EIGHTEENTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO.

1887.

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TABLE OF CONTENTS.

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To the Honourable the Commissioner of Agriculture :

SIR,—In accordance with the provisions of our Statute of Incorporation, I beg to submit herewith the Annual Report of the Entomological Society of Ontario for the year 1887.

The Report contains a record 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 Ottawa, on the 26th and 27th of October, 1887 ; it includes also the audited Financial Statement of the Secretary-Treasurer, the Reports of our Council and Montreal branch, the President's Annual Address, and the various papers read by members at the meeting.

I have also the honour to submit herewith several illustrated papers by our members on injurious, beneficial and other insects, which have been specially prepared for the information of the general public, and particularly for the assistance of the farmers and fruit-growers in dealing with their insect friends or foes.

Our monthly magazine, the *Canadian Entomologist*, has been regularly and punctually issued during the past year. Its nineteenth volume is now almost completed. It continues to be received with marked favour by scientific entomologists both in Europe and America, and it includes amongst its contributors and correspondents the most eminent specialists in this department of natural science both in the United States and our own country.

It is a matter of thankfulness that during the past year our Province has enjoyed great immunity from serious damages by insects ; those that have been particularly troublesome are referred to by our President in his address, or described in the papers that follow.

I have the honour to be, Sir,

Your obedient servant,

W. E. SAUNDERS,

Secretary-Treasurer.

ANNUAL MEETING OF THE SOCIETY.

The annual meeting of the Society was held pursuant to notice at Ottawa, on Wednesday and Thursday, 26th and 27th October, 1887. The meeting was held in Ottawa at the request of several members, in order that an opportunity might be afforded to visit the Central Experimental Farm of the Dominion Government, to examine the valuable collections of insects in the Museum of the Geological and Natural History Survey of Canada, and to inspect the collections of the members resident in Ottawa. Through the kindness of the civic rulers, the meetings were held in the City Hall.

A Council meeting was held on Wednesday, at 10 a.m., on the adjournment of which the Museum was visited and the insect collections examined, the magnificent exhibit of Lepidoptera eliciting universal admiration.

In the afternoon the Experimental Farm was visited, the Director, Prof. Saunders, kindly placing carriages at the disposal of the Council. A Council meeting was held in his office, after which he escorted the visitors around the farm, and explained the work already accomplished, and the plans for future operations. The house and barns in course of construction were justly admired, and it was evident to all that a great and useful work was being accomplished under the oversight of the director and his skilful assistants.

In the evening a general meeting of the Society was held in the council chamber of the City Hall, and the annual address was delivered by the President, Mr. James Fletcher. Among the large audience present were, in addition to members of the Entomological Society, many officers and members of the Ottawa Field Naturalists' Club, of the Ottawa Literary and Scientific Society, of the Geological Museum, of various educational institutions, agricultural associations, etc., as well as gardeners and farmers from the surrounding country.

The address was a very instructive and practical one, and was listened to with great attention and interest by all present. It gave a sketch of the growth of the Society, and an outline of the work being done and to be carried on at the Government Experimental Farms. The value of Natural Sciences as a training for the mental faculties and the co-relationship of the different branches was shown. The latter portion consisted of a report on the insect injuries for the year and the broad general principles regulating the application of remedies. On its conclusion a vote of thanks to the President was moved by Rev. C. J. S. Bethune, who described the work being accomplished in England by Miss Ormerod, and illustrated it by an account of her exertions to ward off the attack of the Hessian fly. The vote of thanks was seconded by Prof. Saunders, who confirmed the statements made in the address, and gave accounts of some experiments with solutions of Paris green as a preventive of curculio in plums, and codling moth in apples.

A collection of Coleoptera captured in the vicinity of Ottawa, was exhibited by Mr. W. Hague Harrington. It was arranged in eighteen cases and contained about 1,250 species.

The meeting for the election of officers, etc., was held at 11 a.m. on Thursday, in a committee room of the City Hall.

The President, Mr. James Fletcher, occupied the chair, and the following members of the Council were among those present:—Rev. C. J. S. Bethune, Port Hope; Mr. J. Alston Moffat, Hamilton; Mr. J. M. Denton, London; and Mr. W. H. Harrington, Ottawa.

The minutes of the previous meeting having been printed and circulated amongst the members, their reading was dispensed with, and they were duly confirmed.

Mr. W. H. Harrington was requested to act as Secretary in the absence of that officer.

Letters were received from Rev. T. W. Fyles, Quebec; Mr. E. Baynes Reed, London; Mr. H. H. Lyman, Montreal; Mr. W. E. Saunders, London; Mr. J. D. Evans, Trenton;

Capt. Gamble Geddes, Toronto, and others, announcing their regret at being unable to be present.

The Report of the Council was read by Rev. C. J. S. Bethune, and on motion of Mr. Denton, seconded by Mr. Moffat, it was duly adopted.

The statement of the Secretary-Treasurer (balance sheet) was received and adopted.

The Reports of the Montreal branch, and of the Delegate to the Royal Society of Canada, were received and referred for publication.

REPORT OF THE COUNCIL.

In presenting their Annual Report, the Council feel highly gratified in announcing the continued success that has attended the work of the Society during the past year.

The *Canadian Entomologist* has been published with regularity, and its pages have been filled as usual with valuable papers, contributed by leading entomologists in Canada the United States and Europe.

The Annual Report to the Legislature of Ontario was duly issued after some delay, and the Council feel justified in stating that it was in no way inferior to its predecessors in the diversity and character of its articles on practical Entomology.

Some valuable additions have been made to the Library by purchase as well as by donation. Among the latter may be especially mentioned the gift of a copy of Westwood's Oriental Entomology, by Miss Ormerod, of St. Alban's, England.

The Society's collection of insects, which was sent last year to the Indian and Colonial Exhibition in London, England, has been brought back and restored to the Society's rooms. The Council regret to state that two of the cases were broken in transit, and a number of specimens of lepidoptera were damaged. They trust, however, that the kindness of members will speedily replace those that are wanting.

The audited statement of the finances of the Society is submitted herewith, and shows a credit balance of $83.

The Council have very great pleasure in offering their hearty congratulations to their President, Mr. James Fletcher, upon his appointment to the important position of Dominion Entomologist and Botanist to the Central Experimental Farm at Ottawa. They cannot but feel that the Society has been much honoured by the selection of two of its presidents (Prof. Saunders and Mr. Fletcher) for high and important positions in the Dominion Experimental Farms, and they regard it as a welcome recognition of the usefulness and good work of the Society.

Since the last annual meeting, the Council have unanimously elected Miss Eleanor A. Ormerod, Consulting Entomologist to the Royal Agricultural Society of England, an Honorary Member, as a slight mark of the high estimation in which her labours in the field of practical entomology are held both here and elsewhere.

They have to deplore the loss they have recently sustained by the lamented death of their colleague, Mr. G. J. Bowles, of Montreal, who was for many years an active and zealous member of the Society, an able and efficient worker, and a valued contributor to the magazine and annual reports.

The annual meeting is this year summoned to be held in the City of Ottawa, at the request of several members, in order that an opportunity may be afforded of visiting the Central Experimental Farm, and inspecting the collections of insects at the Geological Museum and in the possession of resident members of the Society.

Presented on behalf of the Council.

E. BAYNES REED,
Secretary-Treasurer.

STATEMENT OF THE SECRETARY-TREASURER FOR THE YEAR ENDING OCTOBER 24TH, 1887.

Receipts.

Balance from previous year	$100 57
Members' fees, sale of *Entomologist*, etc	144 95
Provincial grant, 1887	1,000 00
Collectors' material—cork, pins, etc	59 74
Interest on Savings' Bank account	7 18
	$1,312 44

Disbursements.

Canadian Entomologist, printing, paper, stationery, etc	$591 77
Library account	110 23
Expenses of Report for 1886	133 10
Engraving	166 22
Annual grant to Editor	100 00
Rent	80 00
Insurance	25 00
Sundries—postage, telegraph, etc	22 39
Balance in hand	83 73
	$1,312 44

We certify that we have examined the above account, with books and vouchers, and found the same to be correct. Balance in hand and in bank, eighty-three dollars and seventy-three cents.

H. P. BOCK,
W. E. SAUNDERS, } Auditors.

London, Ont., October 24th, 1887.

MEETING OF THE MONTREAL BRANCH.

The fourteenth annual meeting of the Montreal Branch of the Entomological Society of Ontario, was held on May 31st, 1887, when the following officers were elected for the ensuing year:—President, G. J. Bowles; Vice-President, H. H. Lyman; Secretary-Treasurer, F. B. Caulfield; Council, W. H. Smith, J. G. Jack, J. F. Hausen and R. C. Holden.

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

Mr. Bowles showed a box of Lepidoptera collected at Sudbury, by Mr. J. D. Evans, several of which were new to the members.

Mr. Lyman read a list of Hymenoptera and Diptera, taken at Hudson's Bay, by Dr. Robert Bell.

Mr. Caulfield read the following report of the Council for the past year:—

In presenting their fourteenth annual report, your Council regrets that owing to unfortunate circumstances, it is not so satisfactory as in former years.

The Society has sustained, since our last annual meeting, a great loss in the lamented death of Mr. Wm. Shaw, a member who enjoyed the highest esteem of his fellow entomologists as a man, and whose talents and energy warranted the expectation of a brilliant career as a naturalist.

During the past year, the absence of several of our most active members from the city, has resulted in but little collecting being done. Mr. Caulfield, however, has success-

fully worked out the life history of *Physonota unipuncta*, and his papers on this subject in the *Entomologist* are both interesting and important.

Only three meetings have been held during the winter, owing to the business engagements of some members and the serious illness of the President, who has been confined to the house for nearly a year. The following papers were read at these meetings :—

1. List of Noctuidæ, not previously recorded, from Montreal.—G. J. Bowles.
2. Notes on some species of Ips.—F. B. Caulfield.
3. Additions to list of Montreal lepidoptera.—G. J. Bowles.
4. Some further notes on Physonota.—F. B. Caulfield.

Your Council would suggest that efforts be made to increase the roll of membership, and urge upon all the need of increased zeal in the pursuit of our favourite science.

The whole is respectfully submitted.

GEO. JNO. BOWLES,
President.

F. B. CAULFIELD,
Secretary.

Montreal, 31st May, 1887.

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

The progress of the Entomological Society has been so uniform and constant during recent years, that it affords material sufficient for only a very brief report.

A great loss has been sustained by the Society in the removal of Prof. Saunders from London to Ottawa, and his consequent inability to longer undertake the onerous duties of President and Editor, which for many years he performed so faithfully and successfully. In his position of Director of the Experimental Farm he will, however, still be able to pursue his researches, and, with the necessary assistance of a competent entomologist, will be able to greatly advance the knowledge of the very important science of Entomology.

The publication of the *Canadian Entomologist* is successfully continued ; volume 18 contains papers from forty-nine contributors, all well-known workers, and many of the articles are of much scientific value. Volume 19 is now being issued under the editorship of Rev. C. J. S. Bethune, who edited the first five volumes, and who has been continuously a member of the editing committee, so that he is eminently qualified to take up the work laid down by Prof. Saunders.

The Sixteenth Annual Report contained as usual much matter of economic importance, and No. 17 is now ready for distribution.

The Annual Meeting of the Society was held in the Society's rooms, London, Ontario, on Wednesday, 20th October, 1886, when there was a very satisfactory atendance of members. The retiring President, Prof. Saunders, delivered a very interesting and instructive address, and several reports and valuable papers were presented.

The following resolution was carried unanimously by the meeting :—

"That the Society learns with regret that their esteemed friend, Prof. Saunders, has found it necessary to withdraw from the presidency of their body, and also from the editorship of their organ, *The Canadian Entomologist*, but recognizing the importance of the work Prof. Saunders has been called to superintend, and the wisdom of the choice made in him by the Government, it congratulates the Professor upon this recognition

of his abilities and zeal in the public service, and respectfully tenders to him a life membership in the Society."

Officers for the current year were elected as follows:—

President ..... James Fletcher, Ottawa, Ont.
Vice-President ..... Rev. C. J. S. Bethune, Port Hope, Ont.
Secretary-Treasurer ..... E. Baynes Reed, London, Ont.

Council..... W. H. Harrington, Ottawa, Ont.; Rev. T. W. Fyles, Quebec, Que.; J. Alston Moffatt, Hamilton, Ont.; G. J. Bowles, Montreal, Que.; J. M. Denton, London, Ont.

W. HAGUE HARRINGTON,
Delegate.

May, 1887.

THE PRESIDENT'S INAUGURAL ADDRESS.

LADIES AND GENTLEMEN,—Through the courtesy of the mayor and corporation of the city we are enabled this evening to make use of this commodious chamber.* The committee room put at our disposal for the other meetings would have been entirely inadequate to accommodate the large audience which I have the great gratification of now seeing before me. This pleasure, too, is considerably heightened, as I notice amongst you many of the class which our Society particularly strives to reach—to wit, farmers and gardeners—men who are daily brought face to face with the foes or friends, of which our members make it their special study to investigate the habits.

As there are many here this evening who are not members of the Entomological Society of Ontario, it is fitting that I should state briefly the nature and objects of that Society. Previous to 1863 there was no such society in Canada; but in that year a few naturalists, living in different parts of the Provinces, met together in Toronto and organized under the name of the Entomological Society of Canada. The membership at first was only sixteen, and this number included all those then known to be interested in insect life in Canada. From this small beginning the Society has steadily increased until its membership now reaches upwards of 500, and includes all the active workers in North America. The work done in the early years of the Society, notwithstanding the fact that the members were widely separated, was such that it soon became manifest that they must have some means of publishing the results of their observations for the benefit of each other and the scientific world in general. Accordingly in August, 1868, appeared the first number of the *Canadian Entomologist*, a monthly periodical, which from that time forward has been regularly published, and was for some years the only publication on the continent of America devoted solely to this important branch of natural history. It has now nearly completed its nineteenth volume. From the outset a noticeable characteristic of this magazine has been, that its pages have been entirely filled with the records of original work, and during its existence it has been the means of disseminating a vast amount of scientific knowledge, which has been of benefit not only to Canada but to the world at large. This organ of the Society is more particularly the scientific record of work done by the members, although it also contains many illustrated elementary and popular papers for the benefit of beginners. In addition to this, however, and what is an important part of our work, a popular report of some 75 or 100 pages is prepared annually upon injurious and beneficial insects, and the best measures for farmers and gardeners to adopt with regard to them. This is published every year as part of the report of the Minister of Agriculture and Arts for the Province of Ontario. Seventeen of these have already been issued, and have given to the farming community a large amount of useful information. Our Provincial Government recognizing the good work which was being

*The President's address was delivered in the council chamber of the Ottawa City Hall, on the evening of October 26th.

done by this Society, incorporated it in 1870, as the Entomological Society of Ontario, and gave at the same time material aid by allowing an annual grant from the public funds. By this assistance, the usefulness of the Society has been greatly widened, and the officers have become an advisory board to whom reference can be made whenever information concerning injurious insects is sought by farmers or others—an advantage of which the intelligent agriculturists of the Province have not been slow to avail themselves.

Of all the important events affecting agriculture in Canada which have happened during the past year, none can compare for importance with the establishment of the system of Experimental Farms throughout the Dominion, lately organized by the Federal Government. To no one more than to our members can it be a source of so great pleasure, that the person chosen for the important and responsible position of Director, should have been the present incumbent, Prof. William Saunders, who has been for so many years identified with the prosperity and progress of our Society; what he has been to us we all know; what others consider his value to have been, is well shown by Prof. A. R. Grote, one of the best American entomologists and a highly esteemed and regular contributor to the *Canadian Entomologist.*

When speaking of that journal in the preface to one of his works, he says :—

"The treatise of Dr. Harris which has become classical on its subject, did much towards creating a general interest in entomology; but the publication of the *Canadian Entomologist*, a journal aided pecuniarily by the Ontario Government, and owing its success chiefly to the unselfish labours of Mr. William Saunders, has assisted the progress of entomology in America probably more than any one other similar undertaking." This statement is not a bit overdrawn. Prof. Saunders—and I speak of him from an intimate acquaintance extending over a space of many years—is an exceptional man, remarkable not less for the diversity than for the thoroughness of his accomplishments, but above all for his tact and good judgment which have made him an object of respect and have endeared him to all who have had intercourse with him. Now, above all things, Prof. Saunders is an entomologist, and to it chiefly he owes his eminence. We congratulate him upon his appointment and also the Honourable Minister of Agriculture upon the wisdom of the choice he has made.

It may not be amiss here to say a few words with regard to the work it is proposed to carry out at these Government experimental stations. In the first place, the system will consist of a Central Experimental Farm at Ottawa and four other branch farms divided as follows : one for Ontario and Quebec, one for the Maritime Provinces, one for British Columbia, and one each for Manitoba and the North-West Territories. The officers at the Central Farm will be, the Director, and an Entomologist and Botanist combined, a Chemist, a Horticulturist and an Agriculturist. At the Central Station there will be a museum for the preservation of objects of interest. These, of course, will include all the different kinds of grain and other crops, and as well, cabinets for entomological and botanical specimens. As most of you are aware, I have been appointed to fill the position of Entomologist and Botanist to the Dominion Experimental Farms. I trust that I may be able to show before long that this selection was not ill advised. At any rate, I can assure you that no efforts will be wanting on my part to render the office one of general utility and a benefit to the farming community. I purpose, as quickly as possible after the building is finished, to place in the museum a collection showing, under each of the principal crops, all the insects by which it is attacked, so that the farmer or gardener who finds any of his crops injured by insects can come to the museum and see for himself, under the head of each plant the injurious insects known to infest it, and at the same time learn the most approved methods of treating them.

In addition to the above, there will be a botanical garden on the farm, a plot of about 65 acres having been appropriated for this purpose. Here native plants of economic value, as our forest trees, will be grown in large numbers for distribution and observation under varying conditions, so as to note their behaviour under different circumstances. Here, also, will be cultivated a large collection of plants of interest to the botanist from all parts of the world, including, of course, all the native species, of which I can obtain roots or seeds. It is thus hoped that many of the difficult problems will be cleared up which at present trouble the

scientific botanist, who has, perhaps, had to work at some of the least known or rare species with scanty and imperfect dried material. In this botanical garden and arboretum there is a remarkable diversity of habitat, from open water and an area of sphagnous bog to sandy upland with all the intervening varieties of soil—rock, shady ravine, heavy clay, light loam, sand, etc.—and I feel confident that a large proportion of our Canadian wild plants can be grown and examined at leisure. It will be noticed that the two posts of entomologist and botanist have been united. I consider this was a very wise arrangement, at any rate until the work in connection with these two posts increases so much as to make the appointment of two officers necessary. One of the most important things the entomologist will have to attend to will be the injuries to plants from insects. It sometimes happens, however, that it is difficult to tell at first the source of an injury to vegetation. The attacks of some of the low forms of vegetable life and of insects being, in their effects, very similar, so much so that instances sometimes occur when even careful observers, unless specially informed, may make mistakes. Again, sometimes injuries due to other causes altogether are attributed to either insects or fungi. During the past summer, there was great consternation in the county of Prince Edward on account of a serious failure in the pea crop, the complaint being that no seeds were formed. In this county peas are largely cultivated, on some farms to the exclusion of all other crops, and the seed produced is of such high quality that the best dealers in the United States and in England find it advantageous to procure their seed from this district. Many suggestions were made to account for this failure which was of such importance to a large proportion of the community, and insects and parasitic fungi were at once accused. It seems probable, however, that the excessive drought which prevailed during the whole summer was the sole cause. It is true that mycelium of fungus was found upon the roots in some instances, but this was always where the plant had been killed and was dead at the collar, the fungus only accompanying the decay of the roots and their tubers. These tubers on the roots of the leguminosæ are very interesting. Through the kindness of Prof. W. G. Farlow, of Harvard University, I have had my attention drawn to an excellent article by A. Tschirch, entitled "A Contribution to the Knowledge of the Root Tubers of the Leguminosæ." It is published in the Transactions of the German Botanical Society of 2nd February, 1887. This, for the first time, explains the use of these bodies, the nature of which had for many years been misunderstood. It would appear that all leguminosæ bear some kind of tubers on their roots. These vary in shape in the different genera; but they all have the same use, namely, to act as reservoirs where, during the time of active growth, nitrogenous materials are stored up until required to supply the large amount necessary to fill the seeds. These latter then draw off from the tubers the nitrogenous materials, leaving them empty. Now, on the plants in Prince Edward county which I had an opportunity of examining on several farms, through the courtesy of J. M. Platt, Esq., M.P., of Picton, the plants presented the characters of having (*i.*) a living stem above, (*ii.*) a vigorous tuber-bearing root, upon which, however, some of the tubers were in a state of decay, and (*iii.*) a short piece of dead stem at the surface of the ground effectually separating these two portions. I feel now pretty well assured that this state of affairs was brought about much in the following manner: Just about the time the peas were coming into flower, a period of drought set in which caused the stems to fade and lie over at a time when there was not sufficient foliage to protect them, in this way their bases were exposed to the direct heat of the sun as well as that from the hot, parched earth, and they were thus injured to such an extent that they could no longer act as channels for the interchange of materials from the root to the stem and *vice versa*. If this be the correct view, the exceptional drought of last year must be assigned as the cause for this shortage, and not any attack which is likely to give trouble in the future. One noticeable feature about the plants examined was the abundance and large size of the root tubers, and this might have been anticipated had their nature at the time been understood. It points to the fact, however, that although this year the crop in Prince Edward county is small it is from an exceptional cause, and there is every reason to believe that with an ordinary season this district, so justly celebrated, will still show that it is without an equal in Ontario as a pea-producing county.

There are other injuries the nature of which is not apt to be understood. Amongst these I would specially mention the "club root" in the cabbage, which is produced by a

fungus (*Plasmodiophora brassicæ, Wor.*), although by many it is thought that it is caused by the attacks of a small beetle. Another injury caused by a fungus, but which has very much the appearance of an injury by insects is the Plum-leaf Fungus (*Septoria cerasina*, Pk.) which has the effect of making small holes in the leaves of plum trees as if they had been perforated by shots from a gun. This has been sent to me during the past summer for information as to the "insect" which was supposed to be the depredator. Again, the curious disease called "bumble-foot," to which some breeds of poultry are liable, is occasionally supposed to be due to the attacks of insects. It is probable, however, that the large swellings on the feet of chickens so named are really abscesses, due to aggravated bruises caused by high perches and a hard floor to the poultry house.

These few instances, however, are sufficient to illustrate the advantage of any investigator being familiar with at any rate the first principles of other branches of study besides his own specialty, for he will frequently be applied to for information, and, indeed, will require for his own work knowledge of allied subjects.

Perhaps one of the greatest surprises to one who begins to devote a portion of his time to the study of Natural History, is the discovery, which soon forces itself upon him, that instead of there being a large number of different sciences, these are merely several branches, all of which are so intimately related, nay, even dependent upon each other, that they are merely component parts of one great whole. Nor does any one branch very much surpass the others in importance, for each one is necessary to the rest. And the special value of any one study over the others is only in the eyes of those students who devote to it their particular attention. All are links in one great chain of knowledge, engrossing to the highest degree to all who are happy and lucky enough to feel its charms, and of enormous importance to the world at large.

In a consideration of this theme we can begin at any one of the links, and, perhaps, to-day it is more fitting to begin at our own special subject—Entomology. Most nearly related to Entomology is Botany, the branch of science which treats of the vegetable kingdom from which so large a proportion of the insect world derives its sustenance. An intimate knowledge of the different species and families of plants is of great importance to the Entomologist. It frequently occurs that in his studies he requires to breed through all its stages some insect which feeds naturally upon a plant not to be obtained in his neighborhood; with a knowledge of the different orders and classes of plants he is able to make use of a nearly related species, sometimes even of a different, but closely allied genus. There are many instances on record where this has been done; but by far a larger number where, for want of this knowledge, valuable insects have been starved from only having improper food offered them. The economic entomologist is much helped in his investigations by this knowledge. Many of the injurious insects which attack our cultivated crops, especially those of which there are two or three annual broods, subsist during one or more of these on wild plants allied to those cultivated. By a removal of the wild plants many of these pests are naturally kept very much in check, for it must never be lost sight of that the great factor which influences the amount of insect-presence is the amount of food-supply. Then the important offices performed by insects in their relations with plants render them objects of very great interest to the botanist; he recognizes in them nature's pruners, which remove or prevent a too great exuberance of growth; and they perform such a conspicuous part in the fertilization of the seeds as to have been designated "the marriage priests of plants," ushering the young seedling into existence; they also remove it from the face of nature directly its usefulness and beauty are gone, so that its place may be taken by others. The fact that insects and seeds form the greater part of the food of so many birds, naturally connects the studies of the ornithologist with the two preceding. By the dissection and examination of the stomachs of birds, many useful assistants of the farmer and fruit grower have regained a good character of which ignorance had robbed them. How many thousand of woodpeckers and owls and hawks, which were nobly doing man's works for him, have fallen victims to this spirit of ignorance.

These remarks will apply equally to several other branches of Zoology.

The next step is to the laboratory of the chemist. Here the entomologist finds the materials for alluring and preserving the specimens for his cabinet, or is provided with

means to wage war against those which increase in such undue numbers as to require to be treated as enemies. The botanist, too, must come to the chemist to discover the exact nature of soils and the different fertilizers, as well as the principles contained in the plants which he collects or cultivates, so as to know the comparative values of each species in a family of plants. Chemistry teaches us not only how, by special treatment, virulent poisons may be transformed into nutritious foods, as in the case of arrowroot and other products derived from the Araceæ, but also how some species in the same genus may be harmless and others noxious. This we find amongst the Sumachs—where we have the Stag's-horn Sumach (*Rhus typhina*), the seed coats of which provide the French Canadian with wholesome vinegar and a refreshing summer beverage, and also its near relative the Poison Ivy (*Rhus Toxicodendron*). Conversely, too, the obligations of the chemist are just as great for the exact information as to species, growth and habits of plants which he receives. The close relationship existing between chemistry and mineralogy is manifest, as is that of the latter with geology. In the last named science the Palæontologist finds frequently the necessity of a thorough knowledge of the different branches of Zoology and Botany, so that he may correctly identify the fossil remains brought before him, and refer the rocks bearing them to their proper ages.

By common consent the students in some of these branches work together with mutual benefit. The botanist delving in the earth in search of roots, or gathering mosses from the woods and swamps, finds many minute insects and shells. The conchologist, wading in the shallow waters or raising up the bark of dead trees when looking for shells, frequently discovers aquatic plants and insects of rarity. The entomologist, peering and prying everywhere to discover the active objects of his quest, is not less useful to the others, and so we find that each branch of science is an aid to the others, and must be developed to the highest degree, not only that as much knowledge as possible may be accumulated in its own domain, but also from the collateral value it may be to other sciences.

But I need not remind you the value and interest in the natural sciences is not for its devotees alone. It is not too much to say that the almost phenomenal strides which have been made in the progress of the world during the past century are due entirely to the developments of scientific knowledge. I will, however, refer briefly to one special line of progress in which this kind of study has been found of great use.

Educationalists in all parts of the world attest the value of the Natural Sciences as a part of the practical education of youth; and the fact that they enter so largely into the curriculum of our Ontario schools does much towards showing the high state of excellence of the methods here adopted towards preparing our young men and women for fighting the battle of life.

These studies, it must be remembered, —used educationally—are essentially not *ends*, but *means*; means for producing in the mind exact and careful methods of thought, of developing the faculties of accurate observation, and above all things are important as giving a power to express in a concise and definite manner what it is wished to relate. If these characters be not found in the Naturalist much of his work is but play, and his labour is lost; his studies are useless to himself and of little value to anyone else.

I cannot help thinking that the scientific outlook in Canada is far brighter at the present time than it has ever been before. The facilities of communication and travel which now exist put us at an enormous advantage over our predecessors. The result of these increased facilities has been, as a matter of course, a great spread of all kinds of knowledge, and entomology is perhaps one of the most benefited.

In all directions we hear of a higher appreciation amongst farmers and others of the value of this study. Addresses from specialists concerning insect life are asked for to be delivered at Teachers' Institutes, before our Normal Schools, at meetings of Farmers' Institutes and similar associations. Quite recently the Legislature of British Columbia has seen the advisability of appointing a Provincial Entomologist, and it is with pleasure that we learn the appointment has been given to one of our members, the Rev. G. W. Taylor, an excellent Naturalist and one who cannot but do good. Lectures explaining and popularizing Entomology are found to be always acceptable before Natural History Societies in all parts of the country, and in *The Educational Review*, a monthly magazine

published in St. John, N.B., a most excellent series of illustrated popular articles is appearing from the pen of Principal A. H. McKay, of Pictou, N.S. These are in the shape of addresses to an imaginary class at "Ferndale School," and from their simplicity and accuracy will certainly be intelligible to all and give much instruction.

From this it will be seen that anyone now-a-days who wishes to obtain knowledge concerning injurious and beneficial insects can do so with very little trouble.

The ease with which parcels of specimens and books may now be sent by mail and the low rates of postage, as well as the extensive development of systems of railways in all the Provinces of the Dominion, by which it is now possible to communicate in a few days with many localities previously inaccessible, bring it within the power of all to obtain almost any desired information. It is my duty, however, to remind you that these advantages also bring with them their responsibilities, and I take the liberty, therefore, of suggesting certain lines of study in which I believe more work should be done by our members. Our monthly magazine still maintains its character as a high-class scientific magazine, and should be, as it doubtless is by most, carefully read by all our members.

I should, however, be glad to see some new names amongst the contributors. There are also certain orders of insects which receive little attention at our hands, and the work, although good, is being done by too small a number of workers. Amongst the lines of investigation which demand our attention, I would mention, first of all, the clearing up of the missing links in the life-histories of our common and conspicuous injurious and beneficial insects. There is a great deal yet to be done with regard to the common injurious insects, as cut-worms and wire-worms, etc. Again the advantages of easy access to the North-West Territories and British Columbia by means of the Canadian Pacific Railway must not be neglected. By the completion of this great highway, connecting the Pacific with the Atlantic it is now possible for us to receive eggs of nearly all the unknown species of our diurnal lepidoptera. The ease with which these can be reared from the egg has been explained in the *Canadian Entomologist* by our highly esteemed contributor, Mr. W. H. Edwards. The keen pleasure to be derived from breeding insects and watching them through all their stages can only be appreciated by those who have tried it. All I can say is that I, for my part, have never derived more true pleasure from any occupation. The excitement of catching the female, the anxiety to know whether she will lay eggs and whether these will hatch, then watching the small larvæ through their successive moults till they are full grown, and the final emergence of the perfect insect, all are intensely interesting. Now the large number of Canadian lepidoptera of which the preparatory stages are unknown, but of which we could with comparative ease obtain eggs, should surely induce some of us to make a great effort to clear up some of these points. Let us, at any rate, try to have a few of them disposed of before the next annual meeting.

Another study of enormous importance which might well receive more attention is that of the dipterous and hymenopterous parasites of injurious insects. Mr. Harrington, of our Council, has done good work in this line. The Abbé Provancher, of Quebec, has also in his excellent little magazine, *La Naturaliste Canadien*, published lately much valuable information concerning both the hymenoptera and the hemiptera.

In this connection I would mention a curious discovery made during the past summer. In examining the seeds of the common Canada thistle with a view to finding out the extent of their fertility, I was surprised to find that in nearly every head most of the seeds had been destroyed by a white dipterous larva, which was generally placed head downwards, only showing a brown disk with two pores on the upper end. It had a peculiar habit of enveloping itself with the pappus of the thistle, which was wrapped tightly round it, as though the larva had twisted itself round and round and drawn the silky pappus with it until a thick wad was formed. This is probably as a protection during the winter, for most of these larvæ were mature, and some which I have in breeding jars remain quiet in these coverings. I was naturally much interested in this beneficial insect which had suddenly developed in such large numbers; but my surprise was great when I found that from upwards of 200 specimens collected, most of them produced a small parasitic hymenopterous fly of a kind unknown to me. We had then the somewhat paradoxical result of an insect parasitic upon another insect being noxious; but

such it undoubtedly is. From all the thistle-heads mentioned, I only obtained one pair of the flies, the larvæ of which were destroying the seed of this troublesome weed (they apparently belong to the Trypetaceæ), all the rest produced the little black parasites. Later in the season, by examining a large number of plants, I secured a few specimens of the larvæ which appear to be healthy, and these are all wrapped tightly in their coverings of thistle down. There were sometimes as many as three larvæ in one head of seed, but as a rule only one. Through the kindness of my friend, Mr. Harrington, the small parasite has been sent to Mr. W. H. Ashmead for identification.*

During the past year several notable collections of insects have been made in unworked districts of Canada, amongst these I would make special mention of those by Prof. Macoun and Rev. G. W. Taylor, in Vancouver Island; Mr. J. M. Macoun, in Hudson Bay; Dr. G. M. Dawson, near the Alaskan boundary; Mr. J. D. Evans, at Sudbury, Ontario; Messrs. J. B. Tyrrell and Dowling, in Manitoba; and Mr. N. H. Cowdry, at Regina and near Fort McLeod.

Several publications worthy of a much longer notice than I have now time to give them, have appeared during the past season. First must be mentioned the resumption of publication of Mr. W. H. Edwards's "Butterflies of North America." From the Division of Entomology at Washington, several reports and bulletins have been issued. Prof. Cook, of Michigan, and Prof. Forbes, of Illinois, have both issued timely publications of great utility, particularly bearing upon the use of arsenical poisons as the best remedies for the codling worm and plum curculio. Prof. F. M. Webster, of Purdue University, has done good work amongst the insects injurious to wheat crops, and has brought his practical common sense to bear upon some of the troubled questions with good results. From the American Entomological Society, has come Mr. Cresson's much wanted Classification of the Hymenoptera, a work which will be found of the greatest use to students.

Prof. Grote's "Hawk Moths of North America," which, although complete in itself, is a part of a series of essays on North America Lepidoptera, will be found a useful work for collectors. It is to be hoped that this talented author will soon issue a further part of his work. Mr. Scudder's great work on the Butterflies of New England, is announced for next spring. From the well known excellence of this author's work, it is needless to say that it is anxiously looked for by Lepidopterists.

I must now pass on to a brief sketch of the most noticeable injuries by insects during the past season. The crops in Canada, notwithstanding the excessive drought, have not suffered from any very severe attack of insects. The wheat midge continues to levy heavy tribute from the farmers' wheat wherever this cereal is cultivated, but only amongst the best farmers in the Province of Nova Scotia has it become sufficiently abundant to induce them to burn the screenings. Throughout Canada, from the Atlantic to the Pacific, the tent caterpillars (Clisiocampa) have been most injuriously abundant. I received, during the month of June, most doleful accounts of their ravages; whole groves were stripped bare, and few trees seemed to come amiss to them. Along our streets here, hardly a tree could be found without its nest of caterpillars. The advocates for the English sparrow received a rude shock in observing their neglect of this large supply of, what they supposed would be, such acceptable food. I must, however, in all fairness to these little usurpers, record that on the 26th May last, I did actually see a little cock sparrow worry to death and afterwards devour with apparent pride and great gusto, a full grown larva of *Clisiocampa Americana*, which was endeavouring in a great hurry to cross a path unobserved.

The wheat crop of the Dominion for the past season has been enormous and of very fine quality. This is chiefly owing to the vast quantities of this staple grain produced in Manitoba and the North-West Territories. Throughout Ontario, however, the excessive drought has prevented the maturing of the seed to a large extent. Complaints of the operations of the wheat midge and Hessian fly have been reported from some localities, and the former of these has made itself too apparent in Nova Scotia and New Brunswick. The wire worm has done its share of destruction, but on the whole the injury to wheat

* It has since been named *Solenotus Fletcheri* by Mr. Ashmead, and is the first representative of the genus as yet discovered in America.

has been inconsiderable. Perhaps the insect of most interest is the "Wheat-stem Maggot," the larva of a small fly known to science under the name of *Meromyza Americana*. This insect has been observed during the past three years, but nowhere in very large numbers, and only a few complaints have been received of its operations; but, on the other hand, it is found upon enquiry, that it has been seen in a great many localities, and, moreover, it appears to be steadily increasing in numbers. In some localities in the Ottawa district where, however, it must be stated most enquiry has been made, it is reported to have been present for years. Dr. Ferguson, M.P. for North Leeds, states that it is always most prevalent in good seasons, and when there is great drought and a small crop the insects do not appear in such large numbers, but when the growth is vigorous and there is a good deal of moisture, they appear almost invariably. As this was an exceptionally dry year, should this theory be correct, I fear we may, in an ordinarily moist season, anticipate a severe attack from this insect. There are two distinct kinds of injury committed by this insect. The presence of the larva of the second or summer brood is indicated by the top joint of the wheat turning white just about the time the wheat is in blossom. This character is very noticeable and has gained for it the name of "Silver-top" in some localities. The other kind of attack is that by which the larva destroys the young central shoot of the autumn grown plants of fall wheat.

Dr. Ferguson states that the usual course amongst farmers in his constituency, has been, where they are general, to put the mower in and cut the crop. This. however, is a severe remedy to which it has not often been necessary to have recourse.

Mr. D. James, of Thornhill, in the County of York, states that it works particularly in the variety known as "Goose spring wheat," and says, "It is three or four times worse in my fields this year than last. At a rough estimate about every thirtieth head is affected, and it may prove more than this."

This information is sufficient to show that it is an object requiring special study.

The life history of this insect is briefly as follows:—The eggs are laid on fall wheat in the autumn—in September and October, these hatch and pass the winter in the larval state, and in the following spring produce, in June and July, the perfect insects. It is supposed by Prof. F. M. Webster, of Purdue University, Ill., that these lay their eggs in volunteer wheat, and that these again produce the injurious brood which attacks the autumn fall wheat. Another supposition is that the perfect insects remain alive until the fall wheat appears above ground. This, however, seems hardly likely, and if Mr. Webster's theory be not correct, it is probable that the gap is bridged over by the existence of a brood in some of the wild grasses.

Timothy hay has for the last few years suffered severely from a similar injury, by which the top shoot is also destroyed, and the records of the two attacks are much mixed up.

I have failed in my efforts to breed this insect to maturity. I am, however, at present of the opinion that it is not the Meromyza. The remedies which suggest themselves for Meromyza at the present stage of the investigation are *late sowing* of fall wheat and clean cultivation, by which all volunteer wheat is destroyed.

From the similarity of the attack by the autumn brood to that of the Hessian fly, I feel confident that the two are sometimes confounded by farmers. The larvæ and pupa cases of the two are, however, very different in appearance. The Hessian fly, I am thankful to say, is not very injurious in Canada at the present time; but in parts of Illinois it has lately committed great depredations. The outbreak of this pest, which occurred in England last year, has drawn much attention to entomology in that conservative country, and the name of one of our honorary members, Miss Eleanor A. Ormerod, is now more than ever a household word amongst the grateful farmers, whom, by her prompt action and safe advice, she has put in a position to protect themselves against this scourge. I am still however of the opinion, notwithstanding the present state of affairs, that the Hessian fly will never become a "first-class pest" in England. As well as Miss Ormerod, Mr. Whitehead continues to write and publish valuable advice to the farmers on injurious insects. It is to be hoped that they may be awakened to see the value of his words and follow the instructions he so plainly gives.

The injury to other grains has been small, and with the exception of the as yet

unexplained "silver-top" injury to hay, this crop in Ontario has not suffered. The clover seed midge is now by early cutting comparatively well kept in hand by growers.

The root crops have been poor for want of rain, turnips suffered severely and late in the season all growth was stopped in some districts by enormous quantities of a grey aphis. When treated in time these were easily destroyed by spraying with kerosene emulsion. Few, however, could be induced to take this trouble so late in the season; preferring to take their chance they did nothing, and as a consequence lost their crop of turnips.

Carrots last year were badly attacked by the carrot fly (*Psila rosæ*), but this year very few complaints were received. Radishes and cabbages were badly attacked by Anthomyian flies, so well known to gardeners as root maggots. I have, however, during the past summer had such success with Prof. Cook's carbolic acid treatment, that I had no trouble in growing radishes entirely free from attack, right through the summer. This remedy consists of one gallon of water in which two quarts of soft soap have been dissolved. Into this when boiling hot one pint of crude carbolic acid is put, and after being boiled and stirred for a short time, is put by in bottles. When required for use I put one cupful in a watering can with fifty cupfuls of soft water. This when stirred up a little is ready for use, and is watered by means of a rose all over the beds, beginning three days after the seed is sown and continuing once a week until the radishes are ready for the table. It can be watered all over the foliage and will have no effect, either on the vegetation or in giving any offensive taste to the vegetable. For cabbages the most successful treatment was as follows:—At the time of planting out gas-lime was sprinkled lightly all round each plant. About first July the earth was well hoed up round the stems and another light application was made. This substance was also found very beneficial by Mr. E. Bell, of Archville, in preventing to a large extent the attacks of the onion maggot. In this case it was sown very lightly broadcast over the whole bed—once a fortnight,—from the beginning of the season until the middle of August.

Potatoes suffered in some localities from the Colorado potato beetle. This pest, however, is so easily and cheaply kept down with Paris green that it is not necessary to speak of it at greater length.

The imported white cabbage butterfly (*Pieris Rapæ*), committed serious injury throughout the Province, notwithstanding the fact that myriads of the larvæ were destroyed by the fungous disease known as *flacherie*. This disease has been noticed for the last seven or eight years from the virulence of its attacks upon the larvæ of this insect; but this year the caterpillars having appeared in undue numbers, its presence seemed to force itself upon everyone's notice. Great injury was done by these caterpillars before the epidemic developed and it was necessary to have recourse to active remedies. Of these, without doubt, insect powder (*Pyrethrum*) is the best. This material can be mixed with four or five times its weight of common flour. With one of the many insect-guns and a very little practice, a large number of plants can be dusted in a short time Treatment with a tea of this poison was not so successful as the dry application.

Orchards have in some districts fared worse than other crops. In the first place the leafing out of the trees was retarded in early spring by the want of rains. The enormous numbers of Clisiocampa and a goodly host of other caterpillars, at one time threatened to entirely strip the foliage from the apple trees. In Nova Scotia the apples were from various causes reduced to one-quarter of the average crop. Two particular insects were most complained of, "the canker worm" and the pear-blight beetle *Xyleborus dispar*, Fab., (*Xyleborus pyri*). This latter was called, locally, "the shot-borer," from the resemblance of its tunnels to small shot holes. It has done much injury. Many specimens have been sent to me from the Annapolis Valley, and by the kind assistance of Mr. T. E. Smith, of the Nova Scotia nursery at Cornwallis, N.S., a close and careful observer, I have been put in possession of much useful knowledge with regard to this insect. Mr. Smith is under the impression that they do attack healthy trees. He writes: "One of my neighbours has lost about forty fine healthy apple trees, mostly Gravensteins and King of Tompkins. They attack the butt, and in some cases well into the limbs of young and bearing trees a foot

in diameter, mostly on the north side of the trees." One specimen of apple wood cut from a branch two inches in diameter and apparently in a living condition, produced, as well as the pear-blight beetle, several specimens of *Monarthrum mali*, another injurious species somewhat resembling the above, but even smaller. A noticeable feature of every specimen of injured wood submitted to me was that the trees from which they were cut were very badly attacked by the "Oyster-shell bark louse." Opinions seem to differ as to whether these beetles will attack vigorous, healthy trees. Efforts will be made to induce the Nova Scotia fruit growers to treat their trees for the "Oyster-shell bark louse," which alone, without the assistance of these borers, are sufficient to rob the trees of much power for bearing fruit. Last spring I was much pleased at receiving from Mr. A. J. Hill, of New Westminster, B.C., some twigs of apple covered with this bark louse, which, when enclosed in a breeding jar, produced hundreds of the useful little parasite *Aphelinus aspidiotidis*. Every scale seemed to be destroyed. After saving a few specimens for the cabinet I turned the others loose in an infested apple tree, and hope next year to find that they are established here. In our own Province by far the worst enemy the orchardist has had to contend with is the codling worm (*Carpocapsa pomonella*.) There is now no doubt that the use of arsenical poisons is the only practicable remedy for this pest. I refer to it now for a special reason. In the *Canadian Horticulturist* for August appeared what I cannot but consider a most injurious and ill-advised article. In it the writer, who, by the way, does not give his name, writers of such articles seldom do, makes several bare statements without giving any proof, warning fruit growers against using arsenic in any form, and draws a vivid picture of the ills which may come from neglecting his advice. This article will be answered in full elsewhere; but I wish to draw attention to two of his statements, viz.:

"That although the mineral arsenic is insoluble in water it is freely soluble in the . . . . acids resulting from decomposition of vegetable matter —and is then readily taken up by the roots of plants, especially by those of the coarser vegetables, as the potato, etc."

"Similarly also, in applying solutions of Paris Green to the apple blossom, it is not only that the petals are destroyed, but the poison may be absorbed by the fruit—"

Now the injury of this article is this: In the first place the statements are inaccurate and secondly being published where it is, it will be read by a large class of people who will not be able to detect the inaccuracy, and who sooner than run any risk will let their crops be destroyed so as to be on the safe side, and besides this there is no doubt that it is less trouble not to make this application, and we all know how easy it is to take a ready-made excuse for not doing a thing which we know ought to be done; but if there is the slightest doubt about the propriety of an action we seldom even need an excuse to be prepared for us. Now, Entomologists have been for years trying to persuade fruit growers to save their apples and plums by using these arsenical poisons, and Prof. Forbes has shown by most careful experiments, that at least 75% more of a crop can be preserved by their use than by leaving the trees alone. Fruit growers were just beginning to be awakened to the value of these remedies when "C." (of Durham, Ont.), comes out with his injurious article. In answer to it I say—if care be taken to apply this remedy as directed by Entomologists *no* danger can result from its use. As to its being absorbed into the potato tubers, "C," seems to forget that these bodies are not roots, nor are they filled from the roots. They are merely swellings at the ends of underground stems, such as are known to botanists as "winter-buds," and are reservoirs for the storing up of reserve material chiefly *taken in by the foliage* for the use of the next year's growth. Even then were it possible for any appreciable amount of the arsenic to get to the roots and be absorbed by them, which I very much doubt, it would be impossible for it to get into the tubers. Prof. Cook, of the Michigan Agricultural College, had some very careful analyses made of plants specially treated with arsenic. Paris green was put on the foliage as strong as possible without killing the plants, and it was also put on the ground where it would be worked to the roots. Both vines and

tubers were analysed by a very careful chemist, but not a trace of arsenic could be found. Again, with regard to the injury to apples, the poison should not be applied until after the petals have fallen, and when consequently the ovaries are fertilised and the stigmatic disk is incapable of absorbing anything, much less a caustic solution of arsenic.

. . . . . .

Here the general broad principles upon which insect remedies are applied was explained and listened to with interest.

. . . . . .

Before closing the President said,—"It is with feelings of the deepest regret that I have to refer to a severe loss our Society has sustained since the last meeting in the removal by death of one of its most active and esteemed members, Mr. George J. Bowles, of Montreal. This gentleman was for several years a member of the Council, and was also, at the time of his death, the President of the Montreal Branch, in which he always took a keen interest, and in the foundation of which he took an active part. His quiet, modest manner made him a favourite with all his associates, while his ability as a naturalist was acknowledged by every one who had intercourse with him. He was a regular contributor to the publications of the Society, and also prepared many valuable papers for the Montreal Branch.

He paid particular attention to the lepidoptera, of which he had extensive and choice collections both of Canadian and exotic species.

Mr. Bowles was a native of Quebec, where he was born in 1837; he leaves a wife and three children, for whom, in their bereavement, our deepest sympathy is called forth.

Another of our members who has passed away is Mr. Charles Chapman, of London. Mr. Chapman as well as taking an active interest in our Society, was also a patron of art, and has been styled the Father of the Western Ontario Art School.

In closing, I wish to draw special attention to the beautiful collection of Coleoptera exhibited by Mr. Harrington this evening, and this collection, I think, will illustrate some of the points upon which I have spoken to-night. The method and care with which they are arranged, and the neatness with which all are named and mounted, point out far better than I can explain the educational value of the study of Entomology.

JAMES FLETCHER.

ELECTION OF OFFICERS.

The election of officers was then proceeded with, and the following gentlemen were duly and unanimously elected :—

President—James Fletcher, Ottawa.
Vice-President—E. Baynes Reed, London.
Secretary-Treasurer—W. E. Saunders, London.
Librarian and Curator—E. Baynes Reed, London.
Council—W. Hague Harrington, Ottawa; Rev. T. W. Fyles, Quebec; J. Alston Moffat, Hamilton; J. M. Denton, London; Rev. Geo. W. Taylor, Victoria, B.C.
Editor *Canadian Entomologist*—Rev. C. J. S. Bethune, Port Hope.
Editing Committee—Prof. W. Saunders, Ottawa; J. M. Denton, London; Dr. Wm. Brodie, and Capt. Gamble Geddes, Toronto.
Auditors—J. M. Denton and E. Baynes Reed, London.
Delegate to Royal Society—H. H. Lyman, Montreal.

THE COTTON MOTH IN CANADA.

Rev. C. J. S. Bethune, of Port Hope, read the following paper :—

It may seem at first sight somewhat out of place to bring before the Entomological Society of Ontario an insect whose name and food-plant are so essentially Southern as the Cotton Moth—*Aletia xylina*, Say ; *A argillacea*, Hubn. It is, however, by no means an uncommon insect in this Province and other northern parts of America, and has this year occurred in large numbers at Port Hope. On the 7th and 8th of October I saw in the day-time many specimens of the moth in my garden, darting, when disturbed, from one place of concealment to another—generally the shelter of a fallen leaf. On Sunday, the 9th, a warm, damp evening, they were very abundant, being especially attracted by light ; and the next day I gathered up over 40 specimens underneath an electric street lamp, not far from my house, where they had been emptied out of the globe by the lamp-cleaner. The night before, I had noticed hundreds of moths flying about this lamp, pursued by the usual attendant bats, and waited for below by the expectant toads. Most of these must have been Cotton Moths, as I found only one specimen of any other insect among the more than two score that I gathered up the next day. At the same time, viz., on Oct. 8, 9, and 10, the shore of Lake Ontario, about a mile to the south of where I live, and a little east of Port Hope harbour—was covered with the same moths, evidently washed up by the waves. Some were alive, some nearly drowned, but the great majority dead.

The question that I wish to bring before the Society is, Where did all these Cotton Moths come from ? Have they flown up from the South on the wings of the wind, or are they natives of our own country ? Were this the only instance of their appearance here, I should answer at once that they must have come to us from the cotton fields of the Southern States, where they are always excessively numerous and destructive. But many of my friends, as well as myself, have repeatedly found this moth in abundance in Canada. As long ago as 1865 I observed it in great numbers late in September on fallen fruit, and nearly every year since it has been more or less common in the autumn. It has been found here in Ottawa, in Quebec, in various parts of Ontario, high up in the Adirondack mountains in the State of New York, at Racine in Wisconsin, etc., always in the autumn, late in September or in the beginning of October.

Professor Riley, Chief of the Entomological Commission of the United States, and the highest authority on the subject in North America, is strongly of opinion that the moth migrates to these northern regions from the cotton States in the South. He considers that the insect possesses ample powers of flight for traversing such a distance, and believes that though it may breed for a season or two in Canada and the Northern States, it does not become a permanent inhabitant, but is really a purely Southern species. On the other hand, many northern Entomologists have agreed with me in thinking that the moth must live in the north as well as in the south, and must therefore feed upon some other plant besides the cotton—some indigenous member of the mallow family (*Malvaceæ*). Our reasons for this opinion are (1) That the moth is so common over the whole of the north, from Maine to Wisconsin ; (2) That the specimens we find are perfectly fresh, with their wings entire, and the scales unrubbed—without, in fact, any indication that would lead one to suppose that they had just arrived from a flight of a thousand miles ; (3) That a specimen was taken by Dr. Hoy, in Wisconsin, with the fore and hind wings on one side in a deformed and crippled state, evidently showing that it had recently emerged from the chrysalis, and that it could not have flown any distance ; (4) That a female was captured also by Dr. Hoy near his residence at Racine, about the middle of June.

The fact that I mentioned at the outset that vast numbers of the moth were this year washed up on the shore of Lake Ontario, seems at first sight to tell against our view and to strengthen that of Prof. Riley. But after all, we have no evidence to show from which direction these moths came, whether they were flying across the lake from the south and fell into the water when near the northern shore, for they could not have been floating for any great distance, or whether they were blown at night off the land

into the water. I am myself strongly inclined to the latter opinion, because we so often find at Port Hope large quantities of insects washed up on the lake-shore at different times in the summer, and as far as my observation goes, always on the days following a stiff northerly wind or squall during the preceding night. We have found, for instance, in June, hundreds of specimens of the large green Carab, *Calosoma scrutator*, (Fig. 1)—usually a very rare beetle indeed—and others of the same genus; these are carnivorous insects, feeding upon caterpillars and other destructive creatures, and are said to especially frequent wheat fields at night. There has been no extraordinary occurrence of these beetles in the State of New York that I have ever heard of, and the prevalent winds, especially at night, have not led me to suppose that they could have got into the lake from any other quarter except from our own fields.

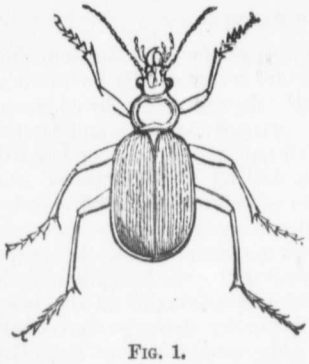

FIG. 1.

This question about the Cotton Moth has been several times discussed at meetings of the Entomological Club of the American Association, and so far we have not been able to arrive at any definite conclusion. My object in bringing it before our Society to-day is to try and enlist the services of Canadian entomologists and botanists in settling the question finally. What we want to ascertain is whether the insect breeds in this country, and if so, what its food-plant is. The Cotton-plant (*Gossypium herbaceum*) belongs to the Mallow family (*Malvaceæ*), and therefore we naturally expect the caterpillar of the Cotton Moth to feed upon one or more plants of this botanical family. There are none, however, indigenous to Canada, but several are common in gardens, such as the Hollyhock, and Hibiscus, and the Mallow weed. We should be very glad if all our botanists, as well as entomologists, would keep a look out upon plants of this family next season, and report at once if they find them infested with caterpillars of any kind. I have no doubt that our President, Mr. Fletcher, will willingly undertake to examine and identify any specimens that may be sent to him, and I shall be glad to do the same, if it is found more convenient to communicate with me.

Before closing, it may be interesting to mention that the destructiveness of this insect in the cotton fields of the South is almost beyond belief. Prof. Riley shews in his report, from carefully obtained statistics, that during the fourteen years succeeding the civil war in the United States the average number of bales of cotton produced amounted to 3,449,200 per annum, and that 594,497 bales were lost during the years of worst attacks by this insect; the value of these bales, at a low average price, was no less a sum than $29,711,000! Of late years the percentage of loss has been much diminished by the use of Paris green and other arsenical poisons, for which the planters have very largely to thank their entomological friends. The loss in 1881, for instance, is computed at 193,482 bales, worth a little less than $9,000,000—a saving of about twenty millions of dollars per annum. Much of this improvement may undoubtedly be placed to the credit of entomologists, and certainly the country gets back many hundredfold the few thousand dollars spent upon this branch of economic science.

Prof. Macoun suggested the basswood tree as a possible food-plant of the larvæ, because there were not in the district sufficient malvaceous plants to furnish food for such numbers of insects.

Mr. Fletcher said that careful search had been made for several years on this tree, as well as on all plants allied to the cotton plant, but no traces of larvæ had been found. He had hitherto been inclined to believe that the moth bred in Canada, and that the theory of migration from the cotton States was not tenable, but what he had learned concerning the appearance of these insects this autumn had somewhat changed his views.

Mr. W. Hague Harrington stated that the appearance of the moths had been very noticeable at Ottawa at almost the same date as they were observed at Port Hope. The first week of October had been comparatively wet, with calms and light winds varying from east through south to west. Sunday, 9th October, had been a remarkably mild day, and on that evening the moths had swarmed at some electric lights. On the following morning he had observed upon the front of the Ottawa Bank a great number of moths, at least 250 or 300. The building faced the north, being situated opposite the Parliament Square, and had in front of it an electric light. Moths were also seen at several points in the city, but not in any great number. From the fresh, unrubbed condition of all those seen he then thought that they could not have flown far, and that possibly they might have been bred upon some of the plants on the Government grounds. Since hearing Mr. Bethune's paper, however, he was more inclined to favour the migration theory.

Mr. J. Alston Moffat reported that on Friday night, 7th October, immense swarms had appeared at Hamilton. He was informed by a friend that on that evening they had been around the electric lights literally in millions—the number being so great that he could not attempt to give an idea of them, other than by saying that all the insects previously observed by him were as nothing in comparison. Mr. Moffat visited the section of the city where they had been most numerous, on the following afternoon, and found the ground for a space of several yards around each electric light pole covered with these insects, every inch having at least one moth. Immense numbers had been crushed under foot, but the rest were lively, and darted off in their accustomed manner when disturbed. That night they were very abundant, but Sunday evening was wet and their numbers were lessened.

Mr. J. M. Denton said that in London the moths had not been observed, although there was an electric light quite near his house.

After the discussion the general opinion of the meeting was that a migration seemed indicated, and it was resolved that endeavours should be made to find out if the moths had been observed at points intermediate between Canada and the Southern States.

Mr. Fletcher exhibited some beautiful paintings, kindly loaned by Mr. Scudder, of four species of Thecla, viz., *strigosa*, *acadica*, *calanus* and *Edwardsii*, and he also showed specimens of several species of these butterflies, and pointed out the points of distinction or affinity.

It being one o'clock, the meeting adjourned until 2.30 p.m.

The afternoon session opened by the reading of a paper contributed by Prof. E. W. Claypole, "Suggestions to Teachers on Collecting and Preserving Insects," followed by two by Capt. Gamble Geddes, on "Several Remarkable Captures during the Summer of 1887 in Ontario," and "Notes on the Genus Argynnis whilst Alive in the Imago State."

SUGGESTIONS TO TEACHERS ON COLLECTING AND PRESERVING INSECTS.

BY E. W. CLAYPOLE, AKRON, OHIO.

In a short paper which appeared in the *Canadian Entomologist* in July last, I mentioned my own experience on the value of gasoline for killing insects for the cabinet. The hints then given were not intended to be of service to professional Entomologists, if there are any such persons, or to amateurs possessing abundance of time and means, but to students and to teachers with whom time is short. I pointed out its superiority over chloroform and cyanide of potassium in rapidity of action and in safety, while its use is attended with no injurious effect on the specimens. I now wish to add a few words with especial reference to the preservation of collections after they have been made.

Here, too, I desire to make it plain at the outset that these hints are also intended mainly for the hard worked teacher or professor whose attention is probably distracted

by being compelled to teach not only Entomology, but also all the Natural Sciences—a load amply sufficient to keep several men busy.

For my own part, after many years of alternate collection and loss of Entomological specimens, I almost abandoned the effort in despair after finding some of my cases filled with webs, cocoons and moths of *Tinea pellionella*, etc., and most of the specimens either destroyed or badly damaged. The task seemed hopeless without more time and attention than I was able to give. I may say that I had for some years been using gasoline to kill specimens, but here my use of it ended. Knowing, however, and feeling the utter impossibility of teaching Entomology without specimens, I began to consider if it was not possible to devise some fairly easy method of keeping my cases free from these and other pests, so as to bring the labour within reasonable limits. I first reduced their capacity, in order that they and their contents might be as compact as possible, and also that "all the eggs might not be in the same basket." My cases are now made about twenty inches by twelve, and about one inch and a quarter in depth. Their sides and ends consist of black walnut, well jointed and about one inch thick. The glass top is set in a rabbet with putty, and is consequently quite insect-proof. The back consists of soft pine or tulip wood about three-eighths of an inch in thickness, and is attached to the frame by twelve screws. This back, when covered with a coat of manilla paper, is generally soft enough to take and hold the pins. But in addition I often line the bottom with sheet-cork, or as the cost of this material soon mounts too high, when as many cases are made as even a small cabinet requires, I generally employ instead of it some one of the forms of packing that are used by druggists—either the strawboard with a backing of cork chips, or the corrugated paper made by Thompson & Norris, of Islington, London, and Prince Street, New York. Either of these is very effectual, nearly as good as sheet cork, and merely nominal in price.

By setting the glass myself and doing any finishing required for effect, I can obtain these cases at about sixty cents each, and in this way a collection, amply sufficient for all the purposes of teaching, may be set up for a comparatively small outlay.

By screwing the back tight up and avoiding opening the cases except in the cold weather, I largely reduce the chances of mischief. All the specimens obtained during a season are placed in a temporary case until the time for assorting arrives.

It is, of course, impossible in collecting, and especially in exchanging, to totally exclude parasites. Indeed, it is more than likely that many insects are infested when they are caught. The disinfection of every specimen singly is a very tedious process, and in my own experience proved a very serious barrier to collecting. I therefore now arrange all the specimens in their desired places without regard to their condition in this respect, and then disinfect them wholesale in the following manner: I have a zinc tray of rather larger size than the cases, and about two inches deep. This I fill with gasoline and then set the whole case, or at least the back, with its charge of insects in it, and allow it to soak for a few minutes until everything is saturated with the liquid. Two or three minutes are usually quite sufficient. I then remove them, drain off the superfluous gasoline, and in a few minutes they are dry and ready to be set back and screwed up again.

By this simple means I secure the purity not only of the insects, but of the case also, from parasitic life, for nothing living can endure this ordeal. So far as opportunity has offered for observation I believe that the operation is equally fatal to eggs.

I need hardly remark that there is no trouble to be apprehended with any order except the Lepidoptera. Even with these I do not hesitate to employ the same method, and find no ill effects from it. Their delicate plumage is not perceptibly injured by free saturation with this very volatile liquid.

Since adopting this plan, I find it only necessary to glance over my cases occasionally during the summer, and if the eye detects any sign of mischief, even the minute dust that indicates the presence of the mite (*A. divinatoria* or *pulsatoria*), I take out the case, loosen the back screws, and place the whole in the gasoline. In five minutes it is replaced with the certainty that all life is extinct.

As I said at the outset, Entomologists with plenty of time will not probably feel much interest in the suggestions here made, but I find, in my own experience, that the

plan above recommended has so far reduced the labour of the work and the disappointment incident to it, as to lead me to hope that I shall be able to prepare and keep a collection of insects in the future without much more outlay of time and thought than is required for a collection of dried plants. I think if other teachers who, like myself, are short of time and distracted by teaching several subjects, will adopt the same plan, their verdict will be equally favourable.

The cases, too, are convenient, and can be handed round a class for inspection without risk, while they make a handsome appearance in the museum, and from their neatness and showiness and cheapness, they form a strong inducement to the students to undertake a collection on their own account—no small argument with the practical teacher.

NOTE.—At the close of a few remarks made by the author on this subject before the Entomological Club of the American Association at its recent meeting in New York, an entomological friend objected that he had found gasoline ineffective to kill many insects, and instanced the Catocalas as an example. By a rather curious coincidence, the last specimen that I captured before leaving for the meeting was one of these, the Red Underwing (*C. ultronia*), and the first that I captured on my return was the same. In neither case was there the slightest trouble; the insect succumbed immediately. I may remark that, in my own experience, I have found the Tigers (*Arctias*) the most refractory, requiring, in some instances, two applications. In most other cases death is almost instantaneous. So effective and so convenient do I find the gasoline that I have for years abandoned the use of the more cumbrous and dangerous appliances and now carry only an ounce phial of this liquid with me into the field.

SOME REMARKABLE CAPTURES IN ONTARIO.

BY GAMBLE GEDDES, TORONTO.

The following paper was read on some remarkable captures during the summer of 1887 in Ontario, by Capt. Gamble Geddes, of Toronto:—

Pelecinus Polyturator, ~~Say~~ Drury.—I had the good fortune to take the male of the above species at Eastwood, Ontario, about the 11th of August. I captured one and saw a second a few minutes later, which, however, proved too quick for me, and I missed it with the net.

I have never observed that the females of this insect fly very high, but that the the males *do*, I have no doubt, as the one I caught was very quick and started to fly straight up in the air over my head, whilst I barely reached it inside the hoop of a long-handled net. The male that I missed capturing, immediately soared aloft and out of sight amongst the high branches of the trees.

I may say that I have watched by the hour for these rare males where the females are in the habit of congregating in large numbers, and have never seen but the two specimens above referred to, *alive*. The only other one I have seen was captured by Dr. Brodie, in 1886, at Toronto.

If any of your subscribers know anything of the life-history of these insects, the information would be most acceptable to many readers of the *Entomologist* in Ontario, as I have made several enquiries, as to their habits, with little or no success. There is no doubt that the female is slow in her flight, and that she is handicapped by the long abdomen that she is obliged to carry with comparatively diminutive wings. It is no wonder that she is not fond of moving about when the wind is blowing, for she is knocked about and quite unable to preserve a straight course from one point to another, whilst the male with his short club-shaped abdomen, has wings equally large, and to all appearance, stronger than the female and can go as he pleases.

The female does not appear to be capable of long flights, my observations going to prove that when flying from one tree to another at any considerable distance, she will drop into the grass for a rest, about half way, and then after remaining in perfect repose for several minutes, she will clumsily struggle free of the grass and complete the journey. Here, lighting on the leaf of a tree, she moves about selecting a sunny spot, where she sits with her abdomen curled up, enjoying the sunshine and the breeze.

Colias Philodice, Godt.—(Fig. 2, male; Fig. 3, female.) At Erlescourt, Davenport, Ontario, in the early part of September, 1887, I captured a large number of a very dimin-

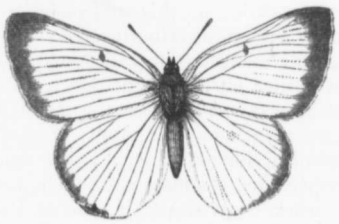

Fig. 2.

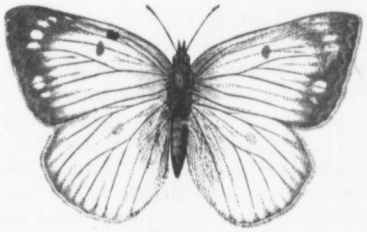

Fig. 3.

utive form of Col. Philodice male *and only two females*, one being a small albino variety, corresponding exactly with the commoner large albino. These two small females were laying their eggs upon lucerne (*Medicago sativa*), and I am curious to know if any of our collectors have made any observations with regard to the effect of this food-plant upon the size of the larvæ of C. Philodice. It is a curious fact that in this field of lucerne I should take all these small specimens, whilst about 300 yards from the same spot the common large Philodice was plentiful upon red clover.

Catocala Relicta, Walk.—In sugaring for Noctuids, etc., the past season, I have been fortunate in obtaining excellent examples of these lovely creatures, (Fig. 4) varying in the

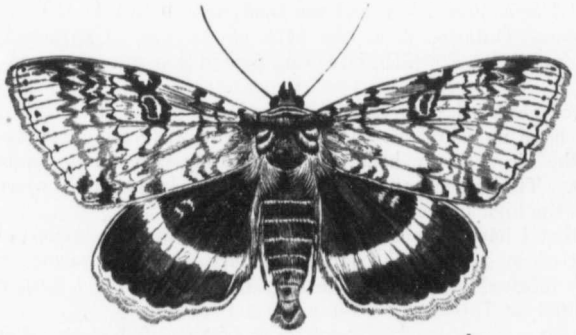

Fig. 4.

black and white markings of the upper side in a remarkable manner. Whilst some are nearly all black and dark grey, with very little white about them, others are snowy white with very occasional black patches. In a single pine grove, not fifty yards in length, I captured as many of these Relictas as I have done in three or four years by trying orchards and woods. The place is very dark and the wind almost entirely excluded by the close growth of the pines, and it may be useful to collectors to observe this in future when sugaring.

Papilio Cresphontes, Cram.—There have been several occurences of this butterfly (Fig. 5) in the County of Oxford this year. I should be glad to hear from the members

FIG. 5.

whether any specimens have been taken during the past summer in other localities in the Dominion of Canada generally, and especially the Provinces of Ontario and Quebec.

In the discussion which followed the paper, Mr. Moffat described his own capture of the male of *Pelecinus polycerator*, and Mr. Fletcher described the unusual abundance at Ottawa of *Colias philodice*. At an excursion of the Field Naturalist's Club to Brittania, a few miles from the city, the sandy shore of the Ottawa had been so thickly covered with them for a distance of several hundred yards, that at one stroke of the net he had captured 47, which, strange to say, were all males.

Prof. Saunders stated that he had made search near London for the larvæ of *Papilio cresphontes*, where it had formerly been captured, but without success.

Mr. Fletcher exhibited a fine collection of Canadian species of the genus Chionobas, and explained the great value of these insects on account of their rarity hitherto in collections. *C. Macounii* Edw. was a new species which had been collected by Prof. Macoun, at Nepigon, in 1885, and the Rocky Mountains in 1886. Closely allied to it was *C. Gigas* Butler, of which until the past summer only three specimens were known in collections. Other beautiful species exhibited and described were *C. Californica*, *C. Chryxus*, *C. Jutta*, *C. Varuna* and *C. Uhleri*, of which Prof. Macoun had taken specimens in the Rocky Mountains.

A pleasant and valuable paper by the Rev. George W. Taylor, of Victoria, B. C., was read, describing an ascent of Mount Finlayson, B. C., in search of *C. Gigas*, and the success which had attended the party.

VISIT TO THE HOME OF CHIONOBAS GIGAS, BUTLER.

The paper which follows was contributed by Rev. G. W. Taylor, of Victoria, British Columbia.

When my friend, Mr. James Fletcher, the Dominion Entomologist, was staying with me in May and June, 1885, we made an excursion together to Mount Finlayson (an isolated conical mountain, situated at the head of the Saanich Inlet, about ten miles from Victoria), which he thought must be the locality where the original specimens of *Chionobas Gigas* were taken by Mr. Crotch, in 1876. Our visit was on June 15th. Mr. Fletcher had been there previously in search of this butterfly on April 26th and May 22nd. On none of these occasions, however, did we capture Gigas, but we were well rewarded by taking many other species not previously seen by either of us on Vancouver Island. Amongst them my first specimen of the somewhat abundant (in British Columbia), *Parnassius Clodius*, which was mentioned by Mr. Crotch as the consort of *C. Gigas* at the time of his visit.

We concluded we were too early for the latter. Mr. Fletcher left for Eastern Canada the next day, and I could not find an opportunity of again visiting the mountain that year.

In 1886 I was at the same place with a couple of friends on June 29th, but though well repaid for our trouble in other ways, we caught not a glimpse of *Gigas*.

1887 — This year we determined that he should be caught if possible, and at last success favoured us.

A picnic was arranged for May 17th. Our party consisted of Prof. Macoun, of Ottawa, and his son; Mr. J. W. Tolmie (an enthusiatic Entomologist), and about a dozen other ladies and gentlemen. Again no success: we were much too early.

We tried again on June 30th (this is a very late season for insects in Vancouver Island), and this time had better luck. Prof. Macoun and Mr. Tolmie were again with me and a party similar to the last.

We started from home betimes and were at Goldstream House, the nearest point by road, by eight a.m. There is a tiresome walk of some two miles through the forest to the base of the hill, and then a stiff climb of 1,300 feet to the summit. Our progress was slow on account of the ladies, but we had all accomplished the ascent, and enjoyed our luncheon by 12 o'clock. It was then that the first *Gigas* was sighted, and after an exciting chase captured by Mr. Tolmie. For several hours the hunt was kept up, and as a result we obtained between us six or seven specimens of our long sought-for butterfly. Only two of these fell into my hands, and one was forthwith sent to Mr. Fletcher that there should be no doubt as to its being genuine *Gigas*.

Prof. Macoun and his son spent several days at Goldstream, and secured several additional specimens, and Mr. Tolmie and I not quite contented with our success paid another visit to the mountain on July 12.

The day was much too dull for butterflies to be out in any numbers, but we managed to catch about six more, as well as a few other species of interest. All our specimens were taken on or near the top of the mountain. *C. Gigas* on the wing looks at first sight very much like a large *Argynnis*, and I am pretty confident that we saw one specimen of it on the first visit I made with Mr. Fletcher in June, 1885. That season was at least three weeks earlier than this, and as all our specimens this year were more or less worn I should say that the proper time for *Gigas* will be about the second week in June, and I think it will be found to occur commonly enough on Mount Finlayson, and possibly also on the many similar hills to be found in other parts of Vancouver Island.

The locality is not very easy of access, but it is a most interesting one both entomologically and botanically. Here are found no less than 15 out of our 20 native species of ferns, and many other rare plants, as will be seen when Prof. Macoun publishes the results of his season's work on the Island.

Here too, I have met with many interesting insects. Amongst them the following butterflies that have not yet occurred to me in the immediate neighbourhood of Victoria:—*Persius* (?), *Parnassius Clodius*, *Argynnis Rhodope*, *Lycæna Phileros*, *Lycæna Melissa*, *Nisoniades* and *Eudamus Pylades*.

The capture of *Gigas* brings the list of Vancouver butterflies to a total of 56 species. Next year if all is well, I shall make an effort to procure eggs so as to observe *Gigas* in its earlier stages. Caterpillars of all this genus are grass feeders, and should be full fed in ordinary seasons towards the latter end of May.

Prof. Macoun, who had accompanied Mr. Taylor, described the manner of flight of this butterfly (*Chionobas Gigas*), which was swift and ceaseless, as was the case with the specimens of *C. Macounii* taken at Nepigon; all the specimens taken, it may be added, of both these species, were males.

Mr. Fletcher exhibited three specimens of the rare *Papilio Nitra*, two taken by Prof. Macoun in the Rocky Mountains, the other by Mr. N. H. Cowdry at Regina, N.W.T.; also some interesting species and varieties of Colias, regarding which there was discussion by several of the members.

Attention was then called to the valuable paper by Mr. H. H. Lyman in the October number of the *Entomologist*, and the beautiful plate accompanying it. A series of the moths brought by different members of the Council was examined in connection with this paper.

Mr. J. Alston Moffat exhibited and distributed among the members specimens of two new species of moths which had been captured by him at Hamilton, and which had been described by Prof. Fernald and Prof. Grote respectively as *Proteoteras Moffatiana* and *Scopelosoma Moffatiana*.

Mr. Fletcher showed specimens of an Halesidota and of its larvæ, which had been very abundant and destructive upon the Douglas Fir in British Columbia during the past year. He also distributed a collection of Coleoptera sent from Vancouver Island for this purpose by Rev. G. W. Taylor.

Mr. W. Hague Harrington read a paper on the "Nuptials of Thalessa," describing the emergence and copulation of these the largest of our Hymenoptera.

THE NUPTIALS OF THALESSA.

W. Hague Harrington, Ottawa, read the following paper:—

For several years I have observed with much interest the oviposition of our large and handsome "long-stings," but not until this summer have I been able to witness their actions preparatory to this duty. Although the males are frequently numerous when the females are ovipositing, the sexes pay no attention to one another, and this fact led me frequently to wonder at what time mating occurs. Last year I had, in company with Mr. Fletcher, observed the males in strange positions, with the tip of the abdomen applied to the bark, or inserted in a crevice, and had suggested that they were awaiting the emergence of the female. The supposition was, however, not proven, and the actions observed were still a matter of conjecture, and for further observation.

On the afternoon of the 7th June last I visited some old maples (*Acer saccharinum*) for the special purpose of making observations on *Oryssus*. The trees are in different stages of disease and decay, and are correspondingly infested by such borers as *Dicerca divaricata*, *Tremex columba*, *Xiphydria albicornis*, *Oryssus Sayi*, etc., while they attract naturally numbers of our larger Pimplidæ, such as *Thalessa*, *Xorides*, *Ephialtes* and *Xylonomus*. Upon these trees during their season could generally be found many specimens of *Thalessa*, but I had never seen one emerge from its prison into the warmth and light of its adult existence. Upon a tree which for years had been much bored by *Tremex*, etc., I, upon the above date, saw several specimens of *T. atrata* and *T. lunator* ovipositing, and at some distance below them a group of males in an evident state of excitement. Three of these had their abdomens inserted more than half way under a flake of bark. Here, I congratulated myself, was an opportunity to ascertain whether

a female was about to emerge. With my knife I pried off the piece of bark, and beheld the head of an insect just appearing through the wood. The males had flown away when disturbed, and I was afraid that they might not return before the female emerged, but two came swiftly back and commenced to pay her attentions before much more than her head was visible. As soon as she was out of the burrow she was embraced by one, and copulation apparently followed, but did not last long, as she began to crawl up the trunk, and when I interfered to prevent her getting out of sight, the male flew away. However another was ready to take his place, and the pair were almost instantly *in coitu*. A few seconds later the female attempted to fly, and fell to the ground ; the male disengaged himself and flew away, and his partner then did the same, starting with a strong and rapid flight.

Visiting another tree not many paces distant, I saw a group of more than a dozen males of *lunator* in very evident anxiety and excitement, their long antennae quivering, and their whole demeanor evidencing some powerful emotion. I peeled off a piece of bark at the centre of attraction, but found no sign of any insect coming forth. An hour or so later, when returning from my ramble, the group was even larger, and several were probing a crevice within an inch of the space from which I had stripped the bark. Thinking that the female might be here, I cut off another piece of bark, but could find no signs of her, although the males were so excited as even to settle on my hands.

Proceeding to the tree from which I had previously seen a female emerge, I saw several males clustered about three inches from where she had come out. Two had the abdomen flexed and the tip inserted in a small aperture in the bark. Stripping off the fragment of bark, I found that a female was there, and had gnawed her passage so nearly through the bark as to have pierced the surface. The males fluttered excitedly around, and, as in the first instance, she was embraced before she was wholly emerged, and copulation was effected as soon as she was out. Being in a hurry, and wishing to preserve the specimens, I boxed them, the other males flying around me in great excitement until this was achieved.

Two days later I was able to visit the same locality for the purpose of making further observations on these insects. On tree number one I saw at some distance up the trunk a small cluster of expectant males. By standing on the top of a dilapidated and shaky fence, I was just able to reach the spot and with my knife remove the covering of bark. As my position was too precarious for comfortable observation, I secured the female as she emerged and carried her to another tree upon which were some males. As soon as she commenced to crawl up the trunk, she was eagerly followed and embraced by one of the more active males. Copulation took place with four different males—the female falling to the ground on each occasion, and being again seized as she crawled up —the last union continuing $2\frac{1}{2}$ minutes, after which she flew away unattended.

On proceeding to tree number two, I found a very large and strongly excited cluster of the males in the immediate vicinity of the spot from which I had cut the bark on the former day. They were about twenty in number, and were packed so closely together that those in the centre could scarcely be seen. Like the inmates of a burning theatre, they trampled over one another in their excitement. Displacing them with some difficulty, I hewed off a slice of bark and revealed the female cutting her way to a new life, her head being partially visible. Her ardent admirers immediately swarmed around and endeavored to get their abdomens down the burrow, an undertaking in which they impeded one another so greatly that the only result was wedging the female in and preventing her from emerging. The cluster was soon so dense that she was entirely hidden, and as there seemed no prospect of her getting out for some time under the circumstances, I began to drive off, or rather forcibly to remove one by one, her besiegers. After nearly all were removed, I saw that one of the few remaining had his abdomen inserted its full length in the burrow. As the female was still unable to emerge, I drove off the remaining males, and as soon as the way was clear she came rapidly out. There was instantly fierce rivalry for her favors, but eventually one stronger, or more agile, than his fellows, succeeded in his desires, the pair remaining about $1\frac{1}{2}$ minutes *in coitu*, after which the female ceased apparently to have further attractions.

The foregoing notes (written upon the second date of observation) show that the

males are able to determine where a female is making her way outward—some time, perhaps, as in the last case recorded, many hours before she appears. Whether this is ascertained by the sense of hearing or smell, or a combination of both, I do not attempt to say, but the antennæ are evidently largely used in locating her, as may be readily seen by the way in which the bark is examined with them. When there is a crevice or aperture, the male bends his abdomen—at the suture between first and second segments—until it is at right angles to the thorax, and endeavors to insert it in the said crevice or aperture. He has then the attitude of a female insect ovipositing. As has been mentioned, if the hole is large enough the abdomen will be fully inserted, and it is perhaps possible that copulation may take place while the female is yet in the burrow. On emergence she is immediately seized, the legs of the male clasping the yet unfolded wings with the abdomen, and thus preventing her from flying. From the large number of males always about at this season, it is probable that the female seldom, if ever, emerges unattended. After the very brief honeymoon, she is no longer an attraction to the opposite sex, and is able to proceed unmolested with her work of depositing the germs of a future generation. I may add that of the pair confined by me the male died the same or following day, while the female was strong and vigorous until she unadvisedly entered a cyanide bottle.

SPECIES, VARIETIES, AND CHECK LISTS.

A paper on this subject was read by J. Alston Moffatt, of Hamilton, as follows :—

That a very considerable diversity of opinion obtains amongst writers "On what constitutes a species?" is apparent to all readers of works on biology, and the discussions about species and varieties make it manifest that the question has not yet been settled to the satisfaction of all.

Therefore, when one is going to speak on the subject, the first thing he ought to do to prevent misunderstanding, is to give as clearly as possible the view he holds about the terms.

Mine is, that fertile progeny is an unmistakeable evidence of oneness of species, regardless of external differences, and that within the bounds of species as thus stated, a limit to variations cannot be set.

That breeding does, in some manner define species, seems to be acknowledged by all. For whenever it is proved, that diverse forms that were called species have a common parentage, they are by general consent termed varieties.

It is not possible in entomology to adopt, in every case, this the natural mode of determining species.

The scientific one of determining them by external marks, is the only available one at first, in most cases, but it is necessarily uncertain, for who shall say that there have not been, or may not yet be varieties of it found.

So that as knowledge increases, species are always liable to be turned into varieties.

Now here comes in a constant source of trouble; it seems that some consider it the proper thing to do, when various forms are proved to have a common parentage, to wipe out all the names but one.

I protest most emphatically as a collector, and in the interest of collectors, against this habit of abolishing names, simply because they cannot be called species.

The impression is getting abroad that we have too many species in our lists; that may be perfectly true, and yet it does not necessarily follow that we have too many names.

Mr. Grote, in his instructive article on "Representative Species," says,—"It is a little odd to notice, in this matter of varieties, how anxious some writers are to draw in the species of others,—and how indifferent they are about drawing in their own varieties." This sentence clearly indicates the unsatisfactory condition this whole subject is in.

I see that this process of "drawing in," is going on in every department of biology.

If it is not judiciously done, it is well calculated to inflict grievous injustice on the industrious workers that went before, and a corresponding loss and labour on those that come after.

Let us look how it works in practice; take as an illustration of the wrong done to the students and investigators of the past, and the loss sustained by the collectors of the present, an extreme but well known example, *Caberodes confusaria*, Hub., a moth that has been redescribed eight times at least, from the fact of its having a large number of distinct varieties.

A beginner takes one form, he gets it named *Caberodes confusaria*, Hub., he turns to his list, marks it off, and thinks he is done with it; takes another which he thinks is different, gets the same name for that, and yet another, and so on, it may be through the whole series; not a shadow of indication, it may be, in his check list to intimate to him that it was a variable insect he had to deal with, and his feeling about it will be one of confusion, if not of disgust.

Now, if the proper names of these varieties with the authority had been retained, a glance at his list would have warned him what he was to expect of this insect, and if he had access to the writings of these authors, he could easily have got the names for himself, thus getting the full benefit of the labours of those that went before him, but as it is at present, these are as good as lost to him, and he has to go over the same ground again for himself; this does not look like advancing science, but a throwing away of advances gained.

Synonyms, of course, must go, but where a variety has been named, even if it be but the extreme of intergrades, let it stay; it is surely far better to run the risk of having too many variety names than attempt to consolidate them all under one by calling it species; but some may say who is to decide which is the species and which the variety.

I think Mr. W. H. Edwards has settled that question effectually,—they are all varieties, it takes the whole series to make up the species.

Priority may settle precedence. Adopt this principle, and it stops at once, and for all time the contention amongst the authorities whether theirs is the species or the variety.

We have the proof of experience, that no one form stands as the progenitor of all the others, but that each is quite capable of producing any one, or all of the rest. Now look at how this would affect the arrangement of our cabinets.

We should have *Caberodes confusaria* Hub., as the name of the species, not to be attached to any form, but including all, then we should have *confusaria var.* this, that and the others, as far as we had obtained material. Thus avoiding the use of three names on a label, which we all know is exceedingly inconvenient; giving us a clear and comprehensive view of a variable insect, and adding greatly to the interest, value, and scientific exactness of our collections. If this principle of dealing with varieties was adopted for all kinds, which Mr. Edwards applies only to seasonal ones, there would have to be a considerable addition made to the names on our lists. Take any species with varieties:—

Catocala relicta, for instance, has three well defined forms, each as truly *relicta*, as the others, two only have separate names, so we want yet another name to give naturalness to our view of the species *relicta*.

As to how we lose by our present method, which of us has any definite conception of *Drasteria erechtea* as a species; we are all familiar enough with bits of it. I see by Mr. Grote's list that it has been endowed with nine names in its time, and I doubt not they could be all occupied to advantage. If I could have got separate names for my different forms I should have collected all I could find, but varieties without names in a collection are a confusion and a nuisance; yet each one is needed to give a correct view of the species as it exists in nature, but our present method offers no inducement to follow it out, as they occupy no permanent place in our literature, whatever they may do in nature; yet it appears to me that the production of varieties, is one of the most intensely interesting operations that is going on in nature's vast laboratory, and well worthy of our closest observation and study.

Rev. C. J. S. Bethune submitted a circular letter from Prof. Alfred Wailly, of England, asking for specimens of any silk moths or their cocoons.

Mr. Fletcher drew attention to an article which had appeared in the August number of the *Canadian Horticulturist*, condemning the use of Paris green as an insecticide. He considered that article inaccurate and very injurious, as it might prevent the farmers from making use of this most valuable remedy, and in confirmation of his opinion read a letter from Prof. A. J. Cook describing experiments with Paris green, and proving that no ill effects could result from eating potatoes or fruit upon which it was used in the ordinary manner for the prevention of insect attacks.

Mr. Harrington submitted a note on "Further Observations on *Orgssus Sayi*," in which attention was also drawn to a clerical error in the paper on that insect in the May number of the *Entomologist*.

A vote of thanks was unanimously ordered to be conveyed to the Mayor and City Council for the use of the council chamber and committee room in the City Hall for the meetings of the Society.

The meeting adjourned at 6 p.m,, *sine die*.

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

The Club met at New York on Tuesday, August 9th, 1887, at 2.30 p. m. The President, Professor Comstock, of Cornell University, Ithaca, took the chair, and Mr. J. B. Smith, of Washington, D.C., acted as Secretary, in the absence of Mr. E. Baynes Reed, of London, Ont.

Meetings were held from time to time during the session of the A. A. A. S. The following persons were present at some or all of the meetings of the Club:—Prof. J. H. Comstock, Ithaca, N.Y.; J. A. Lintner, Albany, N.Y.; Prof. C. V. Riley, J. B. Smith, Washington, D.C.; E. L. Graef, Rev. G. D. Hulst, Brooklyn, N.Y.; W. Beutenmüller, G. W. J. Angell, New York; Mr. and Mrs. E. W. Claypole, Akron, O.; Mr. and Mrs. H. F. Bassett, Waterbury, Conn.; Prof. A. J. Cook, Agric. College, Mich.; G. Dimmock, Cambridge, Mass.; Dr. P. A. Hoy, Racine, Wis.; J. H. Emerton, Boston, Mass.; Rev. J. G. Morris, Baltimore, Ind.; A. S. Fuller, Ridgewood, N.J.; Mr. and Mrs. E. D. Southwick, F. B. Chittenden, E. C. M. Rand, Dr. Maury and others.

The Entomological Society of Ontario was represented by Prof. W. Saunders, of Ottawa.

The President read his annual address, giving a history of the various systems of classification of insects since the time of Linnæus, and especially dwelling upon the more recent subdivisions of some orders by Brauer and Packard. The address is to be printed in a new introductory work on Entomology. Prof. Riley, commenting upon the address, said that the paper was an important one, and he fully realized the difficulties in coming to a final and satisfactory conclusion. For his part he liked the old classifications, based on the trophi and pterostic characters; they had the merit of being well defined and easily limited. He did not believe in the creation of numerous orders, but would rather consider them aberrant groups or sub-orders, if necessary. Classification, however, for some time to come must be a matter of opinion. Many classifications have been proposed since that of Linnæus, have had their day, and have been forgotten. He had the highest respect for Dr. Brauer, but he did not entirely agree with him. He did not think too much stress should be given to the adolescent states, which more than anything were subject to independent changes by their environment.

Mr. J. B. Smith said he was glad Prof. Comstock had chosen the subject he did, for he had long wished that the gist of Brauer's classification could be presented in an accessible form to American students, and Prof. Comstock's paper did that to some extent. He agreed thoroughly with Prof. Riley in his estimate of the value of the adolescent stages.

In the Lepidoptera for instance the larvæ of *Alypia*, *Psychomorpha* and *Eudryas* are scarcely distinguishable, while the imagoes certainly belong to different families. He thought it required considerable courage often, to carry out consistently the idea of giving value to structure, irrespective of number of species or genera. In the Coleoptera only they have consistently based families on structure, whether there was one species or thousands.

Under the call of papers, Mr. Smith read from printed proofs a paper on the species of *Callimorpha*, prepared for the U. S. Nat'l Mus. Proc., illustrated by blackboard sketches. He made nine species of the American forms instead three as heretofore recognized, and pointed out the differences between them, making the pattern of maculation the criterion of his species.

Mr. Graef expressed his dissent from Mr. Smith's views, and showed how in his opinion the maculation could be so modified as to produce the different forms.

Prof. Riley commenting on Mr. Smith's paper said that he did not agree with him at all. He thought that there was but a single white species and possibly there may be three rather well marked species, with three moderately well marked larval forms. He said that in variation not only colour changes but sometimes the pattern does also. Especially is this true in forms that have more than a single brood annually. He instanced cases in the *Tortricidæ*, where forms appear, so different in pattern that there seems no possible connection between them, but bred from the same hatch of eggs.

Mr. Hulst also expressed his dissent from Mr. Smith's views. He thought that the variability of other species in the *Arctiidæ* was well established by breeding, and it should be at least considered probable that other species in the same group varied as much. He had taken specimens numerously, and it seemed to him that he had taken forms from the lightest to the darkest under such circumstances as to make it very certain they were one species.

Mr. Smith replied briefly, admitting the possibility that the white forms may be albino forms of dark species, but again emphasizing the differences in pattern as indicative of specific value.*

On Wednesday, August 10th, the Club met at 9.20 a.m.

The following officers were elected for the ensuing year:—

President—Mr. John B. Smith, Washington, D.C.
Vice-President—Prof. J. A. Lintner, Albany, N.Y.
Secretary—Prof. A. J. Cook, Agricultural College, Mich.

Mr. Basset enquired whether anyone could tell him positively how many broods of the currant worm there are annually.

Prof. Cook said in Michigan there are two; Dr. Morris said two near Baltimore, Md.; Prof. Riley said probably three in the south, but this is uncertain, as the insect is rarely injurious there and attracts less attention; he believes there are three from information he has received, but there are only two broods in the north where it is injurious. Prof. Comstock said they have two broods at Ithaca, N.Y.

Mr. Bassett said that until recently he had believed the same, but last summer a friend brought him every few days eggs and larvæ in all stages throughout the season; he was very much surprised at this and thought it indicated more than two generations.

Prof. Riley replied that this was true; they did appear in that way, but that was caused merely by the difference in the time required for development, some running through their transformations much more rapidly than others. There are, however, only two well marked broods, which overlap each other or leave only a very short interval between them.

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* For further discussion of this subject *vide* Mr. Lyman's paper in the *Can. Entomologist* for October, 1887, page 181, and Mr. Smith's paper *C. E.*, December, 1887, page 235.

Prof. Cook confirmed this statement. He had, in laboratory experiments, carried over the pupæ of the spring brood until the following summer, and in the same way the codling moth has been carried over.

In the afternoon the Entomologists and Botanists joined in an excursion by steamer to Sandy Hook, which proved very interesting and agreeable.

On Thursday, August 11th, the Club met again.

Prof. Saunders, of Ottawa, gave a brief review of what had been done recently in the way of establishing Experiment Stations in Canada, at which Entomology in its relations to Agriculture formed one of the subjects of experiment. Five stations are proposed—a central station at Ottawa, a 2nd in the Maritime Provinces, a 3rd in Manitoba, a 4th in the N. W. Territory and the 5th in British Columbia. At the Central Station an Entomologist—Mr. Fletcher—has been appointed, and a collection of insects of all the sections will be formed there. It is intended also that bulletins be issued several times in the course of the year to interest the public in the work and demonstrate its general utility. He had been travelling about a great deal during the past year and had done little Entomological work; but he had noticed this spring near Ottawa the larva of *Vanessa antiopa* in immense numbers, stripping willows. It is not usually common with them. In Nova Scotia he saw *Saturnia alope* and *nephele* in great numbers, with all sorts of intergrades between. He also found the potato beetle there, which appears in this section for the first time. The growers there follow the old fashioned plan of knocking them into a pan with a stick.

Dr. Morris stated that *Crioceris asparagi* had reached them at Baltimore and proved very destructive. Prof. Saunders said it was not yet found in Canada. Prof. Comstock said he had found it as far west as Geneva, N.Y. The insect seems to have started from Long Island.

Prof. Cook said that the method of knocking the potato beetles from the plants with a stick, is both old and new, for one of the largest growers of potatoes in his section of the country had returned to it after trying all kinds of poisons. He claimed it was cheaper for him to destroy them in that way, and while Prof. Cook did not understand how this could be possible, yet this farmer claims it is so and follows out his belief.

Prof. Saunders said that in the Maritime Provinces, Nova Scotia and New Brunswick, he found the larch saw-fly (*Nematus erichsonii*), extremely abundant and destructive.

Mr. E. C. M. Rand, of New York exhibited some specimens of Coleoptera taken from a mummy, and suggested they might be of interest, as perhaps old types. The mummy dated back at least as far as 1200 B.C., and he explained the number of wrappers and method of covering, and stated that channels had been made in the wrappers, and in these some of the bettles were found.

Prof. Claypole explained the use of gasoline for collecting purposes. (See his paper: "A Practical note on Collecting Insects.") He also exhibited an insect case used by him, which he claims to be superior to any equally cheap contrivance. It consists of a box frame into which a glass top is permanently fixed; the bottom is corked, or not, as desired; it is filled with specimens and then screwed to the frame.

Prof. Cook said that he had tried gasoline, and found it much less rapid and certain than cyanide properly prepared; he did not believe in it at all.

Mr. J. B. Smith objected to Prof. Claypole's case that it was too inconvenient to use, as to get at an insect meant unscrewing the bottom and replacing it. A collection so preserved was useless except for the most superficial comparisons.

Prof. Comstock explained a contrivance for watching the early stages of Hymenoptera nesting in stems of plants. He took a number of slender glass tubes, covered them on the outside with dark paper, and hung them on bushes frequented by such bees. He exhibited several of these tubes in which the bees had nested, containing larvæ in various stages of developement. The whole life history can thus be watched with very little trouble.

Mr. J. B. Smith read a paper on "The Specific characters of the genus *Arctia*." (Published in full in *Entom. Amer.* vol 3, p. 109.)

The date of the first meeting for next year was then discussed, experience having shown that the first meeting of the Club, as now held on the day preceding the general meeting of the Association, was generally poorly attended and the President's address read to almost empty benches. After some discussion it was resolved to hold the first meeting of the Club in future at 9 a.m., on the first day of the meeting of the A.A.A.S.

On *Friday, August 12th*, Prof. Riley gave a short account of the discovery of the female of *Phengodes*. He also spoke on *Pronuba*, and its connection with the pollination of the Yucca; and on a new species of *Lecanium* found on the Austrian pine in Wisconsin. The asparagus bettle (*Crioceris asparagi*), he finds is extending south, having been observed in Fairfax County, Virginia. During the present year there has been a most remarkable swarming of the butterfly *Apatura celtis* in the Southern States. These migrations generally take place in the autumn, but this was in the Spring. The only way of accounting for it is that the conditions were unusually favourable for their hibernation and development.

Dr. Lintner spoke of the alarming increase of the Larch Saw-Fly (*Nematus erichsonii*). He gave a history of the dates and places at which it had been heretofore observed, and the injury it had done.

On July 7th it was reported to him from St. Lawrence Co., N. Y. where it appeared on three Tamaracks growing in a door-yard. About 10th July they appeared in countless hosts completely covering the trees so that the end of a finger could not be placed on a branch of one of them without touching one or more of the worms. They also covered apple and maple trees and shrubbery, but ate nothing but Tamarack.

About the same time examples of the larva were received from Otsego Co., taken from the European Larch. The pupæ were found after July 12th under moss some little distance from the trees. It has done considerable damage also in Hamilton County in the Adirondack region. Every Tamarack for miles around was entirely stripped, and looked as though the fire had been through it. Dr. Packard says the attack is not fatal to the trees, and near Lake Pleasant early in August he observed the Tamaracks putting out new buds. The larvæ were attacked by a *Podisus* allied to *modestus*, and the pupæ were eaten by ants. In Europe the species seemed to be kept in check pretty well by its parasites, and it has never been destructive there.

Prof. Riley said we can hardly hope with Dr. Packard that the attack will not be fatal to the trees. When he went over the ground in Maine with Dr. Packard this spring, many trees were already dead.

In the evening a very pleasant party met at Mr. Graef's residence in Brooklyn where the evening was spent in examining Mr. Graef's collection and discussing the merits of the collation provided.

On Monday, 15th, Mr Emerton read a paper by Prof. L. M. Underwood, on "The Literature of the North American Spiders," reviewing the work thus far done in the *Arachnidæ*.

Mr. Smith made some remarks on the paper mentioning the work being done by students of the group and that the U. S. National Museum was accumulating a very fair collection in the class. He also defended the practice of describing species as justifiable under some circumstances in stimulating or exciting interest, and claims that nothing is so discouraging to beginners as a lot of material which is unnamed and unnameable until some one monographs the whole.

Mr. Emerton said that he intended to continue his work on the New England spiders, and will keep his types, at least until the work is all done. He was opposed to hasty descriptions, and to hasty identifications of old species where there is nothing to

identify them by. He preferred to give a new name to an insect rather than to identify it with an old name, unless he was quite sure of his identification.

Dr. Hoy spoke of the peculiarities of the Lepidopterous fauna, of Racine, Wis., describing the location of the place, and enumerating some of the Southern butterflies and moths that have been taken there,—among them *Terias Mexicana*, *Apatura celtis*, *Argus labruscae*, *Dilophonota ello*, and *Erebus Zenobia*.

On Tuesday, 16th, Dr. Lintner spoke on the larva of *Haltica Alleni*, Harris, now known as *H. bimarginata* Say, which he found in great numbers near Lake Pleasant, skeletonizing Alder. He exhibited specimens of the larvæ and pupæ. The latter are found naked in moss. It was yellow when found, not white as described by Dr. Packard.

Mr. Angell stated that he had recently, for the first time, heard *Polyphylla* stridulate. Mr. Dimmock said that *Cerixa* sometimes makes quite a loud stridulating noise.

Some general remarks and questions concerning captures at Sandy Hook followed, and the Club finally adjourned to meet again at 9 a.m., on the first day of next year's meeting of the A. A. A. S.

[For the above account we are much indebted to Mr. J. B. Smith's Report in *Entomologica Americana* for September and October, 1887].

ADDENDUM TO THE PAPER ON THE COTTON MOTH IN CANADA.

(*Page 18.*)

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

The information brought out during the discussion of my paper on the Cotton Moth —read at the annual meeting of the Entomological Society at Ottawa—has led me to entirely change my views as expressed therein regarding the migration of this insect from the south to the north. I am now convinced that the moth does come to us from the cotton fields of the south, and is not a native of this country, for the following reasons:—

1. The simultaneous appearance of the moths in vast numbers at Hamilton, Port Hope, and Ottawa can only be accounted for by the migration theory.

2. There are not enough plants in the whole of Canada of the order *Malvaceæ* to provide sustenance for the larvæ of the moths seen at the above three places alone.

3. The few common plants of this order have not been observed by our entomologists to be attacked by any insect whatever.

4. No specimens of the larvæ of the cotton moth have ever been found in this Province upon the basswood—the only probable alternative food-plant.

5. The prevailing winds during the week previous to the arrival of the moth were quite favourable to its flight from the south-west.

6. The appearance of the moth in Canada during the many years of its occurrence has always been in the autumn, at the end of September or the beginning of October. At this time of year the cotton fields are pretty well denuded of foliage, and the moth, finding no suitable places for depositing its eggs, flies off to distant localities.

Since the meeting of our Society in October, I have endeavored by correspondence to trace the flight of the moth, but though my friends have been very kind in replying to my enquiries, I have not been very successful. I wrote to one entomologist in each

of the following places along the route by which the moth must have most probably come to us. but in nearly every instance the insect was not observed, and did not, at all events, appear in any remarkable numbers :—

Rochester, N. Y.—No observation.

Buffalo, N. Y.—No reply.

Ithaca, N. Y.—No observation.

Akron, Ohio—Professor Claypole writes, "I have not seen the cotton moth here this year. Since the beginning of September I have had twenty-eight students, more or less eagerly in pursuit of Lepidoptera, but I did not see this insect in their collections."

Dayton, Ohio—Mr. G. R. Pilate writes, "I have not noticed *Aletia argillacea* this year; but two years ago, late in the fall, thousands of them were seen around the electric lights for a number of days. I do not agree with Mr. Grote that they *all* come from the south. When I lived in the centre of this city, some five or six years ago, I took a specimen that had just emerged from a pupa in my garden; the wings were still soft, and when placed in a glass, it emitted the red fluid that all freshly emerged Lepidoptera do."

Lafayette, Ind.—Not observed.

Champaign, Illinois—Professor Forbes, Director of the State Laboratory of Natural History, writes, "The assistant who has had special charge of the electric light collections this season tells me that he visited the light several times on favourable nights in September and October, but took no Aletias. We did not 'sugar,' however, but I think it unlikely that any extensive migration should have occurred here without our notice."

Carbondale, Illinois.—Mr. G. H. French, Professor of Natural History in the Normal University of Southern Illinois, writes that he has been too much occupied with other matters to make any observations during the past season, but in a collection sent him from Galesburg, in the northern part of the State, he found a specimen of *Aletia argillacea*, dated October.

Coalburgh, West Virginia.—No observation.

Allegheny, Pennsylvania.—No observation. Dr. Hamilton writes that "the locality would be difficult to reach by a moth coming from the cotton regions, as from three to five hundred miles of rugged, uncultivated, mountainous country would intervene. The Alleghany Mountains, commencing in New York, are north and east, and circle round south through Maryland, and westwardly through Virginia, West Virginia, and half through Tennessee, thus shutting off all communication from the south."

In consequence of the geographical features referred to by Dr. Hamilton, I took it for granted that the moth must have come to us from the south-west, and accordingly made my enquiries from friends along its probable route. It is very remarkable that the swarm that visited this Province should not have been seen at any of the places mentioned above.

In order to further determine the probable route of our swarm of cotton moths, I obtained from the Observatory at Toronto, through the kindness of Mr. Carpmael, the Superintendent of the Meteorological Service, a full abstract of the direction and velocity of the winds for each hour during the first nine days of October—a period sufficient to cover the time occupied by the flight of the insects. The observations were, of course, made at Toronto, but they are applicable to Port Hope and Hamilton, and all this portion of the Province of Ontario.

On October 1st, the winds were south-west, and very light, averaging 3½ miles an hour, till 6 o'clock a.m.; south, with increasing velocity up to 16 miles an hour, till noon; then south-west, and gradually dying away till midnight. Average direction for the day, south, 27° west; mean velocity, 6.21; resultant velocity, 5.84.

October 2nd, south-east till 8 a.m., and very light; from 9 a.m. to 1 p.m. changing from west to north, north-west and back to south-east, rising to 9 miles an hour; during

the remainder of the day south and south-east, with diminishing force at night. Average direction S. 24° east; mean velocity, 4.12; resultant velocity, 2.44.

October 3rd.—Changing from south to east shortly after midnight, and blowing more strongly from the east, up to 12 miles an hour till 7 a.m.; during the remainder of the day blowing strongly, up to 26 miles an hour, from the south-west, shifting at times to the west. Average direction, S. 43 W.; mean velocity, 16.21; resultant velocity, 11.66.

October 4th.—Strong south-west winds (up to 17½ miles an hour) till 10 a.m.; then blowing harder still, up to 25 miles an hour, from the west, shifting to north-west in the afternoon, and diminishing considerably in force at night (6 miles per hour at 11 p.m.) Average direction S. 85 W.; mean velocity, 15.58; resultant velocity 13.33.

October 5th.—North-west winds all day till 7 p.m., when it changed to the west. Average direction N. 54 W.; mean velocity 10.38, resultant velocity 9.89.

October 6th.—The west wind continued till 3 a.m., then changed to south-west, and at 9 o'clock to south; in the afternoon south-east, changing to south and south-west at night, and to west before midnight. Average direction S. 19 W.; mean velocity 6.56, resultant velocity 5.55. The winds were highest from 11 a.m. to 3 p.m., and very moderate at night.

October 7th.—(The day on which the moths were first observed here.) Very gentle winds west to north-west, varying to north up to noon; then shifting to north-east and east. A fine, mild day. Average direction N. 10 W.; mean velocity 2.85; resultant velocity 1.09.

October 8th.—Winds very light, north-east to east up to noon, then south-east and south till 9 p.m., when they changed to the south-west. Average direction N. 52 E.; mean velocity 4.79; resultant velocity 3.10. On this day, and the preceding, the moths were found in the lake and washed up on the shore. The southerly winds of the 6th may have helped the swarm in their flight across the lake, and then the change to northerly and cooler winds may have checked their flight and caused them to drop into the water.

October 9th.—Winds gentle, south-east, south and south-west. A very mild day, with a little fine rain at night. Average direction of the wind, S. 18 W.; mean velocity 4.50; resultant velocity 4.14.

Mr. Carpmael also very kindly sent me a table of the direction and velocity of the wind at Kingston during the same period taken at the usual hours of observation, viz., 7. a.m., 3 p.m., 10 p.m. This will assist us as regards the appearance of the moth at Ottawa:—October 1st, winds south-west, mean velocity about 7 miles. Oct. 2nd, south in morning, south-west in afternoon and evening; mean velocity 2 miles. Oct. 3rd, east in morning, south-west afternoon and evening; mean velocity 9 miles. Oct 4th. south-west in forenoon, south in afternoon, north-east at night; mean velocity 9 miles. Oct. 5th, north in the morning, north-west in afternoon, west at night; mean velocity about 4 miles. Oct. 6, west in morning, south-west in afternoon and evening; mean velocity about 5 miles. Oct. 7th, west in morning, south-west in afternoon, and north-east at night; mean velocity about 4 miles. Oct. 8th, north-east at each observation; mean velocity 5 miles. Oct. 9th, north-east in morning, south-west in afternoon and evening; mean velocity 3 miles.

From the above we gather that the direction of the wind was very much the same at Kingston as at Toronto, but the velocity was considerably less at the former station.

In addition to the foregoing, I have obtained through Dr. Hamilton a table of similar observations made at Pittsburg, Pennsylvania, by the Signal Service Observer of the U. S. army. This will give us some idea of the prevailing winds to the south of us, and by comparison with the observations at Toronto and Kingston, will help us in the formation of some conclusion regarding the migration of the cotton moth.

The Pittsburgh observations were taken at the same hours as those at Kingston, and are, briefly, as follows:—Oct. 1st, winds south-west throughout the day; mean velocity

about 6 miles. Oct. 2nd, south-west in morning, west in afternoon, south in evening; mean velocity about 7 miles. Oct. 3rd, west morning and afternoon, north-west at night; mean velocity 15 miles. Oct. 4th, west throughout the day; mean velocity 10 miles. Oct. 5th, north-west throughout the day; mean velocity 9 miles. Oct. 6th, south-west morning and afternoon, south at night; mean velocity 10 miles. Oct. 7th, east in the morning, south in afternoon, north at night; mean velocity 4 miles. Oct. 8th, north morning and afternoon, west at night; mean velocity 2 miles. Oct. 9th, north in morning, west during remainder of the day; mean velocity about 5 miles.

From the foregoing meteorological observations we may certainly gather that there was nothing in either the direction or force of the prevailing winds during the first week of October to prevent the cotton moth from flying to Canada from the southern cotton fields, which lie almost entirely to the south-west of us. In the next place, we may conclude that the winds during the first few days of October, though light, were such as would help the flight of the moth in this direction. For the first four days they were nearly always south-west or west, and on the 3rd, when they were at their highest velocity in Toronto, they were south-west. On the whole the meteorological conditions were, I consider, distinctly favourable to the migration of the insect from the southern States to Ontario; the weather was warm, free from frost at night, no heavy showers of rain, a moist atmosphere, and winds for the most part in a direction to aid the flight thitherward.

In conclusion, I must confess myself to have changed from a strenuous supporter of the indigenous theory to an equally firm believer in the opinion upheld by Prof. Riley and Mr. Grote, that the moth may occasionally breed for a season in the north, but that its home is in the south, and that the specimens we observe here have flown to us over wide tracts of country from the cotton fields far away to the south-west.

I trust that in future seasons, further observations may be made, and that in time we may be able to trace the route by which this interesting immigrant so frequently travels to our land.

POPULAR PAPERS ON ENTOMOLOGY.

THE OAK-PRUNER: ELAPHIDION VILLOSUM, Fabr.

BY FREDERICK CLARKSON, NEW YORK.

In support of the records relating to the periods of transformation of this beetle, and the probable cause of their pruning the branches of the Oak, which I had the pleasure to contribute to the Report for 1885, I now add some further facts, resulting from a recent visit to Clermont, N. Y.

On the 29th of October, I gathered from under a group of *Quercus tinctoria* seven branches that had been pruned by this longicorn. The tunnels were from ten to fifteen inches long, in branches from one-half to three-quarters of an inch in thickness. The branches I carefully divided lengthwise, so that the parts could be replaced in position. Six of them contained the pupa, one the larva, which pupated November 4th. One of the pupæ I preserved as a specimen. The imagoes appeared on the following days: Nov. 14th, 22nd, 26th, 29th, Dec. 9th and 25th, all females.

These transformations were rather hindered than advantaged by meteorological conditions, for they occurred in a room having a northern exposure, in which, during the period of the transformations, the thermometrical record differed but little from that in the shade without. Had the branches remained upon the ground, the included insect would have received all the benefits resulting from the direct rays of our Indian summer's sun, as well as the moisture from the ground; influences that ordinarily assist development. As the imagoes appeared they were examined and replaced in their tunnels, where they now remain in a passive state, and are not likely, I think, to exhibit their natural activity until next May or June.

The object of the paper referred to, as well as this article, is to present facts that seemingly disprove certain theories relating to the habits and metamorphoses of this beetle, which have been formulated by distinguished sires and accepted by their credulous sons. What Drs. Peck, Fitch, and Harris have written upon this subject has been substantially repeated by almost every entomologist who has undertaken a history of this beetle. We are very apt to fall into line when we have an abiding confidence in a leader. While I am unwilling to deny the conclusions of these naturalists, I yet think that the facts related go to show that the insect matures at a period earlier than that named by them, and that the benefits supposed to result from a dismemberment of the branch, in so far as the changed environment is concerned, are wholly unnecessary to the development of the included insect, and that there is a plausibility in the inference, if not a certainty as to fact, that the object of pruning the branch is to prevent the flow of sap. If the habits of this beetle as given by these doctors are to be regarded as *ipso facto*, then we must admit the possession of a faculty in these lower organisms that towers above instinct and presents the feature of intelligent reason. This is a subject that cannot very well be discussed in these pages, yet it may not be out of place to say that able writers on the question very generally admit that the habits of insects follow a prescribed law, by some regarded, in a materialistic sense, as mechanical; and by others, spiritually considered, as in furtherance of a divine edict. This latter view is very cleverly presented by St. George Mivart, in Organic Nature's Riddle: "Our experience," he writes, "is in favour of the existence of an intelligence which can implant in and elicit from unconscious bodies activities that are intelligent in appearance and result . . . . 'Unconsciously intelligent action,' improperly called 'intelligent,' is that which is called intelligent only as to its results and not in the innermost principle of the creatures which perform

such actions." "Instinct," Todd says in his Cyclopædia of Anatomy and Physiology, "is a special internal impulse urging animals to the performance of certain actions which are useful to them or to their kind, but the uses of which they do not themselves perceive, and their performance of which is a necessary consequence of their being placed in certain circumstances."

If such definitions are accepted, how are they to be reconciled with the marvellous statement as given by Dr. Fitch? That the larva should prune the branch to prevent the flow of sap would be a necessary consequence of its being placed in certain circumstances, but to do so that the branch may fall to the ground presents a course of reasoning that relates to a condition foreign to the then existing environment. The habits of this beetle from the period of egg-hatching, as given by Dr. Fitch, displaying as it did to him extraordinary intelligence, impress me as presenting the most natural instinctive qualities. The ova, he says, is deposited on a small green twig, the soft, pulpy tissues of which nourish the infant larva, which, when increased in size and strength, attacks the hard wood of the branch, transversely, in a circular direction, consuming it all, leaving the branch supported only by the bark. From these premises, without pursuing the subject further, it is evident that the infant larva requires sap-wood for its sustenance, which it derives from the twig, but so soon as its strength permits, it seeks for dead-wood by attacking the branch, which is found more and more free from sap as the work of severance progresses. The aim therefore from the start is to obtain the dead-wood, and when the branch is eaten through the larva continues its feeding in forming a tunnel through that portion of the branch which is cut off from the supply of sap.

The instinct of insects is wonderful enough, and more accurate perhaps than a mental process, but while we justly ascribe to them all the attributes pertaining to their natural gift, we are not warranted in imputing to them an intelligence only to be arrived at through a course of reason.

THE OAK PRUNER: ELAPHIDION VILLOSUM, Fabr.

BY JOHN HAMILTON, M. D., ALLEGHENY, PA.

The account of this insect given by the early fathers of Œconomic Entomology is so charming that it seems almost profane to disturb a history accepted by most of their credulous offspring with unquestioning faith. Its wonderful habits and supra-rational instincts have been stock in trade ever since, and, like the fiction of the fly walking on glass by a sucker arrangement of its feet, is likely to hold its place in paste and scissor literature for all time to come.

Divested of all romance and imagination, and descending to facts, the observations of Professor Peck, Fitch and Harris may be reduced to this. In the month of July the parent lays the eggs on the limbs, or in the axil of a leaf near the end of the twigs of that year's growth of various species of oak, and perhaps other trees. After hatching, the young larva (in the latter case) penetrates to the pith and devours it downwards till the woody base is reached, and so onward to the centre of the main limb; here it eats away a considerable portion of the inside of the limb, and then plugging the end of the burrow, which it excavates towards the distal end, eventually falls to the ground with the limb, which being weakened, is broken off by the high autumnal winds. They exist here either as larvæ or pupæ till spring, and emerge in June as perfect beetles. Time, one year, though not so stated in words.

The account given in detail below is so different from the above, that were the identity of the individuals not established by actual comparison and by recognized authority, it might well be asserted I had given an account of some other *Elaphidion*.

April, 1883, I procured a barrel of hickory limbs from a tree girdled early in 1882; the limbs were from one-half to one inch in diameter. Very few things developed from them that season; but the next (1884) quite a number of species came forth—*Clytanthus*

ruricola and *albofasciatus*, *Neoclytus luscus* and *erythrocephalus*, *Stenosphenus notatus*, etc. Many larvæ of some Cerambycide continued to work on under the bark; late in the fall I observed that most of these had penetrated the wood, but some remained under the bark till April and May of the next year (1885). The most of the beetles appeared during the first two weeks of June, though individuals occurred occasionally till September. A few larvæ were still found at work, but by October they, likewise, had bored into the wood and appeared as beetles the next June (1886). The normal period of metamorphosis is therefore three years, but in individuals it may be retarded to four or more years.

At the present writing (June 5th) these beetles are issuing in great numbers from a barrel of hickory limbs obtained in April, 1885, from a tree deadened in January, 1884, thus verifying the first observation.

How the larvæ get under the bark could not be ascertained. When first examined, in April, they were from 4 to 5 m.m. long; they ate the wood under the bark, following its grain, and packed their burrow solidly with their dust. The growth and progress were both slow, for by the next April they had scarcely more than doubled in length, and had not travelled more than from four to six inches during the year; but after July they developed an enormous appetite, and consumed the wood for at least an inch in length, and often entirely around the limb, ejecting their castings through holes made in the bark. When full fed they bore obliquely an oval hole into the wood, penetrating it from four to ten inches. The larva then packs the opening with fine castings and enlarges a couple of inches of the interior of the burrow by gnawing off its sides a quantity of coarse fibre, in which it lies, after turning its head to the entrance. When about to become a pupa (I witnessed the process), the skin ruptures on the dorsum of three or four segments next the head; the head of the pupa appears, and after about half an hour's wriggling the whole body is divested of its covering. To the observer the pupa appears to crawl out of the skin, but in fact the skin with the large mandibles is forced backwards by the alternate extension and contraction of the segments, assisted materially by the fibre that surrounds it. After its soft body hardens, the same movements free it from the fibre, some being shoved in advance of the head, and some posteriorly, the exuviæ being often found at the distal end of the hole.

The time spent in the pupal state is indefinite, and does not seem to concern greatly the time of the appearance of the beetle. Sticks split open at different periods from December till March contained larvæ and pupæ about equally, but no developed beetles. A larva that I observed to go into the wood in April appeared as a beetle among the first of such as had presumably pupated in the fall.

The number of these beetles obtained that and the present season was great, and afforded a good opportunity to observe individual variations, and they do differ greatly. In length from 8 to 18 m.m.; in pubescence, some being nearly naked and unicoloured, others having it longer and condensed into spots or almost vittate; some being quite slender and elongate, while others are short and broad; the surface of the elytra is mostly uniform, but in some, especially such as are narrow and elongated, one or two costæ are more or less evident.

Now, although this account differs so widely from that given by Mr. Fitch, still the beetles are the same. Unfortunately, I have never been able to find any pruned oak limbs from which to obtain the insect myself, but I have a good set from Mr. Blanchard, of Mass., presumably from the oak, which are identical. Through the kindness of Mr. F. Clarkson, I have a set of those described by him in the *Can. Ent.*, vol. 17, p. 188, from oak limbs, and which became imagoes in November, and there is no perceptible difference. Dr. Geo. H. Horn says, "They are the same."

To identify *Elaphidion parallelum* had always been a puzzle to me, and I once thought I had a real set; I obtained it about a dozen times by exchange, but could never be satisfied that the specimens received were not pauperized, or peculiar individuals of *E. villosum*. On comparing my hickory insects with all the descriptions of *E. villosum* and *parallelum* and their several synonyms, as far as I possess them, it was easy to pick out sets that would answer satisfactorily all their requirements, and I became satisfied that *E. parallelum* could not be separated.

An inquiry of Dr. Geo. H. Horn elicits the following note and kind permission to use it :—

"Regarding the two species of *Elaphidion* (*villosum* and *parallelum*) of which you write, I can only say that my opinion, based on the series in my cabinet and an examination of those in the cabinet of Dr. Leconte, is that they are inseparable. The slight differences, referred to by Dr. Leconte, in the last ventral segment of the males, are not real but dependent on the angle at which they are seen." The differences referred to are that in *E. villosum* the last ventral segment of the male is rounded, while in *parallelum* it is emarginate. The only other structural difference mentioned by Dr. Leconte is,

"Prothorax scarcely longer than wide—*villosum*.

"Prothorax distinctly longer than wide—*parallelum*."

From the insects before me from the hickory, it is easy to pick out some with the thorax fully one-fourth wider than long, and others with it one-fourth longer than wide, but they are brought together so insensibly by intermediates, that where the proper separation into species should begin it is impossible to decide. The same may be said of the differences in elongation, narrowness, and pubescence; and I can find no basis for retaining *parallelum* as even a racial or varietal name.

I trust the foregoing may stimulate such as have opportunity to investigate the habits of this interesting beetle more thoroughly. I mention some of the points that require clearing up. First, the length of time occupied in the metamorphosis of such as breed in the branches of living trees. One year is certainly an error, as it is opposed to the known history of any other Cerambycide having a similar habit. Second, whether the falling of the limb is not accidental, the majority containing larvæ not being weakened enough to break. Third, whether the end of the limb remaining on the tree does not contain the insect equally with that which falls—points that might be determined by cutting down a tree in autumn from which limbs had been pruned. Fourth, to make a collection for comparison from each species of tree infested.

Besides the accounts of Professors Peck, Fitch, and Harris, the following bibliography may be noticed :—

Haldeman—Trans. Am. Phil. Soc., vol. 10, p. 34.

Larva feeds on the living [?] wood of oak, hickory, and chestnut; also, dead Abies.

Riley—American Ent., vol. 2, p. 60; *ib.* vol. 3, p. 239.

Larva bores in plum and apple twigs, and in dry grape cane, Missouri Rep., 3, p. 6. Bores into and prunes the limbs of the apple. *Ib.* 4, p. 54. Bred abundantly from injured grape stems.

Rathvon—U. S. Agricultural Rep., 1861, p. 615.

Merely a synopsis of Fitch's account.

Packard, jr.—Bul., No. 7, p. 30. U. S. Entomological Commission.

Scissored from Fitch in full.

Clarkson—Can. Ent., vol. 17, p. 188, and vol. 19, p. 31.

Discovers that the insect completes its metamorphosis in the fall and early winter, in oak limbs, and takes issue with Peck, Fitch, and Harris on several points.

Townsend, Can. Ent., vol. 18, p. 12.

Thinks Mr. Clarkson's discovery the exception, and not the rule, in the time of metamorphosis.

THORN AND WILLOW BORERS: SAPERDA FAYI AND S. CONCOLOR.

BY JOHN HAMILTON, M.D., ALLEGHENY, PA.

SAPERDA FAYI, Bland.—This beautiful Saperda breeds in the small limbs of Crataegus. especially *crus-galli* and *tomentosa*, as first observed by Mr. C. D. Zimmermann, *Can. Ent.*, 10, 220; and should it, like some of its allies, acquire a taste for cultivated fruit trees, it would be a formidable enemy, as is evidenced by the way it depredates on thorn bushes. The beetles appear here the last week in May or the first week in June, according to the season, the males preceding the females three or four days. They do not appear to eat, and are short lived, the whole brood (except stragglers) appearing and disappearing within the space of ten or twelve days, so that should the collector be negligent, or the weather unsuitable for collecting at the time of their appearance, he may get none till the next season. As soon as the females appear the males are ready to associate with them, the union lasting three or four hours. They are not much given to flying about, usually ovipositing on the same tree they inhabited as larvæ. There may be several thorn trees not far apart, and one will be depredated on year after year till it is nearly destroyed, while the others will remain untouched till colonized apparently by accident. The beetles are sluggish, and when approached suddenly fall to the ground and quickly endeavour to conceal themselves, not feigning death, as many insects under the same circumstances do; and when I say feigning death, I mean it literally, in opposition to an unsupported dogmatic statement which I lately saw in print somewhere, "that insects can have no knowledge of death."

Oviposition is effected probably during the night, and the process has not been witnessed nor the eggs seen. The limbs selected for this purpose vary from one-third to one and one-fourth inches in diameter, and according to the thickness of the limb, the female with her powerful mandibles makes from three to six longitudinal incisions through the bark, each about three-fourths of an inch long and equi-distant and parallel to one another, dividing the circumference into sections nearly equal; an egg is placed in each end of each of these slits, and as soon as hatched the larva makes a burrow beneath the outer layer of wood, perhaps one-eighth inch in length at first, and uses this as a retreat whence it issues to feed on the diseased wood caused by the incision. These slits and the irritation produced by so many larvæ at work, cause an increased flow of sap to the part, and a consequent thickening of the sections between the slits, so that the injured part soon assumes a gall-like appearance. On the approach of winter, the larvæ having now attained the length of .25 inch, retire back a little further and close the opening of their burrows with borings. One of the larvæ, however, and in thick limbs two or three at each end bore obliquely till one of them reaches the centre of the limb, up which it proceeds, often two or three inches; the others parallel this, but keep a wooden partition between the burrows. These larvæ are much larger—often twice the size—of those inhabiting the outer wood, and are the only ones that produce beetles.

The whole of the interior of the limb is now dead wood enclosed by a growth of living but unsound woody tissue, through which some openings remain. The limbs are much weakened at these places, and many of them, like the oak on which *Elaphidion villosum* depredates, would be broken off by the winter storms were the fibre not very tough and the trees very low. And here analogy leads to the conclusion that as the larvæ inhabit the portion of the limb next the tree, equally with that beyond the injured part, this is likely to be the case in the history of the Elaphidion mentioned.

Many of the larvæ in the outside wood perish during the winter, and the survivors, after feeding a while in the spring, likewise die, their mission seeming to have been merely to insure a sufficiency of dead wood to sustain the life of the favoured few destined for full development.

In the spring the larvæ in the deep wood return and feed on the dead wood, which is now abundant enough for all their wants, and by autumn they are nearly full grown

they again retire for the winter, and in the spring, after opening up communication with the outside world, feed for a short time, and when full grown measure in length about three-fourths of an inch. The larvæ now return to their burrows for final transformation. Some of them bore for at least six inches, while others scarcely go from the entrance more than twice their own lengths; the outer ends are closely packed with borings without and soft fibre within, which also fills the inner ends. The head of the larva may be either toward or away from the opening—seemingly a matter of indifference; in the former case the beetle emerges from the place of entrance, in the latter from a round hole at right angles to the burrow, probably cut by the beetle itself, as no such hole has been detected in the many limbs I have examined containing pupæ with their heads turned from the opening. Pupation occurs after the middle of April, and the perfected beetle will be found in the limbs about the first of May, though few of them emerge till the time stated at the beginning of this paper.

The above is the result of three years' careful observation of the habits of this beetle, and imperfect as the history is, the amount of time and labor expended in developing it can only be understood by those who have attempted similar things. How widely this beetle is distributed is uncertain, as till recently its habitat was unknown. The typical insects were taken in Ohio; it is in Mr. Reinecke's Buffalo Catalogue, and occurs at Hamilton, Ontario (Moffat). Any one can readily ascertain whether it occurs in his fauna by examining the limbs of the Crataegus for the unmistakable swellings it occasions.

SAPERDA CONCOLOR Lec. appears about the same time as *S. Fayi*, and like it, is short lived, few individuals occurring after the middle of June. Its larvæ infest the canes of a small willow growing along watercourses and in swampy places—*Salix longifolia*. The smaller canes are usually selected for breeding purposes, these varying from one-fourth to three-fourth inches in diameter. The beetle makes a longitudinal incision through the bark with her jaws about three-fourths of an inch in length, and in each end deposits an egg. Usually several incisions are made in the same cane some distance apart, which often cause its death the following year. The young larvæ follow the same course as those of *S. Fayi*, only they burrow deeper into the wood, and there are no supernumeraries, as there is no need for them, the wood of the willow dying much more quickly than that of Crataegus, and a warty, gnarly swelling occurring around each incisure.

The beetle, however, does not always select the smaller canes, sometimes choosing ones from one and one-half to two inches thick, in which case the larvæ pursue a different course, for instead of boring up and down, they take a transverse direction and girdle the stem one-third to one-half its circumference, causing a rough, annular swelling and frequently the death of the cane. Two years is the time usually required to complete the transformation, but some individuals probably pass through all the stages in a single year. The head of the pupa is toward the opening, from which the perfect insect emerges. The willow named seems to be the natural food tree of the larvæ of *S. concolor*, and, did it confine itself to this insignificant shrub, could scarcely be classed with injurious insects; but it appears to have likewise either a natural or an acquired taste for poplar, and might become very destructive, a fact first brought to notice in Bul. No. 7, 118, U. S. Ent. Com., where the compiler writes: "Girdling the trunks of sapling poplars, by carrying a mine around the trunk, which causes a swelling often nearly twice the diameter of the tree. We have found numerous saplings of the common poplar in the woods about Providence with the unsightly swellings around the trunk." In case this taste is perpetuated, this beetle will no doubt prove a formidable enemy to this species of shade or forest tree. But in what State this Providence is, or what kind of a tree "common poplar" is, we are not informed. Here the common poplar is the *Liriodendron tulipifera*, but at that Providence it may be a tree of some other genus. This beetle seems to have an extended distribution, occurring in Texas, Michigan, Canada, and New York, as well as here.

NOTES ON THE LOCUSTIDÆ.

BY WM. T. DAVIS, STATEN ISLAND, N. Y.

Whether they fill the listener with a train of happy thoughts, as Gilbert White says, or whether they produce a sadness because the days of summer are nearly gone, as Dr. Harris asserts, the songs of crickets and other Orthoptera have, nevertheless, the merit of always being interesting. An insect that can sing—that has something to say—even though it be the same, night after night, enjoys a sort of individuality, and this long discussion of the Katydids and the quiet murmur of the tree crickets, constitute one of the chief charms of our summer evenings. But they do not always sing or stridulate quite alike, and sometimes, too, their shrilling apparatus is slightly deformed or injured, producing some curious sounds when in use.

I once heard a Katydid whose singing apparatus was out of order, and the sounds given forth contrasted strangely with those of a rival male in an adjoining tree. *Amblycorypha retinervis* produces two somewhat different songs, or perhaps more correctly, varies the same song in time or extent of utterance, so that unless the same individual is listened to for some time, the notes might be attributed to different species. This insect often lays its eggs on the honeysuckle, and I once observed a female on the 16th of Sept., ovipositing on a low tree by the roadside, gradually biting the bark into a ridge, along which the eggs were laid, tile fashion.

On Staten Island, the first Conocephalus that is heard in the garden is *ensiger*, and with *ik-ik-ik*, as if sharpening a saw, enlivens low bushes and particularly the corn patch. This insect seems to especially delight in perching near the top of a corn-stalk and there giving forth its rather impulsive song. I have often watched one crawl, with many a spiral turn, up the stem, fiddling all the while. My notes on its first heard stridulation show considerable uniformity, and the average date may be taken as July 15th.

Conocephalus dissimilis is more of a low grass and weed loving insect than *C. ensiger*, and also comes later in the season. I have found this insect stridulating when its head was gone, picked off perhaps by some vagrant chick. The brown coloured specimens are much more common in this species than in *ensiger*.

Conocephalus robustus resides for the most part mid the grass on sandy ground near the sea shore, though an occasional individual finds its way inland. Along the sea beach they stridulate in early afternoon, especially if slightly cloudy, and when approached they have a curious fashion of dropping to the ground. I have often found them, on such occasions, actually standing on their heads in the soft sand, leaning against the grass stems which grow so close together, without in any way holding on to them. Whether this position is intentional or not, I cannot say, but certain it is that when looked for from above they offer the smallest extent of their bodies to view and may thus escape many enemies.

I have found another Conocephalus on Staten Island, mid the cat-tails that grow on the salt meadows, and a specimen sent to Mr. Samuel H. Scudder was considered by that gentleman to be an undescribed species. This insect keeps very close to the ground, hiding well in the vegetation, and is not easily discovered. The sound produced when stridulating is very faint, not louder than that made by *Gryllus abbrinatus*, and I was much surprised to hear such a faint song come from so large an insect. I have, in consequence of this faint song, named it the "slightly musical" Conocephalus, *C. exiliscanorus*.

HINTS ON COLLECTING HYMENOPTERA.

BY W. HAGUE HARRINGTON, OTTAWA.

To have the specimens in a collection look well, and at the same time be in a condition such as to render their examination as easy as possible, it is necessary that they should be properly collected. The ordinary cyanide bottles prepared either with plaster of Paris, or sawdust which are used for Lepidoptera and Coleoptera, do not furnish good

specimens of Hymenoptera, and those collected in alcohol are less satisfactory. I have found the method advised by Dr. Williston (Psyche, vol. iv., p. 130) for collecting Diptera, so satisfactory that I will quote a portion of his description :—

"I select several two-ounce, wide-mouthed bottles of the same form, and carefully line the bottom and sides with a good quality of blotting paper. Good firm corks are selected, which are interchangeable in the different bottles; in one of these corks a small hole is made, in which it is better to fit a small metallic ferule; a strip of blotting paper is then coiled within this cavity, and it is over this that a few drops of a solution of cyanide of potash is poured."

For those who may not desire to keep on hand a solution of this poison, I would suggest a modification of this method which I find very satisfactory. Scrape a few grains of cyanide into the cavity in the cork and then insert a small wad of damp cotton wool or sponge. The fumes will be readily given off, and it is only necessary to occasionally renew the cyanide. As Dr. Williston suggests, it is well to have several bottles, but it is sometimes impossible for the collector to take more than the minimum amount of apparatus, and he will then limit himself to two, reserving one of them for delicate or small insects. Bees should never be placed in a bottle with previous captures, as honey is often disgorged, and the specimens greatly injured by the matting of pubescence and soiling of the wings; the pollen which the bees so generally carry is almost as bad in its effects. The safest and most desirable plan is for the collector to carry a supply of small pasteboard pill boxes, and transfer his specimens frequently to these, putting only one specimen of such insects as Bombus in a box. These boxes can be obtained of very small sizes, permitting a sufficient number to be packed in a small space. Their use ensures perfect specimens and enables the collector to keep a better record of them by numbering the boxes, and in his field note-book entering full particulars of the contents of each. When possible, it is better to pin the insects before they stiffen, but if time or circumstances do not permit of this, they will keep safely in the boxes, and may be at any time easily relaxed in a damp atmosphere, care being taken not to allow them to become wet. In pinning, it is not at all necessary to set the wings and feet symmetrically, unless one has plenty of time and desires pretty specimens. The wings, however, should be separated, so as to admit of a full examination of the venation both of the anterior and posterior ones, and of the metathorax and the basal segments of the abdomen.

USE OF CHLOROFORM IN COLLECTING.

BY J. A. JACKSON, DES MOINES, IOWA.

In the article of Henry S. Saunders, on Collecting at the Electric Light (*Can. Ent.*, Feb., 1887), he gives his experience in the use of cyanide of potassium and chloroform as follows: "Cyanide of potasium I found the best poison; a few drops of chloroform on cotton would quiet them more quickly, but was more troublesome, the chloroform having to be frequently renewed, occasionally as often as four or five times during the same evening, and sometimes even then the moths would be found alive the next morning."

I should like to explain my method of collecting with chloroform. I have found it better than any other, whether at the electric light or in the field :

Take a glass fruit jar, one in which the lid screws down upon a rubber cushion or packing. Put a bunch of cotton in the bottom, retaining it in its place by pressing down upon it a circular piece of pasteboard, made to fit tightly in the jar, except that two or three notches should be left in the edge for the chloroform to run through to the cotton. Saturate the cotton with chloroform and screw the lid down tight. The bottle is now ready for use, and it will be found that an insect dropped into it will be suffocated almost instantly by the fumes of chloroform that completely fill the bottle. A feeble flutter for a second, a kick or two, and all is over. As soon as the insect is dropped into the bottle, screw the lid down again, and as it fits air tight, the chloroform will not evaporate too rapidly. Less than a teaspoonful will last for a whole evening's work. If on retiring

from the work the chloroform seems nearly exhausted, it would be well to pour in a few drops more, and then close the lid for the night. If these precautions are taken the insects will never revive.

Chloroform, when used in this manner, will be found to possess many advantages over any other poison. It is quicker in its action, much more convenient, and under all circumstances entirely harmless. I use this form of collecting bottle both for the electric light and in the field. The bottle will contain, without injury to the specimens, the captures of a whole evening, or a whole day.

If, through carelessness, so much chloroform has been poured into the bottle as to saturate the pasteboard on which the specimens rest, their wings may become moistened and somewhat damaged. To prevent accidents of this character, pack a bunch of crumpled newspaper tightly down on the pasteboard before putting in any specimens; the paper will be dry, and will prevent the insects from coming in contact with the moist pasteboard.

For Coleoptera I use a morphine bottle prepared in the same way, except that the newspaper is not wanted, and it is closed with a cork. I always carry such a bottle in my pocket ready primed, and thus am always prepared for preserving any specimens captured incidentally while engaged in other affairs.

A PRACTICAL NOTE ON COLLECTING INSECTS.

BY PROF. E. W. CLAYPOLE, AKRON, OHIO.

In reference to the above two notes on collecting, will you allow me to make a few remarks? Entomology is with me a secondary subject, my time being for the most part occupied with another science. Perhaps this has led me to devise means for economizing time and labor more than I should otherwise have done; but the study of insects has great attraction for me, and I spend no little time upon it.

The method which I desire to mention may be too well known to deserve any space in your columns—if so, I can only ask you to overlook my intrusion—but I have never seen it mentioned in print anywhere, nor have I ever seen it used by any entomologist of my acquaintance. Perhaps also there may be some objections to its adoption which I have not discovered in the course of several years' use. In that case I shall be glad to learn them.

Your contributors speak of chloroform and cyanide of potassium as their favourite insecticide materials. Both these I have abandoned for some years, the former because it is expensive, and the latter because it is unpleasant and dangerous, especially the latter to young students, and both because they are comparatively imperfect in their effects. For example: I have often known an insect, especially one of the large bodied *Bombycids*, that recovered after having been apparently killed by chloroform, and even after having been pinned out in the case. The result usually is that it is seriously injured by flapping about. Chloroform is an anæsthetic and not a poison, and its effect soon passes off unless its action is renewed or long continued so as to insure death.

In regard to cyanide of potassium, I may state that last year I found one of my cases bady infested with the fur moth (*T. pellionella*). I put an open bottle containing cyanide of potassium into the case and closed it. For a fortnight it remained so, when desiring to know the result of the poison, I opened it. It was strongly impregnated with the well known smell of cyanide. To my surprise, however, I could not find a dead moth, and the larvæ were as lively, after breathing for fourteen days the so-called deadly atmosphere, as if they had been all the time in the open air. As a substitute for both of these I have for years used no other insecticide for the purpose of killing my specimens than benzine or gasoline. The latter at fourteen cents a gallon, is merely nominal in cost

and perfectly efficacious in action. I use it without hesitation on the Lepidoptera in any quantity. With most of them it causes instant death, and with the few that slightly resist its effects the resistance is very short-lived. I recollect one day seeing a large *Cecropia* moth enter the room where I was sitting and alight on the knob of the door handle. I took my bottle of gasoline and poured some of the liquid on the body of the insect, when it dropped to the floor as if shot and never moved a wing. The result is not in all cases quite so rapid, but it is never tedious. By this means I prevent the mischief that ensues when a fine specimen flutters in a bottle of cyanide or chloroform for several minutes, as is often the case.

I employ the same plan with all insects, and with equal success. The moths that so long resisted the cyanide vapour, as mentioned above, at once yielded to the deadly gasoline, and in five minutes not a living larva was left in the case.

I need scarcely add that the use of this exceedingly volatile liquid never in the least degree injures the delicate plumage of the Lepidoptera. Many of my best specimens have been repeatedly drenched with gasoline. In five or ten minutes they are as dry as before it was applied.

Let me add one word more. I find the most convenient way of applying the gasoline is to carry it in an ounce phial, having a cork through which passes a finely pointed glass tube. The large outer end of this tube is capped with a small india-rubber capsule. The whole may be bought at a drug store for a few cents, under the name of a dropping tube. In this way the tube is always full of liquid ready to be squirted out on an insect in the net or even at rest in the open air, and the specimen is at once fit to be pinned out. This I do on the spot in a cigar box, or in one lined with cork, and so avoid an accumulation of material, which is a great annoyance to a man whose time is otherwise occupied, or indeed to any one at the end of a hard day's work.

The small weight of the outfit here required is an advantage not to be overlooked when compared with the weight of the loaded cyanide bottle usually employed. There are one or two other points which I should like to mention, but having already written more than at the outset I intended, I will forbear.

BOOK NOTICES.

The Butterflies of North America. By W. H. Edwards. Third Series, Part I., 4to. Houghton, Mifflin & Co., Boston.

It is with very great pleasure that we receive from our esteemed contributor, Mr. W. H. Edwards, the First Part of the Third Series of his magnificent work, "The Butterflies of North America."

The last part of Volume II. was issued in November, 1884. It is a matter of deep congratulation to all Lepidopterists that the talented author now sees his way to resume publication; but we regret exceedingly to learn from a notice in Science, of 4th February, that to enable him to continue his unselfish labours he had to sacrifice many of the valuable type specimens in his collection.

The Part which has just come to hand contains three plates and nine pages of descriptive letter-press. Of the former, which have been executed under the supervision of Mrs. Mary Peart, it is not too much to say that they are exquisite, and are all equal to the very best in Vols. I. and II.

Plate I. which is accompanied by a complete life history, illustrates *Colias Eurydice* Bd., var. *Bernardino* Edw., in all its stages, from egg to maturity, and also a female of var. *Amorphæ* Hy. Edw.

On Plate II. we have a life-like representation of *Argynnis Nitocris* Edw., male and female.

On Plate III. we find figures of *Argynnis Lais* Edw., a pretty little species (but belonging to the same group as *Cybele*, *Atlantis*, and *Electa*), discovered in the Northwest Territories by Capt. Gamble Geddes, in July, 1883. The artist has been particularly happy in the coloration of this plate, especially so in catching the peculiar dull ochrey-brown tint which is characteristic of the female. Of most interest to Canadians, however, is the fact that although this species is abundant in certain parts of the Northwest Territories, easily accessible, and comparatively well settled, nothing is known of its preparatory stages. The eggs of the species belonging to the same group are easily obtainable by tying females over growing plants of violets. Surely some of the readers of the *Canadian Entomologist* have friends living in the Calgary District, or at McLean, where it is very abundant, who, even if not entomologists, would, were the scientific importance of the results placed before them, at any rate take the trouble to confine a few females in gauze bags over living plants, and send Mr. Edwards the eggs. There is very little trouble about this matter; living roots of violets can be sent by mail in a piece of oiled-paper, and will grow easily, if kept watered, in any of the tins used for canned vegetables (flower-pots are rare commodities in the N. W. T.) All that is necessary is to bend two pieces of wire so as to make a pent-house over the plant, and then placing a bag of muslin over the whole, secure it by means of an elastic band round the top of the can. This should be kept out of doors in a shady spot.

The importance of Mr. Edwards's studies of the Diurnal Lepidoptera of North America is perhaps hardly appreciated, until we remember that, with the exception of a few of our commonest butterflies, almost nothing was known of their life-histories until he turned his attention to them in 1868. At the present time, however, it is far otherwise; for by close study, diligent care, and accurate observation, he has himself worked out the complete life-histories of a large proportion of the recorded North American species. Moreover, many discoveries of great interest have rewarded his constant efforts: The tri-morphism of *Papilio Ajax* and *Colias Eurytheme*, the seasonal dimorphism first of *Grapta Interrogationis*, then of others in the same genus, as well as the effects of cold upon larvæ and the perfect insects, may especially be referred to.

There was a marked advance in Vol. II. over Vol. I. in the amount of information given concerning the life-histories of the species described. This is accounted for in the prefatory notice of the present part as follows:—

"When Vol. I. was undertaken, in 1868, nothing was known by myself or any one else, of eggs, larvæ, or chrysalids, except of the more common butterflies. As an egg or larva could but rarely be traced back to a particular female, it was impossible that much knowledge could be gained of the life-histories. Scarcely any advance in this respect had been made, in fact, since the time of Abbott, about 1800. . . . But in 1870, I discovered an infallible way to obtain eggs from the female of any species of butterfly, namely, by confining her with the growing food-plant . . . and from that day to the present I have so obtained eggs at will . . . and have reared larvæ without end. In this way, many cases of polymorphism have been established, and the position of many doubtful forms settled. A light has also been thrown on the limits of variation in species. In every case I have preserved descriptions of the several stages . . . Of a large proportion, also, Mrs. Peart has executed colored drawings, magnified when necessary, and my albums contain nearly one thousand figures."

Mr. Edwards concludes: "And so, in this Christmas time of 1886, I commend Vol. III. to the good will of the friends who have made my small audience for so many years."

Surely we may go further—a long way further—than this, and commend it not only to the few friends who have had the good fortune to listen to Mr. Edwards's teaching in the past, and perhaps to catch some of his enthusiasm; but also to every entomologist or possessor of a library, whether in America or any other part of the world, who wishes to have the most complete, as far as it goes, accurate, and, for the style of the work, the cheapest—in short, *the best*—work yet published upon the Butterflies of North America.

The Butterflies of North America. By W. H. Edwards. Third Series, Part II.

The second part of the new series of this superb work contains the usual three exquisitely finished coloured plates of butterflies. The first illustrates the Californian *Colias Harfordii* Hy. Edwards, and its variety *Barbara*, giving no less than nine pictures of the imagines, and more than a dozen of the earlier stages ; the second *Argynnis Coronis* Behr., giving both the upper and under surfaces of the male and female of this beautiful Californian species, which extends northward as far as our own Northwest Territory, where it has been taken by Capt. Gamble Geddes ; the third plate fully illustrates all the stages of *Neonympha Gemma* Hubn. and *N. Henshawi* Edw. There is the usual letter-press description of all the species figured, and also a notice of *Argynnis Callippe* Boisd. It is hardly necessary to add that no Lepidopterist's library can be considered complete without a copy of this admirable work.

Report of Observations of Injurious Insects and Common Farm Pests during the year 1886, with Methods of Prevention and Remedy. By Eleanor A. Ormerod, 8vo., 112 pages. London : Simpkin, Marshall & Co.

We must congratulate our esteemed friend upon the publication of her Tenth Report. It is full of interesting matter and well illustrated with excellent wood-cuts, chiefly the work of the talented authoress. The principal noxious insects treated of are "Earwigs" affecting cabbage—a pest that we are happily free from in this country ; Clover Weevils, the Hessian Fly and other wheat insects, the Hop Aphis, Mustard Beetles, the Horse and Ox Warble-flies, etc. Economic Entomologists everywhere may learn much from these pages ; though the insects treated of are for the most part British, many of them have been transported to this side of the Atlantic and to other distant regions, where they have wrought incalculable damage to crops of various kinds.

Synopsis of the Hymenoptera of America, North of Mexico. By E. T. Cresson. Part I. Families and Genera. 8vo., 154 pages.

This valuable work, published as a supplementary volume by the American Entomological Society in Philadelphia, is a very much needed contribution to the literature of this difficult order of insects. With this assistance towards classification, we trust that many will be encouraged to collect and study these particularly interesting creatures.

Transactions of the American Entomological Society, and Proceedings of the Entomological Section of the Academy of Natural Sciences. Philadelphia. Vol. xiii., 1886.

This volume is replete, as usual, with papers of high scientific value by such well-known authorities as Dr. Horn on Coleoptera, Messrs. Ashmead, Blake, and Howard on Hymenoptera, The Rev. Messrs. Holland and Hulst on Lepidoptera, and Prof. Williston on Diptera.

The Mulberry Silk-worm ; being a Manual of Instructions in Silk Culture. By Prof. C. V. Riley. Bulletin No. 9. Division of Entomology, U. S. Department of Agriculture.

Our Shade Trees and their Insect Defoliators; being a consideration of the four most injurious species which affect the trees of the Capital; with means of destroying them. By Prof. C. V. Riley. Bulletin No. 10.

The species referred to are the Elm-leaf Beetle (*Galerucha xanthomelœna* Schrank.); the Bag Worm (*Thyridopteryx ephemeræformis* Haw.); the White-marked Tussock-moth (*Orgyia leucostigma* Sm. & Abbot); and the Fall Web-worm (*Hyphantria cunea* Drury).

Reports of Experiments with Various Insecticide Substances, chiefly upon insects affecting garden crops, made under the direction of the Entomologist. Bulletin No. 11.

Miscellaneous Notes on the Work of the Division of Entomology for the season of 1885. Prepared by the Entomologist. Bulletin No. 12.

These four works abundantly testify to the value of the Government Commission on Entomology at Washington, and to the ability and industry of its members.

Arsenical Poisons for the Codling Moth (*Carpocapsa pomonella* L.) By Dr. S. A. Forbes, State Entomologist of Illinois. Bulletin No. 1.

Another valuable contribution to Economic Entomology, the result of careful and painstaking work in the field.

Rhopalocera Malayana: A description of the Butterflies of the Malay Peninsula. By W. L. Distant. London, 1882–86, 486 pages, 46 plates.

A short time ago we called attention to a work in progress on the Butterflies in India. Immediately thereafter there came to hand the final part of another notable work on the butterflies of a region still nearer our antipodes—the Malay Peninsula. In this instance the work was undertaken by the author under peculiarly favourable circumstances, inasmuch as all pecuniary anxiety was removed by the appearance of a Maecenas in the person of Mr. D. Logan, of Penang, to whom all credit is due by naturalists the world over, not only for the generous way in which he has allowed the work to be gotten up and illustrated, but for his excellent choice of an author. For Mr. Distant, on his side, has performed his task in a very scholarly manner, and given us a book leaving little to be desired, beyond that constant and bitter craving of naturalists for a knowledge of the earlier stages of life of the insects treated. We could indeed wish that the structural characteristics of the larger divisions had been more amply treated, and that the author had not rested satisfied with groupings in the Lycaeninæ and Hesperidæ, newly manufactured, confessedly artificial and temporary, and to which the very descriptions which follow do violence. But the excellence of the entire work, the consistent manner in which the task has been carried out, the technical skill, excellent judgment and broad learning everywhere displayed, as well as the very considerable addition to our knowledge involved, disarms adverse criticism and invites only praise. Would that such a Maecenas and such an author might oftener company together!

The work is published in quarto in sumptuous style, is unexceptionable in typography and profusely illustrated. Besides 46 plates of some of the best chromo-lithographs of butterflies which we have ever seen, there are 129 wood cuts scattered through the text, generally illustrating special structural features, especially in neuration and leg structure, which are of the greatest value. The author, as would have been expected of one of our best lepidopterists, familiar with the structure as well as the early stages, the form and colouring of butterflies, has followed closely in the lines of classification made prominent in recent years by Bates, in which the Hesperidæ are immediately preceded by their

nearest allies, the Papilionidæ. It remains only to say that a good deal of interesting reading will be found scattered through the portly volume, and that there are points in the preface worthy of careful attention. About 500 species are described.

The Ottawa Naturalist. Vol. i., Nos. 1 and 2, April and May, 1887.

A welcome addition to our few Canadian serials on Natural Science; we heartily wish it abundant success.

A Revision of the Lepidopterous Family Saturniidæ. By John B. Smith. Proceedings of the United States National Museum. Washington, Dec.. 1886.

A very valuable illustrated paper on this interesting family of moths.

North American Lepidoptera: The Hawk Moths of North America, by A. Radcliffe Grote, A.M. Printed by Homeyer and Meyer, Bremen, 1886.

The above is the title of an interesting brochure by our old friend Prof. Grote, who has done so much to advance our knowledge of the North American moths. The press work is superb. For clearness of print, nice paper, and excellent taste in the selection of contrasting type for the heading of the sections, this work is a model.

After a graceful dedication to Prof. William Saunders, former editor of the *Canadian Entomologist*, our author gives directions for collecting and preserving insects, followed by a chapter on the relation and habits of the *Sphingidæ*. He then takes up their classication, beginning with the sub-family *Macroglossinæ*. under which he includes the genera *Hemaris*, *Lepisesia*, *Thyreus*, *Enyo* and *Deidamia*. Then follow the sub-family *Chærocampinæ*, including the genera *Everyx*, *Ampelophaga*, *Deilonche*, *Deilephila* and *Philampelus;* the sub-family *Smerinthinæ*, including the genera *Calasymbolus*, *Paonias*, *Cressonia* and *Triptogon;* and the sub-family *Sphinginæ*, including *Ceratomia*, *Daremma*, *Diludia*, *Dolba*, *Phlegethontius*, *Atreus*, *Ellema*, *Sphinx* and *Dilophonota*.

Prof. Grote divides the time of the work on our lepidoptera into three periods: The first including that of Abbot, Boisduval, the elder LeConte, Say, Peck, Harris, Gosse, Kirtland, and their historian, Dr. J. G. Morris. The second period, the one which he calls the "Renascence," is the period in which the American Lepidopterists catalogue the different families of the lepidoptera and thus lay the foundation for present and future discoveries. This period, which came to an end with the appearance of Grote's New Check List, "was a time during which a great deal of work was performed with good humor and at considerable self-sacrifice," and no one did his share of this work, which was more or less drudgery, more cheerfully than did Mr. Grote himself.

The author says that the writings of our entomologists have a flavouring of the localities from which they emanate, thus, "in some way the scent of the Maine woods has got into Prof. Fernald's writings," and we may say in return that a vein of poetry runs all through this charming little work which we are now reviewing.

OBITUARY.

Since the last Annual Report appeared, our Society has sustained a serious loss by the death of one of its most prominent and highly esteemed members, Mr. George J. Bowles, of Montreal, for a great many years a member of the Society. He was also for the greater part of the time on the Executive Council, and did valuable work, not only in

writing for our publications, but also in fostering and disseminating as widely as possible a love for Entomology. He began to study this branch of science when quite a young man, in the neighbourhood of Quebec. Since that time he has kept quietly on persistently collecting, working, and helping others right up to the day of his death. After his removal to Montreal he took a very active part in the preliminary arrangements and institution of the Montreal Branch of our Society, of which he was for several years the President, and before which he read some valuable papers, many of which have appeared in the Annual Reports or in the *Canadian Entomologist.*

His large collection contained specimens of all the different orders of insects; but he made a specialty of the Lepidoptera, which were well represented by long series of Canadian and Exotic species. It is highly satisfactory to hear that this collection has been transferred to the museum of McGill University, where the good work of instruction by its means will continue to be carried on with even greater facilities than were possessed by the one who built it up with so much care.

Mr. Bowles was a native of Quebec, in which city he was born in 1837. He was a kind and religious man, and always had a helping hand for those who knew less than himself. His quiet, modest manner made him a favourite with all his associates, while his ability as a naturalist was acknowledged by all who came into contact with him.

He leaves a wife and three children, for whom, in their bereavement, our deepest sympathy is called forth.

ENTOMOLOGIST FOR BRITISH COLUMBIA.

It is with much pleasure that we have just learnt of the appointment of the Rev. George W. Taylor, of Victoria, Vancouver Island, B. C., as Honorary Provincial Entomologist of British Columbia. Mr. Taylor has been an active member of our Society for some years, and has done much good work, not only in Entomology, but in general Natural History, by working up the little known but exceedingly interesting fauna of Vancouver Island. He is one of the best Conchologists in the Dominion, and has the finest collection of British Columbian shells extant. His knowledge of Ornithology and Botany will materially enhance the value of his work as Provincial Entomologist, and his appointment cannot but result in great benefit to the farming community of the Province. We tender our sincere congratulations, not only to Mr. Taylor, but also to the Minister of Agriculture and the Provincial Legislature, for the wisdom that has been displayed in the choice of an incumbent for this important office. There are many "first-class pests" which require attention in our Pacific province already, and doubtless, now the Canadian Pacific Railroad is completed, many others from the east may be expected to be introduced by that means, and it is only by having the services of a trained scientific student at their disposal, to identify the marauders, and give information concerning the habits and best means of remedying their attacks, that the farmers can hope to protect themselves against the injuries yearly inflicted by insects.

REMEDIES FOR NOXIOUS INSECTS.

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

In our Annual Report for last year (pages 55-64) I began an account of the remedies that have been found by practical experience the most useful in counteracting the ravages of destructive insects, and, taking them in alphabetical order, described those employed against our chief foes, as far down as the "codling worm." The next insect on our list is

The Colorado Potato Beetle.

This formidable pest of the potato-grower is now far too well known to require any description. The accompanying wood-cut (Fig. 6) illustrates the insect in all its stages:

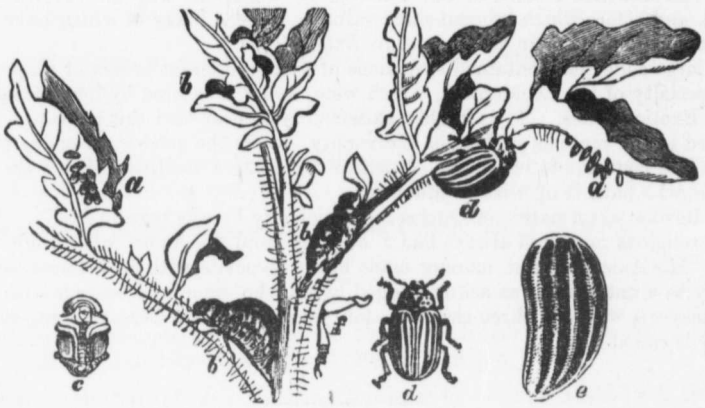

Fig. 6.

a the eggs; *b* the orange coloured larva or grub at different periods of growth; *c* the chrysalis or pupa; *d* the perfect beetle; *e* one wing cover enlarged; *f* a leg magnified.

Though this destructive pest is now widespread over all the eastern half of this continent, wherever potatoes can be grown, and appears in infinite numbers everywhere, it can yet be kept in check without much trouble or expense. As almost everybody knows, Paris green is a perfect remedy for it, and by its timely use almost the whole of the crop can be saved. The main point is to apply the poison carefully and promptly as soon as the first brood of the insect appears in the spring; by so doing the chances of a second attack are very much diminished, but careful watch must be kept throughout the season and the poison applied whenever any of the insects appear. If all the farmers throughout the country would unite in using this remedy, we should in a few years so nearly exterminate the insect as to have little trouble from it. The most satisfactory mode of using the poison, if the Paris green is pure, is to mix one teaspoonful in a pailful of water and carefully sprinkle the affected parts with it; an ordinary watering-can will be found most convenient. As, however, the poison is often adulterated, it may be found necessary to use two or even three spoonfuls instead of one; by trying the smaller quantity first and watching its effect, the proper proportion may be readily ascertained. In the case of the fully developed beetles a poison of much greater strength is required than for the more delicate grubs.

An objection to the use of Paris green has often been raised on the ground that it injures the potato tuber and renders it a dangerous article of food by the absorption of arsenic. Very careful and exhaustive experiments have been made in order to ascertain whether any of the poison gets into the tubers or the roots and stems of the plant, with the result that in no instance could any trace of the arsenic be found. The foliage to which it is applied is often damaged to some extent by the corrosive action of the poison, especially when too strong a mixture is used, but none of it is actually taken into the plant so as to be stored up in the tuber. Any of the arsenic that reaches the ground is speedily neutralized by the oxide of iron in the soil. Of course, in using this or any other virulent poison, care must be taken to keep it out of the reach of children, and to avoid using it in a garden where children play, or in a field to which cattle have access. In such exceptional cases the insect may be kept in check by the more laborious method of hand-picking.

The following extract from an agricultural paper will shew what pains are taken in Germany to prevent the spread of this noxious insect:—

"In the December number of *Agricultural Science* is a translation from the Berlin *Official Gazette* of an account of how the introduction of the Colorado potato beetle into Germany is prevented. The beetle was first discovered on a potato field in the locality of Latitzch. As soon as its appearance was positively settled, an examination was first made of all the fields the beetle could possible have visited. Then for a distance of six miles about the place, placards with coloured illustrations of the insect were distributed among the people to put them on their guard. Eight smaller potato fields were thus discovered to be affected. All these grounds were then strictly quarantined. The potato stalks were most carefully searched for eggs, larvæ and beetles. Next the soil about the roots and stems was examined, and afterwards the tops were cut off and collected in linen-lined baskets. These were placed in pits four feet deep, in layers four inches thick, and saturated with raw benzine oil, destroying the plants; on top of these were placed other layers until a height of twenty inches was reached, then earth was placed on them. The infested fields were ploughed nearly a foot deep, experienced laborers followed the ploughs, collecting any larvæ, chrysalids, or beetles turned up. Then the land was harrowed once, being gone over again by laborers for insects. After the search was ended the fields were thoroughly saturated with raw benzine oil, 165 lbs. being used to 47 square feet. The fields were shut up and no one allowed to go on them. Next year no crops will be grown here, but the fields will be again examined."

The Curculio of the Plum.

The fruit-grower in this Province has no more formidable enemy to contend against than the Plum Curculio (*Conotrachelus nenuphar*, Herbst.), the different stages of which are shewn in the accompanying wood-cut: *a* represents the grub much magnified; *b* the chrysalis, and *c* the beetle, both magnified; *d* the young fruit, shewing the crescent-shaped mark made by the insect, and the curculio, life size, at its work.

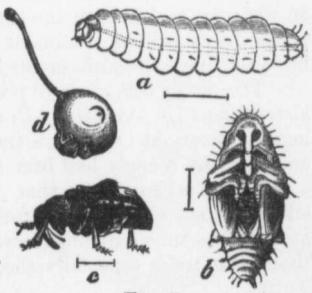

Fig. 7.

Until very recently the only remedies employed against this insect were laborious in their application and uncertain in their results; such, for instance, as jarring the tree and catching the falling insects in sheets spread beneath; trapping them under boards or other articles beneath the trees; planting in poultry yards, etc. Now, happily, a remedy has been discovered, comparatively easy of application, inexpensive, and almost certain in its good results—I refer to the plan of spraying the trees with a weak mixture of Paris green at the time the females are laying their eggs. Three-quarters of an ounce by weight of Paris green mixed with two and a half gallons of water has been found very satisfactory. The liquid must be sprayed all over the trees with a hand force-pump and applied in a fine mist-like spray till the leaves begin to drip. It has been found of advantage to mix a certain amount of flour with the Paris green in order to render the fluid more adhesive to the fruit. Three quarts of flour to a barrel (40 gallons) of water was found to be a satisfactory quantity. The time of application is just after the blossoms fall and when the fruit is of the size shewn in the wood-cut above. If applied before the blossoms are matured, the stigma of the pistil of the flower may be injured by the poison and the fruit prevented from formation. Another evil result is that the honey bees affecting the blossoms may all be poisoned, a fatality that has actually happened when apple trees were sprayed in a similar manner for the prevention of the codling moth. If, on the other hand, the application is delayed too long, the female beetles will have laid their eggs and the young curculios will be out of reach inside the plum.

Since the preparation of our last Report, Professor Forbes, State Entomologist of Illinois, has published an account of his experiments with arsenical poisons for the destruction of the codling moth of the apple. His results may be mentioned here as the

mode of application and the general treatment are the same for the plum curculio as for the apple worm. He states at the outset that "to this codling moth we may fairly attribute a loss to the farmers of Illinois of, say, four and three-quarters millions of dollars each year." He then proceeds to shew, as the result of his experiments, that—putting down the loss to one-half of the amount stated—"at least seven-tenths of that loss may be prevented by a single remedial measure," viz., the application of Paris green, as mentioned above. After giving an account of his experiments, Prof. Forbes states that they show "that eighty-six per cent. of the apples which would have fallen from codling moth injuries have been preserved from falling, and that fifty-nine per cent. of the picked apples, which would have become wormy, remain uninjured; or, taking all the apples from these trees together and comparing with the entire crop of the check trees (which had not been sprayed) we shall find that, of the apples thus exposed to damage, almost exactly seventy per cent. have been saved by our treatment." This is certainly eminently satisfactory.

Experiments were also made as to the effect of spraying the trees once, twice or three times, with this result: "The benefit to the picked fruit apparent from a single spraying, stands at forty-seven per cent., and that from twice spraying at ninety per cent., while that from thrice spraying falls away again to seventy-seven per cent. Or, summarizing still more briefly, we may say, in general, that the results of once or twice spraying with Paris green in early spring, before the young apples had drooped upon their stems, resulted in a saving of about seventy-five per cent. of the apples exposed to injury by the codling moth." It is most important to bear in mind that, in the case of apple trees especially, the spraying must be done before the apples have begun to hang downward; if deferred till a later period there is positive danger that some of the poison will be retained on the fruit and held in the cavity where neither wind nor rain can dislodge it. Enough poison from careless treatment may thus be retained in the apples to be dangerous to the health, if not to the life of the consumer.

The use of this mode of prevention for the plum curculio has, we are glad to find, been already tried in Ontario. Prof. Saunders, in his speech at the meeting of the Entomological Society at Ottawa in October, stated that he had in this way saved his own fruit, and that the remedy had been found effective at Owen Sound and Goderich also.

There is no doubt that the method of spraying with Paris green will be found advantageous when applied for the destruction of the codling moth and plum curculio, at the same time reducing very much the ravages of insects that devour the foliage of these fruit trees, especially the tent caterpillars of the apple and many other destructive worms.

Currant Borers.

There are two species of insects that prove injurious to the currant by boring into the stems and rendering them hollow and weak, and in many cases causing their death. Though similar in their operations, the two insects are utterly unlike, one being a moth and the other a beetle. The moth is commonly called the Imported Currant-borer, (*Ægeria tipuliformis*, Linn) as, like so many others serious insect pests, it has come to us from Europe.

Fig. 8.

Fig. 9.

Fig. 8 represents the moth, a pretty wasp-like creature, with a bluish-black body, crossed by three narrow golden bands; on the thorax and at the base of the wings there are also streaks of the same colour. The wings are transparent, with veins and a bordering of brownish-black with a coppery lustre. The female lays her eggs in June, singly, near the buds, where, in a few days, they hatch into tiny caterpillars and eat their way into the centre of the stem. Here they burrow up and down through the pith until they have formed a cavity of several inches in length. When fully grown the larva changes into a chrysalis (Fig. 9 represents both caterpillar and chrysalis, much magnified), from which the moth issues in the following June.

This insect affects both the white and red currant, and to some extent the gooseberry also. Its presence may be known by the sickly appearance of the foliage and the poorness of the fruit. The remedy for it is simply to cut off and burn all the affected stems either in the autumn or early spring, before the final transformation into a moth.

The other borer, the larva of a beetle, is a native insect, and is therefore commonly called the American Currant-borer (*Psenocerus supernotatus*, Say). Fig. 10 represents the beetle magnified to show the markings and in outline of the natural size. The larva or grub may be distinguished from that of the preceding insects by its smaller size and want of feet. Its habits are much the same, as it feeds upon the pith and burrows up and down through the stalk, but it is more destructive than the larva of the moth from its gregarious life. Usually a number of the grubs, sometimes as many as eight or ten, are found in the same stem, and speedily cause its death. The only remedy seems to be, as in the former case, to cut off and burn all the infested stalks.

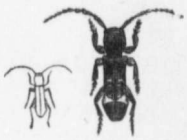

FIG. 10.

CURRANT WORMS.

A number of worms feed upon the leaves of the currant and gooseberry, but only two of them are so commonly destructive as to require notice here. The first and greatest enemy of the gardener in the cultivation of these fruits is the imported Currant Saw-fly (*Nematus ventricosus*, Klug). This insect has come to us from Europe, and was first observed in America in 1858, since which time it has spread over a large part of the continent. Fig. 11 represents (*a*) the male, and (*b*) the female Saw-flies; the hair-lines at the side shew the natural sizes. The body of the male is black above, with a few dull yellow spots, and beneath yellowish, with bright yellow legs. The female is larger and is especially distinguished by its honey-yellow body. It is well that gardeners should become familiar with these insects in their perfect state, as oftentimes they may be captured on the bushes and readily killed.

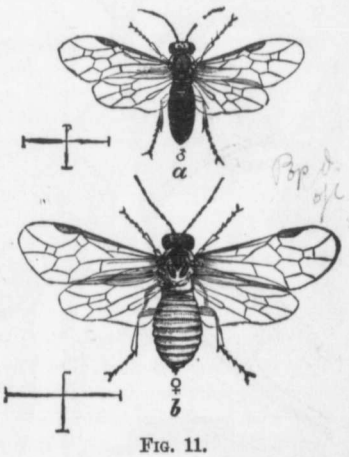

FIG. 11.

The worms are much more familiar to every fruit-grower. They resemble the caterpillars of butterflies and moths very much, but differ from them in having feet under the middle segments of the body and many more in number, and also in their habit of curling the terminal segments. When first hatched they are very small, of a whitish colour, with a large head, having a dark round spot on each side of it. They are then gregarious, feeding in companies of thirty or forty on a leaf till they have consumed all the softer parts of it and left nothing but the frame-work remaining. They soon increase in size, being voracious feeders, and gradually scatter all over the bush. Their colour changes with their growth after successive moults, first becoming apple-green, then green with many black dots, and finally plain green, tinged with yellow at each end. The chrysalis is formed within a tough silken cocoon, nearly oval in shape and brownish in colour, and is made among dry leaves or rubbish on the ground, or in the earth a little way beneath the surface. The fly soon emerges and thus there are several broods during the season, necessitating continual watchfulness on the part of the gardener.

The most effective and simplest remedy is to be found in the application of powdered hellebore mixed with water, in the proportion of an ounce to a pailful, and showered freely over the foliage with a watering-can. If thoroughly applied, especially to the leaves about the bottom and in the middle of the bush, most of the worms will be found

dead in a few hours. Constant inspection of the bushes is, however, required in order to apply the remedy at once whenever a new brood makes its appearance; a few days neglect will often result in the complete stripping of the foliage of the bush.

FIG. 12.

Another mode of counteracting the attacks of these worms is hand-picking. This can be done most effectively before the eggs are hatched, as they are deposited along the ribs on the under side of the leaves, as shewn in Fig. 12. By turning over the lower leaves of the bush the lines of white eggs can readily be seen, or the presence of the young worms may be discovered by the little holes eaten through the leaf, as shown in the same wood-cut. If the leaves, with the eggs or young larvæ, are gathered and destroyed at this stage, before the worms have grown larger and scattered over the foliage, an immense deal of damage may be easily averted.

The other great pest of the currant and gooseberry is the Currant Span-worm (~~*Eufitchia*~~ *ribearia*, Fitch), a well-known and often very destructive insect. In the caterpillar state it can be at once distinguished from the worms of the Saw-fly by its paler and more yellow colour, and by its habit of arching its body into a loop when moving from place to place. The accompanying wood-cut (Fig. 13) represents the caterpillar in this and other attitudes, and illustrates its mode of suspending itself by a silken thread when disturbed or alarmed. When full grown the caterpillar is about an inch long, of a whitish colour, with stripes of yellow running lengthwise and a number of black dots on each segment. It is a native insect and attacks the wild currant and gooseberry bushes in the woods as well as the cultivated varieties in gardens; it is also especially partial to the spicy-scented Flowering Currant, which is so frequently grown in gardens for the sake of its pretty fragrant blossoms. It generally occurs in large numbers, and if let alone will soon make sad work of the foliage of any bush it attacks, but fortunately there is only one brood in the year, and it is in consequence by no means so great a pest as the Saw-fly.

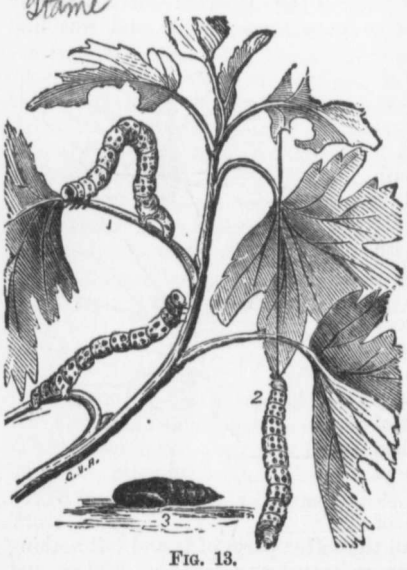

FIG. 13.

The moth, Fig. 14, is a pretty pale yellow creature, with its wings adorned with several dusky bands or spots, which vary very much in different specimens. It usually appears about the end of June, and may be seen in numbers flitting about the affected bushes in the daytime. It is a wise precaution to catch and destroy as many as possible before they have time to deposit their eggs for the next year's crop of caterpillars.

FIG. 14.

It is unfortunate that powdered Hellebore, which is so simple and effective a remedy for the Saw-fly worms, is not sufficiently powerful for the certain destruction of these hardier creatures. If it is used, it must be made of twice or thrice the usual strength. Paris

green would, of course, be effective, but it is too dangerous a remedy to employ in a garden, especially as these worms do not make their appearance till the fruit is well-formed. The only method, apparently, that can be recommended, is hand picking; this is not very difficult, as by shaking the bush the worms will let themselves down by their silken threads, and can then be easily seen and gathered.

Cut Worms.

These noxious creatures, the caterpillars of various night-flying moths, are but too well known to gardeners everywhere, from their annoying habit of cutting off young cabbage and other plants when first set out in the beds. They usually attack the young and tender plants when they are only a few inches high, completely severing the stem just above or below the surface of the ground. They are by no means particular as to the kind of plant, but will destroy spring wheat, Indian corn, any kind of young vegetable, tender annual, or even weed. Some species also have the further evil propensity of climbing trees at night and doing great damage to the expanding foliage and fruit blossoms.

The number of different species of Cut-worms is very large, but the accompanying illustrations will enable any one to recognize some of the commonest forms in both the caterpillar and winged states. Fig. 15 represents the Greasy Cut-worm, so-called from the appearance of the caterpillar; the moth, (*Agrotis ypsilon*, Rott,) into which it transforms, is shewn beneath it. This is one of the commonest of all our species, and has apparently several broods in the year, as the moths can be taken by "sugaring" during the summer and quite late in the autumn.

Fig. 15.

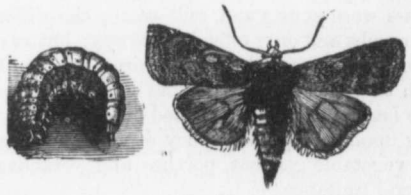

Fig. 16.

The other illustration, Fig. 16, represents the caterpillar and moth of the Dark-sided Cut-worm (*Agrotis Cochranii*, Riley). This species is notorious for its nocturnal habit of climbing apple and other fruit-trees and destroying the buds and young leaves.

Many methods have been tried for the destruction of these pests, but owing to their nocturnal habits it is very difficult to cope with them successfully. Whenever a young plant is noticed to have suddenly withered and died, the culprit may, in almost every case, be found within a few inches of the plant and just below the surface of the ground. It is unnecessary to add that when found he should be ruthlessly crushed under foot. Sprinkling the plants with air-slaked lime, ashes, or powdered hellebore is recommended. When setting out young tomato or cabbage plants, they may be protected by wrapping round the stem of each a piece of paper, extending a few inches up the plant and a little way down into the ground. Where the buds and leaves of fruit-trees and vines are found to be destroyed without apparent cause, search should be made in the ground at the base of the tree, or under any rubbish lying near, and the enemy will generally be found.

The following remedy is quoted by Dr. Lintner, from a correspondent, in his Second Annual Report, and is worth trying:—"One year ago I had a patch of beans entirely destroyed by cut-worms. I planted it over; as soon as they came up the worms began again. I dissolved half a pound of saltpetre in three pints of water, mixed that thoroughly

with one-half bushel of dry ashes, and sprinkled the ashes on the beans just as there was a shower coming on; the rain washed the ashes all off into the ground, and I had no more trouble with the worms, but had a good crop of beans."

Professor Riley (First Missouri Report) says:—"From the orchard planted upon light warm soils, the climbing cut-worms can be driven away entirely by claying the ground about the trees; a wheelbarrow full is well-nigh enough for each tree when spread around its base and as far as the limbs extend. This is the most thorough and lasting remedy."

The Fall Web-Worm.

This very destructive insect (*Hyphantria cunea*, Drury; *textor* Harris), is a familiar nuisance all over Canada and the northern and middle States. Last autumn Professor Saunders observed it defoliating trees in British Columbia; and last year (1886), it became so serious a plague in Washington, D.C., that the attention of the public authorities was drawn to it, and the Entomological Commission was called upon to devise a remedy for its attacks. Professor Riley states in his report (page 521) that: "the city of Washington, as well as its vicinity, was entirely overrun by the caterpillars, with the exception of trees and plants the foliage of which was not agreeable to the taste of this insect; all vegetation suffered greatly. The fine rows of shade trees which grace all the streets and avenues appeared leafless and covered with throngs of hairy worms. Excepting on the very tall trees, in which the highest branches shewed a few leaves, too high for the caterpillars to reach, not a vestige of foliage could be seen. The trees were not alone bare, but were still more disfigured by old and new webs made by the caterpillars, in which bits of leaves and leaf-stems, as well as the dried frass, had collected, producing a very unpleasant sight. The pavements were also covered with this unsightly frass and the empty skins of the various moults the caterpillars had to undergo were drifted about with every wind and collected in masses in corners and tree boxes. As long as the caterpillars were young and still small, the different communities remained under cover of their webs and only offended the eye; but as soon as they reached maturity and commenced to scatter, prompted by the desire to find suitable places to spin their cocoons and transform to pupæ, matters became more unpleasant, and complaints were heard from all those who had to pass such infested trees. In many localities no one could walk without stepping upon caterpillars; they dropped upon everyone and everything; they entered flower and vegetable gardens, porches and verandas and the house itself, and became, in fact, a general nuisance."

The above extracts are given in order to show what a plague this insect may become, and to warn our readers how serious an injury it may cause to an orchard or garden if no effort is made to keep it in check.

The large unsightly webs made by this insect are no doubt familiar to everyone; they are especially noticeable on ash and wild-cherry trees, but may often be found on fruit trees as well. They may be distinguished from the webs of the tent caterpillar by their later appearance in the year in this country (in the south there is a spring brood as well), and by their enveloping two or three feet of the extremity of a branch, instead of being constructed in the fork of a limb. The accompanying illustration, Fig. 17, represents the caterpillar, chrysalis and perfect insect. The moth is a pretty little white creature; it flies only at night, and is consequently not often observed. It appears about the end of May, or early in June, and lays its eggs on the under side of leaves near the ends of branches; from these the caterpillars come out from June to August, according to the locality. The winter is spent in the chrysalis state.

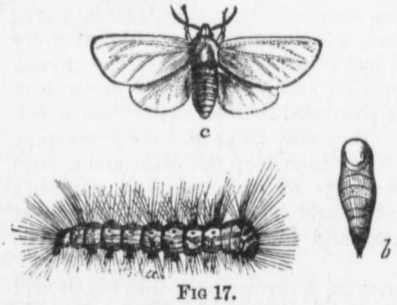

Fig 17.

The simplest and generally the most effective remedy is to cut off the portion of the bough covered by the web and to destroy by burning or treading under foot the enclosed

family of caterpillars. This should be done as soon as the webs are noticed, not only for the sake of preventing further damage, but also because the worms, when nearly full-grown desert the web and scatter over the surrounding foliage. It is well also to kill the caterpillars as quickly as possible after cutting down the web, for they are very lively creatures and will make their escape in numbers if not speedily attended to. If the web should be in such a position that it cannot be conveniently cut off, or should involve the sacrifice of a limb that cannot be spared, it may be destroyed with its contents by burning. This can easily be accomplished by means of rags soaked with coal oil or tar and fastened to the end of a long pole. As a substitute for the rags, a piece of porous brick has been strongly recommended. Professor Riley quotes the following mode of making a brick-torch: "Take a piece of soft brick (one from the outside of a kiln would probably answer best) trim it to an egg shape, then take two soft wires, cross them over this brick, wraping them together around the opposite side so as to firmly secure it, now tie this end to a long stick such as the boys get at the planing-mills, by wrapping around it, then soak the brick in coal oil, light it with a match, and you are armed with the best and cheapest weapon known to science. Holding this brick torch under the nests of caterpillars will precipitate to the ground all the worms on one or two trees at least from one soaking of the brick, and it can be repeated as often as necessary. Then use a broom to roll them under it, and the work will be done, the controversy ended and the trees saved."

Other remedies may be resorted to, such as spraying the trees with Paris green, as recommended for the codling moth and plum curculio, but this would not be satisfactory unless the damage was very serious and the caterpillars had been left too long undisturbed and had grown to maturity. Pruning or burning, or both, are the simplest, easiest, most effective and least dangerous remedies. To these may be added the further precaution of gathering up and burning all fallen leaves, weeds and rubbish that may be found around the base of a tree that has been badly infested. This should be done late in the autumn in order to destroy as many as possible of the chrysalids, that would otherwise remain over winter and produce the moths for a fresh attack the following year.

The list of common noxious insects has by no means been exhausted, there are many more "first-class pests" which are only too well known to our farmers and gardeners. These we must now reserve for a future occasion, but we believe that the many remedies already given in the reports for last year and this will supply methods of treatment that may be employed in numbers of other cases. The main point is to know enough of the life-history and habits of the enemy to understand what remedy to select and especially when to apply it. In most cases, success entirely depends upon attacking the insect foe at the right moment; a few days' delay may involve the loss of the crop, and render the application of the remedy a mere waste of labour. Most people have not the time or the inclination to study these creatures, and therefore it is that we, who are especially devoted to this investigation, believe that we are doing good service to the farmers and gardeners of our country, and therefore to the whole community, by spreading amongst them some knowledge of the appearance and life and habits of these most pernicious and destructive beings.

59-72 pp.

A SKETCH OF CANADIAN ORTHOPTERA.

BY F. B. CAULFIELD, MONTREAL, P.Q.

The destructive insects commonly known as grasshoppers or locusts, with the crickets, cockroaches, walking sticks and earwigs, belong to the order called Orthoptera or straight winged insects. The insects composing this order, unlike the beetle or butterfly, pass through their transformations by a series of simple moultings, moving about and eating from the time they leave the egg until the close of their existence, the principal difference between the larva and adult insect being that of size, and, in the greater number

of species, the presence of wings. Both old and young are voracious eaters, having the mouth parts highly developed, the mandibles being fitted for both cutting and grinding.

From the beginning of summer until late in the fall our gardens and pastures swarm with crickets and locusts, and the amount of grass, leaves, flowers, etc., eaten by these ever hungry little creatures must be very considerable, and is especially noticeable during dry and hot seasons. The Orthoptera have long been celebrated for the musical powers with which many species are endowed. The poets have sung to the "love songs of the grasshoppers," but in reality these merry little fellows are instrumentalists, not vocalists, as they, like all other insects, breathe through spiracles and are of course voiceless. So far as I am aware the musical power is confined to the crickets, grasshoppers and locusts, the remaining families being silent.

In reality the song of an orthopterous insect is a sexual call and is almost entirely confined to the males—entirely so in the crickets, some species of which go through quite an elaborate performance, as may be easily seen by watching the common striped cricket (*Nemobius vittatus*).

When a male of this species wishes to attract the notice of the female, he advances towards her, and, raising the wings and wing-covers, rasps them together, thereby producing a shrill, creaking sound, now and again jerking himself forward with a convulsive movement, touching the female with his antennæ, at times dancing around in a frantic manner. Should the female be pleased with his attentions, she turns around and, seizing him, draws him beneath her, when copulation takes place. Should his serenade prove unsuccessful, the little minstrel either stops shrilling or turns his attention to another female. I have not observed the courtship of our other species, but it is probably much the same in all.

Mr. W. H. Harrington, speaking of *Œcanthus niveus*, says: "An interesting feature of its concerts is one of which I have not been able to find any mention in books accessible. While the male is energetically shuffling together his wings, raised almost vertically, the female may be seen standing just behind him, and with her head applied to the base of the wings, evidently eager to get the full benefit of every note produced."

The courtship of *Ectobia Germanica* is very similar to that of *Nemobius*, but is unaccompanied by any sound, nor are the wings shuffled together. The male follows the female until her attention is attracted, when, turning around and raising the wings until they form a right angle with the body, he backs up to and is seized by the female. I have only seen actual copulation take place in *Nemobius*, but have little doubt that in both Blattidæ and Gryllidæ the male never takes possession of the female by force.

Another remarkable feature of the Orthoptera is the facility with which they elude observation. This is largely owing to the similarity of their colours to the surroundings amidst which they live, and probably serves as a means of defence against their enemies. No doubt many observers have noticed that it is easy to see a grasshopper or locust when it is jumping or flying, but it is just the reverse when the creature remains quiet. A familiar example is the large rattling locust, whose gaily coloured under-wings make it so conspicuous an object when hovering in the air, but which becomes almost invisible when resting with closed wings on the bare dry gravel or dusty roadside; and equally difficult to detect are those green species that live in damp meadows, or on shrubs and trees, their colour just matching the grass and leaves amongst which their lives are spent.

Six families of Orthoptera are represented in Canada, viz.: Gryllidæ, Crickets; Locustidæ, Grasshoppers; Acrididæ, Locusts; Phasmidæ, Spectres or Walking Sticks; Blattidæ, Cockroaches; and Forficulidæ, Earwigs.

Dr. Harris, in his well-known work on Injurious Insects, says: "Cockroaches are general feeders, and nothing comes amiss to them, whether of vegetable or animal nature, but by far the greater part of the Orthopterous insects subsist on vegetable food, grass, flowers, fruits, the leaves and even the bark of trees; whence it follows, in connection with their considerable size, their great voracity, and the immense troops or swarms in which they too often appear, that they are capable of doing great injury to vegetation."

Family 1.—Gryllidæ (Crickets).

The Crickets are robust, thickset insects with a large head and thorax. The antennæ are long and very slender. The wings are laid flat on the body, the outer edge of the front pair being bent down so as to slightly overlap the body. The hindmost thighs are thick and muscular, enabling them to jump quickly and to considerable distances, which perhaps gave birth to the saying, "as lively as a cricket." The ovipositor is long and spear-shaped, and slightly curved upwards. Packard says that "the shrilling of the male is a sexual call, made by raising the fore wings and rubbing them on the hind wings. The noise is due to the peculiar structure of the fore wings, the middle portion of which forms, by its transparent elastic surface, on which there are but few veinlets, a resonant drum, increasing the volume of sound emitted by the rubbing of the *file* on the upper surface of the hind pair of wings. This file is the modified internal vein, the surface of which is greatly thickened, rounded and covered closely with fine teeth. In the females the wings are not thus modified, and they are silent."

The Mole-crickets (*Gryllotalpæ*) may be recognized by their powerful fore-feet, which somewhat resemble those of a mole, being short, stout and flattened and armed with tooth-like projections. They inhabit soft and moist earth in which they drive burrows resembling miniature mole runs. According to Packard, their eggs, from 300 to 400 in number, are laid in the spring in tough sacks in galleries. Only one species, *Gryllotalpa borealis*, Burm., is recorded from Canada, where it appears to be very rare.

"Mole-crickets avoid the light of day, and are active chiefly during the night. They live on the tender roots of plants, and in Europe, where they infest moist gardens and meadows, they often do great injury by burrowing under the turf and cutting off the roots of the grass, and by undermining and destroying, in this way, sometimes whole beds of cabbages, beans and flowers."—(Harris.)

Should our American species become sufficiently numerous to be injurious, they might perhaps be poisoned by scattering grated vegetables sprinkled with Paris green in the vicinity of their burrows.

The large black cricket so common in dry fields during the summer months is the *Gryllus neglectus*, Scud.; specimens in the larval condition may be found under stones as soon as the snow has melted in spring, and on warm sunny days may be observed running through the scanty herbage, making off with hasty jumps when alarmed. By the end of May most of them have attained the perfect condition, but some individuals are later, as I have taken a specimen in the pupa state on June 4th, 1885.

I have not been able to determine whether these hybernated specimens live until the end of the season, or deposit eggs during early summer and then die, but so far as I have observed, their shrilling almost entirely ceases during July. In the beginning of August a few may be heard, and by the middle of the month they are again in full chorus, appearing to be more numerous than in the earlier part of the season. Harris says, "The old insects, for the most part, die on the approach of cold weather; but a few survive the winter by sheltering themselves under stones, or in holes secure from the access of water." This may perhaps be the case in Massachusetts, where, I believe, Dr. Harris observed them; my own experience is that they hybernate as larvæ, that is, about half grown and without wings. About the end of August, and during September, the field crickets lay their eggs. At this time they leave their hiding places and may be seen in great numbers in the fields, particularly on dry hill sides, where the herbage is short and scanty. When about to deposit her eggs, the female walks slowly along, stopping at intervals and feeling the ground with her ovipositor; when a suitable spot is found, she raises her abdomen, inclining the ovipositor downwards until its point touches the earth, into which, by steady and continued pressure, it is gradually forced until completely buried, when the eggs are deposited.

Beside our native species of *Gryllus*, we have the well-known house cricket, *Gryllus domesticus*, which, like its cousins the cockroaches, has crossed the ocean.

This species loves warm quarters, making its home in kitchens and bakehouses feeding on crumbs and scraps, not being particular as to diet. During the day it hides

in chinks and crevices, coming out at night in search of food. It is of a greyish-white colour, marked with spots and lines of brown.

The small black crickets, so plentiful in meadows and pastures, belong to the genus *Nemobius*. They may be distinguished from the species of *Gryllus* by their smaller size, duller colours, and by the thorax or neck, being slightly hairy. These little crickets do not burrow in the earth like the larger kinds, although an occasional specimen may be found under stones or clods of earth. They are of social habits, keeping together in large troops or swarms. The striped cricket, *Nemobius vittatus*, Harris, is our most abundant species; its colour is greyish-brown, marked with lines of black.

Another species of about the same size, but with long wings, may occasionally be found; this is the little long-winged cricket, *Nemobius fasciatus*, DeGeer. It closely resembles the striped cricket, but the wings are about twice the length of the body. It flies well, and sometimes enters houses in the evening, attracted by the light. "Where crickets abound, they do great injury to vegetation, eating the most tender parts of plants, and even devouring roots and fruits whenever they can get them. Melons, squashes, and even potatoes, are often eaten by them, and the quantity of grass that they destroy must be great, from the immense numbers of these insects which are sometimes seen in our meadows and fields."—(Harris.)

Domestic fowls and turkeys will eat crickets and locusts whenever they can get them, and would considerably lessen their numbers if let run in the fields after the crop has been harvested. The broad-winged hawk (*Buteo Pennsylvanicus*) also feeds largely upon them in the fall, as I have on several occasions found them in their crops, one individual having its crop literally crammed with specimens of the common field cricket, (*Gryllus neglectus.*)

Crickets might be easily killed by simply crushing them under foot in the fall, as at this time they congregate in numbers in exposed situations for the purpose of depositing their eggs; they might also be caught with nets by children and destroyed.

All the foregoing species live on the ground, but we have another kind of cricket which spends its life among the leaves and branches of tall weeds and shrubs. It is the ivory climbing cricket, *Œcanthus niveus*, Serv. The male is ivory white, with very broad, transparent wing-covers, crossed by from three to five oblique raised lines. In the female the wing-covers are longer and narrower, and of a pale green colour. The antennæ and legs are long and slender, the insect not being so stoutly built as the ground crickets. The shrilling of this species is more sustained than that of *Gryllus*, the notes running together like the roll of a drum, swelling and decreasing alternately. They commence shrilling about the first of August, and continue until the frosts of October put an end to their existence. This is a very troublesome insect to the fruit grower, attacking the peach, plum and other trees, being particularly injurious to the grape and raspberry. When about to deposit her eggs, the female settles herself on a grape stem or raspberry cane, and pierces it with her ovipositor, laying a long, narrow, yellow egg in the opening thus made, repeating the operation until from four to fifteen have been deposited.

The cane thus attacked often withers above the punctured part, or is so much weakened as to be easily broken off by the wind or by the weight of the leaves in spring, the result in either case being the loss of the fruit. Late in fall or early in spring search should be made for the punctured canes, which should be cut away and burned. The insects themselves may be killed by jarring them from the plants and crushing them under foot. Fences and waste-corners should be kept clean and free from wild vines and briars, such places being prolific breeding grounds of this and various other insect pests.

Family 2.—Locustidæ, (Grasshoppers.)

The term Grasshopper is now generally restricted to certain orthopterous insects with very long, slender legs and antennæ, mostly of a grass or leaf-green colour. In the winged species the wing-covers slope downwards at the sides of the body and overlap a little on the back near the thorax. The ovipositor is generally long and curved like a

cimeter. With few exceptions, grasshoppers are solitary insects, nor are they often sufficiently numerous to be injurious or attract attention. At the head of the family systematists place a group of wingless forms represented in Canada by two species—one restricted to the North-west, the other apparently common in Ontario and Quebec. The latter is the spotted, wingless grasshopper of Harris, *Ceuthophilus maculatus*. This curious insect lives in small communities under stones in damp woods and beneath the loose bark of dead trees. It is rather strongly built, with stout hind thighs; its general colour is brown, thickly mottled with spots of a lighter colour; the back is arched, and the creature has a smooth, shiny appearance as if varnished. It is entirely wingless, ovipositor rather long and nearly straight. It appears to be somewhat carnivorous, as I have taken it in cans baited with meat. The western insect is *Udeopsylla nigra*, Scud. It resembles in form the preceding species, but is heavier and stouter; the ovipositor is rather short, and thick at the base. Colour, shining black.

The next group contains the typical insects of the family, the green grasshoppers or katydids. Most of these possess ample wings and can fly well. Some species live on trees and shrubs, while others inhabit meadows and pastures. They are pretty and harmless creatures, not being numerous enough to be injurious; and owing to their retiring habits and the similarity of their colour to the leaves and grasses amidst which they live, are but seldom noticed even in the localities where they are most abundant.

"The shrilling of these insects is produced by friction of the large veins situated nearly on the inner margin of a talc-like plate at the base of the wing-covers. When the insect shrills, the wing-covers are raised and the bases shuffled together."—Riley. The shrilling of some of the southern species is quite powerful, and where the insects are very abundant the noise is sometimes unpleasantly loud; but in these northern regions the notes of our grasshopper are weak, nor are the insects sufficiently numerous to attract much attention.

Our green grasshoppers may be divided into two groups, one containing the species that live on trees and shrubs, (the true Katydids) the other those species that live on the ground or in tufts of rank herbage (the meadow grasshoppers.)

Our commonest arboreal species is the narrow-winged Katydid, *Phaneroptera curvicauda*, De Geer. It may often be observed resting on shrubs and young trees during the latter part of summer, occasionally taking a short flight from tree to tree. It may be recognized by its narrow and straight wing-covers, and by the male having a cylindrical style curving from below upwards, and resting in the forks of a furcate appendage which projects from the end of the abdomen. The ovipositor of the female is rather short and curved abruptly upwards, the extremity being toothed on both sides. The female deposits her eggs in the edges of leaves, as discovered by Miss Murtfeldt. Prof. Riley describes the note of this species as a soft *zeep, zeep*, sometimes uttered singly, but generally thrice in succession.

While passing through its earlier stages this species wears a more varied dress than the simple green of the adult insect. In the *larvæ* the colours are purplish-black and white, arranged in minute squares on the head and body, the antennæ and legs being marked with rings of the same colours. The *pupa* is green, varied with purple on the sides, and adorned with a double row of crimson spots on the dorsal surface. The mature insect is wholly green. It may be found during August and September.

The Oblong-winged Katydid, *Phylloptera* (*Amblyconypha*) *oblongifolia*, De Geer, is green like the preceding species, but may be distinguished from it by its larger size, and by the oval form of its wing-covers. It appears to be rare in Canada. I have not seen any account of the earlier stages of this insect, but in the latter end of June, 1885, I found two larvæ which, I think, probably belonged to this species, as they were entirely pale green; and on August 1st, 1885, I found two pupæ, also green (*curvicauda* is marked with purple and white when immature), and I know of no other arboreal species in eastern Canada.

The Broad-winged Katydid, *Platyphyllum concavum*, Harr, may be distinguished from our other species "by the greater length and convexity of the wing-covers, which

entirely enclose the abdomen, and with their strong midrib, look exceedingly like a leaf" Riley. This is the true "Katy-did," the name being derived from a fancied resemblance of the call of the male to the words, Katydid.

> "I sit among the leaves here, when evening zephyrs sigh,
> And those that listen to my voice I love to mystify;
> I never tell them all I know, altho' I'm often bid,
> I laugh at curiosity, and chirrup 'Katy did.'"

Prof. Riley states that "the stridulation is quite forcible, representing more often 'Katy-she-did' than 'Katy-did,' and continued at regular intervals."

Rare in Canada, and apparently confined to south-western Ontario.

These are the only aboreal species on our Canadian lists, and so far as known to me, they live altogether on trees and shrubs, never coming to the ground except by accident. Prof. Riley aptly remarks that "they might more appropriately be called tree-vaulters than grasshoppers."

In *Conocephalus* the head is conical, and extends to a point between the eyes, and the ovipositor is long and straight. *C. ensiger*, Harr, is the only species recorded from Canada. It is of a pale green colour, the head whitish, the abdomen and legs brownish green. It measures from an inch and three-quarters to two inches in length. The female has been observed by Prof. S. I. Smith, with its ovipositor forced down between the root-leaves and the stalk of a species of *Andropogon*, where the eggs are probably deposited.

During the latter part of summer, numbers of small, fragile looking green grasshoppers may be found in damp fields. They belong to the genus *Xiphidium*, of which we have two species in Canada, one of which, *X. fasciatum*, is common and generally distributed; the other, *X. saltans*, appears to be rare, and is apparently confined to the North-west. The species resemble each other very closely, their general colour being green, with a brown stripe on top of the head, and the thorax bordered on each side with darker brown. The ovipositor bends abruptly down at the base, and is then straight to the tip.

Prof. Riley states that *X. fasciatum* oviposits in the cone-like willow gall (*Salicis strobiloides*). Although *X. fasciatum* and its variety, *brevipennis*, are abundant at Montreal, I have not heard them shrilling; according to Mr. Scudder, "*Xiphidium* makes a note very similar to *Orchelimum*, but so faint as to be barely perceptible even when close at hand."

The species of *Orchelimum* are almost identical with *Xiphidium* in general appearance and colour, but are larger, measuring about an inch and one-tenth in length from head to tip of wing-covers. They also differ somewhat in habits, according to my observations, *Xiphidium* being generally distributed among the grass, while *Orchelimum* conceals itself in the ranker tufts. *Orchelimum agile*, De Geer, is common in the neighbourhood of Montreal, and may be found in almost every damp field where there are tufts of rank grass or clumps of tall weeds. Concealed in one of these the male takes his stand and trills his simple love song, which is merely a weak, wheezy trill, only audible for the distance of a few feet. When shrilling the insect slightly raises its wing-covers, and shuffles them together with a shivering motion. It shrills in the bright sunshine, and it was by observing the play of light on the wings while in motion that I discovered the insect, as when sitting still it is almost impossible to detect it, so effectually does its green dress conceal it.

The species of *Anabrus*, commonly called western crickets, are large, thick-bodied, clumsy looking insects, the wings being very small and quite useless for the purpose of flight. As the popular name implies, they are found in the west, where at times they occur in immense numbers, often proving very injurious. *A. purpurascens*, Uhler, is the only species on our Canadian lists. It is of a dark purplish-brown colour, mottled with yellow.

Family 3.—Acrididæ, (Locusts.)

This family contains the most destructive insects of the order; indeed I may say, the most destructive of all insects, the terrible migratory locusts. Both the old and new worlds have time and again been scourged by their countless millions, well named by the eastern poet, "The army of the Great God." The desolation caused by their ravages has been the theme of poets and historians since the days of Pharoah's humiliation, when "they covered the face of the whole earth so that the land was darkened."

The noise made by the beating of their wings during flight has been compared to the rushing of a mighty wind, the roar of distant thunder, the crackling sound of burning stubble, etc., and is thus described by the poet Southey:—

> "Onward they came, a dark continuous cloud
> Of congregated myriads numberless,
> The rushing of whose wings was as the sound
> Of a broad river headlong in its course
> Plunged from a mountain summit, or the roar
> Of a wild ocean in the autumn storm
> Shattering its billows on a shore of rocks."

The *Acrididæ*, or Locusts, (Fig. 18) may be distinguished from the grasshoppers by the antennæ being short, not exceeding the body in length, and by the number of joints in the feet, the locusts having only three, the grasshoppers four. The wing-covers are generally long and narrow and slope downwards on the sides like a roof. The under wings are broadly triangular, and when at rest are folded in plaits like a fan. Instead of a long exserted ovipositor like the grasshoppers and crickets, the female locust is provided with four wedge-like pieces, placed in pairs above and below, and opening and shutting opposite to each other. When about to deposit her eggs the female forces these wedges into the earth, these being opened and withdrawn enlarge the opening; the operation being repeated until a hole is formed large and deep enough to admit nearly the whole of the body.

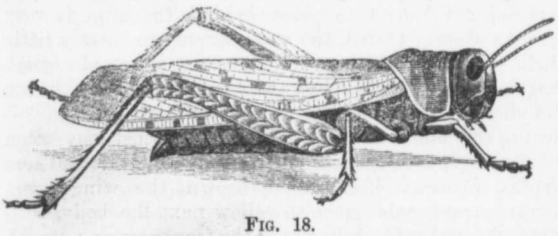

Fig. 18.

Prof. Riley thus describes the manner in which the Rocky Mountain locust (*Caloptenus spretus*) deposits her eggs. (Fig. 19 represents the different positions.) "The female, when about to lay her eggs, forces a hole in the ground by means of the two pairs of horny valves which open and shut at the tip of her abdomen, and which, from their peculiar structure, are admirably fitted for the purpose. With the valves closed she pushes the tips in the ground, and by a series of muscular efforts and the continued opening and shutting of the valves, she drills a hole until, in a few minutes (the time varying with the nature of the soil) the whole abdomen is buried, the tips reaching an inch or more below the surface by means of great distention. Now, with hind legs hoisted straight above the back and the shanks hugging more or less closely the thighs, she commences ovipositing, the eggs being voided in a pale, glistening and glutinous fluid which holds them together and binds them into a long, cylindrical pod, covered with particles of earth which adhere

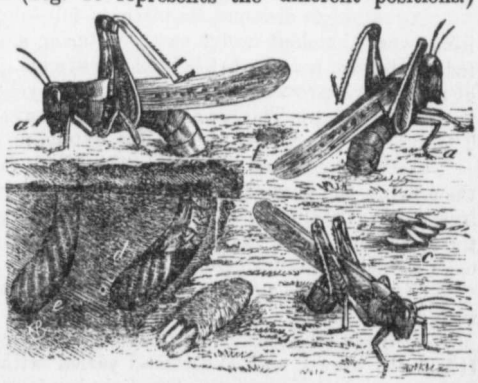

Fig. 19.

to it. When fresh the whole mass is soft and moist, but it soon acquires a firmer consistency. It is often as long as the abdomen, and usually lies in a curved or slanting position. The eggs which compose this mass are laid side by side to the number of from 30 to 100 according to the size of the mass."

Prof. Thomas states that he has obtained the eggs of *Caloptenus femur-rubrum* in rotten wood in which they were placed without any apparent regularity and without being connected by any glutinous secretion.

The sounds made by locusts are produced in two ways, first by rasping the hind thighs up and down on the wing-covers, and second by snapping together the edges of the w ngs and wing-covers during flight.

Our Canadian locusts fall into two sub-families, *Acridinæ* and *Tettiginæ*. To the first belong all those species in which the pronotum (upper surface of thorax) extends only to the base of the wing-covers. This group contains the greater number of our species. To the second belongs a small group of species in which the wing-covers are aborted, appearing as small pads, while the pronotum extends as far as, or past, the extremity of the abdomen.

As regards the time of appearance of our locusts, there is a succession of species from early spring until the fall. As soon as the snow has disappeared from the sunny slopes and grassy banks, several kinds of little locusts may be observed. These are the Grouse-locusts (*Tettix* and *Tettigidea*). They are compactly formed, the body being broadest between the middle pair of legs, tapering gradually to a point behind, the head is very small and the legs are rather short. As already stated, the wing-covers are merely little scales, the wings being folded beneath the extended thorax. The species are all small, measuring about half an inch in length. They pass through their transformations during the latter part of summer and fall, hybernating in the imago or perfect state.

About the end of May and during the month of June a species of locust may often be observed flying with a rustling sound. This is *Tragocephala infuscata*, Harr. There are two forms or varieties. The typical *infuscata* being dusky brown, the wing-covers faintly spotted with brown, wings transparent, pale greenish-yellow next the body, with a large dusky cloud near the hind margin, and a black line near the front margin ; length about three-quarters of an inch. The variety *viridi-fasciata* is almost wholly green and is slightly larger ; it has been described as a distinct species, but as it occurs in the same localities and at the same season it is probably merely a variety of the same species. They hybernate as larvæ, changing to pupæ early in spring, attaining the perfect state about the end of May and disappearing early in July. Dr. Harris states that they "are sometimes very troublesome in gardens, living upon the leaves of vegetables and flowers, and attacking the buds and half-expanded petals."

As *infuscata* dies out, its place is filled by swarms of *Camnula pellucida*, a small locust very abundant in dry pastures during midsummer. General colour ash-brown, face reddish brown, a dark spot behind the eye and just touching it, and another on the side of thorax, wing-covers brown, marked with yellow lines and dark spots, wings colourless, with black veins. The female measures about an inch in length, the male a little less. The flight of this species is noiseless, extending about thirty or forty feet.

During August and September the fields fairly swarm with locusts, prominent among them being the large species that fly with a crackling or snapping noise. Many of these insects have considerable command of themselves while on the wing, being able to change the direction of their flight at will. The wings are generally brightly colored, reminding us of the lepidopterous genus *Catocala*.

Œdipoda verruculata is ash-brown varied with dusky brown, wings yellow at base with a black band.

Œdipoda sordida flies with a rustling noise exactly like the species of *Tragocephala*. It is dusky brown, head and thorax varied with patches of lighter and darker shades, wing-covers dark brown with two light bands on the middle portion. Wings pale greenish yellow on the inner half, remainder smoky brown. *Œdipoda carolina* is our largest species, the female measuring from 1.5 to 1.75 inches. It is of a dull ash-brown colour, sprinkled with small dusky spots, wings deep black, except the margin, which is pale yellow. When alarmed it flies with a muffled, rustling noise.

Œdipoda phœnicoptera is light brown, spotted with dark brown on the wing-covers, wings coral red with a dusky border. This is a vernal species, flying with a loud, snapping noise as soon as the snow is off the ground.

b

FIG. 20.

Our most abundant and troublesome species in the older Provinces is the common red-legged locust, *Caloptenus femur-rubrum*, (Fig. 20), which, during some years, multiplies to such an extent as to seriously injure the hay and other crops.

The Entomologist to the Department of Agriculture in his report for 1885 quotes Mr. J. Scriver, M.P., as follows :—"Grasshoppers were numerous and very destructive in certain localities. In the month of August our pastures were swarming with them, and they afterwards attacked the oats also. They did much injury by biting off the separate flowers just as they came out of the sheath, sometimes destroying the whole panicle. Their ravages were most severe in the townships of Hemmingford and Havelock, and particularly in the parish of Lacolle, where one farmer had to cut down his oats and use them for fodder. The species referred to was the common red-legged locust, *Caloptenus femur-rubrum*."

During 1885 locusts were very numerous all through the country, and several milkmen told me that they had seriously injured their pastures. At Lachine I observed that in many places the shrubs and young trees growing by the fences were almost stripped of leaves by them, presenting a ragged appearance. The species that I found up in the shrubs were the red-legged locust, *Caloptenus femur-rubrum*, and the yellow striped locust, *Caloptenus femoratus*. The latter is a large, clumsy-looking species, easily recognized by having two yellow stripes running from the head to the end of the wing-covers. It is a common species and very troublesome in gardens.

The destructive Rocky Mountain locust, *Caloptenus spretus*, Uhler, (Fig. 21), is almost identical with our commonest red-legged species, but has longer wings, and in the male the end of the abdomen is turned up like the prow of a ship. For a full account of this species, the reader is referred to the Rev. C. J. S. Bethune's valuable paper in the Society's Reports for 1874-75. By the middle of October nearly all our locusts have disappeared, but a few specimens of *Caloptenus* and *Stenobothrus* linger until the autumnal frosts put an end to their existence.

a

FIG. 21.

The ravages of our common locusts might be greatly lessened by beating them with bundles of brush, and thus driving them into hollows or against fences. When thus congregated, they could be killed by beating them with shovels or by gathering into sacks and boiling down for hogs. The best time for this work would be the end of June and beginning of July, as at this time our most injurious kinds have not acquired wings, moreover, they are now mostly in the pastures and can be destroyed without injuring the standing crops. Dr. Harris states that in the south of France "the locusts are taken by means of a piece of stout cloth, carried by four persons, two of whom draw it rapidly along, so that the edge may sweep over the surface of the soil, and the two others hold up the cloth behind at an angle of forty-five degrees. This contrivance seems to operate somewhat like a horse-rake, in gathering the insects into windrows or heaps, from which they are speedily transferred to large sacks."

FAMILY 4.—PHASMIDÆ, (WALKING-STICKS OR SPECTRES).

This family is represented in Canada by only one species, the well-known Walking-stick insect, *Diapheromera femoratum*, Say.

This curious creature is entirely wingless, and looks very like a small twig. It lives almost altogether on trees, on the leaves of which it feeds, being found most frequently on oak and basswood. According to Packard, the egg-sac is flattened, elliptical, with a lid in front which can be pushed open by the embryo when about to hatch, and is deposited in the autumn. With us it is seldom numerous, but some few years ago it

increased enormously in parts of New Jersey, New York and Maine, stripping acres of trees, leaving them as bare as in midwinter, and congregating in heaps by the fences, showing that what is usually a scarce and harmless insect may, under favourable conditions, increase to such an extent as to be seriously injurious.

Family 5.—Blattidæ, (Cockroaches).

Cockroaches are flattened, ovate insects, generally of a dull brown colour, and have an oily and disagreeable smell. They run swiftly, but do not jump like the crickets and locusts. The eggs are laid in a bean-shaped capsule, divided into two compartments, each containing a row of separate chambers, each of which encloses an egg. Some days are required for oviposition, and the female may be seen running about with the egg-case partially protruding from the body. The egg-case is dropped at random, the female not depositing or concealing it in any particular place or manner.

Cockroaches are omnivorous insects, feeding on almost everything eatable, whether animal or vegetable, some species being great pests in houses. The kinds found in our dwellings have been carried here in shipping, and are now common in almost every part of the world.

The large black species so familiar to housewives, under the name of "The Black Beetle," is the *Blatta (Stylophyga) orientalis*, Linn. As the name implies, it is an eastern species, brought to us by commerce. During summer it sometimes takes up temporary quarters in the open air, as I once found a flourishing colony under some stones in a lane in the rear of a bakehouse.

The other important species is the small reddish-brown cockroach, *Ectobia Germanica*, commonly known in the New England States as the "Croton Bug." It infests houses, and is even more troublesome than the large species, making itself at home in wooden partitions and cracks in furniture, soon becoming unpleasantly numerous. It is not so strictly nocturnal in its habits as the large species, and may often be seen on a voyage of discovery in broad daylight.

Our native species live under stones and beneath the loose bark of dead trees, and appear to be rare insects.

Family 6.—Forficulidæ, (Earwigs).

Earwigs may be distinguished from all other Orthoptera, by their narrow, flattened body and short wing covers, and by the extremity of the abdomen being furnished with a forceps, which in some species equals the body in length.

This instrument appears to be used for several purposes. Westwood says "they are weapons of offence and defence." De Geer states "that they are used during sexual intercourse." The Rev. J. G. Wood says "the membranous wings of the earwig are truly beautiful. They are thin and delicate to a degree, very large and rounded, and during the day-time packed in the most admirable manner under the little square elytra. The process of packing is very beautiful, being greatly assisted by the forceps on the tail, which are directed by the creature with wonderful precision, and used as deftly as if they were fingers and directed by eyes."

Dr. John G. Morris's experience does not agree with the Rev. Mr. Wood's account. He says, "last summer I had a good opportunity of observing the habits of this insect, for every night numbers of them came into my study window in the country, and lighted very conveniently upon the table at which I was writing. Each one of them, before he took flight, for they were active, would bend his body back and lift up the short elytra with his forceps before the wings would expand, and this they did invariably. The forceps were not used to fold the semi-circular wings, but only to elevate the wing-covers before flying."

These accounts may perhaps be reconciled upon the assumption that the forceps is not used for the same purpose by every species. The smaller species of *Staphylinidæ*, for which a small earwig would be easily mistaken while on the wing, may very often be

observed tucking in their wings with the aid of the long flexible abdomen, but I do not remember ever seeing the larger species doing so.

The female earwig is remarkable for the care with which she watches over her eggs and young, sitting upon them like a brooding hen, a fact vouched for by Kirby and other eminent entomologists.

During the day, earwigs generally hide in holes and crevices, often concealing themselves among the petals of flowers, the long spur of the nasturtium being a favourite place of refuge. A few of the smallar species are active during the day, flying about in the sunshine. Earwigs feed on vegetable matter, and in Europe, where they are numerous, often do much damage by eating the blossoms of carnations, dahlias, etc. In this country they appear to be rare insects, only one species being recorded from Canada, the *Labia minor* of Linnæus, common to both Europe and America.

So far as known to me, none of the Orthoptera occurring in Canada are double-brooded, with perhaps the exception of *Gryllus*, and of course, those species which infest houses. Of *Gryllus*, some individuals at least, go through their transformations in spring, appearing as larvæ in April, and being in full song by the end of May. The species of *Tragocephala*, which go through their transformations at the same time, are all dead by the end of July, and during this month the crickets if not dead are nearly, if not altogether silent, but in August appear again, and in much greater numbers, while *Tragocephala* is not seen until the return of spring.

With regard to the species found in houses, winter is unknown to them, the result being a constant succession of broods, which accounts for the short time required for stocking a kitchen with cockroaches.

PRELIMINARY LIST OF CANADIAN ORTHOPTERA.

GRYLLIDÆ.

Gryllotalpa borealis, Burm.—Very rare. A pair taken in Essex County, Ont.—Brodie.

Gryllus luctuosus, Serv.—Rare. Two females in August; Montreal.—Caulfield.

Gryllus neglectus, Scudder.—Province of Quebec, very common—Provancher; Montreal, abundant—Caulfield; Toronto, very abundant—Brodie.

Gryllus domesticus, Oliv.—Quebec, common — Provancher; Montreal, common—Caulfield; Ottawa, rare—Fletcher; Toronto, rare—Brodie.

Nemobius vittatus, Harris.—Quebec, common — Provancher; Montreal, common—Caulfield; Ottawa—Fletcher; Toronto, common—Brodie.

Nemobius fasciatus, De Geer.—Quebec, Provancher; Montreal, not common—Caulfield; Ottawa—Fletcher; Toronto—Brodie.

Nemobius (*Anexipha*) *septentrionalis*, Scudder.—Quebec, one specimen—Provancher; Rat Portage—Brodie.

Œcanthus niveus, Serv.—West Farnham, P.Q.—Provancher; St. Hyacinthe, P.Q.—Provancher; Montreal, abundant—Caulfield; Ottawa—Harrington; Toronto—Brodie; London—Saunders. Ent. Reports.

LOCUSTIDÆ.

Ceuthophilus maculatus, Harris.—Anticosti—Verrill; Quebec, common—Provancher; Montreal, common—Caulfield; Ottawa, common—Fletcher; Ontario, generally to north of Lake Superior—Brodie.

Udeopsylla nigra, Scudder.—Common in Manitoba—Scudder and Brodie.

Phaneroptera curvicauda, De Geer.—Province of Quebec, common in August and September—Provancher; Montreal, common—Caulfield; Ottawa, common—Fletcher; Toronto, common in Ontario generally, to north of Lake Superior—Brodie; Red River

Settlements—Scudder; a male, Rosseau River, August 30th, and a female in the vicinity of Souris River—G. M. Dawson.

Phylloptera (*Amblycorypha*) *oblongifolia*, De Geer. — Montreal, rare — Caulfield; Ottawa, common—Fletcher; Toronto, common, and Ontario generally, to north of Lake Superior—Brodie; Regina, N.W.T., one specimen—Fletcher.

Platyphyllum concavum, Harris.—London, taken at electric light—W. E. Saunders.

Conocephalus ensiger, Harris.—Toronto, common—Brodie; London—L. Reed.

Xiphidium fasciatum, De Geer.—Province of Quebec, common—Provancher; Montreal, common—Caulfield; Ottawa, very common — Fletcher; Toronto, common, and Ontario generally, to north of Lake Superior—Brodie; Var. *brevipennis*—Scudder, common in same localities.

Xiphidium saltans, Scudder.—Souris River—G. M. Dawson.

Orchelimum vulgare, Harris.—Toronto, common; Ontario everywhere—Brodie.

Orchelimum agile, De Geer.—Montreal, common—Caulfield; Ottawa, rather uncommon—Fletcher; Toronto—common; Ontario generally, to north of Lake Superior—Brodie.

Anabrus purpurascens, Uhl.—Common on the prairies around Regina—Fletcher; West Butte, July 29th; in the vicinity of Woody Mountain, between June 15 and July 7th, and in the neighbourhood of Souris River—G. M. Dawson.

Acrididæ.

Chloëaltis conspersa, Harris.—Rat Portage, Man.—Brodie; eastern shore of Lake Winnipeg, five specimens—Scudder; Nepigon—Fletcher.

Chloëaltis (*Amblytropidia*) *subhyalina*, Scudder.—Province of Quebec—Provancher.

Stenobothrus curtipennis, Harris—Quebec—Provancher; Montreal, common—Caulfield; Ottawa—Harrington; Ontario generally, to north of Lake Superior.—Brodie.

Stenobothrus propinquans, Scudder.—Cap Rouge, Quebec—Provancher.

Arcyptera lineata, Scudder.—Province of Quebec—Provancher.

Gomphocerus brunneus, Thomas.—Regina, August 12th, 1887—Fletcher.

Gomphocerus clepsydra, Scudder.—Souris River—G. M. Dawson.

Tragocephala infuscata, Harris.—Quebec, common—Provancher; Montreal, common—Caulfied; Ottawa, uncommon—Fletcher; Ontario, generally to north of Lake Superior—Brodie.

Tragocephala Var. *viridifasciata*, Harr.—Same distribution.

Arphia sulphurea, Fabr.—Quebec, very rare—Provancher; Ottawa, common—Fletcher; Toronto, common, and Ontario generally, on sand hills—Brodie.

Arphia tenebrosa, Scudder.—Sudbury, Ont., Regina and Nepigon—Fletcher; Souris—G. M. Dawson.

Arphia sanguinaria?—Regina, August—Fletcher.

Arphia frigida, Scudder.—Taken near Wood End in June—G. M. Dawson.

Arphia trifasciata, Say.—Wood End in June—G. M. Dawson.

Spharagemon collaris, Scudder.—Regina, abundant, August, 1886—Fletcher.

Spharagemon æqualis, Say.—Red River settlements—Scudder.

Trimerotropis verruculata, Kirby.—Quebec, common—Provancher; Montreal, common—Caulfield; Ottawa—Fletcher.

Encoptolophus sordidus, Burm.—Quebec, very common—Provancher; Montreal, common—Caulfield.

Dissosteira carolina, Linn.—Quebec—Provancher; Montreal, common; Ontario, generally to Lake Superior—Brodie; Vancouver Island—Packard.

Hippiscus phœnicoptera, Germ.—Quebec, common—Provancher; Montreal, rare—Caulfield; Toronto, rare—Brodie; Nepigon, common, July 7th, 1887—Fletcher; Dufferin, June 13th and 14th—G. M. Dawson.

Camnula pellucida, Scudder.—Province of Quebec—Provancher; Montreal, common—Caulfield; Regina, Fletcher.

Camnula atrox, Scudder.—Regina, August—Fletcher; Victoria, Vancouver Island—Packard. (Surely a variety of the preceding.)

Pezotettix borealis, Scudder.—A single pair, vicinity of Lake of the Woods—G. M. Dawson.

Pezotettix Dawsonii, Scudder.—Souris River—G. M. Dawson.

Pezotettix septentrionalis, Sauss.—Labrador—Saussure.

Melanoplus repletus, Walk.—Vancouver Island—Walk.

Melanoplus scriptus, Walk—Vancouver Island—Walk.

Melanoplus bilituratus, Walk.—Souris River—G. M. Dawson; Vancouver Island—Walk.

Melanoplus femur-rubrum, Burm.—Quebec—Provancher; Montreal, common—Caulfield; Ottawa—Harrington; Ontario, generally to north of Lake Superior—Brodie.

Melanoplus atlantis, Riley.—Quebec—Provancher; Ottawa—Fletcher.

Melanoplus spretus, Uhler.—Dufferin, Souris River, vicinity of the Lake of the Woods, and the east fork of Milk River—G. M. Dawson.

Melanoplus parvus, Prov.—Cap Rouge, Quebec—Provancher.

Melanoplus femoratus, Burm.—Quebec—Provancher; Montreal—Caulfield; Ontario, everywhere—Brodie; Lake of the Woods—G. M. Dawson; Regina—Fletcher.

Melanoplus Packardii.—Regina, one specimen—Fletcher.

Melanoplus infantilis.—Regina—Fletcher.

Melanoplus extremus, Walk.—Arctic America—Walk.

Melanoplus fasciatus, Walk.—St. Martin's Falls, Albany River, Hudson Bay—Walker.

Melanoplus arcticus, Walk.—Arctic America—Walk.

Melanoplus borealis, Feiber.—Labrador—Feiber.

Acridium appendiculum, Uhler.—Quebec—Provancher.

Tettix granulata, Kirby.—Quebec—Provancher; Montreal, common—Caulfield; Ottawa—Harrington; Ontario, generally to Lake Superior—Brodie; Arctic America—Kirby; Vancouver Island—Packard.

Tettix ornata, Say.—Quebec, common—Provancher; Ontario generally, rare—Brodie.

Tettix cucullata, Scudder.—Toronto, common; Ontario generally, rare—Brodie.

Tettix triangularis, Scudder.—Quebec, rare—Provancher; Montreal, rare—Caulfield; Ottawa—Harrington; Ontario, generally to Lake Superior—Brodie.

Tettix rugosa, Scudder.—Sudbury, Ont.—Fletcher.

Tettigidea lateralis, Say.—Quebec—Provancher; Montreal—Caulfield; Ottawa—Harrington; Ontario, generally to Lake Superior—Brodie.

Tettigidea polymorpha, Burm.—Common in same localities as preceding species.

Tettigidea acadica, Scudder.—Lake of the Woods—G. M. Dawson.

Batrachidea cristata, Harris.—Toronto, rare—Brodie.

Phasmidæ.

Diapheromera femoratum, Say.—Montreal, not uncommon—Caulfield; Ottawa—Fletcher, Harrington; rare in Hickory Woods; Kingston—Rodgers; Ontario generally—Brodie; Red River settlements—Scudder.

Blattidæ.

Stylophyga orientalis, Linn.—Quebec—Provancher; Montreal, common—Caulfield; Toronto—Brodie.

Ectobia Germanica, Stephens.—Chaudiere curve, Quebec—Fyles; Montreal, common—Caulfield; Toronto—Brodie.

Ectobia lithophila, Harris.—Welland and westward—Brodie.

Periplaneta Americana, Linn.—Essex County, Ont.—Brodie.

Ischnoptera Pennsylvanica, De Geer.—Montreal, one specimen; Abbotsford, P.Q., three specimens under bark of stumps—Caulfield.

Temnopteryx marginata.—Montreal, two specimens under bark of dead tree—Caulfield.

FORFICULIDÆ.

Labia minor, Linn.—Cap Rouge and Port Neuf, three specimens—Provancher; Montreal, one specimen at light—Caulfield; Ottawa, one specimen—Harrington; three specimens at light,—Fletcher.

A CHAPTER ON THE STRUCTURE OF BUTTERFLIES AND MOTHS.

BY A. R. GROTE, A.M.

The Lepidoptera, or Butterflies and Moths, form a natural suborder of six-footed insects (*Insecta hexapoda*), characterized by possessing (save in the case of a few species of moths in which the females are wingless or have the wings aborted), two pair of membranous wings, attached to the sides of the thorax and covered, usually completely, sometimes only partially with scales of various shapes, overlapping each other somewhat

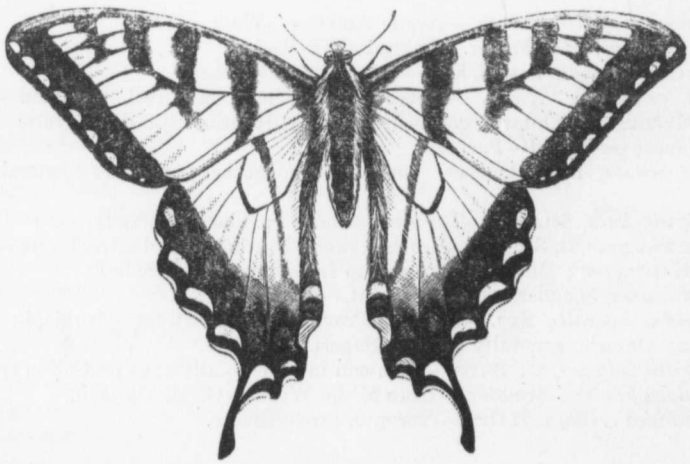

FIG. 22.

like shingles on a roof. The body consists of chitinous or horny rings and is divided into three principal parts by deeper and wider sutures: head in which the rings have become fused, thorax and abdomen in which they are distinct. As we now find them the *Lepidoptera* fall into two principal divisions, the one the true butterflies (*Rhopalocera*), Fig. 22., which fly by day, the other, the moths (*Heterocera*), Fig. 23, which fly chiefly by night. In addition to the scaly wings, the two divisions or groups have several characteristics in common which divide them from other insects. In their younger stages they appear as caterpillars, Fig. 25, having three pair of true or jointed thoracic legs, and this seems to be invariable except in one or two genera of minute leaf-mining moths. In addition they have between 2 and 5 pair of fleshy abdominal or false feet, unjointed and discarded in the pupal and perfect stages. A few genera want these false feet and many have only two pair, so that in

FIG. 23.

crawling, they bend themselves in the shape of a loop or arch in bringing the false and true feet together, (Fig. 26). The silk spinning caterpillars often aid their progression by letting themselves drop from one branch of a tree to another by means of a thread spun from the mouth. The body of the caterpillar consists of a head, three thoracic segments and nine abdominal. Except in a very few cases, they feed on plants and bite

Fig. 26.

their food by means of two powerful mandibles or jaws, covering the opening of the mouth at the sides. The mouth is further protected above by two corneous pieces forming the upper lip which is used to hold the food fast. The substance forming the covering of the head is hard and horny and often darker coloured than the rest of the body, which is usually quite or almost naked, though frequently covered more or less completely with hair, and ornamented with wart-like tubercles, the hairs themselves being gathered into bunches of various lengths and colours, (Fig. 27). The caterpillars are most often of various shades of green and brown, like the leaves on which they feed and the earth into which many enter to form the pupa; but not a few are grayish, like the bark of the trees upon which they often crawl, while their colouring is almost always clearly protective and aids their concealment from their enemies. Not a few are internal feeders, living on the pith or wood, and these are maggotty in appearance, pale yellowish or flesh colour, with dark heads, thus resembling the larvæ of beetles which inhabit similar localities. A few are called "Sack-bearers" from their living in a portable case made of silk and twigs and bits of leaves, (Fig. 28). The caterpillars of the *Tineidæ* frequently form mines on the leaves, eating out the green and fleshy part of the leaf and leaving the transparent pellicle as a protection. The pupa or chrysalis of butterflies and moths is quiescent, covered with a horny skin, with the segments variously impressed or provided

Fig. 25.

Fig. 27.

with spines, and allowing the parts of the perfect insect to be perceived. In some kinds

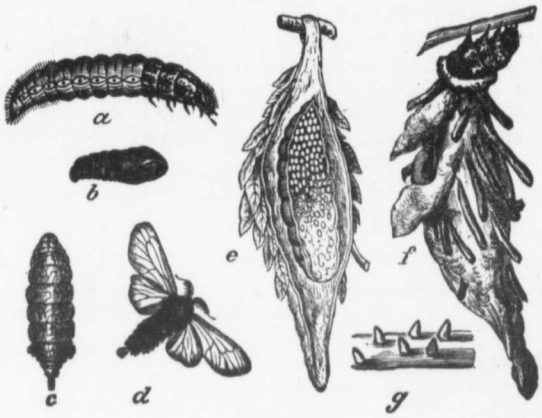

Fig. 28.

the abdomen is moveable and this character is oftenest seen in the moths, in which the chrysalis is mostly protected by a cocoon, (Fig. 29), of varying shape, thickness and construction. In the butterflies the chrysalis is

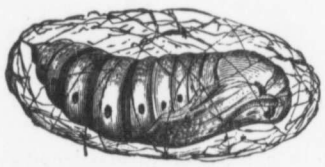

Fig. 29.

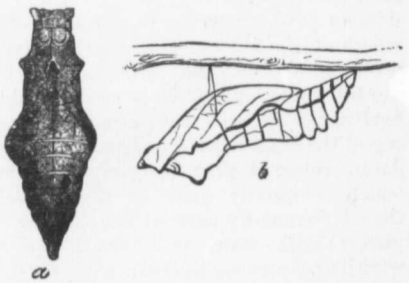

Fig. 30.

usually naked, (Fig. 30*a*), and variously fastened to some object, either hanging from a little button of silk head downward, (Fig. 31), or with the addition of a girdle, (Fig. 30*b*), when the position is reversed, while sometimes the caterpillar enters on its transformation without protection of any kind (Fig. 32), except what is adventitious and accidental upon the surface of the ground. The Hawk Moths or *Sphingidæ*, generally penetrate the earth itself, transforming into the pupa in a cell formed simply by the movement of the body packing the clay together. The wood-borers form a cocoon with the aid of bits of the wood itself variously and curiously wedged together. All these statements are made from my own observations.

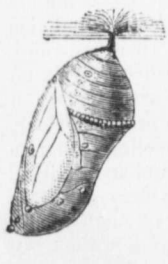

Fig. 31.

Fig. 32.

In the perfect state butterflies and moths agree in the coiled-up tongue, by means of which food is taken up in a liquid state by the insect. Many moths have the mouth

parts aborted, and consequently take no nourishment as perfect insects, their life being correspondingly brief. This spiral tongue consists of the elongated soldered maxillæ; the mandibles or jaws of the larva becoming rudimentary in the perfect state. The sub-equal wings consist of a membrane traversed by a simple system of nerves or veins, the neuration, covered with scales and fringed with hair. The thorax has a distinct portion in front, the collar (*collare*). The abdomen usually tapers posteriorly, in some females it appears blunt, being provided with heavy tufts, the hairs from which are used sometimes as a nesting for the eggs. As caterpillars, the Lepidoptera usually feed and grow, whereas as butterflies and moths they occupy their brief lives chiefly in propagating their kind, the sexes being separate and the females laying eggs, singly or in patches or clusters, from which again caterpillars emerge. To this latter there are a few exceptions. In the case of some Spinners and the Tineid genus *Solenobia*, a parthenogetic race has been observed, the virgin females laying eggs which produce only females, no males being hatched, the complete species is only produced by a union of the sexes. What are called "Hermaphrodites" are also sometimes found, in which, in one and the same individual, the two sexes are variably united, one side being more or less completely male, the other female. This is seen occasionally in the larger spinners, *Platysamia Cecropia* and *Callosamia Promethea*, when the division is clearly marked by the sexual differences in the antennæ and colour. Such specimens are abnormal productions and infertile, not true Hermaphrodites as the snails normally are. Bastards, resulting from the union of two species, occur, and have been noticed, especially in the hawk moths, but I have never seen an undoubted example of this kind myself. By confining the perfect insects, bastards have been artificially produced; in nature they seem to occur rarely. New species are probably never formed in this way of unnatural selection.

The three divisions of the lepidopterous body mark also a division of function. The *head* is provided with jointed appendages for the purpose of holding, biting and masticating the food, or sucking the same in the perfect state, and here the sense-organs, eyes, ocelli and antennæ are situated. The three-ringed *thorax* supports three pairs of slender legs and the wings—the organs of locomotion. The nine-ringed *abdomen* contains the digestive and reproductive parts; breathing or the aëration of the blood is accomplished by stigmata opening on the sides of the body, chiefly the abdomen. In the butterflies those forms are highest in rank in which the front pair of legs are useless for walking, being apparently taken out of the locomotive series, curiously shortened and elevated, and seem like an additional pair of palpi or head organs. The interesting details of the anatomy of the head by my kind friend, Mr. Edward Burgess, should be known by students.

For the essential characters separating the butterflies and moths, I refer more particularly to a paper of mine read before the American Association for the Advancement of Science in August, 1873, the gist of which I here reproduce with fuller statements. There is first to be noted the differences in the structure of the antennæ. These usually long, jointed, thread-like organs, situated on each side of the vertex, are quite uniform in shape throughout the butterflies, being more or less club-shaped or thickened at the tips. From this latter character the name *Rhopalocera* has been given to them by Dr. Boisduval. On the other hand, the moths have the antennæ of quite various shapes and length, usually showing some sexual difference in structure. The *position* of these organs in the two divisions exhibits a marked change. In the butterflies the antennæ are comparatively rigid and straight, and are directed upwards and forwards. In the moths the antennæ are flexible and held horizontally, being not unfrequently deflexed along the sides of the body in repose. The antennæ are apparently less used by the butterflies, which depend more on their sight during their diurnal activity. That they are the organs of smell and are probably also sensitive to vibrations of the air, has been suggested by experiments. The feathered antennæ of so many male moths seem to be sensitive to odours given out by the female. In this way the fact is accounted for, that male moths will come long distances to find unerringly specimens of the opposite sex. One needs only to expose a freshly-hatched female of our larger spinners, even in the heart of the city, to verify this statement. The moths, resting in the daytime, seem also to depend on their antennæ to warn

them of the approach of danger, as they are sensitive when touched, and the jarring of the surface on which the moth rests is probably first communicated to the antennæ, which lie parallel with the plane of repose. The wings are deflexed in the majority of the moths (Fig. 33) when in repose, and clapped together and held upright in the butterflies. In the *Hesperidæ*, the lowest butterflies, the front pair of wings are often alone elevated when the insect is sitting or walking, the hind pair being flatly extended as in many moths, particularly the Spanners. Certain moths sometimes elevate the wings when resting as the larger Bombyces, and many *Geometridæ* do the same when walking. The butterflies want the frenulum, or bristle and hook, which connect the front and hind wings in the majority of moths, and hold them together when flying. As a whole, the nervures are stouter and the wings perhaps stronger in the butterflies. The hawk moths have the wings, however, very strongly built, narrow and with thick ribs; their flight is correspondingly rapid and extended. The body is more thinly scaled in the butterflies, becoming more hairy and tufted in the moths, in which the total vestiture is looser and longer, more downy and somewhat easier abraded. In the butterflies the scales are more complicated in structure and the wings themselves are, on the whole, more equal-sized and with shorter fringes. The legs of the moths are, as a rule, stronger, being often curiously armed and spined. Dr. Boisduval called the moths *Heterocera*, or diversely-horned, in contradistinction to the butterflies, and these terms probably signalize an important difference or degree in the use of the antennæ in the two divisions of Lepidoptera.

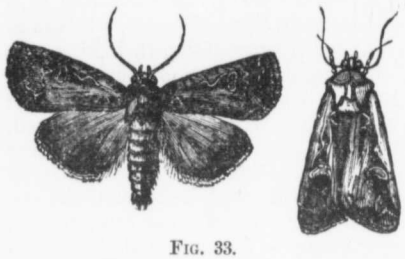

Fig. 33.

The writings of Mr. S. H. Scudder afford us some insight into the ancestry of existing Lepidoptera. In particular, he has called attention to the fact that all the diverse patterns which adorn the wings have originated from shaded bands or lines which run parallel with the outer margin, and have become broken up into spots of such varied form as to make it strange that they should have come from so simple an element. (Fig. 34.)

Fig. 34.

It is evident, however, that this is the correct view. I had previously shown that the ringed spots of the wing in the *Noctuidæ* originated from loopings of the usual transverse lines. There seems to be a correlation between the length of tongue in the Lepidoptera and the corolla of flowers. It is probable that the butterflies came in with the flowering plants and that they were preceded in point of time by moths which had short maxillæ and simply hairy, unscaled wings, unicolorous or faintly banded, and having their parentage in the ancient Neuroptera or dragonflies. These may have had aquatic larvæ and less complete transformations, active in the darkness; living, indeed, at an epoch when the light of the sun was less potent at the surface of the earth than it is at the present day.

A study of the *head* of the perfect moth shows that it is composed of several distinct chitinous pieces protecting the nervous ganglia, and covering the mouth parts which are only fitted to take in liquid food. At the base of the spiral tongue (*spirilingua*) are placed the jointed *maxillary palpi*, (Fig. 35) but these are often, perhaps usually obsolete; they are well developed in the snout moths or *Pyralidæ*, and especially in certain *Tineidæ*. On the other hand all moths possess one pair of *labial palpi*, jointed appendanges, analogous to the legs in ultimate structure and articulated to the lower lip or labium. The space between the eyes is called the *front* or *clypeus*, and this piece varies in comparative shape and size in the different families, and often affords peculiar structure offering generic characters. In the genus *Eudryas*, for example, (Fig. 36) it is smooth, and in the related genus *Copidryas* it is provided with a clypeal horn. The compound eyes vary in shape and external appearance. They are sometimes constricted, as in certain Heliothid genera in the Owlet moths. Again the surface, usually naked, is covered with short hairs arising from the angles of the facets apparently, and only to be properly observed under the microscope. Behind the eyes the small ocelli, or simple eyes, are to be found; these are never more than two in number, and are sometimes wanting, as in the genus *Brephos*. The *antennæ*, or "feelers," are situated on the top of the head on each side, and spring out between the vertex and epicranium. The basal joint is often thickened and longer than the rest. Up to 100 joints have been counted in the antennæ of some moths. They vary much in ultimate structure and exhibit sexual peculiarities,

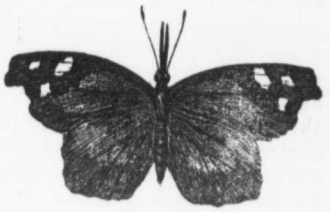

Fig. 35.

Fig. 36.

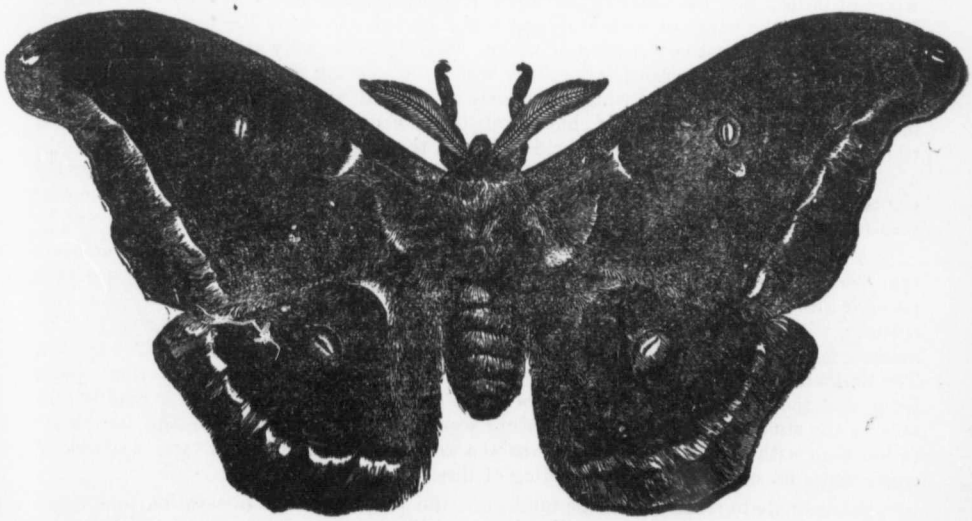

Fig. 37.

being more prominent in the males, feathered, pectinated or ornamented with nodosities. The extremes in total length are apparently afforded by the genera *Adela*, where they are longest and *Hepialus* where they are shortest. They are broadest and most plumose in the genus *Attacus* (Fig. 37.) The average aspect of these organs in the moths may be

found in the *Noctuidæ* where they are bristled beneath, scaled above, and about two-thirds the length of the fore wings.

The thorax supports the organs of locomotion, the legs and wings. The former are six in number and consist of five joints. They are attached to the thorax by the basal joint or *coxa*, and there is a small piece, the *trochanter*, between this and the *femur*, which is stouter than the following *tibia*, the leg terminating in jointed toes or *tarsi*. The *tibiæ* are often armed with spines or prickles, while the fore pair terminate sometimes in claws at the sides. In addition the middle and hind legs bear a pair of *spurs*. When the thorax is denuded of its vestiture it is seen to consist of three principal divisions, *prothorax*, *mesothorax* and *metathorax*, of which the middle piece is the largest. The wings are four in number, and are attached usually in the moths by a bristle and hook; the former is divided in the females and simple in the males, and is situated on the hind wings beneath near the upper edge of the wing; the bristle fits into a sort of socket on the under surface of the fore wings near the base. This character is wanting in the butterflies and in some moths, and seems to be an aid in keeping the wings together when flying. According to the system originally proposed by Dr. Herrich-Schaeffer, the ribs or nervures of the wing are numbered from one on, commencing on the inner margin of each wing. The marginal nervure is wanting, and the subcostal and median nervures form a median cell and branch out into secondary veinlets thrown on the costa and external margin. An accessory cell is sometimes formed beyond the median cell, but the median cell is often open, and there are, as a rule, no cross veins on the wing. The submedian vein or nervure is usually simple. The interspaces between the nervures are also indicated in descriptions so that the markings may be more accurately located. The fore wings are, according to this system, 9 to 12 veined, the number depending on the secondary veins which afford generic characters. The hind wings are similar in structure to the fore wings. They also vary in the number of secondary veins, of which there are usually 7 to 8. These veins are in reality hollow rods through which, when the insect escapes from the chrysalis, air and blood are forced by an action of the muscles of the thorax. They finally become dry and rigid. The wings in insects are thus not analogous to the wings of birds; they are outgrowths of the tracheal system and have only a common function with the wings of vertebrate animals. In order to study the neuration of Lepidoptera the wing must be denuded of scales. This is most easily accomplished by a process invented by Mr. George Dimmock by which the coloring matter is removed from the scales. For this process the wing, previously moistened with ether to remove all fatty matter, is placed in a solution of chloride of lime. From this it may be transferred from time to time to a weak solution of acid to hasten the action of the lime water which, in a short time, decolorizes the scales, rendering them entirely transparent and allowing the course of the veins to be exactly made out. Wings prepared in this manner may be transferred to glass slides and mounted for the microscope.

A study of the wings and external parts of the Lepidoptera leads to the conclusion that the genera are founded on comparative characters. Rarely does the presence of a peculiar structure of some of the organs give a strong character to the genus. The conclusions, with regard to classification, to which I have arrived are, that the generic characters must be dealt with in principle as are those separating the individuals into species. The limits of the genera depend on the want of intermediate forms, the important point being that the combination of characters which constitute the genus shall be readily seizable by the student and verifiable. Nature seems to be concerned with the individual rather than with our divisions, which are to a certain extent arbitrary and matters of convenience for our better understanding of these organisms.

Subordinate to structure in the moths are the pattern of ornamentation and coloration. The former is of the most value in associating species, although the latter is very characteristic in the different groups. In the butterflies we see for instance that the *Satyridæ*, or Meadow Browns, are of a dusky gray or blackish brown color, shading to reddish or yellow, while the wings are usually ornamented with eye-like spots. The *Pieridæ* are usually white, yellow or orange of various shades with black margin to the

wings (Fig. 38 *Pieris protodice*, male; Fig. 39, female); the *Papilionidæ* (Fig. 40) are also oftenest black and yellow and adorned with stripes. (See Fig. 22.) The *Hesperidæ*

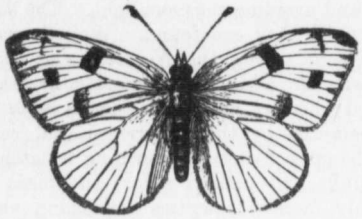

Fig. 38.

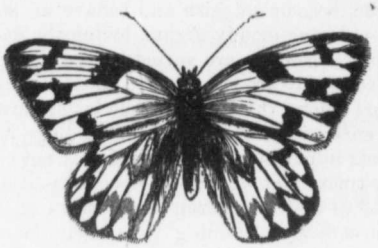

Fig. 39.

are dark yellow and brown, the brighter ground color broken into blotches. In the moths the spinners (Fig. 41) are usually of rich and bright reds and yellows, with transverse bands of darker shades; while the Owlet moths (Fig. 42) are oftenest of obscure

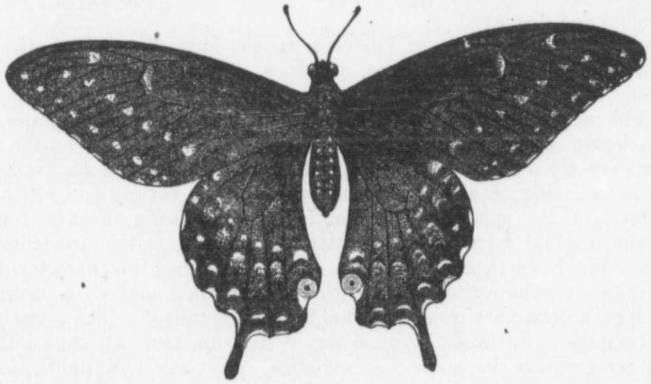

Fig. 40.

tints, certain groups which frequent flowers being brighter colored. In fact the colours of butterflies and moths alike seem to be protective and also dependent on the environment of the species; they have all gradually grown to be what they are to-day, from the total

Fig. 41.

Fig. 42.

effect of the environment upon the species, and interesting facts are being worked out by naturalists from time to time all bearing upon the great question of the derivation and descent of the Lepidoptera. The interaction of flowers and insects forms a fascinating chapter of modern science.

The habits of butterflies and moths can be best observed in a vivarium, their quick flight rendering them difficult objects for free observation, but their lives are so short and

simple that beyond the observations of their various attitudes and the way in which they lay their eggs and provide for their young there is not much to be said about them. The sun is the powerful motor for the butterflies, which, during very dark days or during an eclipse, become sluggish and behave as at nightfall. The moths, per contra, are most active during cloudy nights, loving the darkness and avoiding the moonlight. The habits of the caterpillars are varied by the situation in which they are found. Well deserving of close study are the aquatic larvæ of *Arzama*, *Sphida* among the *Noctuidæ* and *Hydrocampa* among the Pyralids, the latter furnished with thread-like gills for water breathing. The enthusiasm with which entomology is pursued when we are young carries with it a success in our observations which is not counterbalanced by the experience that comes with time. *Quant 'e bella giovinezza*—Lured to be up at five in the morning to catch the moths in their first sleep in the dawn on tree trunks and palings before the birds had disturbed them, finding thus early many freshly disclosed rarities and being amply rewarded for my rising. Caterpillars are also easier found at dawn, before or soon after sunrise. Everything that is beautiful passes with youth, before we have learned to remember, and our experiences are all new and unblunted.

The necessity of exercising our discriminative faculties makes the study of the habits and structure of these insects a useful one to the mind by enlarging its faculties and, if properly guided, helps one to a kindly philosophy and the enjoyment of unselfish pleasures. But entomology, like every other pursuit, is only the frame upon which our moral character is extended and displayed.

Most interesting is the study of *Variation* in the butterflies and moths. We have first to consider the seasonal varieties, where a difference in the different, spring, summer, broods is shown. Then the sexual varieties, peculiar to one sex, as in *Ennomos alniaria*, where, according to Dr. Packard, we have two kinds of males, etc. Then dimorphic varieties, as for instance *Hemaris uniformis*, which is, on the authority of Mr. Hulst, apparently a constantly recurring form in both sexes of *H. Thysbe*. It is not always possible to decide of any two forms which is the variety and which the parent, or original form of the species. The practice of considering the first form that was described as the original form and the latter the variety, is too unscientific to merit consideration. We have then *Aberrations*, mostly individual in character, in which by suffusion of color, or substitution of one tint for another, also by a change from the normal markings, a departure from the usual form is signalized. The cause of variation is evidently complex. Edwards, Dorfmeister, Weismann, have all shown the influence of cold and temperature in producing varieties. Warmth and light, the geological formation, food-plants, in fact, all the physical environments are, in truth, the factors, but it is not always easy to say which is the determining force. While varieties are considered to be nascent species it is probable that this is only relatively true and that a species may produce, under certain conditions, a variety which has insufficient character to become a species. Light and heat are supposed to produce brighter colours. Natural selection fixes the specific character, hardening it into constancy. The butterflies are gaudier than the moths and most brilliant at the Tropics. The day-flying moths are higher colored, as a rule, than the strictly nocturnal species, which are as dusky as the night during which they range. An objection to this is, that the circumstances under which the caterpillar exists can alone be determining upon the colours of the moth. It is thought that the food-plant influences colour, and that the pigments are made by the chemical processes within the body itself. But the colours of the moth are also directly affected, as I have long shown. I am inclined to believe that the moths are a survival of the oldest form of the Lepidoptera. That their colours are inherited, and that formerly all the Lepidoptera were dusky and active in the night or when, during the whole twenty-four hours, the light was less powerful on the surface of the globe than it is now. The influence of the surroundings of a moth upon its color may be witnessed in the case of *Hemileuca tricolor*, a pallid, desert-inhabiting form of a black genus of Bombyces. This moth is, as I have shown, a true *Hemileuca*, differing only in colour from other species of the genus. I have alluded elsewhere to the method of variation by which the under surface of the wings in the moths which are concealed from the light are the least affected. The fact that the under surface of primaries often corresponds with upper

surface of secondaries, as if the pattern of one were photographed upon the other, is deserving of especial notice in this particular. All shadows are photographs which may deepen with time.

Among tropical butterflies *Mimicry*, as illustrated by Bates, Wallace, Fritz Müller, Darwin, plays an important part. The fact that certain species (*Ituna*, *Euplœa*) are protected by a peculiar smell from their natural enemies, seems to have induced a variation in other Lepidoptera not so protected, by which they approach in colour, pattern the protected species and are so preserved. But not only do the Lepidoptera mimic each other, but also other orders of insects and natural objects such as leaves and sticks, the bark of trees, etc. It may be assumed as a general principle that any variation in a direction which would protect the species would be preserved, although it is difficult to think out the steps in such a process. The fact that throughout nature form is conditioned by environment covers such general resemblances as caterpillars to stalks and butterflies to the leaves of plants. It is only when we take animals out of their usual surrounding that they afford contrasts and strike the eye. The resemblances of the *Sesiidæ*, or Clear Wings, to wasps has been often noted (Fig. 43). We have a species in our Fauna, *Sciapteron simulans*, in which this resemblance is carried to a startling extent. I was much struck by the way in which an Orthopterous insect, living on the leaves of garden Okra, which I observed near Savannah, copied the beetle *Tetracha Virginica*. A special enumeration of the cases of protective mimicry already well ascertained would alone fill a large volume.

FIG. 43.

The mass of living forms of butterflies and moths must be regarded as the descendants of original fewer and simple types. The probability that the Lepidoptera root in the *Neuroptera*, is assisted by the known transformation of the mouth parts and the survival of genera with decidedly neuropterous habit, structure, form. Fritz Müller, whose researches are worthy of our most sincere admiration, has traced the resemblances between the *Phryganidæ* and the *Lepidoptera*. Speyer considers the *Psychidæ* and *Tineidæ* the nearest to the *Neuroptera*, and Packard's early studies on the structure of the thorax in *Hepialus* have shown how near existing types of these two suborders of insects approach each other. No doubt in *Hepialus* and *Cossus* we have ancient types surviving; many years ago I read a paper trying to show that our primitive *Lepidoptera* had aquatic larvæ (like *Arzama* yet retains), and less perfect transformations. I differ with Butler as to *Cossus*, not being able to consider it structurally as allied either to *Castnia* or *Sphinx*, but as more directly representing a low or old type from which the spinners were, later on, derived. An outgrowth of a primitive unsightly structure, the Lepidoptera now fill the world with beauty and add to the pleasures of mankind. Life, always transforming itself, perishing to appear in new shapes, is the *perpetuum mobile* of the universe. It is certainly not to be proved that this will ever disappear if we leave out of sight the speculations as to the extinguishing of the sun, which are perhaps more curious than probable. It is a condition of our minds that we imagine a necessary end to all things. Nature, in fact, ends every instant only to transform—bearing children and devouring them. It is our poetical idealization of Nature which makes life supportable to thinking minds. We answer the unanswerable questions, whence, whither, wherefore, of our existence by a poetical apotheosis, or a scheme of usefulness. But when we lay these toys of the mind aside, the misery and faithlessness is only too real. To perish, and to perish in such company! Nor does the materialistic selfishness and insincerity of the present century console us! At a time when more than ever the principles of Christianity are needed, Christianity is going out. Almost do we prefer the intellectual swindle of the last century to what we now suffer. Money rules the world, and the commercial balance sheet is waited for; not the spring and the new year. Everybody asks me, Does your Entomology, your Art, pay? How much do you get by it? I have even been suspected of using it merely to make money by it, which, in one sense, complimented me. But

mainly those who deal in humbug, claptrap, and lies, make money, in Entomology as in other things. If you are poor and have only your good reputation, it is a proof that you have kept yourself reasonably unspotted from a world of deceit and fraud, a world which, in the past at least, has rewarded the betrayer, the successful perjurer, and martyred every human heart that beat for it, ridiculed and oppressed every intellect that opposed reason to its unreason and folly. In every circle of society and activity, the same story of suffering and wrong is wearisomely repeated. Still, hope remains behind and has not flown even out of our Entomological boxes. Thus I wander from my subject, I hope not altogether aimlessly.

The relationship between the butterflies and moths and the flora of any region is so intimate a one, that a word may be said in closing this chapter upon the structure of the larvæ which feed mostly upon plants. The mandibles or jaws of the caterpillars are very powerful machines for biting the food transversely. Especially are the muscles attached to the jaws developed in the *Sesiidæ* and wood-feeding Bombyces and Noctuids. The pith of currant bushes and elder is fed upon by several caterpillars, and these internal feeders look like the larvæ of beetles, but may be distinguished among other characters by their abdominal feet. The *Cossinæ* feed internally on poplar, willow, oak and locust, and prodigious strength is required to tunnel these hard wooded trees. The way in which the cocoon of Bailey's goat moth (*Cossus Centerensis*) is formed out of splinters of the wood has been interestingly described by Dr. Bailey, and at first sight it is wonderful how the moth forces itself through the end of the cocoon, which seems to have no, or little, silk, and finds the open air. That it is through mechanical means that all cocoon makers escape, seems probable, and in *Telea Polyphemus* a hooklet has been discovered at the base of forewings used in cutting or tearing the silk. The "secretive fluid" theory seems to be now rejected. I have never seen any "secretive fluid" escaping by the mouth and used to soften the threads. The cocoons are protective and probably bad conductors, thus ensuring the safety of the chrysalis during heavy frosts. The first chrysalids were probably formed under water, beneath stones or in the stems of water plants. That the silk is usually brown and resembles the bark of trees is owing to "protective" origin, while all cocoons soon "weather"; the rain and sun take out the bright surface lines and the cocoon soon comes to look more and more like the surface on which it is formed. The white patches on the cocoon of Platysamia Columbia look like the patches on the bark of the larch. The fields and woods conceal numbers of insects from predatory birds and animals, bringing a percentage through all dangers. The enemies of insects are so numerous that very slight changes, one must think, would act beneficially upon the preservation of the species. The woods, probably, are more protective than the fields, but the interior of woods seem also the most deserted by insects. The sunlight is probably beneficial, and forces the caterpillars and butterflies and moths into exposed conditions. The tendency to multiply excessively, which the Lepidoptera show, must be kept within bounds, or the balance of Nature would soon become seriously threatened. In every way the adaptation of the insect in its different stages to its total environment is very perceptible and interesting to study. I have shown that the caterpillars of certain Lepidoptera are very plainly independently influenced to variation, the perfect insects being much less affected. Larval variation has probably played the most important part in the formation of the species of *Datana*, etc. I have called such generic assemblages where the contained forms are very close, apparently just separating into "species" by the name "progenera." Throughout the life of the butterfly or moth modifying agencies are active and, though the frail individual easily perishes at the least unfriendly pressure, yet the species is none the less surely affected by a continued force applied in any given direction under natural conditions.

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