TWENTY-SECOND ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF ONTARIO.

1890.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

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TWENTY-FIRST ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO.

To the Honourable the Minister of Agriculture:

SIR,—In accordance with the provisions of our Act of incorporation, I beg to present herewith the twenty-first annual report of the Entomological Society of Ontario.

The report contains an account of the proceedings of our annual meeting for the election of officers and the transaction of the general business of the society, which was held in the city of London on the 27th of August, 1890; it includes also the audited financial statement of the Secretary-Treasurer, the reports of the Council and Montreal branch, the President's annual address, etc.

I have also the honour to submit with the foregoing, several illustrated papers contributed by our members on injurious and other insects, which have been specially prepared for the information of the public, and are intended to assist our farmers and fruit-growers in contending with their insect enemies.

The Society's monthly magazine, *The Canadian Entomologist*, has been regularly and promptly issued during the past year, and has just completed its twenty-second volume. It continues to receive contributions from all the most eminent Entomologists in North America, and to circulate in all parts of the world. During the past year it has been found necessary to issue more than twenty extra pages in order to find space for the many valuable articles which have been furnished the editor.

It is a matter of profound thankfulness that our province, during the past year, has escaped from any serious insect attack. Those that have been specially noticeable are referred in the President's address, or described in the papers that follow.

I have the honour to be, Sir,
Your obedient servant,

W. E. SAUNDERS,
Secretary.

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ANNUAL MEETING OF THE SOCIETY.

The annual meeting of the Society was held in its own rooms in Victoria Hall, London, on Wednesday, August 27th, 1890. A Council meeting was held in the morning at 10 o'clock, at which the following members were present:—The President, Rev. C. J. S. Bethune, head master of Trinity College School, Port Hope; Mr. James Fletcher, Ottawa; Mr. J. A. Moffat. Hamilton; Rev. T. W. Fyles, Quebec; Messrs. J. M. Denton, W. E. Saunders and Dr. Woolverton, London. The annual report of the Council was discussed and adopted, and other routine business was transacted. The Secretary-Treasurer presented his annual financial statement of the receipts and disbursements during the past year. The Council reported the purchase of a large collection of insects from Mr. Johnson Pettit, of Grimsby, which was deposited in the rooms of the Society. The arrangements for the formation of sections in different departments of natural science were laid before the Society by the President, and, on motion, duly approved and ratified. A scheme was submitted for the rearrangement of the work of the officers of the Society, in accordance with which Mr. J. A. Moffat, of Hamilton, is to take entire charge of the rooms, library and collections, and be a permanent resident official in London. A number of tenders for printing *The Canadian Entomologist* were received and considered; no decision was made at the time, but subsequently it was resolved that the tender of the London Printing and Lithographing Company should be accepted. Certain regulations regarding the library and the use of the rooms were drawn up and adopted.

In order to benefit members of the Society it was resolved that for a limited time the volumes of *The Canadian Entomologist*, III. to XXI. inclusive, should be sold at 75 cents each; the annual reports for the following years: 1874, 1880, 1882 to 1889, at 25 cents each; and the new lists of labels for Coleoptera at 25 cents per set, in each case strictly to members only. Applications for these publications at the reduced rates should be made to the Secretary.

It was resolved to separate the offices of Secretary and Treasurer, which have hitherto been held by one person.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year:—

President—Rev. C. J. S. Bethune, M.A., D.C.L., Port Hope.
Vice-President—James Fletcher, F.R.S.C., Ottawa.
Secretary—W. E. Saunders, London.
Treasurer—J. M. Denton, London.
Directors—Division 1—W. H. Harrington, Ottawa.
Division 2—J. D. Evans, Sudbury.
Division 3—Gamble Geddes, Toronto.
Division 4—A. W. Hanham, Hamilton.
Division 5—J. A. Moffat, London.
Librarian and Curator—J. A. Moffat, London.
Editor of the *Canadian Entomologist*—Rev. Dr. Bethune, Port Hope.
Editing Committee—W. E. Saunders, London; H. H. Lyman, Montreal; Rev. T. W. Fyles South Quebec.
Delegate to the Royal Society of Canada—Rev. T. W. Fyles.
Auditors—J. H. Bowman, H. P. Bock, London.

After the completion of the necessary business of the Society, the rest of the afternoon was devoted to the examination of the books and collections of the Society, and the consideration of specimens brought by the members. Among these may be mentioned some live ant-lions (*Myrmelionidæ*) brought from Indiana by Mr. Fletcher; a collection of *Plusias*, and other moths recently captured at Nepigon by Dr. Bethune, and some very interesting specimens of Lepidoptera, from the Province of Quebec, by Mr. Fyles.

The meeting adjourned at 6 p.m.

In the evening the Society held a public meeting in its rooms at 8 o'clock, which was largely attended by members and other friends from London and the neighbourhood. The Rev. Dr. Bethune, President of the Society, occupied the chair. After cordially welcoming those present, he proceeded to deliver the annual address upon the chief topics of interest in the Entomological world during the past year.

ANNUAL ADDRESS OF THE PRESIDENT.

Ladies and Gentlemen,—Fifteen years have gone by since I last had the honour of addressing the members of the Society as its President. So long a period of time has naturally wrought great changes in our comparatively small circle of members, as well as in the world about us; but I am happy to see here to-night some who were with us at our annual meeting in 1875, and to know that many others have continued ever since their active interest in the welfare of the Society and the advancement of entomological science. For twelve years the presidential chair was most worthily filled by our highly esteemed friend, Prof. Wm. Saunders, who only resigned it in order to devote his whole time and energies to the great and important work which he has undertaken as director of the experimental farms of the Dominion. His great success in this new office is well known to all who take an intelligent interest in the prosperity of our country.

The removal of Prof. Saunders from an active share in the work of the Society seemed a very serious blow, and was certainly a very great loss, but happily we were able to find a worthy successor in the person of our excellent friend, Mr. James Fletcher, Dominion Entomologist and Botanist, who has so zealously performed the duties appertaining to the office of president during the last three years. With such able men at its head during so long a period of time, it may be readily understood how substantial was the progress of the Society, and how high was the reputation it achieved both at home and abroad.

The past year has been in some respects an eventful one in the history of the Society. In the month of April last I learned that Mr. Edmund Baynes Reed was about to leave this province and take charge of the meteorological station at Victoria, British Columbia. He was one of the original members, and for more than five and twenty years an active and zealous officer of the Society, filling at different times the positions of vice-president, secretary-treasurer, auditor, librarian and curator. To his energy it is due that we have obtained so large and valuable a collection of scientific books in our library; he also contributed many excellent papers to our annual reports, while discharging various other useful functions in the interests of the Society. His removal from amongst us was so serious a matter that I came up to London to make arrangements for the future management of our affairs, as well as to say good-bye to an old and very dear friend. After much consultation with Mr. Reed and other members of the council, we devised a plan for the general conduct of the business of the Society which has

been laid before you to-day, and which has resulted in the appointment of Mr. J. A. Moffat to the permanent charge of our rooms, library, collections, etc. It will be a great advantage, we are sure, in many ways, to have a qualified person to look after our possessions, and to be on hand at stated times for the admission of members to the rooms, as well as to discharge the other duties appertaining to the position to which he has been appointed.

While here in April last, a meeting of the local members of the society was held in order to consider a plan for the formation of sections which should include persons who took an interest in any department of Natural Science, and thus extend the operations of the society beyond the strict limits of entomology. The scheme which we agreed upon at that meeting was submitted to other members of the council for their approval, and has been fully ratified to-day. As its details have been laid before you already I need not repeat them here. It was very gratifying to learn that advantage was immediately taken of this arrangement, and within a few weeks active sections were formed with very satisfactory lists of members in the departments of Botany. Ornithology and Oology, Geology, and Microscopy. Many new workers have now joined our ranks, among whom we are glad to welcome a large contingent of ladies. A great impetus will thus be given, we trust, to the study of natural science in all its departments in London and the neighbourhood, and we hope that new life and zeal will be infused into the older as well as the later members by active co-operation in the field, the cabinet and the study.

Another matter upon which I may congratulate the society is the acquisition of the valuable collections of Coleoptera and other orders of insects, laboriously gathered together during many years by Mr. Johnson Pettit, an old and valued member of the society. Having ascertained that he was willing to part with his collections, I at once entered into correspondence with him, learned the sum for which he would be willing to transfer them to the society, and obtained the sanction of the members of the council for the purchase. Mr. Pettit was most reasonable in his terms when he understood the destination of the collections, and allowed us to have them at about half the price he would have asked from a private purchaser. Mr. Moffat did good service in the transaction by visiting Grimsby first to report upon the condition, quantity, etc., of the specimens, and subsequently by superintending their packing and removal to London. It is expected that during the coming winter he will be able in his capacity as curator, to dispose of many of the duplicates by sale or exchange for the benefit of the society.

I may turn now from the consideration of our own concerns to matters Entomological affecting the country at large, and following the example of my predecessors in their presidential addresses, refer to the work of injurious insects in the garden, orchard and farm. The most important insect pest that requires the careful attention of our farmers is the well-known Hessian Fly (*Cecidomyia destructor*, Say) Fig. 1, which has made its unwelcome appearance in several parts of the Province. The attacks of this insect upon barley, rye, and wheat, are seldom noticed at first, as the creature is so minute and works out of sight, sucking the sap of the plant from the stem, but concealed from observation beneath the sheath of the leaf. Its depredations are usually made known by the breaking down and falling over of the plant caused by the injury to the stem produced by the insect. There are two attacks in the year, one in the autumn, when the maggots may be found embedded in the crown of the root shoots of fall wheat; the other in the summer, when it lies under the leaf-sheath above the first or second

Fig. 1.

joint of the stem. When fully grown these larvæ harden and turn brown, resembling "flax-seeds" in shape and colour, and in this stage are well-known to observant farmers. The tiny smoky-winged midges themselves, the parents of the destructive maggots, appear in April or May, and again in August, but are seldom noticed, except by entomologists, as they are so excessively minute, and require a lens for their identification. The eggs are scarlet in colour and are laid inside the leaves of the food plant. The most effective remedies for this pest are (1). The late sowing of fall wheat; if this is postponed till about the last week in September the winged Hessian fly is gone before the young plant is sufficiently matured to receive its eggs; (2) The careful burning of all screenings and other refuse from the threshing mill; this will ensure the destruction of large quantities of the insect in the "flax-seed" state. It is well to do this whether the Hessian fly is known to be present or not; (3). The burning of the stubble after the crop has been removed; but if this is not practicable, it is well that the field should be harrowed in order to cause any fallen grain to grow at once and make what is called a "volunteer crop." This will be attacked by the fly as a suitable place for the deposit of the autumn eggs, and the brood thus producod can be readily destroyed by a later plowing after the maggots are hatched out; (4) If a field is found to be infested, care should be taken to have such a rotation of crops that neither wheat, rye nor barley should be grown upon the same ground for at least another year; (5). Good cultivation and plenty of manure will produce a strong, healthy growth and enable many a plant to survive an attack that would be fatal to a less vigorous one.

I have trespassed upon your patience to mention these well-known remedies because the subject is of such vast importance, and constant iteration is required in order that our farmers may be made familiar with the methods of treatment that have been found most satifactory. While much can be done to ward off the evil by an intelligent employment of these remedies, it is cheering to know that we do not entirely depend upon them for immunity, but that there are several minute parasitic insects which prey upon the Hessian-fly in its different stages, and in many instances prevent it from becoming a serious injury. During a recent visit to the central experimental farm at Ottawa, Mr. Fletcher showed me a nnmber of plants of barley that were attacked by the Hessian-fly, but in nearly every one that we pulled up we found a parasitic insect closely associated with the enemy and evidently doing good work in its destruction.

Another insect that has been attacking grain in many parts of the Province is the Grain Aphis (*Siphonophora avenæ*, Fab.) As everyone who is in the least degree observant must be familiar with the appearance and habits of plant-lice, it is unnecessary to enter into any description of this insect here; it will suffice to say that it is found of different colours, green, black, yellow or red, and that it attacks first the leaves of the plant and then the flowers and tender young grain, often causing very serious damage. This year it has appeared in many localities in Ontario, but it was at once attacked by its insect enemies, notably by the larvæ and beetles of various species of "Lady birds" (*Coccinellidæ*), the grubs of Syrphus flies, and the *Aphidius*—a four-winged parasitic fly. These natural enemies speedily reduced the numbers of the plant-lice and prevented their attack from becoming serious.

Cut-worms, the larvæ of several species of night-flying moths, Fig. 2, (*Agrotis, Hadena, Mamestra*) have been abundant in all parts of the country, and especially injurious in gardens, but on the whole their attack has been much less serious than last year. This may perhaps be accounted for by the character of

the season; the frequent rains during the spring and early summer causing a vigorous growth in the young plants and carrying them quickly beyond the reach of injury, while the wet weather would probably interfere greatly with the comfort of the Cut-worms and their ability to attack. The use of poisoned traps, as recommended by Mr. Fletcher in his address last year, has proved most effective wherever tried. I may repeat that they consist of loose bundles of weeds, clover or any succulent vegetation, which are tied together and then dipped into a strong mixture of Paris green and water, and scattered over the land three or four days before the crop is planted out or appears above the ground.

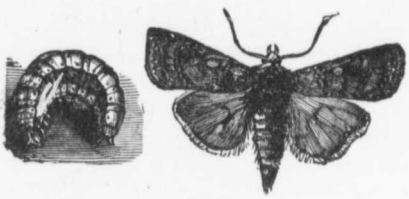

Fig. 2.

The Tent-caterpillars (*Clisiocampa*) which are usually so abundant and so injurious to fruit trees in spring and early summer have been remarkable for their absence or rarity, in all parts of Ontario. We hope, however, that all fruit growers and gardeners will be on the look out for them next spring and consign the webs and their inmates to a speedy destruction.

The Fall web-worm, Fig. 3, (*Hyphantria textor*, Harris) has been exceedingly abundant in all parts of the Province that I have visited this year. I do not think that this insect causes much serious injury to the trees it infests, as it comes so late in the season when the leaves have to a large extent discharged their function as regards the growth and health of the tree, but it is a great eyesore with its unsightly webs, and should be got rid of by every tidy fruit-grower. Nothing is easier than to strip off the web and its living contents with the hands, or when out of reach, by means of a pole with a swab of any kind tied to the end.

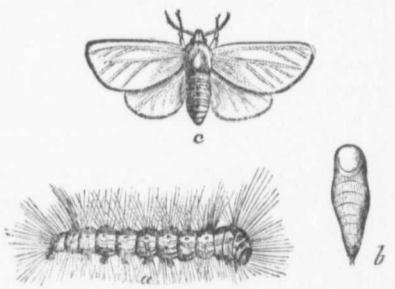

Fig. 3.

The larch saw-fly (*Nematus Ericsonii*), to which reference has been frequently made of late years, has not been nearly so abundant as usual in those parts of Ontario where it has hitherto prevailed. It is to be hoped that its natural enemies have multiplied to a sufficient extent to keep it in subjection and prevent its undue increase.

The squash-bug (*Coreus tristis*, De Geer), Fig. 4, has been very abundant and troublesome in many parts of Western Ontario this year. Where hand-picking and crushing under foot is impracticable, the insect may be readily destroyed by the application of a mixture of coal oil and sand, sprinkled over the stem and leaves nearest the root of the plant.

Fig. 4.

I have this year found a new insect enemy in the caterpillars of the beautiful wood-nymph moth (*Eudryas grata*, Fab.) Fig. 5 represents the caterpillar and moth. I have hitherto looked upon this lovely insect as an object of interest from its beauty and rarity, but this year

the caterpillars appeared in hundreds upon the Virginia creeper (*Ampelopsis quinquefolia*), which covers the front of our building at Port Hope with its graceful foliage. No attention was paid to these creatures at first, but it suddenly became apparent that they were rapidly devouring the leaves, and rendering most unsightly what was before a beautiful mass of green. They began their work near the ground and proceeded upwards, devouring the leaves as they went. On the 9th of August I had the infested creepers sprinkled with Paris green and water. One application sufficed to exterminate the insects, and none were afterwards to be seen. I have mentioned this instance particularly in order to bring before you the great advantage of using Paris green as a remedy for almost all leaf-eating insects—except, of course, those affecting cabbage and similar vegetables which are used as food. A judicious application of a very weak mixture will be found most efficacious. Proper care must, of course, be exercised when dealing with so virulent a poison. Its use as a remedy for the apple codling-worm and the plum curculio has now been fully demonstrated, and any fruit grower who will carefully follow out the directions published in our annual reports will, we are confident, be amply rewarded. It is a subject of no little gratification to us that fruit-growers in England have been at last persuaded to try this remedy, and in every instance that we have heard of the experiment has been crowned with success. It required two or three years of persistent effort on the part of Miss Ormerod aided by Mr. Fletcher to overcome the insular prejudice against adopting anything new and seemingly dangerous. Now that a beginning has been made, we hope for great results in the immediate future.

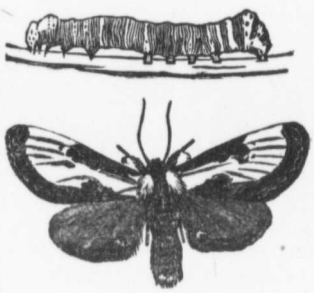

FIG. 5.

Before leaving this practical portion of my address, I wish to refer to a kindred, though not an entomological matter. I have noticed in many parts of Ontario an alarming increase of the fungus growth on plum and other fruit trees, commonly called the "black knot." An Act was passed by the Ontario Legislature a few years ago ordering the cutting down and burning of all infested trees, and imposing penalties for neglecting to do so; but the law seems to be a dead letter and no one apparently dreams of enforcing it. It would be well for our municipal councils to instruct their path-masters and other officials to look after the black-knot and enforce the law wherever its provisions are neglected. If this is not done there will soon be no cherry or plum trees left in the country, as the disease rapidly spreads, and when once it attacks a tree it is almost hopeless to attempt a cure.

Another fungus disease to which I may call your attention is the "downy mildew" of the grape. It is exceedingly injurious and very prevalent. Fortunately it may be readily checked by the use of the "Bordeaux mixture," and other compounds which fruit-growers have employed with great success.

Turning now to what I may call the non-economic aspect of entomology—though all investigations into the habits and distribution of insects have their practical bearing at some time or other—it is worthy of remark that butterflies have been extraordinarily scarce in Eastern Ontario this year. Whole days spent in collecting in localities where they were usually abundant have resulted in the capture of nothing worthy of mention. It is possible that the unwonted mildness of the winter, with its frequent changes from freezing to thawing, and the absence of snow, may have occasioned a great destruction among the hibernating

forms of diurnal lepidoptera. I am the more inclined to give credit to this cause, as I found recently at Nepigon and Port Arthur, where the winter was quite as severe and prolonged as usual, butterflies were remarkably abundant, and could be found in hundreds whenever the sun was shining. Among other interesting captures at Nepigon, which has now become a famous hunting-ground, and where the butterfly collector, careering in hot haste with net in hand after a specimen, is not regarded as an escaped lunatic, as he would be in most parts of the country, but as a scientist engaged in quite as praiseworthy an occupation as trout-fishing—among my captures I may mention a number of specimens of *Plusia* belonging to several different species. As I only returned a few days ago I have not had time to get them identified, but I have brought several of them here for inspection. They were very active indeed upon the flowers of thistles and golden rod, flitting swiftly from one to another in the hot sun.

Since our last annual meeting many important additions have been made to entomological literature. Mr. Scudder's grand work on "The Butterflies of the Eastern United States and Canada" was completed last September. It forms three large volumes, containing 2,000 pages and nearly a hundred plates and maps, about forty of which are coloured. It is truly a magnificent work and a monument of patient labor and careful scientific investigation. However much we may differ from the author on such vexed questions as generic nomenclature, the sequence of families, and the like, we must express our unbounded admiration for his ability and learning, and the excellence of his work. The long pages of descriptive matter are enlivened by essays on all manner of subjects connected with butterfly life, written in a particularly charming style, and to each chapter is prefixed a stanza or two of poetry, so apt and so beautiful, that one is lost in wonder at the diversity and extent of the author's acquaintance with literature. This feature of the work renders it available for all lovers of natural history, even though they may take no special interest in butterflies. The author has published the work at a large pecuniary sacrifice. The list of subscribers is strangely small, but we hope that ere long librarians everywhere will find out that without a copy of Scudder's butterflies their collection of books is very incomplete.

Self-sacrifice in the publication of entomological literature is the order of the day. A similar tale has to be told of the authors of the next two books that I wish to refer to. Mr. W. H. Edwards continues to issue his lovely illustrations of the "Butterflies of North America." The coloured figures of these insects in all their stages are the most perfect and the most beautifully executed that I have ever seen. Nine parts of the third series have now been issued, and the tenth is almost ready; but at what a cost to the author! In order to accomplish this stupendous work he has been obliged to dispose of his collections and nearly all his books—a sacrifice that would be heart-breaking to most of us.

The other work to which I referred is the Rev. Dr. McCook's "American Spiders and their Spinning Work," the second volume of which has just been issued. When complete the work will consist of three large quarto volumes, profusely illustrated with wood cuts and some coloured lithographic plates. It is written in a most interesting manner, and while thoroughly scientific, is so popularly and clearly expressed that it may be read with ease and delight by any one who cares to learn about the strange habits and peculiar life-history of these singular creatures. When finished it will certainly be the most complete and perfect work on spiders in the English language. In this case, too, the author is publishing at his own expense and does not expect to be reimbursed for his

outlay. All these works, I am glad to say, will be found in our Society's library and are available for the use of the members.

Serial publications on North American entomology continue to be represented by the *Transactions of the American Entomological Society*, Philadelphia; *Psyche*, Cambridge, Mass.; *Entomologica Americana*, Brooklyn, N. Y.; *Insect Life*, Washington, D.C., and our own *Canadian Entomologist*. Another addition has been made to the list this year by the issue of *Entomological News and Proceedings of the Entomological Section of the Academy of Natural Sciences of Philadelphia*. The working entomologist can hardly do without any of these publications; each one occupies its own special field, and all are valuable and interesting. Our own magazine, now in its twenty-second volume, continues to be issued with regularity, and, I am happy to say, receives contributions from all the most eminent entomologists in North America, and occasionally from others in Europe.

The study of economic entomology has been making vast strides during the last few years, owing to the establishment of experimental agricultural stations in all the States of the Union, and the appointment in many of them of a skilled entomologist. The bulletins issued from these stations and the central department at Washington are too numerous to mention in detail; they are replete with useful information and interesting records of experiments and observations. That the work is eminently scientific is shown by the names of those employed, for instance, Dr. Riley, Mr. Howard, Dr. Lintner, Professors Forbes, Cook, Smith, Fernald, Webster, Weed. These names, and many others, are familiar to us all as men of distinction in their several localities and departments.

In our own country much valuable work is being done by Mr. Fletcher, the Dominion Entomologist at Ottawa, not only by his investigations and the published results, but also by the addresses which he gives in different places to the meetings of Farmers' Institutes. He is in this way diffusing throughout the country a knowledge of friends and foes amongst insects, and the best modes of encouraging the former and exterminating the latter. The result of his work must in course of time be the saving of hundreds of thousands of dollars to the farmers and fruit-growers of the Dominion.

In England Miss Ormerod continues her unselfish devotion to the cause of economic entomology. Her annual reports are full of very valuable information, and have done much good in the mother land. It is gratifying to find that this department of practical work is being developed also in other parts of the British Empire. We have received a useful report on insect and fungus pests from the Department of Agriculture at Brisbane, Australia, prepared by Mr. Henry Tryon, of the Queensland museum, and several numbers of *Indian Museum Notes*, published at Calcutta by the Government of India Revenue and Agricultural Department. These "Notes" are edited by Mr. E. C. Cotes, and contain a large number of most interesting and valuable papers, both scientific and practical, illustrated with excellent engravings.

Before leaving this subject, I must not omit to mention the publication last autumn of a bulletin on the "Mediterranean Flour-Moth" (*Ephestia Kuhniella*, Zeller), prepared by Dr. Bryce, of Toronto, and issued by the Agricultural Department of Ontario. It is an excellent pamphlet and contains just what one wants to know about this new pest. The mischief referred to seems to have been stamped out, at least I have not heard of any further cases of attack in this province, and we may be quite certain that after the experience of last year, our millers will keep a sharp look out for the pest, and deal with it promptly should it show itself again.

I feel now that I have trespassed quite long enough upon your patience, and must bring my remarks to a close. The prospects of our Society are bright and cheering; we may well congratulate ourselves upon what has been accomplished in the past, and look forward with pleasant anticipations to the future. Let each member work honestly and faithfully in his own special department, and let us all unite in upholding the interests of the Society, and doing all that we can to increase its usefulness, maintain its reputation and ensure its success.

After a cordial vote of thanks to the President for his interesting address had been duly moved and seconded, Mr. Fletcher was called upon to give an account of the meeting at Indianapolis of the Entomological Club of the American Association for the Advancement of Science, to which he had been sent as delegate by the Society, and from attending which he had just returned. Mr. Fletcher stated that it had been an exceptionally good meeting, attended by a larger number than usual of eminent entomologists and botanists, and that its discussions were remarkably interesting and useful. The full account of its proceedings will be found in a subsequent part of this report.

The Rev. T. W. Fyles read a scholarly paper, entitled, "A Day in the Woods," which was highly appreciated by the audience.

The reports of the Council, the Montreal Branch, and the delegate to the Royal Society were read by the President.

REPORT OF THE COUNCIL.

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

The Society, they are happy to say, continues to prosper and maintain its usefulness. The membership is satisfactory and increased interest is being taken in its work.

The twentieth annual report on Economic and General Entomology was sent to the Minister of Agriculture in December last, and was printed and distributed in the following May. As it has been for some time in the hands of the members of the Society, it is unnecessary to refer particularly to it. It consisted of 104 pages, with 50 wood cuts in illustration, and was quite up to the average in the papers which it contained.

The *Canadian Entomologist* has been regularly issued at the beginning of each month, and is now approaching the completion of its 22nd volume. It continues to receive valuable contributions from all the leading entomologists in North America, as well as from some in Europe, and is regarded by scientists as a highly important magazine in the department which it occupies. The editor has found it necessary on two occasions recently to enlarge the number of pages from 20 to 24 in May and 28 in August, owing to the pressure upon his space.

After the disastrous fire at the University of Toronto in February last, the Council decided to present to the library a complete set of the *Canadian Entomologist* and the annual reports.

Several valuable additions have been made to the library of the Society during the past year, among which may be mentioned Mr. S. H. Scudder's "But-

terflies of the New England States and Canada," which is now completed and bound, and the Rev. Dr. McCook's "Spiders and their Spinning-work," two volumes of which have thus far been issued.

In April last a meeting of the Society was held in London, with the president in the chair, at which plans were discussed for the formation of sections of the Society in other departments of natural science. The memorandum agreed upon at the time is herewith submitted for approval and ratification.

In consequence of the removal of Mr. E. Baynes Reed from London to British Columbia, to take charge of the Dominion Meteorological Station at Victoria, it will be necessary to make some new arrangements for the care of the library and collections, and the performance of the official work of the Society. The Council will submit a scheme for the appointment of a permanent officer in the person of Mr. J. Alston Moffat, of Hamilton, which they trust will be found to work satisfactorily, and to increase the usefulness and prosperity of the Society.

The Council desire to place on record their feeling of deep regret at the removal of Mr. Reed from this Province and the loss which the Society thereby sustains. Mr. Reed is one of the original members of the Society, and for more than a quarter of a century has been one of the most active and zealous of its officials, filling at different times the positions of vice-president, secretary-treasurer, librarian, curator and auditor. To him it is especially due that the library has grown to its present dimensions and value, and that so much progress has been made by the Society in many directions. The Council beg to thank Mr. Reed for his services in the past, and wish him all possible success and prosperity in his new and important sphere of labour.

During the month of May last arrangements were entered into for the purchase of the large collections in Coleoptera and other orders of insects made by Mr. Johnson Pettit, of Grimsby. The packing and transportation were superintended by Mr. Moffat, and the collections are now safely deposited in the rooms of the Society.

In accordance with our long-established custom, a member of the Council, Mr. Fletcher, has attended, as representative of the Society, the meeting of the Entomological Club of the American Association for the Advancement of Science, which has just been held at Indianapolis, Ind. Mr. Fletcher will submit a report of its proceedings.

The report of Mr. Lyman, the delegate to the Royal Society of Canada, and the report of the Montreal Branch, are presented herewith. The accounts of the secretary-treasurer have been duly audited, and will be laid before the Society.

Tenders for printing the *Canadian Entomologist* have been procured from several printing offices in London and Toronto, and are now laid before the Society for consideration.

Respectfully submitted on behalf of the Council.

CHARLES J. S. BETHUNE,
President.

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

BY H. H. LYMAN, DELEGATE.

As delegate from the Entomological Society of Ontario, it is again for the third time my duty to submit a short report of the work and progress of the Society during the past year, and I have much pleasure in saying that the Society continues to prosper and to maintain its high position among the scientific institutions of the Dominion and the continent.

The monthly magazine of the Society, the *Canadian Entomologist*, has been regularly and promptly issued during the past year and fully maintains its well known high character. The volume for 1889, which was the twenty-first volume, contained the usual 240 pages of reading matter, and had also one plate. The contributors numbered thirty-four and the articles were quite up to the usual standard of interest. One new genus, thirteen new species and seven new varieties of various orders were described in the volume, which also contained the complete life-histories of four species and partial ones of eight others. A series of papers on popular and economic entomology were also published during the year.

The annual report of the Society for 1889 to the Minister of Agriculture for Ontario has been published and contains many interesting papers of much importance to agriculturists, besides the usual report of the annual meeting and of the finances of the Society.

The annual meeting of the Society was held in Toronto on September 3rd, during the meeting in that city of the American Association for the Advancement of Science, which afforded our members the pleasure of meeting some of the distinguished entomologists of the neighbouring republic whose presence also added much interest to the meeting of our Society.

Our members also enjoyed the pleasure of attending the meetings of the Entomological Club of the American Association, presided over by our then President, Mr. Fletcher.

During the progress of these meetings it was resolved to form an "Association of Official Economic Entomologists" for the United States and Canada, which was accordingly organized and officers duly elected.

This movement is likely to have a very beneficial effect in securing greater co-operation among entomologists in official positions, and the annual meetings with the interchange of members' views cannot fail to be productive of much good. The library of our Society is in excellent order and was reported at the annual meeting as containing 1,052 volumes.

On account of certain provisions of "The Agriculture and Arts Act" of Ontario, recently passed, it was found necessary to make certain changes in the council of the Society, as the Act provides that all societies which receive aid from the Ontario Government must be governed by a board of directors who are residents of the agricultural divisions which they represent, the Entomological Society being permitted to group the thirteen agricultural divisions into five with one director for each. This Act will of course prevent any member of the Society residing out of Ontario holding any of the more important positions in the gift of the Society.

The following officers for the ensuing year were duly elected:

President—Rev. C. J. S. Bethune, M.A., D.C.L., Port Hope.
Vice-President—E. Baynes Reed, London.
Secretary-Treasurer—W. E. Saunders, London.
Librarian—E. Baynes Reed, London.
Curator—Rowland Hill, London.
Directors, Division 1—W. H. Harrington, Ottawa.
" 2—J. D. Evans, Sudbury.
" 3—Gamble Geddes, Toronto.
" 4—J. Alston Moffat, Hamilton.
" 5—J. M. Denton, London.
Editor of the *Canadian Entomologist*—Rev. Dr. Bethune, Port Hope.
Editing Committee—James Fletcher, Ottawa; J. M. Denton, London; Rev. T. W. Fyles, South Quebec; Dr. Brodie, Toronto.
Delegate to the Royal Society of Canada—H. H. Lyman, Montreal.
Auditors—J. M. Denton and E. B. Reed, London.

Early last month our Society, on the suggestion of the President, resolved to extend its field of operations by permitting the formation of sections for the study of other branches of Natural History, and sections have already been formed in Botany, Ornithology, Geology, and Microscopy, and joint field meetings of all the sections will be held regularly during the summer. This movement will, it is anticipated, strengthen the Society by bringing in many additional members. It is also hoped that arrangements may be effected to keep the rooms of the Society open daily.

The Montreal Branch, of which I have the honour to be President, continues I am happy to say in a prosperous condition. A number of new members have joined during the past year, and the monthly meetings have been regularly held and have been usually well attended.

Mr. Scudder's magnificent work on the Butterflies of New England, to which reference was made last year, was completed last October, and its issue marks an epoch in the history of North American Entomology.

The placing by Parliament during the past session, of books which have been published for twenty or more years upon the free list, is a measure of great importance to entomologists, as it removes a very burdensome tax upon men whose studies are seldom remunerative in a pecuniary sense, and will tend to encourage the bringing into the country of many valuable works upon this science which would not otherwise have been done.

REPORT OF THE MONTREAL BRANCH.

The seventeenth annual meeting of the Montreal Branch was held at the residence of Mr. Lyman on May 23rd, 1890, at 8 o'clock, p.m.

The following report of the Council was then submitted by the President:

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

The Council in presenting their report for the year 1889-90, can state with pleasure that the past year has been one of progress for the Branch, no less than six new members having been elected during the year.

The names of those added to our roll are Messrs. Chas. Jackson, P. M. Dawson, E. F. Baynes, Alfred Griffin, G. M. Edwards, and W. C. Adams; but of these Mr. Dawson has recently left Montreal to pursue his studies elsewhere.

During the year ten meetings have been held, one of which, viz.: that in June, held at the residence of Mr. Trenholme, in Cote St. Antoine, was primarily devoted to collecting nocturnal lepidoptera.

The following papers were read during the year:—

1. The North American Callimorphas; A Reply to Critics. H. H. Lyman.
2. Some Insects injurious to the Oak; F. B. Caulfield.
3. Notes on the Lepidoptera of Little Metis, P. Que. A. F. Winn.
3. A Trip to Mount Mansfield. H. H. Lyman.
5. Note on the Occurrence of Erebia Discoidalis at Sudbury, Ont. H. H. Lyman.
6. Notes on some species of Coccinellidae found at Montreal. F. B. Caulfield.
7. Entomology of Pittsfield, Mass. P. M. Dawson.
8. Note on the occurrence of Lepisesia flavofasciata at Ormstown, P. Que. H. H. Lyman.
9. Various notes on Coleoptera. J. F. Hausen.

Comparatively little field work was done during the collecting season of 1889, owing to the unusual scarcity of insects of those orders studied by the members, and though the prospects for this season are not as yet very encouraging, we may hope that more will be done, especially with the increased membership of the Branch; and it must also be remembered that even in an unfavourable season good work may be done in discovering the preparatory stages and foodplants of insects where these are unknown, or only partially known, as was the case last season in regard to Grapta J. album, which was bred by two of our members.

Submitted on behalf of the Council.

(Signed) H. H. LYMAN, President.

The Secretary-Treasurer then submitted the financial statement, shewing a balance on hand of $8.77.

The reports having been adopted, the following officers were elected for the ensuing year:—President, H. H. Lyman; Vice-President, F. B. Caulfield; Secretary-Treasurer, A. F. Winn; Council, E. C. Trenholme and J. F. Hausen.

The President then read an interesting paper, "Notes on Argynnis freya A. Charicleа, and H. Montinus," dealing with the differences between these species and illustrating them by specimens.

(Signed) E. C. TRENHOLME,
Sec.-Treasurer.

ANNUAL STATEMENT OF THE TREASURER.

Receipts, 1889-90.

Membership fees	$229 53
Sales of *Entomologist*	110 89
" pins, cork, etc	144 54
Advertisements	13 1
Government grant	1,000 00
Interest	10 08
Balance from last year	121 73
	$1,629 96

Expenditure, 1889-90.

Printing	$431 75
Report and meeting expenses	154 15
Library	57 26
Purchase of collections, etc	318 52
Expense account (postage, stationery, etc)	91 69
Rent	80 00
Insurance	35 00
Grants to Editor, Secretary and Librarian	200 00
Cork, pins, etc	107 69
Balance	153 90
	$1,629 96

The President read the memorandum which was drawn up in April last regarding the formation of sections of the Society in various departments of natural science, and after giving an account of the enthusiasm with which the project was taken up by the naturalists in London, he congratulated the members on the success of the movement and hoped that it would long continue.

A paper by Mr. Frederick Clarkson, of New York, entitled "Observations from the top of a White Mountain coach," concluded the formal part of the meeting, and was listened to with much interest. At the request of those present, Dr. Bethune gave an entertaining account of the admirable work of Miss Eleanor A. Ormerod, the foremost economic entomologist of Great Britain, including pleasant reminiscences of his personal acquaintance with her.

The meeting then proceeded to discuss the locality and arrangements for an outing the next day, and decided upon visiting the banks of the River Thames a few miles below the city, where there is an excellent collecting ground.

Mr. Dearness, Mr. W. E. Saunders and Dr. Woolverton were next called upon to give a report of the procedings in the botanical, ornithological and geological sections respectively; their remarks were highly interesting and encouraging, and proved that the new departure made by the Society is an excellent one and must greatly redound to its success and prosperity.

After some congratulatory remarks by the President upon the admirable showing of the Society for the past year, the meeting adjourned.

A DAY IN THE WOODS.

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

A day in the woods! What delightful reminiscences do the words awaken —recollections of bird-nesting and nutting expeditions, and of

"The days when we went gipsying a long time ago."

To the busy man, who loves business for itself, a day of relaxation can hardly be unwelcome; but to the man who leads a busy life, not from choice, but from stress of circumstances and for whom the wilderness and the solitary place have especial charms, how delightful is it to escape from his accustomed haunts, and "far from the madding crowd's ignoble strife," to look into the fair face of Nature, and to listen with loving reverence whilst she tells of many things.

It was with something akin to the feelings of such a man that on the 6th day of August last, I proposed to the young people at my house that we should have a day in the woods. The proposition was joyfully welcomed, a party was soon made up, the horse was harnessed, lunch baskets were packed, tin-pails for berrying were stowed away and forthwith we started. We drove along the cliff road to St. David's and then took a by-road leading to St. Henri's. Soon we came to a region of sand. Wherever the turf was cut by the wagon-wheels sand appeared. With change of soil, a change of flora and fauna may be expected. The first thing that took my attention was the multitude of tiger beetles frequenting this green lane. A sandy tract in which ant-hills are numerous is the favorite hunting ground of the cicindelidæ, and in such a tract the mining operations of their larvæ may be easily carried on. Amongst the beetles that I noticed on this occasion, was the blue-black cicindela with the yellow clypeus

(*C. longilabris*

FIG. 6.

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(*C. longilabris* Say), the rich rosy-purple (*C. purpurea*, Oliv.), (Fig. 6), and the deep bronzed-green (*C. limbalis* Kl.). My efforts to capture some of these aroused the curiosity of some *habitants* who were working in an adjacent field. At first they looked with the utmost astonishment at my proceedings, and shook their heads at one another as much as to say, *He is very far gone;* but soon a light seemed to dawn in upon them and there was a general clearing up, they came, in fact, to the conclusion that I and my party were bound on a fishing excursion to the Falls of the Etchemin, and that I was prudently laying in a supply of grasshoppers for bait. And shortly afterwards, when I had occassion to speak to them, I received respectful greeting and attention as one who *knew what he was about.* Resuming our journey we came to a region of second growth balsams, broken in upon by poorly cultivated fields in which blue-berry bushes abounded, and by tracts of green velvety moss dotted over with young pines. As we entered this region the passage of our vehicle disturbed a butterfly. "There goes *Neonympha canthus*," I said, but in a moment the thoughts of the incongruities of time and place for this induced me to leave my wagon and go in search of the insect, and soon I had the great delight of securing for the first time, a living specimen of *Debis Portlandia.* Gosse took this species many years ago at Compton, P. Que., and D'Urban in Argenteuil county, on the River Rouge. It has since been taken by Mr. Caulfield and Mr. Winn on Mount Royal, and by Mr. Fletcher in the neighbourhood of Ottawa. The insect is, however, rare in the Province of Quebec. In the course of a few hours I took two others specimens, dilapidated females. I found that the ovary of one of these had been quite emptied, from the other I obtained by pressure five pearly-white eggs, large for the size of the insect.

FIG. 6.

I did not find *D. Portlandia* difficult to catch. It has the habit of flitting for a few rods, and then settling on the trunk of a tree a yard or two from the ground, trusting it would seem for security to the similarity of its colours to those of the lichens that cling about the balsam stems.

In the glades and open fields *Argynnis Aphrodite* and *Argynnis Atlantis* were everywhere abundant, the latter being readily distinguished by their dusky beauty from their brighter companions. Whilst I was watching these active fritillaries, a butterfly of a different form came into the field. It proved to be *Grapta gracilis.* It was the only one of its kind that I could discover. Another good butterfly that I took on this occasion was *Thecla Titus.* This insect appears to be very widely distributed in Quebec Province. I have found it on Mount Royal, at Oka on the Ottawa, in the Eastern Townships and at Quebec, but solitary, or in pairs only.

Amongst the moths that showed themselves on this occcasion, I noticed two very perfect specimens of that showy insect *Arctia Saundersii*, (Fig. 7), also the beautiful Plusias, *Simplex* and *Precationis.* On the trunks of the trees *Pretophora truncata* was to be seen, and, of course, that ubiquitous insect *Drasteria erecthea* (Cram.) was constantly rising from the grass at my approach. The hour for luncheon having arrived, and my boy having kindled a fire and made the tea, the fruit gatherers were summoned and soon appeared laden with their spoils, raspberries, blueberries and the fruit of *Amelanchier Canadensis* (Torr. and Gr.), called by the French-Canadians *poires.* We sat down under a spreading beech, and amidst such

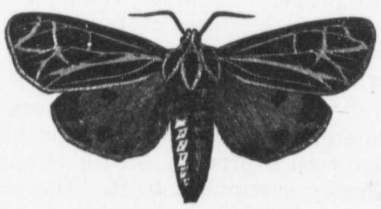

FIG. 7.

a beating of drums as the Queen of England holding high festival in Windsor Castle never heard, for it seemed as if from every tree *Cicada canicularis* was sounding its note. The tattoo of this insect increases in intensity for a while and then breaks off with a few disjointed beats. Now and then a sudden whir-r-r would be heard and the dark body of the bug would be seen shooting like a bolt to fresh vantage ground, the transparent wings of the insect being invisible against the blue sky.

After luncheon the most interesting discovery that I made was that of a species of Gelechia inhabiting galls on the white aster (*Diplopappus umbellatus* Torrey and Gray). The galls were found well up the stems of the plant, from a foot to two feet above the ground, and were smooth and onion-shaped. The largest specimens were five-eighths of an inch across. On opening the galls I found in several a brown chrysalis resting upon a web stretched across the interior. At the bottom was some decomposed matter, and near the top a neat round hole bitten through to the outer skin of the gall. In others of the galls I found a number of white shining grubs, blunt at one end and tapering at the other. Their length was about one line. I counted ten of these in one gall, and they were evidently consuming the remains of their host. In some instances the grubs had spun up into light drab cocoons.

In a few days I obtained from the galls four moths and two ichneumon flies. The latter were black with orange legs. The following is the description of the moths:

Length of body four lines, expanse of wings eight to nine lines.

Head white, eyes black, labial palpi recurved—first joint large and white, lower half of second joint white, upper brown with a white tip, antennæ filiform, light brown ringed with black.

Thorax reddish chocolate in colour; fore-wings rich chocolate red with a white divided fascia near the hind margin, under side grey; hind-wings pale silvery grey; fringes grey with a faint brownish gloss.

Abdomen golden yellow on the upper side of the three first segments, the rest light brown.

These moths differ considerably from those figured and described by Mr. Kellicott in Vol. X. *Can. Ent.*, p. 201, and from those described by Mr. Riley in the First Missouri Report, p. 172. I would suggest for them the name of *Gelechia gallœdiplopappi*.

The life of the Gelechia in its early stages is an interesting and suggestive one. The creature lives and toils in the narrow area of its prison-house, knowing nothing of the higher life and the glorious field for which it is destined, yet impelled by its instincts to make preparations for the change. Dire foes it has; and can it be that some violationof instinct, some erratic course on the part of the larva lays it open to the assaults of these? We know not, but possessed by these, it fails to attain to that nobler state of existence—which things are an allegory, suggestive to us of joys for which we yearn and evils which we fear.

Here as elsewhere this season I could not but notice the abundance of hairy caterpillars, Arctians of various kinds. A large proportion of these caterpillars had been overtaken with a strange disease—a sort of mange—and many had already succumbed to it. The warts upon the caterpillars had dried up, the bristles had blanched and loosened, the intestines had disappeared, and the outer frame of the insect had become spongy, the annules parted at a touch. The unfortunate insects were the prey of a fungus which has been identified by Dr.

Thaxter as *Entomophthora grylli var aulica* (Fres.) I am inclined to believe that the intense heat following upon the long spell of wet weather that we had in early summer induced the disease. Such an epidemic amongst caterpillars I have not witnessed since the time—some years ago—that the larvæ of *Pieris rapæ* were swept away by thousands.

Everywhere upon the choke-cherry bushes were to be found colonies of the little yellow, black-headed larvæ of the Tortrix (*Cacœcia cerasivorana*, Fitch). They bind the terminal leaves of the shoots together with a dense web, and carry on their operations under its shelter.

Of the Coleoptera but few specimens presented themselves. I took several of *Coccinella novem-notata* (Hb.), (Fig. 8) and one handsome Leptura, dusky yellow with a distinct black cross on the elytra. This Mr. Moffatt has identified for me as *L. subhamata* (Rand). The order of insects that was most numerously represented on this occasion was the Hymenoptera. Among the species I noticed were *Bombus fervidus*, (Cress), *Bombus ternarius*, (Say), *Bombus consimilis*, (Cress), *Anthophora bomboides*, (Kirby), *Andrena nivalis*, (Smith), *Vespa media*, (Oliv.), *Odynerus capra*, (Sauss.), *Eumenes fraterna*, (Say), *Crabro singularis*, (Pack), *Hedychrum violaceum*, (Lepelle), *Ichneumon grandis*, (Brulle), *I. lætus*, (Brulle), and the males of *Uroceros cyaneus*, (Fab.)

Fig. 8.

By this time the sun was getting low in the sky, and the voices of my young friends were, I fancied, a little less jubilant than they had been earlier in the day, and feeling the wisdom of not driving pleasure into satiety, I gave the word for the return. Besides my captures, we took back with us a large pailful of raspberries, another of blueberries and a smaller one of *poires*. All of which were afterwards preserved. So we hope that in the dark days of winter we shall be reminded, frequently and pleasantly, of our day in the woods.

OBSERVATIONS FROM THE BOX OF A WHITE MOUNTAIN COACH.

BY FREDERICK CLARKSON, NEW YORK.

On a journey through the White Mountains of New Hampshire, *en route* to Bar Harbor, Me., the past summer, I observed the following Lepidoptera: At Franconia Notch, altitude 2,014 feet, P. Turnus was abundant, constantly flying along the drive and in the woods bordering the road. At the Flume, altitude 4,500 feet, by wet places on the road as many as fifty were found congregated apparently enjoying the moisture. At greater elevations Turnus was rarely seen and above the timber line I failed to discover any Lepidoptera. At the Crawford Notch, altitude 3,134 feet, and through the Glen, Turnus was ever in sight, its brilliant yellow wings contrasting beautifully with the luxuriant green of these primeval forests. In thick woody places, and where the sun shone through in patches, the coquettish L. arthemis frequently appeared, ever alighting within your reach and ever darting away again with hide and go seek playfulness. A. Aphrodite with wings of "Silver bells and cockle shells" delighted the eye in its graceful flight along the road way between Jefferson and Fabyan, and C. philodice, (Fig. 9), rising with the dust at the horses' feet would encircle the coach, and then wander away to join its companions at the roadside brook. D. archippus,

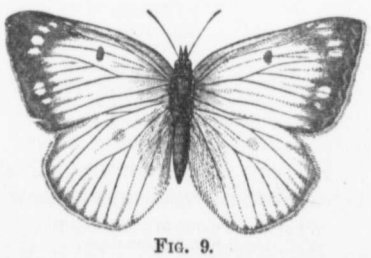

Fig. 9.

(Fig. 10), the universal beauty, though not numerous in the White Mountains as early as the 11th of August, was occasionally seen flitting from flower to flower

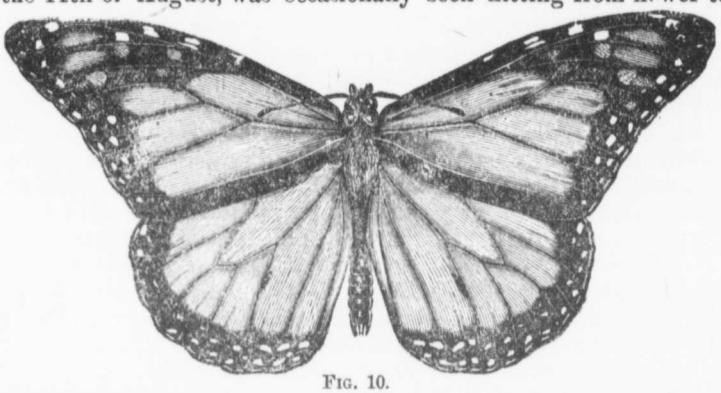

FIG. 10.

with all its well known elegance and dignity of motion. In a small cabinet at the Hotel Waumbek, at Jefferson, there is a single specimen of Chionobas semidea, (Say), captured on the summit of Mount Washington. This butterfly, says Scudder, feeds on sedges and lives upon the summit of Mount Washington; the genus containing several species, is, according to Packard, found on Alpine summits, and in the Arctic regions and on subarctic mountains. It must be a hardy insect to withstand the variable temperature of the mountain top. At the Summit House on Mt. Washington, the mercury on the 15th of July, at 5 a.m. stood at 47°, while a few days previous it was as low as 27°. At midday the power of the sun is felt, and the temperature is as high as that at a much lower altitude.

The cabinet, already referred to, at the Hotel Waumbek, Jefferson, contains the following Lepidoptera, the greater part being captures made at Bethlehem, which is at an altitude of 1,450 feet:

P. Turnus.
D. Archippus.
L. Misippus.
A. Aphrodite.
V. Antiopa.
G. Interrogationis.
C. Philodice.
P. Cardui.
S. Alope.
P. Cecropia.
T. Polyphemus.
A. Luna.
E. Grata.
S. do.
M. Quinque-maculata.
C. Piatrix.

The Profile House, at Franconia Notch, has also a collection of Lepidoptera. The cabinet contains the following, all of which were captured in the vicinity of the hotel, altitude 1,054 feet:

P. Turnus.
V. Antiopa.
P. Atalanta.
D. Archippus.
P. Cardui.
L. Arthemis.
A. Aphrodite.
C. Philodice.
P. Cecropia.
A. Luna.
S. Kalmiae.
S. Drupiferarum.
C. Ultronia.
A. Nessus.
A. Octomaculata.

A stray setter followed our stage from Mount Washington to the Glen and suggested an Entomological joke which I subjoin, and with which I close this record.

What is the name of your dog?
Well, I call him Entomology.
Rather a queer name for a dog, isn't it?
No, I think it singularly appropriate.
Why, Entomology is a science, and means a discourse on insects, in short, it is wholly and altogether a subject of insects.
That's just the reason why I call my dog Entomology, for he is wholly and altogether a subject of insects.

MEETING OF THE SOCIETY IN APRIL.

A meeting of the London members of the Entomological Society of Ontario was held in the rooms, Victoria Hall, London, on Friday evening, April 11th, 1890: the president, Rev. C. J. S. Bethune in the chair. The following resolutions were adopted:

That with a view of increasing the usefulness of the Society and furthering the study of Natural History and the kindred sciences it is desirable to follow the method of the Canadian Institute and the American Association for the Advancement of Science, and permit sections to be formed for the various branches of Botany, Ornithology and Oology, Microscopy, Geology, and such others as may from time to time appear to be desirable. The basis proposed is as follows:

1. All members of the sections shall be members of the Entomological Society and be governed by its rules and regulations and entitled to all its privileges.
2. Any five members may, with the permission of the Council, form themselves into a Section devoted to some special branch, and organize the same, appoint officers and make rules for the meetings, etc., the same not being contrary to the rules of the Society.
3. One-half of the annual fee of each member of a section shall be refunded by the Entomological Society to the Treasurer of that section for the use and benefit of the section.
4. All members of the Society shall be free to attend any meeting of a section and take part in its discussions, but only those shall be entitled to vote who shall have signed the roll of that particular section.
5. A member may elect to be member of one or more sections, but the one-half of the fees returned by the Society can only be paid to one section.

That it is desirable in the interests of the Society that some one should be found who would keep the rooms open daily and be in charge thereof.

The meeting then adjourned.

ORGANIZATION OF SECTIONS.

The following report is taken from the London *Free Press*, of May 5th, 1890:

A most enthusiastic meeting of Naturalists was held in the rooms of the Entomological Society on Saturday evening, for the purpose of organizing sections of the Society for the purpose of active work in the kindred branches of natural history. Sections were formed in Botany, Ornithology, Geology and Microscopy, with the following chairmen *pro tem*:—Botany, John Dearness; Ornithology, William Saunders; Geology, Dr. Woolverton; Microscopy, Prof. J. W. Bowman. Evenings were selected for organizing the sections and the meeting then adjourned. The Botanical section met at once and elected officers as follows:—chairman, John Dearness; vice-chairman, Prof. J. H. Bowman; secretary, Dr. Susannah Carson. The following persons signified their intention of joining the section:—Dr. Jennie Carson, Mrs. W. E. Saunders, Miss Edith McMechan, Miss Fowler, Drs. Hodge and Woolverton, Messrs. E. B. Reed, A. McQueen, A. O. Jeffery, S. H. Craig, Saunders, J. Balkwill, Kelley, A. Craig, R. Elliott and R. A. Gray.

The next meeting will be held on Saturday evening, 10th inst., at 8 o'clock, in the Entomological rooms at which it is expected there will be a large attendance of ladies as well as gentlemen. Mr. Dearness will give suggestions as to collecting and preserving plants, while the identification of plants collected during the week will be an item of special interest. The Ornithological section meets to-night in the Entomological rooms and a general invitation is extended to all interested in the study of Ornithology and Oology to attend so as to make the organization complete at once and ready for the season's study.

ENTOMOLOGICAL CLUB OF THE A. A. A. S.

The Entomological Club of the American Association for the Advancement of Science, assembled in the State House at Indianapolis, Ind., on Wednesday, August 20th, 1890, and began its regular sessions at 9 o'clock a.m., the President, Prof. A. J. Cook, Agricultural College, Mich., in the chair.

There were present during the meetings: W. B, Alwood, Blacksburgh, Va; Geo. F. Atkinson, Columbia, S. C.; W. S. Blachley; P. Carter; Prof. E. W. Claypole, and K. B. Claypole, Akron, Ohio; F. S. Earle, Ocean Springs, Michigan; S. G. Evans, Evansville, Ind.; James Fletcher, Ottawa, Ont.; H. Garman, Lexington, Ky.; Mrs. O. Hanney; C. W. Hargitt, Oxford, Ohio; Thos. Hunt; John Marten,

Albion, Ill.; Miss Mary E. Murtfeldt and Miss Augusta Murtfeldt, St. Louis, Mo.; W. W. Norman; Prof. Herbert Osborn and L. H. Pammel, Ames, Iowa; R. S. F. Perry; C. Robertson, Carlingville, Ind.; Prof. J. W. Spencer, Athens, Ga.; James Troop and Prof. F. M. Webster, Lafayette, Ind.; Dr. Clarence M. Weed, Columbus, Ohio, and others.

THE PRESIDENT'S ADDRESS.

The President, Prof. A. J. Cook, delivered the following address on teaching entomology:

Ladies and Gentlemen of the Entomological Club.—I congratulate you that another year has passed, and our number has not been broken in upon by death. While our ranks have been much enlarged, no one has been called to that undiscovered country from whose bourne no traveller returns. I also congratulate you upon the great increment in our force of working entomologists. I think I may say, with no fear of contradiction, that no year in the history of America has been so remarkable in this respect as has the last. This is a cause for special felicitation, not only to entomologists, but to all our people. Ours is a tremendous country—by ours I include, of course, our Canadian brothers, for we, as scientists, know no line of separation—and to spy out the entire land needs an army of workers or observers, all trained to keen sight and ready apprehension. But more than this the magnitude of our country is fully equalled by the magnitude of the insect hosts, and to know all of these, with their full life history, requires an incalculable amount of closest research. But our business economy demands this for all our species: for so wonderful is the balance of nature, so close the relations of all species of life, that really we may hardly divide insects into those important and those unimportant in our agricultural economy. All are important; and so from an economic, no less than a scientific standpoint, it is desirable that all such research be widely encouraged, and it is a most hopeful omen—the rapid increase of earnest and trained workers. I shall not in this address occupy time by giving the peculiarities of the season in respect to insects, nor yet call attention to interesting discoveries, like the importation of the *Vedalia cardinalis*, All these will be brought out in papers and discussions. I must, however, refer to the new association for the advancement of economic entomology, which was organized at Toronto a year ago, and which held its first meeting at Washington last November. This meeting, under the Presidency of Dr. Riley, was a valuable one; and that society promises much for the science of entomology, as well as for its economic development. It is also a matter of much interest that a new paper—*Insect News* is started at that great centre of entomology—Philadelphia—which will also do much every way for our science. This, with the very excellent periodical *Insect Life*, published by the Entomological Division of the Department of Agriculture, can but give new impetus to entomological research. In addition to these, we have an addition to Prof. Comstock's admirable work, which when completed will form a most valuable adjunct in the development of entomology. If we may judge from what we already have, this will be invaluable in every entomological laboratory. When the Society of Economic Entomologists was organized a year ago it was remarked by one of our first entomologists that that move sounded the death-knell of this Club. I then remarked that such ought not to be the case. That Society is to be composed only of those interested in economic entomology, and of course will only put emphasis in the direction of the practical aspects of the science; this more or less of entomologists in a wider sense, and so will include those interested in practical entomology and also in

the science without relation to utility. The Club then may well continue. I believe it will live and thrive, and will be most helpful to entomologists and to our science. While the other Association will discuss economic questions, this Club will place no limit on either its discussions or its membership, only so far as entomology shall be its aim and purpose. No one doubts but that he who has a thorough training in the science of entomology will be far better prepared for practical work, and so there can be only the most cordial relations between the Association of Economic Entomologists and this Club. Indeed, many of our most active entomologists will be members of both. I have already stated the truism that only can he do the best practical work in entomology who is thoroughly well grounded in the general science of entomology. As we now have a great call for entomologists in our experimental stations, agricultural colleges, and as State entomologists, not to speak of the fact that every farmer and fruit-grower would be more successful if he were well-informed in this science, it goes without saying, that there ought to be in training men for just such work. It seems to me that it needs no argument to show that our agricultural colleges are just the places where this training should be given. They were founded to teach those subjects which would be most serviceable on the farm. Entomology is one of the chief of these. Thus it follows that every student of agriculture should have a thorough course in this science, with the practical aspect of the subject kept in the foreground. In thus presenting this science to large classes—I have from thirty to forty each year who study this subject in the course—the teacher will find some in each class who are specially fitted to succeed. They enjoy the study and work most earnestly just for the love of the pursuit. They have quick observation, and are very accurate and honest in all their work. It needs no prophet to bespeak success in this field for such students. Our agricultural colleges are just the places to discover the men who have great possibilities in this direction; just the places to give the training that shall best fit men to do the most valuable work. It will be my purpose in the remainder of this address to describe the equipment for such work, and to explain the method which I believe will give the best results. Of first importance is a good library; this should contain all the standard works, periodicals and monographs, so that students who may decide to study any insect or genus, may find what has been written on the subject. Of course this cannot be had at once, but it is so essential that no effort should be spared to build up a complete entomological library at the earliest possible moment. *True* the scientist should study *things*, not books, but he will find a wide use of books most helpful in his study. Next to a library, such colleges should have good collections, which are often of more value than the library. A small show collection, illustrating the families and orders, and the several stages of the most injurious species of the place as well as the groups of beneficial ones should be open to the public. This will be studied and appreciated by the practical farmer, who, as he visits the college, will find it helpful, and will also interest and stimulate the under-class men, who will thus have their attention called towards insects before they commence the regular study, which will not occur till they are well along in the course. Drawing, botany, microscopy, and French and German, if thoroughly understood, will be great aids to the student who commences the study of entomology. Thus this study will come late in the course and the show collection will be whetting the appetite of the under-class men from the time they enter college until they commence the study. I would also have what I call a student collection—this is a pretty full collection from the locality of the college. This I would hang upon the wall of the lecture room, which I would have dark, except when in use, so as to preserve the colour of the specimens. I would have this in rather small cases,

with glass in front and also back where it is desirable, as in case of Diurnals, to study both under and upper sides of the wings. This collection should show at least types of each group in all stages, from egg to imago, as well as nests, cocoons, etc. This is an object lesson ever before the student, is ever ready for use by the teacher to illustrate his lecture, and is at the disposal of the students in naming their own collections or in closer study of any group. It seems to me such a collection should be in every college. Lastly, I would have a laboratory collection which should be a biological collection, and the fuller the better. This is in large, tight, glass-faced drawers. I use the Harvard case. This is for the use of teachers and post-graduates who desire to study further in the science. It is too valuable for general use by the student or to be kept to satisfy general curiosity.

As I have before remarked, before the student commences the study of insects he should have had a good course in free-hand drawing, should have had instruction in the use of the microscope and in preparing microscopic specimens and slides, and if he has a ready use of German and French it will be very helpful to him in his study. It is also desirable that the student should have had a full course in botany. The students of our college have had three terms of botany, one devoted entirely to microscopic botany, before they begin the study of entomology. I consider this very valuable preparatory work. Entomology is very close precise work, and the laboratory work if carried on for a less space than three hours at a time is not satsfactory. But three hours of such close work is very wearying unless the student has had a fitting preparation. Thus I am pleased that our students have had *vertebrate dissection* with human and comparative anatomy and physiology before they commence entomology. I know this seems the reverse of the natural method; as nature proceeds from lower to higher; vertebrate dissection is lighter and less trying to eye and brain than is the study of insect anatomy; thus I am pleased to have Anatomy and Physiology of Vertebrates precede that of the Arthropoda in our course. In our college the student attends a course of sixty lectures on the anatomy and physiology of insects, systematic entomology and the economic bearing of the subject. These lectures are illustrated by use of models, the student's collection of insects, already referred to, by microsocopic preparations, mostly prepared at the College, and elaborate charts and drawings also prepared specially for our use. In connection with this course there are 36 hours of laboratory. Each student works three hours one day each week for twelve weeks. In this time they are able to study the internal anatomy, and to examine carefully and accurately one insect of each order. In connection with this several insects are traced to the genus by such keys as Leconte and Horn, Cresson, Williston, etc. Besides the above, each student makes a collection of from ten to twenty-five insects of each order, all neatly put up with date and locality label; each order by itself and all labelled as far as time will permit. Many students succeed in naming a large number of their specimens. Each student is also required to mount insects in all the approved ways. Small insects mounted on triangular pieces of cardboard or rectangles of cork with silver wires, while the larvæ are put in bottles of alcohol with rubber corks and also prepared by eviscerating and drying, while distended with air, in a heated oven. The students are also encouraged to prepare biological collections, in which they preserve the eggs, larvæ after each moult, pupa, cocoon, imago of both sexes, and of various sizes and the several variations. Some of our most enthusiastic students work out several such life histories, describing not only the separate stages, but the several parasites that work to destroy the insects. I regard this work as very valuable. It is excellent discipline for the mind and observation, gives accurate information of the most interesting kind, and arouses

enthusiasm for the study as nothing else can. It is such work as this that will tell for the future of entomological research, that will make entomologists, who will honour alike the fields of pure and applied entomology. But such study ought not and will not stop here. Post-graduates will avail themselves of the opportunities which such laboratories offer. Last winter during our long vacation—ours is an agricultural college and our vacations must needs occur in winter, when farm operations are largely at a standstill—I had ten special students of entomology in my laboratory, one from South Dakota, one from Indiana, one from Ohio, one from Japan, one from Wisconsin, and the others from our own State. Nearly all were college graduates. Six special students, all graduates from colleges, have spent the year in my laboratory in special entomological study as post-graduate students. It seems to me that such are the young men who are going to develop the entomology of our country. They are the young men who can and will do grand work in our colleges and experimental stations. These young men each take up some special family or genus of insects, to which they give the major part of their time and study. They collect in all orders and give special attention to biological work, tracing the life histories of insects, identifying as far as possible the insects they capture and trying to become familiar with entomological literature, so far as they are able. The students are mutually helpful to each other. As the laboratory may be said to be a sort of perpetual Natural History, or more accurately Entomological Society, thus the students become familiar with the general laboratory work, in fact, they each become a factor in some degree in carrying the work forward. Here I will close by explaining briefly the mode of our labaratory work, which differs in some degree from the admirable plan which Prof. Forbes explained at the Washington meeting of Economic Entomologists last November. Our labels give in compact space locality, date, accession and species number. The accession number agrees with a number—serial number—in our accession catalogue for the special year. Thus, ac. 400 shows that the insect or insects bearing that label were the 400th collected during that season. The sp. number is given as the insect is determined, and is the number of the insect in the catalogue which we use. Thus, sp. 25 is "Cicindela purpurea," as the beetle is numbered 25 in Henshaw's catalogue of Coleoptera. In case the catalogue is not numbered, as is the case with Cresson's list of Hymenoptera, then we number it. We have a column in our accession catalogue for date, collector, person who named the specimen, and also for remarks.

This last column is wide, and in it we can usually write all necessary information which we received in the collecting. If we are experimenting with or studying the insect, our notes are kept on cards. These are numbered to agree with accession catalogue, and are kept in serial order until we know the species when we add the species number as well. We now index the card and place it in its correct alphabetical position in our card collections. Thus we can very easily find our notes on any specimen, either by accession number or by the name of the species. This plan works well, and, it seems to me, is very economical in respect to time. Of course our students all see this scheme and become familiar with its workings.

HESSIAN FLY, WHEAT-STEM MAGGOT AND OSCINIS.

Mr. J. Fletcher presented some notes upon injuries caused by the Hessian Fly, the Wheat-stem Maggot and an undetermined species of Oscinis. He said that the note was presented with the object of eliciting further information upon a subject which had proved of great interest to him. During the past season he had endeavoured to determine the number of broods of the Hessian Fly for the

Ottawa district, and had found, first, that the Hessian Fly, the Wheat-stem Maggot and Oscinis were all found at the same time and in the same plant, and further, that, speaking generally, they passed through their stages contemporaneously. Of the three the last had proved much the most destructive. From root shoots of wheat sown on the 14th of April he had bred Hessian Fly and Oscinis at the end of June, and a month later Meromyza had appeared. He had also noticed in some fields at Ottawa that a large quantity of spring wheat was attacked by Hessian fly in the ground shoots or stools in the same manner as fall wheat is attacked in the autumn. It was frequently the case that on plants which had made from fifteen to twenty stools but one would be left, all the others having been destroyed by the insects. He had procured adult Hessian Flies at Ottawa during this season in the beginning of May, at the end of June, and in August, and they would probably appear again in September. He had not been able to find the Hessian Fly breeding in any of the grasses, and would like to know if others had done so. Meromyza and the Oscinis had been most troublesome pests in the experimental grass patches at Ottawa, some grasses being almost exterminated by them. It was remarkable that the spring appearance of Meromyza had been so enormous as to have caused fear of a serious destruction of the wheat crop. As a matter of fact, however, there had been less injury, both to small grains and grasses, than for many years previously. This diminution he could only explain by the supposition that the eggs had been destroyed by some predaceous insect. The eggs must have been laid in large numbers, but there was very little evidence of the presence of the larvæ, either in the standing wheat or barley, or in the root-shoots of barley. The Oscinis he had been unable to identify; but, through the kindness of Mr. John Marten, of Illinois, he had learnt of some work which had been done by Prof. Garman in Kentucky, upon what was probably the same species. This, Mr. Marten said, had been doubtfully identified by Dr. Williston as *O. variabilis.*

Prof. Garman stated that he had studied what appeared to be the same species, and had prepared an article for publication. He also gave some notes upon the life history and anatomy of the insect.

Prof. Osborn had taken at Ames, Iowa, numerous specimens of Oscinis, one of which closely resembled that exhibited by Mr. Fletcher.

Prof. Alwood had studied in Ohio an Oscinis infesting oats, and had published his results in Bulletin 13, Division of Entomology. He had found the eggs, from two to eleven in number, were forced beneath the sheath of the leaf, and that just prior to pupation the larvæ gnawed through the epidermis and the pupa protruded so as to admit of the easy escape of the adult.

Mr. Fletcher, referring again to Meromyza, stated that in many instances he had found the eggs deposited in the field upon the upper surface of the leaf some distance from the stem, and asked if others had observed this to be the case elsewhere.

Prof. Garman had found that the eggs were laid just above the sheath, or sometimes pushed beneath it.

Prof. Webster stated that the eggs of the Hessian Fly, had, in the spring of the present year, throughout Southern and Central Indiana, been deposited near the roots, the "flax-seeds" being found in that portion of the plant; while in the northern part of the State the case had evidently been different, as the "flax-seeds" were there almost invariably located about the second joint.

The Secretary read a paper by Mr. Edward L. Graef, of New York, upon the American Silk Worm Moths or Spinners, in which a serious attack upon the

shade trees of New York by *P. cecropia* was recorded, and the suggestion made that this and other species might be turned to account, if any means could be devised for manufacturing and utilizing their silk. As a stimulus to this industry, Mr. Graef generously offered a prize of fifty dollars for the best essay and model of apparatus for carrying this suggestion into effect.

SECOND DAY'S SESSIONS.

The Club met on Thursday at 8 a.m. Dr. C. M. Weed read an interesting paper upon the clover-stem borer, *Languria mozardi*. Fifteen species of plants were reported upon which the larva had been found feeding. This paper was discussed by Profs. Cook, Alwood, Osborn and others.

Prof. Alwood spoke of tobacco insects, of which he was making a special study. He had observed a stem borer which was very injurious.

Dr. Weed had learned of a tobacco root-louse in Southern Ohio.

Prof. Garman spoke of the mouth parts of several species of some families of Thysanoptera, and stated that some recent studies had shown him that the figures published did not agree with his material. He then read the following paper, entitled "An Asymmetry of the Head and Mouth Parts of Thysanoptera."

In a brief paper in the Bulletin of the Essex Institute I have recently called attention to peculiarities in the structure of the head and mouth parts which set this group quite apart from other orders of Hexapoda. [This has no reference to affinities upon which, I believe, we are not prepared to pronounce until this and several other groups have been more completely studied.] In that paper it was claimed that the endocranium of the species examined was not symmetrical, being deficient on the right side; that the labrum was one-sided; that there was a developed mandible on the left side, with, at most, a rudiment on the right; and that the mandibles of authors were probably lobes of the maxillæ.

At the time the paper was written I had not examined sufficient material to enable me to say whether the features pointed out were limited to certain species or were common to all members of the group. Since then many additional forms have been examined, all, however, belonging to the families Stenopteridæ and Coleoptratidæ, and in no case has there been found a departure in essentials from the structure of the head and mouth parts as they were described in the paper referred to. It is probably safe to assume, therefore, that the asymmetry noted is characteristic of these two families at least.

Of the group Tubulifera no representatives have been studied, I shall not be surprised, since this is the lowest of the suborders, if examples of Phlæothrips are found to be more nearly symmetrical.

As an interesting fact, though in no way related to the main purpose of this communication, I may mention that the solitary mandible of Limothrips and Melanothrips is perforate, like the jaws of larval Chrysopa, of Dytiscidæ, and of Myrmeleon. In specimens of Coleoptratidæ examined, both labial and maxillary palpi are composed of three segments.

Note.—Since my return to Lexington from the meeting of the American Association I have secured a couple of very young Phlæothrips. My examination of these is not completed, but I have succeeded in demonstrating the single jaw on the left side. The parts are greatly elongated, and remind one of the same organs in Hemiptera. The styliform parts are especially long, extending, when

retracted, into the cranial cavity towards the eye, thence bending posteriorly and extending along the posterior wall of the head to the mouth opening. Both mandible and styliform parts are perforate (or possibly grooved).

Two unmistakable tarsal claws are present in this genus. From their relation of position to the pads the latter would seem to be modified pulvilli.

Prof. Osborn was much pleased with what Prof. Garman had stated. He had also observed some of the points mentioned in a special study which he had made of these insects, and hoped Prof. Garman would publish his results as soon as possible.

Dr. Weed presented a short paper on the oviposition of *Listronotus latiusculus*. The eggs are laid in clusters of from five to ten upon the leaf stalks of *Sagittaria variabilis*, and are covered with small pieces of the epidermis which are nibbled off by the adult beetle. This was discussed by Messrs. Garman, Fletcher and Webster.

Mr. Charles Robertson, of Carlinville, Ill., read a most interesting note upon the habits of the bee *Emphor bombiliformis*, which was originally described by Creason as a *Melissodes*, but Paton, in revising the genus, raised it to *Emphor*. This bee, it was stated, confines itself almost exclusively to *Hibiscus*, chiefly *H. lasiocarpus*. The appearance and habits of the bee were described. It was stated that in collecting these bees it is important to catch those flying around the plant without alighting, as these were generally the males, whilst those visiting the flowers for honey and pollen were the females. On August 5th, when walking along a dam with water on one side, he had noticed a female standing upon the water; she then flew to a bank, and he observed that she was carrying water to facilitate the excavation of hard ground, into which she was burrowing to build her nest. Sometimes one pellet of earth would be taken out after such an application of water, but at others three or even four. An interesting discussion followed which was participated in by Messrs. Osborn, Cook, Weed, Fletcher and others.

Prof. Osborn read the following note "On a Peculiar Form of Coleopterous larva": Eleven years ago, while a student in college, I found a peculiar form of larva boring in the twigs of ash trees, and it was described at the time in the students' journal at the college (The Aurora, May, 1879, page 5.) under the caption "A Grub With Legs on its Back." The description is as follows: "The specimen was found boring in the pith of a small twig on an ash tree near the road west of the college, apparently beginning at or near the tip of the twig and working downward. Numerous twigs were found that had been inhabited in this way, but only one specimen of the borer was found—this about a quarter of an inch long, quite slim, and nearly white. Its great peculiarity consists in the disposition of its locomotive apparatus. The first three segments following the head are provided with the usual pair of legs, each in the normal position—that is, on the ventral surface. The following six segments are provided each with a pair of pro-legs, similar to those found on many caterpillars, but, strange to say, these are arranged upon the *dorsal surface*, exactly the opposite of the usual arrangement, while the number six is different from either the caterpillars, where there are four or five, or the saw-fly *larvæ*, which have eight. The remaining three segments have no propellers whatever. The beauty of this arrangement, for the conditions of the borer, can at once be seen, for it has as much foot-hold above as below. Placed upon a flat surface it could make no advancement, but wriggled awkwardly about, evidently seeking its double foot-hold. Placed between two thin plates of glass, it moved rapidly, using all its legs, and going with equal

facility backward or forward, either side up. If provided with some support at one side it was possible for it to travel by means of the legs on its dorsal surface alone."

During the present season an example of a similar larva has come to my notice, specimens being first observed by Prof. L. H. Pammel, occurring in the stems of *Helianthus*. Their possessing similar locomotive organs upon the back called to mind the peculiar larvæ noticed years ago. They differ, however, somewhat in colour as well as in the plant on which they occur, and I find that they attacked voraciously dipterous larvæ that were living in the same stems. Whether they are normally carnivorous remains of course to be determined, but there can be no question of their attacks upon these larvæ, and apparently with the intention of obtaining food from them. These specimens are of a light bluish colour, possessing pro-legs upon segments 4-9, inclusive, and a pair of tubercles on the ventral portion of the anal segment, as well as a dorsal tubercle on the terminal portion of the same segment. In general appearance there is a striking resemblance to the *Languria* larva, as shown in figure exhibited by Dr. Weed, but in his drawing there is no indication of the dorsal feet.

The Club convened at 5 p.m., and considered the following resolution :—

Resolved, That it is the sense of the Club that the meetings of the Association of Economic Entomologists and of the Entomological Club would both be benefited by holding such meetings, if possible, at the same time and place as the meetings of the American Association for the Advancement of Science.

After discussion by Messrs. Fletcher, Osborn, Cook, Alwood, Weed and others, the resolution was unanimously adopted.

The Secretary read a paper by Prof. D. S. Kellicott, of Columbus, O., upon the "Preparatory Stages of *Eustrotia caduca*." He had collected the larvæ upon *Nuphar advena* at Rives Junction, Michigan, in 1876. From these he had bred a moth, afterwards named by Mr. Grote *E. caduca* in the *Canadian Entomologist*, Vol. 8, p. 207. During July of the present year he had again collected the insect at Corunna, Michigan, and had succeeded in breeding and describing all the stages, which were submitted herewith.

The larvæ found in 1876 were feeding in the fruit but those studied during this summer were found upon the leaves. If these latter were floating, the larvæ were exposed on the upper surface, in other cases they were beneath or concealed in folds. A different habit of swimming to that of *Arzama obliquata*, which progresses by horizontal undulations, was noted. *E. caduca* swims strongly, but by an entirely different motion. The posterior third of the body is bent downwards like the tail of a crayfish and then quickly pushed backwards, thus driving the insect ahead by jerks.

Discussed by Messrs. Weed, Webster and others.

Prof. Cook reported having bred *Agrotis C-nigrum* through all its stages upon black currant, the eggs having been laid in a cluster upon leaves of that plant on 1st June—the perfect insect appearing on the 1st of August.

Prof. H. Osborn read a note on the "Period of Development in *Mallophaga*." The habits of the species of *Mallophaga* render accurate observations upon the time required in development of the eggs a matter of considerable difficulty. While in some of the species upon very common birds it is possible to get an abundance of material, in other cases the opportunities for obtaining such material are very rare. But in the most common species the difficulty of determining the exact time of deposition of eggs, and then of keeping individuals in such conditions as to insure a normal development, makes positive observations difficult. This being the case, any observations which may add to our knowledge of the subject seem of interest, and the present note is offered as one such contribution.

The species chosen in the present case is the *Nitzschia pulicare*, which is almost invariably to be found in abundance on the common chimney swift (*Chætura pelasgia.*) This bird is an abundant resident of the building in which my laboratory is located, and being readily obtained on account of its tendency to fly in at the windows, I suggested to Mr. P. H. Rolfs, a graduate student in biology, that he attempt the rearing of larvæ from eggs with a view to determine length of developmental period in connection with studies of its embryology.

For this first purpose he secured on two separate occasions a number of the eggs, and kept them, part in a tight paste-board box, which was kept warm by the heat of his body, the others were enclosed in cotton-plugged tubes under a hen that was kept in the laboratory at the time for incubating eggs for embryological work. Of the first lot, all kept in pocket, secured July 27th, two eggs hatched August 4th, five between August 8-13th, one August 16th, the last giving twenty days, the longest period.

Of the second lot secured, August 3rd, six hatched between the 8th and 13th, four hatched August 14th (three in box and one in tube), two August 15th (one in box and one in tube), part not hatching, and the longest period in this case being thirteen days.

Assuming that those requiring the longest time, had been deposited but a short time before the experiment began, we should have from fifteen to twenty days as the ordinary time required for the eggs to hatch for this species.

Mr. F. S. Earle presented some interesting notes upon the injurious insects of the season in Southern Mississippi. *Diabrotica 12-punctata* was a very abundant insect, and in addition to its well known food plants, it had been a serious pest to peach trees and cabbages. Leaves of the latter, bitten by the insect, at once decayed from the point of injury. Cut-worms were very destructive in gardens, and cucumber and melon vines were much injured by a plant-louse. Potatoes had been much attacked by a black flea-beetle, and the tomatoes by the boll-worm in the fruit, and on the leaves by the sphinx larvæ.

Prof. Cook would like to hear the experience of those present as to a practical remedy for the attack of the boll-worm upon the fruit of tomatoes.

Prof. Osborn said that Mr. Tracy had tried arsenical mixtures with some success, and also had attracted the perfect insects to light.

SOME EXPERIENCES IN REARING INSECTS.

Miss M. E. Murtfeldt read the following paper:

In rearing insects, as with many other enterprises in life, we climb the ladder to success by the rounds of successive failures, having in many cases to exhaust an almost infinite range of "how *not* to do it," before arriving at its happy converse.

Many and great are the disappointments of the entomologist; bnt does he succumb? Never! What single point in the biology of a species has been relegated to the absolutely undiscoverable? I do not know of one, no matter how obscure the subject or how little advance has yet been made in the direction of its elucidation.

"Hope springs eternal" in the breast of the entomologist, and patience and perseverance have in him their "perfect work," until Nature relents, or is caught "off guard," and the secret, so carefully hidden, is revealed.

I am tempted to enumerate some of the discouraging circumstances encountered by the biologist in this field.

Among the *Lepidoptera*, a majority of the *Bombycidæ, Geometridæ* and *Noctuidæ* adapt themselves readily to the conditions of the rearing cage. They accept the food provided and make the best of it, even after it has become a little dry, which must sometimes occur when the caretaker is pressed for time. They thrive in the closer and darker air, and take such exercise as they require within their narrow walls of glass and wire-cloth, and when the metamorphic impulse comes, they contentedly weave their cocoons in the corners of their prison, or bury themseves in the two or three inches of cemeterial earth in the bottom of the cage, and safely pass those mysterious transformations which give to this class of beings their pre-eminent interest.

But there is a great deal of individuality, or rather, specificality, in insects, and not infrequently specimens of larvæ are found for which the collector taxes his ingenuity in vain to provide. Not the freshest of leaves, the cleanest swept earth or the most well-aired of cages wiil seem to promote their development. They wander about the cage with an exhausting activity that pathetically suggests a realisation of their imprisoned condition. They nibble languidly at their food, and aimlessly spin mats of web in inconvenient places, over the cracks of the door or cover, for instance, and, before long, comes the morning, when they are discovered dead and discolored in the bottom of the cage, *and no more of them to be obtained until another season*. Or perhaps the cocoons are spun or the transformation to pupæ safely effected under ground, and the entomologist has full confidence that in due time he will obtain the much desired imago, and, when it may be expected, watches hourly for its emergence, and is rewarded by the appearance of an *Ophion* or a swarm of *Tachina* flies, or of some still smaller enemy, whose existence he did not even suspect.

Again, the collector may be obliged to delegate his cares temporarily to another, who, unused to the almost constant supervision necessary, suffers the precious larva to starve, or, by an oversight, tosses it out with the withered leaves, or crushes it in the hinges of the door, or, still more aggravating, thoughtlessly raises the cover and allows some long looked for imagine to dart out and escape through an open window. All that he will remember for the benefit of the person chiefly concerned, will be that it was a moth and "seemed something peculiar." As the entomologist cannot afford a separate cage for each species, and as he had probably put his choice unknown in with some well known forms of which he wishes simply to increase his duplicates, he probably grasps at the hope that the escaped insect was one of the latter, and so defers the full realization of his loss until weeks and months have passed and all his expected species have emerged, and then he hopes for better success another year, and finds "life well worth living" for this and similar reasons, which only an ardent naturalist can appreciate.

In some respects too much care is as subversive of success as too little. For instance, the very natural curiosity which the student feels to examine into the state of the insect after it has been buried for a short time in the earth. So he sifts the soil in his cage; and though he handles it with all caution, the frail earthen cell in which the treasure is enclosed falls in pieces, and the poor caterpillar in complete helplessness squirms in the loosened earth. Despairingly he tries with clumsy fingers to re-inclose it in the fragments of its cell, or attempts to form a substitute by packing the earth so that it may not be smothered. In vain. In ninety-nine cases in a hundred he never sees the imago.

While the hardy pupæ of most noctuids will bear any amount of handling, and by their activity will beat hard the earth about them at any time, a few

species absolutely resent the least disturbance. I think that for seven or eight successive years Dr. Riley and I tried in vain to obtain the imago of a beautiful larva found every autumn in greater or less numbers on *Gnaphalium*, and occasionally on the Asters and some other *Compositæ*. Not being able to associate it with its species we designated it the "pretty cut-worm." It was Dr. Riley's practice to have the earth in his cages sifted occasionally during late autumn and winter to see how the pupæ were faring, and to have each species collected into its particular corner or side of the cage, which was designated by the label on the door.

But in the case of this particular species this orderliness was fatal. After Dr. Riley went to Washington, I resolved on the "let alone" policy. I put the larvæ into a cage with clean earth with an admixture of sand which I dampened slightly and only at considerable intervals during the winter, kept the cage in a very cool place, and the next summer was rewarded with several fine specimens of *Mamestra legitima*, my only disappointment being that it was a species by no means uncommon.

With me *Scopelosoma sidus* behaved in an almost equally capricious manner, but was, after many trials, finally reared by adopting the same methods as with *legitima*. I now make it a practice to sift or change the earth in my cages only in the spring and autumn before the hibernating pupæ are formed. Of course, if I wish to note pupal characteristics, I have to run the risk of the disturbance, but this is only occasional. I have found that frequent dampening when the cages are kept in doors, is also detrimental, and that hibernating larvæ and pupæ are far less likely to suffer from drought than from dampness.

In rearing the Micro-lepidoptera—in which I have an especial interest—various tactics must be pursued, and the imagination is often vainly taxed to suggest a provision which the delayed changes and general unrest of the insect plainly call for.

Under natural conditions it is very difficult to keep track of these small creatures. The leaves or flowers or fruits on which they may be found feeding on one day will be deserted by the next, and during the darkness they will have betaken themselves to parts unknown, the most assiduous search failing to discover them. In the rearing jar some species adapt themselves very kindly; others will crawl about for days spinning threads of silk over sides and cover and finally dry up without effecting their transformations.

An accident to which the student is liable, and against which he can with difficulty make provision, is to have the larva, which he has perhaps just described and figured, escape. How often have I taken up a bottle in which I had been rearing a particularly precious unknown, and found a tiny hole in the muslin cover, or perhaps a little flap cut at the edge of the bottle, telling only too surely of the loss and delay which a further examination verified. The annual brooded species which appear in the spring are the *betes noir* of the Micro-lepidopterist, especially such species as pupate on or just beneath the surface of the ground. They have to be cared for during the long, hot summer, as well as the autumn and winter, and to keep the safe middle course between the Scylla and Charybdis of drought and of the dampness which would promote the equally fatal mould, requires most careful attention. The annual brooded species which later fold or mine the leaves, or feed in the fruit capsules of various plants, or bore the stems, are comparatively easily reared, with a few exceptions. It was a number of years before I succeeded in obtaining the moth from an interesting larva which fed in the capsules of *Pentstemon*. This was owing to the peculiar change of habit during hibernation. After eating all the seeds from

both divisions of the capsule, it would thoroughly line one all with silk, after cutting an aperture for escape, and ensconce itself, as might reasonably be supposed, for its winter's sleep. But no; the neatly lined cell was only a temporary abode, which, during the inclemency of mid-winter, was to be deserted for an entirely different one. Where, in the state of nature, I have not yet been able to discover. In my rearing jars it perished, year after year, to my inexpressible disappointment, until finally I wintered a number out of doors in a small wire cloth box closed with a cork. From this collection I at last obtained the moth—a beautiful *Conchylis*—from a larva that had bored into and transformed within the cork. But for two or three years I had only the single specimen, and next to the aggravation of utter failure I rank the possession of an unknown unique. It may be new, and if sent to a specialist he will generally feel somewhat aggrieved if you reserve the right of description and further impose upon him the duty of returning the specimen. Then there is the danger of its destruction, either in the mail or express, to be braved, and yet, so long as one does not know the species, or be assured that it is new, one never can take full satisfaction in having bred it.

Last year I had the satisfaction of obtaining nearly a dozen imagines of the *Conchylis* in question by providing a number of bits of pith and cork in which the larvæ bored after their desertion of the capsules where they had fed.

Whenever I can make satisfactory arrangements for keeping track of them, I winter my Micro-larvæ and pupæ out of doors. Such species as bore the pith of stems are very easily cared for, and leaf miners and webbers I enclose on the surface of the ground, in some sheltered situation, under wire sieves or covers, bringing them in in the spring in order to have the little moths emerge where they can more easily be chloroformed or transferred to the cyanide bottle.

I must confess that I have never had signal success in rearing such species of the *Tenthredinidæ* as transform under ground. I have in mind more than half a dozen species—the larvæ of which are most interesting—of which I have so far failed to obtain the imagines, in spite of my utmost care.

The eaf and root-feeding beetles have always developed satisfactorily for me, but the *Cerambycidæ*, which feed on growing wood, have given me much trouble, and, in many cases, failed me utterly.

Orthoptera require but little care, as also do leaf-feeding *Hemiptera*, but the Cannibal species of both these orders are more difficult to cater to, and often refuse a diet that one would think would be irresistible. This is especially true of the carnivorous bugs which I have found require large space and ample provision to preserve them from fraternal rapacity.

With the aquatic orders I have had but little opportunity for experiment, but think they must furnish many very interesting subjects.

I believe that costly insectaries are being constructed by many entomologists, and no doubt will afford room for much thorough study of forms and habits. But such costly appliances are not absolutely necessary, and sometimes make observations more difficult than when the conveniences are more primitive.

A secure enclosure, fresh food, fresh air and clean water in the bottles are almost the only requisites in rearing the herbivorous species, and the more constantly the cage or jar is under observation the more thoroughly of course are the history and habits of the species revealed to us. When I wish to know all about a species, I keep the cage or jar on one corner of my desk and watch its occupant in the intervals of other work.

I cannot hope that I have conveyed much information in these notes to those who have gone over the same ground, but I am at least sure that I have recounted some of the experiences of every biological student of insect life, and can sympathise in his disappointments and appreciate the satisfaction of his successes.

THIRD DAY'S SESSION.

The Club met on Friday at 8.30 a.m. Dr. Weed presented a short paper on the habits of *Lixus concavus*.

As reported in the bulletin of the Ohio Experimental Station, Mr. Alwood had found this insect injuring the stems of rhubarb. During the past summer he had bred it from all parts of the stem of the common curled dock.

Prof. Alwood stated that he had observed the larvæ of *Gortyna nitela* eating those of *Lixus*.

Dr. Weed read a paper upon the habits of *Psephenus Lecontei*.

Prof. Webster and Mr. Fletcher also spoke on the habits of this beetle.

Prof. Hargitt read a note upon a large foliaceous gall which destroyed the tips of the stems of various species of *Solidago*, at Bloomington, Indiana. In many instances as many as ninety-nine per cent. of the flower stems had been destroyed.

Prof. Hargitt read a note upon the Canker Worm. He said: "My attention was drawn to an orchard near Oxford, Ohio, which, for three or four years, had been seriously affected by this pest. In May, 1890, I went to examine the orchard and found it thoroughly over-run by the larvæ, many of the trees being actually dead, and several others in a very weak condition. The orchard, viewed at a distance, had the appearance of having been burned, the leaves being brown and dead. The trees were most attacked upon the outer rows, particularly those adjoining a wood. I recommended spraying with one of the arsenites, but it was too late for the present season. I observed several small birds in the orchard actually engaged in feeding upon the larvæ, amongst them the cedar bird, blue bird, summer warbler, chipping sparrow and field sparrow."

Prof, Hargitt also read a note upon *Cermatia forceps*. He had found that this Myriapod had become abundant in houses and the college building at Oxford, Ohio, during the past two or three years. He had experienced the same difficulty in keeping the insects alive in captivity, as was mentioned by Dr. Lintner in his 4th Report. He had succeeded in keeping them for several days and inducing them to take prey by keeping them in dark quarters in a tin canister during the day. When so confined they had fed freely upon house-flies, and other insects supplied them.

Prof. Webster spoke of the predaceous habits of *C. forceps*, and its special fondness for the Croton-bug (*Ectobia germanica*).

Mr. Fletcher had observed the insect when visiting Mr. Howard at Washington, D. C., who had described to him its remarkable habit of capturing the Croton-bug by springing over it and thus encaging it beneath its many curved legs. He was of the opinion that those who had failed to keep this insect in captivity had done so from omitting to supply a sufficiency of moisture, and thought that Mr. Hargitt's success in the instance mentioned, where the insect was put in a tin can, was more due to this cause than to the darkness. *Myriapods* are general found in damp, dark places.

ELECTION OF OFFICERS.

The Club proceeded to elect officers for the ensuing year. Prof. Cook, the retiring President, congratulated the members upon the harmony which had existed throughout the sessions, and was glad to find that, although some old and pessimistic members of the Club had predicted that it had run its course and would soon flicker out like a spent candle, he was glad to find that the present meetings had not only been the best attended for many years, but that the discussions and papers had been equally interesting to those of any meeting which he had had the pleasure of taking part in. He wished the Club every success and trusted that it would grow stronger and stronger every year. The following officers were elected :—

President, Prof. Herbert Osborn, Ames, Iowa.

Vice-President, Miss Mary E. Murtfeldt, St. Louis, Mo.

Secretary, Dr. C. M. Weed, Columbus, Ohio.

CONTAGIOUS DISEASES OF INSECTS.

Prof. Osborn, at the invitation of the President, introduced the subject of the use of contagious diseases in combating injurious insects. He said that he had already published a paper in the Transactions of the Eastern Iowa Horticultural Society for 1886, pp. 400-405, upon the subject; but that it was of such importance that he desired to hear it discussed by the members of the Club. He first mentioned the well-known fungus and bacterial diseases which attack insects, as Muscadine, Grassen or Jaundice, Pebrine, Flacherie or Flaccidity, Foul-brood of Bees, Fly and Grasshopper Fungus, and the White-grub Fungus, and called attention to the fact that we were already able to control those which affect important domestic species, as Silkworms and Bees, and that to some extent at least we are able to control those available as agents in destroying injurious species. After considering the various conditions limiting the applicability of this means, he drew the following conclusions :—

(1) That there are diseases amply sufficient as a basis for economic work, the bacterial forms giving the most promise for all cases where early results are desired, while those due to fungi, so far as present knowledge goes, propagating slowly, can only be used as slow but efficient checks to injurious forms, the most that we can do with them being to introduce them in localities where they are not already found.

(2) That the diseases can be controlled to the extent of preserving the germs for a season and transporting them from place to place to use for inoculation, but that their spread in nature will be affected by conditions beyond control, while only such insects as occur gregariously, or live in mingled hosts, can be attacked to advantage.

(3) That the cost of application would prevent its adoption except in certain forms.

(4) That we must oonsider this method of contending with insects at best as but one of a number of profitable methods to be used in certain cases where other methods are insufficient, and to supplement other methods when it can be done to advantage. With this end in view, the diseases of insects are worthy of the most careful study, and will not, he thought, disappoint the investigator in their final results.

Mr. Fletcher thought that the chief difficulty with regard to these fungus diseases was their cultivation so that they might be available at the time when needed. One trouble with him had been carrying them over the winter.

Prof. Hargitt spoke of a fungus disease which had attacked the canker worm.

Prof. Cook thought the greatest difficulty in making use of contagious diseases for the destruction of insects was the fact that the insects which it was desired to treat were not always in a susceptible condition.

Prof. Garman thought that although fungus diseases were difficult to introduce, bacterial diseases would probably be more controllable.

The meeting adjourned till 5 o'clock.

VARIOUS INSECTS.

Prof. Atkinson spoke on the "Injurious Insects of Alabama." A bud worm had been extremely injurious to young corn, piercing the central shoot and destroying its growth. *Diabrotica 12-punctata* had also been injurious in the same manner; and, if there were not sufficient food in the stem, the larvæ descended to the roots and tunnelled out irregular channels on the surface. They pupated in the ground. A new attack had been observed on the "Irish potato," viz., by the Cabbage Plusia, which had attacked the leaves. The same insect had been very injurious to cabbages. In the southern part of the State more had been done by the Plusia than by the cabbage worm. At Mobile farmers had complained that 50 per cent. of their melons had been injured by a worm. *Scolytus rugulosus* had been very abundant at Auburn in the spring, attacking trunks which appeared to be perfectly sound. Onions had been badly injured by a species of Thrips. Another species had also been injurious to cotton plants.

Prof. Cook stated that he had also seen a Thrips injuring onions in Michigan.

Prof. Webster stated that he had studied *Scolytus rugulosus* and had found that it invariably attacked trees which were injured. In a single instance, where the beetles had commenced operations on a sound tree, he found that they afterwards left it.

Prof. Cook made some remarks upon the effect of mild winters upon insect presence. He had found cut-worms and saw-flies very abundant in Michigan during the present season. He had also bred a new borer from the black currant, *i.e.*, the small longicorn beetle *Hyperplatys maculatus*. He had also found that the larvæ of *Aegeria typuliformis* had been largely destroyed by a fungus growth like that of the white grub. The leaves of cherry, pear and quince had been badly attacked by the larvæ of saw-flies, but they had been easily kept in check by applications of road dust.

Dr. C. M. Weed presented a paper upon the "Oviposition of *Dectes spinosus* upon *Ambrosia trifida*." He also gave some account of the insect, in all its stages, from specimens which he had bred.

During the meeting a most interesting set of photographs was exhibited by Prof. Webster, showing a likeness of Thomas Say, his birthplace, the house where he lived during the greater part of the time he was writing his works, his tomb and an autograph. Prof. Webster had a few sets of the photographs struck off when his own were printed and is willing to let entomologists have them at the actual cost of production.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

The second annual meeting of the Association was held at Champaign, Illinois, in room 6 of the University of Illinois, beginning November 11th. The following officers and members were present during the meeting:

President, C. V. Riley, Washington; 1st Vice-president, S. A. Forbes, Illinois; 2nd Vice-president, A. J. Cook, Michigan; Secretary, John B. Smith, New Jersey. J. M. Aldrich, S. Dakota; W. B. Alwood, Virginia; G. F. Atkinson, Alabama; M. H. Beckwith, Delaware; James Fletcher, Ottawa, Canada; Lawrence Bruner, Nebraska; H. Garman, Kentucky; C. P. Gillette, Iowa; F. W. Goding, Illinois; C. A. Hart, Illinois; F. L. Harvey, Maine; L. O. Howard, Washington; John Marten, Illinois; Herbert Osborn, Iowa; F. H. Snow, Kansas; H. E. Summers, Tennessee; Roland Thaxter, Connecticut; F. M. Webster, Indiana; Clarence M. Weed, Ohio; C. W. Woodworth, Arkansas; E. F. Goff, Wisconsin.

Several others interested in entomology, not members of the Association, also attended the meeting, giving an average attendance of about 20 at every meeting.

The secretary read his report and submitted some letters for action by the Association.

On the motion of Prof. Cook it was decided that an assessment of 25c. should be made from each member attending the meeting to defray the necessary expenses.

The committee on co-operation (Profs. Riley, Cook, Forbes, Comstock and Lintner) reported progress and was continued.

The requisites of membership were discussed and Drs. A. S. Packard, D. S. Kellicott and Messrs. J. M. Aldrich, E. V. Wilcox, C. A. Hart and A D. Hopkins were placed on the list of active members. Mr. E. W. Doran was elected an associate member,

The constitution was amended by striking out the provision allowing special meetings to be called at the request of members.

SECOND DAY'S SESSION.

On November 12th 29 members were present, including some ladies, and the Hon. Edwin Willits assistant secretary of agriculture for the United States. The president, Prof. Riley, delivered his annual address on "The Outlook in Applied Entomology." This address was a masterly effort and was intently listened to by all who had the good fortune to hear it. It will be published in full in the pages of Insect Life.

Mr. James Fletcher, of Ottawa, spoke in high terms of the paper. He said: "You have drawn our attention to the fact, Mr. President, that this is the most remarkable meeting of economic entomologists which has ever met together, and I feel sure, sir, that everyone present will agree with me that your address is one of the most remarkable we have ever had the privilege of listening to. You have covered so much ground and spoken upon so many subjects on which we know you to be the highest authority, not only from the exceptional advantages you possess from your official position, but also from the experience you have gained from earnest and close attention for a quarter of a century to this special subject which we have gathered together to-day to discuss, that if we heard nothing else we should be well repaid for the trouble of attending this meeting. This great knowledge makes you *facile princeps* the most eminent living economic entomologist—a title to which, on account of the work you have done in developing the science of practical entomology, no one will dispute your claim. The present meeting

being a joint one of the Association of Economic Entomologists and of the Entomological Committee of the U. S. Experiment Stations leads me to make these remarks, because probably the question which is most engaging the attention of many of us at the present time is whether any good purpose will be served by maintaining both of these organizations. We know that the Committee of the Experiment Stations must meet if the directors of stations order it; but I feel confident that the necessarily limited number of entomologists in that committee, even if every station eventually employs such an officer, cannot do such good work for the science and give them equal opportunities, to those offered by an organization of the nature of the Association of Economic Entomologists, which will include many eminent men who are excluded from active membership by the rules of the committee. I refer to such men as Prof. Riley and his assistants, Dr. Packard, Mr. French, Dr. Lintner, and hosts of other economic entomologists in the United States as well as the Canadian entomologists and many others who would be pleased to join in various parts of the world. I submit to the meeting that there is room for good work from both of these organizations and that it would be extremely ill-advised to let either of them drop to the ground for each should be of the greatest assistance to the other. I believe, too, that to no one can the Association be of more use than to the Experiment Station Entomologists, and therefore they should make every effort to sustain an association at the meetings of which they must always have greater freedom than they can have in the committee, where the proceedings will always be subject to a certain degree of restraint, both as to the time allowed for discussion and the subjects brought forward. The Entomological Committee is specially a meeting of the Entomologists of the Experiment Stations and any one else will always, to a certain extent, feel himself an outsider no matter how cordially the hand of friendship may be extended to him. The president has stated that he does not care where the work is done so that it is carried on vigorously. This is probably the case, and the gentlemen I have mentioned have very little to learn from the meeting compared with the advantages which will accrue to us from having such men present at the meetings. I cannot help thinking that we shall make a serious mistake if we allow an organization to drop which will ensure us their sympathy, attendance and services and will at the same time form a bond of union between the economic entomologists of the whole world.

The address was also highly complimented by Prof. Cook, who spoke of the advantage of co-operation between the Association and the Committee of the Experiment Stations. He suggested some ways in which these two organizations could be mutually beneficial.

Prof. John B. Smith thought there was no necessity to have two bodies composed of nearly the same members meeting on the same days and at the same place and covering the same ground. He strongly advocated an effort being made to gain from the Association of Agricultural Colleges the same advantages for the entomological committee as were at preseut offered by the Association of economic entomologists. This, he thought, would be of advantage to station workers, at least, as it wonld give them a recognized place in the official body of Agricultural Colleges and Experiment Stations.

Dr. C. M. Weed thought that there was some misunderstanding as to the status of some of the gentlemen who had been mentioned. The Canadian Experiment Station was represented in the main body and its officers have the same rights and standing in committees as have those of the other stations. The Department of Agriculture is equally represented both in the main body and in the committees.

In reply to Prof. Smith, Mr. Fletcher said that there was no intention of always having the meetings of the Association of Economic Entomologists at the same time and place as the Committee of the Association of Agricultural Experiment Stations. The place of meeting would be decided annually. As to covering the same ground, if the Association of Economic Entomologists continued to exist, it would draw into its membership entomologists from all parts of the world while the committee could only contain the entomologists employed at the various experiment stations. In answer to Dr. Weed he was sure that others than experiment station entomologists would always feel themselves to a large extent outsiders.

Prof. A. J. Cook of Michigan, read a paper on "Work of the Entomologists in Experiment Stations," in which he gave his ideas of the manner in which bulletins should be prepared and detailed his own method of reaching the agricultural public.

There was an interesting discussion on these subjects participated in by Messrs. Woodworth, Harvey, Weed, Smith and Aldrich. Dr. Weed spoke of the plan of furnishing articles to the manufacturers of the plates known as "patent insides," which get a large circulation in rural papers.

Prof. Smith thought the best way to reach farmers was attending and delivering addresses at farmers' institute meetings.

There was considerable discussion as to the advisability of using old and well known information in bulletins. It was, however, generally conceded that this was necessary so as to make the bulletins of the greatest use to agriculturists. Frequently well known insects appear in destructive numbers and it is necessary to give their complete life history.

Prof. J. B. Smith spoke on "Fertilizers as Insecticides," giving his experience with Kainit, and muriate of potash. He spoke highly of their use against cutworms and species of aphides which worked beneath the surface of the ground.

Prof. Riley gave some of his experience with ashes and other materials containing potash. Mr. L. O. Howard read a valuable and extremely interesting paper on "The Habits of Pachyneuron," which demonstrated the good work which is being done by the entomologists of the Division of Entomology at Washington, The question of breeding these and other hymenopterous parasites was discussed by Messrs. Howard and Harvey. In answer to questions from Messrs. Harvey, Fletcher, Cook and Summers, Mr. Howard gave instructions as to the best method of rearing, mailing and mounting specimens.

Mr. Smith read some notes on the Plum Curculio in which he gave the results of some observations upon eggs laid in apples. He found that the larvæ came to maturity only in such fruit as fell from the tree. He was therefore of the opinion that it was necessary for it to be in a state of partial decay. He had found the characteristic injury and larvæ of the curculio in the young fruit of *Amelanchier Canadensis*. He pointed out the importance of collecting and destroying all fallen fruit.

This subject was spoken on by Messrs. Beckwith, Harvey, Gillette, Woodworth, Cook and Fletcher. Prof. Smith gave also "an experience with the Rosebug," giving an account of serious injury by this insect in Southern New Jersey during the past season. All remedies tried had proved of no avail on account of the enormous numbers of the beetles. He had used pyrethrum, copper fungicides, kerosene emulsion, tobacco, whitewash. The greatest measure of success had followed the use of a "slodge soap." He believed the only remedy for grapes was to bag the bunches.

Messrs. Howard and Alwood made remarks on this subject and the meeting adjourned.

THIRD DAY'S SESSION.

On November 13, there was a morning meeting of the association; 21 persons present. The president announced that the first business of the meeting would be the election of officers for the ensuing year. The following were elected: President, Mr. James Fletcher, Dominion Entomologist of Canada; 1st Vice-president, Prof. F. H. Snow, Kansas; 2nd Vice-president, Prof. Herbert Osborn, Iowa; Secretary, Mr. L. O. Howard, Washington, D.C.

The advisability of all members of the association sending their bulletins to other members was brought up and there was a unanimous expression that this should be done. This will not only be a means of apprising each of what others are doing, but will act as a bond of union amongst the members of the association.

It was decided after some discussion to hold the next meeting of the association at Washington, D.C., beginning just before the meeting of the American Association for the Advancement of Science.

The constitution was amended by striking out the word "official" in the title, and an amendment was submitted abolishing the distinction between official and non-official members as to rights and privileges.

Prof. Smith read a paper entitled "Some questions relating to Aphides." Great stress was laid upon the value of the poriferous system of the antennæ of the winged forms in distinguishing species. Only by these characters could the adults of *Aphis mali* and *A. maidis* be separated. The poriferous system of a wingless viviparous female of any species was always like that of the larval form —from this Prof. Smith considered that the process known as "gemmation" was a case of true reproduction by larvæ.

The matter was discussed by Messrs. Webster, Howard and Osborn who agreed with this pretty generally accepted theory.

Prof. C. P. Gillette read a paper—"Notes on the Plum Curculio and Plum Gouger," in which he detailed his observations relative to the egg-laying habits of the two insects. Mr. Lawrence Bruner spoke on "beet-root insects." The increased area under sugar-beet in the State of Nebraska had rendered a study of the insects attacking this crop a necessity He gave a list of all the species he had found attacking the plant.

Mr. Fletcher asked if any practical remedy had been devised for the Anthomyian fly which mined in the leaves of beets and mangolds.

None of those present had had any experience with the insect in injurious numbers.

Mr. Howard asked whether the European pest of the beet-root (*Silpha Opaca*) had be enobserved by Mr. Bruner or any one else as occurring in America.

Mr. Bruner had not noticed it.

Mr. Fletcher expressed interest in the life-history of the Collops beetles and asked if anything was known concerning them. He had only taken them when sweeping grasses. Prof. Smith had taken them on Solidago.

Mr. Smith related his observations on "an invasion by the Clover-leaf Beetle." This had appeared in great numbers in New Jersey during the summer but was entirely exterminated by a fungous disease.

Mr. Howard mentioned a similar attack in Pennsylvania where the insect had developed a fondness for timothy (*Phleum pratense.*) Specimens were sent to Washington and caged over this grass, upon which they were observed to feed.

Mr. Woodworth mentioned that he had observed in Arkansas three epidemics amongst insects which were so severe as apparently to exterminate the infested species: one of these was the tomato worm.

Mr. Fletcher asked whether *Phytonomus nigrirostris* (Fab) had been observed as injurious to clover. He had frequently found the larvæ feeding on the heads of clover as well as the characteristic cocoons. He had found it in many parts of Canada, but upon one occasion, as recorded in his report for 1884, it was injuriously abundant at Dalhousie in New Brunswick. Mr. Gillette also spoke on insects injurious to clover.

Prof. Smith gave an account of some experiments with preservative fluids. He had found a mixture of equal parts of acetic acid and alcohol very satisfactory both in regard to preserving form and colour of delicate insects.

The subject was earnestly discussed by all present as being a subject of much importance. Mr. Woodworth gave as a method which he had found satisfactory for larvæ, to kill in water heated to 90° centigrade: leave from 1 to 5 minutes; then put in alcohol 35° 1 to 2 hours, 50° from 6 to 8 hours, 75° for 24 hours or more and then to absolute alcohol. This would usually preserve perfectly and was a recognized process for hardening and preserving for histological purposes.

Mr. Fletcher asked whether in the case of large larvæ it was necessary to puncture the epidermis so as to allow the preservative fluid to penetrate.

Mr. Woodworth answered that this was not often necessary.

Mr. Fletcher spoke of a large series of the larvæ of *Sphinx chersis* which he had taken during the past summer upon various species of *Fraxinus*. They varied so remarkably in colour that he was able to separate about 40 which showed different markings from the usual glaucous green to a rich vinous purple with yellow epidermal dots. He had placed them iu a jar of 35° alcohol and had found that those at the top were very much discoloured and that those lower down were less so, those at the bottom being of good colour. On placing some in stronger alcohol the discoloration was intensified. He thought the discoloration was due to the gradual decay of the central portions of large larvæ, but could not understand why those at the bottom were less discoloured than those at the top of the jar.

Prof. Forbes stated that he used the method described by Mr. Woodworth in his laboratory and found it fairly successful. It does not preserve greens well, but browns are preserved and the markings are well shown.

Mr. John Marten said that hot alcohol was a convenient way of preserving specimens by this method and that it answered equally well as killing in hot water.

Prof. Forbes read a "Summary history of the corn plant louse." This was an intensely interesting paper and gave the results of continued observations for some years by Prof. Forbes and his assistants. It gave the life-history both above and below the ground. The relations existing between the aphis and the ants which were always found in company with it were explained and suggestions for remedies based on these observations were made.

The discussion on the paper was postponed until the next session.

At the afternoon session 18 persons were present. The president called for discussioa of Prof. Forbes's paper. Messrs. Howard, Riley, Fletcher and Forbes discussed the points brought forward and the difficulties of getting at accurate and final results were brought out. The question of possible relationship between the apple plant louse and the corn plant louse was discussed by Messrs. Riley and Forbes.

Mr. Howard asked whether Prof. Forbes considered his experiments with the apple plant louse were satisfactory.

Prof. Forbes thought not entirely but they were the best they could do under the circumstances.

Mr. Fletcher asked whether the habits of different broods in species which migrated from one plant to another were not very different and therefore difficult to experiment with—as, for instance would the hop inhabiting form of *Phorodon humuli* live upon plum if placed there artificially and *vice versa*.

Prof. Riley thought it would not. It is very difficult to do artificially what nature does in her own time and in her own way. Sometimes an insect will not colonize upon a plant at a certain season, to which at another time of the year it migrates naturally. He asked if the experiments made upon the root forms were done carefully as there are many species which resemble each other which have root forms.

Prof. Forbes stated that great care had been taken in carrying out the experiments.

Prof. Forbes read a paper "On the life-history of White-grubs, with descriptions of new stages." Current mistakes with regard to the life-histories of these injurious insects were pointed out. Several species of Lachnosterna were observed to reach the imago state in the autumn instead of in spring as usually stated and the differences between groups of larvæ were pointed out.

The paper was discussed by Messrs. Smith, Howard, Forbes and Riley, who confirmed many of the points made in the paper.

Mr. C. A. Hart read a carefully prepared paper on "The life-history of Wire-worms," in which he drew particular attention to distinguishing characters by which these larvæ might be divided into groups.

The paper was discussed by Messrs. Cook, Gillette and Bruner.

Prof. Cook had found that one crop of buckwheat will not prevent injury the next year.

Mr. Fletcher gave some "Notes upon Injurious Insects of the year in Canada." Cut-worms of various kinds had been locally abundant. *Agrotis turris* had been destructive in gardens to flowers and vegetables. *Hadena arctica* and *H. devastatrix* had injured fall wheat and grasses in the spring. He was more than ever in favour of the poisoned trap remedy for cut-worms. *Agrotis fennica* had injured clover. The caterpillar of *Pieris rapæ* had been very troublesome, but was easily destroyed with pyrethrum powder diluted with four times its quantity of common flour or slaked lime.

Plutella cruciferarum had also done much harm to cabbages in the North-west Territories and British Columbia. This is much more difficult to destroy with pyrethrum than the last named. The Cabbage Root-maggot had attacked cabbages severely, but had been successfully destroyed by syringing about half a cupful of hellebore tea round each root and then hoeing the soil well up round the stem. He had made some interesting studies of the Hessian fly which agreed in the main with those published by Prof. Forbes in a late bulletin. Spring wheat sown in the end of April had been attacked at the root in the same way as wheat is injured by the autumn brood. From the same wheat plants he had bred the Hessian fly, the Wheat Bulb-worm and *Oscinis variabilis*. Insects injurious to fruit trees had been represented by the Plum Curculio, the Codling Moth, the leaf roller of the apple and the Canker worm. All of these had been successfully treated with Paris green. Observa-

tions on forest insects had shown him that the large cerambycid larvæ from eggs laid early in the season produced the perfect insects the next year; but those laid late passed two years before coming to maturity. He had taken a female of *Monohammus confusor* with the abdomen filled with eggs as late as the middle of September. The attacks of *Nematus erichsonii* on larches in the Provinces of Quebec and New Brunswick were described.

Prof. Webster asked whether *Agrotis fennica* had been observed feeding on cereals.

Mr. Fletcher had found that it fed primarily on clover, but when occurring in numbers is almost omnivorous. Asparagus beds, raspberries and strawberries were injured and some young forest trees grown in nursery rows and of various species had had the terminal buds destroyed.

Prof. Cook had found the larvæ to eat everything. It had attacked blue grass and timothy severely. He was not positive about its attacking grain but believed it would.

Prof. Smith, speaking of the best way to use pyrethrum powder, said that he had found it most satisfactory in water.

Mr. Beckwith had found it could be used most satisfactorily with lime.

Mr. Fletcher asked whether the dry powder was not as a rule better than the water mixture. He had found it so in his experience.

Prof. Cook and Prof. Gillette had found it so also.

Prof. Summers found that the difficulty with water mixtures was to make them adhere to the plant: he asked whether the addition of soap would make them stick better.

Mr. Fletcher said it would on such plants as threw off liquids by reason of a waxy secretion on the leaves, as the cabbage, etc., etc.

Prof. Cook asked whether Mr. Fletcher still made up his cut-worm traps in bundles. He had found it most satisfactory to put a supply of poisoned vegetation on a platform waggon and then pitch it off with a fork.

Mr. Fletcher answered that he did and not only that but he found that it paid for the extra trouble to cover the bundles with shingles which kept them from drying up so soon. He warned those who advised this remedy to mention that the cut-worms do not lie under them in sight, but burrow beneath the soil and are not seen unless looked for. They sometimes wander off to a distance of two or three feet.

Prof. Cook confirmed this. He used clover largely. He sometimes sprayed a patch with poison as it stood and then mowed it and used it as traps.

Mr. Fletcher had found that clover was not the most satisfactory plant for him at Ottawa. It is frequently not far enough advanced in the early spring when needed and did not hold the poison well. He always recommended any succulent plant and was careful to tell farmers that they could use almost any weed growing about their fence corners, He had found *Lepidium Virginicum*, pepper grass, a very attractive plant. *Chenopodium album*, lamb's quarters, is also greedily eaten by cut-worms; but it is difficult to make the poison adhere to it. For such plants it is necessary either to dust them with dry powder after damping them or to rub up some soap in the water.

Prof. Cook had found mullein to be a most attractive plant for cut-worms.

The meeting adjourned to meet again next year at Washington.

KITCHEN-GARDEN PESTS AND HOW TO DEAL WITH THEM.

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

In writing on insect pests I have not hoped to tell of any new discoveries. My object has been to present in a concise form, for the use of husbandmen and housewives, such particulars as I have thought might be interesting and useful to them. I have wished to do my part towards the making of the annual reports of the Entomological Society of Ontario handy repertories of practical information.

I shall in this paper tell of kitchen-garden pests, grouping them as flies, lice, beetles, butterflies and moths.

FLIES (*Order*, Diptera).

THE RADISH FLY (*~~Anthomyia raphani.~~* ~~Harris~~).—This fly appears in the end of June and the beginning of July. It is rather less than half an inch in expanse of wings. Its colour is ash grey. The wings are transparent with a yellowish tinge at the base. The halteres or balancers are yellow. The face is silvery. The eyes are copper-coloured. The insect lays its eggs on the stems of the radish near the ground. The newly-hatched maggots penetrate the swelling roots, enlarging their mines as they grow and filling them with *frass*, rendering the radishes quite unfit for food. When full grown the maggots leave the root and change to pupæ in the soil. The full grown maggot is about a quarter of an inch long, truncated at the end and gradually tapering to a point at the head. This is furnished with a pair of black nippers. At the truncated end of the creature may be seen the outer prolongations of the two main tracheæ, and round the edge of it a number of teeth or tentaculæ. The general colour of the maggot is shining white.

I have found that radishes sown on rich soil as soon as the frost is out of the ground—at Quebec, as soon as the snow disappears, that is to say in the beginning of May—will generally attain a growth of an inch and a quarter in diameter before they begin to show the operations of the maggot. I have this year made three sowings. The first, in May, was a success. Of the second, made early in June, about half of the radishes were fit for the table. Of the third, made in the end of the month, hardly any were eatable. They grew to a large size, but were bored through and through by the maggots. These were operating as late as October. On the 21st of November I had a number of roots dug up from under the snow. They contained no maggots, but showed recent traces of them and holes at the lower side where the creatures had made their exit into the soil.

The remedies that have been suggested against the radish fly have been such as by their foul smell are likely to drive the fly away, carbolic acid, gas-lime, etc. I have not much faith in such protectives. It seems to me that those who would raise late radishes must do so in frames covered, not with glass, but with fine netting fastened to slats.

THE ONION FLY (*~~Phorbia ceparum,~~* ~~Meigen~~).—This fly (Fig. 11) also appears in June. It is ash-coloured and is set sparsely with black

hairs. It has an interrupted dorsal stripe on the abdomen. The wings are clear. It measures half an inch in expanse of wings, and a quarter of an inch in length of body. The mother fly lays her white oval eggs on the edge of the sheath of the onion, near the ground, seldom depositing more than six on one plant. The eggs hatch in a few days, and the maggots, which in general appearance resemble those of the radish fly, work their way downward, inside the sheath, to the bulb. Having devoured one bulb they will pass on to another. They may often be found clustered on the outside of the bulb. It takes them a fortnight to attain their growth, and in another fortnight the perfect flies appear. While the onions are yet very young soot and wood-ashes should be scattered over the bed as a preventive, and where the maggots are really working hot water should be applied to the bulbs with a watering can. This will destroy the maggots without injuring the plants.

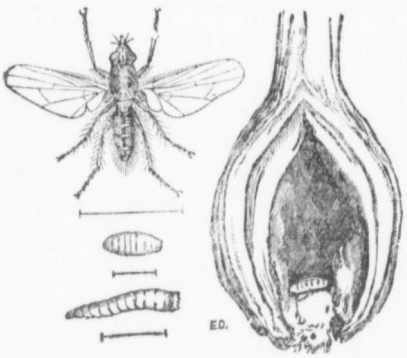

FIG. 11.

For a more full account of this pest see Dr. Bethune's excellent article on "*Remedies for Noxious Insects*," in the Society's 19th annual report.

THE CABBAGE FLY (*Anthomyia brassicæ*, Bouché).—The cabbage fly is ash-grey. The male has three black longitudinal lines on the thorax, a black dorsal line on the abdomen, and black bands at the edges of the segments. In the female the lines on the thorax and the bands on the abdomen are wanting.

The female fly lays her eggs at the junction of the lowest leaves with the stem. The larvæ eat the rootlets and penetrate the main root and the stock. The plant speedily withers away. In wet seasons especially the insects are often very destructive.

It has been recommended as a preventive that, at the time of planting, the roots and stems of the cabbage plants should be dipped in weak lye of ashes. As a remedy Dr. Lintner tells us (1st Annual Report of Injurious and other Insects of the State of New York. p. 190), "Watering the plants with lime-water has been found to be of service in killing the larvæ."

THE ROOT FLY (*Anthomyia radicum*, Linn).—The male of the root fly has the thorax on the upper side, marked with three black longitudinal stripes and three grey ones. The abdomen has a black dorsal line and is crossed with black lines at the sutures. The female is lighter in colour and much resembles *A. brassicæ*, but it has three fuscous longitudinal lines on the thorax. She lays her eggs in the crown of the turnip or other root. These hatching, the ochre-coloured maggots work down into the bulb. When full grown they leave the bulb and pupate in the earth. The flies appear in the spring.

The use of superphosphate as a manure will preserve the turnips from the attacks of the fly.

THE BEET-LEAF MINER (*Chortophila betarum*, Lintner).—This is a small fly, expanding four-tenths of an inch only. The body colour is grey. The thorax has three dusky stripes. The wings have a brownish tinge; and the legs are black. It appears in June, and lays its beautifully reticulated eggs on the under

surface of the leaves. The larvæ work in the leaf, between the upper skin and the lower, consuming the parenchyma. They are, when full grown, a quarter of an inch long, translucent in appearance, pointed at the head, which is furnished with black nippers, and truncated at the other extremity. To pupate they leave the plant and enter the soil. The pupa-case (puparium) is chestnut brown. From it the fly escapes in about twenty days. (See Dr. Lintner's 1st Annual Report on the Insects of New York State.)

The method of dealing with this insect is plainly to break off the affected leaves and to crush them under foot, or throw them into boiling water.

LICE (*Order*, Hemiptera).

THE BEAN LOUSE (*Aphis fabæ ?*).—A few years ago I found on some Mazagan beans that I was growing in my garden at Cowansville, a cluster of plant lice. They were lead-coloured and rather large. I had read of the marvellous increase of the Aphis, and I resolved to let these specimens on my beans live out their life and have their own way. The consequence was, that in a few weeks the whole row of beans—and it was a long one—was blackened with Aphides. This was quite in accordance with Reaumur's statement that one aphis can produce about 90 young ones, and that in five generations the increase from the one will amount to 594,900,000. As the season went on great numbers of the larvæ of one or two species of Lady-birds (Coccinellidæ) appeared on the scene and worked great havoc amongst the hosts of the enemy.

In dealing with a pest such as this, watchfulness and promptitude are required. The first clusters of the aphis should be picked off and destroyed.

THE CABBAGE LOUSE (*Aphis brassicæ*, Linnaeus).—This insect is often very abundant. It is found on the under side of cabbage leaves, and has a whitish, mealy appearance.

Dusting lightly with flour of brimstone has been recommended as a remedy for it.

BEETLES (*Order*, Coleoptera).

THE COLORADO POTATO-BEETLE (*Doryphora decem-lineata*, Say).—This, the well-known Potato-Beetle (Fig. 12) needs no description. Under its normal con-

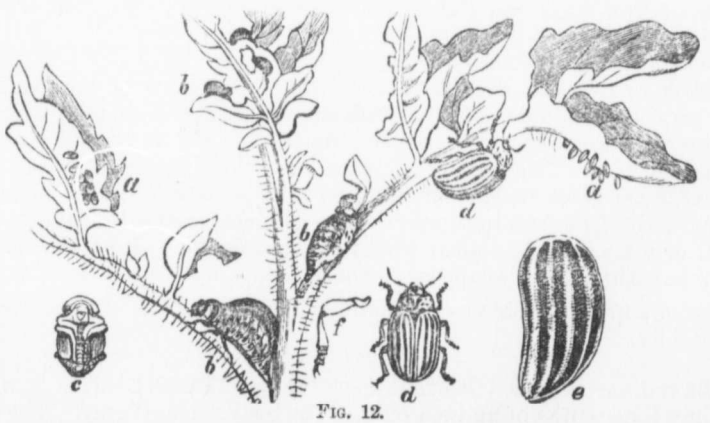

FIG. 12.

ditions, on the slopes of the Rocky Mountains, it fed upon the wild potato, *Solænum rostratum*. Access to the cultivated plant gave it that increase of vitality and fecundity which has rendered it so formidable a foe to the gardener.

Of the Solanaceæ, or Nightshade family, to which the potato belongs, there are in North America six genera, not counting the South American genus, Petunia, now so largely cultivated in flower gardens. They are (1) *Solanum*, Nightshade; (2) *Physalis*, Ground Cherry; (3) *Nicandra*, Apple of Peru; (4) *Hyoscyamus*, Henbane; (5) *Datura*, Thorn-apple; (6) *Nicotiana*, Tobacco. The first of these includes the potato, the egg plant, and the tomato, all of which are eaten with avidity by the beetle. When stinted of its favourite supplies, the insect turns to such other members of the family as may grow within its reach. The tobacco plant is attacked by it, and I have found it also upon Physalis and Datura.

It would seem that the forced vitality of the species is now diminishing. There is a narrowing down apparently, 1st, as to the number of broods, 2ndly as to the number of individuals. Professor Claypole, of Akron, Ohio, brought the diminution in the former case, under the notice of the American Association for the Advancement of Science, at the Minneapolis meeting. He said:—"This insect (the potato beetle) came as usual in middle Pennsylvania in the early summer. I was compelled to use poison as in previous years. In the latter portion of the summer I observed, and noted at the time in the *Canadian Entomologist*, that there was no second brood, or that it was so small as to pass unnoticed. It was my intention to watch in 1883 in order to determine if this second brood was again missing; but to my surprise, in 1883 there was almost no first brood."

In the neighbourhood of Quebec, late plowlng, by disturbing their hibernacula, has destroyed great numbers of the beetles, and the lingering winter has retarded the appearance of the survivors, so that the first brood of the year has been both late and comparatively weak in numbers. For the last two seasons I have not had occasion to use Paris green on the early potatoes grown in my garden, but later-planted field crops have called for an application of the drug. The decrease in the number of perfect beetles appearing in the fall has been very marked.

THE THREE-LINED POTATO-BEETLE (*Lema trilineata*, Olivier).—This is a buff-coloured beetle, (Fig. 13) having three black stripes on the wing covers. Its length is a quarter of an inch. It appears in June, and attacks the potato plants. It lays its yellow eggs in small clusters, and in a fortnight the larvæ appear (Fig 14). They are of a dirty yellowish grey, and are generally seen with a thick coating of excrementa on their backs. This filthy covering is believed to serve for a defence against their insect enemies, and as a protection also from the heat of the sun. In about another fortnight the insects bury themselves in the ground and form cysts in which to undergo their pupal change. In a fortnight more the perfect beetles appear and lay their eggs for a second brood.

FIG 13.

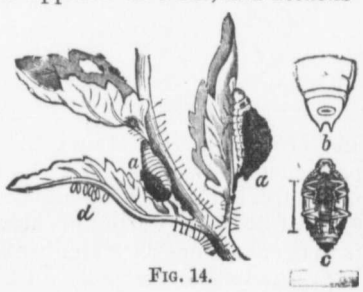

FIG. 14.

Paris green applied in the usual way is the remedy for these pests.

THE CUCUMBER BEETLE (*Diabrotica vittata*, Fab.).—The cucumber beetle is about two lines in length. It is yellow, and has a black head, and three black lines running along the wing-covers. The larvæ feed on the roots, and the perfect insects on the tender leaves of the cucumber, melon and squash.

To destroy the larvæ water the plants with soapsuds, and to check the operations of the beetle sprinkle the leaves with hardwood ashes.

THE STRIPED FLEA-BEETLE (*Haltica striolata*, Illiger).—This minute beetle (Fig. 15) is black, with a buff stripe on each wing cover. It is beautifully formed, highly polished and very lively. It hibernates in the imago state, and comes forth early in spring to lay its eggs, and to enjoy itself at the gardener's expense. Its favourite food plant is the turnip.

FIG 15.

Lime water has been used successfully against its English congener. To disappoint the "flea" *sow late.*

THE ASH-COLOURED BLISTER-BEETLE (*Macrobasis unicolor*, Kirby).—In the Eastern Townships the Windsor beans and potato vines are often infested with an ash-grey beetle of about three-fifths of an inch in length. The ash colour is owing to a soft down which rubs off leaving the surface black. This beetle is one of the Cantharides, and is as efficacious for medical purposes as the "Spanish Fly." It may be easily shaken into a pan of scalding water, and afterwards dried for medical use.

BUTTERFLIES AND MOTHS (*Order*, Lepidoptera).

THE CABBAGE BUTTERFLY (*Pieris rapæ*, Linnaeus).—That destructive pest the cabbage butterfly (Fig. 16 the male, fig. 17 the female) was first taken in Canada by Mr. Wm. Couper of Quebec. This was in 1860. The insect had probably been cast upon the shores of the St. Lawrence in the larval or pupal stage, with refuse cabbages from the steamships. We are indebted to Mr. Scudder for a full and most interesting account of the after progress of the species on this continent. From this account it appears that in 1866 it had spread to Cacouna, where it was taken by Mr. Saunders, to the Eastern Townships, where I captured it myself,

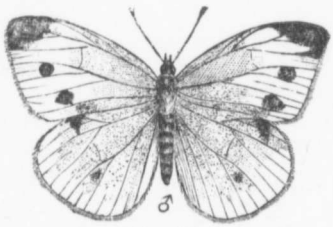

FIG. 16.

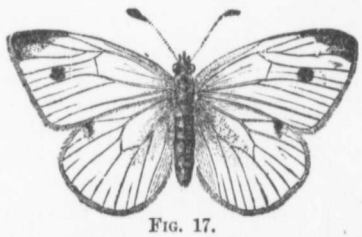

FIG. 17.

and into the State of Maine. In 1867 it reached Montreal. In 1868 a fresh importation by way of New York was made. The story runs that a German naturalist in that city obtained chrysalides from Europe, and that the imagos issued from these during his absence, and escaped through an open window. The insects spread in ever widening curves, both from New York and Quebec, till, in 1871, the two hordes met. In 1876 they had spread over the whole of Western Ontario. In 1881 they covered the country from the seaboard to Texas, Kansas, Nebraska, and Lake Superior; and by 1884 they had been met with on the shores of Hudson's Bay and at the foot of the Rocky Mountains.

Pieris rapæ may be readily distinguished from the less common native white (*Pieris oleracea*, Harris) by the black spots upon its wings. The female may be constantly seen in the summer months hovering over the cabbages, curving its abdomen and attaching its eggs dispersedly upon the plants. The larvæ are green irrorated with black. They have the habit of lying along the ribs of the leaves where they are not readily seen.

Dr. Lintner recommends sprinkling with water heated to 130 Fahr. and upwards (1st An. Rep. p. 59).

THE CABBAGE PLUSIA (*Plusia brassicæ*, Riley).—This insect has at length invaded the Province of Quebec. It has been taken at Metis by Mr. Winn. Its numbers will probably increase. The fore wings of the moth are brownish grey, and have yellowish, indistinct, transverse lines. In the centre of each fore wing is a silvery, horse-shoe-like mark, with a silvery spot beyond it at the lower side. The hind wings are yellowish, with smoky hind margins. The male moth is furnished with conspicuous abdominal side tufts of a golden hue.

The larva is a half-looper, having only twelve legs. Its head is small and flat, and the body is gradually enlarged from it to the anal segment, which appears as if abruptly sliced off. In colour the caterpillar is translucent pale green, marked with delicate longitudinal white lines, and with white spots. In each of the latter is set a short dark hair.

The pupa is of a pale colour, yellowish or green, and is enclosed in a slight cocoon.

Besides the cabbage, the turnip, lettuce, celery and tomato afford food for this pest.

An application of hot water as recommended in the previous case, is probably the best remedy for the assaults of the insect.

THE CUT-WORM MOTHS.—These are a numerous family, including species belonging to the genera, *Agrotis*, *Mamestra*, *Hadena*, etc. They may be grouped as *climbing* and *surface* cut-worms. It is with the latter I am for my present purpose, more particularly concerned. I shall give a short account of a few representative species of these, and for further particulars would refer the reader to a valuable paper written by the late Mr. G. J. Bowles, which may be found in the Society's Annual Report for 1879.

THE DEVASTATING DART-MOTH (*Hadena devastatrix*, Brace)—This moth is one and three-fourths inches in expanse of wings. The fore wings are dark brownish gray, and have several whitish transverse lines. Near the hind margin is a row of arrow-headed black spots pointing towards the base of the wing. The hind wings are light brownish grey. The thorax is dark grey like the fore wings and the abdomen is of the same colour as the hind wings.

The caterpillar, (Fig. 18) known as the "Glassy Cut-Worm," has a translucent glassy-green body, a Venetian-red head, and a dark-brown cervical shield. It has a few scattered spots on each segment—each spot being furnished with a single hair. The caterpillar hibernates in the soil, and, coming out early in the spring, commences its destructive work upon the newly-planted cabbages. It feeds only at night, and lies hid in the soil, near the root of the plant, during the day.

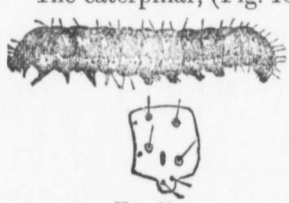

FIG. 18.

THE BARRED-ARCHES MOTH (*Hadena amica*, Harris).—This beautiful moth expands about two inches. The ground colour of its fore wings is rich Spanish brown. Near the hind margin is a broad, wavy, bluish-grey band, and near the base of the wing is a narrower and darker wavy band. The reniform stigma (kidney-shaped spot in the middle of the wing) is large and distinct. The hind wings are ash-coloured, clouded on the outer margin.

The caterpillar which is called the "Yellow-headed Cut-worm," is of a smoky-brown colour, and the head, cervical shield, and anal plate are yellow, or chestnut-coloured. This creature cuts off the young corn *below* the surface of the ground.

THE LANCE RUSTIC MOTH (*Agrotis telifera*, Harris). (*Ypsilon*, Rott).—Harris was the first to describe this fine insect, which measures an inch and a half in expanse of wings. (Fig. 19.) The fore wings are brown, dark along the costa and through the middle. Near the hind margin is a light-brown band, and at the base of the wing is a light-brown patch, shaped like the head of a fish with the mouth open. Pointing outwardly from the reniform stigma is a black lance-shaped mark. The hind wings of the moth are pearly white shaded with brown.

FIG. 19.

The caterpillar known as the "Greasy Cut-worm," is dull leaden brown, spotted with shiny black. Its dorsal and side lines are yellowish. The creature is highly destructive to corn, tobacco, tomatoes, etc., cutting the plants an inch *above* the ground.

THE CLANDESTINE OWLET MOTH (*Agrotis clandestina*, Harris).—In expanse of wings this moth measures an inch and three-quarters. It is a very sober-coloured moth. The fore wings are dark ashen. In them the orbicular and reniform stigmata are connected by a black line. The hind wings are dirty brownish-white, darker towards the hind margin. The fore part of the body is chestnut brown. The moth received its name from its retiring habits and attempts at concealment.

The caterpillar (Fig. 20) is called the "W-marked Cut-worm." It is yellowish grey in colour, lined with yellow, and finely sprinkled with dark spots. On each side of the back, upon the abdominal segments, is a row of black velvety marks. These marks, when viewed from the front, are suggestive of the letter W —hence the common name of the creature.

FIG. 20.

Nothing in the way of vegetables seems to come amiss to this cut-worm; beans, young corn, cabbage, pumpkins, etc., all are eagerly eaten by it. It has the habit of dragging its food under stones or into the ground, that it may feed upon it at leisure.

The methods to be pursued for protecting garden crops from the cut-worms appear to me to be these:—Because the caterpillars pass from plant to plant over the surface of the earth, and will not ascend a friable mound *corn should be "planted in the hill."* Around each newly-planted cabbage a ring of salt should be placed, a few inches from the stem. The larvæ will not pass over this, and the salt will act as a fertilizer. Whenever a plant is found to be nipped off, the cause of the damage should be dug for at the root with a knife or pointed stick, and when found, destroyed. Growing corn, cabbages, cauliflowers, tomatoes, etc., should be earthed up several times during their period of growth.

"The Husbandman's Own Insectide." Take plants of "poison poke," (*Veratrum viride*, Aiton) roots, stems and leaves, cut them into manageable lengths, make a decoction—a sap-kettle will be useful for the purpose—let the liquor cool, and then apply with a sprinkler or water-can. This will be found useful where the application of Paris green would be dangerous.

The gardener has a multitude of insect foes to contend with, but prompt and intelligent applications of preventives and remedies are very sure to be rewarded with success against them.

AN OUTBREAK OF THE ARMY WORM IN MARYLAND.

BY J. ALSTON MOFFAT.

It is seldom that we get an account of a remarkable occurrence in any department of life from a reliable eye-witness so competent to convey to others the facts seen by himself as is to be found in the following extracts taken from the report given by Mr. W. H. Ashmead to the United States Government, through the Entomological Department at Washington.

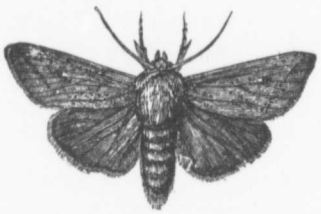

FIG. 21.

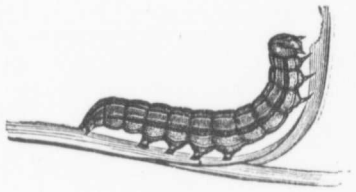

FIG. 22.

Although *Leucania unipuncta* (Fig. 21, the moth; Fig. 22, the caterpillar,) is a permanent resident in Ontario, and is frequently found quite abundant, it has never been reported as attracting special attention from its destructive effects on farm products here; and yet there does not appear to be any reason why it may not at some time do so.

The army worm has caused great loss in the Maritime Provinces, whilst in New York State and Massachusetts, where the climatic conditions must very closely resemble our own, it has been at times particularly destructive, whole fields being utterly ruined by it. Mr. Scudder made a calculation from what he saw, that there must have been at least two million worms to the acre, destroying an entire field in ten or twelve days. Therefore Mr. Ashmead's vivid description of the tremendous power of a combined attack of these despised creatures, should arouse those interested to the terrible possibility that may be awaiting them, and to guard themselves as much as possible against it, for it is a well known fact that slovenly farming is a great source of encouragement to all kinds of pests.

The army worm had a public reputation long before the moth, which gave rise to the destructive hordes, was certainly known to be the parent of all the mischief. It was about the year 1861 that the late Prof. Fitch unmistakably traced the connection between the two, and since then, by the careful industry of others, its life history has been well worked out, but previously many unfortunate moths had to bear the blame for that of which they were not guilty; and even yet the justly dreaded army worm is at times reported to have made its appearance and causes great consternation in a locality, where, if the nature and habits of different insects were better known, it would be readily seen that the army worm, at any rate, was not to blame, and that the fright had been caused, not so much from the attack, as from a want of a knowledge of how to distinguish between things that differ. If this had been possessed there might have been ample evidence to show that there was no cause for alarm, as it was not in the nature of that particular form to do any injury.

On one occasion I had an opportunity of witnessing an occurrence which forcibly illustrates this very condition of things. I had gone on a visit to the country about the end of wheat harvest, when a hot and dry spell was prevailing and all vegetation was, more or less, exhibiting the effects of it, by a rusty tinge

to the green. Amongst the first things that I heard of was that the whole locality was overrun by the army worm, that they had eaten up every green thing and were now devouring the Canada thistles for want of something better, and whatever was to become of the crops next year they did not know. On the first opportunity I made personal observation—sure enough the thistles gave ample evidence that they had been greviously ill-used, many of them with every leaf gone and nothing but the bare stem left, and caterpillars everywhere. In one locality where the road allowance ran between two farms with snake fences on each side, there was, on the one hand, an old pasture field, very brown and desolate to look at, on the other was a summer fallow, which had in places a luxuriant growth of Canada thistles, and I saw the worms crossing the road, in single and double file, in colums and squares, platoons, companies and battalions of them, and a toilsome march they had of it, especially when crossing the road-bed, which was deep with hot dust, leaving the dried up pasture field and all making direct for the fallow, apparently with a full knowledge of the fact that there was food to be got when they reached it; and I observed that the thistles in the fallow were being visibly reduced day by day. But it turned out that this all devouring host which had been causing such consternation in that locality, was composed entirely of the larvæ of *Pyrameis cardui*, or the thistle butterfly; and no doubt but they had rigidly confined themselves all the time to their own natural and proper diet. In due time they disappeared and nothing was heard of them afterwards.

The following is Mr. Ashmead's account of the outbreak of the army worm above referred to:

In accordance with Professor Riley's instructions, on May 31, accompanied by Mr. Albert I. Hayward, of the Maryland Agricultural College, I started for Salisbury, Wicomico County, and Princess Anne, Somerset County, Md., to make such observations on the army worm (*Leucania unipuncta*), then depredating in the vicinity of these places, as the limited time at our disposal should permit.

During our journey we ascertained, in conversation, that the worms were most numerous in the immediate vicinity of Princess Anne, and we took the most direct route for that place.

As we approached our destination we began to see the effects of the worms' work; just before entering the town we passed by a large field of corn, owned by Mr. H. H. Deshields, containing about twelve acres, that had been devastated by them, and only a few green plants could be detected here and there in the field.

This field was in marked contrast with another corn-field adjacent, which had been saved from attacks by ditching, as recommended in the third report of the U. S. Entomological Commission. Another thing observed was that this field was flanked behind with a wood that evidently prevented their ingress that way, whereas the former was contiguous to grass and wheat fields, in which the worms are said to originate.

Just before entering the town we passed another ten-acre corn-field, owned by Mr. John L. Lormer, that but a short time previously presented a most promising appearance, but which to-day is completely "cleaned out" by the worms. It may be worthy of record, as the theory has been advanced that insects originate in just such places, that in an adjoining field were three old hay-stacks. Contrary to our expectations we found the reports of their numbers not at all exaggerated, and the damage done is even worse than we anticipated—the wheat, corn, barley and timothy of many of the farmers being totally ruined by them.

One of the most interesting places for observation we visited was that of Wm. J. Porter, a practical and energetic farmer, who, although he has fought the worms most vigorously, has suffered severely from their attacks. By means of ditching and by burning straw, he has been able to save part of his crops, but several of his fields of corn, timothy and wheat, were already ruined. He reported the worms much less numerous than they had been, but we saw many thousands in his fields.

During our rambles Mr. Porter took us to one of the ditches he had dug to keep the worms out of a large corn-field. In this ditch he had sunk every two or three yards apart, deeper pits, where we found the worms two and three inches deep, and the rest of the ditch was black with the dead and living worms. From the dead a fearful stench arose in such strength as to attract the buzzards, which, as we viewed the scene, were proudly sailing overhead.

Mr. Porter informed us that the worms always originated in the wheat and old grass-fields, and during the morning hid themselves from observation, never appearing in numbers until after 3 o'clock p.m., which accorded with our own observations and with those of the other farmers visited.

They ate up the timothy and corn clean, and after devouring the blades of the wheat congregated, three or four together, on the heads; after devouring several of the lower grains they ate the husks and nipped off the upper portion of the kernel of the rest, thus almost entirely destroying it. If the grain is well advanced and somewhat hard it escapes destruction; but as most of the wheat visited was still in the milk the destruction was great, and not less than 75 per cent. of the crop had been already destroyed.

Although several parasites are known to prey upon the worms, and we kept a sharp lookout for such, none were seen except a few cocoons of an Apanteles which were discovered, together with the worms, under old trash and logs in a wheat-field. A few were gathered and forwarded to the Department, some of which have since hatched, and proved to be *Apanteles militaris*, Walsh.

On a neighboring farm, owned by Mr. Z. Rouch, almost as much damage had been done by the army worm as on the former place. A large corn-field and a field of timothy were totally ruined. A wheat-field, farther advanced than that of Mr. Porter's, was less seriously affected, although it did not escape entirely, the blades of the wheat and the young timothy being entirely eaten up by them.

It was on this place that we saw the effects of the worms on barley. Quite a large field already in head was completely ruined.

In the afternoon we visited probably the largest farm in the county, that of the Hon. D. N. Dennis, comprising 500 acres or more.

No better place existed for the proper study of the pest, as the worms were swarming in all the fields by the millions, and we had hit upon the proper time of day to see them most advantageously, 4 o'clock p.m. The ground was literally black with the crawling worms. Mr. Dennis had made no special efforts to destroy them, although, like some of his neighbours, he had surrounded some of his fields with ditches in an attempt to keep them out of adjoining fields. I believe it would have been quite practicable to have destroyed many thousands with poisonous washes, or, as Mr. Potter did, by burning straw in the ditches, as the bottom of the ditches were black with worms.

This farm is divided by a central lane, on either side of which are fields of wheat, corn, grass, oats, etc., and in passing through this lane we found the worms quite plentiful, crawling almost invariably in the direction of the prevailing wind.

One of the first fields we passed was an immense wheat-field already in the head, and the worms could be plainly discernible on the ground all through it and on the stalks and heads. The worms having already devoured the young timothy and other tender plants usually found growing there, the blades of the wheat, the husks, and a goodly portion of the kernels, evidently could not find sufficient food and were now migrating to pastures new, the sides of the field being black with moving hosts seeking more nutritious food.

These, as well as all the others observed, were moving in a south-westerly direction, the direction of the prevailing wind. They were apparently in all stages of growth, from little fellows not more than a quarter of an inch long to the fully matured larvæ, and all got over the ground and every obstacle in their way with the most surprising rapidity. The fences, posts, and other obstacles in their way were no obstruction to their migratory instinct, or their search for food. The fence rails and posts were often covered with crawling worms, sometimes not less than a dozen worms being found on the top of a single tall post, while others were seen going up on one side as others were going down the opposite. Some specimens were even found under the loose bark on the posts and rails, where they had probably crept for shelter. One specimen thus found was in the jaws of a large hairy spider, *Salticus* sp.

Adjacent to this wheat-field was a large field of timothy, containing 17 acres, the blades of which had been cut off by the worms as clean as cattle could have done. Mr. Jones, the overseer, informed me this field would have harvested not less than three tons of hay to the acre, but now it would not pay for the cutting.

At one side of this field, the side next the wheat, the worms had congregated in countless numbers, every square foot having not less than 30 to 50 worms. The worms were now coming out of this field and going into the adjoining wheat-field and crossing the lane into the opposite fields in great numbers, and it was here that we observed a flock of the common English sparrows and a few robins picking out the smaller worms and feeding on them. Mr. Jones informed us the English sparrows had been thus busily engaged all the past week, and it gives us pleasure to record here this fact in favor of the despised bird.

Some distance off from this field was another one of wheat, containing probably 20 acres, in which the worms were even more numerous, and they had already sufficiently injured it to render the crop unprofitable to harvest. A deep, broad ditch had been dug along one side, and it was now, about 5 o'clock p.m., black with worms. It seemed to us a pity that these worms were not killed, as many of them were able to crawl up the sides and escape into adjoining fields.

Facing this field was a large corn-field of probably 75 acres, of which 50 acres had already been destroyed, and there was but a slight chance that any of the corn still left would escape, although by ditching an effort was being made to save it. Of the 50 acres destroyed 30 acres had already been replanted, and in the newly plowed portion the worms were seen moving about in all directions, having just entered it from the adjoining wheat; it is probable that most of these will die of starvation or from the effects of the hot sun in the middle of the day.

TORTOISE BEETLES.

BY F. B. CAULFIELD, MONTREAL.

The tortoise beetles as they are called, from their resemblance in shape to a turtle or tortoise, belong to the great family of leaf-eating coleoptera, the *Chrysomelidæ*, but were formerly classed as a distinct family, the *Cassidadæ*, a term signifying a helmet, the fore part of the thorax generally projecting over the head like the front of a helmet. In the members of this family the body is generally of a broad, oval form, flattened beneath, convex above. The antennæ are short and thickened at the tip, presenting somewhat the appearance of a club. The head is small and generally hidden beneath the overlapping edge of the thorax, and the legs are very short, not extending much beyond the margin of the wing covers, so that the resemblance to a tortoise is really striking. The larvæ of many kinds of insects are protected from the burning sunshine and the attacks of their enemies by a coat of hair or prickly spines, or else conceal themselves beneath leaves or in crevices during the hotter parts of the day, but the insects in question adopt an entirely different plan, and shelter themselves beneath umbrellas, covered, not with silk or cotton, but with a mass of their own excrement.

In most of these creatures the body resembles the perfect insect in shape, being broad and flattened, but they differ in having a row of spines on each side and in being provided with a tail, and a very remarkable tail at that. This instrument resembles in form a fork, with a rather thick, rounded handle, from which project two long prongs. This forked tail is curved over the creature's back, and upon the prongs and lateral spines the excrement is heaped until a mass almost as large as the creature's body is accumulated. Our Canadian species of tortoise beetles belong to three genera—*Physonota*, *Coptocycla* and *Chelymorpha*. *Physonota helianthi*, Rand, lives on the wild sunflower (*Helianthus*), and soon after these have leafed out in spring, such of the beetles as have survived the winter gather upon them. They are now of a bright, golden-green colour, and are exceedingly beautiful, gleaming and flashing like gems in the sunshine. Soon after this the eggs are deposited in an irregular cluster, covered with a gummy exudation which hardens on exposure to the air. This cluster is placed on the upper surface of the leaf, and near the tip just where it tapers to a point.

The larvæ are oblong-oval in shape, and when full grown measure nearly an inch in length. The general colour is dark olive green, and on the back are three short yellow stripes, that in the centre being a little the longest. On each side is a row of ten simple spines. When undisturbed these slug-like larvæ keep the tail curved over the back, and both body and tail are constantly wet with semi-fluid excreta, so that the form of the creature can hardly be seen. From the middle of July to the end of August these larvæ change to chrysalids, and by the end of the latter month and during September the beetles emerge, and may be found resting quietly on the leaves of their food plant. They are now dressed in a coat of sober black, irregularly spotted with creamy white, very pretty little fellows in a neat evening dress, but very different to the magnificent marriage garment worn by their parents amidst the fresh green leaves and glowing sunshine of the early summer.

The beetles appear to eat very little, but the larvæ are hungry creatures, eating numerous holes in the leaves, and when abundant almost stripping the plants.

When young the larvæ are of social habits, and huddle closely together, the heads all in the centre, surrounded by a ring of curled up tails, presenting a most curious appearance. When nearly full grown they separate and scatter over the plants, each one shifting for himself. The perfect insect measures about five-eighths of an inch in length.

The species belonging to the genus *Coptocycla* are smaller than *Physonota*, and differ somewhat in some of their habits. The eggs are deposited singly on the leaves, and when the larvæ moult, the cast skins are slipped into the forked part of the tail, whereas the larvæ of *Pysonota* leave their discarded garments sticking to the leaves.

The golden tortoise beetle, *Coptocycla aurichalcea*, (Fab.) is very common on the Morning Glory, and often disfigures and injures it by eating holes in the leaves. They also attack the sweet potato. Prof. Riley states that they are often sufficiently numerous to destroy whole fields of this esculent, and they are especially severe on the plants when freshly transplanted from the hotbed. When freshly emerged from chrysalis the beetles are of a dull orange color, but in a few days this tint changes to bright gold color, when they present a most beautiful appearance as they glisten in the sunshine. The larva resembles the beetle in general shape, being broad and flattened, but on each side there is a row of sixteen barbed spines; it is of a dark brown colour, with a pale shade upon the back. Prof. Riley says that it carries its falcifork directly over its back, and the excrement is arranged in a more or less regular trilobed pattern.

The mottled tortoise beetle, *Coptocycla guttata* (Oliv.), is also common on, and injurious to, the morning glory and sweet potato. It varies considerably in colour, some specimens being very dark—almost black, others are mottled with black and gold, and occasionally examples are found altogether of the latter colour. The larva is green, bluish on the back. Prof. Riley states that it carries its dung in irregular broad masses, often branching out into long shreds and ramifications.

Another species, the clubbed tortoise beetle, *Coptocycla clavata*, Oliv. is found on the true potato. It is given in the Society's list of Canadian beetles, but so far as known to me, has not been found in the Province of Quebec.

The "shell" of this species is thin and semitransparent, with patches of darker color, some of which extend to the margin of the wing-covers. I have seen no description of the larva.

Chelymorpha argus, Licht., is of a dull, yellowish-red colour, ornamented with nineteen small black spots, six on the thorax and thirteen on the wing-covers. It measures about three-quarters of an inch in length. Packard states that "the larva differs from that of *Coptocycla aurichalcea*, not only in its greater size, but the body is thicker and narrower, the head is freer from the thorax, and the spines are simple, not spinulated. The body is yellow and less protected by the cast skin. When about to transform the larva attaches itself to the leaf by a silken thread, a few segments from the end where the end of the body of the future pupa is situated. It is .45 of an inch long. The pupa is broad and flattened, dark and spotted with yellow, and covered with a whitish powder, causing the yellow portions to appear more prominently; along each side of the abdomen is a row of five spines, and there are four spines on the anterior edge of the prothorax; it is .40 of an inch in length." He further states that he has found it in all its stages on the silk-weed late in July and early in August, and in one instance in Salem it occurred in abundance on the leaves of the raspberry.

I have myself found it in all stages on the morning glory at Montreal some years ago, but have not met with it recently.

Tortoise beetles may be destroyed with Paris green, but as they often hide beneath the leaves, they are not so easily killed as the Colorado potato beetle. The plants should be closely watched when set out in spring, as at this time the beetles are comparatively few in number, and could be killed before the eggs are deposited, which would save much future trouble and expense. "An ounce of prevention is worth a pound of cure."

Tortoise beetles appear to be remarkably free from parasites. I have bred numbers of *Physonota helianthi*, but only raised one parasite, a small dipterous fly.

QUEBEC REPRESENTATIVES OF THE GENUS PLUSIA.

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

Following are the characteristics of the genus Plusia :—

Imago, antennæ setaceous, thorax and abdomen crested, fore-wings acute, curved on the hind margin, glossy, and often ornamented with metallic markings.

Larva, loops somewhat in walking, having twelve legs only; attenuated anteriorly; feeds exposed on low plants.

Pupa, inclosed in a slight cocoon.

Insects belonging to the genus Plusia may be readily distinguished by the conspicuous crest which they bear on the shoulders, the tufted abdomen, and the bill-hook shaped curve of the inner margin of the fore-wings. These are more or less striking in them all. Some of the species are very abundant, individuals of them may be seen in our gardens, even in the hot sunshine, hovering over the blossoms or passing from plant to plant with easy rapid motions.

The largest, and I think the most beautiful of our Quebec species is *P. balluca* (Gey.) Fig. 23, which is one and three-fourths inches in expanse of wings. The splendid bronze-green of its wings, shining with the richest gloss of satin, will make it known to the veriest tyro in Entomology.

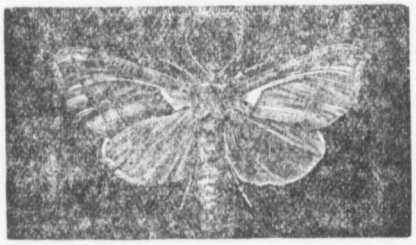

Fig. 23.

P. Putnami (Grote) may also be readily distinguished by its burnt-sienna coloured fore-wings with their golden apical streak, and their two central golden spots, sometimes united.

P. thyatiroides (Guen.) is very rare in the Province of Quebec. To those who are fortunate enough to meet with it, it may at once be known by the patches at the base and inner angles of its fore-wings, which are of a delicate pink, resembling in colour those on the wings of the English "peach blossom moth" (*Thyatira batis*). It is to these that the insect owes its name. The only specimen I have was taken at Cowansville in the Eastern Townships.

P. mortuorum (Guen.) also may be readily known. Its fore-wings are dark brown approaching to black. They are embellished with silvery lines and washes near the hind margin. Extending from the base to the centre of the wing are conspicuous plume-like silvery-white markings. This is one of the smallest species in the genus, expanding about one inch and a quarter.

The fore-wings of *P. ampla* (Walk.) are ash-brown with a rosy tinge. Extending from the inner margin to the middle of the wing is a well-defined dark-brown velvety patch, the inner side of which has a deep curve and is finely outlined with gold colour.

In *P. viridisignata* (Grote) the fore-wings are dark rosy-grey with numerous brown zig-zag lines. In the centre of the wing is an obscure bronzy-green figure, resembling a 3 or an 8 laid on its back.

One of the finest insects in the genus is *P. bimaculata* (Steph.). In expanse of wings it measures an inch and three-eighths. Its fore-wings are rich rosy-brown variegated with dark markings and with a patch of chestnut red in the centre. In this patch are two golden spots, the upper somewhat resembling the letter *v*. I have noticed that the Eastern Township's specimens of this moth are larger and brighter than the more northern specimens.

P. precationis (Guen.) is one of the most common species we have. Its fore-wings are of a rich purple brown with a golden sheen. They have a few pale wavy streaks, and a distinct silvery *y* in the middle of each.

In *P. simplex* (Guen.) Fig. 24 the fore-wing is of a dark ash-grey. It has a brown apical dash, and a brown shade on the inner margin. This shade is separated from the ash-grey base and basal portion of the costa, by a fine white line, which joins the inner arm of the silvery y-like central mark.

Fig. 24.

In *P. falcifera* (Kirby) the arms of the *y* are long and attenuated, and the tail lacks the terminal knob that is characteristic of Precationis and Simplex. Falcifera has rosy-brown fore-wings strikingly marked with curved and dentated rosy-white lines, having dark brown finer lines imposed. I captured several specimens of this insect at Como, P. Que. They were hovering over flowers on a sunny afternoon.

P. brassicæ (Riley, *Ni* Hubn) has been taken at Metis, P. Que., by Mr. Winn. This moth Fig. 25 expands about one and a half inches. It has dark greyish-brown fore-wings, with irregular, pale yellow cross lines, and in the centre a silvery *u* or horse-shoe like mark followed by an oval silvery dot. The underwings are yellowish clouded towards the outer edge.

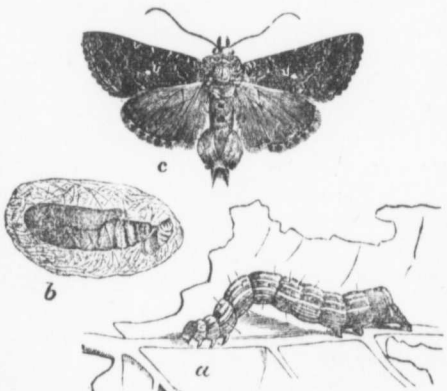

Fig. 25.

Of *P. mappa* (G. & R.) only a few specimens have been taken in the Province of Quebec. The insect may be known by the numerous dark brown wavy lines upon its tawny fore-wings. In the centre of each of these wings is a silvery *u*, or horse-shoe-like mark, followed by a dot or annulet.

P. U-aureum (Boisd.) is a small species expanding one and one-fourth inches. Its fore-wings are dark brown, and bear in the centre a golden or silvery mark resembling a squat capital *N*. On the fore-wings also are several irregular transverse golden or silvery lines.

Besides Balluca we have two species that have no metallic spots in the middle of the fore-wing, *P. ærea* (Hubner), and *P. æreoides* (Grote). In the former the wings are *dark* brassy-brown and in the latter, *pale* brassy-brown. Both have darker transverse markings. Æreoides has also, near the hind margin, a pale brassy transverse band.

TABLE OF QUEBEC SPECIES OF THE GENUS PLUSIA.

I.—Having white or metallic markings in the middle of the fore-wings.
  A. Having y-like markings in the middle of the fore-wings.
    a. Having two golden marks as if the tail were cut off from the y.
      PUTNAMI, which has a *golden* apical streak.
      BIMACULATA, which has a *brown* apical streak.
    b. Having the y complete.
      1. Tarsi of front legs banded brown and white.
        FALCIFERA, which has no knob at the end of the y.
        PRECATIONIS, which has the tail of the y knobbed.
      2. Tarsi of the front legs plain.
        SIMPLEX.
  B. Having markings of other forms in the middle of the fore-wings.
    a. Like *N.* U-AUREUM.
    b. Undulating, like a small snake. AMPLA.
    c. Like the figure 3 lying on its back. VIRIDISIGNATA.
    d. Plume-like. MORTUORUM.
    e. Like a small *v* followed by a dot or annulet.
      1. Having pink spots on the wings. THYATIROIDES.
      2. Having tawny wings. MAPPA.
      3. Having greyish-brown wings. BRASSICÆ.

II.—Having no metallic markings in the middle of the fore-wings.
  A. Having the wings glossy-green. BALLUCA.
  B. Having the wings glossy-brown.
    a. Dark brown. ÆREA.
    b. Light-brown. ÆREOIDES.

ORIGIN AND PERPETUATION OF ARCTIC FORMS.

BY J. ALSTON MOFFAT.

The subject of Arctic Forms is one of special interest in biology, and the frequent reference to it in natural history literature, keeps it constantly before the reader, and has made the theories concerning the origin and preservation of such forms well known, whilst to us as entomologists, it is of the very first importance in our efforts to obtain correct knowledge concerning the geographical distribution of insects. Grant Allen says .—

"On or near the summit of Mount Washington, a small community of butterflies belonging to an old glacial and Arctic species still lingers over a small area, where it has held its own for eighty thousand years that have elapsed since the termination of the great ice age. This same butterfly is found in two other localities on this continent; Long's Peak, Colorado, is eighteen hundred miles distant; Hopedale, Labrador, is probably a thousand miles away; in the intervening districts there are no insects of the same species. Hence we must conclude, that a few butterflies left behind in the retreating main-guard of their race, on that one New Hampshire peak, have gone on for thousands and thousands of years, producing eggs, and growing from caterpillars into mature insects, without once affecting a cross with their congeners."

I learn from the writings of Mr. W. H. Edwards, that the name of that butterfly is *Chionobas Semidea* (Say.) The description given by Mr. Scudder of its terrible struggle for existence, tends to arouse one's interest in it, and draws out one's sympathy for it, as we contemplate the dreary and joyless life it is doomed to lead in its inclement home, so opposite to what is considered to be the typical life of a butterfly. Grant Allen's conclusion is in perfect harmony with the theories prevailing on this subject, but there is another view that can be taken of it, which appears to me to be more in harmony with nature and observation, although it may spoil the romance, and give less play to the imagination; and that is the one contained in the well-known principle of the power of environment to modify the external appearance of living forms, and their ability to accommodate themselves to altered conditions.

To illustrate the principle that I wish to apply in this case, I shall draw upon Mr. Edwards's article on "Pieris Bryoniæ and its derivative forms," to be found in *Papilio*, for June, 1881. He says:

"The species, of which Bryoniæ is one of the forms, is known as Napi, having in Europe three manifestations, Bryoniæ, Napi, and Napææ; the last of these was until recently regarded as a distinct species." Then quoting Dr. Weisman who says of Bryoniæ: "This is to a certain extent the potential winter form of Napi. This type Bryoniæ, in polar regions is the only form of Napi. Bryoniæ produces but one generation a year, and must, then, according to my theory, be regarded as the parent form of Napi." He then states that in the Alps and Jura, Napi swarms everywhere, and crossing takes place, which causes variability in Bryoniæ, but in Lapland Napi is never met with; so Bryoniæ preserves its constancy, and concludes thus: "Pieris Bryoniæ should be elevated to the rank of a species, and ordinary winter and summer forms should be designated varieties Napi and Napææ." Then Mr. Edwards, after a description of the markings of the various forms, says, "There are therefore the three forms under which the species manifests itself in Europe, Bryoniæ, Napi, Napææ; of which Bryoniæ may be considered the present form." Now to get myself into harmony with nature, I have to reverse this order. We all know that butterflies are lovers of the sun; and that they are most numerous in kinds and examples in warm countries where they flourish most luxuriantly, the conditions being more congenial to them. Therefore the natural inference is, that butterflies would first appear on this scene of life, in localities that were most favourable to them, and spread from these into those that were less so. We are all familiar with the restlessness of butterflies, and with what eagerness they will investigate every spot, seemingly with a determination to establish themselves there if possible; they succeed if the conditions are at all favourable, and some of them succeed even where the conditions are most unlikely. Now as Bryoniæ is a darker form than Napi, and Napææ being lighter still, and taking the result of Mr. Edwards's experiments in this direction as a clue to some of nature's methods in this matter, which goes to show that cold has the effect of darkening the colour of some kinds, I infer that Napææ was the first to appear and to spread into a locality with a cold winter. This acting on the chrysalides, Napi appears as the spring form, and Napææ as the summer one. As the distribution goes on it reaches a yet colder climate, where Napææ disappears and Bryoniæ is the spring form, with Napi as the summer one. Pushing yet onward it gets into a locality where the season is too short for two broods, when the single brooded Arctic and Alpine Bryoniæ is alone to be found, and consequently constant, and there does not seem to be the slightest reason to doubt, that if every Bryoniæ was swept out of Europe in one season, their place would soon be filled from the warmer

plains below, and that they would be just as true Bryoniæ as those of the present —the result of the influence of climate on an impressionable organism, and the power of that organism to accommodate itself to altered conditions.

Now, then, let us return to our poor old friend Semidea, who has been having such a weary time of it on top of Mount Washington, for the last eighty thousand years. I do not know the form of Chionobas that flies on the plains of New Hampshire. I am dealing with one of the laws of nature that controls life, a far more reliable guide to correct conclusions, than the changeable external appearance of insects. But whatever they may be like, or by whatever name they may be called, I am quite confident, that upon investigation one of them will be found to stand in the same relation to Semidea that Napi does to Bryoniæ, and will be found capable of pushing its way up Mount Washington and to be modified by the changed conditions, and by the time it has established itself on the top it has become true Semidea; so that if at any time Semidea had been obliterated from Mount Washington by the severity of the conditions, and it would seem little short of a miracle if it never has been, its place could yet be filled from below.

Then there is *Semidea* in the Mountains of Colorado. The Chionobas of the Colorado plains, will undoubtedly be different-looking from those of New Hampshire and discerned by bearing different names, and from one of them the Semideas have come which are found on the mountains; the same principle governing one as the other. We turn to Labrador and the same principle is at work there, only the conditions for the production of Semidea are obtained without the necessity for the elevation. So that from Labrador within the Arctic circle, to Long's Peak, Colorado, an unbroken chain of that species extends across the 2,800 miles that lie between, every link of which may differ somewhat from the one next to it, according to the conditions in which it lives, and be entitled to a distinguishing name, yet all united by the laws of consanguinity. At these three points, Labrador, Mount Washington and Long's Peak, Colorado, the conditions being the same, like results are produced and Semidea is the natural outcome. And according to Mr. Edwards, when specimens are brought from these widely separated localities and compared, they are not known to differ by a scale or a hair. I see that Mr. Scudder does not consider the Labrador form quite the same as the others, if so it would indicate that the conditions are not quite identical.

Mr. Edwards inform us that the Satyrinæ are a very numerous family, with many genera, these having numerous species, which I take as an indication that they are sensitive to external influences and readily modified thereby, and probably a full series might exhibit the gradations to be slight.

This, then, is the view I take of the way in which Arctic forms have been originated and perpetuated, and the principle at work in producing them is that which has been so carefully elaborated with such a wealth of illustration and knowledge of facts by Wallace in his Island Life; only he calls the forms produced by changed conditions "species" instead of varieties of a species, a mode of using the term that is ever liable to lead to confusion and misunderstanding.

FULLER'S ROSE-BEETLE.—(*Aramigus Fulleri*, (Horn).

BY JAMES FLETCHER, OTTAWA.

From time to time complaints come to us of injuries done to greenhouse plants by some insect which gives abundant evidence of its presence, by the nibbled state of the leaves; but which is seldom detected. When such complaints are received, it is suggested that a light be taken into the greenhouse and search made at night. In most instances the culprit is found to be a small brown snout-beetle, shown at Fig. 28. This is known as Fuller's Rose-Beetle. There is no doubt that this insect is far commoner than is generally supposed. Its habit of feeding at night and hiding during the day time, added to the protection afforded it by its colour, saves it from detection until it attracts notice by its excessive numbers.

This is a comparatively new enemy, having only been described in 1876, when Dr. Horn named it after Mr. A. S. Fuller, who first brought it to his notice. It had however, been sent to Dr. J. A. Lintner, State Entomologist of New York, two years previous to that date.

A good deal has been written in different journals and reports upon the best way to overcome this pest; but it still keeps turning up in new localities every year, and is now reported as a greenhouse pest from the Atlantic to the Pacific coast.

Accounts of its life-history and habits are given in the Annual Report of the United States Entomologist for 1878, and Dr. Lintner's report for 1885. From these accounts we find that this insect injures greenhouse plants of many kinds; but its favourite food is undoubtedly the rose, and after this perhaps various kinds of lilies. The injury done by the mature beetle is however slight, compared with that of the larva (Fig. 26), which is a thick white legless grub, when full grown ¼ of an inch in length, the body curved, wrinkled above and flattened below, covered with short tawny bristles. Head yellow with dark, black-tipped, sharp mandibles, with which it consumes the young rootlets of various greenhouse plants, and by the destruction of these fibres with which the plant takes its food, soon destroys the vitality of the plant. Prof. Riley says:—(Ann. Rep., 1878, p. 256). "The most serious injury is done by the larvæ, which feed principally upon the more tender rootlets and thus attack the plant in its most essential parts. I have had a quite healthy rosebush totally destroyed in three weeks' time, by about three dozen of the larvæ, which were placed in the pot containing it." When plants are attacked at the root by larvæ they have generally a characteristic appearance. The new wood is weak and spindly, the colour is unhealthy and very few flowers are produced. When this is the case they seldom recover. I have seen plants of which every one of the young rootlets were destroyed, and which threw out new roots close to the surface; but these never did much good, and florists tell me that it pays better to throw away such plants and replace them with young, vigorous bushes. There is frequently much carelessness amongst florists in not appreciating the serious nature of an introduction of this pest into their premises, and it is not at all uncommon to see plants destroyed by the larvæ, simply pulled out and other healthy plants set in the same soil. This of course is a great mistake, and is a practice which should never be followed. When roses are grown under glass in the usual way, viz.:—in beds, if the soil is found to be infested by the larvæ of this insect, it must all be

Fig. 26.

removed and fresh soil put in its place. There are several instances on record of rose-growers having given up the cultivation of this queen of all flowers, on account of the attacks of this insect; but this is not necessary, if they will learn something of its life-history and apply remedies accordingly. Prof. Riley has worked out the life-history and finds that the eggs are laid in flattened batches of from 10 to 60, the individual eggs being smooth yellow and ovoid and about one millimetre in length. They are laid by the female at the base of the plant just above the ground, and are generally pushed between the loose bark and the stem, or are laid between the earth and the main stem, just at the surface of the ground. They are so firmly glued together and to the place where they are deposited that they can only be detached with difficulty. After about a month the eggs hatch and the active little larvæ at once burrow down into the ground and begin their work of destruction. When full grown they turn to pupæ, Fig. 27, from which the mature beetles emerge in about three weeks. The perfect beetle, Fig. 28, is a brown weevil, a little more than $\frac{1}{4}$ of an inch in length, with a short thick snout and long slender antennæ or feelers, bent abruptly in the middle. The wing-cases are indistinctly striate, and bear rows of large punctures and minute hairs. A whitish stripe runs along the sides of the thorax and half way down the sides where it terminates as an oblique white dash, reaching to the middle of each wing-case. Prof. Riley says: "The parent beetles, like most other snout beetles, live for a considerable time, as I have kept them in confinement for nearly three months. They are nocturnal in habit, being quite active and feeding only after dusk. They shun the light during day-time and hide under the leaves or cling tightly to the branches or in some fork near the base of the plant, always in such position as not easily to be observed. They drop to the ground when disturbed, draw up their legs and 'play possum,' remaining motionless for some time and looking very much like a small lump of dry earth, the colour adding greatly to the resemblance. This habit of simulating death upon disturbance is common to many other insects of this family. They feed upon the leaves, but do more injury by severing them than by the amount of foliage consumed."

Fig. 27.

Fig. 28.

"The beetle seems to be purely American, and the genus Aramigus was in fact erected for it and another species (*A. tesselatus*), of about the same size, but of a silvery white colour, with faint green hue, which I have found in Kansas upon the well-known 'resin weed.' The beetle belongs to the same family, and is pretty closely allied to a well-known European beetle, *Otiorhynchus sulcatus*, Fab., which is larger and darker in colour, and is also very injurious to greenhouse plants, as well as to some grown out of doors. This species also occurs in this country." The last-named beetle has been taken by Mr. Harrington at Sydney, Cape Breton, but has never yet been reported as an injurious insect in Canada.

Remedies.—Probably the most satisfactory remedies for this pest are those which are directed towards the destruction of the mature beetles. As stated above these are very retentive of life. They can, however, certainly be conquered by constant watchfulness and by keeping the plants in the house where they occur frequently sprayed all the time the perfect beetles occur with weak arsenical mixtures. Paris green of the strength of 1 lb. to 300 gallons of water is strong enough to destroy the beetles and will not injure the plants if kept well mixed all the time it is being used. Mr. Alderman Scrim, of Ottawa, an extensive grower of roses and other plants for winter cut-flowers was very successful in trapping the beetles by means of the small bamboo canes commonly used by florists for supporting potted plants in greenhouses. These were cut so that there

was an open joint about three inches in length at the top. Into this chamber so formed the beetles would crawl to hide during the day, and were easily and quickly crushed by pushing a small rod down the cane every morning without removing the cane. In this way Mr. Scrim destroyed large numbers at a time of the year when it was inconvenient to renew all the soil in his rose-houses. Prof. Riley quotes in his 1878 report from an account written by the late Mr. Peter Henderson, of New York, of the work of this beetle. After stating his belief that the failure of many to grow roses is due to the unknown presence of the larvæ at the roots, he says as follows: "Mr. John May, the gardener in charge of Mr. Slaughter's rose-growing establishment at Madison, New Jersey, which is probably the largest in the vicinity of New York, has given great attention to the rose bug, his roses for four or five years being much injured by it; but by persistent efforts in destroying the perfect insect, he has now got entirely clear of it."

Experiments to destroy the larvæ and pupæ in the ground by means of bisulphide of carbon were unsuccessful.

Prof. Riley having discovered the habits of the insect as to the deposition of its eggs suggested the value of placing traps, composed of rags, tape or paper tied round the stems of the plants or round short sticks placed close to the plants. In these the females would lay their eggs. The eggs take about a month to hatch, and by scalding the rags at short intervals all the eggs would be destroyed. If the plan of tying rags to sticks be adopted these can be dipped in scalding water and again replaced at once without untying the rags.

With this as with most of the other injurious insects the most important thing is for the florist to recognise the serious nature of the attack and the necessity of carrying on the war unceasingly until every appearance of the enemy ceases.

HYMENOPTERA PARASITICA.

BY W. HAGUE HARRINGTON, OTTAWA.

In his excellent work entitled a "Synopsis of the Families and Genera of the Hymenoptera of America, north of Mexico," Mr. E. T. Cresson gives the following concise statement of the general characters of the order Hymenoptera.

WINGS four, membranous, the posterior pair almost always smaller than the anterior, with comparatively few nervures.

MOUTH mandibulate, and with a lower lip or tongue, sheathed by the maxillæ.

TARSI generally 5-jointed, rarely 3 or 4-jointed, very rarely heteromerous.

ABDOMEN of the female furnished with a multivalve saw ovipositor, a borer, or a sting.

LARVA vermiform and footless, except in the Phyllophaga and Xylophaga.

PUPA incomplete and inactive.

Keeping these definitions in view it will be seldom difficult even for those who are not entomologists to decide whether a certain insect belongs to the Hymenoptera. Many flies (order Diptera) have a close superficial resemblance to species of Hymenoptera, but they may at once be distinguished on an examination of the wings, of which they invariably have only *two*.

Again insects may be found with four membranous transparent wings, as dragon flies (order Pseudoneuroptera) or cicadas (order Hemiptera), but in these orders the wings have a great number of nervures, or veins, forming a close network, and in all hemipterous species (bugs) the mouth is transformed into a proboscis, and lacks the mandibles or jaws common to Hymenoptera, and which are very apparent in large species like the bees.

We are informed that the abdomen of the female is furnished with a saw ovipositor, a borer, or a sting, and the order can be roughly divided into three sections based upon these differences in the sexual organs. The first section may be styled Phyllophaga (leaf-feeders), and contains the well-known saw flies, the larvæ of which are caterpillar-like and possessed of feet. The second section includes the Xylophaga (wood-feeders), generally known as horntails, the larvæ of which infest the trunks of trees, and the Parasitica (parasites) to which belong the long-stings and numerous allied forms. The third section Aculeata (sting-bearers) contains the bees, wasps, ants, etc.

Of the first and third sections as above indicated I have in former reports treated briefly, and I will now endeavor to outline the Parasitica, which constitute almost the entire second section, and which by reason of their great number and complexity of structure will make my task a difficult one to undertake in a single paper.

The section Parasitica contains at least half of the described species of our Hymenoptera, and the number of undescribed forms must be very large, as many of them are extremely minute and require more careful collecting and study than many entomologists can devote to them. They are divided into several families, of which some contain a large number of genera and species, and which will be briefly treated of in systematic order.

Cynipidæ.—This family contains a moderate number of small species (often minute) and is divided into two sections, one containing three and the other two subfamilies. The species contained in the first section are in the larval state chiefly producers of galls, or dwellers therein, instead of being truly parasitic in their mode of life. There is reason to believe, however, that the few species which constitute the first subfamily (Ibaliinæ) are true parasites upon the larvæ of wood-boring insects. The principal Canadian species is *Ibalia maculipennis* Hald., which occurs somewhat rarely on maple and beech. The structure of the insect is such as to attract attention, for though of moderate size (hardly three-fourths of an inch in length) it is still the largest of our Cynipidæ, and is easily distinguished by its strongly compressed or knife-shaped abdomen. Within the abdomen, which constitutes merely a sheath for it, is coiled a delicate ovipositor, much longer than the insect itself, with which it deposits its eggs in the decaying trunks of the beech and maple, where the larvæ when hatched probably exist upon other insects infesting the wood.

The subfamily Cynipinæ contains species producing galls upon plants. The trees most subject to their attacks are the various species of oak; the galls occurring upon them and the insects produced therefrom being in themselves a sufficient study for an entomologist. Some of the galls, such as the oak-apple, are of enormous size as compared with the minute grub which occupies the central cell therein, and which by some mysterious influence upon the growth of the plant structure causes this wonderful abnormal development. The various species of roses are also very liable to the attack of these insects, the galls chiefly occurring being large potato-shaped ones upon the roots, oval woody enlargements of the stems and clusters of pea-shaped swellings upon the leaves. Although various plants, including the raspberry and blackberry, are subject to these attacks there is not space to enumerate them here.

The subfamily Inquilinæ as its title indicates contains species which are inquilines or guests in the galls of the preceding species, which in structure and appearance they closely resemble.

The truly parasitic species of the Cynipidæ are comparatively few in number.

EVANIIDÆ.—The species belonging to this family are easily distinguished, as the abdomen is attached to the disc or base of the metathorax, instead of to the apex as in the other families. The species found in Canada belong chiefly to the genus Aulacus, the members of which frequent decaying trees, in which they may be found ovipositing. We have also two species of Fœnus—insects with a curious sickle-shaped abdomen—of which one (*F. incertus*) has a short ovipositor, while the other (*F. tarsatorius*) has a very long one. They may frequently be seen flying about trees, telegraph poles, etc., examining and entering insect burrows and crevices, and also upon golden-rod and other flowers in autumn. They are said to be parasitic upon certain bees. The species of Evania, which have curious hatched-shaped abdomens, are said to infest cockroaches.

TRIGONALIDÆ.—This family contains only one genus (Trigonalys) and the four species therein are of rare occurrence and not as yet recorded from Canada. Habits unknown to me.

ICHNEUMONIDÆ.—This family is a very extensive one and contains our largest and best known parasites. It is divided into five sub-families of somewhat equal size. Of the sub-family Ichneumoninæ there are more than two hundred species credited to the typical genus Ichneumon, and of these at least fifty occur in the vicinity of Ottawa. These ichneumons are somewhat wasp-like in form, but more slender; our largest species (*I. grandis*) is sometimes an inch in length, but some of the smaller species are less than one-third of an inch and the average size is about two-thirds. The ovipositor is short and retracted within the abdomen so as to be rarely visible, but the females may be distinguished by their stouter abdomens, and frequently by the antennæ being rolled, while those of the males are longer and straight. The anterior wings have a small pentagonal cell called an areolet, which occurs also in many other Hymenoptera, (see wing of Cryptus, Fig. 29) although the areolet is incomplete, triangular, rudimentary or wanting in many genera. Many of the ichneumons are entirely black (or with a few white markings,) others have the abdomen red, others again are banded with black and yellow, or are ferruginous with black markings. They are parasites of the caterpillars of our butterflies and moths. The genus Amblyteles contains a number of species almost identical in appearance with those of the preceding genus and of similar habits. Hoplismenus is distinguished by having pointed tubercles or spines upon the metathorax. A common and well marked species is *H. morulus*, which is a parasite of certain butterflies. The genus Trogus contains a few large species of which *T. excisorius*, a yellow species with smoky wings, is a common parasite of the caterpillars of our Black Swallow-tail butterfly, *Papilio asterias*.

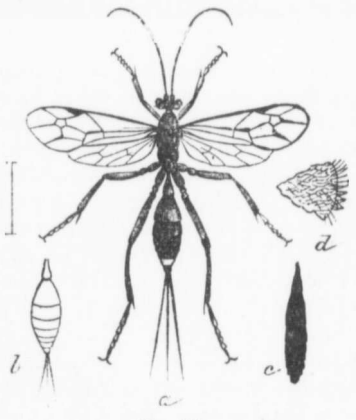

FIG. 29.

CRYPTINÆ.—Cryptus, the typical genus of this sub-family, contains species

very similar in shape and colouring to those of the preceding sub-family, but of smaller size and having the ovipositor exserted and sometimes quite long. A common species is *Cryptus extrematis* which I have frequently bred from the cocoons of our large moth *Telea polyphemus*. Figure 29 shows the female and Figure 30 a cross-section of the moth's cocoon, indicating how the cocoons of the parasite lie side by side within it closely packed. The genus contains a great many species, as does also the genus Phygadeuon, the species of which differ chiefly in having the ovipositor shorter. The genus Hemiteles contains small species with incomplete areolet, which are said to be secondary parasites; *i.e.* parasites of parasites, while the species belonging to Pezomachus are wingless and ant-like in shape and may be found upon the ground or on foliage.

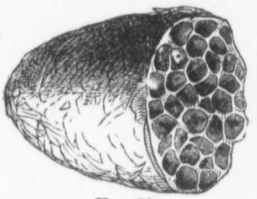

FIG. 30.

OPHIONINÆ.—The species included in this sub-family usually have the ovipositor short, and they differ from the rest of the Ichneumonidæ in having the abdomen compressed laterally, so that it becomes sickle-shaped. Some of the larger forms show this in a marked degree. The typical genus Ophion contains large yellow insects of which some are very abundant. Our largest species is *Ophion macrurum* (Figure 31) which is a parasite of the caterpillar of the large American silkworm moth (*Telea polyphemus*). The larva of the ophion is a large, stout grub, which when full grown spins a dark brown cocoon which almost fills the cocoon of the moth, and from which the fly emerges by cutting a circular door at one end. *O. bilineatum* infests the White Miller moths, while *O. purgatum* (which has two yellow specks in one of the cells of the anterior wing) is a parasite of the army worm.

FIG. 31.

Thyreodon morio is a fine insect of nearly the size and shape of *O. macrurum*, but of a deep black colour, with dark, smoky wings and yellow antennæ. The genera Exochilum and Heteropelma contain a few large species of the same general appearance, while *Opheltes glaucopterus* might be mistaken for *Ophion macrurum*, except that there is an areolet in the anterior wing and that the terminal segments of the abdomen are black. This fine species has been bred by my friend Mr. Fletcher from the cocoons of *Cimbex Americana*, the great Willow Sawfly.* Anomalon and Campoplex contain a large number of species of moderate size, with the abdomen long and very thin. They are parasites of caterpillars, such as the destructive Tent caterpillars, and they do good service in keeping down such pests. Another large genus of very beneficial species is Limneria, but in this and the remaining genera of the sub-family the species are mostly small. Figure 32 shows *Thersilochus conotracheli* a parasite of the plum weevil. In Banchus the scutellum is often armed with a sharp spine.

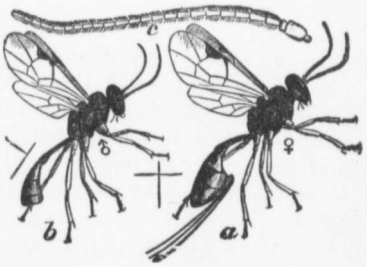

FIG. 32.

* Canadian Entomologist, Vol. XIX, p. 80.

TRYPHONINÆ.—In this and the following sub-family the abdomen instead of being compressed laterally and thus being more or less knife-shaped, is cylindrical or flattened vertically, especially the basal segment, which instead of forming a slender petiole, is in the majority of genera attached to the thorax by its full width. In the present sub-family the ovipositor is short and not exserted. There are a number of genera, of which Mesoleptus and Tryphon are the most important, but without figures it would be difficult to satisfactorily describe any of the species. Euceros is distinguished by its flattened antennæ and Chorinæus by having one or two segments of the abdomen longitudinally keeled above, as in the genus Rhogas of the Braconidæ.

PIMPLINÆ.—This sub-family contains many fine species, including the largest and most striking of all our Hymenoptera. The structure of the abdomen is generally as in the preceding sub-family, but the exserted ovipositor is usually at least half the length of the abdomen, and not unfrequently is much longer than the whole body of the insect. This development of the ovipositor is due to the fact that the victims of those species in which it is very long are usually wood-borers, dwelling in burrows in the wood or under the bark of various trees and apparently secure from the attacks of the enemies of more exposed species. Arotes contains several handsome species; black, with markings of yellow or white, and with the ovipositor about the length of the insect. I have found them ovipositing in dead hickory, infested by *Saperda discoidea*, etc. Of Rhyssa there are five species recorded from Canada, of which *R. persuasoria* is also found in Europe. This is a large species, the female (with ovipositor) being 2½ inches in length. The general colour is black, with white markings, but the legs are rufous. Provancher states that this species is an especial parasite of the large pine-borers, *Monohammus confusor* and *M. scutellatus*. I have not recognized the species at Ottawa yet, but have a male apparently belonging to it from Rev. G. W. Taylor, of Victoria, B.C. The closely allied genus Thalessa contains the giants of the Parasitica, those large species popularly known as "Long-stings." Two species, *atrata* and *lunator*, are common, while three others, which may be perhaps varieties, are recorded. The specific name of *Thalessa atrata* signifies that the species is black, and this is true of the female, with the exception of the head, the antennæ and portions of the legs. The male, however, has the legs almost entirely yellow, the thorax much varied with the same colour, and the abdomen much lighter than that of the female. A large female measures fully an inch and a half from the head to the tip of the abdomen, beyond which the ovipositor extends five inches. The legs, wings and antennæ are developed in proportion, so that the motions of the insect are active and she flies strongly. The size of these insects and their curious method of oviposition (egg-placing) have made them objects of much interest to entomologists. Their larvæ are parasites (feeding externally) of the grubs of the wood boring "Horn tail" called *Tremex columba*. I am sorry that space does not permit me to give a fuller account of their habits, which have been very carefully worked out by Prof Riley. In *T. lunator*, which is a somewhat smaller species and more variable in size, the thorax and abdomen are largely marked with yellow. To those who wish to observe these insects I may say that they can generally be found about old maples and beeches in midsummer.

The genus Ephialtes contains several fine species having the abdomen tuberculate along the sides and the ovipositor as long as the insect itself. *E. irritator*, which I have taken on dead hickory in June has the abdomen and legs red, but other large species such as *gigas* and *occidentalis* are black, with the exception of the legs.

Pimpla, the genus from which the sub-family takes its name, contains a number of very useful species of which *P. conquisitor* (Figure 33) is a great aid in checking the ravages of the Forest Tent-caterpillar. I observed it to be very abundant in 1889. This species has the segments of the abdomen margined with white, but in our other species the thorax and abdomen are entirely black. The legs, however, as in this species, are usually red, and more or less variegated with black and white. Our largest species, *P. pedalis*, also an enemy of Clisiocampa, has the legs red, with the exception of the hinder tibiæ and tarsi, which are black, while *P. pterelas*, which can be bred in large numbers from pods of iris infested by the beetle *Mononychus vulpeculus*, has its legs entirely red. A very closely allied species *P. annulipes* (Figure 34) is said to be a parasite of *Carpocapsa pomonella*, the Codling moth, whose larvæ do such enormous damage to our apples.

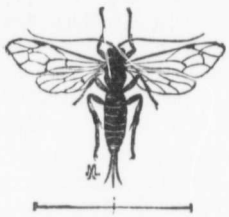

FIG. 33.

FIG. 34.

Differing from Pimplas chiefly in colour are two yellow species belonging to the genus Theronia. In Victoria, B.C., in May, 1888, I observed *T. fulvescens* to be very abundant and as it is a parasite of the western Tent-caterpillar, which was then in immense numbers, I have no donbt that the insects were then engaged in the good work of depositing their eggs in the obnoxious caterpillars. The species which occurs here is called *Theronia melanocephala* from its black head, and I have bred it from cocoons of *Halesidota maculata*.

The sub-family contains many other genera, some of which, as Xorides, Xylonomus, Ecthrus and Odontomerus, include large handsome species.

STEPHANIDÆ.—This family only contains two genera, and the American species described are only four in number. They are rare in collections, and none are yet reported from Canada I think. In appearance they much resemble some species of the next family, and having long ovipositors are probably parasites of wood-borers.

BRACONIDÆ.—The described species of this family are not so numerous as those of the ichneumonidæ, nor are they so large, but they include many interesting forms, and many of great use in keeping down noxious insects. The braconids are distinguished from the ichneumonids by the venation of the anterior wings, which lack the cross-vein known as the second recurrent nervure. On examining the wing of Cryptus, for instance, (see Fig. 29) there is seen just below the areolet (or little pentagonal cell) a cross-vein, but if the wing of a Bracon (see Fig. 35) is examined it will readily be seen that there is no trace of a corresponding cross-vein. In the braconids also (except in one small section) the second and third segments of the abdomen are rigidly connected, instead of being flexibly jointed. They are separated into five divisions, which are further divided into sub-families.

CYCLOSTOMI.—In this division the clypeus (or portion of face just above the mouth) is emarginate, thus forming a semi-circular opening above the mandibles or jaws. There are nine sub-families, but the majority of the species are contained in the genera Bracon and Rhogas.

The larger species of Bracon are usually black, with bright red abdomen, dark, smoky wings, and a long ovipositor. They may be seen upon dead trees, and are largely parasitic upon the larvae of beetles which infest the trees. The larva of the Bracon spins a tough oval cocoon, perfectly flat above and below. Such cocoons can frequently be found under the bark of maple, cedar, etc., in the burrows of the beetles upon which the parasites preyed. The smaller species are reddish or yellowish, and infest dipterous and other larvæ. Fig. 35 shows *Bracon charus* which is said to be a parasite of *Chrysobothris femorata*, the flat-headed apple tree-borer.

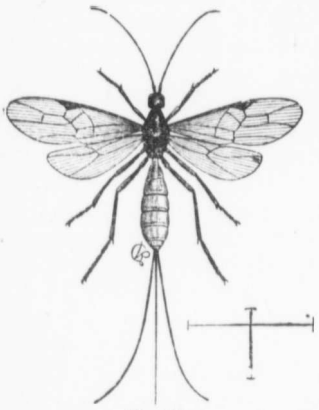

Fig. 35.

The species of Rhogas differ from Bracon in having the ovipositor short, the wings transparent, and especially in having the first segments of the abdomen carinate. *R. intermedius* is a medium sized yellow species which I have frequently bred from a handsome caterpillar (*Acronycta* sp.)

Many larvæ live in one caterpillar, which dies from the attack when it is about full grown. The victims may frequently be seen extended on stems of grass, apparently at rest, but on closer examination are found to be stiff and hard, and perhaps riddled with minute holes from which a score or more of the flies have issued.

Cryptogastres.—The species included in this division are easily recognized by the form of the abdomen which, instead of consisting of several segments, with sutures (or joints) between them, seems to be in one piece. This shield-like abdomen, however, consists of the first three segments welded together. It conceals the ventral segments, and thus gives the name to the division, which contains the two sub-families, Sigalphinæ and Cheloninæ.

Fig. 36 shows very clearly the male and female of *Sigalphus curculionis*, which is one of the parasites of the plum-curculio.

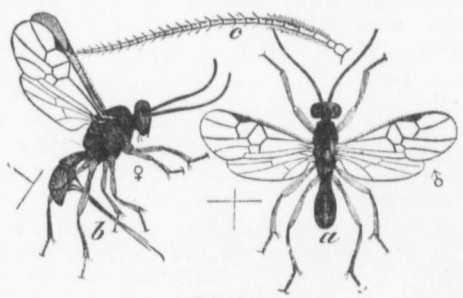

Fig. 36.

Areolarii.—In this division the distinguishing feature is in the venation of the wing, in which the second submarginal is minute, forming a small triangular areolet, or often imperfect. There are two subfamilies as in the preceding division. The first includes the well-known genera Apanteles and Microgaster; each containing many species, which, though small, are of great benefit in holding lepidopterous larvæ in check. Mr. Howard (in Scudder's Butterflies of the United States and Canada) mentions no less than sixteen species of Apanteles as parasites of butterflies.

Polymorphi.—This division contains several subfamilies, and includes some large species, such as Helcon, but it is almost impossible without illustrations to give any satisfactory idea of the numerous genera. Fig. 37 shows, greatly enlarged, *Macrocentrus delicatus*, a parasite of the Codling moth.

EXODONTES.—This division is very poorly represented in Canada, or at least in collections. The species are small, but may be distinguished by an examination of the mouth parts; the mandibles have the tips turned outward (as the name of division indicates), and cannot therefore be used for biting.

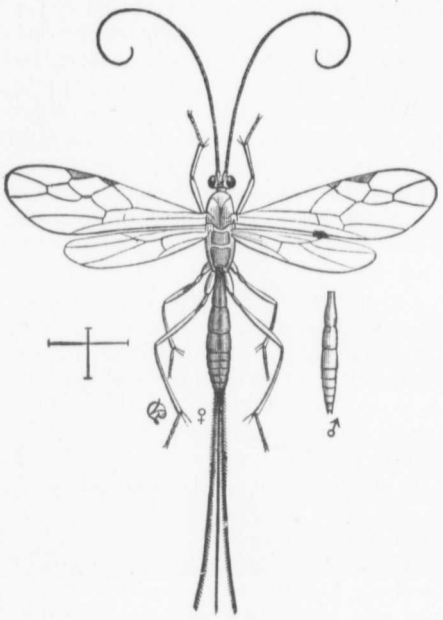

FIG. 37.

FLEXIVENTRES.—This division contains species which differ from all the other braconids in having the segments of the abdomen freely articulated, so that it can be bent under the thorax. There is only one sub-family, the Aphidiinæ, and the species are very small, yet they are of great economic importance, as they are parasites of various species of aphides, or plant-lice. The larva feeds inside the aphis, which becomes swollen, and finally is found fixed to the plant on which it has been feeding, a mere dead shell from which the tiny parasitic fly has escaped. The grain aphis is said to be kept in check by one species, which alone must save an immense sum to our farmers.

CHALCIDIDÆ.—Here we have another very extensive family; the species differing greatly in structure and in habits. They are always small, but frequently are very brilliant in appearance, glittering with bright tints and metallic lustres. It will only be possible to glance at a few of the forms, as the great diversity of structure which obtains among them, and their minuteness make their study and identification difficult except for one who can devote much time to it. The wings have scarcely any traces of venation, except the vein along the front edge.

Leucospis affinis is our largest species; a black and yellow fly about one-fourth of an inch long, with its ovipositor curved up over the abdomen in a curious manner. It is frequently found on golden-rod, and is a parasite of bees.

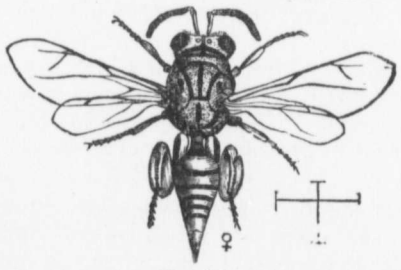

FIG. 38.

FIG. 39.

Smicra and Chalchis contain species remarkable for the development of the hind legs. Fig. 38 shows *Smicra mariæ*, which is a parasite of the Cecropia caterpillar, and Fig. 39 gives *Chalcis flavipes* which attacks the larva of the cotton moth.

The genus Torymus contains a number of species, which may be bred from different galls. The females have the abdomen flattened ovate, and sometimes prolonged to an acute point; the abdomen of the males is very small, and the insects are black. A not uncommon species is *T. gigantea*, which is bred from the large globular galls produced on stems of golden-rod by a fly (*Trypeta solidaginis*), about the size of a house fly, with mottled wings.

The closely allied genus Isosoma contains species which depart from the parasitic habits of the majority of the family, and become themselves noxious insects. *Isosoma hordei* (Fig. 40) is the well-known Joint-worm of wheat and barley straw, making gall-like swellings at the joints, in which several cells may be found, each containing a little grub.

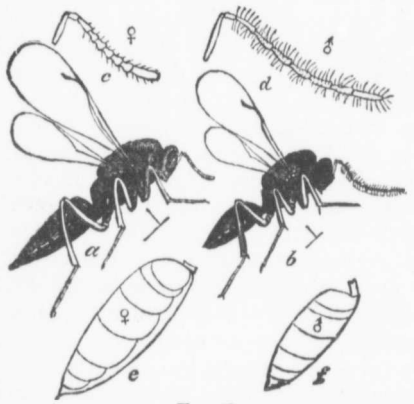

Fig. 40.

The sub-family Pteromalinæ contains, amid a great complex of tribes and genera, a correspondingly great number of species. The typical genus, Pteromalus, alone contains more than 30 species, of which some are well-known parasites of butterflies. *P. puparum* is recorded as bred from eleven species of butterfly, and is a common destroyer of the chrysalids of the cabbage white butterfly (*Pieris rapæ*) and of *Vanessa antiopa*. I have counted more than 450 flies from one pupa of the latter, and sometimes scarcely an uninfested chrysalid can be found. The species of Tetrastichus are also frequently parasites of butterflies, while *T. esurus* (Fig. 42) has been bred from the cotton moth. The genus Trichogramma (which constitutes a sub-family) also has similar habits, and *T. minutum* (Fig. 41) is a parasite of our large Milkweed Butterfly (*Danais archippus*).

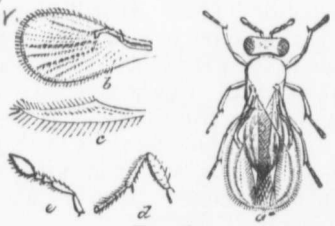

Fig. 41.

Proctotrupidæ.—This family has been but meagrely investigated in Canada, although the species are numerous, and often of interesting structure. They are not so varied in coloring as the Chalcididæ, to which they are closely related, but are usually brown or black. Many of them are wingless, living among low herbage and moss, and some of the genera consist of species so minute that they live and mature in the eggs of other insects. I have found clusters of moths' eggs from each of which, instead of a young caterpillar, has issued a perfect winged fly (*Teleas orgyiæ*.) Those of Scelio infest, I believe, the eggs of grasshoppers or crickets.

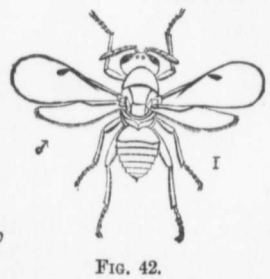

Fig. 42.

Pelecinidæ.—This family is a very easy one to study, as it contains only one species, *Pelecinus polyturator*, the shape of which is so different from all other hymenoptera that it can be quickly recognized. This fine insect is of a glossy black, with short wings, containing few veins. The male has a club-shaped abdomen, but the female has hers greatly elongated—about five times the length of her head and thorax—her total length is about two inches. The females are

not uncommon, and generally fly near the ground, but their habits are otherwise unknown. I have taken them as far eastward as Nova Scotia, but I do not know how far westward their range extends. The male is exceedingly rare, and I have only seen one specimen that was captured in Ontario.

Although this review of the great complex of insects embraced in the Parasitica has been a very rapid and incomplete one, I hope that it has at least given some idea of their great number, their diversity of structure and their economic importance. We see that egg, larva and pupa are alike subject to their attacks, and that scarcely any form of insect defence appears to be sufficient to prevent their attacks. The grub gnawing his hidden burrow in the tree, and the scale insect adhering firmly to the twig, alike have their parasitic foes differing in size and method of attack.

It will be observed further that the value of any species in destroying obnoxious forms does not depend upon its size or strength. The greatest benefits are often effected by atoms so minute as almost to escape our search, but which by their numbers work wholesale destruction to their victims. The tiny fly that destroys a cluster of eggs is a greater helper than the larger one that might later destroy the brood of caterpillars, because in the latter case a certain amount of depredation is committed before the labours of the parasite are fulfilled. The diminutive devourers of aphides are of unknown value, as plant-lice increase so enormously by rapidly succeeding generations that if it were not for such providential safeguards they would swarm everywhere working devastation.

INSECTS INJURIOUS TO THE ELM.

BY F. B. CAULFIELD, MONTREAL.

First are insects injurious to the trunk.

1. The Common Elm-tree Borer, *Saperda tridentata*, Oliv, Order Coleoptera, Family Cerambycidæ.—A very destructive insect, boring in the inner bark and the surface of the wood of elm trees. Fitch states that the eggs are deposited in June and that the young larvæ nearly complete their growth before winter, and soon after warm weather arrives in spring they pass into the pupa state. Packard, who has found the larva in abundance in spring in Providence, under the bark of old dead elms, describes it as follows:—"White, sub-cylindrical, a little flattened, with the lateral fold of the body rather prominent; end of the body flattened, obtuse, and nearly as wide at the end as at the first abdominal ring. The head is one-half as wide as the first prothoracic ring, being rather large. The prothoracic segment, or that next to the head, is transversely oblong, being about twice as broad as long; there is a pale dorsal corneous transversely oblong shield, being about two-thirds as long as wide, and nearly as long as the four succeeding segments; this is smooth, except on the posterior half, which is rough, with the front edge irregular and not extending far down the sides. Fine hairs arise from the front edge and sides of the plate, and similar hairs are scattered over the body and especially around the end. On the upper side of each segment is a transversely oblong ovate roughened area, with the front edge slightly convex, and behind slightly arcuate. On the under side of each segment are similar rough horny plates, but arcuate in front, with the hinder edge straight.

It differs from the larva of *Saperda vestita*, Say, in the shorter body, which is broader, more hairy, with the tip of the abdomen flatter and more hairy. The prothoracic segment is broader and flatter, and the rough portion of the dorsal plates is larger and less transversely ovate."

These destructive grubs by tunnelling and undermining, loosen large portions of the bark, stopping the flow of sap, weakening and finally killing the tree.

The perfect insect is a flat-bodied beetle, measuring from four to six-tenths of an inch in length. It is of a rather dark brown colour above, with a grayish tinge caused by a coat of very short downy hairs. The under surface blueish gray. The basal joints of the antennæ are blackish brown, the remainder paler. A line of orange encircles each eye, and a stripe of the same colour runs from the antennæ to the hind margin of the thorax, and is continued along the edge of the wing-covers where they are bent down over the sides of the body, getting narrower gradually until it reaches the tip. From this border, three branches or teeth run obliquely towards the inner edge of the wing-covers, the middle one being the longest. There are six small black spots on the thorax, two on top just behind the antennæ, and two on each side below the orange stripe, and at each angle of the stripes on the wing-covers, there is a small dark patch or spot.

Any trees known to be attacked by borers should be cut down in the fall or during the winter, and used for firewood, care being taken not to leave any exposed during the summer; particularly in June and July, as at this time most of our borers deposit their eggs. It follows, therefore, that no freshly cut, or fallen trees, or branches should be left lying about, and if cordwood is piled, it should be covered, as the borers will surely find all newly felled wood if left exposed, and where such carelessness is permitted, will congregate and multiply year after year.

2. The Lateral Elm Borer, *Saperda lateralis*, Fab, Order Coleoptera, Family Cerambycidæ.—This beetle very closely resembles the preceding species, and its habits appear to be the same; it differs somewhat in markings, as the orange border on the wing-covers wants the three teeth running towards the inner margin. It bores in the inner bark of the elm, appearing in June, but seems to be less common than *Saperda tridentata*.

3. The Six-banded Dryobius, *Dryobius sexfasciatus*, Say, Order Coleoptera, Family Cerambycidæ.—According to Dr. Fitch, the larva of this species is similar to that of *Saperda tridentata*, and is found along with it; it is, however, larger than that species.

The perfect insect is a black beetle measuring from three-fourths to seven-eighths of an inch in length. The general colour is black, the thorax deeply margined with yellow, and each wing-cover is ornamented with four oblique bands of the same colour; the scutel, as entomologists name the little triangular piece at the base of the wing-covers, is also yellow. The antennæ are reddish brown, the legs reddish, the thighs being dilated or swollen, the abdomen is banded with yellow. I do not find this species on the Society's list of Canadian beetles, but think I have seen it recorded by a Canadian entomologist.

4. The Short-lined Dularius, *Dularius brevilineus*, Say, Order Coleoptera, Family Cerambycidæ.—This is a large black longicorn beetle, with dark blue wing-covers, not covering the whole of the abdomen; a rounded thorax, flattened above and the thighs very much swollen. "The antennæ are about two-thirds the length of the body, flattened towards the end, and somewhat serrate. The body above is velvety black, and brown black beneath. The head is black and coarsely punctured, and the prothorax is covered with short, dense, black hairs, like velvet. The wing-covers are Prussian blue in colour, bent, corrugated, with an interrupted ridge just outside the middle of each cover. They are covered with fine black

hairs, bent over. There is a pair of parallel short honey-yellow lines in the middle of each wing-cover, with a third one a little in front, making in all six streaks. The legs and feet are black. It is a little over eight-tenths of an inch in length." (Packard).

Bores in elm trees. Mr. George Hunt has observed this species inserting its eggs in the crevices of the bark. Occurs in Ontario and Quebec, but apparently is not abundant.

5. THE RED-HEADED CLYTUS, *Neoclytus erythrocephalus* (Fab,) Order Coleoptera, Family Cerambycidæ.—This pretty little beetle bores in the elm and also in hickory, etc. "It is about one-third of an inch long, and hardly one-tenth of an inch wide, the thorax being very cylindrical and as wide as the wing-covers. The colour is a rusty red, the head being of a lighter red, whence the name *erythrocephalus*, from two Greek words signifying "red-head." The antennæ are about one-half as long as the body; the elytra have four narrow yellow bands across them, and the legs are long and slender, especially the hinder pair, which are almost twice as long as the body. This beetle is exceedingly quick in its movements, and is difficult to capture as it runs swiftly, and take to flight instantly, if disturbed." (Harrington). This species has been taken on hickory by Mr. W. H. Harrington and has been bred from that tree by Drs. Leconte and Horn. It has been found under the bark of an old sugar maple by Mr. G. Hunt, and bred from oak by Dr. Riley. It has been found boring in dead elms in Michigan by Hubbard, and I have myself found it at Montreal on a fallen red oak, so that it appears to infest various kinds of forest trees.

At least two species of bark-beetles are known to infest the elm. The *Scolytidæ*, to which family they belong, are all of very small size. The female drives a long gallery between the bark and the wood, depositing an egg at intervals as she progresses; each larva when hatched drives a tunnel at almost a right angle to the main gallery, and when its transformations are completed, cuts a hole through the bark, through which it escapes. A tree infested by these insects, looks as if it had been riddled with shot, and the surface of the wood is scored in all directions with their burrows, loosening the bark and destroying the tree.

6. THE ELM BARK-BORER, *Phlœotribus liminaris*, Harris, Order Coleoptera, Family Scolytidæ.—According to Dr. Harris this little beetle "is of a dark-brown colour; the thorax is punctured, and the wing-covers are marked with deeply punctured furrows, and beset with short hairs. It does not average one-tenth of an inch in length."

7. THE BLACK ELM BARK-BORER, *Hylesinus opaculus*, Leconte, Order Coleoptera, Family Scolytidæ.—This is a stoutly built pitchy-black beetle found under the dry bark of elm and ash trees. Both these species are given in the Society's list of Canadian beetles.

8. According to Packard, THE SNOWY TREE CRICKET, *Œcanthus niveus*, Serville, deposits its eggs in the corky bark of the elm in the Southern States. The perfect insect, Fig. 43, is a slightly formed pale green cricket, with ivory white wings; the female, Fig. 44, with a long ovipositor. Very common in Ontario and Quebec, as far east as Montreal.

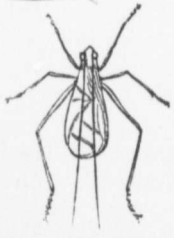

Fig 43.

Fig. 44.

Second are insects injuring the leaves.

9. THE ANTIOPA BUTTERFLY, *Vanessa antiopa*, Linne, Order Lepidoptera, Family Nymphalidæ.—Every one who has walked through the woods in early spring, must have noticed a large dark-colored butterfly, that dashing up when approached, after circling

around for a few moments, now fluttering, and anon gliding on motionless wing, settles down again in some sheltered spot where it sits opening and closing its wings, enjoying the balmy air and bright sunshine that once again awakens nature from her death-like sleep, to renewed life and activity. This is the well-known Antiopa butterfly, the "Camberwell Beauty" of the English entomologists. Antiopa passes the winter in any convenient shelter that it can find. Dr. Harris tells us that he has found it sticking to the rafters of a barn, and in the crevices of walls and stone heaps, huddling together in great numbers. It also hibernates on the ground, clinging to the under surface of stones in dry situations. The female deposits her eggs in a cluster around a twig of elm, willow or poplar; and until nearly full grown, the caterpillars keep together. The mature larva is black, thickly dotted with white giving it a grayish appearance. On top of the back is a row of eight brick-red spots, and the body is armed with a number of strong branching spines. The first brood of caterpillars appears in June, the second in August, and the butterflies from the last brood hibernate. The butterfly is dark maroon brown on the upper side of the wings, with a broad border of yellow, thickly dotted with brown; on the inner side of this border there is a band of black, in which is set a row of blue spots; the front edge of the wings is marked with fine yellow lines and two spots of the same colour. A variety is occasionally met with, in which the yellow border is unusually broad, and the dark band with the blue spots is wanting.

If numerous enough to be troublesome, these caterpillars may be killed by shaking them off the branch on which they are congregated, and crushing them. This should be done while they are small, as when nearly full grown, they scatter over the trees and wander about in search of a suitable place in which to undergo their transformations.

10. The Interrogation Butterfly, *Grapta interrogationis*, Fah, Order Lepidoptera, Family Nymphalidæ.—This is a dimorphic species, the hibernating form being known as *Fabricii*, the other as *Umbrosa*. Fig. 45 represents *G. progne*, a closely allied species.

Fig. 45.

Farther to the south there are about four broods in a season, but with us only two, and while the last brood gives the pale form which hibernates, the other broods are more or less mixed, *Fabricii* has the upper surface fulvous, spotted with black and clouded with warm brown; on the hind wings the brown predominates, the lighter colour being restricted to a patch on the upper angle, and a row of spots a little inside the outer edge; the edges of all the wings are light purplish blue. The front margin of the fore wings is convex, the tip cut squarely off, the outer margin concave. Hind wings tailed. Under surface marbled and clouded with various shades of brown and purple, and with an interrupted C. in the middle. *Umbrosa* has the upper surface of the hind wings almost entirely black, the submarginal row of spots being absent, the fore wings are not so falcate, and the tail on the hind wings is shorter.

"The young larvæ are whitish yellow, somewhat marked with brown, head black. After the first moult their colour is black, more or less specked with white, and they begin to be clothed with short spines, all black except those on the eighth and tenth segments which are whitish. After the second moult they begin to assume the type they retain to maturity. The spines are in seven rows, fleshy at base, slender and many-branching at extremity; the dorsal and first

lateral on joint 3 are black, on joints 2, 4, and 11 russet, the rest yellow; the second laterals black throughout, the lowest row greenish, head bilobed, black, with short black spines on vertices. After the third moult the larvæ vary greatly both in colour of body and spines. Some are black, finely specked with yellowish; others are yellow-brown, specked with yellow tubercles; others gray-brown with indistinct reddish lines between the spines on the dorsal and two lateral rows, and much tuberculated; others are black with fulvous stripes and profusely covered with yellowish tuberculated spots and points. The spines vary from black to fulvous and green and yellow. (French). Feeds on elm, basswood, hop, nettle and false nettle.

Grapta comma, Harris, closely resembles the preceding species but is smaller, and the wings are not so decidedly falcate, Food plants the same.

11. The Spring Canker Worm, *Anisopteryx vernata*, Peck, Order Lepidoptera, Family Phalænidæ.—Late in autumn when the leaves have fallen and the insect tribes have almost entirely disappeared, this fragile looking moth, Fig. 46, may be seen flying slowly through the deserted woods. "The fore wings of the male are ash-coloured and semitransparent, with a broken whitish band crossing the wings near the outer margin, and three interrupted brownish lines between that and the base. There is an oblique black dash near the tip of the fore wings and a nearly continuous black line before the fringe. The hind wings are plain, pale ash-coloured, or very light gray, with a dusky dot about the middle of each." (Saunders.)

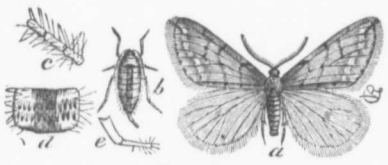

Fig. 46.

A second species, *A pometaria*, Fig. 47, very closely resembles *vernata*, but the wings are less transparent and are a little darker in colour, and the hind wings are generally crossed by a white band. The females of both species are wingless. The eggs are deposited in masses, generally in crevices in the bark. The larvæ vary in colour from greenish yellow to gray and dark brown. When fully grown they leave the trees by creeping down or else lower themselves by means of a silken thread and enter the ground to change to chrysalis. The moths generally emerge late in the fall, but some individuals do not appear until spring. To prevent the females creeping up the trees, strips of canvass or stiff paper, covered with tar or printers' ink, should be applied to the tree, renewing the covering from time to time to keep it soft and sticky, and as the moths may deposit their eggs below the band care must be taken to leave no crevices through which the young caterpillars might pass.

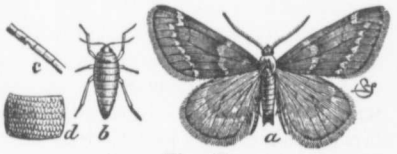

Fig. 47.

Canker worms are widely distributed, occurring in Canada as far east as Montreal at least. They feed on many kinds of leaves, and where precautionary measures are not adopted often prove exceedingly injurious.

12. The November Moth, *Epirrita dilutata*, Hubn, Order Lepidoptera, family Phalænidæ.—This moth, like the Canker worm, flies late in autumn and would be easily mistaken for that insect. The body and wings are pale ash gray, the fore wings with eight wavy black lines and double row of black dots next the margin. Fringe whitish. Hind wings with four faint wavy lines. Wings expand about an inch and a quarter. Although generally not common in this neighbourhood, it is occasionally quite abundant.

The following insects are also known to feed on the elm:

Coleoptera.—Galeruca calmariensis, Linn; Chrysomela scalaris, Leconte; Monocesta caryli, Say; Graptodera chalybea, Ill; Cotalpa lanigera, Linn; Magdalis armicollis, Say.

Hymenoptera.—Tremex columba, Linn; Cimbex Americana, Leach.

Hemiptera.—Colopha ulmicola, Fitch; Eriosoma Rileyi, Thomas; Schizoneura Americana, Riley; Callipterus ulmicola, Thomas.

Lepidoptera.—Papilio turnus, Linn; Ceratomia quadricornis, Harris; Hyphantria textor, Harris; Telea polyphemus, Hubn; Hyperchiria io, Fab; Halisidota caryæ, Harris; Orgyia nova, Fitch; Orgyia leucostigma, Abb and Smith; Datana ministra, Drury; Tolype velleda, Stoll; Edema albifrons, Walk; Clisiocampa Americana, Harris; Clisiocampa sylvatica, Harris; Apatela vinnula, Grote; Apatela occidentalis, Grote; Apatela morula, Guen; Apatela ulmi, Harris; Paraphia unipunctaria, Haw; Metanema quercivorana, Guen; Hibernia tiliaria, Harris; Sicya mucularia, Guen; Metrocampa perlaria, Guen; Eugonia subsignaria, Hubn; Nephopteryx undulatella, Clem; Nephopteryx? ulmi-arrosorella, Clem; Bactra? argutana, Clem: Lithocolletis argentinotella, Clem; Lithocolletis ulmella, Clem; Argyresthia austerella, Zeller.

Mr. A. F. Winn informs me that *Pyrameis atalanta*, Linn, feeds readily on elm in confinement and that he has seen *Grapta j-album* ovipositing on it.

THE ENTOMOLOGY OF SHAKESPEARE.

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

Some time ago, in a list of books upon Shakespeare and his works, I noticed that there was one upon the *Entomology of Shakespeare*. The book was beyond my reach. It occurred to me that it would be an interesting study to examine for myself and find out what particulars the great moralist and prince of poets had gathered concerning insects from the folk-lore of his day and his own observation, and to what account in his plays he had turned the knowledge he had gained. Accordingly, as leisure was afforded me, I read over the plays carefully and noted down the allusions to insects that I discovered. I found that the plays contained at least 168 references to insects, viz.:—To honey-bees, 18; humble-bees, 5; wasps, 8; ants, 3; stinging-insect undesignated, 1; butterflies, 6; moths and their larvæ, 24; beetles and their larvæ, 11; gnats, 10; fleas, 6; brize-flies, 2; bots, 1; blow-flies, 16; flies, 22; sheep-tick, 1; louse, 8; cricket, 4; locust, 1; grasshopper, 1; spiders, 17; scorpions, 3. Grouped according to orders these would give: Hymenoptera, 35; Lepidoptera, 30; Diptera, 58; Coleoptera, 11; Hemiptera, 7; Orthoptera, 6; Arachnida, 20. The references which I discovered are thus distributed: The highest numbers are in Troilus and Cressida, 11 notices referring to 9 species; Romeo and Juliet, 11 notices referring to 8 species; and 2nd Part of K. Henry VI., 10 notices referring to 6 species. Midsummer Night's Dream, K. Henry V., Cymbeline, and King Lear have 8 notices each; 1st Part of K. Henry IV. and Hamlet have 7 each; The Tempest, 2nd Part of K. Henry IV., Coriolanus, Antony and Cleopatra, Titus Andronicus and Othello have each 6 notices; The Winter's Tale has 5; The Merchant of Venice, Taming of the Shrew; 3rd Part of K. Henry VI., and Pericles Prince of Tyre have 4 each; The Two Gentlemen of Verona, Love's Labour's Lost, King John and 1st Part of K. Henry VI. have 3 each; Merry Wives of Windsor, Comedy of Errors, Macbeth, King Richard II. and Julius Cæsar have 2 each; Measure for Measure, As you like it, All's well that ends well, King Richard III., King Henry VIII. and Timon of Athens have each a solitary reference; and in Much ado about nothing I could find none. The number of species mentioned is over 30. We will take them according to orders.

HYMENOPTERA.—Shakespeare's ideas of the honey-bee seem to have been somewhat confused. He was misled probably by the old-world learning newly revived in his day; and, in his allusions to the "magnanimous leaders, the manners and employments, the tribes and battles of the race," he seems to have followed in the footsteps of Virgil (Georgics, Book IV.), or of writers who were acquainted with Virgil. His Archbishop of Canterbury in King Henry V. speaks of the head of the hive as a "King." The passage in which this occurs is very fine; and I am tempted to give it in its entirety.

——So work the honey-bees;
Creatures, that, by a rule in nature, teach
The act of order to a peopled kingdom.
They have a king, and officers of sorts:
Where some, like magistrates, correct at home:
Others, like merchants, venture trade abroad;
Others, like soldiers, armed in their stings
Make boot upon the summer's velvet buds;
Which pillage they with merry march bring home
To the tent-royal of their emperor:
Who, busied in his majesty, surveys
The singing masons building roofs of gold;
The civil citizens kneading up the honey;
The poor mechanic porters crowding in
Their heavy burdens at his narrow gate;
The sad ey'd justice, with his surly hum,
Delivering o'er to executor's pale
The lazy yawning drone.

Act I. sc. 1.

It would seem too that the strange story told by Virgil—how Aristæus, son of Cyrene, sacrificed cattle and left the carcases exposed till, "wondrous to relate, bees through all the belly hum amidst the putrid bowels of the cattle, pour forth with fermenting juices from the burst sides, and in immense clouds roll along, then swarm together on a top of a tree and hang down from the bending boughs" (Georgics, Bk. IV.)—had left an impression upon his mind, for he puts in the mouth of King Henry IV., who is lamenting the behaviour of Prince Henry of Monmouth, the words:

'Tis seldom when the bee doth leave the comb
In the dead carrion.

Act IV., sc. 4.

His observations of the bees however were, in many points, correct. He noticed that they "gather'd honey from the weed" (Henry V., Act IV., sc. 1); that they took "toll from every flower" (2nd Part K. Henry IV., Act IV., sc. 4); that "drones" rob the hives (Pericles, Prince of Tyre, Act II., sc. 1; Merchant of Venice, Act II., sc. 5; 2nd Part K. Henry VI., Act IV., sc. 1); that the wasps steal the honey and kills the bees (Two Gent. of Verona, Act I., sc. 2, and Titus Andronicus, Act II., sc. 3); that the swarm deprived of its leader becomes vindictive:

The commons like an angry hive of bees
That want their leader, scatter up and down
And care not who they sting in his revenge.

2nd Part K. Henry VI., Act III., sc. 2.

With the methods pursued by the bee-masters of his day he was acquainted. Bolingbroke says:

——like the bee tolling from every flower the virtuous sweets,
Our thighs pack'd with wax, our mouths with honey
We bring it to the hive; and like the bees
Are murder'd for our pains.

2nd Part K. Henry IV., Act IV., sc. 4.

And Talbot in 1st Part of K. Henry VI., Act I., sc. 5:

So bees with smoke and doves with noisome stench
Are from their hives and houses driven away.

The "Red-hipped humble-bee" of Shakespeare is *Bombus lapidarius*. This

species makes its nest very commonly under stone-piles by the road-side. It is a handsome and courageous insect; and Nick Bottom the Weaver gave the fairy Cobweb no light task when he bade him:

> Monsieur Cobweb: good monsieur, get your weapons in your hand; and kill me a red-hipped humble-bee on the top of a thistle; and good monsieur, bring me the honey-bag.
> Midsummer Night's Dream, Act IV., sc. 1.

It is to be hoped that Oberon interposed in behalf of the bee, for

> Full merrily the humble-bee doth sing
> Till he hath lost his honey and his sting;
> And being once subdued in armed tail
> Sweet honey and sweet notes together fail.
> Ibid, Act V., sc. 2.

Other passages in which bees are mentioned are The Tempest, Act I., sc. 2, and Act V., sc. 1; Midsummer Night's Dream, Act III., sc. 1, Love's labour's lost, Act III., sc. 1; All's well that ends well, Act IV., sc. 5; Comedy of Errors, Act II., sc. 1; 2nd Part K. Henry VI., Act IV., sc. 2; Troilus and Cressida, Act I., sc. 3, Act II., sc. 2, and Act V., sc. 2; Cymbeline, Act III., sc. 2; and Titus Andronicus, Act IV., sc. 1.

Shakespeare's allusions to the Wasp (*Vespa vulgaris*) convey the ideas of:

(1) *Petulance*—Tempest, Act V., sc. 1:

> Mar's hot minion is returned again
> Her waspish-headed son has broke his arrows.

See also Winter's Tale, Act I., sc. 2; 1st Part K. Henry IV., Act I., sc. 3; and Julius Cæsar, Act IV., sc., 3.

(2) *Injustice*—Two Gentlemen of Verona, Act I., sc. 2:

> O hateful hands to tear such loving words
> Injurious wasps! to feed on such sweet honey,
> And kill the bees that yield it, with your stings.

(3) *Vengeance*—Titus Andronicus, Act II., sc. 3:

> ——When you have the honey you desire
> Let not this wasp outlive, us both to sting.

In the 3rd Part of K. Henry VI., Act II., sc. 6, it is said of the defeated Lancastrians:

> For though they cannot greatly sting to hurt,
> Yet look to have them buz to offend thine ears.

The commonest species of English ants is Formica rufa. This probably is the species mentioned in 1st Part of K. Henry IV., Act I., sc. 3 by Hotspur:

> Why, look you, I am whipp'd and scourg'd with rods,
> Nettled and stung with pismires.

Among the "skimble-skamble stuff" that angered Hotspur was Glendower's talk of "the moldwarp and the ant" (Ib. Act III., sc. 1). The ant also is mentioned in King Lear, Act II., sc. 4.

LEPIDOPTERA.—To butterflies there are but few references in Shakespeare, but the few shew that the great dramatist had closely observed these beautiful objects. He knew of their metamorphoses, and says:

> ——There is a difference between a grub and a butterfly, yet your butterfly was but a grub.
> Coriolanus, Act V., sc. 5.

In his choice of an adjective to describe their wings he could not have found a more appropriate word than he has in

> ——Men like butterflies
> Shew not their mealy wings, but to the summer.
> Troilus and Cressida, Act III., sc. 3.

There is a charming suggestion of the shape of the butterfly's wings in Midsummer Night's Dream, Act II., sc. 1, where Titania bids the fairies:

——Pluck the wings from painted butterflies
To fan the moon-beams from the sleeping eyes.

(of the strange being with whom she is enamoured).

An adjective that Shakespeare applies on two occasions to the butterfly is "gilded":

And laugh at gilded butterflies.
King Lear, Act V., sc. 2.
I saw him run after a gilded butterfly.
Coriolanus, Act I., sc. 3.

What particular species he is alluding to in these passages we cannot tell—probably to one of the Fritillaries, and possibly to the "High Brown" (*Argynnis adippe*). In connection with this insect Morris writes:—"It has been well observed that all the best and highest enjoyments of man are those which, coming as they do direct from the bounteous hand of the Omnipotent himself, are not purchasable with money or any other human commodity. Every aspect under which nature is viewed throws light upon this remark and gilds it with the unmistakable lustre of truth." The under side of the hind-wings of Adippe are gorgeous with their large silver spangles and their rusty red spots. The combination of these as the insect flutters by certainly gives the idea of gilding. Other adjectives used by Shakespeare in relation to butterflies are "painted" (as above), and "summer" (Coriolanus, Act IV., sc. 6), both appropriate enough.

To moths and their larvæ we find many allusions. The canker-worm especially afforded the poet many apt and beautiful comparisons. Several of these refer to love. Who is not familiar with the words of Viola in Twelfth Night telling of the effect of unrequited love upon health:

——She never told her love
But let concealment, like a worm i' the bud
Feed on her damask cheek.
Act II., sc. 4.

There is wisdom quaintly expressed in the advice given by the suspicious Laertes to his sister:

The chariest maid is prodigal enough,
If she unmask her beauty to the moon:
Virtue itself 'scapes not calumnious strokes:
The canker galls the infants of the spring,
Too oft before their buttons be disclosed;
And in the morn and liquid dew of youth
Contagious blastments are most imminent.
Hamlet, Act I., sc. 3.

In the Two Gentlemen of Verona we have a playful conversation upon the effect of love upon the understanding:

Valentine.—Love is your master, for he masters you:
And he that is so yoked by a fool,
Methinks should not be chronicled for wise.
Proteus.—Yet writers say, As in the sweetest bud
The eating canker dwells, so eating love
Inhabits in the finest wits of all.
Valentine.—And writers say, As the most forward bud
Is eaten by the canker ere it blow,
Even so by love the young and tender wit
Is turn'd to folly; blasting in the bud,
Losing his verdure even in the prime,
And all the fair effects of future hopes.

In another passage beautiful and pathetic "grief" is the canker. The unhappy Constance speaks of her little son Arthur, who is in the toils of his wicked uncle John:

But now will canker sorrow eat my bud
And chase the native beauty from his cheek.
King John, Act III., sc. 4.

In the 2nd Part of K. Henry VI. (Act I., sc. 2) the canker is "ambition." The Duke of Gloster, replying to his wife, says:

> O Nell, sweet Nell, if thou dost love thy lord,
> Banish the canker of ambitious thoughts.

In another part of the same play (Act III., sc. 1) it is *disappointment*. The unfortunate Henry exclaims, when ill news comes from France:

> Thus are my blossoms blasted in the bud
> And caterpillars eat my leaves away.

In Hamlet it is overwrought feeling. The gentle Ophelia, mourning for the strange behaviour of her lover, says (Act III., sc. 1):

> And I, of ladies most deject and wretched,
> That suck'd the honey of his music vows,
> Now see that noble and most sovereign reason,
> Like sweet bells jangled, out of tune and harsh
> That unmatched form and feature of blown youth,
> Blasted with ecstasy.

And in Romeo and Juliet it is death:

> Two such opposed foes encamp them still
> In man as well as herbs, grace and rude will;
> And, where the worser is predominant,
> Full soon the canker death eats up the plant.

Other passages in which reference to the canker is made are Midsummer Night's Dream, Act III, sc. 2; 2nd Part of K. Henry IV., Act II., sc. 2, and Act IV., sc. 4; 1st Part of K. Henry VI., Act II., sc. 5; Coriolanus, Act IV., sc. 6; Romeo and Juliet, Act I., sc. 1.

In England the larva of one of the plume moths, *Pterophorus rhododactylus*, feeds in the buds of the rose. There is a variety of small moths that infest the blossoms, leaves and young shoots of the Queen of Flowers. Among them are:

GEOMETRINA.	TORTRICINA.	TINEINA.
Articlea badiata.	*Antithesia ochroleucana.*	*Lampronia quadripunctella.*
" *derivata.*	*Pardia tripunctana.*	*Colophora gryphipennella.*
Cideria psittacata.	*Spilonota roborana.*	
" *fulvata.*	" *rosaecolana.*	
	Hedya pauperana.	
	Crœsia Bergmanniana.	
	" *holmiana.*	
	Peronea variegana.	

Of larvæ that feed upon the flower-buds of the apple, one of the most destructive is that of the Figure of Eight Moth (*Diloba ceruleocephala*), one of the Bombyces. This insect is so destructive that it was called by Linnaeus, the "Pest of Pomona." The larvæ of the Winter Moth (*Cheimatobia brumata*) are also very injurious. Immediately after they are hatched they make their way to the unopened buds and burrow in them, concealing themselves from sight. The Green Pug (*Eupithecia rectangulata*) is another objectionable insect:—"The larva feeding in the young buds of the apple-trees, devouring the stamens and pistils, and protecting itself by tying together the petals" (*Stainton's Manual*, Vol. II., p. 92). By the caterpillars of a tiny moth *Hyponomeuta padellus*, belonging to the Tineina, the apple-trees are not unfrequently entirely stripped of their foliage. Besides the insects already named, at least 15 species, belonging to the groups Tortricina and Tineina, infest the English orchards.

In King Richard II., by a striking metaphor England is represented as a disordered garden, over-run with caterpillars (Act III, sc. 4). Twice the word "caterpillar" is used by Shakespeare as one of contempt; in 1st Part of K. Henry IV., Act II., sc. 2, and in 2nd Part of K. Henry VI., Act IV., sc. 4.

I find the word "moth" used three times: In the *Merchant of Venice*, "Thus has the candle singed the moth," Act II., sc. 9; in *Othello* where Desde-

mona speaks of herself as a "moth of peace," Act I., sc. 3; and in *Coriolanus*, "You would be another Penelope, yet they say all the yarn she spun, in Ulysses' absence, did but fill Ithaca full of moths," Act I., sc. 3. The reference in this last passage is probably to the tapestry moth, *Tinea tapetzella*.

DIPTERA.—The most numerous of Shakespeare's entomological allusions are to the two-winged flies. As a fitting image of littleness and meanness he makes use of the gnat, as where Simonides says that princes who are not given to hospitality:

> Are like to gnats which make a sound, but killed,
> Are wondered at.
> Pericles, Prince of Tyre, Act II., sc. 3.

And where Biron mocking at the love-sick King of Navarre:

> O me, with what strict patience have I sat
> To see a king transformed to a gnat.
> Love's labour's lost, Act IV., sc. 3.

But the diminutive is used with much feeling and affection, where Imogen, speaking of the departure of her banished lord, says:

> I would have broke my eye-strings; crack'd them, but
> To look upon him; till the diminution
> Of space had pointed him sharp as my needle,
> Nay, follow'd him, till he had melted from
> The smallness of a gnat to air.
> "Cymbeline," Act I., sc. 4.

There is knowledge both of human nature and of natural history, in the rebuke which Antipholus of Syracuse administered to Dromio of Syracuse.

> Because that I familiarly sometimes
> Do use you for my fool, and chat with you,
> Your sauciness will jest upon my love,
> And make a common of my serious hours.
> When the sun shines, let foolish gnats make sport,
> But creep in crannies, when he hides his beams.
> Comedy of Errors, Act II., sc. 2.

The Flea (*Pulex irritans*) is spoken of in at any rate seven passages:—"Henry V.," Act II., sc. 3, and Act III., sc. 6; "Merry Wives of Windsor," Act IV.," sc. 2; "Twelfth Night," Act III., sc. 4; "All's Well that Ends Well," Act IV., sc. 3; "Taming the Shrew," Act IV., sc. 3, and 1st Part K. Henry IV., Act II., sc. 1; always in a trifling sense.

Shakespeare's allusions to the breeze-fly or gad-fly of the ox (*Tabanus bovinus*) are forcible. In Troilus and Cressida Nestor, replying to Agamemnon, to illustrate the difference between "valour's show" and "valour's worth," says that in Fortune's

> —— ray and brightness
> The herd hath more annoyance by the brize
> Than by the tiger; but when the splitting wind
> Makes flexible the knees of knotted oaks,
> And flies flee under shade, why then the thing of courage
> As rous'd with rage, with rage doth sympathize.
> Act I., sc. 3.

And in Antony and Cleopatra, Scarus cries out against the Egyptian Queen who was hastening from the fight off Actium:

> Yon ribald-rid nag of Egypt
> . . . . . .
> The brize upon her like a cow in June
> Hoists sails and flies.

Of the many allusions to flies made by Shakespeare, some are used in a slighting and contemptuous sense, as when Timon of Athens calls his false friends

> Most smiling, smooth, detested parasites,
> Courteous destroyers, affable wolves, meek bears,
> You fools of fortune, trencher friends, time's flies.
> Act III., sc. 6.

Or when La Pucelle says of the dead Talbot, whom Sir W. Lucy had enquired for under many sounding titles:

> Here is a silly, stately style indeed!
> The Turk, that two and fifty kingdoms hath,
> Writes not so tedious a style as this.—
> Him, that thou magnifiest, with all these titles,
> Stinking, and fly-blown, lies here at our feet.
> 1st Part of K. Henry VI., Act IV., sc. 7.

Occasionally the references are made vindictively, as when Iago exclaims:

> ——"Call upon her father,
> Rouse him; make after him, poison his delight,
> Proclaim him on the streets, incense her kinsmen,
> And though he in a fertile climate dwells,
> Plague him with flies."
> Othello, Act I, sc. 1.

At one time the fecundity of flies in hot weather, affords the poet an apt simile to denote the fickle populace:

> Impairing Henry, strength'ning, mis-proud York,
> The common people swarm like summer-flies;
> And whither fly the gnats but to the sun?
> And who shines now, but Henry's enemies?
> 3rd Part of K. Henry VI., Act II., sc. 6.

At another it serves to indicate excessive conceit. Biron says of "figures fantastical:"

> —— These summer flies
> Have blown me full of maggot ostentation.
> Love's Labour's Lost, Act V., sc. 2.

Often the allusion has a tragic ring, as when poor blinded Gloster cries in his despair:

> As flies to wanton boys are we to the gods;
> They kill us for their sport.
> King Lear, Act IV., sc. 1.

And when, in Cymbeline Sicilius Leonatus, addressing Jupiter, says:

> No more thou thunder-master show
> Thy spite on mortal flies.
> Act V., sc. 4.

Among the references to flies are two that show how closely Shakespeare had observed these insects. In K. Henry V., Act V., sc. 1, he places in the mouth of the Duke of Burgundy the words:

> Like flies at Bartholomew-tide, blind, though
> They have their eyes; and then they will endure handling,
> Which before would not abide looking on.

St. Bartholemew's day comes on the 24th of August; under the old style it would be September 4th, when the flies in the cool English autumn would be growing dull and sluggish. But an allusion shewing more close attention even than that is found in Othello, Act IV., sc. 2.

> ——O, ay, as summer flies are in the shambles,
> That quicken even in blowing.

It is not every one who knows that the flesh-fly, *Sarcophaga carnaria* is ovo-viviparous; but Shakespeare knew it.

The sheep-tick, *Melophagus ovinus* is mentioned once in the plays.

> —— I would rather be a tick in a sheep than such a valiant ignerance.
> Troilus and Cressida, Act III., sc. 3.

Other references to flies will be found in The Tempest, Act III., sc. 2; As You Like It, Act IV., sc. 1; Winter's Tale, Act IV., sc. 3; King John, Act IV., sc. 1; 2nd Part K. Henry IV., Act III., sc. 1; 2nd Part of K. Henry VI., Act I., sc. 2; Troilus and Cressida, Act II., sc. 3; Antony and Cleopatra, Act II., sc. 2 and Act III., sc. 2; Cymbeline, Act IV., sc. 2; Titus Andronicus, Act III., sc. 2, and Act V., sc. 2; Pericles, Prince of Tyre, Act IV., sc. 1, and Act IV., sc. 4;

King Lear, Act IV., sc. 6; Romeo and Juliet, Act II., sc. 3, and Act II., sc. 4; Hamlet, Act II., sc. 2, Act IV., sc. 3, Act V., sc. 1, and Act V., sc. 2, and Titus Andronicus, Act IV., sc. 1.

COLEOPTERA.—Shakespeare's allusions to beetles are very fine and telling. What can be more so than this:

> Ere to black Hecate's summons
> The shard-borne beetle with his drowsy hum
> Hath rung night's yawning peal, there shall be done
> A deed of dreadful note.
>
> Macbeth, Act III., sc. 4.

The expression "shard-borne," is not quite correct. The elytra of the beetle are uplifted during flight, it is true; but the gauzy wings that ply beneath them are the sustaining and propelling instruments. What particular species of beetle (if any), Shakespeare had in his mind when he penned these words we cannot tell. The Dor-beetle, *Geotrupes stercorarius*, is a striking object, and flies in the dusk, and may have attracted his attention.

Scarcely less beautiful than the reference given above, is that to *Lampyris noctiluca*:

> The glow-worm shews the matin to be near
> And 'gins to pale his ineffectual fire.
>
> Ibid, Act I, sc. 1.

Another fine passage is found in Measure for Measure, Act III., sc. 1.

> —— Dar'st thou die?
> The sense of death is most in apprehension;
> And the poor beetle, that we tread upon,
> In corporal sufferance finds a pang as great
> As when a giant dies.

Here, of course the intention is not to give an increased idea of the pains of the beetle, but to make us think less of the death-throes of the giant—the giant suffers as little as the beetle.

What a conception of depth is conveyed to us in the words:

> —— How fearful
> And dizzy 'tis to cast one's eyes so low!
> The crows and choughs that wing the midway air
> Show scarce so gross as beetles.
>
> King Lear, Act IV., sc. 6

By Caliban in The Tempest, Act I., sc. 2, and by the fairies in Midsummer Night's Dream, beetles are spoken of as things to be dreaded.

In the 2nd Part of King Henry IV., Act II., sc. 4, there is a very curious metaphor:

> His face is Lucifer's privy kitchen,
> Where he doth nothing but roast malt-worms.

The malt-worms are the larvæ of *Tenebrio molitor* and *Tenebrio obscurus*.

Other references to beetles will be found in Midsummer Night's Dream, Act III., sc. 1; Taming of the Shrew, Act IV., sc. 1; Antony and Cleopatra, Act III., sc. 2; and Cymbeline, Act III., sc. 3.

HEMIPTERA.—In the Merry Wives of Windsor, Act I., sc. 1, is an amusing play upon the word "luce." Slender exalting Robert Shallow, "Justice of the Peace and *coram*," and "*cust-alorum*," and "*ratolorum*," and "*armigero*," says:

> All his successors, gone before him, have done 't; and all his ancestors that come after him, may; they may give the dozen white luces in their coat.

To which Sir Hugh Evans, the Welsh chaplain replies:

> The dozen white louses do become an old coat well, it agrees well passant; it is a familiar beast to man, and signifies—love.

The passage shews that Shakespeare had not forgotten his early escapade, and angry slur upon Sir Thomas Lucy of Charlecote:

> If lousy is lucy, as some folks miscall it,
> Then Lucy is lousy whatever befall it.

The "luce" is, of course, the fleur-de-lis, or flower-de-luce, and the "coat," Robert Shallow's coat of arms. In the association of the "familiar beast," with "love," we are reminded of the "lousy and lecherous" of one of our modern ballad-writers.

Shakespeare makes at least eight allusions to the louse. One of them conveys the strongest expression of contempt that can possibly be imagined: "I care not to be the louse of a lazar." (*i. e.* of a man afflicted with loathsome diseases). Troilus and Cressida, Act V., sc. 1.

ORTHOPTERA.—"Shall we be merry?" asks Prince Henry in 1st Part of K. Henry IV., Act II., sc. 4. "As merry as crickets," answers Poins. The cheerful note of the cricket (*Acheta domestica*), produced by the rubbing together of the notched edges of the insect's upper wings, must have been a familiar sound to Shakespeare. When all is quiet around the hearth the note arises in many an English dwelling. But a very slight noise will startle the insect, and cause a cessation of its music. So the little Mamillius in a Winter's Tale, says that he will tell his story *so softly*, that "yon crickets shall not hear it," Act II., sc. 1.

Amongst the equipments of Queen Mab is a "whip of cricket bone." Romeo and Juliet, Act I., sc. 4. The "winter cricket" is spoken of in the Taming of the Shrew, Act IV., sc. 3.

I find but one allusion to locusts—that made by Iago when speaking of Othello and his countrymen.

> These Moors are changeable in their wills:—fill thy purse with money; the food that to him now is as luscious as locusts, shall be to him shortly as bitter as coloquintida.—Othello, Act I, sc. 3.

The species mentioned here is doubtless *Œdipoda migratorius*, which often visits Morocco, and is used for food.

The grasshopper is mentioned in Romeo and Juliet Act I., sc. 4, where the cover of Queen Mab's wagon is said to be made of the wings of grasshoppers.

ARACHNIDA.—In the Merchant of Venice we have an instance of the skill with which the great poet could draw, even from the work of a disgusting insect, a fitting illustration to enhance the attractions of an admired lady.

> —— Here, in her hair,
> The painter plays the spider, and hath woven
> A golden mesh, to entrap the hearts of men,
> Faster than gnats in cobwebs.
> Act III., sc. 2.

A different kind of weaving is spoken of in the 2nd Part of K. Henry VI., Act III., sc. 1:

> My brain more busy than the labouring spider
> Weaves tedious snares to trap mine enemies.

And in Othello, Act II., sc. 1, where Iago says to himself,

> With as little a web as this
> Will I ensnare as great a fly as Cassio.

And yet again in K. Henry VIII., Act, I., sc. 1, where it is said of Wolsey:

> —— Spider-like
> Out of his self-drawing web, he gives us note
> The force of his own merit makes his way.

With wonderful effect Shakespeare makes use of the Spider in shewing the power of imagination.

> There may be in the cup
> A spider steep'd, and one may drink, depart,
> And yet partake no venom; for his knowledge
> Is not infected: but if one present
> The abhorr'd ingredient to his eye, make known
> How he hath drank, he cracks his gorge, his sides,
> With violent hefts:—I have drunk and seen the spider.
> Winter's Tale, Act II., sc. 1.

In Troilus and Cressida, Act V., sc. 2, is a reference to Arachne. Arachne, according to the ancients, was the daughter of Idmon, a Lydian. She was a skilful spinner, and contended with Pallas. Defeated and chagrined, she hanged herself, and was turned into a spider.

In King John, Act IV., sc. 3, Hubert suspected of murdering Prince Arthur, is told that

> The smallest thread,
> That ever spider twisted from her womb,
> Will serve to strangle thee.

Other passages referring to spiders may be found in Midsummer Night's Dream, Act II., sc. 3; King Richard II., Act III., sc. 2; King Richard III., Act I., sc. 2, and Act II., sc. 4; Cymbeline, Act IV., sc. 2; King Lear, Act IV., sc. 6; Romeo and Juliet, Act I. sc. 4, and Act II., sc. 6.

Scorpions are spoken of in Macbeth, Act III., sc. 4; 2nd Part of K. Henry VI., Act III., sc. 2; and Cymbeline, Act V., sc. 5.

It is evident that Shakespeare, in his walks around Stratford and on the pleasant banks of Avon, had found food for reflection in the appearances and habits of the commoner insect tribes. His were the observing eye and the contemplative mind; and with marvellous power he turned the knowledge of insect-life that he acquired to account, for the instruction and amusement of the men of his own day, and of after generations. He was one who could find

> Tongues in trees, books in the running brooks,
> Sermons in stones, and good in everything.

And we are happy in that he has, in so many instances, interpreted these tongues, translated these books, written down the sermons and pointed out the good for us.

Enemies of the Grain Aphis.—Prof. H. Garman, Entomologist and Botanist of the Kentucky Agricultural Experiment Station, in a paper on the grain louse (Siphonophora avenæ) has the following to say about its natural enemies:

The helplessness of plant lice makes them the prey of many predaceous and parasitic insects. A visit to infested wheat fields in June showed great numbers of these present among the lice. Undoubtedly the injury to grain was very much lessened by the work of these friends of ours, yet, as we have shown, lice still exist in the fields, and they are liable again to assume destructive numbers.

Chief among the enemies of the grain louse are certain small, dark-coloured, four-winged flies, which belong to the same order as the common honey bee. These little flies deposit their eggs in the bodies of the plant lice, placing a single egg in each louse, and from the eggs come small grubs which live in the interior of their host, finally emerging after its death as egg-laying flies. Grain lice infested with these grubs become swollen, assume a brown colour, and by some means are fastened to the plants, where they remain as empty skins after the parasite emerges.

Small two-winged flies, about five-sixteenths of an inch long, with brassy brown thorax, and with the abdomen striped crosswise with black and yellow, also do good service in destroying the lice. They scatter their eggs among the colonies, and from these hatch greenish larvæ, which destroy the lice by seizing them and sucking their juices.

The lady bugs in both larval and adult stages devour the lice bodily. Several species of these beetles were common in the fields, but the most conspicuous from

size and abundance, was the nine-spotted lady bug (*Coccinella 9-notata*). It may be recognized by the arrangement of the nine black spots on the brown wing covers—four on each side, the ninth just behind the thorax and overlying the middle line. It is very nearly a half sphere in shape. The other species are like it in general shape, but differ in details of colour and markings. A small list of other insects which do more or less good in destroying the aphides could be given, but this will suffice to give an idea of the more abundant and useful of our insect friends.

Birds have been thought to destroy the lice, but I have seen no evidence of their doing so. Most birds depend on larger insects, and it is only occasionally that the small species, such as warblers, eat plant lice of any kind. Excepting the Maryland yellow-throat, birds of this family rarely occur in our grain fields, so that we can hope nothing from their help. The English sparrow, with its clumsy beak and grain-eating propensity, certainly does no good in this direction.

EXPERIMENTS WITH ARSENITES.—In the Bulletin of the Iowa Agricultural Experiment Station for August, 1890, Prof. Gillette gives an elaborate and interesting account of a series of experiments that he carried out for the purpose of testing the use of arsenites in the warfare against noxious insects.

"Paris green, he says, was brought into prominence as an insecticide for the first time in this country in 1869, and London purple in 1877. Arsenious acid (white arsenic) was successfully used for the destruction of the Canker-worm as early as 1875 and is still frequently recommended for the destruction of insects. During these years the arsenites have arisen to the first rank as insect destroyers. They have been largely experimented with by entomologists and widely used by farmers and fruit-growers, and yet there is much difference of opinion as to the proportions in which each may by safely applied to different plants for the destruction of insects. In fact a serious obstacle in the way of a more free and successful use of the arsenites has been their liability to injure tender foliage, even when applied very dilute. In the experiments of the past two seasons, herein reported, I have given much attention to the finding of some method of applying these poisons so as to prevent injury to foliage without lessening their effectiveness in destroying insect life, and the success met with in this direction has been most gratifying. I also give the results of experiments to determine relative injuries to foliage from applications of the arsenites when freshly mixed and when allowed to stand a few days before being applied; to show the effect upon foliage by adding paste or soap to arsenical mixtures; to show the effects of sun, dew and rain upon foliage treated with arsenical mixtures; to show whether or not it is practical and safe, so far as injury to the plant is concerned, to mix the arsenites with insecticides that kill by external contact; and to show the effects of combining the arsenites with fungicides."

After giving a detailed account of his various experiments, he arrives at the following conclusions:—

"*1. The oldest leaves are most susceptible to injury from arsenical applications. They often turn yellow and drop without showing the burnt spotted appearance.**

2. Dews, and probably direct sunlight, increase the injuries done by the arsenites to foliage.

* I have put in italics those conclusions that seem to me to be well proven from the experiments here reported. Concerning the others there is some doubt, and further experiments are necessary to determine positively the facts.

3. Leaves kept perfectly dry can hardly be injured by the arsenites, even when they are applied very abundantly.

4. Applications made in the heat of the day and in the bright sunlight do not injure foliage more than when applied in the cool of the day.

5. The only effect of a heavy rain or dashing shower following an application of one of the arsenites is to lessen the injury to foliage.

6. Leaves suffering from a fungous disease are more susceptible to injury than are healthy leaves.

7. When freshly mixed and applied, London purple is most and white arsenic is least injurious to foliage.

8. White arsenic in solution should not be used upon foliage without first adding lime, Bordeaux mixture or some other substance to prevent its injurious effects upon foliage.

9. White arsenic, if ollowed to stand many days in water before being applied, will do far greater harm to foliage than if applied as soon as mixed.

10. Lime added to London purple or Paris green in water greatly lessens the injury that these poisons would otherwise do to foliage.

11. Lime added to a mixture of white arsenic in water will greatly increase the injury that this poison would otherwise do to foliage. If the arsenic is all in solution, the lime witl then lessen the injury, as in the case of London purple or Paris green.

12. London purple (Paris green and white arsenic have not yet been tried) can be used. at least, eight or ten times as strong without injury to foliage if applied in common Bordeaux mixture instead of water.

13. The arsenites cannot by any ordinary method be successfully mixed in a kerosene emulsion.

14. The arsenites mix readily in resin compounds and do not seem to be more injurious to foliage than as ordinarily applied in water.

15. The arsenites in strong soapy mixtures do considerably more damage to foliage than when applied in water only.

16. The arsenites mix readily in carbonate of copper solution and do not seem to do more harm than when applied in water only.

17. London purple in sulphate of copper solution does vastly more harm than when applied in water only.

HONEY BEES AND ARSENICALS USED AS SPRAYS.—Mr. H. O. Kruschke, of Juneau county, Wisconsin, in the *American Garden* for January, 1890, p. 57, warns prospective sprayers that the first man caught applying arsenic to trees in full bloom will be prosecuted—reasoning that the spraying of such trees will result in the storage by the bees of poisoned honey, the consumption of which will be dangerous.

In our Report for last year, (1889, page 87) we quoted from *Insect Life* an account from Prof. Webster of the spraying of fruit trees without any ill results to either bees or honey. "The prevailing belief," says *Insect Life*, "is, however, the other way, and cases are on record where serious destruction of bees has resulted from spraying. In the case of the apple, particularly, the application should not be made until the bloom has begun to fall, when no injury will be

likely to result. It was because of the possibility of danger that in the beginning we were very slow to recommend the wholesale spraying of orchards with the arsenical mixtures, but experience has shown here, as in other cases, judicious and cautious use is attended only with benefit, and that the possible harm is reduced to such a minimum as to almost justify its being left out of consideration."

ANT HILLS AND SLUGS.—I have resorted to many expedients to get rid of the ant hills that disfigure my lawn and sometimes seriously injure plants and shrubs, and have finally succeeded in conquering them. I first hive them,—break up the nest pretty thoroughly and if it is near the roots of a plant draw as much of the débris as possible a little way from it and turn over it a large plant jar. The ants will promptly appropriate the jar, remove their larvæ to it, and fill it with pellets of earth. I then drench this with kerosene emulsion reduced to a strength of 2 to 3 per cent., which will kill every ant thoroughly drenched with it. It is more destructive to them than pure kerosene, which does not adhere to them. In this way I have thoroughly conquered the ants.

The rose slug and the currant worm I keep completely under by use of hellebore, a tablespoonful to a gallon of water, and forcing it violently among the foliage with a hydropult. Commencing in the spring before I can find a slug or a worm, and repeating the drenching once a week for three or four weeks, I can destroy them completely before they do any damage. On one hundred roses I was able this spring to find only two slugs, while the foliage of some common sorts I did not spray was completely destroyed.—[M. C. Read, Hudson, Ohio, n *Insect Life.*

GOOD INSECTIVOROUS BIRDS.—The following birds are to be classed among the most helpful kinds in the general warfare against insects: Robins, for cut and other earth worms. Swallows, night-hawks and purple martins, for moth catchers. Pewees, for striped cucumber bugs. Wood thrushes and wrens, for cut worms. Cat birds, for tent caterpillars. Meadow larks, crows and woodpeckers, for wireworms. Blue-throated buntings, for canker worms. Black, red-winged birds, jays, pigeons, doves, and chippies—strawberry pests. Quail, for chinch bugs and locusts. Whip-poor-wills, for moths. Hawks, all night birds, owls, tanagers, black-winged summer red birds, etc.—curculios. There may also be mentioned the following insect pest destroyers: Indigo birds, nut crackers, fly catchers, chimney swifts, chipping and song sparrows, black birds, mocking birds and orioles.

There is little doubt that for every bird which is injurious to fruit that is killed, there are a hundred killed that are beneficial. Of course the whole life of the bird must be considered, for very many are fruit eaters. The only question is, does the bird, on the whole, do most damage or good?

The man who indiscriminately kills the birds in his orchard and berry patch is not fit to live, and he will surely lose more than he will gain even from a financial point of view.—*Prairie Farmer.*

RESISTANCE TO COLD BY A CATERPILLAR.—Mr. Otto Dugger, St. Anthony Park, Minn., gives in *Insect Life* the following instance of resistance to extreme cold by a caterpillar of the Dusky Spilosoma (*S. fuliginosa*, Linn):—"December 3, 1889. Found to-day in a little depression of the soil a clear cake of ice, and

imbedded in it the larva of the above species. By means of a hot iron I separated a cube of ice with the inclosed larva, and took it to my office. The caterpillar was entirely and solidly inclosed by the ice; no air-spaces could be detected among the hair. How long the caterpillar had been inclosed I could not say. Left the cube of ice in front of my window, where the temperature sunk for two days to 11° below zero. Later the weather moderated, and during the day a little ice would melt near the caterpillar, but never exposing it to the air. After being inclosed for fourteen days, I carefully melted the ice and removed the caterpillar to a piece of blotting paper. In less than thirty minutes the larva was crawling about, not injured in the least. Yet, to escape further experimentation, it has shown good sense and spun up, and transformed into a pupa, healthy to all appearances."

Saw-fly Borer in Wheat.—Prof. J. H. Comstock, Entomologist, Cornell University, Ithaca, N. Y., describes a new saw-fly working in wheat, known as Cephus pygmæus, order Hymenoptera, of the family Tenthredinidae as follows

An insect destructive to wheat, but previously unknown in this country, has appeared in considerable numbers on the Cornell University farm. I do not know of its occurrence anywhere else in this State; but as it is extremely abundant here, it is doubtless spread over a considerable area. It was first observed in this locality two years ago by one of our students, the late Mr. S. H. Crossman while making an investigation of wheat insects. Mr. Crossman's studies, however, were sadly terminated before he had carried his investigations of this species very far; and it has fallen to me to continue the work begun by him.

On examining the stalks of wheat at harvest time by splitting them throughout their length, it was found that some of them had been tunnelled by an insect larva. This larva had eaten a passage through each of the joints so that it could pass freely from one end of the cavity of the straw to the other. In addition to tunnelling the joints they had also fed more or less on the inner surface of the straw between the joints; and, scattered throughout the entire length of the cavity of the straw, except the smaller part near the head, were to be seen yellowish particles, the excrement of the insect.

If infested straws be examined a week or ten days before the ripening of the wheat, the cause of this injury can be found at work within them. It is at that time a yellowish, milky-white worm, varying in size from 1-5 inch (5 mm.) to ½ inch (12 mm.) in length. The smaller ones may not have bored through a single joint; while the larger ones will have tunnelled all of them, except, perhaps, the one next to the ground.

As the grain becomes ripe the larva works its way towards the ground, and at the time of the harvest the greater number of them have penetrated to the root. Here in the lowest part of the cavity of the straw they make preparations for passing the winter, and even for their escape from the straw the following year. This last is done by cutting the straw circularly on the inside, nearly severing it a short distance, varying from one-half inch to one inch from the ground. If the wheat were growing wild, the winter winds would cause the stalk to break off at this point, and thus the insect after it had reached the adult stage in the following year could easily escape; while but for this cut, it would be very liable to be imprisoned within the straw. But under ordinary circumstances the straw is cut by the reaper before it is broken off at this point, and consequently that breaking off does not occur. If, however, there is a strong wind just before the harvest and after the straws have been cut in this manner by the insects, they

are very liable to break off; the lodging of the grain may, therefore, be largely due to the injuries of this insect. In one field just before the harvest I observed a large number of isolated straws lying in a horizontal position; there was not the general breaking down of the grain characteristic of wind and rain; but distributed through the grain that was standing there was a large number of isolated straws that were lodged. A careful examination showed that this breaking down of the grain, in 45 per cent. of the cases, was directly due to the injuries of this insect. In many cases the straws had been broken off a considerable distance above the ground, and before the larva had made the characteristic circular cut near the root. An examination of these straws showed that the larva had eaten all, or nearly all, of the softer inner part of the straw for a short distance, thus making a weak place which was easily broken. As a rule, however, the larva obtains a greater part of its nourishment by tunnelling the joints of the straw and does not eat enough of the straw in any place to cause it to break until it makes the circular cut near the ground described above.

After the circular cut has been made, the larva fills the cavity of the straw just below it for a short distance with a plug of borings. Between this plug and the lower end of the cavity of the straw there is a place measuring about one-half inch in length (10 mm. to 15 mm.) It is here that the insect passes the winter. Immediately after cutting the straw and making this plug the larva makes a cocoon by lining the walls of this space with a layer of silk. This layer is thin but very firm and more or less parchment-like; it can, however, be broken with slight difficulty, being somewhat brittle.

Within this cocoon, which remains in the stubble after the grain is cut, the insect passes the winter, in the larval state. It changes to a pupa during March or April; and sometime during the month of May the adult insect appears.

The exact date of the appearance of the insect depends upon the nature of the weather. This year from pupæ collected on the 23rd of April and brought into the Insectary, the adults emerged from the 8th to the 10th of May; while the insects left in the fields were ten days later in emerging.

The adult insect is a four-winged fly belonging to the order *Hymenoptera*, the order that includes the bees, wasps and ants; and it is a member of the family *Tenthredinidae* of this order, a family comprising the insects commonly known as saw-flies. This popular name refers to the fact that in this family the female insects are furnished with a more or less saw-like organ. This arises near the caudal end of the body, and is the ovipositor. By means of it the insects are able to make incisions in the tissues of plants for the reception of their eggs.

In the *Canadian Entomologist*, 1890, p. 40, Mr. Harrington records the occurrence of this insect at Ottawa, Ont., and also at Buffalo, N. Y.

THE HABITS OF A GROUND-HORNET.—*Stizus speciosus* is the largest native ground-hornet, and its formidable appearance and great activity generally secure it undisputed possession of the square rod where it happens to alight. It is from an inch to an inch and one half in length; the head and thorax are brown and the abdomen is black with six irregular yellow blotches. These markings are discernible as it flies swiftly about its business and give it a particularly tiger like appearance. It seems to be afraid of nothing, and if you walk near its burrow it flies with a menacing buzz in circles about you, and its brown, black and yellow body gleams in the sunlight.

In constructing its burrows it usually selects a country road side or a dry barren hill, where a freedom from roots makes digging less laborious.

On the hill back of Richmond village, on Staten Island, I have seen them carrying heavy harvest flies to these burrows, several of which are dug there nearly every summer. The task of carrying so great a burden as a Cicada is a particularly laborious one, and they do not fly very fast when thus heavily laden. Sometimes they drag the harvest-flies a distance along the ground, and sometimes they resort to an ingenious method to finally get them to their burrows.

In August, 1889, I observed a Stizus carrying a Cicada and flying slowly up a hill side. It lit at the base of a black birch on the hill top, and dragged the harvest-fly, holding the smooth dorsal surface to the bark, to the topmost branches finally disappearing among the leaves. I did not see it leave the tree, for I was unable to command a view on all sides at the same time, and then there was a neighboring birch whose branches interlocked with the one where the hornet was. I satisfied myself that it did leave, by climbing up and violently shaking the branches and tree top, Stizus employs this method of transporting the heavy Cicada; it climbs the tree with the insect, and then flies from the branches, the excessive weight gradually bringing it to the ground again but nearer to its burrow.

Professor Morse, in his annual address before the American Association in 1887, notices the following:—Dr. Thomas Meehan describes a hornet that was gifted with great intelligence. He saw this insect struggling with a large locust in unsuccessful attempts to fly away with it. After several fruitless efforts to fly up from the ground with his victim, he finally dragged it fully thirty feet to a tree, to the top of which he laboriously ascended, still clinging to his burden, and having attained this elevated position he flew off in a horizontal direction with the locust."

Commenting upon this, Mr. C. G. Rockwood, jr., in Science for August 19th, 1887, gives an account of a large insect evidently of the wasp family, that carried a Cicada for a distance of twenty feet up a maple tree and then flew away with it as described above.

Wishing to ascertain the relative weights of these insects, I had dried specimens, including pins, weighed in a druggist's scales. *Cicada tibicen* weighed thirteen grains and *Stizus speciosus* seven and one half.—W. T. Davis, Tompkinsville, Staten Island, N. Y.

EXPERIMENTS FOR THE DESTRUCTION OF CHINCH BUGS.

BY PROF. F. H. SNOW, UNIVERSITY OF KANSAS, LAWRENCE.

These experiments have been continued through the two seasons of 1889 and 1890 and have been remarkably successful. As entomologist to the Kansas State Board of Agriculture I had prepared an article for the annual meeting of that Board in January, 1889, stating what was known at that time upon the subject, and calling attention to the investigations of Professors Forbes, Burrill and Lugger. In June, 1889, a letter was received from Dr. J. T Curtiss, of Dwight, Morris County, Kansas, announcing that one of the diseases mentioned in the article (Entomophthora) was raging in various fields in that region, and stating that in many places in fields of oats and wheat the ground was fairly white with the dead bugs. Some of these dead bugs were at once obtained and experiments were begun in the entomological laboratory of the University. It was found that living healthy bugs, when placed in the same jar with the dead

bugs from Morris County, were sickened and killed within ten days. A Lawrence newspaper reporter learning of this fact published the statement that any farmers who were troubled by chinch-bugs might easily destroy them from their entire farms by sending to me for some diseased bugs. This announcement was published all over the country, and in a few days I received applications from Agricultural Experiment Stations and farmers in nine different States, praying for a few "diseased and deceased" bugs with which to inoculate the destroying pests with a fatal disease. Some fifty packages were sent out during the season of 1889, and the results were in the main highly favorable. It was my belief that sick bugs would prove more serviceable in the dissemination of disease than dead bugs. I accordingly sent out a circular letter with each package, instructing the receiver to place the dead bugs in a jar for 48 hours, with from ten to twenty times as many live bugs from the field. In this way the disease would be communicated to the live bugs in the jar. These sick bugs being deposited in different portions of the field of experiment would communicate the disease more thoroughly while moving about among the healthy bugs by which they would be surrounded. This belief was corroborated by the results. This disease was successfully introduced from my laboratory into the States of Missouri, Nebraska, Indiana, Ohio and Minnesota, and into various counties of the State of Kansas. A report of my observations and experiments in 1889 has been published in the transactions of the Kansas Academy of Science, vol. XII., pp. 34-37, also in the report of the proceedings of the Annual Meeting of the Kansas State Board of Agriculture in January, 1890.

The next point to be attained was the preservation of the disease through the winter, in order that it might be under my control and be available for use in the season of 1890. To accomplish this result, I placed fresh healthy bugs in the infection jar late in November 1889, and was pleased to note that they contracted disease and died in the same way as in the earlier part of the season. I was not able to obtain fresh material for the purpose of testing the vitality of the disease germs in the spring of 1890, until the month of April, and then only a limited supply of live bugs could be secured. I quote the following from my laboratory notes:

April 10: twenty-five chinch-bugs that had hibernated in the field were put in the infection jars. They were supplied with young wheat plants. The bugs appeared lively and healthy.

April 16: some of the bugs were dead and all appeared stupid.

April 20: all of the bugs were dead.

One week later, a new supply of fourteen bugs was put into the jar; they were supplied with growing wheat. They ran substantially the same course as the first twenty-five. Some had died at the end of the first week and all were dead by the end of the thirteenth day.

The chinch-bug seemed to have been very generally exterminated in Kansas in 1889, and only three applications for diseased bugs were received in 1890 up to the middle of July. On account of the limited amount of infection material on hand, I required each applicant to send me a box of live bugs, which I placed in the infection jars, returning in a few days a portion of the sick bugs to the sender. The three applicants above noted reported the complete success of the experiments. I give the following letter from Mr. M. F. Mattocks, of Wauneta, Chautauqua County, Kansas:

Wauneta, Kansas, July 7, 1890.

DEAR SIR:—I received from you a few days since, a box of diseased chinch-bugs. I treated them according to instructions, and I have watched them closely, and find that they have conveyed the disease almost all over my farm, and bugs are dying at a rapid rate. I have not found any dead bugs on farms adjoining me. I here enclose you a box of healthy bugs that I gathered 1½ miles from my place; I do not think they are diseased. Yours, M. F. MATTOCKS.

I also quote the following clipping from the Cedar Vale (Chautauqua Co.) *Star:*

INFECTING CHINCH-BUGS.—There is no longer any need of having our crops destroyed by chinch-bugs. A remedy that is sure as death and costs nothing, has been discovered and is used in this country with complete success. Mr. M.F. Mattocks, living a mile and a half east of Wauneta, on the H. P. Moser farm, is entitled to the credit of demonstrating in this part, the efficiency of the remedy. He was about to lose his corn crop by the bugs that were swarming into it from the stubble. He sent to Chancellor F. H. Snow, of the State University at Lawrence, and from him received a box containing a half-dozen diseased bugs. With them he exterminated a forty acre field full of the pests. They have died by the millions, in fact, they have about all died from the infection of those six bugs. A little circular of instructions, which he followed out, came with them. The six bugs were placed in a bottle with three or four hundred from the field, and were left together thirty-six hours and then turned loose, both the living ones and the dead, in the field. Devastation followed, and Mr. Mattocks will be troubled no more with chinch-bugs this year. If your crop is in danger you can save it by the same means of getting the diseased bugs in your field. It will cost you nothing and is a dead sure remedy. He has been sending dead and infected bugs to others in the country and to Prof. Snow, whose supply was running down.

I personally visited Mr. Mattocks's farm and verified the above statements.

The difficulty of obtaining enough live bugs to experiment with in the laboratory led to the sending out of the following advertisement, which was sent out to twenty prominent papers with requests for its publication:

WANTED! CHINCH-BUGS!

Prof. F. H. Snow, of the University of Kansas, is in great need of some live and healthy chinch-bugs with which to carry on his experiments in chinch-bug infection. Anyone who will send a small lot of bugs to Prof. Snow, University of Kansas, Lawrence, Kansas, will confer a favor on the investigator, and, it is hoped, on the farmers of Kansas.

This request for live bugs was given wide circulation and resulted in keeping the laboratory fairly well supplied with material for experiment.

Before the close of the season of 1890, it became evident that there were at least three diseases at work in our infection jars, the "white fungus" (Entomophthora or Empusa), a bacterial disease (Micrococcus), and a fungus considered by Dr. Roland Thaxter to be *Isaria* or perhaps more properly *Trichoderma.*

The following report which describes the bugs as "collecting in clusters" points to the bacterial disease as the cause of destruction:

PIQUA, Wcodson Co., Kansas, 7th December, 1890.

DEAR SIR.—Since writing you from Humboldt, Ks., the 6th inst., I have made the happy discovery that the germs of contagious diseases sent me were vital. On Sunday last upon examination of the millet field I found millions of dead bugs. They were collected in clusters. My idea is that dampness facilitates the spread of the contagion. The first distribution of diseased bugs two days after I received the package by mail apparently produced no results. A part of them were retained in the infection jar (quart Mason fruit jar); half a pint of bugs were collected from the field; three days later a foul stench was found to emanate from the jar, and a part of the bugs in it were dead. On July 3rd I took advantage of the cool damp evening and took a few buckets of cold water and sprinkled the edge of the millet and distributed more infected bugs. On the 6th I found millions of dead bugs. I think the night and sprinkling the millet caused the disease to spread. We have had no rain in this neighborhood since June 17th, if I remember correctly. The depredations of chinch-bugs are always more serious in dry, hot weather. You have conferred a lasting benefit on the farming interests of the United States, the value of which cannot be estimated in dollars and cents. It was estimated that during one of the visitation years of this insect the damage in the Mississippi valley amounted to ten millions of dollars. I have no doubt that by a proper manipulation of the contagious disease in the hands of intelligent persons it will prove an effective remedy. I think the contagion should be introduced among them early to prevent the migration of the young brood. In my case I received it too late. Early sown millet presents a favorable place to infect the bugs, as they seem to collect in the shade and die. Hoping that when the next Legislature meets an appreciative public will suitably reward you for your beneficient discovery, I am gratefully yours, J. W. J. MCCORMICK.

The field experiments were apparently equally successful in the months of July, August and September. The following August field-report is inserted as a fair sample of the manner in which the farmers themselves regard these experiments:

FLORENCE, Marion Co., Kansas, November 1st, 1890

DEAR SIR.—On the 20th of August (I think it was) I wrote to you to send me some infected chinch bugs, and on the 30th of the same month you sent me a small lot of infected bugs, I suppose about thirty in all. I then put with these about twenty times as many healthy ones and kept them forty-eight hours, and then deposited them in and through my field—I have about 55 acres under cultivation

At the time I wrote for bugs my place was all in corn and a very large crop of chinch bugs. I am safe in saying that there were more bugs on my farm than on any two farms with the same amount of land under cultivation. At the time of sending to you for bugs I told two of my neighbors of my intention, and they laughed at the idea, nevertheless I sent. When I put them in my field it had rained fully a half day, and after noon I commenced to place them about in different places in my field. I noticed no change in the bugs for three days, it being cold. On the fourth and fifth days the weather was more warm, and it was then that the destruction of the enemy commenced with great satistaction to myself and great surprise to mylaughing neighbors. One of my neighbors, Mr. George Winchester, said that there ought to be a subscription raised and donated to me. I told him not to me but to you the praise belonged. I think that it took about eight days after the five from the time that I placed them in my field before they were all destroyed. The fifth day after I put out the diseased bugs I noticed that a great many bugs were flying away from my place. I cannot say if the disease spread in this way or not, or if it spread at all. Three or four persons said they would come and procure of me some of the dead bugs, but no one came. This much I can say, with me this experiment has been a complete success. It has done me a great deal of good. I cannot give it a money value, but am satisfied that had it not been for the infected bugs obtained of you that I would have lost twenty-seven acres of wheat and eight acres of rye, and when I wrote to you for bugs I then contemplated putting out considerable wheat, and I was at that time considerably troubled about the bugs in my corn, thinking that if I put out any wheat at all it would be destroyed by bugs; but thanks to you my wheat is now safe from bugs, at least those that were on my place before sowing my wheat. I only wish that I had written to you sooner than this. I will send by express one bottle of bugs that I gathered after they commenced to die. Respectfully yours, JOHN KNOBLE.

The following report from R. L. Stangaard is inserted as being of a more scientifically circumstantial character than most of the other reports:

FLORENCE, Kan., Aug. 22nd, 1890.

DEAR SIR.—In reply to your favor of July 27th, I would say that infected bugs were applied, after they were kept with live ones about forty-two hours. Most of the bugs mixed were dead when taken out of the box. They were applied in seven different hills, being put into every ninth hill. I marked every hill with a number so as to be better able to watch the progress. Examined after forty-eight hours application with the following results:—No. 1, mostly dead. No. 2, bugs mostly alive, seemingly very restless. No. 3, bugs seem to be sick. No. 4 bugs mostly dead. On hills around this one bugs seem to be restless. No. 5, not examined. On hills around it the bugs seem to be sick. Examination eight days after application with the following results:—No. 3, bugs seemingly in a dying condition. On the hills around it the bugs seem to be well with exception of one hill where they seem to be dying and some dead. No. 4, not a live bug in the hill. No. 5, apparently dying, also dying in the hills around this. No. 6, bugs dying in hill. No. 7, apparently not dying. On August 16th, twelve days after application, I found the bugs to be dying and dead all through the field—twelve acres. On August 20th, I again found the bugs to be dying rapidly. A field being forty rods distant had sure marks of bugs in a dying condition. What I mean by bugs being in a dying condition is this: they lay on their backs, almost motionless, and others lay in same position, moving limbs violently. This remedy was applied on A. G. Rosiere's farm on Bruno creek, Marion Co., Kansas, being nine miles east and three miles south of Marion. Thanking you for your favors, I remain, yours truly, R. L. STANGAARD.

The laboratory experiments have been continued through the season. Of the three diseases identified, that produced by the Trichoderma appears to be less fatal than the other two, as is indicated by the following laboratory notes:

September 28th, dead chinch-bugs showing no signs of fungus externally were taken from the infection jars and crushed on a glass slide in distilled water. Oval hyphal bodies of a fungus (Trichoderma) were found in considerable number. These were put under a bell jar.

September 29th, some of the hyphal bodies had put out slender mycelial growths; others in immense numbers were multiplying by division.

October 1st, the hyphal bodies were still multiplying by division. The mycelial growths had become much longer and in some instances had variously branched.

October 3rd, a dead chinch-bug taken from an infected field was crushed on a glass slide in distilled water. Both round and oval hyphal bodies were found in considerable numbers. The sewere put under a bell jar to prevent dying.

October 4th, both round and oval hyphal bodies were multiplying by division and were putting out mycelial growths.

October 5th, fresh chinch-bugs from an uninfected field were immersed in the liquid containing the above fungi and were put in a new jar with young corn plants.

October 16th, many of the bugs were dead; the others apparently lively. The dead bugs were found to contain hyphal bodies similar to those with which they were infected. A live chinch-bug from the same jar was crushed and found to contain round hyphal bodies; but these refused to germinate.

November 5th, not all of the bugs are yet dead. The few remaining are apparently lively.

The following is a summary of the results of the field experiments in the season of 1890:

Number of boxes of diseased bugs sent out, 38. Seven of these lots were either not received, or received and not used. Reports were received from 26 of

the 31 remaining cases. Of these 26 reports, 3 were unfavorable, 19 favorable, and 4 doubtful, concerning the success of the experiment. These doubtful cases are not to be looked upon as unfavorable, but more evidence is needed to transfer them to the list of favorable reports. These 19 out of 26 reports, or 73 per cent., were decidedly favorable. The experiments will be continued during the season of 1891.

In presenting this paper I wish to acknowledge the invaluable aid continually received during the progress of the work from my assistants, Messrs. W. C. Stevens and V. L. Kellogg.

BOOK NOTICES.

BUTTERFLIES OF NORTH AMERICA. Third Series—Part X. By W. H. Edwards.

The last part of Mr. Edwards's superb work has just come to hand. It is of exceptional beauty and interest. Special attention has been lately called to the American species of the genus Argynnis, by the publication of Mr. H. J. Elwes's "Revision of the genus Argynnis." (Trans. Ent. Soc. Lond. 1889. Part IV.) and Mr. Edwards's "Notes" thereon (Can. Ent. XII. p. 82.) The present number contains plates and descriptions of three species of this genus, the validity of two of which has been questioned by Mr. Elwes. Plate I. illustrates the complete life history of *A. Alcestis* by which it is shown that not only is it distinct in the imago state from both *Aphrodite* and *Cipris* but also in its preparatory stages.

Plate II. *Argynnis Adiante* (male and female). This is a local Californian species of which Mr. Elwes had only male specimens taken many years ago—from what material he had he was inclined to regard it as merely a variety of either *Zerene* or *Monticola*. It appears, however, that it is not such a rare species as he supposed, and Mr. Edwards had ample material to show that this species is valid. The male is figured from Dr. Boisduval's actual type. Dr. Behr, the well-known San Francisco lepidopterist, writes of it that it is common in its season at the proper locality, and further that unlike many Californian Argynnides it is very constant. On the same plate as *A. Adiante* is figured another interesting species *A. Atossa* (n. sp.) the male of which has been in Mr. Edwards's collection for twenty years; but the female was only discovered in 1889. From the figure it appears to be very distinct from anything we have in our fauna.

Plate III. shows *Satyrodes Canthus* in great detail. The text of this plate is very complete. Mr. Edwards has adopted Mr. Scudder's genus for this species but believes the name *Eurydice* does not belong to it.—J. F.

THE CAVE FAUNA OF NORTH AMERICA, with remarks on the Anatomy of the Brain and Origin of the Blind Species. By A. S. Packard, M.D. Vol. IV.: First Memoir—National Academy of Sciences. 4to., pp. 156.

The author of this admirable volume is everywhere known throughout the scientific world from his numerous works, especially on entomology, and has obtained a deservedly high reputation in Europe as well as in America. This reputation will, we are confident, be, if possible, enhanced by the elaborate monograph before us. It contains many original observations of cave animals, some careful scientific investigations, and a very interesting chapter of philosophic

considerations. It is also fully illustrated by a map of the Mammoth Cave in Kentucky, a number of wood cuts and a series of twenty-seven beautiful lithographs, nearly all of them drawn by the author himself. The work begins with a description of the Mammoth Cave and others in the neighbourhood, and gives lists of the various animals found within them; an account of the Wyandotte and other caves in Indiana, Clinton's Cave in Utah, and one in Colorado; a discussion of the geological age of the caves and their inhabitants, the mode of colonization and the source of their food-supply. The second chapter describes the vegetable life of the caves, which is naturally of the most meagre description. Then follows a systematic description and list of the invertebrate animals found in North American caves, among which spiders are the most numerous. Insects are represented by eight species of Thysanura, four of Orthoptera, two of Platyptera, ten of Coleoptera and nine of Diptera—a by no means extensive list, but one that includes some very curious and interesting forms. The beetles of the genus *Anophthalmus* are especially remarkable and attractive to the ordinary entomologist. Lists are also given of the European and North American cave animals, and of the blind, eyeless creatures which do not live in caves, and which, strange to say, almost equal in number their cavernous relatives. The next chapter gives a careful account of the anatomy of the brain and eyes (when partly developed) of certain blind Arthropods. The chief interest of the work culminates in the final chapter where the author discusses the origin of the cave species as bearing upon the theory of evolution. We have not space for any abstract of his views, which are well-deserving of study, but must refer the reader who desires fresh evidence on the subject of evolution to the work itself. We entirely agree with the author in his closing words: "In the case of too many naturalists the dogma or creed of natural selection has tied their hands, obscured their vision, and prevented their seeking by observation and experiment to discover, so far as human intelligence can do so, the tangible, genuine, efficient factors of organic evolution."—C. J. S. B.

AMERICAN SPIDERS AND THEIR SPINNING WORK. A natural history of the Orb-weaving Spiders of the United States, with special regard to their Industry and Habits. By Henry C. McCook, D.D. Vol. I. Published by the Author, Academy of Natural Sciences of Philadelphia, 1889. 4to., pp. 372.

The author of this sumptuous volume is so well known from his valuable and interesting works on the natural history of various kinds of ants, and his charming little book "The Tenants of an old Farm," that any productions of his pen are looked forward to with lively anticipation and keen interest. We are quite sure that no one of the subscribers to this, his latest and greatest work, has been in the least degree disappointed by this first volume of the promised three. Though spiders are not insects, we have no doubt that every entomologist, and indeed every lover of natural history in any of its departments, will deeply enjoy the perusal of this volume. We cannot give a better idea of its contents than by mentioning the subjects treated of. They are, first, the general classification, structure and spinning organs of spiders; the construction and armature of Orbweavers' snares; the characteristic forms and varieties of snares; unbeaded orbs and spring snares; the engineering and mechanical skill and intelligence of spiders; their modes of procuring food and habits in feeding; their fangs and poison bags; their modes of nest making and its development in various tribes; and finally the "genesis of snares." All these different subjects are fully illustrated with more than three hundred and fifty wood cuts. The second volume is to treat of the mating and maternal instincts, the life of the

young, the distribution of species, etc.; and the third will be devoted to descriptions of the orbweaving fauna of the United States, with coloured illustrations of a number of species. The whole will form one of the most complete works of the kind in the English language. Entomologists will need to have long purses if they wish to possess all the literature of the day, and to procure for themselves such costly and beautiful books as Scudder's and Edwards's Butterflies and McCook's Spiders. We trust that all who can possibly afford it will aid the authors in their self-sacrificing enterprises by subscribing for their books, but those who cannot do so should use their influence with their local Scientific Societies and Public Libraries and induce those in charge to purchase these valuable works for the general benefit. We are glad to say that the Public Library in Toronto and our Entomological Society have set a good example in this respect and rendered these works available for many of our readers.—C. J. S. B

REPORT ON INSECT AND FUNGUS PESTS. No. I. By Henry Tryon, Assistant Curator of the Queensland Museum. Published by the Department of Agriculture, Brisbane, Australia, 1889. 1 Vol., 8vo., pp. 238.

We have perused with great interest this first work that we have seen on the Economic Entomology of Australia. Some of the pests referred to are very familiar to us here, for instance, the Codling Moth and the Woolly Aphis of the apple tree, while others are species closely allied to those which are very destructive with us. The report takes up different fruits, vegetables and field crops that are most commonly cultivated in the colony, and describes the insects which especially attack them; as far as possible the life history of each pest is given and remedies are suggested. The work is very carefully and thoroughly done, and will, no doubt, be of great value to the fruit growers and farmers in that part of the world. Its usefulness would of course be greatly enhanced by illustrations of the insects treated of, but evidently there were difficulties in the way of procuring these that could not at first be overcome. Future reports will doubtless be made popular in this way. The author deserves much credit for the valuable book he has produced. We trust that the Queensland Government will give him all the assistance and encouragement possible in the prosecution of his studies in practical entomology, and enable him to continue a work that is of the utmost economic importance.—C. J. S. B.

THE BUTTERFLIES OF INDIA, BURMAH AND CEYLON. By Lionel de Nicéville, Calcutta. Vol. 3. 12+503 pp. 6 pl. 1890. 8o.

Some three years or more ago, we noticed a work on the above subject by Marshall and de Nicéville, of which two volumes had been published, the last by de Nicéville alone. A third volume of over 500 compact pages has just come to hand, the most notable thing about which, at least to a dweller in temperate regions, is that it is wholly concerned with the Lycaenidæ, of which eighty-two genera and over four hundred species are described. Such wealth in these pigmies among butterflies is a striking fact. The author, however, beyond the generic collocation has made no attempt to classify this immense assemblage, contenting himself with only distinguishing certain groups of genera by the name of one of the included genera, as the "Thecla group," etc., which groups are characterised in a general but not formal way in the body of the work. These agree tolerably well with the groups Doherty had previously characterised from the egg alone, but are about twice as numerous and are established mainly upon the

structural features of the imago. This is better than Distant's artificial divisions but there is plainly an open field here for investigation, and one which there is apparently no need for great delay in occupying, since (excepting the egg) the early stages of Lycaeninæ appear to offer less service to the systematist than in any other group of butterflies.

What will surprise one in this volume, is the very considerable addition to our knowledge of the early stages of the Lycaeninæ, for excepting the Hesperidæ this group is in general the least known of butterflies. Yet something is recorded of no less than thirty-four genera, much of it new, and in many a good deal of interesting history is related. This is a great improvement on the preceding volumes. One particular case, that of the pomegranate butterflies, whose history was briefly and partially given by Westwood, seems valuable enough to reprint for the benefit of American readers; and another, Curetis thetis, may well be mentioned here:—"The twelfth segment [of the larva] bears two most extraordinary structures, which consist of two diverging, cylindrical, rigid pillars, arising from the subdorsal region and of a pale green color. When the insect is touched or alarmed, from each pillar is everted a deep maroon tentacle as long as the rigid pillar, bearing at its end long parti-coloured hairs, the basal third of each hair being black, the upper two-thirds white. The maroon tentacle with its long hairs spread out like a circular fan or rosette is whirled round with great rapidity in a plane parallel to the body, its use being almost certainly to frighten away its enemies, as this larva, as far as I am aware, is not attended by protecting ants and lacks the honey-gland on the eleventh segment present in so many lycænid larvæ which are affected by ants."

Ants have been found attendant upon half a dozen genera, and in many cases they have been identified by Dr. A. Forel, of Switzerland. At least a dozen species are concerned, and they are about equally divided between the Formicidæ and Myrmicidæ.

Spalgis, it appears, is another instance of a carnivorous lycænid comparable to our Feniseca, the larva associating with and feeding upon the "mealy bug" of the planters, a species of Dactylopius. De Nicéville in no way favours Edwards's belief that Feniseca belongs to the Lemoniinæ, and adds nothing, as we had hoped he might be able to do, to Holland's suggestions that Liphyra, too, might be carnivorous, though he points out that the two genera differ in their perfect state in the number of subcostal nervules, and are therefore not so closely allied as Dr. Holland thought.

The seasonal dimorphism of many Indian Lycænidæ is well brought out, the dry and wet season taking the place of our spring and summer; indeed, it occurs in no less than eighteen genera, and this will be a revelation to many, and seems to bid fair to renovate the study of tropical butterflies. But while in India proper "the seasonal forms seem to be chiefly restricted to two, a wet and a dry," in the Himalayan district of Sikkim "the dry season form which occurs at the end of the year differs somewhat from the dry season form which occurs in the spring, so that with regard to some species there may be said to be three forms—a spring, a wet season, and a winter form." Sexual dimorphism on the contrary is very rare among tropical Lycænidæ, de Nicéville stating that he does not know positively of any case, though he suspects it in a species of Zephyrus. On the authority of Doherty (a native of Cincinnati by the way, working most industriously in the east), he credits half a dozen or more species as mimicking others of the same or neighboring groups of Lycænidæ. Much attention is also paid to the secondary sexual characteristics so far as their gross appearances are concerned, and they are noted in no less than nineteen genera.

Finally, we may call attention to the very interesting general chapter on the Lycænidæ at the beginning of the volume, which is of more than usual interest and rather exceptional in a work of this kind. The work itself must serve a very useful purpose; its execution is remarkably even and shows great skill and balance on the part of the author. There are half a dozen plates like those of the former volumes and executed by the same parties, excepting that two of them are chromo-lithographs, but we could wish that some plates of the early stages might have been added, and the direct purposes of the book for the Indian student would have been served by others giving structural details.—S. H. S.

MANUAL OF INJURIOUS INSECTS AND METHODS OF PREVENTION. By Eleanor A. Ormerod, Second Edition, 1890.

The enlarged and thoroughly revised edition of Miss Ormerod's Manual of Injurious Insects which has lately appeared, is a work of such importance to all engaged in agricultural pursuits, that it is thought well to place a notice of it in our Annual Report so that such of our readers who have not seen it may know of its publication. We feel confident that a perusal of this work would well repay all those engaged in the cultivation of farm, orchard or garden crops. The study of economic entomology has made great progress during the decade which has elapsed since the appearance of the first edition of Miss Ormerod's Manual in 1881, and this progress is to a large measure due to the unceasing labours of this talented lady. Her annual reports are eagerly looked for by thousands of farmers in Great Britain and by scientific students in all parts of the world. They give a concise account of the insect attacks which have occurred in the British Isles during the year which has followed the issue of the previous report. A feature of these reports is their practical nature, every attention being given to the best, not the largest number of, remedies for each insect mentioned. This character is also very manifest, as might have been expected, in this more important work of Miss Ormerod's. There is no writer upon the practical science of combating the ravages of insects which attack crops, in Australia, India, South Africa, the United States, Canada, or elsewhere, who does not quote her opinion as the highest authority upon any subject which she has written about. This is due to the careful and thorough manner in which all of her investigations are carried out. In the last number of "Insect Life" issued by the United States Department of Agriculture and edited by the highest living authorities upon economic entomology, the following complimentary notice of this work appears:—"On account of its convenient size, admirable arrangement, plain language, and abundant illustration, it is almost a model of what such a work should be."—"Miss Ormerod's work cannot be too highly commended."

Now the merits above enumerated are just the points which render this work so valuable, for it is perfectly intelligible to anyone who can read, and thus becomes almost indispensable to every farmer, gardener, or fruit grower, who would carry on his work in the most successful manner. Nor is this the case in England alone, where the work was written, for so many of the actual insects treated are common as agricultural pests both in Europe and in North America, and moreover the general principles recommended for the prevention of injury are applicable all the world over. Besides this from the fact that most of our most injurious insects are imported species, we know not at what moment any of those so well treated of in this work, may not appear in our midst as a serious tax upon our cultivated crops. The different kinds of attacks are arranged alphabetically under the three headings, Food Crops, Forest Trees, and Fruit. Some new attacks not mentioned in the first edition and which appeared sub-

sequently to its issue, are now paid particular attention to, amongst these are the Hessian Fly, Stem Eel-worms and the Wheat Bulb-fly. The information concerning all the attacks treated of in both editions has been largely augmented and the special subjects of Wireworms, Turnip-flea-beetle, Mustard Beetle, and Hop Aphis are entered on at length.

Special attention has been given to the presentation of the latest developments in the way of preventive measures. Attention is drawn to the use of chemical manures which are highly beneficial as plant-stimulants (but by no means so to vegetable-feeding grubs and maggots), and the many kinds of agricultural implements, by which the soil can be more completely broken up on the surface, or the surface more thoroughly buried down than was formerly the case, these are of great assistance to us. As an Appendix to the Manual is given a short and copiously illustrated "Introduction to Entomology," where, in the plainest possible language, the structure and changes of insects are described, and illustrations and definitions of the various natural orders into which they are classified are given, so as to "enable the observer of a crop attack to tell at least what kind of insect is before him," and also "in the list of the orders of insects, notes are given of the most observable of the characteristic points by which the insects composing these different orders may be distinguished from each other."

A glossary of terms and a full index render this work very complete. It contains 410 pages, and is illustrated with 155 excellent figures, many of them from the authoress's own pencil. The frontispiece is a portrait of the authoress which has been prefixed by desire of many friends and will be of interest to many in this country who have not had the pleasure of meeting Miss Ormerod. The manual is well printed, neatly bound in cloth, and the small price at which it is published ($1.25) brings it within the reach of all.

There are many articles in the manual which are of interest to Canadian readers as they describe insects which also occur here—amongst these the following may be mentioned:

The Bean Weevil (*Bruchus granarius*).—Treating the seed with a solution of sulphate of copper and carbolic acid are recommended, also soaking the seed beans for some time before they are sown, or dropping them for one minute into boiling water.

The Cabbage Aphis (*Aphis brassicæ*).—In garden cultivation drenching the infested plant with soap-suds is practicable, syringing with an infusion of tobacco in lime-water has been found useful and dusting with caustic lime and soot are stated to be very effective in getting rid of the aphis.

The Small White Cabbage Butterfly (*Pieris rapæ*).—The greatest confidence seems to be placed in strengthening the plant, so as to enable it to outgrow the attacks of the caterpillars. In this country this is insufficient and undoubtedly the best remedy is pyrethrum powder reduced with 4 times its weight of common flour or finely sifted lime and then dusted over the plants.

Cabbage Fly (*Anthomyia brassicæ*).—The use of barn-yard manure immediately before a cabbage crop seems to induce attack, also the continuous cultivation of cabbages on the same ground. The value of lime and ashes are emphasized by the experience of correspondents.

Carrot Fly (*Psila rosæ*).—This is an uncommon insect in Canada; but is found here and is liable at any time to develop in numbers. The remedies suggested consist chiefly of, careful cultivation of the soil so as to induce a vigorous growth, care at the time of thinning the rows and the use of obnoxious materials to deter the females from egg-laying.

STEM EELWORM (*Tylenchus devastatrix*).—"Clover sickness" and "Tulip, root" in oats are caused by small nematode worms. We have not so far observed these in Canada, but they have been studied in the United States and we should be on our guard, Some points in the life-history of the species are given in regard to which some common-sense remedies are suggested, such as not planting a crop liable to attack upon infested ground. It is shown that several plants are injured by the worms and that they can survive the operation of digestion in animals fed on infested fodder. It is the same species which causes stem-sickness in clover and "tulip-root" in oats. Grain Aphis *Siphonophora granaria*, Kirby. Early maturing varieties of grain are recommended. The full life-history of this insect is still unknown.

DADDY LONGLEGS (*Tipulæ*).—These troublesome insects are treated at some length. Amongst measures to be taken to lessen the quantity of eggs laid, are mowing down coarse vegetation in places suitable for the females to lay eggs, and feeding sheep on infested pastures. Draining of low land and the use of quick-acting fertilisers are suggested.

HESSIAN FLY (*Cecidomyia destructor*).—This well known pest has been specially studied by Miss Ormerod. The chief remedies are burning infested stubble and screenings, the selection of varieties least attacked, and the use of special fertilisers in the spring to strengthen injured plants.

WHEAT MIDGE (*Cecidomyia tritici*).—Deep plowing directly after harvest and the destruction of screenings seem to be the best remedies.

THRIPS (*Thrips cerealium*).—Deep ploughing and clean farming are thought to be the best remedies.

WIREWORMS (larvæ of the Click Beetles).—"Wireworms may perhaps be said to do the greatest amount of mischief of any of our farm pests; they destroy root grain and fodder crops." So Miss Ormerod begins her article and it is almost as true for some parts of Canada. Great stress is laid on the preparation of the land before a crop liable to attack. Autumn feeding with sheep and the use of gas-lime and salt are highly spoken of. Sir Richard Keene writes "If the lea is broken for oats (our general crop) it is sure to be attacked more or less by wire-worms; I top-dress with 4 cwt. agricultural salt, 2 cwt. superphosphate and sometimes 1 cwt. nitrate of soda. I have never known this to fail if applied in time. If the lea is broken in autumn, to have green crops in the following year, I have the land worked as much as possible and apply 8 tons hot lime to the statute acre; lime as hot as possible. I always sow the seed with a liberal dressing of farmyard dung, for such crops as mangold, turnip, cabbage, carrot, and parsnip, and I use the following dressing of artificial:—2 cwt. best bone meal, 1 cwt. nitrate of soda, and 3 cwt. common salt. I find the plants are soon forced up beyond the reach of damage.

HOP APHIS (*Phorodon humuli*).—This is another insect which sometimes does enormous injury in Europe, and which has received particular attention from both the authoress and Prof. Riley whose studies have supplied important links in the life-chain of this insect. The remedies most to be relied on are the treatment of plum trees early in the season to destroy the first brood of aphis and afterwards "washing or spraying the hop plants when they are found to be infested.

RED SPIDER (*Tetranychus telarius*).—This is another of the dire enemies of the hop as well as many other plants. Washes containing sulphur or kerosene are suggested.

MANGOLD OR BEET FLY (*Anthomyia betæ*).—The remedy most spoken of is high cultivation; but the benefits of a kerosene emulsion are suggested by the experience of one of the correspondents quoted.

ONION FLY (*Anthomyia ceparum*).—The remedies offered for this well-known pest are careful preparation of ground which has not borne onions the previous year, growing them in trenches so that the bulb may be kept covered, the removal of diseased bulbs, and the treatment of infested plants with what is practically a kerosene emulsion or simply with soap suds.

SLUGS.—These troublesome mollusks are not insects but are treated in the manual because so frequently sent in by people who suppose they are. Gas-lime, lime, and salt if applied frequently at short intervals are sure remedies.

THE DIAMOND-BACK MOTH (*Plutella cruciferarum*).—This insect frequently so injurious to cabbages in this country is spoken of as an occasional pest of turnips. A dry dressing of gas-lime, one bushel; lime from the kiln, one bushel; sulphur, 6 pounds; and soot, 10 lbs., was found useful.

In Part II. "Forest Trees and the Insects that injure them," there are no insects which actually injure our forest trees in Canada although the general principles of prevention and remedy give valuable suggestions.

In Part III. "Fruit Crops and Insects that injure them," we find many too well known enemies of the orchardist.

THE WOOLLY APHIS (*Schizoneura lanigera*).—Of the many remedies given it seems to us that the treatment of the stem inhabiting form with soap-washes or kerosene emulsion will be the most effective, and the latter is probably the best remedy for the root inhabiting form which is so difficult to reach.

APPLE APHIS (*Aphis mali*).—Syringing with soft-soap and other washes is recommended.

CODLING MOTH (*Carpocapsa pomonella*).—Scraping, banding, and washing the trees, form the chief remedies. Spraying with Paris green. This is the first mention of this now universally used American remedy. Up to last year Paris green as an insecticide was unknown in England. Now however at Miss Ormerod's suggestion it has been tried and has proved so successful that there is no doubt that it will rise rapidly in public favour. Probably some from carelessness or recklessness, in not following the instructions closely, will put on the washes too strong and injure the foliage; but the benefits which will follow its adoption will be so enormous that Miss Ormerod will speedily be recognised as a public benefactor by thousands of the ignorant *educated* people in Great Britain who "did not know that grubs and creeping things were of any interest to them."

MUSSEL SCALE (*Mytilaspis pomorum*).—This is our familiar oyster-shell bark louse. The usual soap washes in spring and the mechanical removal of the scales are recommended.

GOOSEBERRY SAW-FLY (*Nematus ribesii*, Curtis).—Great stress is laid on the value of removing the surface soil from beneath bushes which have been infested by the larvæ. Mention is made of some mixtures containing soot or sulphur. We are surprised to find that "white hellebore" is not mentioned.

SHOT BORER "PEAR BLIGHT" (*Xyleborus dispar*).—A most complete article is given on this insect which has been very injurious in our Maritime Provinces for some years; preventive remedies in the shape of washes to prevent the females from laying eggs are given.

MOTTLED UMBER MOTH (*Hybernia defoliaria*).—This moth is interesting to us from the fact that it has been taken on three occasions in Vancouver Island by Rev. George W. Taylor—whether indigenous or introduced is uncertain.

This is one of several moths which have been very injurious for many years in England but which have been successfully treated during the past season with Paris green. A long article detailing the experiments of the Evesham Fruit Conference with Paris green, under Miss Ormerod's guidance, gives an account of the successful introduction of Paris green into England as an insecticide. J. F.

THE RUSSIAN PARASITE OF THE HESSIAN FLY.—Miss Eleanor A. Ormerod, the eminent consulting entomologist of the Royal Agricultural Society of England, in a communication to the Mark Lane *Express*, thus refers to the discovery of this parasite :—

"It is announced in the United States that Professor C. V. Riley, the well-known entomologist to the United States Department of Agriculture, has introduced into that country living specimens of *Semiotellus nigripes*, a Russian parasite of the Hessian fly, in order to acclimatize it. By its aid he hopes to practically exterminate the pests in that country. Curiously enough he obtained this parasite from England, and it is said that quite a number have been reared for the purpose. If this is the case, there should be no difficulty in the way of adopting the same means of getting rid of the Hessian fly in this country, and it would be interesting to have Miss E. A. Ormerod's opinion on the subject."

My opinion is that, quite certainly, it would be worse than useless (in this country) to make any such attempt. In the United States of America things are on a very different footing. There are differences in temperature, conditions of climate, and also of area of cropping, and other agricultural arrangements which must affect this question. Likewise there are special arrangements at the Government experimental stations for rearing insects, and skilled Government entomologists who can trustworthily examine the collections before they are turned loose on the conntry.

The parasite fly (the *Semiotellus nigripes*) is only about one line long, and without the help of a magnifying glass and some technical knowledge it would be impossible for any but skilled entomologists to be certain whether many pests were not included amongst the parasites which they set free. Also it is to be remembered for the most part insects pair, lay eggs, and die very shortly after they make their appearance from the chrysalids, but even supposing these minute creatures lived on awhile, where are they to be taken to ?

We do not know what corn is infested until attack is thoroughly set up, for the most part till the mischief is so advanced that the time for action of the parasite is past ; and at a vast expense the intended destroyers would in many cases be carried where there was nothing to destroy.

This work of rearing could not be done on a broad scale—that is, by collections from the threshing machine by farmers—and the payment to a staff of collectors. rearers, and distributors would involve enormous outlay.

The present plan of destroying the Hessian fly chrysalids in the fine screenings is much the safest, and also has, for this country, the stated approval of Prof. Riley himself. It is easily done, costs scarcely anything, and causes no loss; and thus. though we destroy the parasites (of which there are several kinds), we also quite certainly destroy the pest.