. He entered upon his duties April 1, 1868, and published his first annual report in December of that year. From that date there followed annually eight additional reports, the ninth being submitted March 14, 1877, and covering the year 1876.

There is no need of any comment upon these nine Missouri reports before any body of economic or scientific entomologists. They are monuments to the State of Missouri, and more especially to the man who wrote them. They are original, practical, and scientific; they cover a very great range of injurious insects, and practically all the species which were especially injurious during those nine years received full and careful treatment. They may be said to have formed the basis for the new economic entomology of the world, and they include a multitude of observations and intelligent deductions which have influenced scientific thought. The value to the agriculturist, as well as to the

scientific readers, was greatly enhanced by the remarkable series of illustrations which were drawn by the author and engraved upon wood by the most skilful wood engravers of that time. Aside from a few of the illustrations to the Flint edition of Harris, they are the best woodcuts ever made of insects in this country, and as a whole the drawing far excels that of the Harris illustrations in its lifelike accuracy, artistic beauty, and closeness of detail. Prof. Riley abandoned his Missouri work on taking up the directorship of the U. S. Entomological Commission, and in pursuance of a shortsighted policy Missouri has never since had a State entomologist.

OTHER STATES AND THE HATCH STATE AGRICULTURAL EXPERIMENT STATIONS. Massachusetts, New York, Illinois, and Missouri are the only States which may be said to have supported official economic entomologists. There are letters on file in the Division, dated in 1880, from Mr. J. T. Humphreys, who announces himself in his letter head as "Late naturalist and entomologist to the Georgia Department of Agriculture;" but although I have made something of an effort to learn the details of Mr. Humphreys's employment, I have so far been unsuccessful. The State of Pennsylvania has for some years handled its economic entomology by means of an officer who holds an honorary commission from the State Board of Agriculture. This commission was held for some years prior to his death by Dr. S. S. Rathvon. At the present time Dr. Henry Skinner, of Philadelphia, and Dr. R. C. Scheidt, of Lancaster, are entomologists to the State Board.

In the spring of 1888, the State Agricultural Experiment Stations, founded under the Hatch Act, were organized. A number of entomologists were soon appointed and active work began practically in the month of February. This movement, the importance of which to American economic entomology can hardly be overestimated, is too recent to require full treatment here.

The first entomological bulletin published by any of the experiment stations was issued in April, 1888, from the Arkansas station by Mr. S. H. Crossman, and was entitled *The Peach-tree Borer and the Codling Moth*. Bulletins from Hulst, in New Jersey; Morse, in California; Tracy, in Mississippi; Ashmead, in Florida, and Weed, in Ohio, followed in May. Popenoe in Kansas, and Perkins in Vermont, published one each in June, and Fernald, in Massachusetts, and Luggar, in Minnesota, one each in July.

Through the kindness of Mr. A. C. True, director of the Office of Experiment Stations of the U. S. Department of Agriculture, I am in possession of a bibliographical list of the entomological publications of the agricultural experiment stations down to the present month. This was drawn up by Mr. F. C. Test, of Mr. True's office, and will be published as an appendix to this address. An analysis of its contents shows that 42 States and Territories have employed persons to do entomological work, and that the number of experiment station workers who have published entomological bulletins or reports reaches 77. Not half of these writers, however, have been officially designated as entomologists to the station. Of those so designated there are 28; 8 have held the title botanist and entomologist; 6, consulting entomologist; 4, assistant entomologist; 4, horticulturist and entomologist; 1, special entomologist; 1, entomologist and physiologist; 2, entomologist and zoologist; 1, entomologist and superintendent of farms; 1, director, entomologist, and botanist; 1, vice-director, horticulturist, entomologist, and mycologist; 1, special agent; 1, apiarist; 2, biologist. The other writers bear titles which indicate that they are not specialists in entomology. They are as follows: Agriculturist, 1; assistant agriculturist, 1; horticulturist and agriculturist, 1; horticulturist, 3; assistant horticulturist, 1; botanist and mycologist, 1; director, 2; botanist, 2; superintendent of grounds, 1; pomologist, 1; specialist, 1; veterinarian, 1; clerk and librarian, 1.

The entomological publications of these experiment stations have numbered 311, of which 88 have been annual reports, 213 bulletins, and 10 leaflets and circulars. In character the bulletins and such reports as have definite titles may be thrown into three categories: 1, those which treat only of insecticides and insecticide machinery, 40; 2, those which contain compiled accounts of insects, with measures for their destruction, 60; 3, those which contain the results of more or less sound original observation, with compiled matter and matter upon remedies 117. There are also two small classes: 1, apiculture, 6; and 2, classificatory, 4.

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It would be a matter of very considerable interest if I were able at this time to give a more critical summary of the results achieved by our experiment station workers in entomology. The little analysis which precedes shows a gratifying preponderance of bulletins and reports which contain results of original work; and yet at the same time we must remember that while these papers advance our knowledge of entomological science, the compilations may frequently accomplish greater practical good. This point is illustrated by a statement which I have from Prof. Garman, of the Kentucky station. He says that Bulletin No. 40 of his station, containing condensed accounts of some of the commoner and more injurious insects of the farm and garden, is the one for which there has been the greatest demand. The original edition of 12,000 was soon exhausted, and another lot has since been printed. The bulletin was prepared by request, and naturally is not the sort of work which our station entomologists prefer to do. "Its success," writes Prof. Garman, "has been a lesson to me as to what farmers want and will use."

It occurred to me that it might be valuable to have a statement from each of the experiment station entomologists as to the piece of work he had done which seemed to have accomplished the most practical good, in the light of his own accurate information concerning the farming population of his State. I therefore addressed letters to nearly all of the station workers in entomology, but have received replies from only about half of them, so that a statement of this kind would hardly be justified. It is interesting to note, however, that experiment station workers place in very high esteem the results of their correspondence with farmers and of their lectures before farmers institutes and other bodies. It is in these two ways that the popular sentiment among agriculturists as to the importance of economic entomology is being much more rapidly spread than, perhaps, by the publication of bulletins upon injurious insects.

CANADA.

The Rev. C. J. S. Bethune, for many years one of the most prominent writers on entomology in Canada, and a well-known contributor to the columns of the *Canadian Farmer* on the subject of agricultural entomology, was largely responsible for the organization of the Entomological Society of Ontario, and for the first appropriation of money made to that society with a view to the development of economic entomology among our neighbors across the border. The council of the Agriculture and Arts Association of Ontario in 1869 voted a grant of \$400 to the Entomological Society of Ontario for the year 1870, on condition that the Entomological Society should furnish an annual report, should found a cabinet of insects, useful or prejudicial to agriculture and horticulture, to be placed at the disposal of the council, and that it should also continue to publish the *Canadian Entomologist*. This was the origin of the first annual report of the Ontario society, which was published in 1871 by the Agricultural and Arts Association. This association also gave the society \$100 additional, and the Fruit-Growers' Association of Ontario \$50 additional, to be used for the purpose of illustrating the report. During the session of the Legislature of the Province of Ontario in 1870-71 the Agriculture and Arts Act was passed. By this Act the Entomological Society of Ontario was incorporated, and a grant of \$500 per annum was made to it from the Provincial Treasury. In 1872 the Legislature made an extra grant of \$200 for the purchase of woodcuts, etc., making the total appropriation \$700. In 1873 an extra grant of \$500 was made, and the annual grant for 1874 was increased to \$750. In 1875 the grant was \$750, plus \$100 for illustrations; in 1876 \$750, plus \$500 towards the expense of an exhibit at the Centennial Exhibition at Philadelphia; in 1877, 1878, and 1879 it was \$750 per annum, and in 1880 the grant was increased to \$1,000, at which sum it has continued since that date. The Government also pays the expense of printing the annual report.

The society has conscientiously complied with the conditions of the grant. Its reports, published annually, have greatly increased in size and in the general interest of their contents. They have contained much matter of economic value as well as of educational interest.

In 1884 the Department of Agriculture of Canada established the office of honorary entomologist, and this office was filled by the appointment of Mr. James Fletcher, at that time an employee of the Government Library at Ottawa, and already widely known in entomological circles through his active interest in the Ontario society and his contributions to its publications. On July 1, 1887, Mr. Fletcher was transferred to the staff of the Dominion Experimental Farm at Ottawa as entomologist and botanist. Mr. Fletcher's footing since that date has been practically identical with that of an entomologist to one of our State experiment stations, except that his field is larger. He has published a report yearly in the Annual Report of the Experimental Farms, published as an appendix to the report of the Minister of Agriculture. Mr. Fletcher has shown himself to be a man of extraordinary energy, a most entertaining writer, and a most careful observer, and one who has always kept the practical part of his work foremost in view. He has paid a great deal of attention to a side of his work which is neglected by many of our own official entomologists, namely, personal intercourse with farmers, frequent talks on injurious insects at farmers' institutes, etc., and has in this way built up a very large clientele among the most intelligent agriculturists in the Dominion. In economic entomology Canada at the present day is perhaps in no way behind the United States, and this is largely due to Mr. Fletcher's individual efforts, aided and encouraged as they are by the warm support of the eminent director of the experimental farm system, Mr. William Saunders, himself a pioneer in economic entomology in Canada and the author of one of the most valuable treatises upon the subject that has ever been published in America. Canada has the man and the knowledge, but has been hampered by want of funds. The result is that while she has immediately and intelligently adopted the results of researches made in this country, she has not been able to lead us in original investigation.

EUROPEAN COUNTRIES.

In general it may be said that Europe has not felt the need of entomological investigation from the economic standpoint to anything like the same extent as the United States. A climate much less favorable to the undue multiplication of injurious insects than that of North America, and which, moreover, seems to act as a barrier against the importation of foreign destructive species, the actually smaller number of injurious species and the vastly greater familiarity with all phases of the life-history of these species by all classes of the people, partly resulting from the older civilization, partly from educational methods, and partly from the abundance of elementary and popular literature on questions of this character, the denser population, and the resulting vastly smaller holdings in farms, the necessarily greatly diversified crops, the frequent rotation of crops, together with the clean and close cultivation necessitated by the small size of the holdings, and the cheaper and more abundant labor, have all resulted in a very different state of affairs regarding the damage which may be done by injurious insects. In summarizing these points, the Chief of the Agricultural Section of the Ministry of Agriculture of Prussia, in conversation with the writer last summer, argued that Germany does not need to employ general economic entomologists; that its experiment stations seldom receive applications for advice on entomological topics. Special insects, it is true, occasionally spring into prominence; the Phylloxera is one of these, and in an emergency like the Phylloxera outbreak, the work is handled by special commissions. European nations, therefore, can afford to let the insect problem alone to a much greater extent than the United States, for the reason that it is of infinitely less importance with them than with us. The most simple remedies, such as hand-picking, together with a rigid enforcement of the public regulations regarding hand destruction, usually suffice to keep injurious insects in check. Nevertheless, insect outbreaks do occasionally occur, and there is a certain percentage of loss every year from the work of injurious species. The results obtained in the United States, where the number of native injurious species is much greater than in Europe, and where we have in addition to deal with a host of imported species—in short, where the fighting of insect foes has become an absolute necessity—have, however, acted to a certain degree as incentives, not only to other countries which

labor under the degree to Europe competent persons worth while.*

There is no work in economic entomology in the Colonies. Reports upon insects are published, a series of reports on injurious plants, trees, and crops. In 1881 reports upon insects are published, and in 1889 there is a technical report on insects on crops, but also reports on insects on special bulletin form. Mr. Fletcher's work cost him £250 only. Reports issued have been on Caterpillar Blossom Weevil, Mite, 1893; and

While Mr. Fletcher's cultural entomology and practical work in his official capacity from 1876 to 1887 at the Royal Agricultural College, on his own expense a very largely to among the farmers and has encouraged receptive to a perseverance with English crop entomology and has made a wood, and has successful in crop entomology has accomplish the hands of England.

Aside from the Manual of Injurious Insects, treating of the insects of the last two be-

* We regret to have to state that we have not been able to obtain a copy of the work mentioned.

labor under the same climatic disadvantages as the United States, but even to a certain degree to European countries, where more thorough investigation of injurious insects by competent persons especially appointed for the purpose is gradually becoming thought worth while.*

GREAT BRITAIN.

There is not and never has been in Great Britain a special government appropriation for work in economic entomology. In 1885 Mr. Charles Whitehead suggested to the lords of the Committee of Council for Agriculture, that it would be valuable to publish reports upon insects injurious to various farm crops. He prepared, and the council published, a series of four reports upon insects injurious to the hop plant, corn and leguminous plants, to turnips, cabbage and other cultivated cruciferous plants, and to fruit crops. In 1886 Mr. Whitehead was appointed agricultural adviser and prepared a report upon insects and fungi injurious to crops of the farm, orchard and garden for 1887-88, and in 1889 the Board of Agriculture was formed, and Mr. Whitehead was retained as technical adviser, especially with reference to insects and fungi injurious to crops, but also with reference to other agricultural questions. He prepared annual reports on insects and fungi for 1889, 1891 and 1892, and a number of leaflets and special bulletins on insects unusually prevalent from 1889 down to the present time. I learn from Mr. Whitehead, that there is no specific law authorizing this expenditure; that his work has been continuous since 1887, and that he has received an annual sum of £250 only. The more important of the special bulletins and leaflets which have been issued have been: Special Report on an attack of the Diamond back Moth Caterpillar, 1892; Caterpillars on Fruit Trees; Hessian Fly; Moths on Fruit Trees, 1890; Apple Blossom Weevil, Raspberry Moth and the Mangel Wurzel Fly, 1892; Black Currant Mite, 1893; and the Red Spider and Apple Sucker, 1894.

While Mr. Whitehead has, therefore, been the only governmental worker in agricultural entomology, a very considerable work has been done in a semi-official way by an untiring and public-spirited woman, Miss Eleanor A. Ormerod, who is, or rather was, in her official capacity, honorary consulting entomologist to the Royal Agricultural Society. From 1876 to 1893 Miss Ormerod held this position; conducted the correspondence of the Royal Agricultural Society on the subject of injurious insects, and published at her own expense a series of annual reports, seventeen in number, which have contributed very largely to the diffusion of knowledge concerning injurious insects in Great Britain among the farming classes. She has had a most conservative class of people to deal with, and has encountered many obstacles. She has shown herself ingenious, careful and receptive to a degree, and at the same time possessed of an enthusiasm and an unlimited perseverance which are calculated to overcome all obstacles. She has studied many of the English crop enemies *de novo*; she has popularized the work of other English entomologists, and has made accessible to the agricultural class the work of John Curtis and Prof. Westwood, and has adopted, and strongly advocated the adoption of, measures found to be successful in other countries, particularly in America. The good which Miss Ormerod has accomplished can hardly be estimated at the present time, but she will deserve, at the hands of posterity, canonization as the patron saint of economic entomology in England.

Aside from her annual reports, Miss Ormerod has published a large work entitled, *Manual of Injurious Insects and Methods of Prevention*, and numerous smaller works, treating of the Hessian fly, sugar cane insects and the injurious insects of South Africa, the last two being devoted to the agricultural interests of the English colonies.

* We regret that our space will not permit us to publish the whole of Mr. Howard's address. We are reluctantly compelled to omit his account of the work in foreign countries.—Ed.

Within the year the Royal Agricultural Society has made the office of consulting entomologist, or rather zoologist—for they have broadened the term—a salaried one, and Mr. Cecil Warburton, an able student of zoology, although not known as an entomologist, has been appointed to the position. Mr. Warburton has published one report, which is mainly compiled and devoted to extracts from the correspondence of the society, but it is too early as yet to judge of his capabilities from our standpoint.

Miss Ormerod's legitimate predecessor may be said to have been John Curtis, who, from the beginning of Dr. Lindley's *Gardener's Chronicle* contributed an important series of essays upon injurious insects to its columns, under the *nom de plume* "Ruricola." Mr. Curtis's connection with this famous agricultural journal was of great advantage to him, as it enabled him to secure information and specimens from all parts of the kingdom. He had also accumulated a large amount of information during the twenty years he was engaged in writing his great work upon British entomology. When the Royal Agricultural Society of England was founded, in 1840, the council of the Society invited Mr. Curtis to prepare a series of reports upon the insects affecting various crops cultivated in Great Britain and Ireland, and in the *Journal of the Royal Agricultural Society* for the years 1841 to 1857, he published a series of sixteen such reports. The matter of these reports, and also of his previously published *Gardener's Chronicle* articles, was drawn upon largely for, and in fact forms the major portion of, his standard work upon *Farm Insects*, published by Blackie & Sons, London, Glasgow and Edinburgh, in 1860. Whether Curtis was remunerated for his work for the Royal Agricultural Society or not I am unable at this time to state, although he probably received some compensation. I learn, through the kindness of Miss Ormerod, that, chiefly on account of the value of his writings upon economic entomology, Mr. Curtis was awarded a pension from the civil list, which was augmented about three years before his death, on account of the sad loss of sight which he experienced.

In 1877 a strong effort was made to secure the appointment of a Government entomologist. A conference was held at the Society of Arts, which was largely attended and was presided over by the Duke of Buccleugh, K.G. The most important paper read was by Mr. Andrew Murray, and after a long discussion the conference resolved:

That much of the loss occasioned by insects is preventable and ought to be prevented; that it properly belongs to government to provide the necessary means for protecting cultivators from this loss, as it is only by simultaneous action over considerable districts that it can be effectually done, and government alone possesses or can obtain the requisite means of indorsing such action; that the president and lords of the Council and the Agricultural Societies of the United Kingdom be informed of the opinion of this conference and urged to take the subject at once into their consideration, with a view to providing a remedy.

While we have no doubt that this conference was of sufficient importance and attracted enough attention to induce the president, lords, etc., to take the subject into consideration, no further action resulted.

IRELAND.

Mr. George H. Carpenter was appointed in 1890 consulting entomologist to the Royal Dublin Society, and has submitted four reports, entitled, Report on Economic Entomology for the year 1890, and the same for 1891, 1892 and 1893. Reprints of these reports from the Reports of the Council of the Royal Dublin Society have been distributed. Mr. Carpenter is assistant naturalist in the Science and Art Museum in Dublin, and I am not informed as to whether he receives special compensation for his work as consulting entomologist.

INDIA.

Among the English colonies the government of India stands out very prominently in the support which it has given to economic entomology. A most interesting account of the beginning and growth of this work has been transmitted to me by Mr. E. O. Cotes, from which I take, for the purposes of this paper, the following facts:

The present arrangement was the outgrowth of two reports, one on the wheat and rice weevil and the other on insecticides, which were drawn up unofficially in the early

part of the year of India, in the charge of the published by two numbers this serial was Museum consists. The work real agricultural provincial government of land record took to arranging agriculture in on such investments aided by a state were sent out soon began to lated among a cation of specimens in different parts ascertaining cases, which affect them, and the cases. Infor nature of their ments have be of the world numbers of them and a number India, and on sheets for use gation of the for the support special grant India. This fund which is the institution one of which quarters as a importance is made in influence and making it Department and his assistance upon entomology

The Agricultural Cape Colony, the last four of vine Phylloxera necessity for of the matter was ever appointed made certain in ing entomology lication of Miss

part of the year 1888 by Mr. Cotes, at the suggestion of the secretary to the government of India, in the Revenue and Agricultural Department. Mr. Cotes was at that time in charge of the entomological collections of the Indian Museum, and the reports were published by the government, with the consent of the trustees of the Museum, as the first two numbers of an official series entitled Notes on Economic Entomology. The title of this serial was subsequently changed to Indian Museum notes, when the trustees of the Museum consented to charge themselves officially with the conduct of the investigation. The work really commenced in March, 1888, when Mr. Cotes was deputed to attend an agricultural conference at Delhi, where the part to be taken in the scheme by the various provincial governments was discussed. As a result of this conference the departments of land records and agriculture, attached to the various provincial governments, undertook to arrange for the submittal of reports and specimens from officials concerned with agriculture in all parts of India. The task of collating the results, and also of carrying on such investigations as could be conducted at headquarters, was intrusted to Mr. Cotes, aided by a staff of six office assistants, whom he was permitted to select. Circular letters were sent out to all parts of the country, and large numbers of reports and specimens soon began to come in. The results were published from time to time and freely circulated among all interested. One of the greatest of the early difficulties was the identification of species, but this was accomplished mainly through correspondence with specialists in different parts of the world. The results of six years of work are, in brief: The ascertaining of the identity of several hundred of the more important injurious species which affect crops in India. The recording of the nature of the damage occasioned by them, and the tracing out of the main facts in the life histories in a large number of cases. Information has been continuously supplied to officials and planters as to the nature of their insect pests and the most promising methods of treatment. Many experiments have been tried with a view to the adaptation of insecticides in use in other parts of the world to the requirements of special crops under cultivation in India. Fourteen numbers of the Indian Museum Notes, comprised in three volumes, have been published, and a number of special reports have also been sent out; one on the locust of northwest India, and one entitled Handbook of the Silk Insects of India. Two preliminary lesson sheets for use in native schools have also been prepared by the office. A thorough investigation of the insects affecting the tea plant is now in progress. The funds appropriated for the support of entomological investigation have varied from year to year; the only special grant for the purpose is one of 5,000 rupees per annum from the government of India. This is paid to the account of the Indian Museum, and forms a part of a general fund which is distributed at the discretion of the trustees, partly for the maintenance of the institution and partly for the support of the work carried on in various departments, one of which includes economic entomology. The work was at first looked upon in many quarters as a matter of comparative insignificance, but Mr. Cotes informs me that its importance is now very generally recognized, and that strong representations are being made in influential quarters, urging the desirability of extending the scope of the work, and making it, like other branches of research, an integral portion of the Agricultural Department of the government. The work which has so far been done by Mr. Cotes and his assistants has been admirable, and we know of no more interesting publication upon entomology than the Indian Museum Notes.

SOUTH AFRICA.

The *Agricultural Journal*, the official organ of the Department of Agriculture of Cape Colony, has been paying a great deal of attention to economic entomology during the last four or five years. The so-called Australian bug (*Icerya purchasi*), the grapevine Phylloxera, and the injurious locusts seemed to have roused the colonists to the necessity for more or less investigation, and the Agricultural Department has taken hold of the matter with some little energy. No distinctively official entomologist, however, was ever appointed. Privately Mr. S. D. Bairstow and one or two other colonists have made certain investigations, and their correspondence with Miss Ormerod, honorary consulting entomologist to the Royal Agricultural Society of Great Britain, resulted in the publication of Miss Ormerod's little book, entitled Notes and Descriptions of a Few Injurious

Farm and Fruit Insects of South Africa, with Descriptions and Identifications of the Insects by Oliver E. Jansen. Prior to the publication of this work Miss Ormerod published a leaflet entitled Observations on the Australian Bug, treating the insect from the South African standpoint. For several years, from 1889 to 1893, Mr. Louis Peringuey, an officer of the South African Museum at Cape Town, was employed as entomological adviser to the Department of Agriculture, and drew £100 per annum for his services. His duties in the Museum, however, did not permit him to devote anything like his entire time to entomological work, and in his advisory functions he chiefly answered questions as to the names of insects and the best remedies for insect pests. Acting upon his advice, the government attempted to stamp out the phylloxera by means of the bisulphide of carbon treatment, but without success, and he resigned his office in 1893. Since that time, and in fact for some time previously, the director of the Botanic Garden at Cape Town, Prof. P. MacOwan, a man of very wide information, although not a trained entomologist, has answered entomological questions for the government. His communications, most of them subsequently published in the *Agricultural Journal*, show him to be a clear-headed, practical man, and it is a pity for the interests of the colony that he is too much interested in his garden and botanical work to take up economic entomology as a study. Mr. MacOwan modestly writes, under date of April 11, 1894:

Unfortunately, I have been in the habit of reading everything that comes in the way and indexing it, so that really they consult my indexes. It is only thus, in the rough, practical way that a garden director, in a dozen years, gets some acquaintance with injurious and beneficial insects that I have answered questions of economic entomology. I only know what I have seen and fought against in the Botanic Garden, and anybody is welcome to such experience. . . . I only wish we could get some such man as seems to be raised easily in the States to do practical science work in the love of it.

AUSTRALIA.

The Australian colonies of Victoria, New South Wales, Queensland, South Australia and Tasmania have all interested themselves to a very considerable extent in the subject of economic entomology. With an energy and receptivity to new ideas akin to our own, their agricultural societies and departments of agriculture have not been content to allow injurious insects full sway, but all have, in one form or another, made efforts to remedy the damage.

TASMANIA. The earliest attempts were made in Tasmania nearly twenty years ago, when the Codling-Moth Act was introduced in the legislative assembly. The provisions of this Act were quite as wisely drawn as those of any subsequent injurious-insect legislation. It was not until 1891, however, that a definite council of agriculture was established by this colony, and not until 1892 that an official entomologist was appointed. In February, 1892, Rev. Edward H. Thompson, a clergyman of the Church of England and a naturalist of very considerable attainments, who had made himself prominent in this connection by his writings for the local press, was appointed entomologist and pathologist to the Council of Agriculture. Authority for the appointment was given in section 13, clause 1, of the Council of Agriculture Act, and reads as follows:

3. To employ from time to time, with the approval of the governor in council, persons competent to give instructions of a practical character in matters pertaining to agricultural and horticultural science, and to arrange for occasional lectures on subjects of interest to cultivators of the soil.

Mr. Thompson's annual compensation was fixed at £300, which in 1894 was reduced to £270, in pursuance of a policy of general retrenchment. The entomologist has charge of no funds for expenses, and up to the present time has been allowed no assistants. Very considerable interest has been aroused, however, in the subject of economic entomology. Mr. Thompson has lectured upon insect pests throughout the colony, and during 1893 received nearly 1,500 letters of inquiry. A little volume of 100 pages, entitled Handbook to the Insect Pests of the Farm and Orchard; their Life History and Methods of Prevention, Part I., has been published, and will be followed by others in the same line, provided the appropriations continue.

NEW SOUTH WALES In New South Wales there was started in 1890 an important publication under the Bureau of Mines and Agriculture, entitled *The Agricultural Gazette* of New South Wales. To this periodical Mr. A. Silney Olliff, entomologist to the

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Australian Museum at Sydney, has contributed many important articles on entomological subjects, which have resulted from his appointment to the charge of the entomological branch of the Department of Mines and Agriculture. Whether Mr. Olliff receives a separate compensation for his work in this direction from the Department, aside from his salary as an officer of the Museum, I have been unable to learn. The prominence given to entomological matters in the *Gazette*, however, is an indication of the live interest taken in the subject. In a series of entomological bulletins, begun in 1892, Mr. Olliff's name appears on the title page as "Government Entomologist, New South Wales." Another able entomologist is employed in the Technological Museum at Sydney, in the person of Mr. W. W. Froggatt, who has, under the "Technical Education Series" of leaflets, published at least one important paper bearing upon economic entomology, which has reference to the damage done to boots and shoes by *Anobium (Sitodrepa) paniceum*.

QUEENSLAND. In Queensland there is at the present time no official entomologist, although one of the best bits of printed matter relating to economic entomology which has been issued by any of the Australian colonies emanated from the Queensland Department of Agriculture. In 1889 there was published a report on insects and fungus diseases by Henry Tryon, who held, and probably still holds, the position of assistant curator of the Queensland Museum at Brisbane. This is a thoroughly practical and very able report, covering some 250 pages, and contains a great amount of important information. The report is designated as No. 1 upon this subject, but No. 2 has, unfortunately, not yet been published. The occasional bulletins issued by the Queensland Department of Agriculture, giving an account of the agricultural conferences held in different districts of the colony, show a very live interest in the warfare against insects, and this has been particularly the case since Prof. E. M. Shelton, an Englishman by birth, but since his early boyhood a resident of America, and long engaged in agricultural teaching and experimental work here, was employed by the Queensland government as instructor in agriculture in 1890. The Department has begun the publication of a series of bulletins giving the results of recent experiments made at the American agricultural experiment stations, edited by Prof. Shelton, in which late entomological information is given.

SOUTH AUSTRALIA. The first work on injurious insects in South Australia was done by Mr. Frazer S. Crawford, a practical man of wide reading, who interested himself for some years before his lamented death in the study of insects and fungus pests. He read an important paper, under the title of "Insects and fungus pests," before the first congress of agricultural bureaus of South Australia in March, 1890, illustrating the paper by careful drawings done and engraved by himself. It is likely that, had Mr. Crawford lived, he would have been appointed official entomologist to the colony of South Australia. Since his death, however, a vivid interest in the subject has been kept up, largely through the interest shown in the matter by *Garden and Field*, an important agricultural newspaper published at Adelaide, the editor of which, Mr. W. C. Grasby, has visited this country, and is very appreciative of the work which has been done in the United States. The government viticultural expert, Prof. A. J. Perkins, is also a man of some entomological knowledge, although his researches have mainly been connected with the subject of insects injurious to the vine.

VICTORIA. In August, 1890, a conference was held at Melbourne, Victoria, with representatives from the board of viticulture, the council of agricultural education, the different horticultural societies, and wine and fruit growers' associations, for the purpose of considering means for the suppression of insect pests injurious to vegetation; and partly as a result of this conference and further agitation, Mr. Charles French was, in 1891, appointed entomologist to the government of Victoria, under the Department of Agriculture of the Colony. Mr. French's work is largely included in the two parts of an important handbook of the Destructive Insects of Victoria, the first part published in 1891 and the second in 1893. These reports are written in a popular style, and much attention is given to means of destruction. Their distinguishing feature, however, consists in their illustrations, which are colored, and many of which are very lifelike.

THE BRITISH WEST INDIES.

Injurious insects in the British West Indies have only recently received official or semiofficial attention, with the single exception that in the year 1801 a special commission composed of members of the general assembly of the Bahamas was appointed to investigate the damage done to the cotton crop by the red bug (*Dysdercus*, probably *suturellus*) and the chenille (*Aletia xyliana*). Within the past two or three years, however, several of the islands have taken up the subject, with or without governmental support, and there is now a rapidly increasing spirit of investigation.

JAMAICA. In the appointment of Mr. T. D. A. Cockerell, a well-known entomologist, to the office of curator of the Institute of Jamaica, at Kingston, it was specially desired that the appointee should conduct investigations in economic entomology and answer all correspondence in this direction which might come in from planters. Upon taking charge of his new office, in June, 1891, Mr. Cockerell was immediately struck by the extraordinary abundance of scale insects in Jamaica, and their importance as enemies to many cultivated plants. With his accustomed energy he at once undertook the study of these insects, and has since published many papers about them, which have been contributions to knowledge. He started an interesting series of stylographic notes, mainly about injurious insects, disseminated much information on this subject among the planters, and fostered an interest in the study which it is to be hoped will not die out. He was succeeded in office in June, 1893, by Mr. C. H. Tyler Townsend, formerly an assistant in the Division of Entomology, U. S. Department of Agriculture, and entomologist to the State Agricultural Experiment Station of New Mexico, who, during the short time of his residence in Jamaica, followed in the lines laid down by Mr. Cockerell, and published a number of very interesting notes, both in the journal of the Institute and in the stylographic series of notes, which he continued. Mr. Townsend resigned in May of the present year, and we have not heard that his successor has been appointed.

LEEWARD ISLANDS. Although no officially designated entomologist is employed by the Leeward Islands, Mr. C. A. Barber, superintendent of agriculture for these islands, is a well-informed man, a trained botanist, and fully alive to the importance of entomological work. He has conducted some important investigations on the sugar-cane shot-borer and other sugar-cane insects, which have been published in the *Leeward Islands Gazette*.

TRINIDAD. No official recognition of economic entomology has yet been reached in this island, but a very active organization, known as the Trinidad Field Naturalists' Club, has been established, which is well worth mention in this connection, since its president, Mr. H. Caracciolo, and its secretary, Mr. F. W. Urich, have interested themselves especially in the subject of economic entomology and are laboring to interest the government. His Excellency the Governor occasionally attends the meetings of the club, and by the institution of prizes for essays and by similar means, a widespread interest in economic entomology is being aroused. The appointment of an official entomologist is probably a matter of only a short time. *The Journal of the Field Naturalists' Club* is an interesting periodical, full of entomological information, and is now in its second volume.

NEW ZEALAND.

New Zealanders have for some time been fully alive to the importance of the study of economic entomology. They have passed laws concerning the destruction of the codling moth and have made an effort to establish quarantine regulations against the introduction of infested substances from abroad. No governmental entomologist has been appointed, although the Department of Forestry and Agriculture published, in 1887, a monograph of the Coccidæ, by Mr. W. M. Maskell, registrar of the University of New Zealand, the title page of which reads: "An Account of the Insects Noxious to Agriculture and Plants in New Zealand." A second part of this account was promised in an introductory note, but has not appeared. Mr. Maskell has also written upon injurious insects in some of the New Zealand newspapers. Much credit is due to a corresponding member of this society, Mr. R. Allan Wight, of Auckland, for the public-spirited interest which he has

taken in economic entomology several years ago. He has been instrumental in the organization of the Entomological Society of New Zealand, and his efforts have been of great value to the science. He is now in England, and his return to New Zealand is expected this date.

In connection with the annual meeting of the Entomological Society of New Zealand, held in London, the attention of the public had received four years ago. The department of economic entomology is now being studied in New Zealand.

These legislative enactments of the people of the amount of the country the logical office of the General Government. Agriculture has added to the sum total by the entomological American association in interest result in some respects, but has enabled agriculture to be times that our former Washington.

In the study of insects, the classes of insects are being studied by the entomologists; try, mechanical, have been laboring. Cockerell has discovered the apple codling moth, a suggestion of the same method public count the count eminently

taken in economic entomology. Nearly every number of the *New Zealand Farmer* for several years has contained lengthy articles from his pen, and he has travelled a great deal for the purpose of lecturing before fruit growers' associations and other farmers' organizations. The editor of the *New Zealand Farmer* has also helped the good work along, and has published editorially a number of articles upon the subject. New Zealanders are agitating the question of the appointment of an official entomologist, but at this date seem to have little hope of immediate success.

IN CONCLUSION.

In concluding a review of this character, an American writer may perhaps be pardoned for an exhibition of national pride. Writing in 1870, Dr. A. S. Packard, in his first annual report upon the Injurious and Beneficial Insects of Massachusetts, compared the attention paid to economic entomology in this country with that which it received or had received up to that time in Europe, very much to our own discredit. In the twenty-four years which have intervened the change has been vast. All of the great advances in our science have come from America, and it may justly be said that, aside from the one department of forestry' insects, the whole world looks to America for instruction in economic entomology.

These great advances, we must remember, would not have been possible without legislative encouragement. Activity on the part of workers and appreciation on the part of the people and their representatives have gone hand in hand. At the present time the amount of money expended for work in economic entomology is far greater in this country than in any other. Our regular annual expenditure in the support of entomological offices amounts to about \$100,000, very nearly all of which is appropriated by the General Government, \$29,000 going to the Division of Entomology of the Department of Agriculture and about \$60,000 to experiment-station entomologists. To this amount must be added the large sums expended annually in publishing our reports and bulletins. The sum total thus reached will probably exceed the amount expended in this direction by the entire remainder of the world. Much more is therefore to be expected from American workers than from workers in other countries. The American members of this association must bear this fact in mind, and must realize that with the present rapid increase in interest among other nations nothing but the most energetic and painstaking work will result in the retention by the United States of her present prominent position. In some respects our results, have not been commensurate with our opportunities, but we have certainly justified in vast degree the money expenditure which has enabled us to prosecute our work. Not a year passes in which the sum saved to agricultural and horticulture, as the direct result of our work, does not amount to many times that which the Government appropriates, as has been often shown, and notably by our former president, Mr. James Fletcher, in his most able and interesting address at our Washington meeting in 1891.

In the good which has been accomplished in the way of remedial work against insects, the work of the official economic entomologists greatly exceeds that of all other classes of individuals. They have been investigators and teachers, students and propagandists; they have carried their researches into the fields of botany, bacteriology, chemistry, mechanics, and general zoology. Nearly all of the practical remedies in use to-day have been of their suggestion, and all great advances in recent years have come from their labors. Occasionally a practical agriculturist or horticulturist, unskilled in entomology, has discovered an important remedy, as was the case when Mr. J. S. Woodward sprayed his apple orchard with Paris green for canker-worms and found it to be a remedy for the codling moth; but Mr. Woodward would never have sprayed his trees at all but for the suggestion of Dr. LeBaron several years previously. And then, too, Prof. Cook, making the same discovery independently, was the one who, by his careful experiments, established public confidence in the remedy, and it is to him, more than to any one man, that the country to-day owes the great annual saving from the widespread adoption of this eminently practical remedy.

We have, then, done good work. We have accomplished results which have added greatly to the productive wealth of the world. We have justified our existence as a class. We are now better equipped for the prosecution of our work than ever before, and it may confidently be expected that the results of the closing years of the century will firmly fix the importance of economic entomology, in the minds of all thinking men of all countries.

On motion of Dr. Lintner, the thanks of the society were unanimously extended to the president for the admirable address presented.

A letter from the secretary, Mr. Gillette, announced that he would be unable to attend the meeting.

The following active members were elected :

F. C. Test, C. E. Chambliss and H. C. Hubbard, all of the Department of Agriculture, Washington, D. C. ; Victor H. Lowe and F. A. Serrine, of Jamaica, N. Y. ; and F. W. Raine, of Morgantown, W. Va.

The following persons were elected to foreign membership :

Walter W. Froggatt, Technological Museum, Sydney, N. S. W.
 Charles Whitehead, Barning House, Maidstone, Kent, England.
 Geo. H. Carpenter, Science and Art Museum, Dublin, Ireland.
 Dr. Geza Horvath, Ministry of Agriculture, Buda Pesth, Austria.
 Prof. A. Targioni-Tozzetti, R. Staz. d. Entom. Agric., Firenze, Italy.
 Prof. A. Giard, 14 Rue Stanislas, Paris, France.
 M. J. Danysz, Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
 Dr. J. Ritzema Bos, Wageningen, Netherlands.
 Mr. Sven Lampa, Entomologist, Dep't. Agric., Stockholm, Sweden.
 Dr. N. Cholodkowsky, Institut Forestier, St. Petersburg, Russia.
 Dr. K. Lindemann, Landwirtschaftliche Akademie, Moscow, Russia.
 Prof. A. Portschinsky, Bur. Entom., Ministère de l'Agriculture, St. Petersburg, Russia.
 Mr. E. C. Reed, Baños de los Cauquenos, Chile.

Mr. J. B. Smith, New Brunswick, N. J., presented the following paper :

BISULPHIDE OF CARBON AS AN INSECTICIDE.

BY J. B. SMITH, NEW BRUNSWICK, N. J.

Bisulphide of carbon as an insecticide of very limited range has been known for many years ; but for ordinary field crops it has not been in general use. In the 1893 meeting of the Association of Economic Entomologists, Prof. Garman mentioned that he had used it in the garden, covering melon vines with a tub and allowing a quantity of the bisulphide to evaporate, destroying thereby the aphides infesting the vines. This interested me greatly, because the melon louse, (*Aphis cucumeris*, Forbes,) is at times a most destructive pest in parts of New York and New Jersey, and one of the most difficult to deal with, owing to the fact that the leaves are close to the ground and that they curl as soon as seriously affected, making it simply impossible to reach them all, even with an underspray nozzle. A lot of pot-grown plants becoming badly infested with aphides in the botanical laboratory, I made a series of experiments, which were not recorded, but which determined that the liquid evaporated slowly, that it killed plants very readily, and that it killed plants with equal facility if used in any large quantity. The appearance of the lice on cantaloupe and citron melons in New Jersey gave me an opportunity of making experiments, and Mr. Howard G. Taylor, of Riverton, N. J., kindly permitted me to kill as many hills as might be necessary to carry them on. I procured a dozen wooden bowls thirteen inches in diameter and six inches deep, inside measurement, and a series of small, graduated tumblers, in which "1 teaspoonful" and

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"1 dram" corresponded. To get at the rate of evaporation I poured 1 dram into a graduate and left it exposed; but placed in a shaded spot. It required fifteen minutes to disappear completely. Eleven badly infested hills were then covered by bowls, the vines being crowded under when necessary, and 1 dram in a graduate was placed under each. At the end of twenty minutes I lifted one bowl, found that less than half the material had evaporated; that all the Coccinellidæ were dead, the small lice dying, and the Diabrotica, ants, and large viviparous aphides were yet all alive. Ten minutes later there was little change. At the end of three-fourths of an hour, though scarcely more than half the liquid was gone, all save a few of the mature, wingless, viviparous females were dead. In one hour there was yet liquid in all the graduates; but all the aphides were dead, or appeared so. To test the matter, all the hills treated were marked to be examined later. Another series of infested hills were selected; but the experiment was varied by using 2 drams of bisulphide in some cases, using a shallow saucer in others, pouring the liquid on the ground in two cases, and covering other hills with large square boxes, some of them anything but tight. All coverings were left on for one hour, undisturbed. Examined first a square box covering a shallow saucer with two drams of bisulphide; found this all evaporated and every aphid killed. The bowls covering the saucers in which 1 dram was used showed like results. Two square boxes which were not tight, covering graduates with 2 drams of liquid, had all insects unaffected and the material scarcely half gone. The two bowls under which the bisulphide was poured on the ground were then lifted and all the aphides were found dead. All the other hills covered by bowls showed all the lice dead and not all the bisulphide evaporated. The hills first treated were again examined and there was no sign of recovered life anywhere visible. Bowls, graduates and bisulphide were left with Mr. Taylor, and all the treated hills were marked for later examination and to note the effects of the chemical. The experiments were made in the middle of a very hot day, the thermometer 93° in the shade, little or no wind blowing, and the sand so hot that it burned through shoe soles and could scarcely be handled more than a few moments at a time. Many of the hills showed the edges of the leaves, when the covers were removed, yellowed and set with numerous drops of a clear liquid. I feared permanent injury, but instructed Mr. Taylor if he found that the plants died to continue his work before the sun was high or after it was quite low. He wrote me under date of July 19: "The hills you treated when here last started to grow nicely, except the two hills where the carbon was poured on the ground; that killed them. The treated hills showed no lice at last examination." I am quite satisfied, from the experiments above recorded and from others that were not recorded, but were simply made to settle practical questions, that in melon fields at least bisulphide of carbon can be used satisfactorily and effectively. It has the enormous advantage of reaching everything on all parts of the plant, not a specimen escaping. With a stock of from 50 to 100 light covering boxes about 18 inches in diameter, as many shallow dishes, and a bottle of bisulphide the infested hills in a field can be treated in a comparatively short time.

The paper was discussed by various members, Mr. Southwick describing a combination of bisulphide with "Polysolve" which he had used in the form of an emulsion; and Mr. Lintner suggesting the use of cloth coverings in place of the boxes employed by Mr. Smith. Mr. Galloway suggested the use of the protection cloth used by seedsmen, which is treated with oil and is practically air-tight; Mr. Howard referred to the original suggestion by Garman, of the use of a wash-tub, which was thought to be very satisfactory for limited applications; and Mr. Smith and Mr. Saunders suggested the use of paper caps, similar to but smaller than, those used by farmers for the protection of the hay crop. The subject of the relation of parasites to the control of the louse was also discussed, as well as the effect of the bisulphide on the plants themselves, also upon the germination of seeds, when employed for the eradication of grain pests, etc.

AFTERNOON SESSION—AUGUST 14TH, 1894.

The report of the committee appointed last year, on co-operation among station entomologists, was presented by Mr. Smith, in the absence of the chairman. The report covered the matter of concerted work upon the life-history of special insects and their geographical distribution, the selection of certain groups of species to be studied from year to year, co-operation in experimentation with insecticide machinery to avoid duplication, and suggestions in the matter of securing conjoint legislative action among the States. The report was accepted and ordered to be printed, so that opportunity might be afforded members to examine it, in order to be able to take definite action on its adoption at the meeting of 1895.

A letter from Miss Eleanor A. Ormerod was read by the President, in which she expressed her regret at being unable to be present at the meeting.

A paper by Mr. J. M. Aldrich, on spraying without a pump, was read in his absence by Mr. Davis. This paper described a scheme for the mechanical mixture of water and oil by the use of an ordinary Nixon climax nozzle, the combination of water and oil being made in the nozzle itself.

In the next paper Mr. C. L. Marlatt gave a review of a number of experiments conducted during the present year with several standard insecticide mixtures, also a series of experiments testing certain of the more important new insecticides or substances which seem to be of value as insect destroyers recently put before the public. The work was mainly to determine (1) the best methods of treating scale insects, (2) the effect of various mixtures on trees and foliage, in both summer and winter applications, (3) to show the relative merits of the old insecticides compared with some of the newer ones, and (4) the possibility of successfully combining insecticides and fungicides.

The paper was discussed by Messrs. Smith, Galloway and others.

Professor Galloway followed with a paper on various insecticide substances with which he had been experimenting for a number of years past, many of them in lines which had not hitherto been worked to any extent. He discussed particularly the kerosene emulsion made with lime, with resin wash, and the Bordeaux mixture. He also described a new method of making resin wash devised by one of his field agents in Florida, which, briefly, consisted in using purer caustic soda, causing a much more rapid formation of the resin soap. Various other mixtures of possible insecticide value were also suggested. The paper was accompanied by the exhibition of a large series of vials illustrating the various mixtures and combinations described by the author. The communication was generally discussed, and the important point emphasized that none of the emulsions were as perfect or as permanent as the standard milk and soap emulsions in common use, although some of them are possibly of value for immediate application.

In the absence of the author the following paper by Mr. Webster was read by the secretary:

SPRAYING WITH ARSENITES *vs.* BEES.

BY F. M. WEBSTER, WOOSTER, OHIO.

At the Rochester, N. Y., meeting of the association, I gave the results of some experiments looking toward a solution of the problem, "Will spraying fruit trees while in bloom affect the bees which afterwards visit these trees for the purpose of securing either honey or any other substance carried to the hives, and if such be the case, what is the effect upon the inmates of such hives?" The results of my first attempt at settling this question will be found on record in *Insect Life*, vol. v, pp. 121-123, and it will, therefore not be necessary for me to repeat them here. On account of the meteorological conditions under which the experiments were carried on they have never been deemed conclusive in point of definite results, even by myself, and I have only been waiting a favorable season in order to finish the work. This year the time appeared to have arrived in which I might hope to solve the problem.

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On May 2nd two apple trees in full bloom—and the blossoms were abundant—were thoroughly sprayed with a mixture of 1 ounce of Paris green to each 12 gallons of water. After the water had evaporated the poison could be clearly observed both on bloom and foliage. The application was made during the forenoon, the day being warm and clear, and during the afternoon quite a number of bees were caught while visiting the bloom and marked with carmine ink. The hives were located but a few yards distant from the trees, and both being situated at a considerable distance from any other trees at that time in bloom. None of these marked bees were afterwards found dead about the hives. During the night following the application there was a rainfall of 0.20 inch. On the following day bees were caught and killed by being dropped into a cyanide bottle where the cyanide was embedded in plaster of Paris, after the usual custom. As soon as the bees were dead they were dissected as follows: The posterior legs with pollen attached were severed from the bodies and placed in a small glass vial and securely corked. The contents of the abdomens, including the honey sacs, were next dissected out and placed in a separate vial, and the same mode of procedure was followed with the whole inside of the thorax, this giving me the entire bee except the head, anterior and middle legs, wings, and chitinous walls of the thorax and abdomen. Besides these a number of the bees were kept intact. The whole series was submitted to the assistant professor of chemistry of the Ohio State University, L. M. Bloomfield, to be tested for arsenic by the Marsh method. Mr. Bloomfield found the weight of material submitted in each case to be as follows: Posterior legs, with pollen attached, 0.3498 gram; contents of abdomens and honey sacs, 0.0990 gram; ditto thorax, 0.0710 gram. After the usual tests to prove the absence of arsenic in the reagents it was found that no arsenic was associated with the posterior legs or the pollen with which they were loaded, none had been left in the thoracic matter, but the material from the abdomens gave unmistakable proof of the presence of arsenic. The entire bodies of a number of the bees, taken at the same time from the same tree, were then washed with diluted ammonia water, three washings failing to give a trace of arsenic, but the bodies, after being thus treated, and being boiled in water slightly acidulated, gave distinct traces of the poison, thus eliminating any possibility of the poison having been introduced into the abdominal matter at the time of dissection and from the exterior. May 15th a crabapple tree (*Crataegus*) was sprayed with a mixture of the same ratio of Paris green as before, but in this case only the contents of the abdomens were retained. This matter, to the weight of 0.1463 gram, treated as in the preceding, gave unmistakable proof of the presence of arsenic.

Just at this stage of my investigations, chance, if such a thing there be, threw in my way still more conclusive proof. A few days prior to my last experiment, probably about May 10th, a small apple orchard on the experiment farm was sprayed with Bordeaux mixture, to which had been added Paris green at the rate of 4 ounces to each 50 gallons of the mixture. The bloom had at this time nearly all fallen from the trees the exceptions being an occasional belated cluster. Three colonies of bees, recently brought on to the premises, were located near by, to all appearances in a perfectly healthy condition. A few days after the application of the poisoned Bordeaux mixture one colony suddenly became extinct and a second greatly reduced in numbers, dead bees being abundant about both hives. From these colonies I was able to secure dead bees, and both honey from uncapped cells and dead brood from the hive that had been so mysteriously depopulated. When tested for arsenic by Mr. Bloomfield, precisely as with the other matter, contents of abdomens of the dead bees to the amount of 0.2334 gram revealed the presence of arsenic; 3.7061 grams of honey gave no trace of poison, while 1.8481 grams dead brood showed it to be present, and the entire bodies of the dead bees, thrice washed in ammonia water, as before explained, gave traces of arsenic. In regard to the honey I can only say that it was from uncapped cells, which might and probably did contain last year's honey that was still being used for a partial food supply by the bees.

Briefly recapitulated, arsenic was found present in the contents of the abdomens of bees frequenting recently sprayed blossoms, and we are at least free to assume that more or less of it was contained in the honey sacs. The dead bees three times washed in ammonia water, the latter not revealing the presence of arsenic externally, when tested

showed its presence internally. Brood from uncapped cells (larvæ) of a colony suddenly dying without other apparent cause gave evidence of having died from the effect of arsenic which could have been introduced only from without.

In summing up the matter, then, I can see no other conclusion that can be drawn from the results of my experiments than that bees are liable to be poisoned by spraying the bloom of fruit trees, the liability increasing in proportion as the weather is favorable for the activity of the bees, and that all bloom must have fallen from the trees before the danger will have ceased.

Finally, I believe we now have the first conclusive proof of the effect on bees by the use of arsenical poisons in the orchard while the trees are in bloom. Heretofore all has been uncertainty, the statements made being based on either pure assumption, or, as in one instance, on the result of penning up bees and feeding them on poisoned sweetened water. It is certainly to the credit of the entomological fraternity of America that among their number but few could be found willing to risk a positive assertion based on such slender and unreliable information, and I feel that I am fully justified in pointing out the fact that in the case of two of our fellow members, Dr. Lintner and Mr. Fletcher, in the face of the legislative bodies of their respective States, both refused to commit themselves to the extent of making positive statements either one way or the other.

Mr. Lintner said that his position hitherto had been that laws ought not to be passed on the subject unless it was amply proved that harm did result to bees; and even in that event, the relative interests of the bee-keepers and fruit-growers should be carefully weighed, since it has been showed by him that many harmful insects also visited the blossoms, and they would stand an equal chance with the bees of being poisoned by the arsenical mixtures.

Mr. Smith said that the bee-keepers would always have an advantage when it came to securing legislative action, because, while they represented a comparatively small number of individuals, they are well organized, and can secure action where the much larger body of fruit growers would be powerless.

Mr. Southwick read the following paper:

ECONOMIC ENTOMOLOGICAL WORK IN THE PARKS OF NEW YORK CITY.

By E. B. SOUTHWICK, NEW YORK CITY.

The work of the entomologist of the Department of Public Parks in New York City is the care of trees, shrubs, and plants in an entomological sense, and is under the direction of the Commissioners.

The ground to be covered is about 4,000 acres more or less, but most of the work is confined to the Central and other parks of the city proper. Two men, with the entom-



Fig. 56.—The male moth.

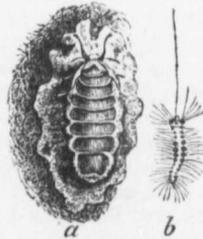


Fig. 57.—(a) The wingless female, (b) a young larva,



Fig. 58.—(c) The male chrysalis, (d) the female.

ologist, constitute the working force, save when the *Orgyia* cocoons become very abundant, then laborers assist in their removal.

The work is continued the year round every day save Sundays and an occasional holiday. A one-horse spraying machine carrying $2\frac{1}{2}$ barrels of liquid is used for the or-

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dinary work of spraying, and a one-horse machine with a powerful force pump for knocking off plant-lice, cottony scale, etc. Various other tools and appliances are used for the removal of egg masses, webs, bag-worm, cases, larvæ, etc. The poisons used are those that are now quite commonly accepted to be the best, viz., London purple, Paris green, kerosene, crude petroleum, crude carbolic acid, bisulphuret of carbon, hellebore, pyrethrum, and others. The insect that requires the most attention the year round is *Orgyia leucostigma*. Fig. 56, the male moth; fig. 57, (a) the wingless female, (b) a young larva; fig. 58, (c) the male chrysalis, (d) the female. This species is reduced in several ways.

(1) By hand-picking, by which means barrels of the cocoons and egg masses are removed each year. This work is carried on through the entire winter, when all the parks have to be gone over and the trees put in as good condition as possible.

(2) By jarring the larvæ (fig. 59) down with a pole so arranged that a blow from a mallet on a projection placed at the larger end of the pole, will jar down any that may be on the limb.

(3) By poisoning the foliage with London purple, which is quite effective, and used especially on very large trees that cannot be treated otherwise.

(4) By spraying the trunks of large trees that are covered with cocoons with an emulsion of petroleum and carbolic acid. This spray put on with force will penetrate most of the cocoons and destroy the pupæ or larvæ within, and many of the eggs that may have been deposited on the outside. This last method is only resorted to when we are unable to subdue them in other ways. Large quantities of the cocoons of this insect are collected each year and taken to the arsenal, where the parasites when bred are allowed to escape from the windows of the building to continue their work of parasitism.

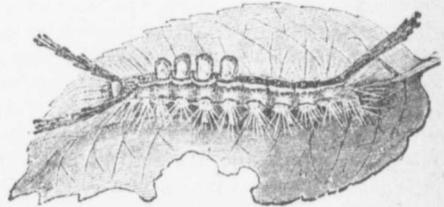


Fig. 59.

The bag-worm, that at one time defoliated whole sections of the park, has been so subdued that it no longer gives us much trouble. Barrels of their cases have been removed from the trees, and each year we remove all that appear in devastating numbers as far as it is possible to do so.

The European leopard moth (*Zeuzera pyrina*) is one of the worst insects we have to contend with. It works in secret, and not until the damage is done can we locate it. Last season we spent two months on this insect alone, collecting and destroying the larvæ and pupæ. All the affected limbs were collected, the insects removed, and then the limbs were taken to the dump and destroyed by fire, in this way making the work complete. A great many wagon-loads were so collected and destroyed, and this work manifested itself this year in the lesser number of trees affected. This year we continued the work of collecting, but were only able to give two weeks to it, but with the aid of the gardeners we were able to destroy a great many. I believe the work we have done with this insect alone, has saved thousands of trees in our parks that would otherwise have been either destroyed or deformed. This question is a serious one when we are considering such valuable representations of our Silva as are collected in our city parks, for when a limb is amputated by this insect the stub is sure to die, and if the fungus does not immediately take possession of it, it will be amputated by a so-called gardener, who does not see the advisability of protecting the scar from fungi and insects; and here is offered a field for the greedy fungi, whose ever-present spores are ready to grow when the proper field offers itself, and they hardly ever fail to take possession, and all over, our fine elms can be seen with groups of *Agaricus ulmarius* in all stages of growth. This close pruning, without proper protection from insects and fungi, is one of the most important questions of our times, for every year great numbers of trees are destroyed for want of proper protection and a knowledge of seasonable pruning.

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Right here the sap fly, which I take to be *Mycetobia pallipes*,* finds congenial habitat, and hundreds of trees are weakened by the flow of sap they cause, besides being unsightly from the slimy frass running down their sides. Those we treat with a crude carbolic-acid emulsion sprayed over them; after a time, however, they again show themselves, and have to be treated again.

The elm leaf-beetle is another pest that we have to fight, but with the force of two men, and miles of ground to cover, it is very difficult to keep this insect in subjection. Our success has been in preventive measures rather than otherwise. However, we do successfully destroy them when they have spread over the entire tree. As soon as the first eggs are discovered on the leaves, about the 1st of June, we immediately poison the foliage and keep them from spreading. When the larvæ come down to pupate and collect at the base of the tree, we treat them by spraying with an emulsion of kerosene and crude carbolic acid. In this way we destroy bushels of them, and with the spraying are able to keep them in check in our city parks.

The pine Chermes (*Chermes pinicorticis*) is another insect that is giving us a great deal of trouble, but we can subdue it most effectually with a stiff spray. The tree is then treated with the kerosene emulsion, and also those insects collected or washed down around the base of the tree. This has to be done at least three times a year. For the past seven years I have been using the stiff spray for different work, and it is one of the best means I know of for cleaning maples of *Pulvinaria*. Three years ago *Pulvinaria innumerabilis* was very abundant on a great number of trees in our parks, and I treated them with the hose and emulsion until I had them in fair subjection. The Chermes and *Pulvinaria* were at one time taken off with corn brooms, but the spray is much more effectual, and gets in among the small twigs without breaking them.

Scale insects are treated with washes and taken off with steel brushes, and are also sprayed with an emulsion, which covers the smaller branches. *Eriosoma Rileyi* is common on our young elms, and these are treated with the kerosene and carbolic emulsion.

The larvæ of the larger silk producers are collected and destroyed, as well as the cocoons. *Datanas* are collected by hand, as they are assembled in masses, and destroyed. The web-worm, always abundant in our parks, is collected either by taking down the twigs or, if the tree is a valuable one, by twisting them out and crushing the larvæ.

Alypia octomaculata, fig. 60, (a) the caterpillar, (b) a segment showing markings, (c) the moth, is abundant where *Ampelopsis* is grown. These are effectually destroyed with the London purple solution.

The catalpa have been affected by a species of *Cecidomyia*, which causes the ends of the branches to turn black and break off. These are collected every year and destroyed before the larvæ leave the twigs. Leaf-skeletonizers are always abundant on many of our trees, and the *Platanus* and *Liquidambar* species have suffered most. These insects are cut off as soon as they can be seen working and destroyed. If left for any length of time they make the tree very unsightly.

Aphis species are treated with the kerosene emulsion after the colonies have been broken up with the stiff spray. I have found it impossible to get an emulsion to act upon many of the plant-lice on account of the secretion; but let me play the hose on them a short time and they are disintegrated and demoralized, and many are killed outright by the shock; then a fine spray of emulsion will reach them more effectually than otherwise. The more I have occasion to use a force of water the more I see the benefits that will accrue from it, especially in economic entomological work, for larvæ of many kinds can be knocked down by it, and my men have brought me birds that they have knocked out of a tree and captured.

*Mr. A. D. Hopkins says it is probably a species of *Sciara*.—E. B. S.

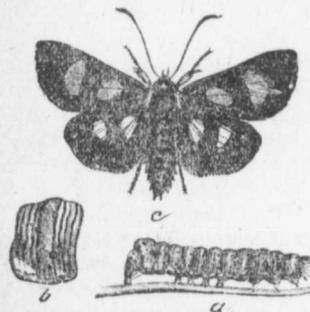


Fig. 60.—(a) The caterpillar, (b) a segment showing markings, (c) the moth.

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Other insects that are working on the foliage and in the stems of our plants we have in great numbers, but enough has been said to give an idea of some of the work we try to accomplish. Could we have sufficient force to do the work at the proper time there seems to be no reason why our parks could not be kept in the best condition; but with a force of but two men, with the entomologist, the wonder is that even a respectable showing can be made and the vegetation kept in as good condition as we now find it.

Mr. Howard said that he was very much interested in Mr. Southwick's account of the use of water as an insecticide and referred to some experiments in the same line which he had conducted, in which he showed a strong stream of water to be an effective agent against the rose slug and certain other insects.

Some discussion followed on the nature of the work and the probable species of the sap worm described by Mr. Southwick, which was thought by Mr. Lintner to be probably a species of *Sciara*.

Mr. Southwick followed with a second paper on the Wood Leopard Moth in the parks of New York, giving an historical account of the insect, its present status, the nature of the injury, the plants affected, and the means he had adopted to exterminate the pest. He stated that this is a most difficult insect to control, and could only be reached by cutting off the affected limb. In the case of rare trees, he had adopted the plan of putting a little bisulphide of carbon in the larval burrow with an oil can, closing the entrance with putty, which had proved an effective remedy.

The paper was discussed by Messrs. Smith, Howard and others.

In the absence of Prof. F. H. Snow, of Lawrence, Kansas, his paper was read by Mr. Victor H. Lowe. This communication, entitled "Work in Economic Entomology at the University of Kansas for the season of 1894," related particularly to the successful work with the chinch bug disease (*Sporotrichum globuliferum*), and a new alfalfa and wheat pest, which proved, on rearing, to be *Agrotis introferans*, Grote.

Mr. Smith reported that the same noctuid had been found by Mr. Gillette to occur very abundantly the present year in Colorado, and Mr. Howard referred to the occurrence of the moth in enormous numbers in Nebraska.

Messrs. Ashmead, Lintner and Hopkins were appointed by the President a committee to nominate officers for the ensuing year.

MORNING SESSION—AUGUST 15TH, 1894.

Mr. Hopkins presented notes on some discoveries and observations of the year in West Virginia. The paper dealt chiefly with wood-working insects, but also covered various garden pests, such as the potato-scab gnat, the melon plant-louse, etc. The paper was discussed at some length by Mr. Smith, Dr. Lintner, Mr. Raine, and others.

The President read a letter from Mr. Webster, stating that he was unable to be present on account of being actively engaged in stamping out an attack of *Fidia* larvæ on grape roots, by the use of bisulphide of carbon.

Mr. Howard read a paper on the eastern occurrences of the San Jose scale, in which he briefly reviewed the history of the insect in the United States and showed that as a result of investigations during the winter of 1893-4 and the summer of 1894, the scale has been discovered in six localities in the eastern United States outside of New Jersey, while in the latter State it occurs at many points. He traced the introduction to two nursery firms in the state of New Jersey and one in Missouri. He detailed in full the remedial work which has been undertaken by the Division of Entomology of the United States Department of Agriculture in each of the six eastern localities, and showed that by virtue of the active measures which have been taken, the insect will probably be stamped out in the east by the close of the season.

The next paper was on the same subject, and discussion was therefore deferred.

Mr. Smith then read a paper on the San Jose scale in New Jersey. He stated that the scale had first come to him from a nursery in the state in March, 1892, but had not been recognized and he did not become aware of the true nature of the insect until he received the special circular sent out by the United States Department of Agriculture early in 1894. He described his work in connection with the stamping out of the scale, and particularly the active and energetic steps taken by the owners of the infested nurseries, from which the scale had been exterminated on young stock. He reported sending out letters to all persons who had obtained stock from the nurseries in question, enclosing the circular from the Department of Agriculture referred to, and the examination of nearly 100 orchards in person. As a result of his observations and work, he felt confident that the scale would ultimately be completely stamped out. The introduction of the scale was shown to have been either in 1886 or 1887, on some plum stock claimed to be curculio-proof, obtained from the San Jose region in California. Other fruit trees imported from California were also shown to be very likely infested. He gave some facts in regard to the trees and varieties which are most liable to be infested, also some notes on remedies.

In the discussion of these two papers Dr. Lintner considered the possibility of the introduction of the scale on fruit from California and concluded that the likelihood of the scale, so introduced, obtaining a foothold, was very slight.

Mr. Marlatt thought there was danger in placing too much confidence in the work or the statements of nurserymen as to the completeness of the eradication of the scale, pointing out the great difficulty of thorough extermination and the ease with which a random scale here and there could be overlooked. Mr. Banks referred to the publication in a New York paper of occurrences of the scale in two or three localities in New York, accompanied with the report of the adoption of active measures to stamp it out in each instance.

AFTERNOON SESSION—AUGUST 15TH, 1894.

In continuation of the discussion of the morning session, Mr. Smith exhibited specimens of California pears, obtained in Brooklyn which were covered with the San Jose scale in all stages of development.

Mr. Lintner exhibited an apple coming from Ottawa, Canada, handed to him by Mr. Saunders which was covered with the scales of *Mytilaspis pomorum*. (Fig. 51.)

Mr. Davis read a paper on mealy bugs and other lice. He gave a careful resume of the life history of the common mealy bug (*Dactylopius destructor*) with detailed descriptions of the different stages, also some notes on *D. longifolia*. He also described a coccus which he found on roots of clover, giving a general account of the habits and careful descriptions of the species. He also referred to *Eriococcus azaleae* and other scale insects.

The paper was discussed by Messrs. Serrine, Ashmead and Howard. Mr. Serrine thought Mr. Davis's clover coccus was the same as the one found by Professor Forbes on white clover, and named by him *Coccus trifolii*, Mr. Ashmead coinciding in this view, and Mr. Howard stating that the *Eriococcus azaleae* was certainly not an introduced species from Belgium, as suggested by the author, since the species is not known in Europe, and Professor Comstock has found it on wild plants near Ithaca, indicating that it is undoubtedly a native species. He said also that the two old species of *Dactylopius* referred to by the author had been shown by Berlese to be synonymous with European species, and that their life histories had been worked out by this author in great detail.

Mr. Marlatt read a paper on the Pear-tree Psylla in Maryland, in which he described the sudden occurrence of this northern pear pest in two orchards on the eastern shore of Maryland, in very destructive numbers. The introduction of the species was shown to have been upon nursery stock from infested regions in New York, and the author was confident that the injury, while excessively severe for the moment, would not be of long duration, judging from the past history of the insect. A brief review of the life history was given, with some notes on the natural enemies, notably a species of lace-wing fly,

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Chrysopa oculata, the larva of which feeds voraciously on all stages of the Psylla; also various species of lady-birds which are useful in a similar way. The life history of the lace-wing fly was carefully worked out. Experiments with various insecticides on the eggs on the Psylla were detailed, and general recommendations for remedial work were given.

The paper was discussed by Messrs. Davis, Southwick, Lintner and others, both Messrs. Southwick and Lintner reporting cases of sudden appearance of the Psylla, with subsequent equally sudden disappearance.

Mr. Smith deferred speaking until the reading of his own paper which included a reference to the same insect, in which he said that the conditions described by Mr. Mariatt were identical with the conditions obtaining in localities in New Jersey, and that the source of the introduction was also the same.

Mr. Smith then read a paper entitled "Notes of the year in New Jersey," which was a summary of the important insects brought to the attention of the entomologist during the present season. It contained references to occurrences of the Pear-tree Psylla, the Pear Blister-mite, the Pear Midge, a new pear pest in a species of *Agrilus*, probably *anxius*, the habits of this last insect being described at some length. The paper also considered the use of protective coverings for the trunks of trees as a means against the borer, invasions of cutworms, the Periodical Cicada, some potato insects, onion maggots, the remarkable mortality of the clover-leaf weevil larvæ, and the potato-stalk borer, *Trichobaris trinotatus*, which had been brought to his attention for the first time the present year. The paper was discussed by most of the members present.

Mr. Davis also presented a communication covering notes on special economic insects of the season in Michigan, referring particularly to the occurrence of *Diplotaxis Harperi* as a strawberry pest, a dipteran raspberry girdler, *Adimonia clavicollis* as a cherry tree defoliator, *Notoxus anchora*, as feeding on fruit of cherry.

In the discussion Mr. Hopkins stated that he had found the raspberry cane maggot described by Mr. Davis, in the Alleghany Mountains in 1892, but did not rear the adult.

In the absence of Mr. Chittenden his paper entitled "Supplementary Notes on the Strawberry Weevil, its Habits and Remedies," was read by Mr. Southwick. The writer noted the occurrence of the strawberry Weevil, (*Anthonomus signatus*, Say) in more or less injurious numbers in parts of Maryland, Virginia, Delaware, Pennsylvania, and New Jersey in 1893 and 1894. Three new food plants were discovered, the red-bud (*Cercis Canadensis*), the dewberry and raspberry and the life-cycle from egg to adult was found to extend over a period of four weeks. The methods of oviposition and of severing stems were described. A table showing by States the destructive appearances of the insects from 1871 to date is given. Under the head of remedies, the necessity of clean culture is pointed out, also the benefit that might be derived from early-blooming varieties of staminate, and of the red-bud tree as trap-crop. Kerosene emulsion and Paris green were found by experiment to be of service, but the latter gave the better results. Directions are given for the application of these insecticides, three or four sprayings being advised, beginning two or three days before first bloom. The subject of covering beds is considered, and, in conclusion, the fruit-grower is urged not to trust entirely to staminate varieties.

Mr. Smith said he had anticipated damage from this insect the present season, but so far as he had observed, it did not manifest itself in New Jersey.

In view of the lateness of the hour, the following papers were read by title only:

"Notes on the Insects of Northern Idaho," by J. M. Aldrich, Moscow, Idaho. This paper included a few notes on the principal pests of the "Pan-handle" district of Idaho, where the farming land is at an elevation of 700 to 3,500 feet, with a corresponding change in climate. The insects discussed were the Wheat Aphis, the Codling Moth, Bud Moth, Woolly Aphis, Pear-leaf Blister-mite, and the San José scale, which latter the author stated was the most dreaded insect pest, and a considerable effort was being made to prevent its spread to new localities.

"Insects of the Year," by F. M. Webster, Wooster, Ohio. Mr. Webster's paper had particular reference to the occurrence of the larvæ of *Fidia viticida*, Walsh, in vineyards, which was the important insect manifestation of the year in Ohio. It also covered the raspberry *Agrilus*, the strawberry Weevil, the pear tree Blister-beetle, joint worms, the Bean Leaf-beetle, and other garden and small fruit pests, such as the Grain Louse, Corn Bill-bug, and a Thrips, which is proving very destructive to onion crops. Other insects were also mentioned briefly.

"Notes from New Mexico," by T. D. A. Cockerell, Las Cruces, N.M. This paper covered numerous short notes on various insects observed in New Mexico, with a description of the climatic and other conditions characteristic of the more important natural districts of the State, and the bearing of these on the insect fauna.

"Some Experience with Mosquitoes," by Howard Evarts Weed, Agricultural College, Miss. This communication covered the result of certain experiments in the use of kerosene as a means of preventing the breeding of mosquitoes in water reservoirs on the college campus. The use of kerosene was very satisfactory, and resulted in a very marked subsidence of the mosquito trouble. The author also reports that kerosene is a very good preventive to apply to the hands or face in the case of mosquito outbreaks.

The report of the committee on nominations was presented by Mr. Lintner as follows:

President—J. B. Smith.

Vice-President—C. H. Fernald.

Secretary—C. L. Marlatt.

The report was unanimously adopted and the officers named duly elected. (By inadvertence no second vice-president was nominated or elected.) It was decided to follow the usual custom for the next meeting, and hold it on the two days preceding the meeting of the American Association for the Advancement of Science, and at the place decided upon for the next meeting of that Association. On motion, it was requested that the minutes be printed in full in "Insect Life."

After the reading and approval of the minutes of the entire session, Mr. Southwick moved that the thanks of the Association be tendered to the President and Secretary for the able and satisfactory manner in which they had discharged their respective duties. The resolution was adopted.

The Association was then declared adjourned by the President for one year.

PROFESSOR C. V. RILEY.

Every entomologist in North America will, we are confident, join with us in the expression of the deepest regret, that Professor C. V. Riley has felt compelled, owing to the impaired state of his health, to resign his position as Entomologist of the United States Department of Agriculture. The admirable work that Dr. Riley and his staff have accomplished, both in scientific and economic entomology, during the many years that he was Director of the Division, is so well and widely known that it is unnecessary to enter into any details here. There are few who possess, in so eminent a degree as Dr. Riley, scientific ability, accurate knowledge, painstaking industry, and acute powers of observation; these gifts and attainments have been abundantly manifested in the immense additions that he has made to the knowledge of insect life in all its various phases, and

it would be a calamity indeed if they were withdrawn from active exercise. It is gratifying, then, to know that Dr. Riley will retain the honorary Curatorship of the Department of Insects in the United States National Museum at Washington, and that he will now devote himself to some long contemplated work of a purely scientific character. We earnestly trust that the relief from the cares and anxieties of administrative work in a Government office will speedily restore his health and strength, and that we shall see the fruits of his labors during many a year to come.

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While we deplore Dr. Riley's resignation, we cannot refrain from expressing our gratification at the appointment of his successor. The authorities at Washington have shown their wisdom in conferring the vacant office upon Mr. L. O. Howard, who has been so long and so ably sharing in its duties as First Assistant. The Department is certainly to be congratulated upon having at hand a skilled and learned entomologist who possesses in every respect the varied qualifications necessary for the successful performance of so important an office. We have every confidence that the world-wide reputation now possessed by the Division of Entomology at Washington will be in no wise impaired under the administration of Mr. Howard, and we heartily wish him health, strength, and a long life for the successful performance of his arduous and important duties.—*C.J.S.B., Canadian Entomologist*, June, 1894.

BOOK NOTICES.

THE BUTTERFLIES OF NORTH AMERICA: By W. H. Edwards. Third Series. Part XIII.

Another part of Mr. Edwards's magnificent work has been received, and is of particular interest to Canadian students. The three beautiful plates represent the following: Plate I., *Neominois Ridingsii*, Edw. The upper and lower sides of both sexes of the early and late forms are shown, together with the egg and pupa, and a full series of enlarged drawings illustrating the larva in all its stages. This is a Coloradan insect, and flies in the mountains at an elevation of from 5,000 to 8,000 feet. Up to the present there is no recorded instance of *N. Ridingsii* having been taken in Canada.

Plate II. shows *Chionobas Aeno*, Bdl., male and female, and a variety of the male, as well as *Ch. Aeno*, var. *Assimilis*, Butler, and the egg of *Crambis*, Freyer. *Aeno* is an arctic species occurring with the variety in Labrador, and also in Colorado where it inhabits the loftiest mountain peaks. An interesting account of its habits is given from the notes of Mr. David Bruce, who has done a great deal to work up the life-histories of the butterflies of the Coloradan mountains. *Aeno* belongs to the *Semidea* group of the genus, and has been confounded with that species and *Crambis*, Freyer. Mr. Edwards says: "It was not till Mr. Bruce explored the peaks of Colorado that it became possible to understand what *Aeno* was, and the limitation of *Brucei* made clear the position of *Crambis*."

The series is now arranged as follows:

1. CRAMBIS, Freyer.
2. BRUCEI, Edw.
3. AENO, Bdl.
—— var. ASSIMILIS, Butler.
4. SEMIDEA.
5. SUBHYALINA.

Ch. Also, Bdl., Mr. Edwards rejects altogether as an American species.

Plate III. shows *Ch. Macounii*, the grand species which was discovered at Nepigon, north of Lake Superior, by Prof. John Macoun, of the Geological Survey, in whose honor it was named. *Ch. Macounii* belongs to a different group of the genus to the species mentioned above, and finds its place with *Californica* and some other large species occurring on the Pacific Coast. It is a fine insect expanding 2-2½ inches and has the remarkable feature of lacking the sexual band of androconia or special scales, which is such a striking characteristic of the males of all the other species in the genus. The plate is a very beautiful one, and shows a pale male and the full life-history with the exception of the pupa. The female figured, although of course copied from an actual specimen, is

hardly typical of that sex, and it is to be hoped that at some future time Mr. Edwards will publish another illustration showing the more usual form, which has a much richer appearance both on the upper and under sides.

Ch. Macounii is decidedly a variable species, both in the intensity of the golden brown of the wings, in the amount of infuscation along the nervures, and in the size and number of the ocelli. Both sexes frequently have three ocelli on the primaries, and occasionally four. One specimen in my collection, plainly a male, has four distinct ocelli on the primaries, the second and fourth from the apex large and pupilled. In fact, this specimen has more nearly the markings of what appears to me the typical form of the females. There is also a very much infuscated variation of the male which is rarely taken, in which the nervures, are all broadly bordered and the greater part of the surface of the disk is covered with dark scales. One of these was mentioned by Mr. Edwards in his original description (*Can. Ent.*, xvii., p. 74), and was omitted from the plate now published for want of space. The life-history of this species has not yet been worked out, as no one has succeeded in obtaining the pupa. It will probably be much like that of *Ch. Chryceus*; but for the present it is unknown, and it remains for some expert and patient breeder to carry the larvæ through all their stages and obtain this missing link. The eggs are easily obtained when a female has been captured; but the breeding is very tedious, the larval life lasting nearly two years.

J. F.

MONOGRAPH OF THE NORTH AMERICAN PROCTOTRYPIDÆ: By William H. Ashmead. Bulletin of the U. S. National Museum, No. 45; pages 472; plates 18.

Every student of the Hymenoptera must be delighted at the issue of this magnificent volume, which bears most ample testimony to the extensive studies and patient industry of the author. Treating, as he does, of a family in which the American species had previously been but meagrely represented in collections, he has necessarily been compelled to describe a large proportion of the insects now recognized, and to erect a considerable number of genera for their reception. The labor involved in the critical examinations requisite for the determination and description of so many microscopic forms, and in the preparation of the voluminous text, must have been enormous, yet the author has been able to amplify and embellish his work by the delineation of some one hundred and fifty exquisite figures.

The position of the Proctotrypidæ in the order Hymenoptera is considered to be much more closely allied to some families of the Aculeata than to the Chalcididæ, with which they have been usually grouped, while they also approach in other respects the parasitic Cynipidæ. The Mymarinae, hitherto included as a sub-family, are set aside as constituting a distinct family allied to the Chalcididæ, so that the species now contained in the Proctotrypidæ are characterized, and distinguished from the Chalcids, by the pronotum extending back to the tegulæ, and the ovipositor issuing from the tip of the abdomen. Ten sub-families are recognized, which contain about one hundred and thirty genera, represented by nearly six hundred species—a doubling of the genera and quadrupling of the species as enumerated in the catalogue of Hymenoptera issued a few years ago by Mr. Cresson. Many of the genera are known only by single species, but others contain numerous forms, the most extensive being *Polygnotus* (32), *Proctotrypes* (21), *Prosacantha* (27) and *Telenomus* (32). The synoptic tables requisite for the separation of the species in such genera, as well as the tables for the distinction of genera, etc., give evidence of great care and skill in their preparation and arrangement.

While many of the genera are apparently confined to the more southerly and westerly regions, the species in other groups have an extended range, which at times seems to be almost continental, as for instance *Proctotrypes californicus*, which has been taken at Ottawa. The members of this family have received but scanty attention in Canada, so that their distribution northward cannot be stated, but undoubtedly many interesting species could be found by a careful and patient collector in any locality. Provancher, in his *Faune Entomologique*, was able only to announce the occurrence of nine species, and about twice as many are recorded in his *Additions* completed just before

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his death. Mr. Ashmead, however, has been able to enlarge the list of Canadian species to about ninety. With the exception of three forms from Vancouver Island, the species are all from a few localities in eastern Ontario and Quebec, so that the Dominion as a whole has been practically unworked. The three western species are *Mesitius vancouverensis* and *Polymecus vancouverensis*, collected by the Rev. G. W. Taylor, of Victoria (and communicated through the writer to Mr. Ashmead), and *Anteon puncticeps*, taken by Mr. Wickham.

Although the Proctotrypids are all small, and frequently microscopic, they show great variations in structure, and their study thus becomes very interesting. A large proportion of them are egg-parasites, while others prey upon Aphididae, Cecidomyidae, etc. In many species (noticeably in the sub-family Bethylinæ) the females differ largely from the males in the shape of the head, antennæ and structure generally. Those of the sub-family Dryininæ have remarkable chelate, or pincer-like claws, on the anterior feet, which are probably for more firmly grasping, during oviposition, the small, active homopterous insects on which the larvæ are parasitic. Many forms are wingless or have very rudimentary wings, but they are, nevertheless, very nimble little atoms, and can leap many times their own length.

As the appearance of Mr. Ashmead's splendid monograph may stimulate some of our members to the collection and study of these insects, it may be stated that a considerable number of the species, such as *Bæus*, etc., may be obtained even in winter by sifting moss as it is done for small coleoptera. This habit of hibernating in the moss of swampy localities is another feature (not mentioned by the author) which separates them from the other hymenoptera known to me, with the exception, perhaps, of ants, which are also occasionally obtained in sifting.

W. H. H.

THE BUTTERFLY HUNTERS IN THE CARIBBEES: By Dr. Eugene Murray-Aaron. New York; Charles Scribners' Sons, 1894; pp 269.

It is a novel event in literature to have a boys' book of adventure written by an entomologist; we were, therefore, prepared to peruse with interest the volume which Dr. Murray-Aaron has just published. Belonging, perhaps, to those whom he characterizes as the "younger old people," we were charmed beyond measure with the book and read it through from beginning to end with as much avidity and enjoyment as any adventure-loving school-boy. It relates, in pleasant easy style, the expedition made by a couple of boys under the guidance of their naturalist friend "the doctor." During the early winter months they visited several of the islands of the Bahamas, and then made a more venturesome excursion across Haiti and into Santo Domingo, winding up with a flying visit to Jamaica. Their object was to collect butterflies especially, and at the same time to gather all the animal and vegetable curiosities that they conveniently could. For an account of their success and the various "dodges" they had recourse to, especially when in pursuit of *Papilio Homærus*, we must refer the reader to the book itself. It is not, however, a mere record of the doings of collectors; a great deal of interesting information is given regarding the condition of the negro races in their barbarism where left to themselves, and their happy condition when under British rule. Much pleasant instruction may also be gained regarding the geography, scenery and government of the various islands that were visited. If any paterfamilias is looking for a book to put in his boy's Christmas stocking, he cannot do better than purchase a copy of this; if his boy has any taste for natural history it will delight him beyond measure. The book is handsomely printed and bound, and illustrated with several well-executed plates. The entomologist may be disappointed at the absence of lists or names of species and pictures of butterflies, but the book is not meant for a scientific treatise, though its statements may be relied upon as strictly accurate, the author being well-known as the editor for a time of *Papilio*, and Curator of the American Entomological Society at Philadelphia, as well as a valued contributor to the *Canadian Entomologist*.

C. J. S. B.

RANDOM RECOLLECTIONS OF WOODLAND, FEN AND HILL; AND WOODSIDE, BURNSIDE, HILLSIDE AND MARSH: By J. W. Tutt, Editor of the *Entomologists' Record and Journal of Variation*. London: Swan, Sonnenschein & Co.

The name of the author of these two volumes must be familiar to our readers as an occasional contributor to our pages, while he is widely known as a writer of much scientific repute on matters concerning the lepidoptera. In these two books he has assumed a lighter and more popular role; his aim has been—to quote his own words—“to bring under the notice of the general public, in readable and untechnical language, a few of the interesting phenomena which are to be observed everywhere around us by those who take the trouble to look for them, and to give such explanations of their causes as may easily be understood even by those whose scientific knowledge is small.” He has certainly carried out his design most successfully and given to the world two very charming and interesting books on out-of-doors natural history. Any one, whether young or old, who takes any pleasure in the beauties of nature and any interest in the varied world of animal and vegetable life, will read them with the greatest delight and follow the author with unflagging interest during his rambles over hill and dale, and by marsh and burn and fen. In the former work more attention is paid to the habits and variations of insects, while the latter treats of any animal or plant that may be met with in expeditions to widely different localities. Amusing episodes and pretty bits of verse enliven the volumes, and many capital pictures render the later one still more attractive.

C. J. S. B.

REPORT OF THE ENTOMOLOGICAL DEPARTMENT OF THE NEW JERSEY AGRICULTURAL COLLEGE EXPERIMENT STATION: By John B. Smith, Sc.D., for the year 1893.

It is obviously impossible to notice all the ever-welcome bulletins and reports that constantly flow from the various experimental stations throughout North America, for copies of which we are very grateful to their authors. We may, however, call attention to Dr. Smith's excellent departure from the ordinary report. After giving the usual general review of the season, and an account of the most important insect attacks of the year, he devotes a large portion of his work to a most useful and admirable account of the “Beneficial Insects” in all the different orders. It is clearly and plainly written, so as to be within the comprehension of non-entomologists, and is profusely illustrated with excellent figures, many of them being new reproductions by means of photography. It ought to be widely distributed, in order to teach the general public that a very large proportion of insects are not noxious, and should not be wantonly destroyed. C. J. S. B.

REPORT OF THE ENTOMOLOGIST AND BOTANIST (JAMES FLETCHER, F.R.S.C., F.L.S.), Central Experimental Farm, Ottawa, 1894.

Mr. Fletcher's Reports are always interesting and valuable; and the present record of the chief insect attacks of last year, and his observations upon them, is not less so than its predecessors. The season of 1893, as far as destructive insects were concerned, was only remarkable for the superabundance of locusts (grasshoppers), and the consequent damage inflicted upon oats and many other field and garden crops. Other attacks were for the most part of the familiar kinds which we have always with us; these are briefly mentioned in the Report, while more attention is paid to the serious injury caused to grain crops in Manitoba and the North West by cut-worms, the ravages of locusts, granary insects at the Chicago Exhibition, the horn-fly, etc. Very interesting accounts are also given of *Silpha bituberosa*, which attacks vegetables in the North West Territories; and *Polyphylla decemlineata*, which was very injurious to shrubs of various kinds in a nursery at Victoria, B.C.

In the Botanical section of the Report there are two papers especially noteworthy: those, namely, on “Grass for the protection of shores and harbors,” and on the “Tumble-weeds” of the North West. The pamphlet is illustrated by a handsome full page picture of Mr. Fletcher's grass plots at the Experimental Farm, which are full of interest to every visitor; and thirty wood-cuts. It is gratifying to observe how steadily the author's reputation is growing, and how highly his work has come to be appreciated from one end of the Dominion to the other.

C. J. S. B.

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EIGHTH REPORT OF THE INJURIOUS AND OTHER INSECTS OF THE STATE OF NEW YORK
FOR THE YEAR 1891 : By J. A. Lintner, Ph. D., State Entomologist, Albany, 1893.

Anything published by Dr. Lintner is sure to contain much valuable information and to be highly interesting, whether the subjects treated of are new to us or not. The Report before us fully supports this statement. It treats of a large number of insects, injurious or otherwise; and gives in most cases a life history of each, including the author's own observations, which are always accurate and clearly detailed. Attention may especially be drawn to the accounts of the Raspberry Geometer (*Synchlora glaucaria*), the Birch-leaf Bucculatrix (*B. Canadensisella*), and the Pear-midge (*Diplosis pyricora*). An appendix contains some very interesting popular lectures on Economic Entomology, which are well worth perusal. The only drawback to the Report is the late date of its publication, which is more than two years after the observations recorded in it were made.

C. J. S. B.

BUTTERFLIES FROM CHINA, JAPAN AND COREA : By John Henry Leech, B.A., F.L.S., etc.
In parts, 4-to, 642 pp., 43 plates; R. H. Porter, London, Dec., 1892—Jan., 1894.

The fifth and last part of the letter-press of Mr. Leech's work has just been issued, and is accompanied by the statement that five plates of Hesperidæ and a supplemental plate will shortly follow, completing the work. Presumably these plates will be accompanied by the letter-press of the title page, preface and index, with which the work will be ready for the binder. As to the typography of the book, it must be said that it leaves nothing to be desired. The paper is luxuriously heavy; the type is beautifully clear and large; and the text conspicuously free from errors of a minor character, such as occasionally appear even in the most carefully edited works. The scholarship and taste of Mr. Leech and his accomplished secretary, Mr. Richard South, are reflected in the execution of the literary portions of the work. The plates, which are from drawings by William Purkiss, and are executed by chromo-lithography by William Greve, of Berlin, are without doubt the finest examples of this form of work which have as yet graced any similar publication. While a preference is by many accorded to figures lithographed and afterwards colored by hand, and the most exquisitely perfect illustrations have been produced in this way; and while the results of chromo-lithography as ordinarily employed in scientific illustrations have generally been more or less marred by striking crudities, these plates before us are most marvellous illustrations of the capabilities of the chromo-lithographic process, when employed by those who are masters of the art. The plates are almost perfect facsimiles in form and color of Mr. Purkiss's exquisite drawings; and the student of Chinese and Japanese lepidoptera may well rejoice upon having at his command such an infallible guide to specific identity as is found in these beautiful illustrations. The only adverse criticism which the mechanical and typographical execution of the work admits is on the score of the bulk of the letter press, which will necessarily be bound up in one volume. The heavy paper employed results in the production of a book which, as a manual of reference, promises to be somewhat uncomfortably "fat."

The title of the book indicates the consciousness of the author that, in our present state of knowledge, any effort to deal with the lepidopterous fauna of the great regions covered by this work must at best be attended by imperfections. There are wide areas in China in which little or no attempt has yet been made to make collections; and it must necessarily be many years before it can be asserted that our knowledge of the faunistic resources of Central Asia is complete. In his classification, Mr. Leech follows the order now almost universally recognized by writers in England and on the continent as most natural. He erects, as far as the writer has been able to observe, no new genera; and while giving us a large number of new species, appears to have pursued a conservative course in this regard, which is to be commended. To the student of Asiatic lepidoptera the work is simple indispensable, and will remain a lasting monument of the energy and scientific accomplishments of its learned and enthusiastic author. W. J. HOLLAND.

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MISCELLANEOUS ENTOMOLOGICAL PAPERS, BY F. M. WEBSTER, FEB. 1894.

We have just received a neat pamphlet of 59 pages, which forms Bulletin 51 of the Ohio Agricultural Experiment Station. It is by Prof. F. M. Webster and like all his work shows careful preparation.

The insects treated of in the first part are: The asparagus beetle, the western corn root worm, the broad striped flea beetle, blister beetles, the basket worm, the cabbage aphid and the apple leaf louse.

An interesting account of the insects which have been introduced into the State is given under the head of "Some insect immigrants in Ohio." There appears to have been two great highways which insects imported from Europe have followed: those which have entered the State at its northeastern corner and spread westward, and those from Southern Europe which have generally entered by way of the Ohio Valley and have a more or less restricted northern distribution.

In the article "Insect foes of American Cereals" the writer is evidently dealing with a subject of which he has made a special study. By patient observation and the application of practical common sense, Prof. Webster has made some important discoveries in Economic Entomology. Not the least of these is the fact recorded in this pamphlet that the apple aphid passes part of the year as an injurious enemy on wheat. In fact Mr. Webster says: "So far as my own observations go, it is more detrimental to the wheat than to the apple." This is an important discovery and will doubtless draw the attention of entomologists to this important subject of the "Alternation of Generations" among the aphides—a line of investigation which has engaged much of the time of Messrs. Riley and Howard at Washington. Speaking of remedies, Prof. Webster says: "It would appear almost visionary to advocate spraying apple orchards with kerosene emulsion in mid-winter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of the apple during the winter season. I refer to the apple leaf louse, (*Aphis mali*, Fab.)"

"Soon after the young wheat plants appear in the fall the winged viviparous females of this species flock to the fields, and on these give birth to their young, which at once make their way to the roots, where they continue reproduction, sapping the life from young plants . . . though they are seldom killed outright, these infested plants cease to grow, and later take on a sickly look, and not until the aphid abandons them in autumn to return to the apple, do they show any amount of vigor. It is very seldom that the affected plants fully recover, at least in autumn; and the result must be to reduce their productiveness the following year." The eggs of the apple leaf aphid are deposited on the twigs and limbs of apple trees late in the autumn; these do not hatch until the following spring; the plant lice remain on the apple trees for two or three generations, when winged females are produced, which fly to grasses and weeds and there pass the summer. After the young wheat is up in the autumn, the lice congregate on the plants and reproduce rapidly.

The above is briefly the life history of this insect in Ohio as worked out by Prof. Webster by careful experiments which are detailed in the Bulletin. At Ottawa this probably may also, to a large extent, be the case; but the aphid is also sometimes abundant on young apple trees right through the season. It is, however, seldom injuriously abundant in Ontario, although in British Columbia it is to-day one of the most serious enemies of the apple grower.

Prof. Webster's paper will doubtless cause many other entomologists to study this insect more closely, when it is probable that further discoveries will be made, perhaps not less interesting than that now discussed.

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THE INTER-RELATION OF INSECTS AND FLOWERS.

During the last 8 years there have appeared from the pen of Mr. Charles Robertson, of Carlinville, Ill., several most interesting articles on the inter-relation of insects and flowers. The titles are as follows :

Botanical Gazette—

1886. Notes the on pollination of *Asclepias*.
 1887. Insect relations of certain *Asclepiads*.
 1887. Fertilization of *Calopogon parviflorus*.
 1888. Effect of the wind on bees and flowers.
 1888. Zygomorphy and its causes : I-III.
 1889-93. Flowers and Insects : I-XI.

Trans. Am. Ent. Soc.—

1889. Synopsis of North American species of *Oxybelus*.
 1891-93. Descriptions of new species of North American Bees.

Trans. St. Louis Acad. of Science—

- 1891-92. Flowers and Insects : *Asclepiadaceæ* to *Scrofulariaceæ*, *Umbellifereæ*, *Labiataæ*.

Mr. Robertson began in 1886 to study the visits of insects to flowers and by his persevering observations he has succeeded in collecting an enormous number of facts which he has published mostly in the *Botanical Gazette* and in the Transactions of the St. Louis Academy of Science.

He has studied the subject especially from a botanical point of view and has given particular attention to the attractions offered to insects by the flowers of different species of plants, to the peculiarities of arrangement of their different parts, to their coloration, and to the modifications which many flowers seem to have undergone from their being constantly frequented by certain species of insects.

Such studies have nevertheless an immediate bearing on entomology, as they give us at the same time an insight into the purposes of insects in visiting flowers, into their habits of feeding and collecting either nectar or pollen, or both at once, and into the intelligence they display in order to attain their end. The close attention thus necessarily given to insects, has had besides the natural result of causing Mr. Robertson to discover that many of those insects which he was observing in his locality, Carlinville, Ill., had not even been described. Therefore, he found it necessary at first to pay particular attention to collecting and determining insects. He was helped in this work by specialists in Diptera and Coleoptera, and had himself to work out and describe many species of Hymenoptera : 10 out of 14 species of *Oxybelus*, 28 out of 30 of *Andrena* and at least thirty other species of *Andrenidæ*. The descriptions of these have appeared in the *Trans. Am. Ent. Soc.*, 1889-1893.

The two great agencies of cross-fertilization of flowers are the wind and insects ; hence Mr. Robertson has thus been led to notice some interesting facts concerning the effect of wind on bees and flowers.—*Bot. Gaz.*, xiii, 1888, p. 33.

The first papers by Mr. Robertson are on the pollination of *Asclepias*, the flowers of which are most interesting in their peculiar adaptation for cross-fertilization by the agency of insects. Their structure and the great difficulty the smaller insects have in effecting pollinations, leads Mr. Robertson to believe, "that bumble-bees have had most influence in modifying the flowers, and they are the most common visitors after the hive bees. Hive bees, it is to be remembered, do not belong to our fauna."

Our space is too limited to allow us to follow the writer into what he has observed in all the different orders and species of flowering plants studied ; but the names of all the insects observed visiting the flowers, are given, as well as tabular data of the respective number of visitors of the different classes, Hymenoptera, Diptera, Lepidoptera,

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Coleoptera and Hemiptera. As an instance, it may be mentioned that on the flowers of *Ceanothus Americana* there were seen forty-eight species of Hymenoptera, forty five of Diptera, two of Lepidoptera, thirteen of Coleoptera, and four of Hemiptera; and considerations are given as in the case of all other blossoms treated of, on the arrangement of the flowers, their form, color and other peculiarities of structure, some of them exceedingly minute, in which close and patient observation often succeeds in discovering most wonderful purpose and design for insuring cross-fertilization.

These investigations are of great interest and we commend them to the attention of entomologists and botanists as a fertile field of useful special study. Our idea of mentioning these excellent articles of Mr. Robertson's is to draw to this subject the attention it deserves from entomologists, who from their place of publication might not be aware of their existence.

J. A. GUIGNARD and J. FLETCHER.

A PEN SKETCH OF PROF. WILLIAM SAUNDERS, F.R.S.C., F.L.S., ETC.*

By F. W. GODING, M.D., Ph.D., Rutland, Illinois.

A sketch of the life of Wm. Saunders is peculiarly instructive to young men, because of the fact that he has accomplished so much with so few opportunities in the way of a liberal education, having left school at the age of fourteen; but by painstaking study and observation he has risen to the topmost pinnacle of fame as an entomologist, horticulturist and experimental agriculturist. He was born in Crediton, Devonshire, England June 16, 1836. At the age of twelve with his parents he removed to Canada, and two years later was apprenticed to a chemist. After learning the art he engaged in business, continuing it in London, Ont., until his recent promotion in 1886 to the Directorship of the Dominion Experimental Farms. As a chemist and pharmacist he is well known throughout the United States and Canada, his published papers being widely copied and translated into several foreign languages. He was President of the American Pharmaceutical Association in 1877-8, while in 1874 he was elected an honorary member of the Pharmaceutical Council of Great Britain. The Canadian Government recognizing his special qualifications appointed him Public Analyst, in which capacity he did good service in detecting and exposing adulterations, especially in articles of food. He was for a number of years, preceeding his recent promotion, Professor of Materia Medica in the Medical Department of Western University in London, Ont., a position he was peculiarly qualified to fill.

Coupled with all these attainments he has others in which we are far more deeply interested. As an entomologist and horticulturist he is known to every student of either branch, and to mention all the things accomplished by him in these departments would require far more space than is allotted to this paper. He began the study of botany some thirty-five years ago, publishing the first list of plants found in Western Ontario, embracing 545 species, in 1863. Some time prior to this he captured a fine specimen of *Papilio turnus* (in 1859 or 60) and found it possessed of so many beauties that he was led to look for others. From this chance occurrence he was directed to the study of insects in general, and as an entomologist is considered second to none in point of eminence. At the time of the organization of this society, in 1863, he took an active part, and much of its present flourishing condition is due to his careful management as President, a position he occupied during the greater part of its existence. While editor of the *Canadian Entomologist*, the only entomological magazine ever published in America that has been able to live to attain its majority, he was also one of its principal contributors, his articles published therein and in your society reports reaching many hundreds. The

*This account of the life of Prof. Saunders, whose portrait is prefixed to this Report, was written two or three years ago, and will be read with interest as conveying the impressions of a foreigner, who cannot be charged with the partiality of intimate friendship.—ED.

crowning work of his pen, however, is his "Fruit Insects," a magnificent volume of 436 pages, which has reached the second edition. The book has been received all over the world as the most valuable work of the kind ever published. One reviewer says of the book:

"We do not think that we are speaking too highly in praise of the work—though we admit it is saying a great deal—when we express our opinion that Mr. Saunders's volume will take rank with that standard of excellence, Harris's injurious insects of Mass., and that he has done for insects affecting fruits at the present day what his justly famed predecessor accomplished long ago for those injurious to vegetation in general."

It appears that the work was just what was wanted from the immense sale of it, about 2,500 copies having been sold. This seems all the more strange when it is stated that the average circulation of entomological works rarely exceeds two or three hundred copies.

Since 1867 he has been a director of the Fruit Growers' Association of Ontario, and its president since 1882. In his experimental grounds he has tested a great variety of fruits, laboring constantly to ascertain which are best adapted to the climate of Canada. In this manner he has, by experiments in cross-fertilization, obtained several good raspberries, gooseberries and grapes. His interest in horticulture and forestry has prompted him to become familiar with these important departments and caused him to awake general interest in these matters in the province in which he lives.

A special commission was appointed by the Government of Ontario, in 1880, to inquire into the progress and condition of agriculture in the Province. As one of the commissioners, Mr. Saunders was charged with the special duty of inquiring into the subjects of fruit growing and forestry, insects and insectivorous birds, and bee-keeping. In his report, published in a large 8vo volume of over 850 pages, he treats each of these subjects as one familiar with them, leaving no topic to be hereafter completed.

As a result of this careful inquiry into the agricultural condition of the Province, the Government caused to be purchased large tracts of land located in the various Provinces, to be known as the Experimental Farms, which were fitted up with all modern appliances and buildings, properly stocked, and then placed Prof. Saunders in charge as Director. Probably nowhere in the Dominion could be found a man so well qualified, by education, tastes and executive ability, as he, to be placed in this responsible position. Already this institution has taken a front rank among similar ones and under Prof. Saunders's charge is destined to become second to none.

Prof. Saunders's services have been recognized in various ways. Some years ago he received from the Duke of Mantua and Montserrat a handsome gold medal in acknowledgment of valuable services in the interests of natural science. He is Fellow of A.A. A.S.; of Linnean Society of London, and of Royal Microscopical Society of London, England; one of the twenty original members of the Royal Society of Canada; Corresponding Member of American Entomological Society; Natural History Society of Montreal; Buffalo Society of Natural Science, etc., etc.

He was married August 1st, 1857, to Sarah Agnes, daughter of Rev. J. H. Robinson, of London, Ontario. They have six children, one daughter and five sons. Several of the latter have inherited the tastes of their honored sire, and are working their way into public favor.

Prof. Saunders is five feet ten inches in height, with a symmetrical figure, and weighs about 175 pounds. His hair is dark brown, his eyes blue. He is one of the most approachable of men, with a look of kindness ever beaming from his genial countenance, yet with a quiet dignity which forbids familiarity.

And now our pleasant task is done. Prof. Saunders at last has found a sphere in which his broadly developed abilities have ample space in which to labor. And here we leave him with the agricultural eyes of Canada ever upon him, awaiting developments that are sure to come and wholly for their interests.

OBITUARY.

THE LATE DR. HAGEN.

Hermann August Hagen was born May 30, 1817, at Königsberg, in Prussia. His parents were Carl Heinrich Hagen, Professor of Political Economy, Technology and Agriculture at the University of Königsberg, and Anna Dorothea Linch. His first instruction was received at the gymnasium "Collegium Friedericianum," whence he was transferred in 1830 to the "Kneiphofische Gymnasium." He graduated in 1836, studied medicine at the University of Königsberg and received the degree of Doctor of Medicine in 1840. After the death of his grandfather, Carl Gottfried Hagen, Professor of Natural History in Königsberg, the latter's entomological collection and library came into the possession of the grandson. Under his father's direction he studied entomology in his leisure time, collecting chiefly Odonata, because by chance the first specimen he caught proved to be an undescribed insect of that order. While he became gradually more interested in this particular study, he had the benefit of some instruction from two eminent and still active naturalists, Theodor von Siebold and Carl Ernst von Baer, who called his attention to the necessity of the study of medicine for the naturalist, the knowledge of pathology being indispensable to a comprehension of any normally constituted organism. He attended also for several years the lectures of Professor Rathke, the celebrated embryologist, and accompanied him in 1839 on his scientific journey through Norway, Sweden and Denmark, studying chiefly the anatomy and habits of marine animals. In 1840, he published at Königsberg, as a dissertation for the degree of Doctor of Medicine, a little work entitled "Synonymia Libellularium Europæorum." From 1840-1 he studied at the University of Berlin and passed, according to the law of Prussia, the necessary examinations as physician and surgeon. He then travelled through the greater part of Europe. In Vienna he attended clinical and medical lectures for six months, and in Paris for nearly a year. The study of natural history was in the meantime always pursued, so far as time and circumstances allowed, and his acquaintance with Baron de Selys-Longchamps, of Liege, made in Paris, 1842, gave rise to a series of entomological publications containing their combined studies of the family of the Odonata. He was favored at this time with the counsel and encouragement of the prominent entomologists, Klug, Erichson, Kollar, Von Siebold, and many others whose personal acquaintance he had made during his travels. He returned to Königsberg in 1843, and settled there as a practising physician. For three years he was first assistant at the surgical hospital, performing the greater part of the operations. In 1851 he was married to Johanna Maria Elise Gerhards. His duties as a physician limiting his studies in natural history to leisure hours, he confined himself to entomology (with especial reference to the Neuroptera), entomological biology, and the study of the microscope. The fear of wasting time in investigating subjects which had already been elucidated induced him to catalogue carefully all accessible entomological publications. This compilation, begun for his own use, was afterwards published as "Bibliotheca Entomologica," in two volumes, Leipzig, 1862. Alone, or jointly with Baron de Selys-Longchamps, he has published in various scientific periodicals a large number of notes, papers and monographs, all of which, up to 1861, are mentioned in his "Bibliotheca." His first publication was made in 1834, on "Prussian Odonata." It was his wish to prepare monographs in all families belonging to the Linnæan Neuroptera, but circumstances did not permit the full execution of this plan. In 1849, 1857 and 1861 he made extended scientific journeys through Germany, Belgium, Holland and England for the sake of comparing collections and libraries. From 1863-67, his official duties as Vice-President of the City Council and Member of the School Board of the City of Königsberg left him no leisure. A large number of reports on a great variety of subjects relating to these duties demanded much careful study. Some of them, as for instance one on "Life Insurance," are exceedingly elaborate treatises. In 1863 he received the honorary degree of Doctor of Philosophy from the University of Königsberg.

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He was corresponding or honorary member of a large number of learned societies. In 1867 Professor Agassiz invited him to come to Cambridge as assistant in entomology, and in 1870 he was appointed Professor of Entomology in Harvard University.*

"Dr. Hagen entered upon his duties at the Museum with great zeal; and his detailed plan for the arrangement of the collections, though somewhat modified, is, and is likely to remain, the basis for the future. Deeply interested in everything relating to museum work, as his appreciation of series of specimens, his care for their preservation and for the accuracy of their localities, and many minor details, clearly indicate, it is in this collection as well as in his writings that his contributions to science are to be found. Here alone we can fully realize the extent of his discoveries, the keenness of his insight, his skill at preparation and dissection, and with the pencil. His devotion to the Museum knew no bounds; all personal interests were secondary. In 1876 he refused a most flattering and urgent invitation to take charge of the great entomological collections of the Konigliches Museum für Naturkunde in Berlin, and the time that might have been given to original work was lavished upon the care and arrangement of the collections, which grew rapidly both in size and value. The biological collection, or that illustrating the life history of the species, is a prominent specialty of the Cambridge Museum. In this are preserved specimens showing every condition of an insect's life, the eggs, larvæ in all stages, from those just hatched to those full-grown, their burrows, nests, partially devoured leaves, etc., the work of both larvæ and adults, the frass or excrements often of great importance, pupal stages, adults of both sexes, and the parasitic and predaceous enemies, also in all stages of development. Dr. Hagen's influence upon the formation of such biological collections has been very great; few were in existence at the time when, almost unaided, he created that at Cambridge, and the care and elaborateness with which the whole is labelled makes it not only a worthy model, but most truly a monument to persistent and well-directed industry.

"His lectures, given at rare intervals to advanced students, contained much genuine and exact knowledge, and his many acts of kindness and words of wise counsel will not soon be forgotten by those who enjoyed the facilities of the Department under his charge.

"Most of Dr. Hagen's journeys were undertaken for study among collections and in libraries. In the summer of 1882, however, accepting the generous and thoughtful invitation of Professor Raphael Pumpelly, at that time Director of the Northern Transcontinental Survey, he visited California, Oregon, Washington and Montana. The object of the survey was to collect data concerning insects injurious to vegetation, both of the field and of the forest. The greater part of the time was spent in the Yokima and Columbia regions of Washington; many important entomological discoveries were made, some with a direct economic bearing, and large collections of insects were obtained from a most interesting locality.

"Dr. Hagen was a man of marked character, simple and sympathetic, and if at times somewhat hot and hasty in temper and impatient of opposition, he had also one of the warmest of hearts and most generous of dispositions. His unostentatious hospitality was enjoyed by many entomologists, who found his life in Cambridge quiet, contented and happy.

"Of Dr. Hagen's domestic life it is sufficient to record here that in 1851 he married Johanna Maria Elise Gerhards, who survives him.

"Dr. Hagen received the honorary degree of Doctor of Philosophy from the University of Königsberg in 1863. Harvard made him a Doctor of Science in 1887. The renewal of his medical degree on the 17th of October, 1890, the date of his graduation fifty years previously, after the custom of German Universities, gave him great pleasure. He was elected a fellow of the American Academy of Arts and Sciences, November 11, 1868, and served on the Council in 1877-78. He was also a member of a goodly number of scientific associations and most of the entomological societies the world over were glad to enroll him as an honorary member.

* From "Biographies" following Thomas S. Cary's sketch. "The Museum of Comparative Zoology," in *The Harvard Book*, by F. O. Vaille and H. A. Clark. Cambridge, 1875, Vol. I., p. 345-346, with portrait.