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ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO,

FOR THE YEAR 1876.

INCLUDING REPORTS ON SOME OF THE NOXIOUS, BENEFICIAL, AND OTHER INSECTS OF THE PROVINCE OF ONTARIO.

PREPARED FOR THE HONOURABLE THE COMMISSIONER OF AGRICULTURE, ON BEHALF OF THE SOCIETY,

BY

WILLIAM SAUNDERS,

President of the Entomological Society of Ontario; Editor of the Canadian Entomologist,

REV. C. J. S. BETHUNE, M. A.

Head Master of Trinity College School, Port Hope; Vice-President of the Entomological Society of Ontario;

AND

JOSEPH WILLIAMS,

London, Ontario.

REPORT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO, FOR THE YEAR 1876.

To the Honourable the Commissioner of Agriculture:

SIR,—I have the honour to submit, herewith, for your consideration, the Report of the Entomological Society of Ontario, for the year 1876, including a detailed statement of the receipts and expenditures during the year, all of which have been duly audited.

The Canadian Entomologist, the monthly organ of our Society, continues to be regularly issued about the 15th of each month, and has, during the past year, contained a

great many papers of much practical value. It has now nearly reached the close of its eighth volume, and throughout its issue it has been almost entirely filled with original matter: hence it has become such a depository of the results of entomological observation, that no student of American entomology can dispense with it. Yearly it is growing in favour in European and American scientific circles, and continues also to carry on a good work in our midst by the diffusion from month to month of much valuable information in reference to insect life about us.

The Annual Meeting of the Society was held this year in the City of Hamilton, during the time of the exhibition of the Agricultural and Arts Association, in accordance with the provisions of the Statute, when the various reports were read and approved, and the officers for 1877 duly elected.

I have also the pleasure of submitting a Report on some of the noxious, beneficial, and other insects of the Province which have been prepared on behalf of the Society by Mr. Wm. Saunders, Rev. C. J. S. Bethune, M.A., and Mr. J. Williams.

The pages of this Report will be found illustrated with many excellent cuts, a number of which are entirely new; we have also a plate of a very excellent character, illustrating some of the insects treated of: a new feature in our Reports, and one which we believe will add greatly to their interest.

I have the honour to remain, Sir,

Your obedient servant,

J. H. McMechan,

Secretary-Treasurer Entomological Society of Ontario.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The sixth annual meeting of the above Society was held in the Court House in the City of Hamilton, on the 20th day of September, when the various reports of the officers were read and adopted, followed by the delivery of the President's annual address, a copy of which was requested for publication.

The election of officers for the ensuing year then took place, with the following results:—

President.—W. Saunders, London.

Vice-President.—Rev. C. J. S. Bethune, M.A., Port Hope.

Secretary-Treasurer.—J. H. McMechan, London.

Council.—Wm. Couper, Montreal; R. V. Rogers, Kingston; E. B. Reed, and J. M. Denton, London; J. Pettit, Grimsby.

Editor of Entomologist.—W. Saunders, London.

Editing Committee.—Rev. C. J. S. Bethune, M.A., Port Hope; E. B. Reed, London; and G. J. Bowles, Montreal.

Library Committee.—Messrs. Saunders, Reed, Denton, and McMechan, London.

Committee on Centennial Exhibition.—W. Saunders, Rev. C. J. S. Bethune, M.A., and J. H. McMechan.

Auditors.—J. Williams and Chas. Chapman, London.

FINANCIAL STATEMENT OF THE SECRETARY-TREASURER.

Receipts.

To Balance from 1875	$232 33
" Cash refunded from Centennial account	50 00
" Government Grant for Centennial exhibit	500 00
" Annual grant, 1876	750 00
" Members' Fees	237 70
" Sales of corks, pins, &c., to members	107 32
	$1877 35

Disbursements.

By *Canadian Entomologist*, printing and paper	$391 71
" Engravings	83 63
" Expenses of Annual Report	84 00
" Library	42 47
" Editor's salary	100 00
" Secretary-Treasurer's salary	50 00
" Travelling expenses officers' attending meetings	86 25
" Expenses, sundry small	38 72
" Rent of hall	80 00
" Cork, Pins, &c	163 46
" Collection California Coleoptera	30 12
" Centennial Exhibition expenses	541 39
" Balance cash on hand	185 60
	$1877 35

We certify that the above is a correct statement of accounts for the year ending, September, 1877, as shown by the Treasurer's Books, with vouchers for disbursements.

CHAS. CHAPMAN,
J. WILLIAMS, } *Auditors.*

REPORT OF THE COUNCIL.

It is our pleasing duty, at this the sixth anniversary of our Society, to draw attention to the increasing importance of its work, and the growing interest manifested by many in its welfare. The importance of the study of insects is yearly becoming more felt, so much so that it is being introduced in common with other departments of natural history in some of our best schools.

The preparation of the collection of Canadian insects by our Society for the Centennial Exhibition has been a great success. When we ventured the opinion in our last report that this collection would prove an interesting feature in the Canadian Department, and would be in every way worthy of our Society, we scarcely looked for the magnificent display which has since been brought together; a collection of our insects far surpassing anything ever before seen. This collection will, it is hoped, be preserved as far as possible in its present condition, as a collection of reference for the use of our members. In this way it will be of great service to many who have hitherto found great difficulties in the way of procuring the correct names of insects on which they had recorded observations, or which they had collected for their cabinets.

The meetings of the Entomological Club of the American Association for the Advancement of Science were held at Buffalo, beginning on the 22nd day of August. Our Society was represented by three of its prominent and active members: our President, W. Saunders; Vice-President, Rev. C. J. S. Bethune; and Mr. E. B. Reed, all of whom took part in the discussions which took place at the several meetings. Some important conclusions were reached in reference to entomological nomenclature, and a series of rules presented and partially adopted which we hope will greatly tend to the permanency of the names of our insects. Many interesting features of insect life were brought under the notice of the members, and several important papers read. A full report of these meetings will be found elsewhere.

The eighth volume of our monthly magazine is nearly completed, and fully sustains the reputation it has hitherto acquired as a valuable medium for the publication of original observations on insects. In such a journal as ours the great bulk of the matter must necessarily be scientific, and cannot be void of technicalities; yet we are pleased to record

the efforts which have been made to present our readers who are not deeply versed in the science of Entomology with such matter as will interest and instruct them.

Our branches in London, Montreal, and Kingston, are still carrying on the good work in their respective spheres; we hope that the coming year will witness a large accession to the number of their members.

Submitted, on behalf of the Council, by

J. H. McMechan,
Secretary-Treasurer.

ANNUAL MEETING OF THE LONDON BRANCH.

The annual meeting of the London Branch of the Entomological Society of Ontario was held on the 18th day of January, 1876, at the Society's rooms.

The minutes of the last meeting having been read and approved, and the usual routine business transacted, the following gentlemen were elected as officers for the year 1876:—President, G. Geddes; Vice-President, H. B. Bock; Secretary-Treasurer, J. M. Denton; Curator, Chas. Chapman; Auditors, J. H. McMechan and J. H. Griffiths.

The annual report of the Secretary-Treasurer, which had been duly audited, was then read, conveying the pleasing intelligence that there was a balance to the credit of the Branch, after all the current expenses of the year had been defrayed.

REPORT OF THE COUNCIL OF THE LONDON BRANCH.

The Council of the London Branch of the Entomological Society of Ontario feel gratified at the continued interest manifested in Entomological matters by our members. This interest and zeal was especially apparent during the earlier months in the year, when the collection of the Parent Society was being prepared for exhibition at Philadelphia. Then meetings were frequently held, and labours in connection with this undertaking assiduously followed day after day, and we believe that to the efforts of the members of the London branch may be attributed a large measure of the success which has attended the preparation of this collection; the pledge given last year that our members would do their utmost has certainly been fully redeemed. Following the completion and shipment of this collection, Centennial engagements and the approach of the collecting season interfered for a time with the regularity of our meetings.

Some interesting additions have been made to the collections of our members during the summer by captures at sugar, and otherwise, further establishing the favourable position of London and its surroundings as a collecting ground. We hope that with the increased facilities for naming insects which will be afforded by the return of the Society's collection from Philadelphia, that many will be attracted to our ranks, and thus the interests of Entomology be still further subserved.

On behalf of the Council,

John M. Denton,
Secretary-Treasurer.

ANNUAL MEETING OF THE MONTREAL BRANCH.

The third annual meeting of the Montreal Branch of the Entomological Society of Ontario was held on the 2nd of May, 1876, when the following officers were elected for the ensuing year:—President, G. J. Bowles; Vice-President, F. B. Caulfield; Secretary-

Treasurer, Geo. B. Pearson; Curator, C. W. Pearson; Council—W. Couper, H. H. Lyman, and Robert Jack.

The reports of the Council and Secretary-Treasurer were read and adopted.

All business communications to be addressed to G. B. Pearson, 83 Cathcart Street, Montreal, P.Q.

ANNUAL REPORT OF THE COUNCIL OF THE MONTREAL BRANCH OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

Your Council, in presenting their third Annual Report, would congratulate the Society on the solid progress made during the year. Although the membership has not increased, much good work has been accomplished, and great interest taken by the members in the study of our science. The monthly meetings have been well kept up during the year, and many interesting insects, both native and foreign, brought before the members. Your Council would remark, that as the result of your labours, the Lepidoptera of the district have been well worked up, and some progress made with the Coleoptera and Orthoptera. The other orders, however, have been comparatively neglected.

Your Council would recommend the members to collect *all* the orders, so that the work of the Society may be better developed and material gathered for future study.

The following papers have been read during the year:—

"On the extraordinary flight of *Danais Archippus*," by Geo. B. Pearson.

"The excursion of the Montreal Branch on Dominion Day," by Geo. B. Pearson.

"List of *Noctuidæ* taken at sugar, at Chateauguay Basin, on 1st July, 1875," by F. B. Caulfield.

"Description of a new species of *Dryocampa*," by G. J. Bowles.

"Notes on *Biston Ursaria*—Walker," by G. J. Bowles.

"List of *Lepidoptera*, collected at the Godbout River," by W. Couper.

"Notes on sugaring for *Noctuidæ*," by F. B Caulfield.

"Notes on the remarkable variations of *Colias Philodice*," by Geo. B. Pearson.

"Description of the larvæ and chrysalis of *Grapta interrogationis*," by H. H. Lyman.

"Notes on some species of *Orthoptera* occuring on the Island of Montreal," by F. B. Caulfield.

"A proposal to compile the Montreal Catalogue," by G. J Bowles.

"On Scudder's historical sketch of the generic names proposed for Butterflies," by W. Couper.

"On *Platysamia Columbia*," by F. B. Caulfield.

"List of the Diurnal *Lepidoptera* of Portland," by H. H. Lyman.

"List of the *Bombycidæ*, occurring at Montreal," by F. B. Caulfield.

"Our work," by C. W. Pearson.

"List of *Noctuidæ* occurring at Montreal," by F. B. Caulfield.

"On the Snow Fly found in April, at Rivière du Loup en bas," by W. Couper.

Your Council have great pleasure in thanking our worthy President for a valuable check-list which he has compiled, for cataloguing the insects of all the orders occurring on the Island of Montreal. This is a work that was very desirable. On the kind invitation of Robert Jack, Esq., the members proceeded to Chateauguay Basin on the 1st of uly last year, and spent a very pleasant and profitable day in collecting in that neighbourhood, and in enjoying the generous hospitality of Mr. Jack and his family.

The following books have been donated to our library during the year:—

Vol. I. "Memoirs of the American Association for the Advancement of Science," donated by S. H. Scudder, Esq.

"Revision of the hitherto known species of *Chionobas* in North America," donated by S. H. Scudder, Esq.

"Notes on some New England Orthoptera;" "The Two Principal Groups of Urbicolæ (Hesperidæ);" "Notes on the Species of Glaucopsyche from East North America;" "Entomological Notes," Nos. 1, 3, and 4; "An Historical Sketch of the Generic Names

Proposed for Butterflies;" "Recherches sur les Mœurs des Fourmis Indigenes," by P. Huber; "De partibus quibus insecta spiritus ducunt," by Christianus Loewe, all of which were generously donated by S. H. Scudder, Esq., of Cambridge, U. S. "Entomological Contributions," Nos. 1, 2, and 3, also kindly donated by J. A. Lintner, Esq., of Albany, New York, and vols. 1, 2, and 3, "Bulletin of the Buffalo Society of Natural Sciences."

"Notes on the North American Lepidoptera contained in the British Museum;" "List of the North American Platyptirices, Attaci, etc., etc., with Notes;" "List of the North American Noctuidæ." two numbers, all of which were generously given by Aug. R. Grote, Esq., Buffalo, New York.

All of which is respectfully submitted.

WILLIAM COUPER,
Chairman.

GEO. JNO. BOWLES,
President.

G. B. PEARSON,
Secretary-Treasurer.

ANNUAL ADDRESS OF THE PRESIDENT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

To the Members of the Entomological Society of Ontario:—

GENTLEMEN,—In accordance with time-honoured usage, it devolves upon your retiring President at the close of another year of the existence of our Society to offer you a few remarks bearing upon the objects and interests of our body, or of Entomology in general.

And first, gentlemen, I desire to congratulate you on the continued prosperity of our Society and the increasing interest felt and manifested in the furtherance of the chief objects we as an organization have in view, viz., the diffusion of practical information in reference to the life history and habits of our insects, so that we may be able to distinguish our friends from our foes, and thus be placed in a position to apply intelligently such remedial measures for the check of insect ravages as experience may suggest to be most practical and effective.

During the past year circumstances have arisen which have brought our Society more prominently before our people than ever before, notably the fact of the accumulation of that grand collection of Canadian insects which we have prepared and forwarded to the Centennial Exhibition in Philapelphia. My esteemed predecessor, in his annual address last year in Toronto, referred to this proposed work, and expressed himself as confidently anticipating the active co-operation of our members in all sections of our country. The result has more than realized our fondest hopes; our members entered most heartily into the work, bringing together a collection of Canadian insects far surpassing anything ever before seen. The carrying out of the details of this work was entrusted last year to a special committee, consisting of Messrs. Bethune, Saunders and McMechan, and upon consultation it was resolved to accumulate all the material for this collection at the Society's headquarters in London, and there make such selections from the insects sent as might seem desirable. All our members in London who had collections, freely placed them entirely at the disposal of the committee, while many of those resident in other localities throughout the country expressed their readiness to contribute anything or everything in their power to fill up blanks in the desired series of specimens.

As is usual in such cases, the bulk of the work of arranging, classifying and labelling specimens fell upon a few individuals. It affords me much pleasure to have the opportunity of naming especially *one* who has laboured most assiduously and has contributed more than any other person towards the success of this enterprise; I allude to my esteemed friend, Mr. Johnson Pettit, of Grimsby, who arranged the entire collection of Coleoptera and freely contributed from his own stores—the accumulation of years—a large proportion of the specimens. The extreme neatness and care manifested by him in the mounting and arrangement of the insects has been the admiration of all, and some idea of the

accuracy of his determinations may be arrived at when I say that such authorities as Dr. Horn and Dr. LeConte, of Philadelphia, after a critical scrutiny of the whole series of Coleoptera, filling some twenty-seven cases in all, could only detect two or three errors, and these among the smallest and least conspicuous specimens; such results reflect great credit on the labours of our esteemed coadjutor. In the arrangement of the other departments, your President was ably aided by several gentlemen, notably Messrs. E. B. Reed, J. M. Denton and G. Geddes, of London; indeed, all our London members were ever ready to render all the assistance in their power.

The expenses necessarily attendant on this work have been considerable. The making and lining of suitable cases in which to display the insects, the printing of labels, &c., and the numberless outlays entailed by the transmission of specimens to and fro from all parts of the country, as well as many other incidentals which it is needless to enumerate here, combined, have involved a large outlay. This has been chiefly met by a special grant of five hundred dollars from the Government of Ontario, the remainder being drawn from the Society's resources.

To make the collection as perfect as possible, as far as accurate naming is concerned, the doubtful specimens in the orders most largely represented were submitted to the examination and correction of specialists. The entire collection of Lepidoptera was carefully gone over by Prof. A. R. Grote, of Buffalo, who generously placed his services at the disposal of the Society for this purpose, and twice visited London in order to complete the work. Dr. Horn also kindly rendered all possible aid in the determination of such Coleoptera as were sumbitted to him, and to Dr. A. S. Packard we are indebted for naming some of the Geometridæ.

The collection arrived safely and in good condition in Philadelphia, where it at once attracted much attention. The whole display consisted of eighty-six glass cases, forty-five of which were filled with Lepidoptera, twenty-seven with Coleoptera, and the remaining fourteen occupied by the other orders, the whole arranged in a double row on a suitable stand *seventy-six* feet in length, in the Canadian Department in Agricultural Hall.

There were no other collections on exhibition in Philadelphia which would compare favourably with that sent by our Society. There was a very good one in the United States Government Building, from the Department of Agriculture in Washington, arranged by Prof. Townend Glover; this, however, consisted chiefly of Lepidoptera.

There was a small collection shown in the Canadian Department, adjoining that of our Society, consisting of four or five cases, containing Canadian insects, representing the various orders; they came, I believe, from Montreal, but I did not succeed in finding the name of the party to whom they belonged. Through the neglect or carelessness of our Canadian Commission, neither this collection nor that of our own Society *are mentioned* in the official catalogue, do not appear to have been entered as belonging to any department of the exhibition, and hence were not examined at all by the Centennial judges. Had it been otherwise, we should no doubt have been honoured with awards which, in the case of our Society, if we may judge from the laudatory comments of those best able to form an opinion, were well deserved.

In the Kansas State Building there was a collection from the State Board of Agriculture, arranged by Prof. Snow, consisting of thirty cases: sixteen of Lepidoptera (seven of butterflies and nine of moths), five of Coleoptera, two Neuroptera, two Orthoptera, three Hymenoptera, one Diptera, and one Hemiptera. These were very well set up, classified, and nearly all named, and were very creditable to Prof. Snow and the Board by whom they were sent. There was, nevertheless, one drawback to viewing them with any satisfaction: the dust was allowed to accumulate on the glasses to such an extent as to obscure the objects contained.

There was a collection from Brazil, shown in the Brazilian Department in the Main Building. This, we were told, was the work and property of a private gentleman residing in Rio Janeiro; it was arranged in thirty-five cases, thirty-one of which were Coleoptera and four Lepidoptera. This collection was very much mixed; there was no attempt made to name the insects, except to the extent of partially indicating the family names. Neither was there much effort towards a correct classification; they seemed to be partly arranged with regard to their natural relationship and partly with the view of display. Among the butterflies and moths there were some superb specimens whose brilliance at-

tracted much attention. There were also some very beautiful and interesting things among the Coleoptera. The Curculionidæ were very brilliant and numerous in species, with forms greatly varied; the Cerambycidæ were also remarkable, handsome, and largely represented, some of them of great size. We noticed one enormous *Prionus* fully six inches long; the *Cetonias* were also very beautiful. Some of the Buprestidæ were wonderfully brilliant with metallic shadings, and the Chrysomelidæ very numerous, and some of them very charming, the Cassidæ being largely represented. Among the Scarabeidæ there were some enormous specimens, among others, species of *Copris* with remarkable horns, and some brilliant species of *Onthophagus*; there were also a number of very handsome *Elaters*. One of the rarities in this collection was a fine example of *Hypocephalus armatus*, an extremely rare insect about two inches in length, and of which it is said there are only two or three known specimens in collections. The more brilliant Brazillian insects, especially the Coleoptera, are largely employed by the inhabitants of that country in the ornamentation of jewellery and other fancy articles, often associated in the latter case with the feathers of their brilliant plumaged birds.

In the Department of Queensland there was a large case, filled chiefly with Lepidoptera in a fine state of preservation, embracing many very beautiful and strange-looking things; almost the only familiar objects among them were specimens of *Danais archippus*. In this instance, also, none of the specimens were named, which detracted greatly from the interest which would otherwise have attached to them. We learned that this collection had been sold for $150 to Mrs. Brigham, of New York, a lady who, we believe, takes a deep interest in Entomology, and who has a very large and handsome collection of Lepidoptera.

The Orange Free State of South Africa exhibited two cases of insects, among which there was a curious admixture of millipedes, scorpions and spiders, arranged in a semi-ornamental manner. One case contained chiefly Coleoptera, with a few Hymenoptera, Hemiptera and Orthoptera. Among the Coleoptera there were some curious and beautiful forms, especially among the Cetonidæ and Cerambycidæ; also some handsome Scarabeans, Chrysomelans and Curculios. The second case was filled mainly with butterflies, among which there were a few very handsome ones. That cosmopolitan species, "the painted lady," *Cynthia cardui*, was represented by several specimens; there was also a *Sphinx* closely resembling the death's-head moth of Europe, and a *Utesthesia* very like our *bella*. Besides these there were a number of very curious and handsome moths, with a few Orthoptera and Neuroptera. No attempt was made in the way of naming anything in this collection, nor any effort at classification.

An American gentleman, whose name I did not learn, had a very curious exhibit of insects in Agricultural Hall, of a purely ornamental character, in three cases. One was a circular arrangement, and was built up chiefly with butterflies and moths; the other two represented public buildings and were constructed of beetles; the specimens were immensely numerous and well preserved; the whole arrangement indicating great ingenuity and perseverance on the part of the collector.

India had a very fine exhibit of silks, raw and manufactured, with the insects and cocoons from which they were obtained. The Tusseh silk-worm moth, *Antheræ paphia*, is very handsome, not unlike our *polyphemus;* the cocoon is egg-shaped, and yields a very strong-looking silk. The *Bombyx Huttonii*, or wild silk-worm moth, is also very pretty; in form it resembles *B. mori*, but its wings are beautifully marked and tipped with brown.

It was very gratifying to observe the prominence given to the study of Natural History in the Educational Departments of many of the nations thus represented at the Centennial. Nearly all of them had small collections illustrating the course of teaching in this branch of study, and in nearly every instance Entomology occupied a prominent position. In the model schools of Sweden and Belgium this was very noticeable; also in the Russian exhibit, where there were cases of insects of all orders, including in many instances the blown larvæ very neatly set up. In the same department in the Japan exhibit there were similar cases fairly classified, illustrating the various orders. The Chinese make use of insects, too, but with them they are used as medicines; among their *materia medica* collections we observed dried caterpillars, the empty pupa cases of a species of *Cicada*, and other similar substances, all extolled as possessing rare medicinal virtues.

The bringing together of such an immense number of agricultural productions as are now on exhibition in Philadelphia, including almost every variety of grain, peas, beans and other useful productions on the face of the globe, affords a favourable opportunity for the introduction of any insect pests which may infest these articles in the country of their growth; these, if introduced and acclimatized, may attack similar or related products in this country, unless precautions are taken against their dissemination, and thus we may have new foes to fight which may be very difficult to contend with. The American Centennial Commission, who do not seem to have overlooked anything, have, with wise foresight, appointed a special Commission of eminent Entomologists to report on the insects introduced along with the products exhibited. This report will be looked forward to with much interest by agriculturists as well as Entomologists.

The Agricultural Building in which our insects were shown, was well supplied with skylights, which admitted a flood of light on everything below. Exposure to this brilliant light for so many months has had a damaging effect on the colours of some of our Lepidoptera, the moths being much more faded than the butterflies; this fading is especially noticeable in insects having any red colours on their wings, such as the Catocalas and Arctians; many of these, however, can be replaced without much difficulty.

Suitable arrangements have been made for the careful packing and re-shipping of the insects at the close of the Exhibition, when they will be forwarded to the Society's rooms in London, Ont. Here it is proposed to keep the collection as far as possible undisturbed, where it will serve a good purpose as a collection of reference for collectors to name their specimens from. Mr. Pettit has kindly consented to allow all that he has contributed to remain in the Society's rooms, and all the London members will follow his example. Mr. Wm. Couper, of Montreal, has generously donated all he has sent to the Society, and I doubt not that most of our other friends in Montreal and elsewhere, who have contributed to the collection, will allow such of their insects as are not represented in our cabinets in London, to remain at least for a time, when no doubt most of them could be replaced. The advantages which will result to our Society from the possession of a collection so well worked up and so correctly named, can scarcely be overestimated, affording as it will, conveniences to collectors for naming specimens such as we have never had before. If for no other reason, we shall, in the possession of these advantages, always have cause to remember with pleasure the hundredth anniversary of American independence.

The continuance of the organ of our Society, the *Canadian Entomologist*, has also contributed greatly to the maintenance of the interest felt in our Society. During the past year important matters have been discussed in its pages, and a mass of new facts, throwing light on the habits and life history of many of our insects, placed before our readers. Much space has also been given to the important department of descriptive Entomology. Indeed, I scarcely think we should be deemed presumptuous in saying that our little journal is an important bond which does much to bind together the brotherhood of Entomologists throughout America.

The recent action of American Entomologists on the subject of Entomological nomenclature claims more than a passing notice. At the meetings of the Entomological Club of the American Association for the Advancement of Science, held last month in Buffalo, N.Y., this important subject was discussed and conclusions reached in reference to it which, I hope, will greatly tend to the stability of our nomenclature, the great end and aim which all parties claim to have in view. Amidst the conflicting opinions held by leading Entomologists on this subject, it was scarcely to be expected that entire unanimity could be secured; but it was most gratifying to notice the conciliatory spirit manifested by all, and the desire apparently as far as possible to meet each other's views. A series of resolutions touching on important points was presented by the Committee named last year to report on this subject, and on some of these they were unanimous, while on others there was a divided opinion. Those rules which were unanimously adopted will, it is understood, be strictly carried out by all who were present, while those on which there was expressed a divided opinion will, in the meantime, be left to be acted on or not, as the individual choice may dictate. Although this does not leave the subject in as satisfactory a state as entire unanimity would have done, still it was felt that by the action taken very much had been done towards settling some of the disturbing elements

which interfere with the fixity of nomenclature. A report of these important meetings will be found in the *Entomologist;* we commend them to the careful perusal of our readers. Our own Society was well represented in this gathering by the presence of the Rev. C. J. S. Bethune, M.A., E. Baynes Reed, and your President.

I shall not attempt, gentlemen, to trespass longer on your time and patience. Thanking you for your kind partiality in electing me to fill so important an office among you,

I have the honour to be, very sincerely yours,

WM. SAUNDERS.

London, September, 1876.

REPORT OF THE COMMITTEE ON CENTENNIAL EXHIBITION.

Your committee take much pleasure in reporting the great success which has attended the enterprise of which they have had charge, a success indeed greater than the most sanguine had anticipated. On entering upon our labours the magnitude of the undertaking was such, that we felt some misgivings. To get together such a collection as would do credit to our Society and to the Province we have the honour to represent, in so short a time as that allotted to us was felt to be no mean task, but having resolved to do our best, work was begun without delay.

On mature deliberation it was thought best to bring together in London, all the insects that could be procured from the collections of all our members in Canada, and there making the Society's rooms our head-quarters, to assort and arrange them as experience might suggest. Our first attention was given to the preparation of suitable cases in which to place our specimens, which should be as near as possible dust-proof and pest-proof It was finally determined to adopt the form of case used in the Zoological Museum, at Cambridge, Mass., with some slight modifications; and having been furnished through the kindness of Professor Hagen, with a sample case as a pattern, we had but little further difficulty in this matter. To secure the specimens against injury during the transportation to so great a distance, we thought it necessary that the bottoms of the cases should be lined with cork of extra thickness, so that when the pins on which the specimens were mounted were thrust into it they should be held firmly in place. We accordingly ordered from a cork factory in Manchester, England, a sufficient supply for this purpose, of double the ordinary thickness, and when the drawers were lined with this cork, and the pins firmly inserted, it was almost impossible with any ordinary amount of jarring or shaking to displace them.

The work to be done on the Coleoptera was very laborious. This was kindly undertaken by Mr. Johnson Pettit, of Grimsby, and to his labours and kind contributions of material, we are indebted for much of the success of our enterprise. The writer undertook the work needed on the Lepidoptera; Mr. E. B. Reed devoted his attention to the Hemiptera and Diptera; Mr. Geddes, to the Hymenoptera; and Mr. J. M. Denton, to Orthoptera. By this division the labour was lightened, and the work progressed rapidly. The following collections in London were placed entirely at our disposal, viz:—Those of Messrs. W. Saunders, E. B. Reed, J. M. Denton, G. Geddes, H. B. Bock, W. E. Saunders, and J. Williams. Large stores of valuable specimens were forwarded by Mr. Pettit. Messrs. William Murray, and J. Moffatt, of Hamilton, sent some very handsome Lepidoptera, and Mr. H. Cowdry, of Toronto, contributed to the Coleoptera. Our members in Montreal were also very prompt and liberal in responding to our appeal. Mr. Wm. Couper donated a large number of specimens, while a great many additional were loaned by Messrs. F. B. Caulfield, C. W. and G. B. Pearson, H. H. Lyman, P. Keutzing, G. J. Bowles, W. Hibbins, J. T. Whiteaves, indeed without their help we should have been entirely without representatives of many species restricted to the eastern portions of our Dominion. Added to all these were the specimens already contained in our Society's cabinets in London.

In due time the collection was completed and ready for shipment. It consisted of eighty-six cases, twenty-seven of which were filled with Coleoptera, forty-five with Lepi-

doptera, three Hymenoptera, five Neuroptera, two Hemiptera, three Diptera, and one Orthoptera, and when spread out they presented a very fine appearance. To ensure correctness in naming, all doubtful specimens were as far as possible submitted to specialists. Our best thanks are due to Mr. A. R. Grote, of Buffalo, N. Y., who twice visited London for the purpose of examining and naming our Lepidoptera. To Dr. A. S. Packard, of Salem, Mass., we are indebted for naming some of our Geometers, and to Dr. Geo. H. Horn, of Philadelphia, for his abundant labours in naming our Coleoptera.

The cases were packed with cotton in suitable Cabinets and these enclosed in strong outer cases with elastic packing between the two and with these precautions the collection reached its destination in safety. Arrangements were made for the careful unpacking of the specimens on arrival, and their proper classification when displayed. Similar provisions have also been made for their re-packing and return. Our insects are displayed in the Canadian department in Agricultural Hall, on a suitable stand built for the purpose, seventy-six feet in length. The many encomiums bestowed on our collection by those best able to judge of its merits will warrant us in stating that our Society may justly take to itself the credit of having brought together by far the finest collection of Canadian insects ever seen. We trust that this magnificent collection will, on its return, be preserved as far as possible in its present state as a collection of reference for the convenience of our members who may desire to name their specimens and as an enduring memento of the interest taken by our Society in the great Centennial Exhibition.

On behalf of the Committee,

WM. SAUNDERS,
Chairman.

From among the many favourable notices of our collection which appeared in the American papers, we clip the following from *The Daily Graphic*, New York, Sept. 26, 1876 :—

AT THE CENTENNIAL.—*The Exhibit of the Entomological Society of Ontario, Canada.*—Every lover of nature, every admirer of beauty in form or colour who visits the Centennial Exposition can scarcely avoid being charmed with the display of Canadian insects, exhibited by the enterprising Entomological Society of the Province of Ontario. The collection is in the Canadian department in Agricultural Hall. It is arranged in eighty-six glazed cases laid in a double row upon a table over seventy-five feet in length. Forty-five of these cases are filled with butterflies and moths (Lepidoptera) ; twenty-seven with beetles (Coleoptera) ; and the remaining fourteen with insects of all other orders—viz. : Bees, wasps, hornets, and other stinging and piercing insects, cicadas and bugs (properly so-called), dragon flies, lace-winged flies, &c., grasshoppers, locusts, crickets, &c., the small two-winged flies, and many others. Many of the specimens are so large and so gorgeously coloured that they have the appearance of natives of some of the tropics rather than of the more northern Canada—a country which many are apt to imagine is a land of ice and snow. This display, combined with that of the Canadian Fruit-Growers' Association near by, ought to do much to instruct the general public in regard to the vast resources and the excellent climate of the great Dominion.

The collection must not, however, be regarded merely as a display of curious or beautiful objects ; it possesses a very high scientific value as well. The practised student of entomology will there find thousands of species of insects, all correctly named both as regards genus and species, and all scientifically arranged according to the best system of classification. Although the critic may find fault with the particular system of nomenclature that has been adopted in some special families, he must confess that there is given an excellent illustration of the progress of scientific zoology in Canada, and of the energy and skill of the members of the Canadian Entomological Society in particular. This society was first organized in 1863, and had few members and exceedingly limited resources. For five years it continued to make good progress in a quiet way, the labours of its members being chiefly confined to the collection and determination of species and the publication of lists of Canadian insects. A great deal of good work was thus done, and the way was paved for other work of a more practical though not a more useful and scientific character. In August, 1868, the society issued the first number of the *Canadian Entomologist*, a small monthly publication, containing original papers on the classification,

description, habits, and general history of insects. This serial has been received with much favour by the leading entomologists of America, most of whom have from time to time contributed to its pages. It has now reached the middle of its eighth volume, and has increased to three times its original dimensions; it has also improved very much in style and typographical appearance, as well as in the excellence of its illustrations. The editor of the first five volumes was the Rev. C. J. S. Bethune, of Port Hope, who was succeeded by Mr. Wm. Saunders, of London, the present conductor of the journal. It is noteworthy, as an evidence of the persistent enterprise of the Canadians, that this is the only serial publication on insects in North America that has continued to exist for more than a few years; it has succeeded in outliving several contemporaries started about the same time. In 1870 the society first began to receive a small pecuniary grant from the public funds of the Province of Ontario, in return for which it annually presents to the Legislature an illustrated report on insects, useful to agriculture, horticulture, and aboriculture. Five of these reports have thus far been issued, and have been widely distributed amongst the farmers, gardeners, and others of the Province. The information and instruction thus afforded have done much to educate the people of the country and to save their crops and fruits from the pestilent ravages of destructive insects.

The present officers of the society are as follows: President, William Saunders, London; Vice-President, Rev. C. J. S. Bethune, Port Hope; Secretary and Treasurer, J. H. McMechan, London; Council—Wm. Couper, Montreal; R. V. Rogers, Kingston; J. Pettit, Grimsby; J. M. Denton and E. B. Reed, London. The headquarters of the society with its library and cabinets, are at London. It has also flourishing branches in Montreal and Kingston.

MEETINGS OF THE ENTOMOLOGICAL CLUB OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In accordance with previous announcement, the members of the Entomological Club met on Tuesday, the 22nd of August, at 2.30 p.m., in the rooms of the Buffalo Society of Natural Sciences, Dr. LeConte in the chair. The following members were present:—Dr. John L. LeConte, Philadelphia, President; S. H. Scudder, Cambridge, Massachusetts, Vice-President; C. V. Riley, St. Louis, Mo., Secretary; J. A. Lintner, Albany, N.Y.; Dr. H. Hagen, Cambridge, Massachusetts; Dr. John G. Morris, Baltimore, Md.; B. P. Mann, Cambridge, Mass.; W. Saunders, London, Ont.; Rev. C. J. S. Bethune, Port Hope, Ont.; E. B. Reed, London, Ont.; A. R. Grote, M. M. Maycock, Dr. L. F. Harvey, Henry S. Sprague, O. Reinecke, W. W. Stewart, of Buffalo, and others.

PRESIDENT'S ADDRESS.

After calling the meeting to order, the President read the following address:—

In resuming the chair, which by your kind partiality I occupied at the last meeting of the club, permit me, after thanking you for the honour you have done me in thus calling me a second time to this position, to congratulate you on the evidence of increased interest felt in the branch of Zoology to which we give our attention.

This increased interest is shown not only by the larger attendance at the present meeting of Entomologists from distant residences, but by the increase of correspondence between those who collect and study insects. I have received during the year several applications from new correspondents for advice and assistance in the study of Coleopetra; and my colleague, Dr. Horn, informs me that the same is the case with himself. Unfortunately I have been obliged to reply to some of the applicants with a temporary negative, as my time has been almost wholly taken up with efforts to complete my memoir on Rhynchophora, now in the course of publication by the American Philosophical Society. This memoir would have been finished some weeks ago, but the exceptional inclemency of the summer heat rendered all work with lenses difficult and uncertain. I think that I may promise that the MSS. will be complete in a few weeks. Meanwhile I am glad to

say that the arrangement of my cabinet specimens is so far perfected that Dr. Horn or I will be willing to name any sets of Rhyncophora of the United States or Dominion of Canada, which are sent us, provided that the return of the specimens sent is not required. The subject has been such an extremely troublesome one, and there are still so many uniques in our cabinets, that they need filling up in order to give them that value for future reference which I hope they will possess, and it will also be desirable for the proper recognition of the new genera and species, many of which are very abundant, that specimens should be distributed to foreigners, who have studied this difficult group of objects.

The excellent volume of Dr. A. S. Packard, jr., "Monograph of the Geometrid Moths of the United States," forming Vol. X of the United States Geological Survey of the Territories, requires special mention among the contributions to Entomology since our last meeting. We owe the existence of this volume to Dr. F. V. Hayden, Geologist-in-Chief of the Survey, and I hope that a continued appreciation by the National Legislature of the importance of the work done and published by the survey, will ensure us many future volumes of similar merit.

The ordinary routine work of the description of new genera and species, is going on in the various orders of insects with about the usual degree of rapidity. But from every one comes the same complaint: Too many new forms to be described!

The observations on economic applications of Entomology for the protection of agriculture are also advancing in a most commendable mannner, considering that the public and their servants in office still fail to recognise the magnitude of the interests involved.

References to the memoirs contained in the volumes of reports, and to isolated papers in agricultural and other journals, will be found in *Psyche*, a periodical, which, though small, is indispensable to every one occupied in the study of the insects of North America.

I would gladly stop here, but a truthful instinct, a sense of duty to science, and my obligation to you alike forbid silence. I have to speak of a subject of a disagreeable nature.

It is concerning the efforts made by you and other members of the Association at the last meeting at Detroit, to procure the appointment of a Commission for the protection of agriculture against noxious insects; this Commission to be composed of properly informed men of science, and chosen under such circumstances as would prevent the influence of political bias, or personal favouritism. If I do not fatigue your memory too much, you will recollect the memorials that were so extensively signed in relation to this subject, copies of which memorials are again before you. These memorials were extensively circulated at the West, and were signed by many of the most influential bodies for the promotion and protection of agriculture in that region. During the winter these memorials were sent to Congress, in the expectation that some proper legislation would follow. One of the Senators, in fact, introduced a bill which seems to have been very carefully considered, and indeed bears upon its face some evidence of scientific guidance. This bill provided for the appointment of three Commissioners for five years, the Commissioners to be nominated by the Council of the National Academy of Science to the Secretary of the Interior. This bill, having been referred to the Committee on Agriculture, was returned, completely orchidized, in such form as to provide for one Commissioner, to be appointed by the Department of Agriculture, the very enemy and incubus from which the western agriculturists specially desired to be relieved.

The bill in this form passed the Senate, several of the members taking occasion in the discussion which preceded the passage to talk to the demonstration of their own ignorance of the subject. However, this discussion has been already so severely commented upon in several of the newspapers of the Mississippi Valley, that it is quite unnecessary for me to add anything farther, except the hope that the Legislature which choose the successors of those Senators will have men of better education and higher intelligence offered to them as candidates for the position.

I regret to have been obliged to introduce this unpleasant subject, about which I feel a warmth and severity, unsuited to the position in which you have placed me. I must therefore close by begging you, in your respective localities, to continue aiding me in my

endeavour to cause the Government authorities to give proper attention to this most important subject.

The minutes of the last meeting held in Detroit were read by the Secretary, C. V. Riley, and approved.

The consideration of reports of committees was postponed, owing to the non-arrival of some of the members.

Mr. Riley made some remarks upon the variation in the venation of the wings of *Anisopteryx pometaria* (or *A. autumnata*), and exhibited mounted preparations of wings of this insect differing greatly from the figures in Dr. Packard's new work.

Mr. Grote considered the variation of neuration in the Geometridæ as of no great value as a specific distinction.

Mr. Riley said that he had scarcely ever raised a large number of forms from the egg without finding that in the imago state there appeared to be more than one so-called species. Whenever he used large quantities of material he found this result. He thought, therefore, that writers when describing species should always state the number of specimens they had before them.

Dr. Hagen then read a valuable paper "On Genera," at the conclusion of which he was warmly applauded.

On motion of Mr. Grote, the Report of the Committee on Nomenclature was then taken up, when Mr. Riley read a majority report of the committee.

Mr. Scudder did not approve of the course taken in reference to the rules on nomenclature which had been presented, and thought that members of the committee had exceeded their instructions, and desired that the resolution passed at the last meeting, appointing the committee and defining its duties, be read. He thought that the opinions of leading naturalists on this subject should have been gathered and compared.

The resolution giving instructions to the committee was read as follows: "That the Club appoint a committee of five to prepare and present to the Club at its next annual meeting a compendium of the views of the leading Entomologists of the country upon points which, in their judgment, require elucidation, and also to present a series of resolutions touching such points, in order that intelligent discussion may be had upon them and some general agreement, if possible, arrived at."

Mr. Riley urged as reasons why a majority report had been presented, the difficulty of getting the members of the committee together, and the urgent necessity that some action should be taken in the matter without further delay.

Mr. Saunders supported these views, and urged that the opinions of many of the leading Entomologists on the subject of nomenclature had been given in the pages of the *Canadian Entomologist* during the past year, while others had expressed their views by letter to members of the committee; and seeing that there had been no opportunity for the committee to meet together as a whole, he thought it desirable that these resolutions, which had been endorsed by a majority, should be presented as a guide to the discussions which might take place on the subject.

Mr. Scudder did not think this a proper time or place for the introduction of such rules; he fully agreed, however, that it was very desirable to establish stability in nomenclature.

Mr. Mann regarded Mr. Scudder's remarks as a motion to set aside these rules, and as such was prepared to support it.

Dr. Hagen, in a few words, gave a sketch of the history of nomenclature, showing how tidal waves of new names had been poured from time to time on the Entomological world with the greatest zeal on the part of those who had introduced them; that in many instances these changes were unnecessary, and produced confusion instead of establishing order. He thought it highly necessary that some understanding should be arrived at among Entomologists which would lead to greater stability in nomenclature.

Mr. E. B. Reed spoke for those who had comparatively little time to devote to Entomology, and thought that they were a class who should be considered, and that while it was, perhaps, no great task for those who devoted their whole time to Entomological studies to master the great number of new generic and specific names from time to time introduced, it was imposing a burden on their less fortunate brethren which was grievous

to be borne—which was, in fact, more than they could bear, and tended to discourage many and deter others from entering on the study of Entomology. He urged that it was from among the ranks of these beginners that some of the future leaders of Entomological science would be drawn, and it was well to consider what effect these discouraging circumstances would have on the present and future progress of the study.

After some further discussion, the resolutions were referred back to the Committee to report on to-morrow. Meanwhile, they were ordered to be printed for the members, so that discussion could be had upon them.

Evening Session.

At 7.30 the meeting was again called to order, the President in the chair.

Mr. Riley offered some remarks on a parasite, a mite which attacked the Colorado Potato Beetle. This insect (of which mounted specimens for microscopic examination were submitted) is furnished with a strange and extraordinary development of what he supposed were the maxillæ, by which it was able to attach itself to the Doryphora, and at the same time extract nourishment as well. He thought it was an organ somewhat similar in character to the extensile maxillæ of the larvæ of Dragon Flies.

Mr. Scudder thought that since they appeared to him to be jointed, they must be a palpus of some sort.

Dr. LeConte, after further examination, was of opinion that they were not jointed.

Mr. Scudder then read an interesting paper on "Mimicry in Butterflies explained by Natural Selection," quoting largely from a recent contribution by Fritz Muller on this subject, in which he gives the results of observations made by him on butterflies in Southern Brazil. This paper will appear in *Psyche*, the organ of the Cambridge Entomological Club.

Mr. Riley gave the result of some observations on the eggs of *Corydalis cornutus*, from which it would appear that the mass of eggs hitherto regarded as belonging to this species are probably those of a *Belostoma*. He had found in one day thirty or forty patches of eggs, which he believed to be those of *Corydalis cornutus*, on the leaves of trees whose branches overhung the water. These flat patches were very strangely arranged, and contained an immense number of eggs, often numbering between three and four thousand in a patch. The eggs are at first translucent, but become darker as they approach maturity, when the young larvæ break through the eggs beneath.

Dr. Morris doubted whether these really were the eggs of the *C. cornutus*, and questioned whether the larva was aquatic at all.

Dr. Hagen thought that there was something strange in reference to these insects. Mr. Riley had kindly sent him a large number of eggs, but when hatched he had failed in every attempt to keep the young larvæ alive. Since they are furnished with both branchia and stigmata, he thought they must be regarded as water insects.

Mr. Lintner had found the larvæ under stones, but when they enter the chrysalis state they make their way into the water, and in this condition they are often captured in large numbers and used as fish bait.

Mr. Riley said that the larvæ in Missouri are frequently found in water, and he had no doubt but that the eggs he had referred to were those of *Corydalis cornutus*.

Mr. Scudder stated that Mr. Sanborn had frequently taken large numbers of the larvæ in the water in the neighbourhood of Cambridge.

Mr. Saunders had never found them in the water, but had frequently captured them buried in moist sand or under stones along the banks of rivers.

Mr. Riley next exhibited to the Club some silken masses containing eggs of *Hydrophilus triangularis*, which were very remarkable and interesting.

Mr. Saunders offered some remarks on a mass of pupæ and escaping insects of *Calopteron reticulatum*, which he found one morning early in summer at the roots of some long grass. The mass was fully as large as a hen's egg, and must have contained some hundreds of individuals. A large number of the freshly escaped insects were captured, with a view to ascertain whether there was much variation in the markings, and whether the

form *terminalis*, which is said to be a variety of *reticulatum*, could be found among them. He saw none approaching this latter form—all were well-marked specimens of *reticulatum*.

Dr. LeConte mentioned the curious fact that in some species of *Calopteron* the larval skin was not shed when it pupated, but that the larva skin and pupa skin both remained *in situ* until the perfect insect escaped.

Dr. Morris then made some interesting remarks on the mouth parts of the woodpeckers.

Mr. Riley exhibited specimens of blown larvæ very nicely set up; he thinks, however, that in this condition they are scarcely of value for scientific study, and for this purpose prefers the specimens preserved in alcohol.

Mr. Scudder differed from Mr. Riley, and thinks that the advantages are in favour of the blown specimens, and much prefers to study larvæ in this way.

Dr. Hagen agreed with Mr. Scudder that blown larvæ were advantageous for study.

Dr. Morris asked if any of the gentlemen present who were in the habit of raising larvæ, had made any observations in reference to the length of time the development of the perfect insect may be retarded. He stated that three or four years since he had placed a number of cocoons of *S. cynthia* on a shelf in his house, and that after lying there all that time some of them had this year produced the perfect insect.

Dr. Hagen referred to an instance related by Kirby & Spence where a beetle, *Buprestis splendida*, was ascertained to have existed in the wood of a pine table more than twenty years (7th edition, p. 121).

Mr. Saunders mentioned the fact that the perfect insect of *Œcanthus niveus* frequently came to sugar at night, when they were readily captured. He thought that where they were very numerous this method of trapping them might be employed with advantage.

Mr. Lintner observed that he had take 16 species of *Catocala* at sugar this season, and that a friend of his who has been sugaring industriously has found the *Catocalas* to be most abundant about midnight.

On the 24th another meeting of the Club was held at 2 p. m., the President in the Chair.

The Committee on Nomenclature, consisting of Dr. LeConte, S. H. Scudder, A. R. Grote, C. V. Riley and W. Saunders, reported a set of rules, on some of which they were unanimous, while on others there was a divided opinion. They had given all the attention to the subject possible within the limited time at their disposal, but had not found time to consider the explanations offered in the majority report presented, and suggested that these be referred back to the Committee, with power to print such explanations as may be agreed on with the rules.

The following are the rules submitted :—

1. The binominal system, as originated by Linnæus, is the only one to be recognised. The use of a third word, however, connected with the second by a hyphen, as is common and desirable in the case of gall insects, *e.g. Cynips quercus-palustris*, is not to be considered as an infraction of this rule. (Unanimous.)

2. Where a specific name has been generally adopted during a period of twenty years, such name shall not be changed for one of prior date. (Divided opinion.)

3. The name placed after a genus should be that of the author who established the genus in the sense in which it is actually used, but the name of the author who first proposed the term should be cited in brackets. (Unanimous.)

4. No generic or specific name should be acknowledged which has not been printed in a published work. (Unanimous.)

5. A generic name, when once established, should never be cancelled in any subsequent subdivision of the group, but retained in a restricted sense for one of the constituent portions of the original genus. (Unanimous.)

6. In constructing family names they should end in *idæ*. (Divided opinion.)

7. The tribe should occupy an intermediate place between the sub-family and genus. (Unanimous.)

8. The authority for the species and not for the generic combination should follow the name of an insect. (Divided opinion.)

9. The proposition of a genus by simple designation of a type is to be greatly deprecated. All new names should be accompanied by ample definitions that will permit no doubt as to the species intended or as to the characters of the genus proposed. (Unanimous.)

10. No description should be made from a figure. (Unanimous.)

11. The number of individuals upon which either a specific or generic diagnosis is based should always be stated. (Unanimous.)

After a lengthy discussion, on motion of Mr. E. B. Reed, the following resolution was unanimously passed:

That the report of the committee be adopted, and that any rules on which this committee have expressed a divided opinion have a marginal note attached thereto, reciting such fact.

It was also resolved that all the explanations, &c., offered in the majority report be referred back to the committee with power to print such explanations as may be agreed on, with the rules.

Moved by Rev. C. J. S. Bethune, seconded by S. H. Scudder—That no alteration or addition to the rules now adopted be made, unless such alteration or addition be proposed at one annual meeting of the Club, and be adopted at a subsequent annual meeting. Carried unanimously.

The election of offcers for the ensuing year then took place, resulting as follows:—President, Dr. LeConte; Vice-President, S. H. Scudder; Secretary, C. V. Riley.

Mr. Scudder brought to the notice of the members a pattern insect box, which he believed to be pest-proof. These boxes are exceedingly well made (manufacturers, Hancock & Greeley, Cambridgeport, Mass.), are about 19 x 15 in., and are sold at $2.70 each, without cork.

Mr. Saunders suggested the desirability of the Club appointing a permanent committee to whom disputed points in reference to Entomological matters might be referred. On motion of Mr. Mann, seconded by Mr. Saunders, it was resolved that the Permanent Committee of the Club shall consist of the President, as chairman, and four other members to be named by him.

Mr. Lintner presented to the meeting a very complete and extensive list of insects taken at sugar by him during the present season. These were arranged in a tabular form in a very neat and methodical manner, showing at a glance the insects taken each evening, and whether they were abundant or scarce.

On motion of Mr. Riley, Dr. Larkin was requested to bring before the Club some facts in reference to a mite said to be parasitic on the human subject, when he read a very amusing letter from an afflicted patient in reference to this matter. The Club then adjourned.

ON GENERA.

By Dr. H. Hagen, Cambridge, Mass.

(*Read before the Entomological Club of the A. A. A. S., at Buffalo, N. Y.*)

There will hardly be a naturalist who has not spent considerable time to study the questions:—What is a genus, and what are generic characters? Indeed, work is nearly impossible without having taken a position with regard to these questions. A full record of the literature, even the most condensed one, would be here out of place, but I have been induced by a recent and most surprising discovery bearing upon this question to make this communication. I have been speaking here only about *natural* genera. The consideration of the genus as an artificial division differs fundamentally, and to avoid mistake we

should not call artificial divisions by this name. The characters of artificial genera depend solely upon the taste of the worker and the convenience of separating into groups animals and plants. All species are considered to belong to the same natural genus which agree in structural characters, external and internal, or anatomical ones in the different stages, in transformation, in the manner of living. These definitions of a genus are accepted as well by naturalists who are strong Darwinians as those who oppose the development theory. In a prize essay of the Jena University, D. P. Mayer, a pupil of Prof. Haeckel, in a paper on the "Ontogeny and Phylogeny of Insects," enlarges this definition in so far as he asks for a conformity in the embryological characters. I believe no one will object that this definition is a good and exhaustive one; but if we attempt to use it in a special case we become bewildered by the astonishing amount of characters unknown to us, and the impossibility to make them out for our work. At present we know hardly well enough the external character of the imago. Of other characters our knowledge is merely fragmentary and often a *tabula rasa*. We may say that a century of hard work will not fill these gaps in our knowledge. It is obvious that we cannot wait till this enormous amount of work is done. And it is certain that naturalists will not and can not stop creating new genera.

Genera created with such a limited amount of knowledge will depend upon the experience and taste of the worker. Many of such genera will have to be modified or dropped by a farther advancing knowledge,

The most important question (what are generic characters?) is still unanswered.

The large literature and the difference of opinion emitted by prominent authorities seem to prove that a sufficient affirmative answer is impossible till our knowledge is further advanced. But here, as in other abstract questions, we can proceed in a negative manner by exclusion.

Genera consist of a number of related species. If we knew the character of the species, the specific character, we can by exclusion come nearer the character of the genus. Species differ by structural character, and as the species form the lowest degree of the classification, we can be sure that species must differ at least by minutest points of structure.

I think there is no objection of consequence possible. I know very well that differences in minuter points of structure have been considered as generic characters. But naturalists beginning with the construction and definition of the higher degrees of class, order, family, &c., used up all characters at hand, till, coming to genera, nothing was left but minute differences of structure; the simple consequence of using specific characters for generic ones was that nearly every species was considered to be a genus.

I said before that species must differ at least by minuter points of structure. The discovery which I mentioned before proves that structural characters of species are more important, and can by a different manner of living be changed in such a way as to represent forms which were formerly believed to belong to different genera. *Branchipus* and *Artemia*, belonging to the Phyllopod Crustacea, are represented by several species here and in Europe. The two genera are nearly related one to the other, and differ principally in the following points: *Artemia* has eight post-abdominal segments, the last one very long. *Branchipus* has nine post-abdominal segments, the last two of equal size. *Artemia* has three articulated claspers in the male; *Branchipus* two articulated claspers. *Artemia* is often propagated by Parthenogenesis, *Branchipus* never.

Nobody will deny that those characters of structure go very far beyond minuter points of structure, and are marked well enough to justify the separation sixty years ago by Dr. Leach. Now it is proved that not only the species of *Artemia* known up to-day from Europe, Asia and Africa, but even some species of *Branchipus* belong to one and the same genus and species. In the American fauna five species of *Artemia* and three of *Branchipus* are described; of course they will have to be studied again in a similar manner as the European ones. The two European species of *Artemia* are remarkably different. *Artemia salina* has a strongly bifid tail surrounded by 15 to 20 bristles and narrow gills; *Artemia mulhauseni* has a rounded tail without bristles and very large gills. This latter species lives in pools of a very concentrated salt water of 25° Beaumé; the other species in common salt water of about 8°. In 1871, a dam which surrounded a salt pool containing *Artemia mulhauseni*, broke down by accident, and the sea water washed in at the same time; *Ar-*

temia salina, which abounds in the sea water, appeared in large numbers in the pool. The dam was immediately repaired, and in the space of three years the amount of the salt in the pool arrived gradually at the same concentration as before.

A Russian naturalist, Mr. Schmaukevitch, living near the spot and studying carefully *Artemia*, was astonished to find the species somewhat changed in every following generation, till in three years the *Artemia salina* was changed entirely into *mulhauseni*. The fact was so extraordinary that he decided to confirm it by a more conclusive proof. He raised at home in open glass dishes *Artemia salina*, and by successive additions of salt to the water, he was able to transform the species into *Artemia mulhauseni*. To make the counter proof, he diluted the water gradually and the species returned to the form of *Artemia salina*. But by continued dilution of the water he was more surprised to find that in the third generation the long abdominal segment began to be separated into two segments, and finally to be changed as in a *Branchipus*. He found later in salt pools of only four to five degrees (living together) *Artemia salina* and *Branchipus spinosa*, and in water with a lower degree of salt two other related species, *Branchipus ferox* and *media*.

Mr. Schmaukevitch has made similar experiments with similar results on *Daphnia*, *Cyclops*, and *Canthocamptus*, which he has not yet published. There can be no doubt about the facts under such conclusive proof, and Prof. V. Siebold is now engaged in raising the American species from Salt Lake for similar experiments. These facts oblige us to consider all these different forms as belonging to one and the same species, since it is possible to change at will one form into another by altering the conditions of living. As long as this is possible they cannot be considered as differentiating or Darwinian species. We have now the proof that specific characters exist which do not depend on minuter points of structure. Therefore, we are taught that we must considerably enlarge the characters of species and those of the genus.

What has been thus proven in Crustacea will certainly be observed also with other Articulates. Since insects do not possess a post-abdomen, there cannot occur the same differences as in the case cited, but analogous ones will not be wanting. It is obvious that so-called "salt insects" are the first ones which will need new and careful study. Those known areColeoptera, Diptera, Hemipteraand Orthoptera, and the species are often nearly related to other ones which do not live in salt regions. Further, it is evident that similar changes will be the result of different conditions of life. So-called "local varieties" are certainly nothing else, and a vast field of observation and study is opened by the remarkable discoveries of Mr. Schmaukevitch. I believe that we are now justified when we exclude from generic characters all the following ones:

1. Every character based on the number of parts, when the number ceases to be a small one; the more so when it varies in related species. If a number is larger than about a dozen, we can never rely upon the constancy of the number in antennal joints and anal appendages. In spines, bristles, spurs, a much smaller number is constant; transversal veins of the wings belong to the same category.

2. The external coating of the body, consisting in hairs, scales and other appendages, is not a generic character. The hairs, tufts, brushes, spines, spurs, are often only sexual and can not be considered generic characters; also, hairy eyes, since we find this character changing in the most related species and probably in the same species in Diptera.

3. The presence or want of the ocelli or eyes is not a generic character.

4. The veins of the wings give only to a certain degree generic characters, viz: the principal branches, but certainly not after the bifurcation.

Having arriving so far by exclusion, it is important to state what is left for generic characters.

So far as I am advanced in the study of generic characters, I think the following should be used:

1. The form and relation of the three principal parts of the body.

2. The organs providing nutrition (mouth parts).

3. The organs making possible the working of the mouth parts, *i. e.*, the organs of locomotion.

The anatomical characters may be of prominent help. At present our knowledge as

to their details is too limited to admit our using them to a profitable extent. We begin to be better acquainted with the previous stages, and this acquaintance will bring these characters into more prominence. I doubt embryological characters to be of generic value. But very little is certainly known about them, and nothing known is ready for our use. The parts serving for propagation have probably a higher value than generic characters. Characters for genera should be of a co-ordinate value. I think it is obvious that a genus should never be accepted if its characters are not satisfactorily given, and that genera based on the mere specification of a type should never be accepted.

INSECTS INTRODUCED BY THE CENTENNIAL EXHIBITION.

During the progress of the Centennial Exhibition, it was observed that many of the cereals and seeds exhibited were infested with insects, some samples being almost destroyed by these pests. At the suggestion of the Centennial Commission, a committee of scientific gentlemen was appointed to investigate this matter and report as early as practicable on the character of the insects thus introduued. This committee was also charged with the further work of reporting on any new plants or weeds which might be similarly brought into the country. A report on the plants could not be prepared until next year, but as the subject of injurious insects was a highly important one, it was deemed wise to report on that as soon as possible, hence all the information obtainable on the subject up to the time of the close of the Exhibition was submitted in the following report, read by Dr. LeConte, chairman of the committee, at a meeting of the Academy of Natural Sciences in Philadelphia, held early in November :—

REPORT ON INSECTS INTRODUCED BY MEANS OF THE INTERNATIONAL EXHIBITION.

On behalf of the Committee appointed by the Academy of Natural Sciences of Philadelphia, at the meeting held October 10th, 1876, "to investigate and report upon the introduction of new species of insects and plants through the medium of foreign exhibits at the Centennial Exhibition," I have the honour to present the following report, with the desire that it may be forwarded to the proper authorities of the Centennial Commission, at whose instance the Committee was appointed.

The Committee is composed of the following members of the Academy :—

Dr. Joseph Leidy, Dr. George H. Horn, Mr. Thomas Meehan, Dr. J. Gibbons Hunt, and Dr. John L. Le Conte, Chairman.

It was apparent that while the labours of the botanists of the Committee could not properly commence until next spring, when careful observation will recognise any new introductions of plants, the entomological investigations should be made as speedily as possible. Accordingly, Dr. Horn and myself, availing ourselves of the admission cards which had, with great liberality, been sent to the members of the Committee, went frequently to the exhibits in the Main Building and Agricultural Hall, and made collections in all the agricultural products from foreign countries, which were found to be infected.

Most of the species which we obtained have been already distributed over the globe by the ordinary channels of trade, and nothing is to be apprehended from the addition of a few hundred thousand specimens, to the incalculable millions of individuals of the same kind, that we have now domiciled amongst us.

I am happy to add that the species found, which have not been previously observed in the United States, will be innocuous ; they are dependant for their support upon plants which do not grow here, and which would be of no commercial value to us if they were cultivated.

I may therefore announce, with moderate certainty, that no evil result will occur to our agricultural interests from any introduction of foreign insects by means of the Centennial exhibits.

Before concluding this report, by a list of the insects collected in the buildings, it is our duty to notice some remarkable differences between the exhibits from different countries, indicating the care with which the specimens had been prepared, and the means taken to prevent depredations by insects.

All those exhibits which had been moist when packed, or had become moist or mouldy on the voyage or during the Exhibition, abounded in *Bruchus*, *Calandra*, and *Tineidæ;* while those which were protected against moisture were unattacked. It stands to reason, in fact, that insects dependent on a circulating fluid for their vitality, and having, during their early stages as larvæ, a very soft and moist body, cannot obtain in properly dried grains the requisite amount of moisture for their sustenance, and the egg, if previously deposited, will remain, like an ungerminating seed, for a favourable moment to develop, or if hatched, the larva will die at an early stage.

It was, therefore, with great pleasure that we recognised the appreciation of this almost self-evident proposition by the Department of Agriculture of Portugal. The exhibits in bottles were entirely free from all mould and infection, and in each bottle was a small quantity of caustic lime,* wrapped in paper, which, by its hygrometric power, had kept the specimens perfectly dry.

We do not intend to have it inferred, from what is above stated, that all the other exhibits were in a condition inferior to that of Portugal; on the contrary, many of them, as well as many from our own States, were in most admirable order; but, so far as we could learn, this good condition had been produced by great personal care, and the removal from time to time of the infected parts; not by the use of a preventive agent.

While investigating the occurrence of a small species of *Tineidæ* in the Italian exhibit of Leghorn straw, I learned that some importations of straw goods, by Messrs. Albinola & Bailey, of New York, had been attacked by insects. I immediately wrote to those gentlemen, who, with great courtesy, sent me two collections of the insects, infesting a recent importation which had become mouldy from being packed in a moist condition. The names of the species contained in this set are appended; they are all either carnivorous or fungivorous, and can therefore do no harm; some of them have not been before observed in the United States, or their habits have not been noted. What is more important, however, is that none of the straw goods were attacked by moths either on this or previous occasions. It is therefore to be inferred that the moth in the Italian exhibit was the grain-moth of the seed of the grass which produced the straw used in the manufacture of the Italian goods. What confirms this inference is that the moths occurred in but one case, in which were exhibited several bunches of the straw with the heads of grain still remaining.

Prof. C. V. Riley, in the Proceedings of the Academy of Science of St. Louis, Oct. 2, 1876, has given a list of the species which he collected at the Centennial Exhibition, with very useful and suggestive remarks. We have obtained specimens of all the species mentioned by him except one, Crambide Lepidopteron, from the Egyptian exhibit, for which we sought without success. At an earlier period in the season, and with smaller attendance of visitors, the number of species in our list would perhaps have been larger, but no additional advantage would have been obtained therefrom. The species, with the few exceptions noted, are either innocuous or previously introduced.

J. L. LeConte, *Chairman*,
Geo. H. Horn,
Joseph Leidy.

* The nature of the powder was suspected by the Committee, but the determination was made through the analysis of Mr. Edward Goldsmith.

List of Species Collected in the Centennial Buildings in Foreign Exhibits.

COLEOPTERA.

SILVANUS SURINAMENSIS.

Argentine Confederation and Brazil, in various materials.

LÆMOPHLŒUS FERRUGINEUS.

In beans, Brazil. These two species lived upon the debris of *Bruchus*, and were accompanied by a species of *Psocus*.

BRUCHUS PICTURATUS, *Fahræus.*

Argentine Confederation; in seeds of two leguminous plants, one of which produces a screw bean, resembling *Strombocarpus* of Arizona.

BRUCHUS, *sp.*

Allied to *B. prosopis*, of Arizona and New Mexico. Argentine Confederation; also in the screw bean. These two *Bruchi* are depredated upon by three small species of Ichneumonidæ.

BRUCHUS, *sp.*

Of larger size and more uniform colour. Argentine Confederation, in the seeds of another leguminous plant, allied to *Prosopis*.

BRUCHUS, *sp.*

Of larger size and more mottled colour; in the seeds of three other leguminous plants of the Argentine Confederation.

BRUCHUS SCUTELLARIS.

Venezuela, in beans.

BRUCHUS OBSOLETUS.

In beans from various countries of both continents.

BRUCHUS PISI.

In peas; Spain and Portugal.

BRUCHUS, *sp.*

A small broad species, with traverse prothorax; male rather uniformly clothed with grey-brown pubescence; antennæ as long as the body; female black, with a grayish-brown broad dorsal stripe on the prothorax, and a small transverse white band on each elytron, extending from the side margin nearly to the suture, a little in front of the middle; thighs not toothed. Length ·09 inch.

Brazil, in a bluish-gray variety of bean. I cannot identify this species among those described in Schönherr's work; it is of the same form, and belongs to the same division as *B. pisi*, but is much smaller, and quite different in other characters. It is the only one of the species here mentioned which is capable of being introduced; and I have, therefore, given such a description as will enable it to be recognised. The antennæ are only feebly serrate. This species is mentioned by Mr. Riley as *B. granarius*, but it does not agree with the figure of Olivier.

RHIZOPERTHA PUSILLA.

Victoria, Australia; in wheat. This insect has been previously introduced into the United States in Persian wheat, distributed by the Patent office. (*Vide* Lec. Class, Col. N. Am. p. 208.)

CALANDRA ORYZÆ.

This destructive insect abounded in exhibits of corn (maize), wheat, and rice from every part of the globe. I also observed it in arrow-root from Brazil.

ARÆOCERUS COFFEÆ.

Eating the thin shell of cacao-nuts from Brazil, but apparently not attacking the interior of the nut. Previously introduced both in the Atlantic and Pacific States.

LEPIDOPTERA.

The ordinary and well-known *Tineidæ* which affect wheat and corn (maize) (*Butalis cerealella*, *Ephestia Zeæ*), abounded in exhibits from various countries. There was a smaller form which is mentioned above, as coming from the grass seeds of the Leghorn straw. Specimens have been identified by Professor C. V. Riley as the common grain moth, *B. cerealella*.

HYMENOPTERA.

Besides the three *Ichneumonida* parasitic on the *Bruchi* in the Argentine Confederation exhibit, I observed a small species of *Pteromalus* parasitic on the *Tinea*, *Bruchus obsoletus*, or *Calandra oryzæ* which infested a small bag of Brazilian wheat.

List of the Species Found in Mouldy Specimens of Straw Goods from Italy.

These species were collected by Messrs. Albinola & Bailey, in New York. They are either carnivorous or fungivorous; those of the latter kind live upon the mould, which, as determined by Dr. J. G. Hunt, is a species of *Aspergillus*, previously known in this country.

LATHRIDIUS FILIFORMIS.

LATHRIDIUS STRIATUS.

CORTICARIA, *sp.*

(Not identified.)

HOLOPARAMECUS SINGULARIS.

Has not been previously observed in the United States.

SILVANUS SURINAMENSIS.

SILVANUS ADVENA.

LÆMOPHLŒUS FERRUGINEUS.

MURMIDIUS OVALIS.

Habits not previously observed in the United States, though its occurrence was known.

TRIBOLIUM FERRUGINEUM.

ON BLISTERING BEETLES.

BY W. SAUNDERS, LONDON, ONTARIO.

Probably there are few of our readers who are not practically acquainted with the powerful blistering qualities of the imported Cantharides, or as the insect is more commonly, although incorrectly designated, the Spanish Fly. It belongs to the order of Coleoptera (Beetles), and hence should be known as the Spanish Beetle. The use of this insect, in the practice of medicine, dates from a very early period, and it is one of the few remedies, the usefulness of which, within certain limits, neither time nor fashion has been able to set aside. That species of Cantharides known as the Spanish Beetle is not the only one in use. In China and India, allied insects, very different in colour, but similar in properties, have long been used for like purposes; and these Asiatic insects are now found in our drug markets, and having proved equally efficient with the well-known European variety, are gradually growing in favour.

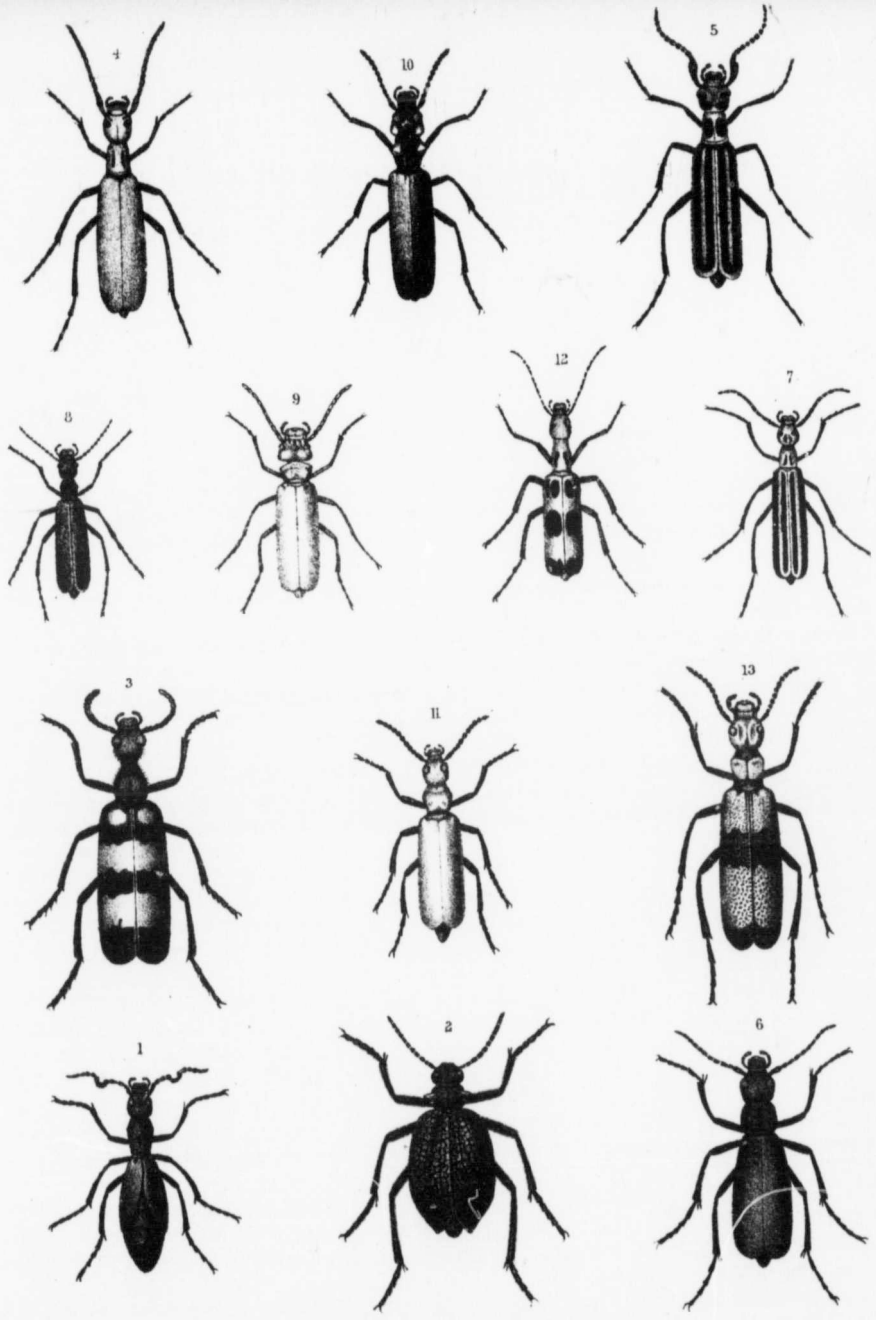
It is not so well or so generally known that we have in America, and even in Canada, several species of Cantharides, as well as some other closely allied blistering insects, which might at any time be used as substitutes for the Spanish Beetle (*Cantharis vesicatoria*).

One of our commonest species is that known as "the Striped Blister Beetle" (*Epicauta vittata*), see fig 7 in plate, which is very destructive in some seasons to the potato vines, and also attacks the leaves of beets, devouring them most voraciously. At times, these insects are found in such numbers, that they are very injurious to the crops they infest. In some of the Western States, this species has occasionally committed havoc on the potato vines as great and as terrible as that of the now well-known Colorado Potato Beetle. The circumstances attending their propagation and growth, as we shall hereafter show, are, however, of such an exceptional character, that a year of abundance is almost sure to be followed in the same locality by one of unusual scarcity.

The Ash Grey Blister Beetle (*Epicauta cinerea*), is another species very common in many parts of Canada. We have been informed that in the Great Manitoulin Island, this species, as well as the preceding one, is usually found in considerable abundance. The body is of an ash grey colour, occasioned by its being thickly clothed with short ash-coloured hairs or down, which, when handled, comes off like the bloom of a plum, and leaves the insect black. This variety attacks not only the potato leaves, but also English or Windsor Beans, and according to Mr. Riley, the foliage of the apple tree sometimes suffers from its depredations.

The Black Blister Beetle (*Epicauta atrata*) is also common with us; it is usually found during the month of August, on the leaves and blossoms of the common Golden Rod (*Solidago*). When approached or disturbed, they quickly quit their hold on the plant and drop to the ground.

These northern species are smaller in size than the European insect, a feature which would add to the cost of collecting them. Another bar to their successful introduction has been found in their colour. By a strange misconception, the presence of the brilliant green particles in the wing-cases, in the powdered Cantharides, has been associated with their activity, and any sample of powder or of prepared blistering-plaster where these brilliant particles are wanting, would, by many, be at once condemned. The Chinese Beetle (*Mylabris cichorii*), recently introduced, has done much to remove the latter objection; yet, notwithstanding, it has been shown that the Chinese insect is fully as powerful in its action as that from Europe, the relative market value of the insects belonging to these two species indicates that popular prejudice still favours the use of the Spanish Beetle.



1. Meloe angusticollis Say.
2. Cysteodemus armatus Lec.
3. Mylabris cichorii Linn.
4. Macrobasis albida Say.
5. Macrobasis atrivittata Lec.
6. " " segmentata Say.
7. Epicauta vittata Fab.
8. " " cinerea Forst.
13. Tegrodera erosa Lec.
9. Cantharis vesicatoria Linn.
10. " " vulnerata Lec.
11. " " nuttalli Say.
12. Pyrota mylabrina Chev.

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In the western and southern portions of our continent we have species which are large as well as abundant, and which, there is every reason to believe, possess all the activity needed, most of them probably would be found in every respect as valuable as the imported beetles. Some of the species about to be referred to have not yet been recorded as occurring within the limits of the Dominion of Canada, but when the insect fauna of the rich plains of the west shall have been carefully collected, doubtless some of these or others equally large and useful, will be found on our own side of the line ; in the meantime, we give the localities where they are at present known to occur.

Through the kindness of Dr. George H. Horn, of Philadelphia, whose extensive contributions to our knowledge of American Coleoptera have made his name familiar both in Europe and America, we have been supplied with much information in reference to the species here treated of ; an acknowledgment is also due to Prof. C. V. Riley, State Entomologist of Missouri, for some valuable notes on the habits of these insects. We have had a lithographic plate prepared by Messrs. Sinclair & Sons, of Philadelphia, under the kind supervision of Dr. Horn, in which each of the species referred to is figured of the natural size, excepting 7 and 8, which are somewhat enlarged. This plate is remarkably well executed, and is probably one of the best plates of Coleoptera ever published ; besides the American species, it contains figures of *M. cichorii* and *C. vesicatoria.*

We shall first enumerate the species, giving brief descriptions, as plain and void of technicalities as possible.

1. *Meloe angusticollis*—Say.—This insect (see fig. 1 on plate) is of a dark bluish violaceous colour, with the head, thorax and wing-cases thickly punctured with minute dots or impressions. The thorax is slender, narrower than the head ; feet slightly hairy, with the spines of the legs reddish. Found in the Eastern States and in many parts of Canada.

2. *Cysteodemus armatus*—Lec.—Entire body bluish black ; thorax with a strong lateral spine on each side ; wing-cases very convex, and much larger than the abdomen, which they cover, and with very coarse elevated reticulations on their surface. This insect varies greatly in size ; the figure represents a medium sized specimen.

Extremely abundant in Arizona and the desert regions of California wherever the greasewood, *Larrea Mexicana*, grows. This insect is not as good a vesicant as some others ; the proportion of hard tissue in its structure is large as compared with the softer and more active portion, too large, perhaps, to admit of its being of much value.

3. *Mylabris cichorii*—Linn.—All parts of this insect are black, excepting the wing-covers, which are of an obscure yellow, with three transverse, black, irregular, undulating bands, the one at the apex broadest. The first band is sometimes interrupted, and occasionally reduced to three or four spots.

Found in abundance in the southern portions of China, and also throughout India, on the flowers of the wild chicory and other composite plants. It is also said to occur in southern Europe, extending from Italy through Greece and Egypt to China.

4. *Macrobasis albida*—Say.—All parts of body black, densely covered with minute greenish or yellowish-white hairs. The thorax is slightly longer than wide, the wing-covers broader than the thorax, becoming wider behind, and are densely punctured.

Abundant in Texas, New Mexico and on the plains.

5. *Macrobasis atrivittata*—Lec.—Also black ; form more elongated than *albida ;* head thickly clothed with fine black hairs, with a small white space in front of the eyes ; thorax with grayish hairs, with a large black space in the middle ; the wing-covers have black hairs, and their apex and sides are margined with gray ; there is also a moderately broad grayish stripe extending from the humerus to near the apex.

Found in Texas, and is probably quite abundant, but we have not been able to obtain definite information on this point.

6. *Macrobasis segmentata*—Say.—This insect is black also, with the segments of the body beneath margined with whitish. The thorax is nearly as broad as long, and its posterior edges are grayish. Wing-covers finely punctured and sparsely covered with short black hairs.

Occurs with *M. albida*, and is also abundant.

7. *Epicauta vittata*—Fab.—The head of this species is of a light reddish colour, with darker spots ; antennæ black ; thorax black, with three yellow lines ; wing-covers black,

margined with yellow, and with a yellow stripe down the middle. Abdomen and legs black, covered with grayish hairs.

Is found throughout the United States and Canada, but more abundant northward and westward of the Carolinas, extending to near the base of the Rocky Mountains. In the south it is replaced by *lemniscata*, a species closely resembling *vittata*, but differs in having another white stripe. This species has been tested, and has been found fully equal to *vesicatoria* as a vesicant.

8. *Epicauta cinerea*—Forster.—Black, closely punctured, and clothed with grayish hairs; beneath clothing dense, upper surface variable. Head sparingly hairy. Thorax densely punctured, sometimes entirely covered with gray hairs, often with a large triangular central space black, divided by a grayish line along the middle. Wing-cases finely punctured, and either entirely grayish or margined with grayish all around.

Occurs all over the United States east of the Rocky Mountains, and in many parts of Canada. In the Southern States it becomes larger, with the wing cases entirely gray; fully equal in strength to *vesicatoria*.

9. *Cantharis vesicatoria*—Linn.—Colour, above and below, a beautiful shining golden green; head, thorax and wing-covers closely punctured; antennæ black.

Found most abundant in Spain, Italy and the south of France; also found in all the temperate parts of Europe, and in the west of Asia.

10. *Cantharis vulnerata*—Lec.—Body black; head orange yellow, sometimes with a broad black stripe down the middle; wing-cases black.

Extremely abundant throughout the entire Pacific region west of the Sierra Nevadas. Dr. Horn has seen bushels of this insect in some localities literally strewing the ground; also very common on a species of *Baccharis;* he has experimented with them and found them powerfully vesicant, and producing strangury very readily when taken internally in the form of tincture.

11. *Cantharis Nuttalli*—Say.—Head deep greenish or golden green; antennæ black; thorax golden green with a polished surface, and a few small scattered punctures. Wing-cases golden purple, striped with green. Body beneath green, polished; thighs purplish, feet black. This large and beautiful insect is extremely abundant in Kansas and Colorado.

12. *Pyrota mylabrina*—Chev.—Entire body and legs dull ochre yellow. Thorax with two, sometimes four black spots; wing-covers with three transverse black bands, divided in the middle by the suture, the anterior one being sometimes further divided into four spots; knees and feet black.

Found from Kansas to Mexico, and is abundant throughout the whole region.

13. *Tergrodera erosa*—Lec.—Body and legs black; head and thorax reddish, the former with a deep groove; wing-covers bright yellow, their surface roughened with coarse reticulations, with a median and apical black band, which in some specimens are wanting. Abundant in Southern California and peninsula of Lower California, on a low herbaceous plant with a blue flower.

In all these species the female is more valuable than the male, especially when well distended with eggs, owing to the relatively larger proportion of the soft parts. Eggs have the same power as the other soft parts; the blood Dr. Horn believes to be more active than any other portion.

Having referred in detail to the perfect insects, it is now proposed to sketch their history, as far as known, through the earlier stages of their existence.

The life history of *Meloe*, which has been well worked up in Europe, may be taken as a type of all the species mentioned, since all the facts accumulated on this subject point to a similarity in the character of the transformations and habits, which in the vesicating insects are very remarkable.

In the 20th volume of the "Linnean Transactions," there is a memoir on the natural history of *Meloe*, from which many of the following facts are derived.

The *Meloe* beetles, when fresh from their pupa cases in spring, are feeble, move slowly, and have their bodies small and contracted, but after feeding a few days these enlarge greatly, the abdomen of the female expanding to twice its original size, owing to the enormous quantity of ova within its body in process of development. The abdomen will then measure an inch or more in length, and appears to be dragged along with difficulty. They

are fond of basking in the hot sunshine, and are said to be most active during the early and middle parts of the day. When confined in boxes for the purpose of observing their habits, it is necessary to expose them much to the sun, and supply them with an abundance of food; they are then quite at home, and their proceedings may be easily watched. They drink freely of water, and require their food to be well wetted. In a few days after leaving their winter quarters they pair.

The eggs are deposited in the earth. A small excavation is made by the female, sometimes as much as two inches in depth, into which, when finished, she projects her body, with the head just perceptible at the entrance. After remaining in this position ovipositing for about two hours, the body is withdrawn, and the earth raked with her feet into the hole until it is entirely closed. These burrows are commonly made among the roots of grass in a dry soil and a sunny spot; often on the margins of a dry footpath. The female always deposits two, and sometimes three or four separate layings of eggs, at intervals of from two to three weeks. The first is always the most abundant, amounting usually to three or four thousand. After each deposit the abdomen seems to be almost entirely emptied; the insect then feeds voraciously, and fresh ova are soon developed.

The eggs when first deposited are about one-twentieth of an inch in length, slightly conical, obtuse at both ends, and of a bright orange colour. They are placed in such a way that they may be parallel to each other, and adhere together at their sides, with one end directed to the entrance of the burrow. The duration of the egg stage is greatly influenced by temperature, averaging from four to five weeks.

Fig. 1.

From the egg there escapes a little active, agile creature, somewhat resembling a *pediculus* in habits; in fact, the larva of one of the European species was described by so eminent an Entomologist as Kirby, in 1802, as *Pediculus melittæ*. This young larva, a magnified illustration of which is given in Fig. 1,* is of a bright yellow colour, and of an elongated form, with fourteen segments. The three segments which constitute the trunk are strong and powerful, for the attachment of the legs, which are furnished with sharp-pointed claws, especially adapted for clinging securely to any object. The anal segment on its under surface is developed into a pair of short prolegs. It moves with great celerity with its six true legs; it can also make use of its anal prolegs, and thus climb a nearly smooth and vertical surface.

The young larvæ of most insects, if food is not supplied to them within a day or so of the time of their escaping from the egg, will die of starvation; but these young creatures will live from two to three weeks without food and maintain their activity, a wonderful adaptation to the circumstances in which they are placed. When hatched, they crawl to the surface and run up the stems of various plants, and often lodge themselves in the flowers and there await the visits of bees and other insects who alight to collect pollen or honey. They watch their opportunity, and attach themselves with great readiness to any of these insects who may come within their reach. It is astonishing with what celerity they fasten themselves to their victim the instant any part of its body is accessible, and with what tenacity they adhere to it, seizing it by the leg, wing, or hairs of the body, and crawling up and adhering aroung the insertion of its legs between the head and thorax or the thorax and abdomen, exciting the greatest possible uneasiness in the winged insect, who vainly endeavours to detach them from its body.

Some observers are of opinion that the parasite draws nourishment from the bee on which it fastens, but the main object of this instinctive attachment seems to be to get access to the cells in which the young and food are stored. Once here, the young larva of *Meloe* is said to attack the larva of the bee or other hymenopterous insect whose nest is thus invaded, and being furnished with strong mandibles, they thrust them into the soft parts of their victims, and prey on their substance through the wounded integuments, while the young bee is nourished with the stored pollen and honey. In this state, having no longer any use for their active limbs, they are gradually reduced to mere tubercles, and after a change of skin, the once active and sprightly creature assumes the form of a

* The small outline alongside shows this larva of the natural size.

thick, fleshy maggot. In this form it continues to feed on the young bees or the bee bread and honey stored for their use, and after passing through some remarkable changes while in the larval condition, first changing to a semi-pupa, then to another form of larva, it subsequently assumes the true pupa state, in which condition it remains in its snug retreat until the following spring, when it bursts its bonds and appears as a beetle.

The young *Meloe* larvæ often attach themselves to the hairs of insects which construct no cells and do not store up food for their young; and in such cases, which must be very numerous, they necessarily perish. In the light of this fact we can appreciate the importance of the great fecundity of the females.

The larva of *Cantharis vesicatoria* is almost identical in form with that of *Meloe*, but soon after escaping from the egg it changes from a yellow to a darker hue, and finally to a deep black.

The history of our American species is as yet very fragmentary. Dr. Packard has observed the larva of *Meloe angusticollis*, and found it to differ but little from its European congeners. In a recent number of the *Canadian Entomologist*, Mr. W. Brodie, of Toronto, gives some highly interesting observations on this species, extending over a series of years. He says :—

"According to my experience, *Meloes* make their appearance in the perfect state about the end of August or beginning of September, when they feed greedily on *Ranunculus acris*. Later in the season, when the abdomens of the females are much enlarged, they pair, and later still—sometimes after the first frost—they deposit their eggs and invariably die that season.

"The larvæ emerge from the eggs early the following spring, and I think attach themselves to bees generally on the blossoms of the willow. I presume this because I often find females about to oviposit near to willow bushes, but I have detected the young larvæ in the flowers of *Caltha palustris*, and suppose they will take to any early flowering plant.

"In confirmation of these statements I submit the following from my notes on *Meloe* in the vicinity of Toronto, dating from 1870.

"Although *Meloe* is common here, I have never found them much further to the north, and as I am pretty well acquainted with all parts of the county, I would say they are not found in the central nor in the northern portions of the County of York. This is curious, as in the better wooded sections the storing Hymenoptera are more numerous than about Toronto.

"1870—Aug. 30th. In early morning saw several *Meloes* descending a white oak tree, in St. James' Cemetery, which tree was afterwards blown down and proved to be a *bee tree*. This would indicate that *Meloe* pupates in the hive, and when perfect, deserts it during the night.

"1871. *Meloes* first seen Aug. 10th.

"1872—Aug. 20th. *Meloes* feeding on *R. acris*.

"1873—Aug.-Oct. *Meloes* very numerous, feeding on *R. acris*; found many females ovipositing in a cold, wet situation, after first fall frost.

"1874—Aug. 29th. Found about forty *Meloes* closely huddled in a ball; they were not fighting, and although both sexes were present, do not think they were pairing. None of the females had large abdomens, and when disturbed they all quickly ran away.

"Sept. 1st—10th. Found about sixty *Meloes*, of both sexes, many of them pairing; feeding on *R. acris*, on a small miry patch, about one-fourth acre, bounded on the right by a small stream which they could not cross; on the left, about 150 yards up a bank, were six hives of neglected bees. This is the same situation where, in 1873, I found females ovipositing after frost.

"1875—Aug. Found *Meloes* in same localities as last season. Captured several females; fed them on *R. acris;* they began ovipositing Sept. 20th. Oct. 20th, all dead. The eggs were of an orange colour, and placed in a hole about $\frac{3}{4}$ inch deep, and large enough to receive the abdomen.

"1876—Aug. 15th. *Meloes* first seen. Sept. 1st, found about fifty in a ball as I had found them in 1874. Do not think they were either fighting or pairing; could not make out what they were doing; when disturbed they soon ran away. This season they were about as numerous as in 1875, in same localities at same dates.

"From these notes, from my own recollections and from the recollections of my children, I infer that *Meloes* make their appearance about the middle of August, that they pair and oviposit before the winter sets in, and that they never survive the winter; and that they are very seldom, if ever, found under stones in the neighbourhood of Toronto."

Prof. Riley has made some observations on *Epicauta vittata*. He describes the eggs of *vittata* as follows: Length, 0·08 inch, five times as long as wide, elliptical and so uniform in diameter that it is difficult to say which is the anterior end, though there is a slight difference. Egg sometimes very slightly curved. Colour, very pale whitish yellow, smooth and shining.

The young larva is yellowish-brown, borders of head and thorax and of joints somewhat more dusky than general surface; tip of jaws and eyes dark brown. Legs and venter paler; venter not corneus except at sides and across segments eleven and twelve. About ten stiff hairs visible superiorly on the posterior border on the middle segments, with a cone-like prominence at the base of each, and six minor bristles in front of them. There are also rows of fainter ventral bristles.

The curious history of these insects throws some light on the fact that while in some localities they are enormously abundant one season, they will be very scarce another. It is to be expected that there would be an alternation between the abundance of certain species of hymenopterous insects and cantharides. When the insects they prey on are abundant the blistering beetles multiply amazingly, and during this immense multiplication exhaust the stock of material on which they feed to such an extent that a year of great abundance in any given locality can scarcely fail to be followed by a season of corresponding scarcity. In other, and sometimes adjacent localities, where the same causes have not operated to a like extent, the insects may be common enough. The great abundance of the sociable and solitary bees in the great plains of the West will probably always afford food sufficient to admit of the maturing of large broods of cantharides.

The Destructive Locust of the West.

By Rev. C. J. S. Bethune, M. A.

Fig. 2.

Caloptenus femur-rubrum.

In our last two Reports—those for 1874 and 1875—we devoted a considerable portion of our space to the consideration of the history, ravages, etc., of the destructive Locust of the West. As a supplement to the accounts that we then laid before the reader, we now beg to draw his attention to the following excellent summary of the migrations of this most noxious insect, and the suggestions that are made for the alleviation of the plague. The article is taken from the current number of the *American Naturalist*, and is from the pen of Prof. A. S. Packard, Jr.—one of the ablest American Entomologists of the day.

"The following remarks concerning the probable causes of the migrations of the western locust are extracted from a forthcoming report on this and other injurious insects in Prof. F. V. Hayden's Annual Report of the United States Geological and Geographical Survey of the Territories for 1875. The facts and theories were in part suggested by observations made by myself in Colorado, Utah, and Wyoming, in 1875, while attached for a few weeks to the Survey, and in part by the reports of Prof. C. V. Riley, State Entomologist of Missouri, and by the statements of Prof. Cyrus Thomas, State Entomologist of Illinois, and Hon. W. N. Byers of Denver, and others.

"In dealing with this fearfully destructive insect, which has attracted so much notice from the public, and in seeking for remedies against its devastations, it is of prime importance to have a thorough knowledge of its breeding places, the frequency and extent of its migrations, and to seek for the connection between the direction of the winds and other meteorological phenomena, and the flights of the locust.

"The locust is quite or nearly as destructive in Africa, Asia, and Southern Europe, as in this country, but the laws of their migrations and their connection with meteorological phenomena have never been studied in those regions, and it remains for the United States, with its Weather Signal Bureau, to institute in connection with the scientific surveys of the West investigations regarding the nature of the evil, and the best means to overcome it.

"In endeavouring to trace the connection between the migrations of the locusts and the course of the winds at different months, the writer has been led into some theoretical considerations which seem to be supported by the facts presented in the unpublished report, and which may be confirmed or disproved by future investigations.

"*History of the Migrations of the Locust.*—The following table, compiled from the reports of A. S. Taylor, the late Mr. B. D. Walsh, Prof. C. V. Riley, Prof. C. Thomas, Mr. G. M. Dawson, and the observations of Mr. W. N. Byers, will show the years when the locust was excessively abundant and destructive in the different territories and states, and also serve to roughly indicate the frequency and extent of the migrations of the destructive locust of the West. The dates which are starred are years when the progeny of the locusts of the preceding year abounded, and when in most cases there were no fresh incursions from the westward. The species referred to under the head of California, Washington and Oregon may be some other than *Caloptenus spretus*.

Manitoba.	Minnesota and Western Iowa.	Montana and Dakota.	Wyoming and Idaho.	Utah.	Colorado.	Nebraska, Kansas, and Western Missouri.	Indian Territory and Texas.	California.	Washington and Oregon.
1818	1818								1827 or 1828
1819	1819								1834 or 1835
	1820					1820 or 1821		1838	
			1845				1845		
						1846?			
			1852	1852			1849		1852
	1855	1855?	1855?	1855	1855?	1855	1855	1855	1855
	1856*			1856*			1856*	1856*	
1857				1857					
1864	1864	1864			1864				
					1865*				
						1866	1866		
1867	1867			1867	1867	1867	1867		
1868*				1868*	1868	1868*			
1869						1869*			
1872									
	1873	1873	1873	1873?	1873			1873	
1874	1874	1874	1874		1874	1874	1874	South	
?	1875	1875	1875		1875*	1875*	1875	Cal.	
	1876	1876	1876		1876	1876	1876		

"This table and the data on which it is based are necessarily very imperfect, owing to the vast extent of the territory over which the locusts swarmed, and the fact that the greater portion is uninhabited, while the inhabited portions have been settled only within comparatively few years.

"*The Theory of Migrations.*—(1) *The immediate cause of the migration of the locust from its original breeding places is the unusual abundance of the species during certain years.* It has been found in some cases that the exceptional years when the locust migrates are periods of unusual heat and dryness, conditions unusually favourable to the excessive increase of insect life. As may be seen in the accounts of the eastern locust, the grass army worm, the grain aphis, the chinch bug, and other less destructive insects, when the early part of the season, the spring and early weeks of the summer, are warm and dry, without sudden changes of temperature, insects abound and enormously exceed their ordinary numbers. When two such seasons occur, one after the other, the conditions become still more favourable for the undue development of insect life. Now it is well known that in the Eastern States the summers of 1860 and 1874, preceding the appear-

ance of the army worm and grain aphis, were unusually warm and dry, and favourable not only for the hatching of the eggs laid the year previous, but for the growth and development of the larvæ or young. Look now at the conditions for the development of locust life on the hot and dry plains, chiefly of Dakota, Montana, Wyoming, and Idaho. We have no meteorological records from these regions at hand, but it is more than probable that the years preceding the migrations of the locusts were exceptionally warm and dry, when the soil was parched with long-sustained droughts, as we know that the corresponding species east of the Mississippi River abounds during dry summers following dry and warm springs.

"Given, then, the exceptional years of drought and heat and the great extent of territory, and we have as the result vast numbers of young hatched out. The year previous having, perhaps, been warm and dry, the locusts would abound, and more eggs than usual would be laid. These would, with remarkably few exceptions, hatch, and the young soon consume the buffalo grass and other herbage, and move about from one region to another, following often a determinate course in search of food. In this way large broods may migrate a long distance, from perhaps twenty to fifty miles. In about six or seven weeks they acquire wings. Experience shows that the western locust, as soon as it is fledged, rises up high in the air, sometimes a thousand feet or much higher. They have been seen to settle at night on the ground, eat during this time, and towards noon the next day fill the air again with their glistening wings. As more and more become fledged, the vast swarm exhausts the supply of food, and when the hosts are finally marshalled, new swarms joining perhaps the original one, the whole swarm, possibly hundred of miles in extent, begins to fly off, borne by the prevailing westerly and north-westerly winds, in a general easterly and south easterly course.

"(2.) *The secondary cause of the migration is the desire for food, and possibly the reproductive instinct.* The fact that in their migrations the locusts often seem to select cultivated tracts, rapidly cross the treeless, barren plains, and linger and die on the prairies and western edge of the fertile valleys of the Missouri and Mississippi, indicate that the impelling force is due primarily to the want of food, and that the guiding force is the direction of the prevailing winds, for they have no leaders, and we do not believe in the existence of a "migratory instinct" in the locust any more than in the grass army worm, or the cotton army worm, which it is sufficiently evident migrate from field to field, simply in search of more abundant food. Meanwhile the reproductive system of the locusts is maturing, the eggs ripening, and the uneasiness of the locusts during the course of their travels may be unconsciously stimulated by the sexual instincts and the desire to discover suitable places for egg-laying—a long and tedious operation.

"It has been sufficiently shown that a swarm of locusts observed by Professor Robinson near the entrance to Boulder Cañon, Colorado, travelled a distance of about six hundred miles to Eastern Kansas and Missouri. Though the swarm was first observed at some distance north of Denver, Colorado, it was then on its way from the north, and may have come from some part of Wyoming two or three hundred miles north-westward or northward. Though the winds may vary, and counter-currents exist, and storm gusts from due north, such as often sweep over the plains, and local southerly breezes may retard their flight, the course is either eastward or south-easterly. We know enough of the winds in the Western States and Territories to lay down the law that the general direction of the winds in July and August, along the eastern slope of the Rocky Mountains and on the plains, is from the west and north-west, and accords with the eastward course of the locust swarms. The relations between the average direction of the winds and the migrations of the locust have, however, never been sufficiently studied, either, so far as we are aware, in Europe or in this country. And yet, if we would intelligently study the causes of the excessive increase and migrations of the locust, we must examine the meteorological features of the country, ascertain the periods of drought and undue rainfall, the average direction of the wind for the different months, in order to learn how far they correspond with the phenomena of insect life. That there are meteorological cycles, dry and hot seasons recurring at irregular intervals, while the general average may remain nearly the same century after century, is supported, though it may be vaguely, by observed meteorological facts.

"The question then arises: *Can meteorologists predict the coming of seasons of undue heat and drought? and consequently can we predict insect years? that is, the migrations of locusts and the undue increase of the chinch bug and the army and cotton worm?* I believe that we shall, after the lapse of years, be able to foretell with a good degree of certainty locust invasions, and be able to provide against the losses thus incurred.

"On the frontier of the Western States, in Colorado, or in the Territories of Wyoming, Montana, and Utah, where the losses from the ravages of the locust cannot easily be made up by importations from contiguous territories, it seems the most practicable mode to provide in years of plenty against years of want. We should imitate on a grand scale the usage of the ancient Egyptians under Pharaoh, who laid up in time of unusual harvests stores of grain for times of famine. It is said that this has been done on a small scale by the Mormons. If this were done in the far West, in seasons immediately preceding insect years, which had been predicted by entomologists in conjunction with the meteorologists we should be saved the distress, destitution, and even loss of life from starvation, which have resulted from ignorance of the laws regulating the appearance of destructive insects, especially the western locust.

"*The Return Migration.*—By simultaneous observations for a number of years over the region liable to be visited by migratory hordes of locusts, added to the knowledge we already possess, it will not only be possible to predict the course of certain swarms from their breeding-places, and their probable destination, so that when a swarm starts from Montana or Wyoming, its arrival in Colorado a week or a fortnight later may with some certainty be predicted, and again, its arrival in Kansas and adjoining States be announced with a certain amount of precision, as has already been done by Dr. Riley, but we shall be able to foretell the course taken in the return flight of their progeny in the succeeding year. I will confess that, previous to my visit to Kansas and Colorado, in 1875, I was sceptical as to Dr. Riley's opinion that there was a general movement in a north-west course of the young of the previous year, broods from Missouri and adjoining regions north-westward. The facts and resulting theory have already been stated in full by Dr. Riley and others. It remains to determine the causes of this return migration, this completion of the 'migration-cycle,' as Professor Dawson terms it. It is evident that in this case the desire for food is not the cause, for food is many times more abundant in the Mississippi Valley than on the plains whither they return. The solution of the problem, I think, must be sought in the direction of the prevailing winds during the middle of June, the time they become winged. It may be fonnd after a series of careful meteorological observations, that the prevailing winds at this early season are southerly and south-easterly. It has been shown by meteorologists, as I learn from Prof. C. Abbe, that during May and June the winds blow inwards towards the heart of the continent from the Atlantic Ocean and Gulf of Mexico. On application to Gen. A. J. Myer, Chief of the Signal Service of the United States Army, for the meteorological data necessary to confirm this hypothesis, I promptly received a full summary of data observed by the officers of the Weather Signal Bureau for periods of from two to five (usualiy the latter) years between 1871 to 1876, which show that the prevailing winds in June, in Davenport, Dodge City and Keokuk, Iowa; St. Paul and Breckenridge, Minnesota; Yankton and Fort Sully, Dakota; Omaha, Leavenworth, and Fort Gibson, Indian Territory—all within the locust area—are from the south-east and south. This fact may be sufficient to account for the prevailing course of the return migrations of the locust from the eastern limits of the locust area.

"Let us therefore grant this setting-in of southerly and easterly winds, which may last until the locusts are winged. When they rise on the wing into the air they are known to move in a general north-west direction. It is highly probable that they are borne along by these generally south-easterly winds, and pass over on to the plains. The cause is seen, then, to be entirely independent of subsistence; possibly the reproductive instinct causes them to become uneasy, restless, to assemble high in the air, and seek the dry, hot, elevated plateau of the north-west. Should this be so the cause of the migrations is probably purely mechanical. Abundant testimony is at hand to show that they are wholly at the mercy of the prevailing winds, and that, as a rule, the course of their migrations is quite dependent on the direction of the winds, while the course of the winds depend more or less on the season of the year. We may expect that future

research over sufficient territory will show that the June migrations, from the eastern limits of the locust area, will be towards the north-west, and the July, August, and early Septembar migrations, from the Rocky Mountain plateau, will be in a general easterly and south-easterly direction.

"It is not only of great scientific interest, but of high practical importance, to collect all facts bearing on the return migrations, in order to know where the locusts go in their return migrations the second year, as we only know that they do fly a certain distance northwestward. We want to ascertain the extreme western limits of this return migration. We also want to learn whether they return to their original breeding-places on the eastern slopes of the Rocky Mountains, or whether the westerly winds, if they are westerly, drive them back and scatter them, so that they do not breed extensively.

"It will be seen by the reader that all grounds for a reliable working theory of locust migrations are based on the work of our Signal Bureau and local observers, and that the observations of the meteorologists and entomologists must go hand in hand. The government has provided a well-organized corps of meteorological observers, and we submit that a number of competent entomologists should take the field, under government auspices. Not only should the border States, especially Texas, Kansas, Nebraska, Minnesota, and Iowa, employ competent entomologists, following the liberal policy of Missouri, which for eight years has had a state entomologist, whose reports have proved of incalculable practical value, as well as of great scientific interest, but the habits of the locust need first of all to be thoroughly studied in the Territories, particularly those of Wyoming, Montana, Idaho, Dakota, Utah, New Mexico, Arizona, and in the State of Colorado. A commission of entomologists should be appointed to make a thorough detailed study for several successive seasons of the habits of the locusts in the Territories mentioned. It would seem that the recommendations made at the recent meeting of Western Governors at Omaha, that an appropriation be made by Congress, and a commission be attached to the existing United States Geological and Geographical Survey of the Territories, is the most feasible and economical method of securing the speediest and best results.

Let us for a moment look at the losses sustained in the United States from the attacks of insects. The annual agricultural products of this country by the last census amounted in value to $2,500,000,000. Of this amount we in all probability *annually* lose over $200,000,000 from the attacks of injurious insects alone. Dr. Riley avers that the losses during 1874 in Missouri from locusts—and it will be remembered that only the western third was invaded—exceeded $15,000,000. This would make the losses in other parts of the West at least twice as much more, or $45,000,000 in all. The estimated money loss occasioned by the chinch bug in Illinois in 1864 was over $73,000,000, in Missouri, in 1874, it is estimated by Dr. Riley to have been $19,000,000. The annual losses from the chinch bug are greater, Mr. Riley says, than from any other insect. The average annual loss to the cotton crop from the attacks of the cotton army worm alone is estimated at $50,000,000. Adding to these the losses sustained by the attacks of about a thousand other species of insects which affect our cereals, forage and field crops, fruit trees and shrubs, garden vegetables, shade and ornamental trees, as well as our hard and pine forests, and stored fruits, and it will not be thought an exaggeration to put our annual losses at $200,000,000. If the people of this country would only look at this annual depletion, this absolute waste, which drags her backward in the race with the countries of the Old World, they might see the necessity of taking effectual preventive measures in restraining the ravages of insects. With care and forethought based on the observance of facts by scientific men, we believe that from $50,000,000 to $100,000,000, or from one quarter to one half of this annual waste, could be saved to the country. And the practical, most efficient way is for the States to co-operate with the general Government in the appointment of salaried entomologists, and of a United States commission of entomologists, who should combine the results of the State officials, and issue weekly, or, if necessary, daily bulletins, perhaps in combination with the Weather Signal Bureau, as to the conditions of the insect world, forewarning farmers and gardeners from week to week as to what enemies should be guarded against and what preventive and remedial measures should be used.

"The Weather Signal Bureau, first suggested and urged by the late I. A. Lapham,

was not instituted without ridicule and opposition, but it has saved millions to our commerce and agriculture. The maintenance of an entomological commission and the appointment of State entomologists would involve comparatively little expense. Already, owing to the full information regarding the invasion of Missouri by the locust in 1874, contained in the reports of Prof. C. V. Riley, the people of that State will be well prepared from the direful experience of the past, to deal more intelligently and efficiently with the locust for the future.

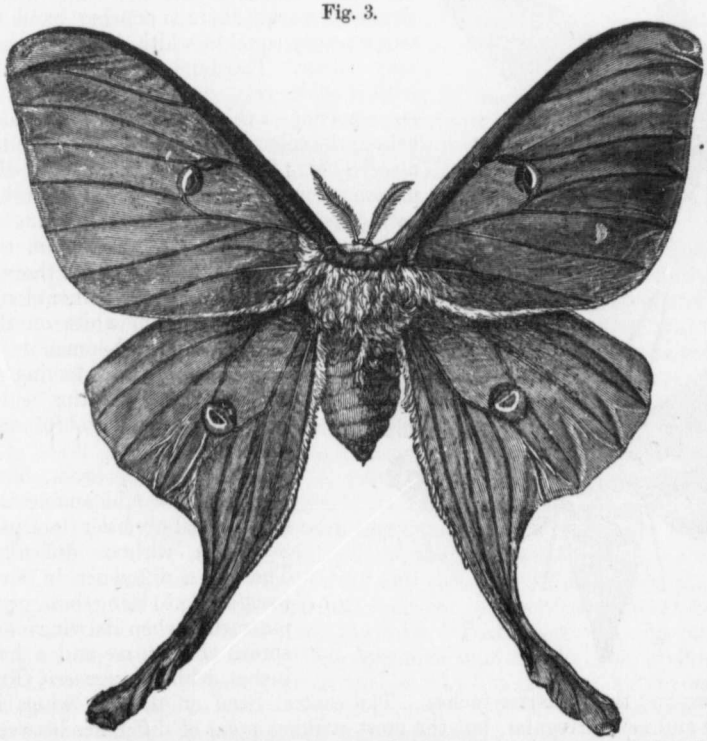
ON SOME OF OUR COMMON INSECTS.

BY W. SAUNDERS, LONDON, ONTARIO.

THE LUNA MOTH (*~~Actias~~ luna*, LINN).

In our Report last year, there was an interesting article on this beautiful insect, by Mr. R. V. Rogers, of Kingston, Ontario. At the time that appeared, we were unable to supply an illustration of the moth, but lately we have succeeded in obtaining a very beautiful one, drawn and engraved expressly for our pages.

Fig. 3.



This moth (Fig. 3) measures when its wings are spread from $4\frac{3}{4}$ to $5\frac{1}{2}$ inches. The wings are of a delicate green colour, thickly covered with pale hairs as they approach the body. There is a purplish brown stripe along the front margin of the fore wings, which stretches also across the thorax, while a small branch of the same is extended to the eye spot near the middle of the wing. The eye spots are transparent in the middle and margined with rings of white, yellow, blue and black. The hinder edges of the wings are bordered with purplish brown. The head is white while the beautifully pectinated antennæ are of a brownish tinge. The thorax and abdomen are whitish or greenish white, thickly clothed with a woolly down, the former crossed by the purplish brown stripe already mentioned. The legs are purplish brown.

This lovely creature is not at all common in the neighbourhood of London; indeed it can scarcely be called common anywhere in Ontario, although it is very widely and generally distributed. Seldom a season passes without some being captured in our midst, and occasionally we have had them fly in at the windows at night, attracted apparently by the light.

The larva, which is of a bluish green colour, feeds on Hickory, Walnut, Butternut, and sometimes on Beech and Oak, and closely resembles that of *polyphemus*, from which it may be distinguished by its having a pale yellow lateral stripe, bands of the same between the segments, and a brown V-shaped mark on the terminal segment.

For fuller details, we refer our readers to Mr. Rogers' excellent paper.

Celerio gallii Rott Fabr.

DEILEPHILA CHAMŒNERII AND LINEATA.

Both these members of the Sphinx family are found more or less plentifully in nearly all portions of the Provinces of Ontario and Quebec; *lineata*, as far as we have been able to learn, is more abundant in Ontario and *chamœnerii* in Quebec. They are both very handsome moths, and so strong and active when on the wing that it is difficult to capture them without injury. About twilight or a little later their period of activity begins, when they may be seen flitting about with spectre-like rapidity, hovering like the humming bird over flowers, into which their long and slender tongues are inserted in search of the nectar there stored.

They are much alike. In both the ground colour of the fore wings is of a rich greenish olive, crossed about the middle by a pale buff stripe or bar, extending almost the whole length to the tip, while along the outer margin there is another band or stripe nearly equal in width, but of a dull ashy colour. The hind wings are small, with a wide rosy band, which covers a large portion of the wing, while above and below, the colour is almost black, the hinder margin being fringed with white. In the markings on the bodies they also resemble each other very much. There is a line of white on each side, extending from the head to the base of the thorax, and other less prominent longitudinal lines of white on the thorax. The abdomen is of a greenish olive, having a reddish hue on the sides and spotted with white and black.

Fig 4.

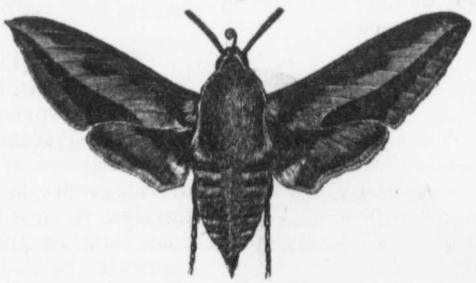
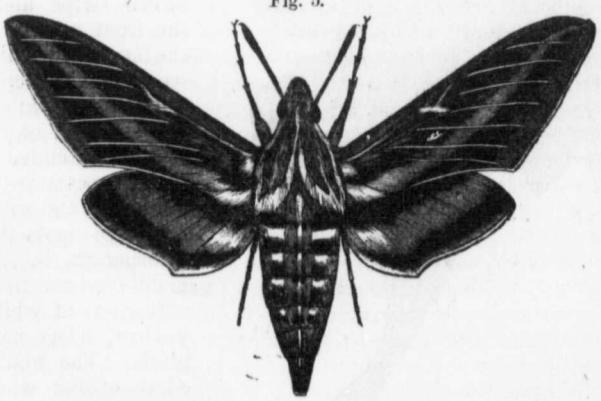


Fig. 5.

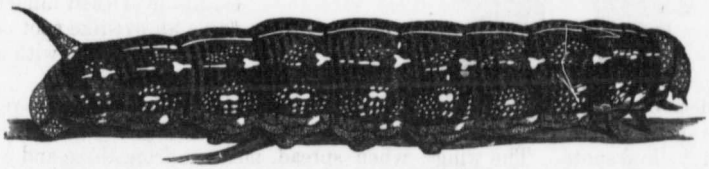


There are differences, however, which would enable the most casual observer to separate them without difficulty. There is a difference in size, *lineata* (Fig.5) being the largest, measuring when its wings are spread about three and a half inches, while *chamœnerii* (Fig. 4) rarely exceeds two and three-quarter inches. The central band on the fore wings in *chamœnerii* is wider and more irregular, but the most striking point of difference between the species is that the veins of the fore wings in *lineata* are distinctly margined with white, a character entirely wanting in *chamœnerii*. These differences will be readily appreciated by reference to the figures.

In our Report for 1874, we gave a short description of *D. lineata*, known also as "the white lined morning sphinx;" but since some of our readers may not have access to that report, we have reproduced some of the figures then used. The beautiful figure of *D. Chamœnerii* has been drawn and engraved expressly for this report.

Fig. 6.

Fig. 7.



The caterpillars of *lineata* vary much in appearance. In Fig. 6 we have a representation of the most common form, while another form is shown in Fig. 7. They are said to feed upon purslane, turnip, buckwheat, watermelon, also on grape and apple leaves. Mr. Pile, of Dundas, Ont., has found them feeding on the common plantain. They are found in the larval condition during the month of July, and when full grown they are said to descend into the ground, where they change into light brown chrysalids, and appear as moths in September.

The following description of the larva of *D. chamænerii* was made from three examples found feeding on grape leaves on the 5th of July :—

Length, two and a half inches, tapering towards each end : head small, rather flat in front, slightly bilobed, and of a dull pinkish colour, with a black stripe across the front at the base ; basal half of palpi yellow, upper half black ; mandibles black, with a patch of yellow between them and the black stripe.

Body above deep olive green, with a brownish tinge and a polished surface. Second segment with a cervical shield similar in colour to head, its sides dull greenish, with two yellow dots. There is a pale yellowish dorsal line terminating at the base of the caudal horn ; each segment from 3rd to 12th, inclusive, has a pale yellow spot on each side of the dorsal line, about half way towards the stigmata, those on 3rd segment small and almost crescent-shaped, on the 4th larger and nearly round, 5th still larger, nearly round, 6th, 7th, 8th, 9th, 10th and 11th about equal in size, nearly oval and larger than those on 5th. On 12th segment the spot is more elongated, and extending upwards, terminates at the base of the caudal horn. There is a wide but indistinct blackish band across the anterior part of each segment, in which the yellow spots are set ; the sides of the body below the spots are thickly sprinkled with minute raised yellow dots. Caudal horn long, curved backwards, red, slightly tipped with black, and with a roughened surface ; terminal segment dull pinkish ; stigmata oval, yellow, shaded around with dull black.

Under surface much paler, colour dull pale pinkish green, the pink colour predominating from 5th to terminal segments inclusive, and with a number of very minute raised yellowish dots placed chiefly along the sides. Feet black ; pro-legs pink, with a patch of black on the outside of each. One specimen spun a light web, binding a portion of the leaf in the manner of *pampinatrix*, within which it changed to chrysalis on the 10th of July, and from this the imago appeared on the 28th of the same month. The other two larvæ died before completing their transformations.

The Black Swallowtail Butterfly (*Papilio asterius*).

This is one of our commonest butterflies, and is found in nearly all parts of Canada and the United States. It is a very handsome species, with the wings of a black or deep blackish brown colour, with yellow and blue markings. Across the wings there are two bands of yellow spots ; those composing the inner one in the male are large and distinct, while in the female they are smaller and sometimes almost obsolete. In Fig. 10, also

Fig. 8.

engraved expressly for this report, we have an excellent representation of the female. The spots forming the outer band are smaller and near the margin. Besides these, the fore wings have one or two spots towards the upper margin and the hind wings, which are tailed, have a series of seven blue spots or patches, and near their hinder angle an eye-like spot of an orange colour, with a black centre.

The under surface of both wings is paler, with the spots arranged nearly as above, excepting that those on the hind wings are tinted with orange. The body is black, with longitudinal rows of yellow spots. The wings, when spread, measure from three and a-half to four inches across.

The caterpillars, when fresh from the egg, do not measure more than a tenth of an inch in length, are black with a broad white band across the middle, and another on the hinder segments, while the body is studded with small black projecting points. After the first skin is cast the white band is restricted to the sixth and seventh segments, and around the base of the black projecting points are spots of an orange colour, while low down on the sides is a row of white spots; there are also two of the same colour on the top of the first segment, and a larger one on the hinder segment. With each moult these caterpillars alter in colour and appearance, and before they are half grown the projecting points, white band, and spots entirely disappear, the skin becomes smooth and of a delicate green colour, rather paler at the sides and whitish below, and each ring is crossed by a band composed of alternate black and yellow spots. When irritated they push forth, from a slit in the first segment of the body, a pair of soft, orange-coloured horns, united at their base, and shaped somewhat like the letter Y; from these, when extended, a disagreeable odour is given off, which serves to defend the caterpillars from the attack of their enemies. They feed on parsley, rue, carrot, parsnip, carraway, and several other plants, both wild and cultivated. When full grown the caterpillar measures an inch and a half in length, it then leaves off eating, and seeks a sheltered spot in which to pass the chrysalis state. Here it first spins a little web of silk against the surface of the spot selected, to which its hind feet are firmly secured, it then spins a loop or girth of silken threads to furnish a support to the body, after which it casts its caterpillar skin and appears as a chrysalis. In this state it continues from ten to fifteen days in summer, the time varying with the temperature, when the butterfly escapes.

NOTES OF THE YEAR.

BY WM. SAUNDERS, LONDON, ONT.

THE ARMY WORM (~~*Heliophila unipuncta*~~ *Leucania unipuncta*).

This troublesome insect has appeared in several sections of our Province during the past year, and although it has not occurred in such hordes as in times past, yet its numbers were sufficiently great during the latter part of the season to excite apprehension of the probability of a more severe invasion during the coming summer. Towards the end of the warm weather the moths were very abundant, and could be captured by hundreds by preparing a bait of molasses and beer, and painting it on fence boards or trees early in the evening.

The moth, when its wings are spread, measures nearly an inch and three-quarters. It is of a yellowish drab colour, approaching russet, with a small white dot on the forewings near the middle, and a dusky oblique stripe near the tip, and a few blackish dots over their surface. The hind wings are darker, with a silky lustre, and almost semi-transparent. The fore part of the body is similar in colour to the fore-wings, the hinder part a little darker than the hind wings.

The worm when full grown, measures about an inch and a half in length, is of a dark grey colour, with yellowish and dusky longitudinal stripes. They sometimes appear in immense swarms, devouring whole fields of grain and other grasses during their progress.

THE GOOSEBERRY FRUIT WORM (*Pampelia grossularia*).

This troublesome pest is increasing rapidly from year to year, and committing great havoc among the gooseberries. We have had many complaints from fruitgrowers during the past season of their destructiveness, with inquiries as to the best methods of counteracting their ravages. One of our correspondents, Mr. B. Gott, of Arkona, has so well explained the workings of this insect, that we think it best in this connection to quote his own words. He says "for some time past we have suffered from the depredations of a worm upon our gooseberries, and not having observed anything in type treating upon this particular insect, I thought it advisable to acquaint you with the facts of the case. While the gooseberry is yet young and tender, say about the size of a pea, a small worm appears and eats its way into the heart of the berry and becomes of a greenish colour. After living there for some time and scooping clean the contents of that berry, it will attack the next nearest berry and secure itself effectually against accident or danger by a sort of net or web-work thrown around and over those berries, at the same time growing in length and strength and prospering everyway as satisfactorily as insect could desire. About the time that gooseberries are nearly ripe, say during the latter part of July, it has attained its full dimensions as a devouring larva, and is about one inch or one and a quarter in length with six claw-like feet towards the head. By this time it has enclosed some ten or twelve berries in its capacious web to satisfy its voracious and increasing demands, scooping all out thoroughly.

"The worms work by thousands on our plantations of a few hundred bushes and destroy from one-half to two-thirds of the entire crop of berries. Now as this fruit is of considerable value and importance, this insect depredation is felt to be something more than a benefit. It amounts to more than thinning; it is an actual loss to the grower, and

the trouble is an ever increasing and rapidly growing one. What can be done to counteract the workings of this enemy to gooseberry culture ?"

This worm is the progeny of a small grey moth (see Fig. 9), which lays its eggs upon the gooseberries as soon as they begin to form. The moth, when its wings are expanded, measures nearly an inch across. Its fore wings are pale grey with dark streaks and bands. There is a transverse diffuse band a short distance from the base of the wing, enclosing an irregular whitish line which terminates before reaching the front edge of the wing. Near the outer edge is another transverse band enclosing a whitish zig-zag line. There is also a row of blackish dots within the outer margin; the veins and their branches are white. The hind wings are paler and dusky. The head, antennæ, body and legs are all pale grey, more silvery underneath than above.

Fig. 9.

This insect passes the winter in the chrysalis state, enclosed in a brown papery-looking cocoon (see Fig. 9), hid amongst leaves or other rubbish on the surface of the ground, and escapes from the chrysalis, and appears as a moth during the latter part of April. Shortly after they seek their mates, and the females are ready to deposit their eggs as soon as the fruit is sufficiently advanced in growth, these are probably attached singly to the fruit, where in a few days they hatch, producing worms, which burrow in the fruit as our correspondent has described.

When full grown, the worms lower themselves to the ground by silken threads which they spin at will, and there construct their little silken cocoons amongst the dried leaves and rubbish, and remain in this inactive state until the following spring; hence there is only one brood during the year.

The infested fruit soon indicates the presence of this larva, by becoming discoloured and withered. We have found them attacking currants also, both white and red, and occasionally infesting the black currant.

The most satisfactory remedy we know of, is hand-picking. The evidences of their presence are not difficult to detect. Any berries found colouring prematurely, should be examined, and as the larvæ slip out and fall to the ground very quickly care must be taken that they do not escape in this manner. We have tried dusting the bushes with fresh air-slacked lime late in April, with good results, the moths seeming to avoid almost entirely bushes so dusted. We would also suggest keeping the ground under the bushes clean, so as to afford them no hiding-places, also the use of some ashes or lime strewed under the bushes. It is said that, if chickens are allowed the run of the gooseberry patch after the fruit has been picked, they will greatly lessen their numbers by devouring the chrysalids. The mode of life adopted by this insect prevents the successful use of any poison applied to the bushes as may be readily done when the larva feed on the leaves of the bush they infest.

The Cabbage Butterfly (*Pieris rapæ*).

While we regret to have to record the onward march of the Cabbage Butterfly which has now spread over the whole of western Ontario, destroying yearly tens of thousands of cabbages, we are at the same pleased to be able to state that its natural enemy the little ichneumon parasite, *Pteromalus puparum*, described in our previous reports, is closely following in its wake—out of a large number of chrysalids of the butterfly found about London, a considerable proportion have been found upon examination to be infested with these parasites.

This friendly insect is a tiny four-winged fly, about one-eighth of an inch long, with a golden coloured body and greenish head. The female spends her time in searching for the chrysalids of the butterfly, into which she drills little holes and therein deposits her eggs; these hatch into tiny maggots, which prey upon the substance of the chrysalis and finally devour it.

BENEFICIAL AND INJURIOUS INSECTS.

(Chiefly of the Order Hymenoptera.)

BY JOSEPH WILLIAMS, LONDON, ONT.

1. The Common Bee (*Apis mellifica.*)
2. The Bee-moth or Wax-worm (*Gallerea cereana*) Fabr.
3. The Bee-killer (*Trupanea apivora*) Fitch.
4. The Ring-legged Pimpla (*Pimpla annulipes*) Br.
5. The Pigeon Tremex (*Tremex columba*) Linn.
6. The Sigalphus Circulio Parasite (*Sigalphus curculionis*) Fitch.
7. The Porizon Curculio Parasite (*Porizon conotracheli*) Riley.

To the student of insect life, and even to the most ordinary observer, there is no class of insects more interesting and wonderful than the Hymenoptera (membranous winged insects), as our readers will no doubt admit when we say that to this order belong the Bees, Humble Bees, Wasps, Ants, Gall Flies, and many other less familiar forms. Naturalists, as well as poets and thinkers of all ages, have been led to admire them for their wonderful powers of architecture, their economic foresight, their marvellous instincts, and their admirable social organizations, all of which prove a very high order of intelligence. Two living entomologists—Dana and Packard—place them at the head of their lists in their systems of classification, considering them the most perfect insects. Dana says of them, "They exhibit the *normal size* of the insect type, which is between eight and twelve lines in length, and two and a half or three in breadth." Packard ascribes to them "instincts and a kind of reason differing, perhaps, *only in degree* from that of man.

The metamorphoses of the Hymenoptera are complete, that is, in their development they pass through the four stages of a typical insect, viz. : the egg, the larva, the pupa or chrysalis, and the imago or perfect insect.

They have small but powerful membranous wings well adapted for long sustained flights.

We propose to compile such information, from scattered authors, as may be at once interesting and instructive ; and will commence with the common Honey Bee.

The Honey Bee (*Apis mellifica*).

This valuable little insect has been known from the times of the ancients, and at present it is cultivated over the entire civilized world, and in many uncivilized and thinly peopled countries is found wild ; it was introduced into America during the seventeenth century.

In a complete hive of bees there are three very distinct kinds of individuals—the female, mother, or queen bee,—the neuters or working bees which are incompletely developed females—and the males or drones.

A still further subdivision may be made : "There have been observed amongst bees two sorts of females or queens, a large one and a small. Needham first observed the latter : and their existence, P. Huber tells us, has been confirmed by several observations of his father. They are bred in cells nearly as large as those of the common queens, from which they differ only in size. Though they have ovaries, they have never been observed to lay eggs. Reamur observes that some queens are much larger than others ; but he attributes this difference of their size to the state of the eggs in their body. There are two descriptions of males—one not bigger than the workers, supposed to be produced from a male egg laid in a worker's cell. The common males are much larger and will counterpoise two workers. The workers are divided into the *wax workers* and the *nurse bees* ; the latter are smaller than the former ; their stomach is not capable of such distension ; and their office is to build the combs and cells after the foundation has been laid by the wax workers, to collect honey, and to feed the larvæ. The nurse bees, however, do secrete wax, but in very small quantities." (Kirby and Spence's Entomology.)

The working bees are the crowd, the masses, the living force ; they greatly outnumber other individuals. The worker is smaller than either the queen or drone ; it has three pairs of legs as have the others, but the hindermost pair of the worker's legs is developed in a peculiar manner to enable it to perform the duties belonging to it ; the leg is much enlarged near its farther end, and resembles a long triangle in outline ; a set of sharp points or many strong spines, which are regularly distributed, form a kind of rake toward the extremity, and this implement enables the bee to seize the waxy plates that are between its abdominal segments. The first joint of the tarsus or foot succeeds the leg and attains a great size, when compared with that of the other members of the structure. Being articulated with or jointed to the leg by its internal angle, the free external portion forms, with the leg, a true pair of pincers ; moreover two small spines render the arrangement all the more perfect. This joint is square in outline, and is perfectly smooth on the outside, whilst it is furnished on the inside with many transverse sets of stiff hairs of equal size. The limb acts capitally as a trowel and as a brush. The fertile female or queen, which never works, has the traces of this arrangement, and the males also ; but neither of them has the pinching and brushing structures : these are restricted to the workers.

The worker or neuter possesses a pair of movable mandibles or jaws which close the mouth on the side ; its trunk or proboscis consists of four horny like scales which enclose a tongue about the size of a hair, which when magnified appears to be formed of successive rings. One pair of these sheathing scales is provided with a fringe of hairs, intended, no doubt, to brush off and secure the honey which is found in the cups of flowers, and a more efficient and beautiful instrument we could not conceive of. This tongue is not used for sucking as in the case of butterflies, but for lapping ; when not in use it is folded in a small compass. The antennæ are twelve jointed and terminate in a knob ; they probably serve as a means of communication, and as delicate organs of touch. The abdomen consists of six joints or rings, and under the scaly coverings of the four middle ones are situated the receptacle for the wax. Neither the queens nor the drones have any provision for the collection of pollen or the secretion of wax, as their duties are of another kind. The abdomen of the worker is terminated by a straight sting ; the drone has none ; that of the queen is curved. The wings of the worker and those of the drone, cover the abdomen entirely, whilst those of the queen cover only one-half. Other characteristics and the relations of these creatures to each other will be best shown by an examination of their social life, and their division of labour, which are among the strongest arguments for ascribing powers of reason to these insects.

A colony of bees consists, besides the young brood, of one queen, several hundreds of males or drones, and many thousand workers or neuters.

In the summer time, a bee hive is truly a busy place : all is bustle without confusion : each insect has its appointed work to do, and all are diligent. At the door stand the watchful sentinels ready to challenge rash intruders, while passing in and out are hundreds of busy workers, some carrying their sweet burdens to the common store-house, whilst others are setting off in search of new supplies. Here we see a worker engaged in a contest with a venturesome stranger, and there are others performing the last sad offices for a dead companion. Their industry is remarkable and has become proverbial, as can testify many a lagging urchin who has been referred to the bee to find incitement to industry.

"How doth the little busy bee,
Improve each shining hour," &c.

When a colony takes possession of a hive, be it an artificial one or a natural cavity, the first operation is to stop up all the openings, except one, which is to form the door. The substance used in this process is called *propolis*, and is an odorous gum resin taken from the buds of the poplar, pine, fir, and beech trees. It is said that bees sometimes use this propolis for embalming the dead bodies of enemies which cannot be removed fromt he hive, and which are in this way prevented from decomposing. If so, the Egyptians lose a trifle of their celebrity in this regard. After the hive is properly prepared, the next step is to lay the foundation for the cells which are to form the comb. The material necessary, is wax. Wax was formerly supposed to be derived from the pollen of flowers

alone, but it has been proved that bees fed solely on pollen do not secrete wax, but do when saccharine matter is supplied. A detachment of workers is sent to the fields to collect supplies and soon return loaded. One now attaches itself to the roof, allowing its body to hang down; another fastens its front legs to the hinder ones of the first; and this operation is repeated until a large cluster is formed, suspended from the top of the hive. The bees remain in this position about twenty-four hours, during which time the food they have collected is altered by some process into wax, and appears under the joints of the abdomen. One now separates itself from the mass, and forcing its way to the roof, clears a space of about an inch in diameter, in which it can move freely: it then suspends itself, and, seizing one of the laminæ of wax with a pincer formed by two joints of the hind leg, withdraws it from beneath the abdominal ring, and carries it to its mouth. Here it masticates it, mixing it with the frothy saliva; during the operation the tongue assumes many forms: now it is flattened like a spatula; then like a trowel; at other times it resembles a pencil terminating in a point. The saliva mixed with the wax gives it a whiteness and opacity which it had not before, and another object of the admixture is doubtless to give it that ductility and tenacity which it possesses in its perfect state. The bee next applies the ribands of wax which result to the vault of the hive, disposing them with its mandibles in the direction which it wishes them to take: it continues these manœuvres until it has employed all the laminæ of wax it has elaborated. At length it leaves its work, and is lost in the crowd of its companions. Another succeeds and resumes the employment; then a third; all follow the same plan of placing their little masses, and if any by chance gives them a contrary direction, another coming removes them to their proper place. The wax-makers having thus laid the foundation of a comb, are succeeded by the nurse bees, which are alone competent to model and perfect the work. The former are the labourers who convey the stone and mortar; the latter the masons who work them up into the form which the intended structure requires. One of the nurse bees with its mandibles moulds in the wall a cavity which is to form the base of one of the cells. When it has worked some minutes it departs, and another takes its place, deepening the cavity, heightening its lateral margins by heaping up the wax to the right and left, by means of its teeth and fore feet. More than twenty bees successively employ themselves in this work. At a certain time other bees begin on the yet untouched and opposite side of the mass, and commencing the bottom of *two* cells, are in turn relieved by others. The wax-makers bring fresh supplies from time to time for the use of the nurse bees. After having worked the bottom of the cells of the first row into their proper forms, they polish them, while others begin the outline of a new series. The cells or prisons are next constructed, and engrafted on the borders of the cavities, and the length of the tubes is so perfectly proportioned, that there is no observable inequality among them. It is to be remarked that although the general form of the cells is hexagonal, the first begun are pentagonal. "When one has well examined," says Reamur, "the true shape of each cell, when one has studied their arrangement, geometry seems to have guided the design for the whole work. One finds that all the advantages which could have been desired are here combined. The bees seem to have had to solve a problem containing conditions which would have made the solution appear difficult to many geometricians. The problem may be thus enunciated: given a quantity of matter, say of wax, it is required to form cells which shall be equal and similar to each other, of a determined capacity, but as large as possible in proportion to the quantity of matter employed, and the cells to be so placed that they may occupy the least possible space in the hive. To satisfy this last condition, the cells should touch each other in such a way that no angular spaces remain between them."

That the bees have fully solved the above problem is evident, and the judgment they use renders it impossible for us to view them as mere organized machines, whose instinct is their spring of action: we are forced to concede to them intelligence—(Figuieur).

The two rows of cells placed back to back form the comb, and the combs are so arranged that the bees have just space to pass between them. The size of the cell varies, but the majority of them are small, some are slightly larger, and a few are of considerable size, and those usually at the ends of the combs. The smallest are for the larvæ of the workers, the next will be filled by those of the male, and the largest cells will contain queens or fertile females.

As soon as the cells are finished the queen or fertile female runs over the surface of the combs and lays an egg in each cavity, and she is attended by a host of workers who take care that only one egg is dropped into each cell. Should two fall in, one is pulled out and destroyed. When the laying is finished the work of the queen is at an end, and she does not concern herself in any way about the larvæ. The eggs are not long in being hatched. From the moment when the larva comes out of the egg until that of its metamorphosis into a pupa, it keeps in its cell, motionless as an Indian idol. The working bees visit it from time to time. In from three to five days the larvæ are developed; they have absorbed all their pap, and have no need from that time of any nourishment, for they are now about to change to pupæ. The nurses now pay them a last attention, they wall them up in their cells, closing the openings with a waxen covering. In thirty-six hours they have spun for themselves a silken cocoon in which they undergo their transformation. The perfect insect is ready in seven or eight days to appear in broad daylight; it breaks through the thin transparent covering in which it is swathed; then with its mandibles it pierces the door of its prison and issues forth. It soon becomes strong, and if it is a worker it is not long in getting to work and mixing with its companions in labour. Queens require sixteen days from the laying of the egg before they are ready to emerge from their cells; workers require twenty; and drones require twenty-four. The rearing and birth of the queen differs from that of others. In proportion as their larvæ increase in size do the workers enlarge the cells which contain them, and then again gradually diminish their size as the moment of their last change approaches. A special and peculiar food is given to the larvæ that are to form the queens, it is heavier and sweeter than that given to the other larvæ. The food and the situation appear to be the causes which decide the nature of the forthcoming insect, as when the hive becomes in any way queenless the workers choose a larva which, in ordinary circumstances, would become a worker, and by alterations in its dwelling and by supplying it with royal food ultimately produces a perfect female or queen. As soon as they have quited their cradles, the young queens are ready for flight; but the workers and males are less strongly organized, they require a rest of about a day before taking part in the sports and labours of the older ones.

When hatching has begun, each day adds some hundreds of young bees to the population of the hive, which soon becomes too small, and then occur those remarkable emigrations called swarms. When this remedy becomes necessary, the inhabitants become excited, drop their work, and the agitation becomes general; the queen runs from place to place, but does not receive her customary homage; the workers are no longer attentive to the young brood; the hum increases in intensity, and as if panic striken the bees rush from the hive, led or accompanied by a queen. The swarm flies about and soon settles on a suitable branch, forming a dense mass of living animals supporting each other by the claws of their feet. Sometimes it happens that two queens go out with the same swarm; and the result is that the swarm at first divides into two bodies, one under each leader but they usually unite again, and when the whole are housed the question of sovereignty is settled by the stronger queen destroying the weaker. Until this great question is decided, the bees do not settle to their usual labour. Two queens in the same hive is something that cannot be endured, and there are many accounts of the singular duels which decide such matters.

When the colony is thoroughly organized, and the members are beginning to accumulate provisions, a most singular tragedy takes place. The drones or males are no longer wanted, and they must be got rid of. The massacre is performed by the workers, who seize the drones, pull them by their legs, wings, or antennæ, and finally kill them with their stings. The pitiless executioners do not spare even the larvæ and pupæ of the males. The slaughter goes on for several days or until all the males are killed, they not being able to defend themselves as they have no stings. In two cases the drones are not destroyed—when the queen lays only male eggs, and when the hive is without a queen. But we have said little as yet about the most familiar product of the bee—we mean honey. Let us accompany them on their excursions into the fields. On these occasions the principal object of the bees is to furnish themselves with three different materials: the nectar of flowers from which they elaborate honey and wax; the pollen, or fertilizing dust from the anthers of the flowers, of which they make what is called the bee-bread, serving as

food both to old and young; and the resinous substance called *propolis*, which we have described in speaking of the preparation of the hive in the first place. The nectar is a fluid secreted by the flowers, and is extracted by the bees by means of their long tongues they do not take up this fluid by suction but by a lapping motion; the juice is then conveyed into the first stomach or honey bag, which is small when empty, but when filled becomes swelled to a considerable size. In the honey-bag the fluid is changed into honey, and from this bag the bee ejects it into one of the cells on her return to the hive. Honey is never found in the second stomach, which is reserved for the bee-bread. In collecting honey, bees do not confine themselves solely to flowers; they will sometimes very greedily absorb the sweet juices of fruits, they are also fond of sugar; though the great mass of the food of bees is collected from flowers, they do not wholly confine themselves to a vegetable diet; for, besides the honeyed secretion of the aphides, the possession of which they will sometimes dispute with the ants, upon particular occasions they will eat the eggs of the queen; they are also very fond of the fluid that oozes from the cells of the pupæ, and will suck eagerly all that is fluid in their own abdomens after they are wounded by their rivals. Although bees in some instances appear to know and do avoid many flowers yielding poisonous honey, yet they have been known to collect poisonous honey in large quantities. In the autumn and winter of the year 1790, an extensive mortality was produced amongst those who had partaken of the honey collected in the neighbourhood of Philadelphia. The attention of the American Government was excited by the general distress, a minute inquiry into the cause of the mortality ensued, and it was satisfactorily ascertained that the honey had been chiefly extracted from the flowers of *Kalmia latifolia*—known by the common names of Mountain Laurel or Calico Bush—a plant possessing strong narcotic properties. History informs us that honey found at Trebizond, on the Black Sea, threatened fatal effects to such of the Greek army, as partook of it, in the celebrated retreat after the death of the younger Cyrus; those soldiers who ate it in small quantities appeared as if intoxicated, while such as partook of it freely appeared as if mad or about to die, numbers lying on the ground as if after a defeat. Pliny observes that this honey was collected from a species of *Rhododendron*.

When the stomach of the bee is filled with nectar, it next, by means of the feathered hairs with which its body is covered, pilfers from the flowers the fertilizing dust of the anthers—the pollen, which is equally necessary with the honey to the society, and may be named the ambrosia of the hive, since from it the bee-bread is made. Sometimes the bee is so discoloured with this powder as to look like a different insect, becoming white, yellow or orange, according to the flowers in which it has been busy. Reamur was urged to visit the hives of a gentleman who, on this account, thought his bees were different from the common kind. He suspected, and examination proved, that the circumstance just mentioned occasioned the mistaken idea. When the body of the bee is covered with farina, with the brushes of its legs, especially its hind ones, it wipes it off; not as we do with our dusty clothes; to dissipate and disperse it in the air, but to collect every particle of it, and then to knead it and form it into two little masses, which she places, one in each, in the baskets formed by hairs on her hind legs.

Reamur seems to think that bees fly indiscrimately from one species of flower to another, but the testimony of many other naturalists is, that they collect only from the same species on each trip, as they have been observed to pass over numerous others in search of flowers similar to that with which they began. It seems not improbable that the reason why the bee visits the same species of plant during one excursion may be this: her instinct teaches her that the grains of pollen which enter into the same mass should be homogeneous, in order perhaps for their more effectual cohesion; and thus Providence also secures two important ends—the impregnation of those flowers that require such aid, by the bees passing from one to another; and the avoiding of the production of hybird plants, from the application of the pollen of one kind of plant to the stigma of another.

When a bee has completed her lading she returns to the hive to dispose of it. The honey is disgorged into the pots or cells destined to receive it, being discharged from the honey-bag by its alternate contraction and dilation. A cell will contain the contents of many honey-bags. Bees, when they bring home the honey do not always disgorge it; they sometimes give it to such of their companions as have been at work within the hive. Some of the cells are filled with honey for daily use, and some with what is intended as a re-

serve, and stored up against bad weather or a bad season ; these are covered with waxen lids.

The pollen is employed as circumstances direct. When the bee laden with it arrives at the hive, she sometimes stops at the entrance, and very leisurely detaches it by piecemeal, devours one or both the pellets on her legs, chewing them with her jaws, and passing them then down the little orifice before noticed. Sometimes she enters the hive, and by a peculiar noise produced by beating her wings she attracts to her three or four of her companions who relieve her of the supply and devour it.

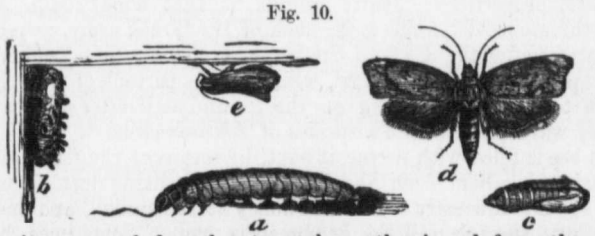
Very much more might be said about bees, especially in regard to such points as their love, anger and hate, their foresight, and the numerous expressed theories as to their possession of more than mere sensation as their guide. Such topics, although very interesting, are of a nature too speculative for the present, but those desirous of pursuing the subject in that direction can obtain abundance of literature. We will conclude by describing, in the next two articles, two insect enemies of the bee, although they are not members of the Hymenopterous order. It is well known among cultivators that bees-hives are subject to the attacks of large hawkmoths, and even mice are known to enter a hive. Bees are also afflicted by parasites. But by far the worst enemy the bee-keeper has to contend with is—

G. mellonella Linn.

THE BEE-MOTH OR WAX WORM. (~~*Gallerea cereana*~~) ~~FABR.~~ Linn. (*Lepidoptera, Tineidæ*).

The following is from Riley's First Annual Report for Missouri :—

Fig. 10.



"This insect is so well known to bee-men generally, that it scarcely needs a description. It is well illustrated above (Fig. 10) in all its shapes, *a* showing the full-grown worm, *b* the cocoon which it spins, *c* the chrysalis to which it changes, *d* the female with wings expanded, and *e* the male moth viewed from the side with the wings closed. It suffices to say, that the colour of the moth is dusky gray, the fore wings which are scolloped at the end, being more or less sprinkled and dotted with purple brown. The female is generally a good deal larger than the male, though there is not so much difference between the sexes as some writers have supposed. The worms which produce these moths are of an ash-gray colour above, and yellowish white beneath.

"The Rev. L. L. Longstroth, in his excellent work on the Honey Bee, which every bee-keeper should possess, has given such a complete account of the Bee-moth, that it is only necessary for me to mention a few of the most important facts with regard to it, my object being principally to show that there can be no such thing as a *moth proof hive* ; that wire gauze contrivances are of no avail, and that the man who pretends to sell a moth proof *hive*, may usually be set down as a know-nothing or as a swindler.

"The Bee-moth was first introduced into this country from Europe about the commencement of the present century, and it was in all probability imported with the common bee-hive. There are two broods of the moth each year, the first brood appearing in May or June, and the second, which is the most numerous, in August. During the daytime these moths remain quietly ensconced in some angle of the hive, but as night approaches they become active, and the female uses her best endeavours to get into the hive, her object being to deposit her eggs in as favourable a place as possible. Wire gauze contrivances are of no account to keep her out, as she frequently commences flying before all the bees have ceased their work. But even if she were entirely prevented from entering the hive, she could yet deposit her eggs on the outside, or by means of her extensile ovipositor thrust them in between the slightest joint or crack, and the young worms hatching from them would readily make their way into the hive. The moment the worm is hatched, it commences spinning a silken tube for its protection, and this tube is enlarged as it increases in size. This worm cuts its channels right through the comb,

feeding on the wax, and destroying the young bees on its way. When full-grown it creeps into a corner of the hive or under some ledge at the bottom, and forms a tough white cocoon of silk intermingled with its own black excrement as in figure *b*. In due time the moth emerges from this cocoon.

"A worm-infested hive may generally be known by the discouraged aspect which the bees present, and by the bottom board being covered with pieces of bee-bread mixed with the black gunpowder-like excrement of the worm. It must not be forgotten, however, that in the spring of the year, pieces of bee-bread at the bottom of the hive, *when not mixed with the black excrement*, is not necessarily a sign of the presence of the worm, but, on the contrary, may indicate industry and thrift. If a hive is very badly infested with the worm, it is better to drive out the bees and secure what honey and wax there may be left than to preserve it as a moth-breeder to infest the apiary. If put into a new hive, the bees may do something, and if they do not there is no loss, as they would have perished finally from the ravages of the worm.

"It should invariably be borne in mind that a strong stock of bees is ever capable of resisting, to a great extent, the attacks of the worm; while a starved or queenless swarm is quite indifferent to its attacks. In a common box-hive, a good way to entrap the worms after they are once in a hive is to raise the front upon two small wooden blocks, and to put a piece of woollen rag between the bottom board and the back of the hive. The worms find a cozy place under the rag, in which they form their cocoons, and may there be found and killed from time to time. Much can be done in the way of prevention, by killing every morning the moths which may be found on the outside of the hives. At this time of the day they allow themselves to be crushed, with very good grace, and if two or three are killed each morning, they would form an important item at the end of the year, especially when we recollect that each female is capable of furnishing a hive with at least 300 eggs. In conclusion, I give it as my conviction that immunity from the ravages of the bee-worm can only be guaranteed where a thorough control is had of both hive and bees: hence the great importance of the movable frame hive."

The Bee-killer (*Trupanea apivora*), Fitch (*Diptera, Asilidæ*).

Fig. 11.

The following is also from Riley's First Annual Report:—

"In the last chapter of his ninth Report, Dr. Fitch describes a fly by the name of of the 'Nebraska Bee-killer,' which he received from Mr. R. O. Thompson, of Nursery Hill, Otoe County, Nebraska, and which the latter named gentleman had found preying upon the bee in North Nebraska in the summer of 1864. Mr. Thompson has since removed from Nebraska to North Missouri, and in conversation with him he informed me that he had met with this bee-killer each year since 1864, and that it seemed to be increasing. At a later day, in a communication to the *Rural World*, of Sept. 12th, 1868, he states that it made its appearance in such numbers in North Missouri last summer that it, to a great extent, prevented the bees from swarming. I present above, at Fig. 11, a life-size portrait of this voracious insect, its general colour being yellowish-brown or yellowish-gray. This figure will enable its ready recognition, and those who wish a very full and detailed description of it will find it in the report of Dr. Fitch, above referred to. It belongs to the *Asilus* family of two-winged flies, which have been very aptly termed the hawks of the insect world. Last July I found these flies quite common in Mr. Shaw's beautiful gardens in St. Louis, and I watched them by the hour, and found, to my amazement, that though other insects were flying all around, as well as other species of bees, yet they never seized any other species but the common honey-bee. They capture the bee on the wing, pouncing on it with lightning-like rapidity, and grasping it securely with the fore legs, they alight upon some plant, or even upon the ground, and rapidly suck out the inside of the bee, with the stout and powerful proboscis which is shown in the figure, leaving the empty shell when they get through. Mr. Thompson says that beneath some favourable perch that is near the apiary, hundreds of these bee-shells may be found accumulated in a single day, while he

has watched and found that a single fly on one of those perches destroyed no less than 141 bees in that period of time.

"The habits of these flies are little known, and until they are better understood no feasible way of protecting the bees from their attacks can be given. Those which are known to haunt the apiary should be captured, and this can best be done by means of a net. It is almost impossible to catch them while on the wing, though as soon as they have settled with their prey they are caught with comparative ease. It will pay thus to catch them, for they are, doubtless, the cause of much of the non-swarming which we hear of."

In addition to the Bee-moth and the Bee-killer, there are several small insects which are parasitic on the Honey Bee, but which, although very numerous in Europe, are not very familar in America, We give here a few notes from Packard's work entitled "Our Common Insects."

In Europe, one of the most formidable foes of the hive bee is the Phora, a small fly about a line and a-half in length: it is found in the summer and autumn flying slowly about flowers and windows, and in the vicinity of bee hives. When impelled by instinct to provide for the continuance of its species, the Phora enters the bee-hive and gains admission to a cell, when it bores with its ovipositor through the skin of the bee larva, laying its long oval egg in a horizontal position just under the skin. The embryo of the Phora is already well developed, so that in three hours after the egg is inserted in the body of its unsuspecting and helpless host, the embryo is nearly ready to hatch. In about two hours more it actually breaks off the larger end of the egg-shell and at once begins to eat the fatty tissues of its victim, its posterior half still remaining in the shell. In an hour more it leaves the egg entirely, and buries itself completely in the fatty portion of the young bee. The maggot moults three times. In twelve hours after the last moult it turns around with its head towards the posterior end of the body of its host, and in another twelve hours, having become full-fed, it bores through the skin of the young, eats its way through the brood-covering of the cell, and falls to the bottom of the hive, where it changes to a pupa in the dust and dirt. Twelve days after the fly appears.

The young bee, emaciated and enfeebled by the attacks of its ravenous parasite, dies, and its decaying body fills the bottom of the cell with a slimy, foul-smelling mass, called "foul-brood." This gives rise to a miasma which poisons the neighbouring brood, until the contagion (for the disease is analogous to typhus, jail, or ship fever) spreads through the whole hive, unless promptly checked by removing the cause and thoroughly cleansing the hive.

Foul-brood sometimes attacks an American hive, and, though the cause may not yet be known, yet from hints given above, we hope to have the history of our species of Phora cleared up, should our disease be found to be sometimes due to the attacks of such a parasite fly.

Another foe is the Bee-louse of Europe, *Braula cæca*, a singular wingless spiker-like fly, allied to the wingless sheep-tick, the wingless bat-tick, and the winged horse-fly. The head is very large, without eyes or ocelli (simple eyes), while the ovate hind-body consists of five segments, and is covered with stiff hairs. It is one-half to two-thirds of a line long. This spider fly is "pupiparous," that is, the young, of which only a very few are produced, is not born until it has assumed the pupa state, or is just about to do so. The larva is oval, eleven-jointed, and white in colour. The very day it is hatched, it sheds its skin, and changes into an oval puparium of a dark brown colour. Its habits resemble those of a flea. Indeed, should we compress its body strongly, it would bear a striking resemblance to that insect. It is evidently a connecting link between the flea and the two-winged flies. Like the former, it lives on the body of its host, and obtains its food by plunging its stout beak into the bee and sucking the blood. It has not been noticed in this country, but is liable to be imported on the bodies of Italian bees. Generally one or two of the Braulas may be detected on the body of the bee: sometimes the poor bees are loaded down by as many as a hundred of these hungry blood-suckers. Assmuss recommends rubbing them off with a feather, as the bee goes in and out of the door of its hive.

Among beetles, the *Trichodes apiarius* has long been known in Europe to attack the young bees. In its perfect or beetle state, it is found on flowers, like our *Trichodes Nuttallii*, which is commonly found on Spiræas in August, and which may yet prove

to enter our bee hives. The larva devours the brood, but with the modern hive its ravages may readily be detected.

The Oil-beetle, *Meloë angusticollis*, is a large dark-blue insect found crawling in the grass in the vicinity of *Andrena*, *Halictus*, and other wild bees in May, and again in August and September. (Our readers will find this Meloë fully described in another part of this Report, by Mr. Saunders.)

Fabre has also, in a lively and well-written account, given a history of the *Sitaris*, a European beetle, somewhat resembling Meloë. He says that Sitaris lays its eggs near the entrance of bees' nests, and at the very moment the bee lays her egg in the honey cell, the flattened, ovate Sitaris larva drops from the body of the bee upon which it has been living, and feasts upon the contents of the freshly laid egg. After eating this delicate morsel, it devours the honey in the cells of the bee, and changes into a white, cylindrical, nearly footless grub; and after it is full-fed, and has assumed a supposed "pupa" state, the skin, without bursting, incloses a kind of hard "pupa" skin, which is very similar in outline to the former larva, within whose skin is found a whitish larva which directly changes into the true pupa. In a succeeding state, this pupa in the ordinary way changes into a beetle which belongs to the same group of Coleoptera as Meloë.

The history of *Stylops*, a beetle allied to Meloë, is no less strange than that of Meloë, and is in some respects still more interesting. On June 18th, I captured an *Andrena vicina* which had been "Stylopized." On looking at my capture, I saw a pale reddish brown triangular mark on the bee's abdomen: this was the flattened head and thorax of a female Stylops. On carefully drawing out the whole body, which is very extensible, soft and baggy, and examining it under a high power of the microscope, we saw multitudes, at least several hundreds, of very minute larvæ, like particles of dust to the naked eye, issuing in every direction from the body of the parent now torn open in many places, though most of them made their exit through an opening on the under side of the head thorax. The Stylops, being hatched while still in the body of the parent, is therefore viviparous. She, probably, never lays eggs. It appears that the larvæ are hatched during the middle or last of June from eggs fertilized in April. The larvæ then crawl out on the body of the bee, on which they are transported to its nest, where they enter, according to Peck's observations, the body of the larva, on whose fatty parts they feed. Previous to changing to a pupa, the larva lies with its head turned towards that of its host, but before assuming the perfect state (which they do in the late summer or autumn), it must reverse its position. The female protrudes the front part of her body between the segments of the abdomen of her host. This change, Newport thinks, takes place after the bee-host has undergone its metamorphoses, though the bee does not leave her earthen cell until the following spring. Though the male Stylops deserts his host, his wingless partner is imprisoned during her whole life within her host, and dies immediately after giving birth to her numerous (for Newport thinks she produces over two thousand) offspring.

As in the higher animals, bees are afflicted with parasitic worms which induce disease and sometimes death. The well known hair-worm, Gordius, is an insect parasite; the adult form is about the size of a slender knitting needle, and is seen in moist soil and in pools; it lays, according to Dr. Leidy, "millions of eggs connected together in long cords." The microscopical, tadpole-shaped young, penetrate into the bodies of insects frequenting damp localities; fairly ensconced within the body of their unsuspecting host, they luxuriate on its fatty tissues, and pass through their metamorphoses into the adult form, when they desert their living house and take to the water to lay their eggs. In Europe, Siebold has described *Gordius subbifurcus*, which infests the drones of the honey-bee, and also other insects. Professor Siebold has also described *Mermis albicans*, which is a similar kind of worm, from two to five inches long, and of a whitish colour; this worm is also found, strangely enough, only in the drones, though it is the workers which frequent watery places to appease their thirst.

The Ring-legged Pimpla (*Pimpla annulipes*) Br.

In a previous Report (1874) occur descriptions and illustrations of two insects which are parasitic on the larvæ of the Codling-moth, which descriptions were from the fifth

Annual Report of Mr. Charles V. Riley; these two insects are the Ring-legged Pimpla, which will be described in this article, and the Delicate Long-sting will follow.

"The Ring-legged Pimpla is a black fly, varying considerably in size, the female sometimes measuring but ¼, others fully ½ inch, exclusive of ovipositor, the male somewhat smaller. The genus Pimpla was briefly characterized in my last report, p. 43, where it was shown that this same species attacks the Walnut Case-bearer (*Acrobasis juglandis*, Le B. I annex a lateral outline of a female Pimpla, Fig. 12). The male has a more slender abdomen, which is unarmed.

Fig. 12.

"Pimpla annulipes is black, the abdomen rough punctured above, with the borders of the joints polished and inclined to brown. The tegulæ are white, and the legs are reddish, with the exception of the middle and hind tibiæ which are dusky, especially the hind pair, and have a broad white annulus, sometimes indistinct on the middle pair, the posterior tarsi are dusky, especially the tip, the palpi are pale yellow. Cresson says it may be distinguished from the other species of this genus, by the scutellum being black, the tegulæ white, and the anterior coxæ yellowish red.

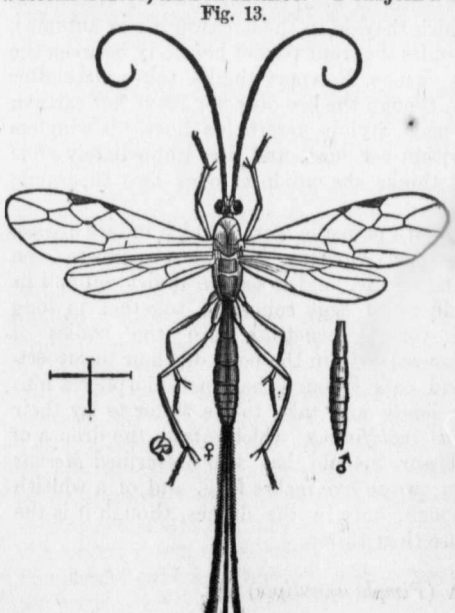
"This fly eats its way through the chrysalis and cocoon of the Codling-moth, without having previously made any cocoon of its own. It was quite abundant last summer, as from one lot of one hundred and sixty-two *Carpocapsas*, I obtained twenty-one parasites, all of them females but one. It is a widely distributed and common species."

The second parasite may be called the

Delicate Long-sting (*Macrocentrus delicatus*) Cress.

"It has recently been described by Mr. E. T. Cresson (Trans. Am. Ent. Soc. iv., p. 178), and is a somewhat variable species, occurring throughout the eastern, middle, and western States, and in Mexico. I subjoin a description drawn up from my bred-specimens,

Fig. 13.



Male. Length 0·25; expanse 0·45, inch slender, colour pale, polished, honey yellow; uniformly and sparsely pubescent; tinged with brown superiorly, the basal joint of the abdomen and a medio-dorsal line on the other joints being quite black. Head, with the eyes (except at disc), and a spot between ocelli, brown-black; palpi long and almost white; antennæ one fourth-longer than the whole body, about 48 joints, exclusive of bulbus, curled at tip, the ends of basal joints and the whole of joints dusky. Thorax, with the sutures well defined, and two small triangular black spots behind front tegulæ, the metathorax strongly trilobed; legs very long, pale honey yellow, with tips of tibiæ and tarsi faintly dusky; wings yellowish, hyaline and iridescent, with the veins luteous and the stigma pale honey yellow.

"Female, rather larger and with abdomen somewhat paler, otherwise similarly marked. Ovipositor yellow, ⅛ longer than body, the sheaths quite pilose, and inclining to fuscous, described from two females and one male.

"It is a graceful fly with very long antennæ and legs, and the female with a long ovipositor, (Fig. 13) the hair lines at the side of the figure show the natural size of the

fly. The colour is pale honey yellow inclining to brown above. The unfortunate apple worm is probably pierced while yet in the fruit, as it always succumbs soon after forming its cocoon, and before changing to chrysalis; while in the case of *Pimpla*, it is probably attacked either while leaving the fruit or after having spun its cocoon. The larva of the Delicate Long-sting forms for itself, within the cocoon of its victim, a sufficiently tough, thin, oblong-oval, shiny, brown cocoon, from which the perfect fly issues by cutting open a lid at one end.

"As both these parasites transform within the cocoon of the *Carpocapsa*, it is next to impossible and quite impracticable to separate friend and foe in removing and destroying the contents of the bandages; but where it is desired to disseminate the parasites they may be bred by enclosing large numbers of the *Carpocapsa* cocoons in some tight vessel."

On the 13th of August, 1873, Mr. Saunders took a number of chrysalides of the Codling-moth under a bandage on an apple tree, and among them there was one which was infested by ichneumons. The chrysalis, when emptied, was found to contain six of the parasitic larvæ, of which the following description was taken:—length, a little over one-tenth of an inch; body, tapering almost to a point towards the head; colour, dull, yellowish white, with a tinge of yellow along the dorsal region, very transparent, the internal organs showing plainly through. On each segment is a transverse row of short, whitish spines; terminal segment encircled with stouter whitish spines; no proper feet or prolegs, but in moving the mouth parts attach first with a sucker-like disc, and the hinder parts of the body are drawn gradually forward, different portions of the under surface being furnished with small fleshy prominences, which are attached, and in turn withdrawn from the surface on which the larva is moving: the principal points of attachment, however, seem to be the first and terminal segments; under the latter, when viewed sideways, there appears a fleshy projection much larger than any of those on the other segments, and this projection expands into a flattened disc, which holds the larva firmly to the place of attachment.

Mr. Saunders did not succeed in rearing these larvæ: after the chrysalis which contained them was broken open, they, one after another, died, in spite of all efforts for their preservation. Whether this would have proved distinct from the species last described by Mr. Riley, and thus make a third parasite on this pest (the Codling-moth), we are at present unable to determine.

The Pigeon Tremex (*Tremex columba*), Linn.

This insect has been found injurious to the pear, button-wood, and elm-trees.

The following is from Harris's "Injurious Insects":——

"The body of the female is cylindrical, about as thick as a common lead-pencil, and an inch and a half or more in length, exclusive of the borer, which is an inch long and projects three-eighths of an inch beyond the body. The latter rounds upwards like the stern of a boat, and is armed with a point or short horn. The head and thorax are rust-coloured, varied with black. The abdomen, or hinder and longest part of the body, is black, with seven ochre-yellow bands across the back, all of them but the first two interrupted in the middle. The horned tail, and a round spot before it, impressed as if with a seal, are ochre-yellow. The antennæ are rather short and blunt, rust coloured, with a broad black ring in the middle. The wings expand two inches and a quarter, or more; they are smoky-brown and semi-transparent. The legs are ochre-yellow, with blackish thighs. The borer, awl, or needle, is as thick as a bristle, spear-pointed at the end, and of a black colour; it is concealed, when not in use, between two narrow rust-coloured side-pieces, forming a kind of scabbard to it.

"This insect is figured and described in the second volume of the late Mr. Say's 'Entomology.' The male does not appear to have been described by any author; and, although agreeing in some respects with the two other species represented by Mr. Say, is evidently distinct from both of them. He is extremely unlike the female in colour, form and size, and is not furnished with the remarkable borer of the other sex. He is rust-coloured, variegated with black. His antennæ are rust-yellow or blackish. His wings

are smoky, but clearer than those of the female. His hind body is somewhat flattened, rather widest behind, and ends with a conical horn. His hind legs are flattened, much wider than those of the female, and of a blackish colour; the other legs are rust-coloured, and more or less shaded with black. The length of his body varies from three-quarters of an inch to one inch and a quarter, and his wings expand from one inch and a quarter to two inches or more.

"An old elm tree in this vicinity (Cambridge, Mass.) used to be a favourite place of resort for the *Tremex columba*, or Pigeon Tremex, and around it great numbers of the insects were often collected, during the months of July and August and the early part of September. Six or more females might frequently be seen at once upon it, employed in boring the trunk and laying their eggs, while swarms of males hovered around them. For fifteen years or more, some large buttonwood trees in Cambridge have been visited by them in the same way. The female, when about to lay her eggs, draws her borer out of its sheath, till it stands perpendicularly under the middle of the body, when she plunges it, by repeated wriggling motions through the bark into the wood. When the hole is made deep enough she then drops an egg therein, conducting it to the place by means of the the two furrowed pieces of the sheath. The borer often pierces the bark and wood to the depth of half an inch or more, and is sometimes driven in so tightly that the insect cannot draw it out again, but remains fastened to the tree until she dies. The eggs are oblong oval, pointed at each end, and rather less than one twentieth of an inch in length. The larva, or grub, is yellowish white, of a cylindrical shape, rounded behind, with a conical horny point on the upper part of the hinder extremity, and it grows to the length of about an inch and a half. It is often destroyed by the maggots of two kinds of Ichneumon flies (*Pimpla atrata* and *Pimpla lunator*, Fabr.) These flies may frequently be seen thrusting their slender borer, measuring from three to four inches in length, into the trunks of trees inhabited by the grubs of the tremex, and by other wood-eating insects; and like the female tremex, they sometimes become fastened to the trees and die without being able to withdraw their borers."

In the *Canadian Entomologist*, November 1868, Vincent Clementi reports the capture in North Douro, Ontario, of several specimens of the Pigeon Termex; they were taken from an oak tree, which had been cut for cordwood, and were all found to be females.

The Sigalphus Curculio Parasite (*Sigalphus curculionis*) Fitch.

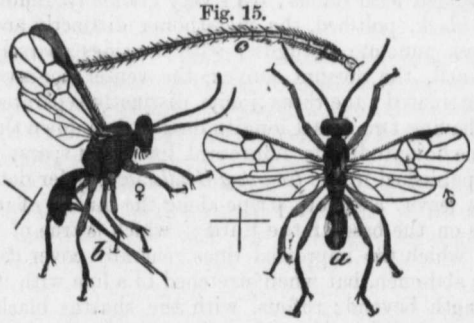
To those whose plum trees have been repeatedly ravaged by the Plum curculio and whose efforts have only been slightly successful in preventing the wholesale destruction of fruit, it will not be uninteresting to know that there are two known parasites of the curculio of which the following descriptions and illustrations are taken from Riley's Report, of 1870, for the State of Missouri.

"In 1860, in his address on the curculio delivered at the annual meeting of the N. Y. State Agricultural Society, Dr. Fitch gave an account, accompanied with a figure, of a small Ichneumon-fly which he named *Sigalphus curculionis*, and which he believed was parasitic on the curculio. Before that time no parasite had been known to attack this pestilent little weevil, and even to the present time (1870), it is currently believed that no such parasite exists; for unfortunately the evidence given by Dr. Fitch was not sufficient to satisfy some of our most eminent entomologists. These parasites were in fact received by him from Mr. D. W. Beadle, of St. Catharines, C. W., who had bred them from black-knot, from which he bred at the same time a certain number of curculios; but as other worms besides those of the curculio are likewise found in black-knot, we had no absolute proof that this fly was parasitic on the insect in question; consequently we find that Mr. Walsh, in his report as acting State Entomologist of Illinois rather ridicules the idea of its being a curculio parasite and endeavours to show that it is parasitic instead on the larva of his plum-moth (*Semasia prunivora*). But I have this year not only proved that poor Walsh was himself wrong in this particular inference, but that he was equally wrong in supposing his little plum-moth, so called, to be confined to plums; for I have bred it from galls (*Quercus frondosa*, Bassett), from haws, from crab-apples and abundantly from apples.

"To be brief, Dr. Fitch's *Sigalphus* is a true parasite on the plum curculio and I have bred hundreds of the flies from curculio larvæ. The first bred specimens gave me much pleasure, for as soon as I saw they belonged to the same genus as Dr. Fitch's fly, I felt assured that another disputed question was settled, but to make assurance doubly sure, I repeatedly half filled large jars with pure earth, finely sifted so that no living animal remained in it. Into these jars I placed curculio larvæ from day to day as they issued from peaches that were thrown into another vessel, and in due time the parasitic flies began to issue from the ground along with the perfect curculios. Nay, more than this, I soon learned to distinguish such curculio larvæ as were parasitised, and after they had worried themselves under the ground—seldom more than half an inch—I would uncover them, and on several occasions had the satisfaction of watching the gnawing worm within reduce its victim until finally nothing was left of him. As soon as the curculio larva is destroyed by the parasite, the latter (Fig. 14 *a*) encloses itself in a tough little yellowish cocoon of silk (Fig. 14 *b*.) then gradually assumes the pupa state (Fig. 14 *c*.) and at the end of about the same length of time that the curculio require to undergo *its* transformations and issue as a beetle, this, its deadly foe, gnaws a hole through its cocoon and issues to the light of day as a black four winged fly (Fig. 15 *a*, male; *b*, female). In the vicinity of St. Louis, this fly was so common the past season that after very careful estimates, I am satisfied three-fourths of all the more early developed curculio larvæ were destroyed by it. On the 17th and 18th of April, in that locality a severe frost killed the peach buds on all but a few of the young and most vigorous trees of Hale's Early and Crawford, so that instead of a large and abundant crop of peaches to depredate on, the little Turk had to concentrate his attacks on the few peaches that were left; and no one expected any fruit would be saved. Yet, the work of this little parasite was so effectual that, wherever fruit set, a fair crop was gathered even by those who made no effort at all to protect their trees.

Fig. 14.

Fig. 15.



"While visiting Dr. Fitch last August, at his house in Salem, N. Y., I compared my bred specimens with his species, and found them identically the same; but a full description will be found below, and it is not necessary at present to dwell upon its characters.

"As Mr. Walsh bred this same parasite from the larva of his little plum-moth, it doubtless attacks other soft-bodied insects, and does not confine itself to the plum curculio. This is the more likely as it would scarcely pass the winter in the fly state. The female, with that wonderful instinct which is exhibited in such a surpassing degree in the insect world, knows as well as we, great lords of creation, what the little crescent mark upon the peach or plum indicates; and can doubtless tell with more surety, though she has never received a lesson from her parents, whether or not a curculio larva is drilling its way through the fruit. When she has once ascertained the presence of such a larva by the aid of her antennæ, which she deftly applies to different parts of the fruit, and which doubtless possess some occult and delicate sense of perception, which, with our comparatively dull senses, we are unable to comprehend—then she pierces the fruit, and with unerring precision deposits a single egg in her victim by means of her ovipositor.

"Now there is, as I shall shew in the description, a variety (*rufus*) of this parasite, with the ovipositor nearly one-fifth of an inch in length; but in the normal form the ovipositor is only twelve-hundreths of an inch long, and the curculio larva must be reached soon after it hatches, or while yet very young. Consequently we find that the earliest curculio larvæ or those which hatch while the fruit is yet small, are the most subject to be parasitised, and while from larvæ obtained early in the season, I bred more parasites

than curculios, this order of things was reversed a little later in the year. Some persons will no doubt wonder how such a large fly can be developed from a curculio larva which is stung while so young; but we do not know how long the parasite egg remains unhatched, and it must be remembered that it is a rule, wisely ordained and long known to exist in insect life, that the parasitic larva does not at first kill outright, but subsists without retarding growth, upon the fatty portions of its victim, until its own growth is attained. Thus the first worm derives its nourishment from the juicy fruit and grows on regardless of the parasite which is consuming its adipose substance until the latter is sufficiently developed, and the appointed time arrives for it to destroy its prey by attacking those parts more vital.

"This parasite, which I will now proceed to describe, belongs to the second subfamily (*Braconides*) of the Ichneumon flies (*Ichneumonidæ*), and the venation of its wings, and the three-jointed abdomen, place it in the genus *Sigalphus*. Westwood (Synopsis, p. 63), gives three cubital panes or areolets in the front wings as characteristic of the, genus; but Brulé (p. 510) and, as Mr. Cresson informs me, Westmael in his *Braconides de Belgique*, give only two, which is the number in our insect.

"*Sigalphus curculionis*, Fitch—Imago (Fig. 15 *a*, male; *b*, female). *Head*, black, subpolished and sparsely covered on the face with short whitish hairs; ocelli touching each other; labrum and jaws brown; palpi pale yellow; antennæ (Fig. 15 *c*) twenty-seven-jointed, filiform, reaching when turned back, to middle joint of abdomen or beyond, the bulbous and small second joint rufus and glabrous, the rest black or dark brown, though 3-10 in many specimens are more or less tinged with rufous; 3-14 very gradually diminishing in size; 14-27 sub-equal. *Thorax*, black, polished, the metathorax distinctly and broadly punctate, and the rest more or less punctate or rugose, with the sides sparsely pubescent. *Abdomen*, pitchy-black, flattened, the dorsum convex, the venter concave, and the sides narrow-edged and slightly carinated; the three joints distinctly separated and of about equal length; the first joint having two dorsal longitudinal carinæ down the middle; all densely marked with very fine longitudinally impressed lines, and sparsely pubescent (Dr. Fitch in his description published in the *Country Gentleman*, under date of September, 1859, states that these lines leave 'a smooth stripe along the middle of its second segment, and a large smooth space on the base of the third;' which is true of a few specimens, but not of the majority in which the impressed lines generally cover the whole abdomen). Ovipositor longer than abdomen, but when stretched in a line with it, projecting backwards about the same length beyond; rufous, with the sheaths black. *Legs*, pale rufous, with the upper part of hind tibiæ and tarsi, and sometimes the hind femora, dusky. *Wings*, sub-hyaline and iridescent, the veins pale rufous, and the stigma black. Length, female .15-.16 inch, expanse, .30; male differs only in his somewhat smaller size, and in lacking the ovipositor. In many specimens the mesothorax and the eyes are more or less distinctly rufous.

"Described from 50 females, and 10 males, bred June 23rd—July 29th, 1870; from larvæ of *Conotrachelus nenuphar*, and 2 females obtained from Dr. Fitch."

"*Larva* (Fig. 14 *a*), white, with translucent yellowish mottlings. *Pupa* (Fig. 14 *c*, female), .17th inch long, whitish, members all distinct, the antennæ touching hind tarsi, the ovipositor curved round behind, reaching and touching with its tip the third abdominal joint, which afterwards forms the apical joint of imago; five ventral joints which in the imago become much absorbed and hidden, being strongly developed. *Cocoon* (Fig. 14 *b*), composed of one layer of closely woven yellowish silk."

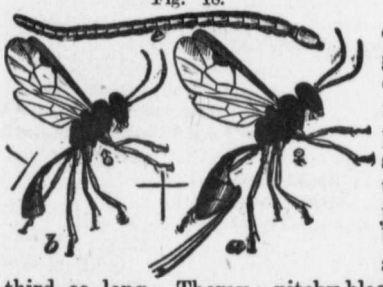
"*Variety Rufus.*—Head, thorax and most of the first abdominal joints entirely rufous, with the middle and hind tibiæ dusky, and the ovipositor three times as long as abdomen, and projecting more than twice the length of the same beyond its tip. Described from three females bred promiscuously with the others. This variety is slightly larger, and differs so remarkably from the normal form that, were it not for the absolute correspondence in all the sculpturing of the thorax and body, and in the venation of the wings, it might be considered distinct. The greater length of the ovipositor is very characteristic, and accompanies the other variation in all three of the specimens."

The Porizon Curculio Parasite (*Porizon conotracheli*).

This parasite of the plum curculio is also described in Mr. Riley's Report for 1870, from which the following account is taken :—

"The present insect, instead of issuing the same summer as a fly, remains in its somewhat tougher and more yellowish cocoon all through the fall and winter, and does not issue in the winged state until the following spring. This parasite was first discovered by Dr. Trimble, who sent me the cocoon, from which I subsequently bred the perfect fly. It belongs to the first sub-family (*Ichneumonides*) of the Ichneumon-flies, and apparently to the genus Porizon, of which it forms a new species. It is only necessary here to state that it differs from the previous species in its reddish-brown abdomen, as well as in form, which may be seen by referring to the figures (*a*, female ; *b*, male ; *c*, antenna).

Fig. 18.



Porizon conotracheli, N. Sp.—Head : pitchy black, opaque, the ocelli triangularly placed, and close together. Eyes : oval, polished and black. Face : covered with a silvery white pubescence ; labrum rufous, with yellowish hairs ; mandibles and palpi, pale yellowish brown ; antennæ inserted in depressions between the eyes, reaching to metathorax when turned back, filiform, 24-jointed ; black with basal joints 6-1 becoming more and more rufous, the bulbus always distinctly rufous ; bulbus rather longer and twice as thick as joint 3 ; joint 2 about one-third as long. Thorax : pitchy-black, opaque, the sides slightly pubescent with whitish hairs, the mesothorax rounded and bulging anteriorly, the scutellum slightly excavated and sharply defined by a carina each side ; metathorax with the elevated lines well defined, and running parallel and close together from scutellum to about one-fourth of their length, then suddenly diverging, and each forking about the middle. Abdomen : glabrous, polished, very slender at base, gradually broader and much compressed from the sides at the apex, which is truncated ; peduncle uniform in diameter, and as long as joints 2 and 3 together ; joints 2–5 sub-equal in length ; colour rufous, with the peduncle wholly, dorsum of joint 2, a lateral shade of joint 3, and more or less of the two apical joints superiorly, especially at their anterior edges, black ; venter more yellowish ; ovipositor about as long as abdomen, porrect when in use, curved upwards when at rest, rufous, with the sheaths longer, and black. Legs, including trochanters and coxæ, uniformly pale yellowish-brown, with the tips of tarsi dusky. Wings subhyaline and iridescent, with veins and stigma dark brown, the stigma quite large, and the two discoidal cells sub-equal, and, as usual in this genus, joining end to end, but with the upper veins, which separate them from the radial cell, slightly elbowed, instead of being straight, thus giving the radial cell a quadrangular rather than a triangular appearance. Male differs from female only in his somewhat smaller size and unarmed abdomen. Expanse female 0·32 inch, length of body, exclusive of ovipositor, 0·22 ; expanse male 0·28, length 0.18.

"Described from 3, two females one male, bred May 26th-27th, 1870, from cocoons received from Dr. I. P. Trimble, of New Jersey, and 1 female subsequently received from the same gentleman—all obtained from larvæ of *Conotrachelus nenuphar*.

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