ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF THE

PROVINCE OF ONTARIO,

FOR THE YEAR

1879.

Printed by Order of the Legislative Assembly.

Toronto:
PRINTED BY C. BLACKETT ROBINSON, 5 JORDAN STREET.
1880.

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ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO,

FOR THE YEAR 1879.

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

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

BY

WILLIAM SAUNDERS,
President of the Entomological Society; Editor of the Canadian Entomologist, London.

JAMES FLETCHER,
Vice-President of the Entomological Society, Ottawa.

REV. C. J. S. BETHUNE, M.A.,
Head Master of Trinity College School, Port Hope.

G. J. BOWLES,
President of the Montreal Branch, Montreal.

W. H. HARRINGTON,
Ottawa.

AND

B. GOTT,
Arkona.

REPORT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO, FOR THE YEAR 1879.

To the Honourable the Commisioner of Agriculture:

SIR,—In accordance with the provisions of the Statute, I have the honour to submit for your consideration the Annual Report of the Entomological Society of Ontario

for the year 1879, in which is contained an account of our financial condition, the reports of the Council and of our several branches, also such papers from our members as we think most adapted to the wants of our agriculturists, and most likely to further the design of the Department in promoting the knowledge of practical Entomology.

The *Canadian Entomologist* has now completed its eleventh volume. Appearing as it does monthly, with an ever widening circle of influence, it cannot but have great and beneficial effects upon the agricultural interests of the Dominion, rendering by timely warning and advice, such information as has afforded much protection against the noxious insects that are ever invading our crops. It has been well supported by able contributions from our members and is favourably looked upon by its readers.

Were our funds sufficient we would gladly introduce a much greater number of appropriate cuts which would make our journal more acceptable and valuable to the community, as, with suitable illustrations, the articles it contains would be much more readily understood.

The annual meeting of the Society was held at Ottawa, at the time of the Dominion Exhibition, when the reports of the officers, duly audited, were presented and approved of, also officers for 1880 were elected. The Society's collection of insects was on exhibition there and was awarded the Dominion Gold Medal.

The articles contained in the report are, we trust, such as will prove interesting and useful to the public and especially to agriculturists, for whose benefit they are particularly intended. We also trust that they will meet with your approval.

I have the honour to remain, Sir,
Your obedient servant,
JAMES H. BOWMAN.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The ninth annual meeting of the Entomological Society of Ontario, was held in Ottawa, in the Museum of the Ottawa Literary and Scientific Society, on Thursday the 25th of September, at 4.30 p.m. In addition to the members of the Society, there were present on invitation about twenty members of the Ottawa Field Naturalists' Club.

In the absence of the Secretary-Treasurer, Mr. Jas. Fletcher was appointed Secretary *pro tem.*

The President read a telegram which he had received from the Vice-President, regretting that important engagements prevented him from being present.

The annual statement of the Secretary-Treasurer was read and adopted.

ANNUAL STATEMENT OF THE SECRETARY-TREASURER, ENTOMOLOGICAL SOCIETY OF ONTARIO, SEPT., 1879.

Receipts.

To Balance from 1878	$191 08
" Members' Fees, and sales of *Entomologist*	229 78
" Mdse. pins, lists, cork	29 16
" Advertisements	20 00
" Interest	12 57
" Government Grant	750 00
	$1,232 59

Disbursements.

By Postage	$20 25
" Expenses of Council, Delegations, &c.	65 00
" Petty expenses, freight, &c	10 75
" Annual vote to Editor and Secretary	150 00
" Expenses on Annual Report	149 74
" Engraving	13 45
" Mdse, pins	63 90
" Printing *Entomologist*	373 20
" Mailing "	32 00
" Paper for "	84 80
" Insurance	10 63
" Library	26 25
" Rent for 1879	80 00
Balance in hand	152 62
	$1232 59

We certify the above to be correct.

Sept. 18th, 1879.

CHAS. CHAPMAN,
ABM. PUDDICOMBE, } *Auditors.*

The report of the Council was read and adopted.

REPORT OF THE COUNCIL.

Your Council feel highly gratified at the success which has attended the efforts of the Society during the past year. Nine years have now passed since our incorporation; these have all been prosperous years, and the one we have just completed has not been less so than any of its predecessors. All the operations of the Society have been carried on harmoniously, and we have been able to present the public with many of the results of your investigations which will prove of value to it.

Our Report to the Government, which you have all had the opportunity of perusing, continues to maintain its interest, if we may judge by the manner in which it is sought after. We think that it is perhaps our best medium for reaching those whose knowledge of Entomology is limited, and to whom it is necessary to present the science in its more elementary and popular forms, if we would create a taste for its study. The fact that our reports are so much in demand indicate that the science of practical Entomology is rapidly growing in favour among the more intelligent of our agriculturists.

The new enterprise of the "Fruit Growers' Association," the publication of the *Horticulturist*, to the pages of which your members contribute largely, will, we trust, be a means of still more widely diffusing Entomological knowledge, as this journal enters the homes of nearly all our horticulturists, and in addition to the many valuable papers on fruits and flowers which it contains, it carries much information on our noxious and beneficial insects.

One great drawback to the Society's efforts has been the lack of funds to carry on its operations, and to enable us to procure woodcuts and electrotypes to illustrate the pages of our journal. We are satisfied that without figures of the insects we treat of, much of our labour is lost as far as the general public is concerned; we earnestly hope that before long our annual grant may be sufficiently increased to enable us to overcome this difficulty.

Our journal, *The Canadian Entomologist*, has now completed its eleventh year, and has made a reputation for itself which is second to none in the same department of

science; it has been regularly issued and has always been well filled with useful matter. The articles have been almost entirely original, and any new developments in Entomology have been promptly recorded in its pages.

The meeting of the Entomological Club of the American Association for the Advancement of Science, was held at Saratoga, commencing on the 26th of August. Our society was represented by the President, Mr. Wm. Saunders, and the Vice-President, Rev. C. J. S. Bethune, M.A.

It has been decided to exhibit our collection of Canadian insects at the Dominion Exhibition at Ottawa, and our collection of foreign ones at the Western Fair in London. The Ottawa collection is formed of the bulk of our Centennial display, so that those members who visit Ottawa, who have not before seen our collection, may be enabled to judge of its value.

Our branches in Montreal and London are still carrying on a successful work, and join the Parent Society in hailing the coming year as one of increased usefulness and success.

Submitted on behalf of the Council, by

JAS. H. BOWMAN,
Secretary-Treasurer.

Mr. Couper then read the report of the Montreal Branch, indicating very satisfactory progress; this was referred for publication.

The annual address of the President was next in order, after the reading of which a vote of thanks was tendered to him, both in the name of the Society and also in that of the Ottawa Field Naturalists' Club, for his exceedingly interesting and instructive address, and a copy was requested for publication in the Annual Report.

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

To the Members of the Entomological Society of Ontario:

GENTLEMEN,—Again it is my privilege as your retiring President to address you, to draw your attention to Entomological subjects, and more especially to the operations of the insect world about you, and to record the progress or decline of those noiseless disturbers of our peace—injurious insects.

The City of Ottawa being one of the great centres of our lumbering interest, it seems fitting that I should on this occasion call your particular attention to some of those insects most injurious to our pine forests. The losses occasioned by the destructive work of borers in pine trees, both before and after they are cut, are unfortunately too well known to those interested in the lumber trade, although the sufferers may not be familiar with the life histories of their enemies so as to be able to recognize them in the various stages of their existence. The lumberman suffers from the work of a number of destructive species, nearly all of which inflict their greatest injuries during the larval stage of their existence.

There are three families of beetles in which are included the greater number of our enemies in this department. I allude to the longicorns or long-horned beetles, *Cerambycidæ*; the serricorn or saw-horn beetles, *Buprestidæ*, and the cylindrical bark beetles, *Scolytidæ*. To go over this long series in detail would weary you. A brief sketch of the life history of a single example in each family will serve as representatives of the whole.

One of the most destructive of the species included in the *Cerambycidæ* is a large grey beetle with very long horns, known to Entomologists under the name of *Monohammus confusor*, and popularly in this district as the "Ottawa Cow." Where trees have become diseased from any cause, or where a fire has ravaged a pine forest and scorched

and partially destroyed the timber, or where logs after being cut have been allowed to remain a season in the woods or in the mill yard—there these insects gather and soon multiply to a prodigious extent. The mature insect is over an inch in length; the antennæ of the male reaches the extraordinary length of from two to three inches, while those of the female are shorter. The female lays her eggs in the crevices of the bark, where the larvæ when hatched eat their way into the wood, burrowing extensive galleries through the solid timber; when mature they are large, white, almost cylindrical, footless grubs. They pass their chrysalis stage within their burrows, and the perfect insect on its escape eats its way out through the bark. There are about a dozen species in this family known to be destructive to pine.

Most of the insects belonging to the family *Buprestidæ* may be recognized by their brilliant metallic colours; they have very short antennæ which are notched on one side like the teeth of a saw, and are often hidden from view by being bent under the thorax. *Chalcophora liberta* is one of the most destructive to pine trees, and its history is very similar to that of the long-horned beetle just described, but the larva is of a different form, and has the anterior segments or rings of the body very large, reminding one of the appearance of a tadpole. The perfect insect is about three-quarters of an inch long, of a brassy or coppery hue, with the thorax and wing-covers deeply furrowed by irregular longitudinal depressions. Dr. Fitch enumerates twelve species belonging to this family which are known to be injurious to pine. Additional information in reference to these beetles may be found in an article contained in the last annual report of our Society, by Mr. J. Fletcher, of Ottawa.

The cylindrical bark beetles, *Scolytidæ*, are also a numerous family, eight species of which are known to attack pine. The boring Hylurgus, *Hylurgus terebrans*, is probably one of the commonest. This beetle is about a quarter of an inch long, of a chestnut red colour, thinly clothed with yellowish hairs, and is found during the month of May. The larva, which is a small yellowish white footless grub, bores winding passages in every direction in the inner layers of the bark of the tree, and also through the outer surface of the wood.

In some parts of our Province pines are greatly injured and sometimes killed by the attacks of a woolly bark louse, which covers parts of the trunk and branches with a white cottony secretion, under the protection of which myriads of tiny lice live, puncturing the bark with their sharp beaks and exhausting the trees by feeding upon the sap.

While we are mainly interested in the preservation of our mature forests, the future of our country demands that we shall not overlook the young growth on which the lumber supply fifty or a hundred years hence must largely depend, and which it should be the policy of our rulers to protect as far as possible. Most of the governments of Europe are now fully alive to the importance of this matter, and are annually spending large sums of money in establishing young forests. Two years ago I called your attention to an insect then recently discovered by Prof. A. R. Grote, of Buffalo, which was greatly injuring the terminal shoots of both the white and red pines in Western New York; it was the larva of a small moth, *Nephopteryx Zimmermani*, which fed under the bark, causing a free exudation of resinous matter from the wounds it made, followed usually by the death of the twigs infested. Since then it has been found over a much wider area than was at first anticipated, and I have no doubt but that it is to-day materially retarding the growth of young pine trees in many portions of our Province.

At a recent meeting of the Entomological Club of the American Association for the Advancement of Science (where our Society was represented by your President and Vice-President), Mr. S. H. Scudder, of Boston, submitted some observations on another lepidopterous insect which is injuring the young pines growing on the Island of Nantucket. It is a species of *Retinia* closely allied to *Retinia duplana* of Europe. The moth lays her eggs near the tips of the twigs, down which the young larvæ burrow, killing them outright, and thus stunting and almost destroying the trees. Prof. Comstock, of Washington, also referred to two other species of *Retinia* which he had observed injuring the pine trees in that city.

In addition to all these, there are a score or two of species of insects which are known

to devour the leaves of the pines, damaging them in some instances very much. From the facts enumerated it is evident that we are suffering serious loss in all our lumbering districts from the silent workings of these insidious foes, and since in some measure to be fore-warned is to be fore-armed, I desire to call the special attention of those immediately concerned in the prosperity, present and future, of the lumbering interests of our country, to this important subject. Unfortunately it does not as yet seem to be within the power of man to do much directly towards restricting the operations of these enemies to our forests; yet this should not deter us from studying their habits and history, since an intimate acquaintance with these may result much more to our advantage than we now anticipate. A few trees, such as a belt, or a group planted for shelter or ornament, may be protected from the leaf and twig destroyers by syringing with a mixture of Paris Green and water in the proportion of a teaspoonful to a pail of water, and the bark lice may be killed by the use of alkaline washes applied with a brush or broom, and a timely application of the same will prevent the operations of the borers; but it is scarcely possible that such remedies can ever be applied over extended areas of forest. It is, however, gratifying to know that in addition to the numbers devoured by our insectivorous birds, almost every injurious species is in turn attacked to a greater or less extent by insect parasites of the most active habits, who seek out and destroy these pests with ceaseless diligence; were it not for these friendly insects the destructive species would be far more numerous individually than they now are.

The question as to how best to check the increase of destructive insects is of the greatest practical importance, and probably no insecticide has of late played so important a part in this connection as Paris Green, which is a compound of arsenic and copper, comparatively insoluble and a substance which seems admirably qualified for the destruction of insect life. Besides its special use as a potato-beetle killer, it can be successfully used to destroy any and every insect which eats the leaves of plants, shrubs or trees. So poisonous an agent should be handled with caution if accidents are to be prevented, and it is a matter of great regret that in consequence of carelessness in its use the lives of many valuable animals have been sacrificed, and occasionally even human lives have been imperilled or lost. From the ease with which it can be procured it has also been resorted to in several instances by those determined on suicide. These unfortunate occurrences are greatly to be deplored, and every possible precaution should be taken to avoid accidents. It is quite a common occurrence for painters, hardware dealers and general merchants to sell Paris Green and to send it out without label of any sort, and sometimes the parcel is very insecurely put up and packed with groceries and other articles for home use in the most indifferent manner. Such recklessness should not be permitted and no one should be allowed to sell any substance so dangerous unless it is properly labelled with the name of the article and the word "Poison" prominently attached; with such precautions generally adopted many accidents which now occur would be prevented. It has been urged by some that so many evils have attended the use of Paris Green that it does more harm than good, and that its use should be discontinued; but in this I am not prepared to concur, as I am satisfied that without it, unless some suitable substitute were found, the potato crop in many localities could not be preserved from destruction. If reasonable care is exercised and the powder be used mixed with water, there is no danger attending it, and its use in this manner in the proportion already mentioned of a teaspoonful to a pail of water and applied with a whisk, is not only safe but most economical.

For some years past experiments have been made with various other substances with the view of finding a substitute for Paris Green which would be less dangerous in the hands of the careless, and among them I believe none have been used with greater success than common blue vitriol or sulphate of copper, in solution in the proportion of about an ounce to a pail of water, and applied in the same manner as the Paris Green mixture. This article is worthy of, and will doubtless receive, a more extended trial, as its use under any circumstances would be attended with but little danger. For the destruction of household pests Insect Powder has lately attracted much attention, and is probably the most valuable agent we have for this purpose, and it is quite harmless to man and the higher animals. There are two sorts of this powder, known in commerce

under the respective names of Persian and Dalmatian Insect Powder; the former is the powdered flowers of *Pyrethrum roseum*, the latter of *Pyrethrum cinnerariæ-folium*. The Dalmatian Powder is most highly esteemed. The powder is diffused through the atmosphere by means of a small bellows, or insect gun, and in a very short time it brings house-flies, cockroaches, etc., on their backs, and dusted among bed-clothing is equally effectual on noxious pests there. It does not at first kill the insects outright, but paralyzes them so that they are unable to use either legs or wings, and after remaining in this condition many hours and sometimes days, a solitary individual here and there will either wholly or partially recover, but the great bulk of them die.

A very active blue-bottle fly placed under the influence of the powder was brought on its back in one and a half minutes. After six minutes it performed some remarkable evolutions, throwing itself about in the most desperate manner by the aid of its wings, for by this time it had lost the use of its legs; in a few moments more it was quiet, but still able to move its legs, and this power it retained for two days, after which it was lost sight of. The same powder was applied to a full-grown grasshopper; immediate uneasiness was manifested, and within two minutes its hind legs were partially paralyzed so that they could not be used with much effect. The first symptoms were a general rubbing of the legs against each other and a peculiar backward movement of the body; in four minutes there was a trembling of the whole frame, while all the legs were so much affected that locomotion was very feeble. In six minutes the insect had lost all control over its limbs, and in nine minutes it was on its back, with no power to recover its natural position. A second patient manifested precisely similar symptoms, but was not affected quite so rapidly. Applied to house-flies in a room, some of them begin to fall powerless in two or three minutes; others will remain active several minutes longer, but manifest constant uneasiness, evidenced in unnatural movements of wings and legs, and a frequent thrusting out of the proboscis. Having operated in a room one day about noon, I swept up after a few minutes several hundred flies and put part of them in a tumbler covered with a small plate, and the remainder in a chip box which I carried in my pocket for the first day, where the flies would receive some warmth from the body. After five or six hours the box was opened, when several crawled out or flew with a very weak, short flight; these were evidently recovering; the others remained on their backs, many of them moving their legs now and then. At the same time those in the tumbler were looked at; all were on their backs, but still alive. In twenty-four hours afterwards those in the glass were in the same helpless condition, barely alive, while in the box three more had so far recovered as to be able to walk, and one of them could fly a little. The following day they were examined again and every one of those in the box were dead, while in the tumbler, out of 137, there were 22 alive, which number was reduced to three the following day; this small remnant survived two days longer, when all died.

In the use of Insect Powder on the green Aphis, which infests house plants, the same course was observed; the insects dropped from the plants as if paralyzed, and after a short time were incapable of locomotion. After two days they were found still alive, but in this instance there was no sign of recovery in any of them, and all died within two or three days afterwards, but whether from the direct effects of the powder or from starvation I was unable to decide.

When I addressed you last year I referred to a strange disease which had destroyed large numbers of that destructive pest, the Forest Tent Caterpillar, *Clisiocampa sylvatica*. After the disease had reached a certain stage the larvæ remained motionless, retaining their hold on fences and the trunks of trees; shortly, although in appearance they were quite natural, when touched they were found to be dead, and their bodies were so decayed as to burst with a very gentle handling. Subsequent observations convinced me that this was the result of a fungoid disease to which caterpillars, as well as some perfect insects, are very subject. A similar disease sometimes attacks the silk-worm and causes great devastation, and the common house-fly is liable every autumn to die from the effects of a fungus which multiplies with amazing rapidity within the fluids of the fly's body, soon destroys life, and forms a circle of luxuriant growth all around its victim. Examples of this may be found on the windows of almost every dwelling during

the month of September. Some years ago a learned European professor claimed that he had proved the identity of this fungus with the common blue mould and also with that of yeast; and in proof used the fungus of the fly for the purpose of raising bread, and shewed that it was possible to brew beer with the common mould. The close relationship, if not the actual identity, of these three was thus established. Quite recently it has been proposed by Dr. Hagen, of Cambridge, Mass., to use a diluted solution of yeast in water with an atomizer as a means of destroying noxious caterpillars and other insects by introducing disease among them, and it seems quite likely that the use of this remedy may to some extent prove effectual.

The Cabbage Butterfly, *Pieris rapæ*, having pretty well colonized the northern portions of America, is still travelling southward. During the present season it has been reported as common in many localities in the State of Alabama, and has nearly reached the Gulf of Mexico; it seems as capable of adapting itself to extremes of heat as of cold. The Forest Tent Caterpillar, *Clisiocampa sylvatica*, which has been so very numerous and destructive in our neighbourhood for two years past, has almost disappeared. The Colorado Potato Beetle seems to have fairly established itself in several places in Europe, and if it proves as prolific there as here it will be rapidly disseminated. The Wheat Midge, *Cecidomyia tritici*, has appeared in the neighbourhood of Port Hope, Ont., but not to any alarming extent. The Plum Curculio, *Conotrachelus nenuphar*, has been common as usual, while reports have been received from several districts of the increasing prevalence of the Codling Worm, *Carpocapsa pomonella*.

Our journal, *The Canadian Entomologist* has been well sustained during the past year, and through the kindness of our esteemed contributors we have been enabled to present our readers with many original papers of great practical value. Mr. W. H. Edwards, of West Virginia, has continued his very useful and valuable papers on the life histories of our butterflies. Dr. Bailey, of Albany, N. Y., has given us an interesting description of the various stages of *Cossus Centerensis*, illustrated by an excellent lithographic plate. Many new species of insects have been described by Messrs. A. R. Grote, W. H. Edwards, V. T. Chambers, Prof. Fernald and others, besides which we have published a very large number of papers of general interest.

Among the more important recent contributions to our Entomological literature may be mentioned a new edition of the Catalogue of the Described Diptera of North America, by Baron Osten Sacken; the Coleoptera of Florida and Michigan, by John L. LeConte, M. D., and E. A. Schwarz; Report on the Insect and other Animal Forms of Caledonia Creek, New York, by J. A. Linter; the Coleoptera of the Alpine Regions of the Rocky Mountains, by John L. LeConte, M. D.; on the Collection of Insects made by Dr. Elliot Coues in Dakota and Montana—the Orthoptera by Cyrus Thomas, Hemiptera by P. R. Uhler, Lepidoptera by W. H. Edwards; Notice of the Butterflies Collected by Dr. Edward Palmer in Southern Utah and Northern Arizona, in 1877, by Samuel H. Scudder; and an account of some insects of unusual interest from the tertiary rocks of Colorado and Wyoming, by the same distinguished author. The elaborate and voluminous report of the U. S. Entomological Commission on the Rocky Mountain Locust, with maps and illustrations, issued in 1878, did not reach us in time to be noticed at our last annual meeting. It is a work which has involved great labour, and besides containing much that is new, covers the entire field of our knowledge in reference to this destructive pest. Prof. C. V. Riley, of Washington, has issued a special report on the Silk-worm, being a brief manual of instructions for the production of silk, with illustrations. Prof. A. R. Grote has written Preliminary Studies on the North American Pyralidæ, and Samuel H. Scudder a Century of Orthoptera. Several additional numbers of Edwards' magnificent work on North American Butterflies have appeared, with charming plates.

The members of the Entomological Commission of the United States are devoting their attention this year especially to the Hessian Fly, investigating its habits, preparing statistics of the losses occasioned by its attacks, and testing the various remedies which have been suggested for its destruction. In a circular issued in June last they solicit the co-operation of Entomologists, many of whom will, I trust, be able to render them efficient aid in this good work.

During the year, death has removed from our ranks three well known labourers in

the Entomological field, Dr. Asa Fitch, late State Entomologist of New York; Dr. Hermann Loew, the eminent German Dipterist, who has done so much to advance our knowledge of American Diptera; and Frederick Smith, the renowned English Hymenopterist. Thus, year by year, we are called to mourn the loss of those whose names, for their works' sake, we revere. They have gone to their reward; we live to labour. Let us each endeavour to make the best possible use of the time and opportunities we have, however limited they may be, and dilligently and contentedly labour in the sphere in which God has placed us; prompted by pure motives, may we with earnest effort probe deep into the secrets of nature, and draw from thence treasures new, so that when we pass away, we may leave behind us some little lustre which may lend a light, however dim, to those who will fill our places.

I have the honour to be, very sincerely yours,
WM. SAUNDERS.

The election of officers then took place, resulting in the appointment of the following gentlemen :—

President.—W. Saunders, London.
Vice-President.—Jas. Fletcher, Ottawa.
Secretary-Treasurer.—Jas. H. Bowman, London.
Council.—Rev. C. J. S. Bethune, M.A., Port Hope; Wm. Couper, Montreal; J. M. Denton and E. B. Reed, London; R. V. Rogers, Kingston; G. J. Bowles, Montreal; and W. Harrington, Ottawa.
Editor of Entomologist.—W. Saunders.
Editing Committee.—Jas. Fletcher, G. J. Bowles and E. B. Reed,
Librarian.—W. E. Saunders, London.
Library Committee.—E. B. Reed, J. M. Denton, H. B. Bock, London, with the President, Librarian and Secretary.
Auditors.—Chas. Chapman and A. Puddicombe, London.

A short time was agreeably spent in asking and replying to queries in reference to insects and their habits, and in examining the collections of insects in the Museum, after which the meeting adjourned.

ANNUAL MEETING OF THE LONDON BRANCH.

The Annual Meeting of the London Branch of the Entomological Society of Ontario, was held on the evening of February 11th, 1879, at the residence of the President, Mr. J. M. Denton. The President occupied the chair.

The Secretary-Treasurer read his annual report, which was adopted. His report shewed that the finances of the Branch were in a satisfactory condition.

The election of officers than took place with the following results.
President.—J. M. Denton.
Vice-President.—A. Puddicombe.
Secretary-Treasurer.—W. E. Saunders.
Curator.—C. Chapman.
Council.—Messrs. H. B. Bock, E. B. Reed and W. Saunders.
Auditors.—H. B. Bock and Jas. H. Bowman.

Permission was asked by Mr. C. Chapman for the School of Design to use specimens of some of our large Butterflies and Moths as models for the drawing and painting classes, which was cheerfully granted.

Mr. Saunders gave an interesting account of his recent visit to Florida, and exhibited some of the insects obtained by him while there.

Mr. H. B. Bock kindly presented the Society with a number of specimens of Coleoptera from Germany.

Subsequently an hour or two was spent in social intercourse and participation in the many means for enjoyment provided by Mr. Denton for the members. After spending an exceedingly pleasant evening the meeting adjourned.

W. E. Saunders,
Secretary-Treasurer.

MONTREAL BRANCH OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The Sixth Annual General Meeting of the Montreal Branch of the Entomological Society of Ontario was held at the residence of G. J. Bowles, Esq., on Tuesday the 3rd June, 1879, at 8 o'clock p.m.

Mr. Bowles read a paper entitled, "Some of the insects that frequent the orchard and garden, under what circumstances they increase unduly, what insects to spare, what to kill, and how to kill them, with other useful information," by the Rev. F. W. Fyles, corresponding member of the Natural History Society.

The annual report of the Secretary-Treasurer was then read and adopted. This report shewed that after meeting the current expenses of the year, there still remained a very fair balance on hand.

The proceedings were closed by the election of the following officers for the ensuing year:—

President, G. J. Bowles; *Vice-President*, H. H. Lyman; *Secretary and Treasurer*, Geo. H. Bowles; *Curator*, F. B. Caulfield; *Council*, Robert Jack, W. Couper and G. B. Pearson.

The meeting then adjourned.

G. H. Bowles,
Secretary.

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

In presenting their Sixth Annual Report, your Council have much pleasure in stating that the Society is still making satisfactory progress.

Eight very pleasant meetings have been held during the year, and besides the many interesting Entomological items recorded in the minutes of the Society, the following papers have been read before the members:—

1. "On the Larvæ of *Papilio Brevicauda* and *Pieris Borealis*, and the food plants."—W. Couper.
2. "On the May beetle, *Lachnosterna quercina*, and its parasites."—G. J. Bowles.
3. "Introductory notes on the *Ichneumonidæ*."—G. J. Bowles.
4. "Notes on *Phyciodes Harrisii* and *Nycteis*."—H. H. Lyman.
5. "On the Saw-flies."—G. J. Bowles.
6. "My Entomological trip to the Godbout River, 1878."—W. Couper.
7. "On the Insects of the Mammoth Cave" (selected).—Geo. H. Bowles.

The following books have been added to the Library:—

"Riley's Reports," 2, 4 and 5, making the set complete. The nine reports have been bound in three volumes, and form a very valuable addition to our library.

"Hentz's Spiders of the United States," with 21 plates.

"Sausser's Solitary Wasps of America," with 4 plates.

"*La Crysomele des Patates*," from the Department of Agriculture, with 1 plate.

"Report of the Entomological Society of Ontario, 1878."

"Reports of the Fruit Growers' Association of Montreal, 1877 and 1878."

Our order for books to the Naturalists' agency is still not quite filled, and a balance of about $10 remains in their hands.

Your Council would note that additions are still being made to the list of species in the "Montreal Catalogue," and would recommend the work to the members as one worthy of zealous prosecution.

In regard to the labours of the coming season, your Council feel glad to report that the members are beginning their collections with renewed vigour; and they trust that the next year's operations will show a great advance in the study of our fascinating science in Montreal.

The whole respectfully submitted,

GEO. JNO. BOWLES,
President

Montreal, 3rd June, 1879.

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

The Annual Meeting was held, as announced, on the 26th day of August, in the Town Hall, in Saratoga, N.Y. The first session began at 12.30 p.m., the President, J. A. Lintner, of Albany, in the chair. The following members were present during the several sessions: Dr. John L. LeConte, S. H. Scudder, C. V. Riley, A. R. Grote, C. H. Fernald, Dr. John G. Morris, Rev. C. J. S. Bethune, Wm. Saunders, J. H. Comstock, E. P. Austin, F. W. Putnam, B. P. Mann, H. F. Bassett, W. S. Barnard, D. S. Martin, E. L. Graef, Dr. J. S. Bailey and E. H. Pohlman.

The Secretary, Mr. B. P. Mann, read the minutes of the last meeting in St. Louis, Mo., after which the President delivered the following address:—

ANNUAL ADDRESS OF THE PRESIDENT.

GENTLEMEN:—In the remarks which I presented to the Club at our last annual meeting, a brief review was given of the progress in American Entomology within the preceding half century. It was shewn that within the last few years rapid progress had been made; that the study of insects had enlisted the labours of many earnest and successful workers, and given to them names honoured in science both at home and abroad; that many large and valuable collections had been accumulated—several of which contained so large a number of types that their preservation in the future was a matter demanding serious consideration; that the literature had become quite extensive; that much had been done in working out the life-histories of our species and presenting them to the public in their economic relations; and finally, that the importance of the study had at last been recognized here, as long ago it had been in Europe, by a Commission appointed by our General Government, for the investigation of some of the insect pests which were the occasion of serious pecuniary loss, poverty, and almost starvation in some portions of our country.

It affords me pleasure to be able to report, that the past year has shewn no diminution of interest or activity in our department, but that work in it is being prosecuted with an energy and with results fully up to any other department of Natural Science, if we except those to which Congress and several of our States are extending their liberal aid.

If fewer new species have been described during the year, we may find encouragement in the explanation that we are approaching the period, if not already reached, when a new species may not be claimed as the reward of every Entomological excursion. And indeed, there does not seem to be urgent need of descriptions of forms so very far in advance of some degree of knowledge of transformations, habits and relations to the vegetable world.

An evidence of increasing interest is to be found in the frequent inquiries made for instructions in collecting, apparatus for preparation, and books for study. While the first two requests can be promptly met, not so with the last. We are unable to place

in the hands of the student the volumes which he requires for naming his collections. This cannot but be the occasion of discouragement to the beginner, and often the cause of diversion of earnest labour to other departments of Natural History. A great need of our science at the present is, monographs of the families prepared by specialists, in which descriptions of all the species shall be given (not simply referred to), and accompanied by such synoptical tables and illustrations as will enable the student readily to ascertain the names of any species which has been described.

At our last meeting I stated to you that the names of 281 persons are recorded in the last edition of the Naturalists' Directory who are making Entomology their study in North America, and that it was probable that a full list would extend the number to at least 350. It now appears that half the truth was not told. A list kept by the Secretary of the Cambridge Entomological Club, published in Psyche, vol. ii., p. 9 of Advertiser, accompanying the numbers for Sept.-Dec., 1878, contained at the close of last year the names of 762 Entomologists in the United States and Dominion of Canada. I am informed by the Secretary that the list at the present time, without having been subjected to a critical revision, contains 835 names.

As a record of the current literature of any science is virtually a record of the progress of that science, may I ask your attention to a brief notice of some of the publications of the year following our St. Louis meeting.

A work that might serve as a model in the illustration of insects in their relations to the plants upon which they feed or frequent, is one of the unique series by Mr. Glover of *Manuscript Notes from My Journal*, entitled, "Cotton, and the principal Insects frequenting or injuring the plant." In its twenty-two quarto plates, engraved on copper, is shown the cotton plant in every stage of development from the seed to the mature plant, and in its various conditions as resulting from insect attack or from disease. In association with these figures, twenty-four insects frequenting the plant are represented. Several of the species are illustrated in an agreeable prodigality, giving enlarged views of the egg, the larva at different stages of growth, the pupa, the cocoon, the perfect insect at rest and in flight, its under surface, enlargements of parts, and the more marked varieties of the larva and the imago. Although not so stated, it is believed that the edition of these Notes was no larger than the others of the series, and consequently, that only about fifty societies and individuals have been the fortunate recipients of a copy.

The Natural History of the Agricultural Ant of Texas is a volume of 208 pages and 24 plates, by H. C. McCook, treating at length of the habits, structure and architecture of this interesting insect. The histological details have been worked out from preparations made by Prof. J. G. Hunt.

A volume, upon which Baron Osten Sacken has been for a long time engaged, has recently been completed and published by the Smithsonian Institution. The *Catalogue of the Diptera of North America* prepared by this author and published in 1858 was simply a compilation of published names, not claiming synonymic accuracy. It contained 1,800 species, but many of the number were too imperfectly described for identification. The new Catalogue is of such merit as to deserve more than a passing mention. It is fully up to, and in itself materially advances, our knowledge of the Diptera of our country. Its author modestly regards it as only critical in part—so far as the families have been worked out into monographs, and as still remaining a mere list of reference to earlier writers, in those families which have not been studied, or in which the existing collections are to a great extent still unnamed, as in the *Culicidæ*, *Chironomidæ*, *Cenopidæ*, the group of *Muscidæ calypteræ*, and the section *Asilina*. Its critical character may be seen from the statement, that of the 102 species of *Tabanus* enumerated in the old Catalogue, only 36 have been adopted in this.

An admirable feature of this Catalogue is that a large proportion of the species which it records—over 2,000 carefully described and authoritatively labelled species—are contained in the Collections of the Museum of Comparative Zoology at Cambridge, fwhere every possible care is given to them, and where they are accessible to the student or comparison and study. Most of these are types of Loew and Osten Sacken, or their determinations.

The remarks of the author on synonymy, nomenclature and priority, seem to me to be most excellent and worthy of serious consideration. In an extended discussion of the merits of the descriptions of Diptera of the late Mr. Walker of the British Museum, he characterizes them as so extremely superficial—descriptive rather of the specimen than of the species, that in his opinion, they should be entitled to no claim for priority whenever they cannot be positively identified without an examination of the type specimen. Thus, of twenty-six species of Dolichopus described by him, not a single one could be recognized. The question suggests itself, to what extent might this rule be extended to descriptions in the other orders of insects by this author, and in general, to the writings of other authors.

In considering the number of Diptera, Osten Sacken believes, that rejecting those descriptions which will probably prove irrecognizable, the number of described Diptera of North America, north of Mexico, will hardly reach 2,500; that the undescribed material at present in collections, if worked up, would perhaps double the number; and that when the long neglected order shall have received the attention given to the Coleoptera, it will equal if not exceed the latter, numerically.

Reference at the present to studies in the Diptera, naturally suggests the great loss which Dipterology has sustained in the recent death—in April last—of the distinguished Prussian Dipterist, Dr. H. Loew, long known as one of the most eminent cultivators of this branch of Entomology. During the last twenty years he has been engaged in the study of North American Diptera, and at the request of the Smithsonian Institution he has prepared a series of monographs, three volumes of which (Parts i., ii. and iv.) have been published by that Institution. While his removal from his work at this stage of its progress, cannot but be deeply deplored, there is a consolation to be found in the knowledge that it is not to be wholly arrested, but that a worthy collaborator—Baron Osten Sacken—remains to conduct it to a completion, we hope, of the plan proposed.

The series of *Dimmock's Special Bibliographies*, now being published at Cambridge, Mass., will prove to be of eminent service to the student who desires to avail himself of the literature of our insects, so widely scattered through the various scientific and popular journals, government surveys, and other publications. Two numbers of the series have been issued—the first containing a complete list to date, it is believed, of the Entomological writings of Dr. John L. LeConte, and the second, those of Dr. George H. Horn. A third, of the writings of Mr. S. H. Scudder, is nearly completed. I regret that it has been thought necessary, in this series, to dispense wholly with the use of capitals in all scientific names, even in the family and ordinal divisions, and I believe that many of you will agree with me in claiming for the royalty of science exemption from conformity to an innovation based on mere convenience.

Prof. C. V. Riley and J. Monell have contributed to the Bulletin of the U. S. Geolog.-Geograph. Survey (vol. v., pp. 1-32) a paper entitled *Notes of the Aphididæ of the United States, with Descriptions of Species Occurring West of the Mississippi.* Part I contains extended biological notes on the Pemphiginæ, by Prof. Riley, and Part II., notes on Aphidinæ with descriptions of new species, by Mr. Monell. The paper, illustrated by two plates, is a valuable contribution to our knowledge of these exceedingly interesting insects.

A special Report from the Department of Agriculture, entitled, *The Silk-worm, being a brief Manual of Instruction for the Production of Silk*, has been prepared by Prof. Riley, and largely distributed by the Department, to meet the demand from various portions of the United States for information upon the important industry of silk-culture. The Manual is quite full in the natural history of the Silk-worm, in the methods of culture, and directions for reeling the cocoons. There seems no reason why this industry, properly fostered, may not be made to add materially to the productive resources of our country.

Abstracts of the papers presented by Prof. Riley at the St. Louis meeting of the American Association for the Advancement of Science, have been published in the Proceedings of the Society, and also in a separate pamphlet. Among these are *Notes on the Life-History of the Blister Beetles and on the Structure and Development of Hornia; on the Larval Characteristics of Corydalus and Chauliodes*, and *A New Source of Wealth to the United States* [Sericulture].

A *Century of Orthoptera*, commenced by Mr. S. H. Scudder in 1868, and continued at intervals in vols. 12-20 of Proc. Bost. Soc. Nat. Hist., has been completed during the present year by the publication of the last three decades, in vol. 20, op. cit. The species described pertain to the Gryllides, Locustariæ, Acridii and Forficulariæ. The several parts as originally published have been reprinted in a pamphlet of 84 pages. Mr. Scudder has also published (Psyche, vol. ii., p. 154) a short list of Orthoptera collected in Appalachicola.

Entomological Notes, No. vi., by Mr. Scudder, issued the past year, is mainly a reprint of papers upon the Orthoptera originally published in the preceding year. The accompanyingindex furnishes a ready means of reference to the species contained in the several papers.

In the Annual Report of the Chief of Engineers for 1878, Prof. Cyrus Thomas reports upon a small collection of Orthoptera made in the Explorations and Surveys of the San Juan region of Colorado. The same volume contains a report by Mr. H. Strecker, on the Hymenoptera, Lepidoptera and Coleoptera from the same region, in which several new species of Heterocera are described, and a few figured.

Of our Entomological serials, the Canadian Entomologist continues to sustain its high reputation, and to merit the contributory aid which it is receiving from nearly all of our American Entomologists, and from some of our European friends.

Psyche, the organ of the Cambridge Entomological Club, is near the completion of its second volume. With the commencement of its third volume such improvements are promised as will render it of still higher importance to every student of American Entomological literature.

The *Transactions of the American Entomological Society* have reached the seventh volume. Although the Society has become a section of the Academy of Natural Sciences of Philadelphia, it is proposed to continue the publication of the Transactions as at present as rapidly as the limited means available for the purpose will permit.

The *Bulletin of the Brooklyn Entomological Society* is continued. That of the Long Island Society has been discontinued.

The second volume of the *Butterflies of North America*, by Mr. W. H. Edwards, is in course of publication. It continues to maintain the high reputation which it has commanded, from its admirable delineations of forms and colouring, and the exceedingly interesting new biological details presented.

The North American Entomologist is a new candidate for favour and support, of which two numbers have appeared. It is a monthly periodical, published at Buffalo, N. Y., under the editorial charge of A. R. Grote. It purposes to present articles of value both to the specialist and the agriculturist on the subject of North American insects, together with notices of current entomological literature,

Descriptions of the Noctuidæ have been continued by Prof. A. R. Grote in contributions to the Canadian Entomologist and in the *North American Entomologist*. With a diminution in the number of new forms of Noctuæ presenting themselves, Mr. Grote has directed his attention to the Pyralidæ, and has published a paper in the Bull. U. S. Geolog.-Geograph. Survey (vol. iv., pp. 669-705), entitled, *A Preliminary Study of the North American Pyralidæ*, in which a number of new species are described, the species of Botis enumerated, and the venation given of certain genera of the Phycidæ. A supplement to this paper follows in the *North American Entomologist*, No. 2, pp. 9-12.

To the study of the Tortricidæ—a family which has received scarcely any attention in this country since the death of Mr. C. T. Robinson, Prof. C. H. Fernald, of Orono, Me., has been devoting special and earnest attention. He has been able to examine nearly all the material contained in the principal collections in this country, and during the past winter has visited the larger collections in Europe for their study and a comparison with our forms. In England, the Tortricidæ in the following collections were critically examined by him: those of the British Museum, of H. T. Stainton, R. McLachlan, C. J. Barrett and Lord Walsingham; and on the continent, the collections in Brussels, Berlin, Munich, Naples, of Prof. Zeller in Stettin, Dr. O. Staudinger, MM. Deyrolle and Ragenot and the Jardin des Plantes in Paris. The above amount of preliminary work should certainly enable Prof. Fernald, as is his hope, to present us with

a rearrangement of this extensive family quite in advance of any heretofore proposed. Prof. Fernald has prepared a synonymical list of our North American species, which is nearly ready for publication.

The work of Mr. V. T. Chambers on the Tineidæ of the United States, has been vigorously prosecuted, as may be seen in his frequent publications in the CANADIAN ENTOMOLOGIST. His papers on *Tineina and their Food-plants, and Index to the Described Tineina of the United States and Canada* (Bull. U. S. Geolog.-Geograph. Surv., vol. iv., pp. 107-167), have been appreciatively received as very convenient for reference.

The comparatively small but difficult group of the Pterophoridæ has engaged the attention of Mr. Charles Fish, of Oldtown, Me., and his studies have already made him our best authority in these forms.

From the above references to special studies in several of the families of the Lepidoptera, it will be seen that this attractive Order gives every promise of soon occupying high vantage ground.

In the other Orders—it is quite unnecessary that I should refer in the Coleoptera to the labours of Drs. LeConte and Horn. You will know of their untiring work, which has made the field which they are so thoroughly working almost exclusively their own.

In the Diptera, Mr. C. P. Whitney has published descriptions of a few species of Tabanidæ.

Mr. W. H. Patton has communicated some descriptive papers on Hymenoptera to the CANADIAN ENTOMOLOGIST.

Mr. E. T. Cresson has published a catalogue of North American Apidæ, with descriptions of new species, comprising 108 pages of vol. vii. of the Trans. Amer. Entolog. Soc.

Some valuable lists of species collected in particular regions have been given us, which are of service in extending our knowledge of Geographical Distribution. Among these, in the Coleoptera, may be mentioned, a list by E. A. Schwarz of 1,457 Florida species (Proc. Amer. Philosoph. Soc., v. 17, pp. 353-472); of 1,246 species from the Lake Superior region by H. C. Hubbard and E. A. Schwarz; by the same, of 1,787 species from the lower Peninsula of Michigan (loc. cit., v. 17, pp. 593--666); by Dr. LeConte, of 220 species collected in the Rocky Mountains at an elevation of 6,000 feet and upwards (Bull. Geolog,-Geograph. Surv. Terr., v. 4, pp. 447-480); additions to Messrs. Austin and LeConte's Catalogue of the Coleoptera of Mt. Washington, of 89 species, extending the number to 319, by F. Gardiner, jr. (Psyche, v. 2, p. 211); 316 species from Wallace Co., Kansas, by F. H. Snow (Trans. Kans. Acad. Sci. vol. vi., pp. 61-70); and additions of 435 species to the Catalogue of Kansas Coleoptera, by E. A. Popenoe (ut. cit. pp. 77-86), increasing the number to 1,711.

In the Lepidoptera, Mr. C. E. Worthington furnishes a list of 229 species of Noctuidæ from the vicinity of Chicago, Ill., (Canad. Entomol., v. xi., p. 68); Mr. W. L. Devereaux, a shorter list of species taken in Wayne Co., N. Y. (ut. cit., p. 105); Prof. F. H. Snow, a list of 104 species collected in Colorado, by the Kansas University Scientific Expedition in 1876.

The valuable biological studies of Mr. W. H. Edwards have been continued with their wonted earnestness. Through the success attained by him in carrying a large number of species of butterflies from the egg through their transformations, he has secured their entire life-histories, several of which have been published during the past year, and others illustrated in the volume of the *Butterflies of North America*. Of the Satyridæ, the larva of which are so rarely met with that I may venture to say many members of this Club have not seen a living example, he has reared all of our Eastern species with the two exceptions of *Satyrus Pegale* and *Chionobas semidea*. The interesting experiments in producing change in the imago by the application of cold to the chrysalis have been continued and been duly recorded.

A large number of biological papers have been contributed to our Entomological journals. From those accessible to me at the time of writing I find contributions from the following:—C. J. S. Bethune, J. Boll, Robert Bunker, V. T. Chambers, A. J. Cook, Charles Dury, H. Edwards, W. H. Edwards, J. H. Emerton, G. H. French, H. A.

Hagen, E. C. Howe, D. S. Kellicott, J. L. LeConte, B. P. Mann, T. L. Mead, C. V. Riley, W. Saunders, C. G. Siewers, Emma A. Smith, F. H. Snow, C. E. Webster, O. S. Westcott, C. E. Worthington, and G. D. Zimmerman—a quite incomplete list of the contributors to this department.

Results of anatomical studies of insects have been published by Messrs. C. F. Gissler, J. D. Hyatt, E. L. Mark, and C. V. Riley.

It would be inexcusable in a notice of biological work to omit reference to what is being done in this direction at the Museum of Comparative Zoology at Cambridge. Under the hand of the eminent Curator of the Entomological Department, Dr. H. A. Hagen, a biological collection of insects has been brought together that is far in advance of any similar collection in the world. It was my privilege recently to give it a partial examination, and when I say that I know not how to express my high estimation of it, I give it but imperfect praise. No one, whose studies have prepared him for the appreciation of such a collection, can examine it without wondering when, where and how the material was obtained. As an illustration of the natural history of species in their several stages, architecture, depredations, food-plants, diseases, parasites, etc., it is difficult to see how its plan of arrangement can be improved. In consideration of its high value, it is very gratifying to see that such unusual means have been resorted to for its preservation, as, with a reasonable supervision and without the operation of other than the ordinary causes of destruction, will extend its benefits to our successors in coming centuries. In addition to the biological collection, two others have been arranged: the one comprising the insects of North America, and the other those of the world. Of the number of type specimens contained in these collections, there is not the time at present, nor is it the occasion, for more than simple mention. The student in American Entomology, who aims to be fully abreast of the most advanced progress in his line of study, cannot neglect the means of information which the Collections and Library of the Entomological Department at the Cambridge Museum offer him.

The published results of economic investigations during the year have been quite limited. In consideration of the exceeding importance of these studies, it is painful to have to record the fact of the issue of but one Annual Report of a State Entomologist —that of Cyrus Thomas. This second report of Dr. Thomas, forming the seventh in the series of the Illinois reports, is a volume of nearly 300 pages. In it Dr. Thomas discusses the depredations of some of the Orthoptera, Coleoptera and Hemiptera. Prof. G. H. French, Assistant Entomologist, presents brief descriptions of a large number of diurnal and nocturnal Lepidoptera and their larvæ, with notices of their habits, accompanied by analytical tables for their identification. Miss Emma A. Smith, special Assistant Entomologist, offers the results of original investigations in some species of special economic importance. The publication of this and the preceding Report, without, as is evident, the opportunity of the revision and correction of proof by the authors, is much to be regretted, as serious errors in the nomenclature and elsewhere have thereby been given extensive circulation.

The Annual Report of the Entomological Society of Ontario, making the ninth in the series, contains its usual amount of matter of interest to the Entomologist, and of value to the agriculturist and horticulturist.

Several articles treating of insect depredations have appeared in our scientific journals, which cannot now be referred to.

The United States Entomological Commission, continued by an appropriation by the last Congress of $10,000, is actively engaged in its second year's operations. In its investigations of the Rocky Mountain Locust, its labours have been almost entirely confined to that portion of country designated as the Permanent region, with a view of determining the limits of these permanent breeding grounds, and to obtain the requisite data for the preparation of a map, and a scheme to be recommended to the Government, by which the excessive multiplication of the species in that region, and the consequent migration therefrom, may be prevented. It is understood that the recommendation to the Government will be, that in connection with the authorities in British America, efforts be made to restrain the extensive prairie fires in autumn which are common to that region, and subsequently to burn them in the spring after the hatching

of the young locusts. This plan is believed to be feasible, as the breeding grounds are not co-extensive with the so-called Permanent region, but are limited to the richer valleys, plateaus and river borders within it.

The Commission will also, it is understood, in its forthcoming report, recommend to the Government a scheme for a system of warning and prevention, through the aid of the mounted police patrol of the Dominion Government, and our signal bureau and military posts.

Having been favoured with a transcript of the subjects to be treated of in the forthcoming Second Report of the Commission, and the assignment of subjects to the respective members of the Commission, I have no hesitancy in giving assurance of a volume of unusual interest and value. It is to be hoped that Congress will not repeat the inexcusable blunder of ordering of it an edition by far too small to supply the demand, or for the accomplishment of a main object in its labourious preparation—the diffusion of the needed information among those to whom it could not fail of proving beneficial.

The Commission is also occupied with investigation of the Hessian-fly and the Chinch-bug—each of which are chargeable with annual injuries to the amount of several millions of dollars.

The investigation of the natural history and habits of the Cotton-worm, commenced by the Department of Agriculture last year, has by direction of Congress, been transferred to the Entomological Commission. Prof. Riley has been pursuing its study in Southern Texas and in the Gulf States, aided by special assistants, and it is believed that discoveries have recently been made which will reduce the cost of destroying the larvæ to perhaps a fourth of what it has hitherto been.

Among the special subjects of study which have claimed attention lately, an interesting one has been the pupation of butterflies. Observations made during the past year on the pupation of some of our butterflies have shown us that we have been at fault in accepting the account given of it by Reaumur over a century ago, and received and quoted by subsequent authors. The most interesting operation in the pupation of the suspensi butterflies is the withdrawal of the chrysalis from the larval skin, the casting off of the skin with its attachment by the terminal legs to a button of silk spun for the purpose by the larva, and the attachment and suspension of the chrysalis by its anal spine to the silk button. Reaumur represented it as accomplished by the chrysalis in its extensions and contractions grasping the larval skin between the segments, and by this means raising itself until it regained the button. Recently Mr. Osborne, an English Entomologist, discovered a membrane serving as a suspensory agent in the change to the pupal state, and for the first, questioned the account given by Reaumur. His observations were confirmed by those of Mr. W. H. Edwards, and followed up by additional observations on large numbers of Nymphalidæ and Danaidæ, some of which have been presented in the Canadian Entomologist. There seems to be no question of the existence of such a membrane, and that it consists of the portion of the larval skin lining the region of the rectum, caught upon two knobs conveniently placed for the purpose. Prof. Riley, in a communication to *Psyche* (vol. ii., p. 249) finds other means of chrysalis suspension—the principal one being the shed intestinal canal, and accessory ones, the tracheal vessels of the last pair of spiracles; these Prof. Riley regards as the principal agents in suspension. In opposition to this, Mr. Edwards considers these ligaments as of but little, if any, service, and finds the membrane to furnish all the requisite support. Additional observations are required to reconcile these different views.

The beds of fossil insects recently discovered in the Tertiaries of our western Territories are proving to be wonderfully rich in number of species and condition of preservation. From a single small basin exposed by a railway cut in the vicinity of Green River Station, Union Pacific Railroad, in Wyoming, Mr. S. H. Scudder in *Fossil Insects of the Green River Shales* (Bull. U. S. Geolog.-Geograp. Surv. Terr., iv., No. 4, pp. 747-776) enumerates eighty species, representing all the orders of the Insecta except Lepidoptera. An idea of the richness of these beds may be obtained from the statement, that a two hours' search was rewarded by the collection of fifty new species. We are glad to learn that Mr. Scudder is engaged upon a general work on our fossil insects, which will form

one of the volumes of the quarto reports of the Hayden Survey—the beautiful typography and illustration of which causes us to regret the prospective speedy termination of the series. As the Tertiary Shales of the Rocky Mountain region give every promise of being richer in insect remains than any other country in the world, the material for this volume will be more ample than any other student in fossil entomology has been able to command.

For the evident omission of reference to much valuable work done during the period reviewed, I ask indulgence. The time that I had allotted to the preparation of my sketch was found, too late, to be quite insufficient for the extended bibliographical examinations required for even an approach to completeness. I offer it only as a partial sketch, and as such please accept it.

On motion, the thanks of the Club were tendered to the President for his able and interesting address, with the request that a copy be sent to the CANADIAN ENTOMOLOGIST for publication.

The Club next proceeded to consider the amendment to the Constitution proposed at the St. Louis meeting, and after much discussion, the amendment was adopted in the following form:—

1st—No resolution affecting important scientific questions shall be adopted at any meeting of the Club unless there shall be present at least seven members who shall have been enrolled at least one year previous to said meeting.

2nd—When any motion has been carried by the Club, such motion shall not be rescinded at any subsequent meeting unless there shall be present at least seven persons who shall have been enrolled as members one year or more previous to said meeting.

3rd—Five members shall constitute a quorum for the transaction of ordinary business.

The Secretary was instructed to draw up a list of members of the Club, to be embodied in the record of its proceedings, including all those who had been present at previous meetings.

The second meeting was held at 4:30 p.m., the President in the chair.

Mr. Grote exhibited specimens of *Pseudohasis eglanterina* sent him by Mr. James Behrens, of San Francisco, who had collected them on the top of Mount Shasta. These differed from the ordinary specimens in being almost entirely black on the upper side. Mr. Grote expressed the opinion that this variation was mainly due to the climatic influences to which they were subjected in this elevated situation.

Dr. J. G. Morris referred to the fact that certain Water Beetles carry with them when they dive a globule of air underneath their bodies, and asked for information as to what purpose it served. Mr. E. P. Austin said that this bubble was retained underneath by the stiff hairs along the abdomen, and as it was known that the air gradually disappeared if the insect remained long under water, it was supposed that the air was gradually inhaled by the insect, which was thus enabled to lengthen its stay under the water.

Mr. B. P. Mann presented a list of the Entomologists of North America, and requested the members to confer with him as to additions and corrections. Some beautiful examples of coloured drawings of *Noctuæ* by Mr. Pohlman, of Buffalo, were laid upon the table for the inspection of those present, and were much admired.

Mr. Scudder called the attention of the members to a lepidopterous insect which was doing much damage to the pines on the Island of Nantucket. Previous to the war of 1812 the island was well wooded, but during that struggle the occupants were reduced to such straits for fuel that they had burned every tree. For many years the island had remained in a barren state, but some time ago plantations of Pines were begun, and a broad belt of young trees of *Pinus rigida* from 10 to 20 feet high, with scrub Oaks, now cover a large part of the island. The success of this experiment is seriously threatened by the presence of the insect referred to, which is a Tortrix belonging to the genus *Retinia*, and closely allied to *duplana*, *sylvostrana* and *frustrana* of Europe. The larva affects the tip of each terminal bud and bores its way through this into the twig to the depth of two or three inches, killing the terminal leaves and thus preventing the trees from mak-

ing any growth. The moth is double brooded, and has not been observed in that locality beyond the precincts of the island. Mr. Scudder also presented a plate with enlarged drawings of the insect and its work.

Mr. Comstock had met with the same insect on *P. inops*, and had found that the tips of the branches of the Pines were usually covered with a web. He had also found another species of *Retinia* infesting the twigs of *P. rigida*. This latter bores into the small twigs of the tree, from which exude masses of resin. The larva lives within the branch upon the wood, and before pupating forces its way through the mass to the outside.

Mr. Bassett had observed some fifteen years ago, about Waterbury, Conn., that the common White Pine (*Pinus strobus*) was greatly injured at the tips of the branches by *Pissodes Strobi*, but for the last ten years this pest had almost disappeared. Mr. Riley referred to another Tortrix affecting the Junipers on Long Island, *Dapsilia rutilana*, a European species recently imported.

Prof. Fernald stated that he had received from Oregon and Washington Territory, specimens of *Retinia duplana* and *sylvostrana* identical with the European forms, and further referred to the fact that in America the species of Tortricidæ are more abundant in the West than in the East.

Mr. Grote called the attention of the membersto the ravages of *Nephopteryx Zimmermani*, which he believed had inflicted more injury on young pines than any other insect; it is found throughout the northern and north-western parts of New York State. Mr. Grote laid particular stress on the fact that the European pines imported and sold by nurserymen are much infested, and desired to call public attention to this matter. With regard to the use of Paris Green as an insecticide, he thought that it was doubtful whether the injury caused by it was not greater than would occur from the Potato Beetle were it allowed to go unmolested; and instanced the loss of a stallion valued at $2,500, poisoned by Paris Green, and also referred to the frequent injuries to animals and man reported in the newspapers. This opinion was opposed by other members present, who stated that but for the use of Paris Green or some such poison it would be impossible in some sections of the country to grow potatoes at all.

Prof. Fernald referred to a Tortrix found in Maine, *Tortrix nigridia*, which had very much injured the pines there; he had collected a large number of the larvæ and chrysalids of this insect, and from them, besides the moths, had obtained many ichneumon parasites and also several hair snakes. Prof. Fernald embraced this opportunity of calling the attention of the members to the condition in which he had found the types of the Northern American Tortricide. Many of them were being destroyed by the verdigris formed by the corrosion of the pins on which they were mounted, and in some instances this verdigris has accumulated to such an extent as to burst the bodies of the insects. To avoid this difficulty he has used japanned pins, and found that when thus coated they remained free from corrosion.

Mr. Grote remarked that *Scoliopteryx libatrix* was very widely distributed in this country as well as in Europe, being found here from Hudson's Bay to the Southern States. He also referred to Mr. Grey's discovery that *Limenitis arthemis, disippus, ursula* and *proserpina* are connected by intermediate individuals, and that this indicated that they had not long been separated from a common stock, and expressed the opinion that *arthemis* was probably nearest the original form.

Mr. Lintner held that it was premature to conclude that the different species of *Limenitis* are identical until it could be proven positively by rearing the one supposed species from the eggs of the other.

Mr. Scudder exhibited a piece of a woody root which was represented as coming from the interglacial beds of clay near Toronto, Ontario. This root proves by microscopic examination to belong to a species of Juniper and is bored by an insect, probably a *Scolytus*, but one which differs materially in its habits from any known species now existing. Mr. Scudder also referred to the abundance of insect remains which he had found in the peat deposits on the Island of Nantucket; from one mass of about a cubic foot he had obtained 300 fragments of Coleoptera, among which were several which he had been unable to refer to any species now known to exist; a number of these specimens were shown to the members.

Mr. Austin exhibited specimens of a wasp, *Polistes metrica* Say, infested with parasites.

On motion the meeting was adjourned until 8 p.m.

EVENING SESSION.

Prof. Comstock exhibited specimens of a small Pyralid which is carnivorous, feeding in the larval state on the maple tree bark lice, under the cottony matter secreted by the lice. He had bred forty of the moths fed in this way.

Mr. Scudder drew attention to a very singular fossil, of which he had obtained about 100 specimens, somewhat resembling the larva of an insect, but yet quite different from anything hitherto known. His remarks were illustrated by a figure of the object. It consists of only six segments.

Mr. Barnard exhibited specimens of *Phymata erosa*, which has proved quite destructive to other insects; they have been known to destroy quite a number of *Pieris rapæ*. Mr. Barnard exhibited a number of specimens which had been caught on the burrs of the Burdock.

Prof. Riley stated that *Pieris rapæ* was now quite common in Alabama; it had been seen as far as Selma, but had not yet reached Mobile. Mr. Scudder remarked that it had been found in Savannah, Ga., two years ago.

Prof. Comstock had received specimens of the Colorado Potato Beetle, this year, from Manitoba, and thought that this was the farthest point north it has yet reached.

Mr. Saunders made some remarks in reference to the capture of insects by the flowers of a species of *Bidens*, probably *chrysanthemoides*; the insects which he had observed thus captured were Dipterous, all of whom had been caught by the mouth; some were found dead, others still living, but unable to withdraw their proboscis.

In reference to the flight of butterflies, Mr. Lintner spoke of the enormous flocks of *Vanessa cardui* which had been seen in Italy, Spain and Germany during the summer.

Mr. Grote referred to an undescribed insect for which he proposes the name of *Oiketicus Abbotti*; he had obtained the cases of this insect on the cotton plant in the South, but had not seen the imago until he had reared it. This species is figured by Abbot in unpublished plates in the British Museum; it is referred to also in Harris' Correspondence, edited by Scudder.

The election of officers then took place, with the following result:—

President.—S. H. Scudder.

Vice-President.—A. R. Grote.

Secretary.—B. P. Mann.

After some discussion it was agreed that in future it was desirable that the President and Vice-President hold office for one year only.

The meeting then adjourned until the afternoon of the following day.

WEDNESDAY AFTERNOON SESSION.

Dr. Morris mentioned an interesting case of retarded development which had come under his notice, where a specimen of *Papilio asterias* remained in the chrysalis state two years and a half before the imago appeared.

Mr. Lintner remarked that instances of retarded development were common among the Bombycidæ, and especially mentioned *cecropia*; it also occurs frequently among the the Sphingidæ, where a specimen will pass over one season until the next in the chrysalis state; this has been supposed to be a natural provision for the perpetuation of the species.

Mr. Bassett inquired whether in such examples they were not uniformly females. Mr. Lintner stated that in his experience both sexes were retarded.

Prof. Martin exhibited transparent specimens of gum copal in which were imbedded Hymenopterous insects. He stated that copal is a fossil resin of the post-tertiary period obtained chiefly from Mazambique; that he had found in this resin about fifty species of insects, about one-third of which were Coleoptera, one-third Diptera and the

other third of the remaining Orders; two of the latter were Lepidopterous, one a Geometer, and the other he thought belonged to Zygaenidæ.

Mr. Bethune mentioned that he had found the larvæ of the Colorado Potato Beetle eating the leaves of the common Milk-weed, *Asclepias*.

Mr. Barnard had also seen one of these larvæ feeding on Milk-weed, but in this instance the larva was lighter in colour than usual. Mr. Lintner remarked that it was unfortunate that the Potato Beetle would feed in the larval state on quite a number of different plants, and in the absence of vegetable food would sometimes feed on one another.

Mr. Saunders had observed this carnivorous propensity of the Potato Beetle larvæ on several occasions, and had seen the same among the Cut-worms, and in one or two instances among larvæ of the Lycaenidæ. Mr. Scudder had also observed similar habits. Prof. Comstock had noticed it especially in the Cotton-ball worm *Heliothis armigera*.

Mr. Lintner invited Prof. Comstock to give some details in reference to the present plans and operations connected with his department at Washington. Prof. Comstock stated that he was endeavouring to work up a biological collection of insects on such a scale and in such a manner as shall be a credit to the Government. He has a large number of breeding cages, and an assistant who devotes his whole time to the rearing and mounting of insects. Special attention has been paid this year to insects feeding on clover, and the collection now contains over fifty species known to be destructive to this valuable crop. Prof. Comstock asked the aid of all Entomologists and assured them that any insects sent him would be well taken care of.

Mr. Scudder urged that Entomologists should recognize the fact that it is of the utmost importance that a collection as complete as possible should be formed in Washington, and that it should assume a national character.

Mr. Barnard asked for some information as to the method of arrangement adopted in the collection referred to. Prof. Comstock stated that he arranged the insects in their usual order and place; with the insect, its usual food plant, and where it feeds on several or many plants, a memorandum is placed with such specimen containing a list of the plants; by this method much duplication is avoided.

Prof. Fernald was asked to give some explanations regarding his work on the Tortricidæ. He began the study of this group two years ago, commencing with those species found in Maine, but soon found that he could do nothing satisfactorily without taking in all those found throughout the United States and Canada. He has also found it necessary to study the European forms, and is now engaged in examining all these structurally, with the view, if possible, of improving their classification, and earnestly desires help from collectors in all parts of the country, especially in reference to the larvæ of the different species. He thinks that the character of the head, thoracic shield and anal plate will probably be of most value in separating the species.

Mr. Saunders reported that *Papilio cresphontes* had been found rather common both in the larval and perfect state in several parts of Ontario this season. Dr. Morris said that he had found *Papilio ajax* particularly local in its distribution, abounding in some localities, but very scarce in others.

Mr. Lintner stated that *Pholisora catullus* had not been found about Albany until three years ago, when a single specimen was taken; this year it is one of the commonest species in and about the city; its food plant is *Monarda punctata*.

Rev. C. J. S. Bethune referred to the great abundance of *Papilio philenor* one season, many years ago in the neighborhood of Hamilton, Ontario; since then he was not aware that it had ever been found common in any part of Ontario.

A question was asked by Mr. Grote as to whether any of the species of *Cucullia* ever come to sugar. In reply, Dr. Bailey stated that he had captured three species of *Cucullia* and ten species of *Plusia* at sugar. Recently, when sugaring in a certain locality, he was surprised to find a large numberof Noctuids on decomposing animal matter, especially some partially decomposed deer hides.

Mr. Grote reported having taken *Audela acronyctoides*; one male was captured this month at light. He thought that this was the first time it had been taken in New York State.

Mr. Saunders referred to the fact that in the location where he resided large numbers of the larvæ of *Clisiocampa sylvatica* had died from a fungoid disease, and asked whether any of the members had tried solution of yeast as an insect destroyer, as lately suggested by Dr. Hagen.

Prof. Comstock stated that he had fed several larvæ on leaves dipped in yeast, but so far the yeast-fed larvæ had thrived remarkably well; his experiments had only been continued but a short time, hence he was not prepared to give any definite opinion on this subject.

The meeting then adjourned.

On Friday afternoon the closing session of the Club was held.

Dr. Morris stated that an apiarian in his neighbourhood had been severely censured by some fruit-growers because his bees had pierced their peaches, grapes, etc., and destroyed the fruit; he asked whether the bees really were the original authors of the mischief, or whether they only attacked such fruit as had been previously pierced by birds, wasps and other insects. He knew that writers differed on this subject, and mentioned that Prof. Cook and Prof. Riley take opposite sides here.

Prof. Macloskie thought that the mandibles of bees were not strong enough to tear the outer covering of peaches or grapes. Prof. Comstock was of a different opinion. Prof. Riley remarked that in some articles which he had published in the *New York Tribune* he had proved that bees are the depredators, and made some further interesting statements on this subject.

Dr. LeConte spoke of the destruction of some of our valuable forest trees by various insects, and requested the members during the next year to collect facts and to report them at the next meeting, so that the nature of their depredations may become fully known and further remedies may be suggested.

Mr. Minot offered some very interesting remarks on the larvæ of a number of species of water insects, chiefly Dipterous, illustrated by many beautiful drawings of the larvæ highly magnified.

Mr. Lintner referred to the importance of the study of aquatic larvæ, regretting that so little was known of their habits, and hoped that Mr. Minot would continue his studies in this direction.

From aquatic larvæ the conversation turned in the direction of that tiny tormentor, the mosquito, and marvellous accounts of its abundance in certain localities, and the sufferings of man and beast from its bloodthirsty propensities, were related by Mr. Scudder, Dr. Morris and others.

Mr. Riley made some remarks on the Cotton Worm, and stated that he had bred nine distinct parasites which preyed on this insect.

The time for adjournment having arrived, the members, after referring to the great pleasure they had derived from the interesting sessions of the Club, unanimously expressed the hope that all present might meet again next year in Boston.

The following articles have been selected on account of their general interest from the pages of *The Canadian Entomologist*, where they have appeared during the past year as original contributions.

OBNOXIOUS PESTS—SUGGESTIONS RELATIVE TO THEIR DESTRUCTION.

BY DR. H. HAGEN, CAMBRIDGE, MASS.

The question how to check the ravages of obnoxious insects is a very important one, and I am very often asked for advice in special cases. While occupied with a close examination of the proposed remedies and looking through a large number of scientific tracts, some of them fell into my hands and induced me to study them again. The present communication is the result of those studies.

Somewhat more than twenty years ago the lower forms of some fungi attracted the attention of many students, and especially of Dr. Bail, of Prussia. The reports of his observations are scattered in different periodicals, and the final result of my study of those reports was the conviction that a remedy for insect pests, offering several prominent advantages, could be found in the easy application of the yeast fungus. Further, that this remedy could be used probably against the famous Colorado grasshopper, for the destruction of which the Government has appointed a commission appropriated with $75,000; also, that the remedy could be tried in an easy way against the obnoxious hairy caterpillars, against the potato bugs, and last, but not least, in every greenhouse against leaf lice and similar pests.

Dr. Bail asserts that he has proved by many skilful experiments that four species of microscopical fungi are merely different developments of the same species. One of them, the fungus of the common house-fly, is the vexation of every housekeeper. The dead flies stick in the fall firmly to the windows, or anywhere else, and are covered by a white mould not easy to be removed. The second is the common mould, known to everybody and easily to be produced on vegetable matter in a damp place. The third is the yeast fungus, a microscopical species, and the basis of the work done by yeast of fermentation. The fourth is a small water plant, known only to professional botanists. Dr. Bail contends that the spores of the fungus of the house-fly develop in water in this last species, out of water in mould, and that the seeds of mould are transformed in the mash tub into yeast fungus.

The experiments made by Dr. Bail cover a period of more than a dozen years, since the numerous objections which were made against his results induced him to repeat again and again his experiments in different ways. I am obliged to state that even now prominent botanists do not accept Dr. Bail's views, which he maintains to be true and to be corroborated by new and sure experiments. This question, important as it may be for botanists, is without any influence regarding my proposition, as Dr. Bail has proved that mould sowed on mash produces fermentation and the formation of a yeast-fungus, which kills insects as well as the fungus of the house-fly. I was present at the lectures of Dr. Bail before the association of naturalists, in 1861, which were illustrated by the exhibition of mould grown on mash, on which the fungus of the house-fly had been sown, and by a keg of beer brewed from such mash, and by a cake baked with this yeast. Both productions were declared perfect by all who tasted them —an experiment in which I did not feel obliged myself to join, as both are to be had prepared without the fungus of the house-fly.

In a later communication Dr. Bail states that the use of mould has been the secret in brewing formerly certain kinds of a strong and well-reputed beer.

For the so-called jopenbier in Danzig the mash was not used before the forests of mould grown on its surface had sunk to the bottom—or, in other words, till the spores of the mould were sown by themselves on the mash.

Dr. Bail has proved by numerous experiments that healthy insects brought in contact with mash and fed with it are directly infested by the spores of the fungus with fatal consequence. These facts, not belonging strictly to the main part of his experiments, were observed first by chance and later on purpose. The most different insects, flies, mosquitoes, caterpillars, showed all the same results. The experiments were made in such a delicate manner that a small drop of blood taken with an oculist's needle from the abdomen of a house-fly left the animal so far intact that the same operation could be repeated in two days again. Both drops examined with the microscope proved to be filled with spores of fungus.

More to the point are epizootics produced by this fungus and observed on insects in the open air.

A really pestilential epizootic of the common dung-fly was observed in 1867. Not only those, but many other insects, died in the same locality and in the same manner; also other species of flies and gnats, the caterpillars of moths and of Phalænids, and the common hairy caterpillars of a moth which is very nearly related to the famous hairy caterpillar of the Boston Common. Of some species the destruction was so complete that the next year they were very rare. During those years the caterpillars of

two species of moths had destroyed pine forests belonging to the State and valued at several millions, and a larger calamity was imminent, when suddenly all caterpillars died from the same fungus.

Similar observations have been made in other places in Europe and here. Mr. Trouvelot formerly began in Medford, Mass., the raising of the Polyphemus moth for silk, and was successful enough to get a prize in the Paris Exhibition of 1867. Unfortunately he brought home from Paris eggs of another species from China, and purported to be superior for silk-raising in the open air. Those eggs proved to be infested by fungus, and the caterpillars hatched from them died, but not those alone. All caterpillars of the Polyphemus moth became infested, and even most of the other indigenous species living on the twelve acres of shrub land which Mr. Trouvelot utilized for this purpose, died rapidly. After two years of a similar calamity, Mr. Trouvelot was obliged to stop his experiments, which might have developed, perhaps, a new source of wealth for this country. A similar pest of an indigenous species of moth stopped only last year the interesting observations of Mr. Siewers in Newport, Kentucky.

The common silkworm in Europe has been in recent times extensively affected by a sickness called muscardine, which is also the consequence of a fungus. Similar fatal epizootics have been observed on the honey bee, and in Brazil several years ago nearly all the bees died from this cause. In Entomological journals are reported fatal epizootics of leaf lice, of grasshoppers, of the cabbage butterfly and of the currant worm, both imported here only a few years ago, and both very obnoxious.

Considering those facts, which are doubtless true, and considering the easy way in which the poisonous fungus can always and everywhere be procured and adhibited, I believe that I should be justified in proposing to make a trial of it against insect calamities. Nature uses always to attain its purposes the most simple and the most effectual ways ; therefore it is always the safest way to follow nature.

Beer mash or diluted yeast should be applied either with a syringe or with a sprinkler ; and the fact that infested insects poison others with which they come in contact will be a great help. Of course it will be impossible to destroy all insects, but a certain limit to calamities could be attained, and I think that is all that could reasonably be expected. In greenhouses the result would probably justify very well a trial, and on currant worms and potato bugs the experiment would not be a difficult one, as the larvæ of both insects live upon the leaves, which can easily be sprinkled. But it seems to me more important to make the trial with the Colorado grasshopper. I should recommend to infest the newly-hatched brood, which live always together in great numbers, and I should recommend also to bring the poison, if possible, in contact with the eggs in the egg-holes, to arrive at the same results, which were so fatal to Mr. Trouvelot's silk-raising. After all, the remedy proposed is very cheap, is everywhere to be had or easily to be prepared, has the great advantage of not being obnoxious to man or domestic animals, and if successful would be really a benefit to mankind. Nevertheless, I should not be astonished at all if the first trial with this remedy would not be very successful, even a failure. The quantity to be applied and the manner of the application can only be known by experiment, but I am sure that it will not be difficult to find out the right method. I myself have more confidence in the proposed remedy, since it is neither an hypothesis nor a guess-work, but simply the application of true and well-observed facts. I hear the question—When all this has been known for so long a time, why was it not used long ago ? But is that not true for many, not to say for all, discoveries ? Most of them are like the famous Columbus egg.

A SUCCESSFUL MOTH-TRAP.

BY O. S. WESTCOTT, RACINE, WIS.

Many attempts have been made to devise something by means of which to capture the Noctuidæ, but the results have been usually so meagre that the contrivances have been abandoned in disgust. I have been using a contrivance this season which will

really abundantly repay one for the trifling trouble and expense involved in its construction. It consists first of a gallon glass jar, heavily charged with cyanide of potassium. To the top of this is fitted a funnel, the spreading mouth of which opens at right angles to the axis of the poisoned jar. The lower end of the funnel is four or five inches below the mouth of the jar and has an opening three inches in diameter, the funnel mouth being twelve or thirteen inches across. Opposite the mouth of the funnel, and on the opposite side of the jar, is soldered to the funnel a sheet of tin so bent as to thoroughly enclose a lamp. The lamp is supported by a piece of tin hinged to the outer edge of this projection. The lamp being placed in position, the tin support is made to rest upon the projecting part of the jar below its neck. Immediately in front of the light is placed a sheet of mica. The whole contrivance is placed within a tight wooden box, and a tin flap is also arranged above the lamp chimney as a precaution against an undesired conflagration.

The moth attracted by the light, flies into the mouth of the funnel, is stopped by the mica, and after fluttering a very short time, is so far overcome by the fumes of the potassium as to fall within the poisoned jar, whence it cannot emerge. A projecting lip of an inch or so in height is soldered to the lower edge of the mouth of the funnel in such a way as to catch any insect that falls outside the mouth of the jar. It thus is most likely to return to the light. I have taken with this contrivance hundreds of Noctuidæ and Coleoptera, among the former many things—especially among the Tineidæ—entirely new to my cabinet.

A CHEAP ENTOMOLOGICAL CABINET.

BY W. H. HARRINGTON, OTTAWA, ONT.

I have recently been looking over the back volumes of the *Entomologist*, and have found them, as I do the later numbers, very interesting and instructive reading. Among other valuable items, I have noticed suggestions regarding the construction of cheap cases for holding specimens, and as the question of expense is always an important one especially to young collectors, I will, if you can spare me space, briefly describe the style of cabinet I am now using, and which has been adopted by one of my friends.

Among the substitutes for cork mentioned by Packard (in his Guide to the Study of Insects) are thin frames covered on each side with paper and fitted into the bottom of drawers in a cabinet. Now I have gone a step farther, and discarding the drawers entirely, have adopted the frames and adapted them to a cabinet without drawers. This cabinet can be made of any size and be divided by upright partitions to suit the taste of the owner, and the frames can run in grooves made in the sides and partitions before it is put together, or between movable strips tacked or screwed in afterward at suitable distances, say two inches. The one I now use (a small one made as an experiment) is three feet two inches wide inside, with two partitions, so that there are three spaces each one foot in width. It is fifteen inches deep and two feet high. Placing the frames two inches apart gives me twelve in each section, or thirty-six in all, and as each has a surface of twelve by fifteen inches, I have an aggregate expanse of thirty-six square feet. The advantages claimed for this cabinet are its lesser weight and expense. It is easily handled and can stand pretty rough usage without fear of damaging specimens, as the pins are firmly held, and the frames, running in grooves or between strips, cannot stir when the door shuts close against them. It does away with the expense of drawers, the cork alone for which (thirty-six feet at 18 cents per foot) would be $6.48. The frames constructed of thin stuff (say quarter-inch) cost at the most five cents each, and suitable stiff cartridge paper is very cheap. If the frames are made slightly smaller than those mentioned one sheet will cover both sides of two frames. The paper is put on when damp, but should not be too wet. The frames can be easily re-papered if needful, and if the sections are made of equal width, they will all be interchangeable, which will be found a great convenience.

This manner of keeping specimens will, I think, be particularly useful to collectors of Coleoptera. I send this, feeling that each member of the Society should contribute his mite of experience and knowledge for the benefit of his fellow-workers.

NOTES ON A WINTER HOLIDAY.

B. W. SAUNDERS, LONDON, ONT.

During a recent holiday, while on a trip South, I spent a day among the Entomologists at Albany, N.Y. To say that it was a pleasant day, an *exceedingly enjoyable* day, would convey but a faint idea of the pleasures there experienced. Arriving early in the morning, I made my way to the State Museum of Natural History, where under the guidance of Messrs. Lintner, Meske and Hill, three veteran Entomologists, I had the pleasure of inspecting the countless rarities contained in the collections of Lepidoptera made by those gentlemen in this vicinity. I have seen many collections in the course of my wanderings, but for multiplicity of species, full series of rarities and matchless perfection of individual specimens, it had never before been my pleasure to witness anything that would compare with the valued stores contained in the cabinets of these enthusiastic collectors at Albany ; and without fear of contradiction, it may be said that the Entomologists resident there have contributed more towards our knowledge of the Lepidoptera native to the northern portions of America, than any other equal number of collectors in the country. The enthusiasm they have long maintained and their indomitable perseverance have enabled them to overcome almost every obstacle and accumulate such wonderful series of specimens, especially by night captures at sugar, as no less favoured Entomologist could look over without feelings almost akin to envy. After one had seen scores upon scores of individuals of some rare Noctuid, which in one's own collection had perhaps long been represented by a treasured fragment, the question would frequently rise as to whether *anything* in this line be rare in the neighbourhood of Albany.

During the day I was also privileged to see the magnificent series of Catocalas in the collection of Dr. Jas. H. Bailey, and one could only regret that the day was too short to do any sort of justice to the mass of material to be inspected. After labouring busily from early morn until late at night, we parted at the railway station, with the most pleasant recollections of a day happily spent amidst old and and newly-found Entomological friends.

On reaching Washington, Nov'r 23, a brief visit was paid to the Entomological rooms, in the Department of Agriculture, where I had expected to find my esteemed friend, Prof. C. V. Riley, but unfortunately business had called him away from home. Through the kindness of Messrs. Pergande and Howard I was shown very many things of interest, especially in the way of insects in their earlier stages, both living in breeding cages and preserved as blown larvae, and in this way a very pleasant and instructive hour or two was spent. It was a source of grief to learn from our good friend, Chas. R. Dodge, that "Field and Forest" was about to be discontinued for want of sufficient support. This valued periodical has done good service in the cause of Natural Science, awakening an interest in this direction in many minds, and in its decease we have lost a valuable aid. It gave me much pleasure to find that veteran Entomologist, Prof. T. Glover, with health almost restored, busily engaged in his Entomological work. Through the affable kindness of Dr. T. V. Hayden, I was shown through the Department of the Interior, that great national laboratory from whence has issued so many works invaluable to the naturalist in every field of labour. After lingering long among the many interesting objects which claimed attention, I returned laden with useful works and pamphlets on subjects relating to Entomology, deeply impressed with the important work here carried on by a great and progressive nation in the interests of science; and with very pleasant recollections of the great personal kindness shown me by the worthy and distinguished head of this most useful branch of the national service.

The Smithsonian Institution was also visited, with its immense collections and innumerable objects of interest, and through the kindness and liberality of the Secretary, some recent and valuable works on Entomology and kindred subjects were secured for our Society's library.

Passing through Virginia, the Carolinas and Georgia, we landed in Fernandina, Florida, with its historic surroundings, on the 30th day of November, where everything assumed a tropical aspect, the landscape dotted with palms, orange trees, magnolias, live-oaks, and other evergreen trees, and the air so balmy as to at once suggest thoughts of butterfly nets and collecting bottles. Of the latter a supply was at hand, but not expecting to meet with anything on the wing, insect nets were left folded away in their wintry home. Many logs and chips were turned over in search of insect life, but very little was found. Subsequently, while wandering about in Jacksonville, I saw several butterflies on the wing, most of them unfamiliar; that charming yellow *Callidryas eubule*, was recognized as it floated about among the beautiful roses, jessamines, poinsettas and other flowers in the gardens, and one longed for a net that he might cultivate a closer acquaintance with this and some of the other interesting species. An old friend, *Danais archippus*, was frequently met with, and reminded me of summer at home. Florida, however, is very poor in insects at this season of the year, but as summer approaches it is in many parts a paradise for the collector. During a week spent in this land of flowers I travelled over 800 miles along its rivers and railways, seeing much of its characteristic scenery, the most southerly point touched being Leesburgh, on Lake Griffin, a little south of the 29th degree of latitude and 300 miles south of Jacksonville, by tortuous river travel. Here butterflies were more abundant, and having landed with a very pleasant party in an orange grove, amidst half a million of oranges on 2,500 large bearing trees, one was puzzled what to do first. The oranges were tempting, but the sight of beautiful specimens of *Agraulis vanillæ*, *D. berenice*, with charming *Heliconias*, *Theclas*, etc., was still more overpowering, and with hat in hand, the butterflies were vigorously pursued until several specimens had been secured, but with such imperfect means of capture at hand, the beautiful insects were battered and torn, and ones clothing having become covered with malignant burs collected in the chase, it was thought best under the circumstances—the first burst of enthusiasm being over—to devote more particular attention to the orange question.

While vigorously consuming oranges, enquiries were made as to whether the trees or fruit were subject to insect enemies. Beyond occasional specimens of the larva of *Papilio Cresphontes*, I could not learn of any caterpillar which consumed the leaves, and the only insect which seemed to trouble the orange growers at all was a species of Coccus —*Aspidiotus citricola*—which attacks the bark and foliage of both the orange and lemon trees, and occasionally, if very numerous, gives the tree a sickly appearance. But such an effect was rare, and one could not help feeling astonished at the luxuriant and vigorous growth of the average orange grove and the symmetry and beauty of the trees laden with their golden fruit, in soil, in most instances, so poor that one wondered where the nourishment came from. In our course up and down the Ocklawaha River, where the trees are everywhere clothed with the beautiful Florida moss, *Tillandsia usneoides*, and the swampy margins decked with brilliant asters and other composite flowers, many Neuropterous insects were seen on the wing, but none were captured; indeed, the catching of an insect seemed insignificant work in the midst of the excitement attendant on the shooting of alligators, herons, ducks and other large game, and at the close of the week there were very few spoils wherewith to grace the Entomological cabinet. Now, a few days later, amidst frosts and snow, the novel recollection of the recent heated butterfly chase, the cooling off under the shade of orange trees, imbibing the sweet rich juice of the fully-ripened fruit, and the additional novelty of a sunburnt brow, all in the midst of the month of December, are things not soon to be forgotten.

THE CLOVER-SEED FLY—A NEW INSECT PEST.

BY J. A. LINTNER, N. Y. STATE MUSEUM NAT. HIST., ALBANY.

In the summer of 1877, my attention was called to some "worms" which had been discovered in the heads of red clover *(Trifolium pratense)*, and were said to be preying upon the seeds. They were found to be minute maggot-like creatures, hidden within the seed-pods and entirely destroying the seeds which they attacked. Numbers of them were subsequently detected in the examination of heads of clover taken from several localities in the vicinity of Albany, and in Warren County, N. Y. I was unable at the time to refer the insect to any described species, or to find any record of a similar depredation on clover seeds in this country or in Europe.

The following season additional examples of infested clover heads were submitted to me, which had been sent from Mr. George W. Hoffman, Presiden tof the New York State Agricultural Society, from Elmira, N. Y. A number of the larvæ were obtained from these heads, and their careful examination enabled me to refer them to the Cecidomyidæ—of a species probably closely related to the well-known wheat-midge, *Cecidomyia destructor*. Several of the larvæ were preserved in alcohol, and the larger number placed in a pot of damp sand, in which they speedily buried themselves for their transformation.

At the annual meeting of the N. Y. State Agricultural Society, in this city, in January last, in a paper presented to the Society on some injurious insects observed during the past year, I gave an account of this new depredator upon an important crop, and described its larva as follows:

Cecidomyia leguminicola, n. sp.—Head subacute, subtriangular, slightly rounded laterally on its posterior half, giving that portion a subquadrangular form; a short cylindrical horny ? process at its tip, and two longer antennal processes, cylindrical, tapering apically. Body eriptical, moderately constricted at the joints, flattened on the sides, rather rounded behind, delicately shagreened, laterally at about the middle of each segment, a short fleshy papilliform process, with two short bristles of unequal length near the posterior of the segment; posterior segment bilobed, each lobe armed with two short fleshy ? processes, of which the outer is the longer; "breast-bone" of a pale yellowish colour, its projecting end divided into two rather blunt, laterally rounded, points. A dorsal row of processes similar to the lateral ones is suspected, but was not definitely made out. Colour of the living larvæ, pinkish, approaching orange; length, 0.08 of an inch.

The reading of the paper elicited the information that the insect had committed serious depredation upon clover-seed in Tompkins, Seneca and other counties in Western New York, during the past year. In Seneca County, fields of clover which had been kept for seed, proved to be not worth the cutting. It was also stated that a worm similar to those in the heads had been discovered preying upon the roots, but these are probably the same larvæ, which having matured, had left the heads for their pupation in the ground, where the Cecidomyidæ larvæ frequently remain unaltered for a considerable length of time.

The extent of the ravages throughout our country of this newly discovered insect, which promises to be of considerable economic importance, will be an interesting subject of inquiry for the ensuing summer; and the interesting question also arises, now that its hidden covert has been detected, will the species also be discovered in Europe, whence the red clover was introduced in this country.

I have been successful in obtaining examples of the imago of *Cecid. leguminicola*. Anticipating failure (since realized) in my efforts to rear it from the larvæ obtained by me last year, I applied, in May last, to Mr. R. J. Swan, of Geneva, N. Y., who at the annual meeting of the N. Y. State Agricultural Society, in January, had spoken of the occurrence in very large numbers of the larvæ in a clover field upon his farm, requesting that some of the surface soil from the field might be collected and forwarded to me. A small box of the earth (containing also some of the clover roots) of about six inches

cube, was received by me on the 2nd of June, and spread out in a glass-covered case. On the following morning a male and female were found in the box. Additional examples were disclosed from the earth—about twenty-five in all—from that time to the 27th of June, since when none have been obtained. They had undoubtedly commenced to emerge during the month of May.

Marked features of the species, which will serve in its recognition, are the genitalia of the male, which are quite broad, projected on a pedicel, and arranged in an extended pair of clasping organs; and the long jointed ovipositor of the female, of about twice the length of the abdomen.

The antennæ of the Cecidomyiæ afford perhaps the best features for determination of species. The following description of the antennæ of the male of *C. leguminicola* was drawn from fresh specimens just after death:

Number of joints seventeen in all—the basal one coloured and short, the next one black, short and naked, followed by fifteen verticillate ones. Joints on penduncles as long as the joints, subcylindrical with rounded ends, about one-half longer than broad, rather thickly verticillate; the longest hairs nearly three times as long as the joints, and projected at nearly right angles to them; the shorter hairs about equal in length to the joints, some of which curve upward and have their tips nearly in the plane of the succeeding joint; joints regularly and gradually diminishing in size to the terminal one, which is about but one-half the size of the penultimate one, and of an ovate form.

The wings are clothed with numerous short, curved, blackish hairs, which give them a dusky appearance; ciliæ paler, long. The abdomen is fuscous, marked on each segment dorsally with black hairs forming a segment of a circle having the curve in front. The thorax is black above, clothed with rather long hairs.

The insect is in all probability quite generally distributed throughout the State of New York, and will be found in adjoining States. On the 1st of July, examples of the larvæ were obtained from clover heads gathered by me on Mount Equinox, Vermont, at an elevation of 2,500 feet above tide. On July 5th, although a late period for the larvæ, mature specimens were taken from clover growing within the city of Albany, from the sidewalk of Western Avenue. The only example of the fly which has up to the present, so far as my knowledge extends, been taken at large, was captured on the Hudson River, in the vicinity of Castleton, on the 16th of the present month (July), by Mr. Dempster A. Lansingh, of Albany. The keen eye that could detect so minute an object on the crowded deck of an excursion boat, deserves to be trained for use in entomological science.

From information kindly communicated to me by Prof. Wm. H. Brewer, of Yale College, New Haven, Conn., it is very probable that the existence of this clover pest was known at least thirty years ago. He writes as follows:

"My father, Henry Brewer, of Enfield Center, Tompkins Co., N. Y., was an enthusiastic grower of clover and clover-seed as far back as I can remember. Many years ago—how long, I cannot definitely say, but certainly before 1848, it was known to us that an insect attacked the clover, which hatched out a fly. Our belief then was that the larva existed *within the seed*. On two occasions I hatched out the flies and sent them by mail to Albany, to the Entomologist there—once before 1848, and once later, somewhere between 1851 and 1855. The fly was very small and very slender, but having been found so many years ago, that is all the recollection I have of it. The clover heads were not affected externally by its presence."

There cannot be much doubt but that the above insect is identical with the little midge which has so recently commanded our attention, as the result of its multiplication, or, as is more probable, from a period of its unusual abundance. Accepting their identity, it is quite interesting that the first notice of the species, so far as known, comes from a county which is believed to be suffering more from its depredations, at the present time than any other portion of the State.

From the July number of the *American Agriculturist*, I learn, for the first time, that Prof. Riley has been engaged in investigations on this interesting insect. The article is drawn from a conversation with Prof. R., and in part from a communication by him a short time ago to the *N. Y. Tribune*. It contains a notice of the depredations, trans-

formations and appearances of the midge, and is accompanied by excellent figures of the male and female with enlargements of parts, which will be of great service in its identification.

ON THE NEW CARPET BUG.

BY DR. HAGEN, CAMBRIDGE, MASS.

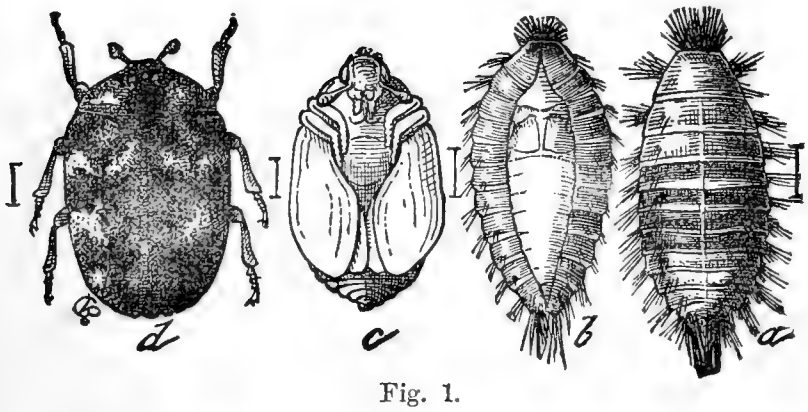


Fig. 1.

(The accompanying figure 1 represents this insect in its various stages: *a* the larva, *b* the skin of the larva, *c* the pupa and *d* the perfect beetle. This cut appeared in our last "Annual Report," but as the insect is being rapidly disseminated, we reproduce the figure here, so that all our readers may become familiar with its appearance. W.S.)

Perhaps a few additions to Mr. J. A. Lintner's very interesting article will not be out of place. In 1872 the late Mrs. W. P. L. Garrison came to visit the Museum, and told me about an insect destroying the carpets in Buffalo, N. Y., and named there "the Buffalo pest." I had not then heard anything about the insect, and Mrs. Garrison, after her departure, was kind enough to send me some living specimens from Buffalo. I bred them here in the Museum, and determined them as *Anthrenus scrophulariæ* L. The following years I had numerous inquiries from Cambridge and Boston in relation to this carpet pest, and I traced about three-fourths of all cases to a large carpet store in Washington St. in Boston, where the carpets were bought, and what ought not to have been done, they were directly laid in the rooms, without beating them before strongly and disinfecting them in some way.

Mr. Lintner was unable to find any record of its preying upon carpets or other woollens in the Old World. But there exists enough in the literature. Dr. H. Noerdlinger, in his well-known book, "Die kleinen Feinde der Landwirthschaft," etc., 1855, 8vo., p. 90, states as follows:—

"The common flower-beetle, *Anthrenus scrophulariæ*, is from April common on many flowers, especially on fruit trees and roses. It is common also in houses, etc., where it can become very obnoxious by the destruction of furs, clothes, animal collections, and even leather and dried plants. The obnoxious larva, which naturalists should take care to avoid, is common in closets and rooms in the attic, where it finds dead flies and from whence it likes to enter the other rooms."

I have taken Noerdlinger's book at random, but it would not be difficult to find such notices in similar books. To show that this pest is not a new one, I add two older authors taken at random.

F. W. Herbst, Coleoptera, vol. 7, 1797, p. 328, says:—"This beetle is everywhere very common in rooms, on buds, and especially common on tulips. It destroys, as well as its relatives, collections of insects and plants. The larva lives in he houses, like the *Dermestes*, and destroys all kinds of collections of natural objects, cloths, furs, leather and victuals." The variety of *A. scrophulariæ—sutura grisea*—is described from Europe by Illiger, 1798, p. 398. F. Wiegmann, Handbook der Zoologie, 1832, p. 308:—"The larva lives on animal matters, and is sometimes very injurious to hides."

I have ascertained this summer that the carpet bug eats of a piece of cloth consisting half of worsted, half of cotton, only the worsted threads, and left the cotton threads uninjured.

I may add some words concerning the list of the obnoxious insects introduced from

Europe into America. It is, as I believe, overlooked that about three-fourths of the insects enumerated are surely not originally European insects. They were introduced into Europe from the East by the advancement and progress of culture, and in the same way by the advancement of culture from Europe to America. The same is the case with the common weeds, and some years ago, by carefully comparing the list of European weeds in Prof. Ratzeburg's work with the lists of the described American plants, I found out that two-thirds of all European weeds are common in the United States, and perhaps a part of the last third, of which I was not able to make certain. I myself was at first much surprised to find in the middle of the prairie, near the railway to St. Paul, Minn., common European weeds. I should state that I share entirely in the wishes of the inhabitants of N. America to receive and enjoy progress and advancement of culture, without the accompanying drawbacks which nature seems to have so closely united with them.

After all, I should state that it is remarkable that such pests as the Colorado beetles emigrate very exceptionally from the west to the east; so the locust tree is even now entirely free from pests in Europe, though imported a century ago and very common everywhere. There are some American insects imported into Europe which have been overlooked. *Blatta Americana* is common in all sugar refineries to Archangel, and everywhere in large cities in store-houses. *Termes flavipes* is probably also imported from this continent. *Blatta orientalis* was imported from Asia to the west of Europe, and made from there a well ascertained migration to the east again and through Siberia. All insects finding it easier to live in the company of man, or by articles used and needed by man, will of course follow him as well as dogs and rats.

Mr. Lintner has not mentioned *Phylloxera*, which has in Europe done more injury and has caused more losses than almost all the other pests together.

NOTES ON THE HUMBLE BEES.

BY G. J. BOWLES, MONTREAL, P. Q.

(*Read before the Montreal Branch of the Ent. Soc. of Ontario.*)

Packard places the Hymenoptera at the head of the Class Insecta, on account of the completeness of their transformations and the perfection of their instincts. This is also the position assigned to this Order by Dana. Packard ranks the Bees (Apidæ) at the head of the Hymenoptera, thus placing them at the very summit of the insect creation. Cresson, however in his "Catalogue of the Described Species of N. A. Hymenoptera," has them a long way down the list, after the Ants, Wasps, etc. Who shall decide when such authorities disagree?

I wish to draw attention to the Humble Bees of this part of Canada, giving, as far as I can, the names of the species found here and some notes on their economy, the latter chiefly taken from Putnam's paper published in 1863.

The genus *Bombus*, says Swainson, appears to be a Northern and chiefly European and American genus; there are very few inter-tropical species, and very few Oriental. Some of the tropical species, however, are very large, much larger than those found in temperate climates. As regards North America, Cresson, in 1863, enumerated 46 species, of which the greater number are found in the northern part of the continent. I have carefully tabulated his list, and find that the arrangement of their habitats is as follows, beginning at the south: Mexico 6, Southern States 3, Middle 7, Western 5, Kansas and Utah 8, California 2, New England 8, Canada 7, Hudson Bay 5, Arctic 13, Sitka 3, Greenland 1, unknown 3, and one species from Antigua. The large number from Arctic America is surprising, and would lead one to think that the number given for the more southern parts is not correct. The Arctic species, however, are peculiar to that

part of the continent, only three of them being found in Hudson Bay Territory, and only one of them coming as far south as Canada. Many of the other species are also local, but some are found over a wide area. Thus *virginicus* is found all over Canada and the United States, east of the Rocky Mountains, *vagans* from Canada to the west, *fervidus pennsylvanicus* and *separatus* the same, and *ternarius*, the only arctic species found in Canada (according to Cresson), seems to extend also over the North-Eastern, Middle and far Western States. Britain possess about 40 species.

The common name, Humble Bee, is said to be derived from Hummel or Hummer Bee, alluding to the noise made by the wings during flight. In Scotland the largest species found there is called the Bumbee.

In North America the Humble Bee is the nearest approach we have, as far as indigenous Bees are concerned, to the Hive Bee. The latter *(A. mellifica)*, however, has become naturalized on this continent in the forests to a considerable degree beyond civilization, making its nests in hollow trees, or among the branches, sometimes under ledges or in clefts of the rocks. It is said not to have been found to the West of the Mississippi before 1797, but in fourteen years it had advanced 600 miles further in that direction. I have never heard of the Honey Bee becoming wild in Canada, but it probably would if neglected when swarming takes place.

To return, however, to the Humble Bees. They do not form communities so large as Honey Bees, seldom more than two or three hundred occupying one nest, in some species not more than fifty or sixty. The community is dissolved on the approach of winter; the males and workers die, and only females have the power of passing the winter in a torpid state, among moss, in rotten wood, or in some other situation where they may enjoy protection from frost and concealment from enemies—to perpetuate the race by founding new communities in the ensuing spring. Workers are chiefly produced in the earlier part of the season, males and perfect females in the latter part of it. The females are much less prolific than those of Honey Bees, and seemingly as a kind of provision for this deprivation, they, unlike the Honey Bees, live in the same community without seeking to destroy one another, provided they belong to the same colony or nest.

Their nests are placed in different situations, some species having different habits from others in this respect. Thus of the English species, *B. terrestris* makes its nest in holes in the ground, at the depth of a foot or more, floored with leaves and lined with wax, and often entered by a winding passage. Others, as *B. lapidarius*, make their waxen nests among stones; others, as *B. muscorum*, among moss, which they mix and join with wax. The nests are enlarged as the community increases. In the spring the female or queen bee, having awaked from her torpid state, roams about until she finds a suitable place for a nest. On deciding, she immediately collects a small amount of pollen mixed with honey, and in this deposits from seven to fourteen eggs, gradually adding to the pollen mass until the first brood is hatched.

As regards the Bees which I have examined, some were taken at Quebec by me some years ago, and one or two species here. I have to thank Mr. Caulfield for the principal part of the material.

There are certain differences between the sexes which render it easy to distinguish them. Not to enter too scientifically upon this part of the subject, I give the principal points of difference.

The females may be known by their large size, and the corbiculæ or baskets on the posterior tibiæ, formed by a fringe of long hairs on *each side*.

The workers generally resemble the females very closely, the only observable difference being in the size, and this varies greatly. They may be found of all sizes from the female downwards, so that it is impossible to tell the difference in some cases.

The male is smaller than the female and larger than the generality of the workers. It has one joint more in the antennæ and one section more in the abdomen than the female.

Cresson says a very conspicuous character to distinguish the sexes is this: In the male the inner tooth of the tarsal claws is almost as long as the outer, in the female the inner tooth is quite short compared with the outer. The posterior tibiæ are without baskets, but have a fringe of hairs on the outer side.

Apathus, *Newm.*

The following remarks on this genus are from Mr. Cresson's "List of the North American species of *Bombus* and *Apathus*," Proc. Ent. Soc'y Phil., 1863:

This genus is parasitic on that of *Bombus*, and resembles it very much in general appearance. The characters with which to distinguish it from *Bombus* are as follows:—The posterior tibiæ are destitute of corbiculæ (or baskets) and are convex exteriorly; the basal joint of the posterior tarsi has no tooth at its base above. In the *female* the apex of the abdomen curves under, and the apical segment beneath has the lateral margins elevated. The mandibles have a single notch, while those of *Bombus* are distinctly toothed. This genus has no workers.

The males may be distinguished from those of *Bombus* by the posterior tibiæ being exteriorly convex and thickly coated with short hairs. The males of the latter genus have the exterior surface of the posterior tibiæ concave in the centre, with a few scattered hairs, and are fringed at the exterior margins.

The economy of our species is almost unknown.

List of Bees of the Genera Bombus and Apathus taken in the Province of Quebec.

Bombus, *Latreille.*

Virginicus, Oliv.—1 male, 4 females, 1 worker; Quebec, Montreal.
Separatus, Cresson.—1 male; Montreal.
Vagans, Smith.—2 females, 1 worker; Quebec, Montreal.
Perplexus, Cresson.—1 male; Montreal.
Fervidus, Fab.—1 male, 3 females, 2 workers; Quebec, Montreal.
Pensylvanicus, DeGeer.—1 female; Montreal, Quebec (Provancher).
Terricola, Kirby.—2 females; Quebec, Montreal.
Ternarius, Say.—1 male, 6 females, 2 workers; Montreal, Quebec.
Flavifrons, Cresson.—1 male, 3 workers; Montreal.
Sylvicola, Kirby.—3 workers; Montreal.

Apathus, *Newm.*

Ashtoni, Cresson.—1 male, 2 females; Quebec, Montreal.
Elatus, Cresson.—3 females; Montreal.

INSECT DESTRUCTIVE TO PINE TREES.—NEPHOPTERYX ZIMMERMANI.

BY D. S. KELLICOTT, BUFFALO, N. Y.

This pine-boring Pyralid was described by Prof. A. R. Grote in a paper read at the Nashville Meeting, 1877, of the American Assoc. for the Adv. of Science, and published in *Canadian Entomologist*, vol. ix., 161. During the summer and autumn of 1878, and again this year, I have made some observations upon the occurrence, larval habits and parasitic enemies of this moth, and am able to state concerning them some additional facts of interest.

The moth, it appears, is pretty widely spread, and it seems rather odd that it should not have been discovered until 1877, having been overlooked by our excellent economic Entomologists. I have met with it in some one of its stages in the following localities: It occurs not uncommonly in both foreign and native pines in and about Buffalo; many of the trees of this species in the Niagara St. Parks have been bored by it. I found it quite abundant in small white pines of the forest at Chehtowaga, Erie Co., N. Y. At

this place I found many plants had been dwarfed and ruined by their ravages. It also occurs, to what extent I am unable to say, at Hamburg and Clarence Center, in the same County. I recently visited a portion of this State, Oswego Co., formerly clad to some considerable extent with white pine, and there are yet standing some virgin forests of this splendid tree. In divers places in that county I found our borer; it is so abundant in one locality, at least, that it proves a grave enemy to the young pines of second growth where the primitive trees have been removed by the lumberman. There is near Hastings Center an "old slash" in which at least one-half of the many such small pines have been injured; indeed, in one neglected corner, among scores, scarcely one tree had escaped. In this instance, also, many pines were stunted, while some thus weakened had been broken off by the wind. In other localities where the pine is indigenous I have been unable to find it, or else it was only occasional; for example, at Portage, where young pines are plentiful, and although the trunks bore masses of pitch closely like those from the wounds by *Zimmermani*, yet a diligent search discovered but one pupa skin, and of the identity of it I am not quite certain, as it was badly broken in removing from the pitch.

April 12th last, at Hastings, I took many larvæ of various sizes from .25 to .7 of an inch in length when crawling, so there is no longer a doubt as to the winter stage. None of these taken were "livid or blackish green," but dull white; nor do the hairs arise from a "series of black dots," but from light brown ones. I take it to be a case where a naked hybernating larva is lighter than during the warm summer. Otherwise the caterpillars were as described by Mr. Grote.

In a clump of pines whose trunks were from 6 in. to 1 ft. in diameter many of the larger ones had been "boxed," i. e., inclined incisions had been cut by the axe through the sap-wood in order to catch the pitch exuding from the wound. Around the borders of these "boxes" the galleries with both pupa skins and living larvæ were plentiful. It appears that the larva cannot penetrate the outer bark of other than quite tender trees; nor could I find evidence of their attacking the branches of larger trees, although I had opportunity to examine such that had been felled during the winter just past. Since this larva so readily take advantage of a wound, may it not stand related as a *messmate* to other borers? At both Chehtowaga and Hastings I found on trunks in the same neighborhood masses of exuding pitch in which were larvæ of an orange colour, attaining a length of .45 of an inch, remaining through the winter, and going into pupa towards spring, as I found them in both conditions April 12th and early in May. These larvæ are those of one of the *pine weevils*. It appears to me that *Zimmermani* may and does take advantage of these wounds by the weevil, as it does of those made by the axe.

I have found the moth's galleries in both trunk and branch, both above and below the whorls (usually below), sometimes completely girdling the stem, thus killing the portion above; in one instance I found a gallery passing from one whorl to the one above.

Now, when the moth borer and the weevil work together and pretty much in the same way, *i. e.*, by cutting the inner bark and the cambium layer, thus scoring and girdling the stem, to which culprit belongs the greatest amount of credit for mischief? Both are guilty of enough to justify everlasting execration.

It remains to add a word about its insect enemies. The hymenopterous parasite which Mr. Grote found to fill certain of the chrysalids, I have found in every location where the moth is at all abundant; there is another which I have found quite as abundant. Early in April I obtained from the galleries of last year a number of brown cocoons, about .4 of an inch long, nearly cylindrical, ends rounded, texture thin papery, pupa visible through the cocoon. The skin and head of the victim was found at one end of this cocoon, showing that the caterpillar was the host.

In a few days there appeared from each cocoon a lively fly. Expanse of male, .6 in.; of female, .7 in. Colour above black, legs yellow, underside of abdomen white with a row of black dashes on side, front of male white, of female black. A white line on shoulder of each extends on to the costa. Ovipositor as long as the abdomen.

I shall presently refer the species for identification.

NOTES ON THE LARVA OF THE MAY BEETLE—LACHNOSTERNA FUSCA.

BY L. O. HOWARD, WASHINGTON.

The following note may prove of interest as showing the numbers in which the larvæ of *Lachnosterna fusca* may exist in a lawn without perceptible damage to the grass resulting.

On the 17th of September, while walking through the Capitol grounds a few hours after a heavy shower of rain, I observed these larvæ in great numbers upon the stone pavement north and east of the Capitol building. I counted up to three hundred, and then came to a spot where they were so thick that I had to give it up. I certainly saw *thousands*, nearly all of which were dead, either from heat or from having been trodden upon. Upon interviewing the Superintendent of the ground, I learned that at this season of the year the grubs always make their appearance in like numbers after a hard rain. This gentleman informed me, and his statement was corroborated by several others, that frequently the sweepers of a morning in going over the walks would collect at the bottom of the hill as many as a *bushel* of the grubs. The pavement is edged on both sides by a two-inch curb, and the larvæ falling over this are unable to return ; only those grubs inhabiting the earth near the curb would reach the walk, and the great numbers killed in this way after every shower afford an index to the immense number which the entire lawn must contain. Yet, in spite of this most serious drawback, as one would naturally call it, the grass over the entire plot is so fresh and green as to call for universal admiration.

The movements of the larvæ upon the smooth pavement were very interesting. The characteristic bend of the body unfits them for walking on smooth surfaces, and every live individual that I observed was upon its back, moving forward quite rapidly by the alternate expansion and contraction of the segments. This mode of locomotion seemed strange at first, but upon reflecting that the probable natural position of the larva in the earth is upon its back with its legs grasping the grass roots, it seemed not so unnatural after all. The strong transverse corrugations and rows of bristles upon the dorsum, taken in connection with the extremely business-like and natural air with which the larvæ took this position and the rapid progress which they made while in it, would seem to indicate that the back is used for locomotion with these insects more than has perhaps been suspected.

OTTAWA FIELD-NATURALISTS' CLUB.

We are glad to learn that the Naturalists resident in Ottawa have organized under the above heading, with the avowed object of paying special attention to the Natural History of the Ottawa District. The Club is under the patronage of His Excellency the Governor-General, and has an efficient staff of officers ; among whom we observe the names of two of our esteemed contributors, J. Fletcher and W. H. Harrington, both enthusiastic Entomologists, and we are pleased to see Entomology so well represented in this connection. It is intended to have occasional excursions during the summer, and evening meetings during the winter for the pursuit and discussion of Natural History subjects. Already the Club has had one very successful excursion, the party numbering in all, ladies and gentlemen, about forty. We should like to see such clubs organized in every city in our Dominion. There is a growing fondness for this interesting study, especially among our young people, and a little stimulus of this sort would materially aid in developing it.

OBITUARY NOTICES.

W. V. ANDREWS.

It becomes our painful duty to announce the death of one of our correspondents, Mr. W. V. Andrews, of Brooklyn, N. Y., who died on the 20th of October, 1878, after a brief illness, resulting from a sudden attack of paralysis.

William Valentine Andrews, was born on the 11th of February, 1811, in Pilton, Somerset, England. At an early age he entered the British service, and served as a private in the Coldstream Guards, rising eventually to the rank of Captain. Subsequently he resigned his commission and removed to Canada, where he resided for several years in London, Ont., engaged in the book and periodical business. From thence he removed to the United States and settled in Brooklyn, where he spent the last few years of his life in the same branch of business, devoting his leisure time chiefly to the study of Entomology, in which he made rapid progress. He had a well arranged collection of Coleoptera and Lepidoptera, and a small but well selected library of Entomological works. His remains were interred at Rosedale Cemetery, New Jersey.

Since his decease his collections and library have been purchased by Mr. John Akhurst, of Brooklyn, N. Y.

FREDERICK SMITH.

Another veteran in the Entomological ranks has passed to his rest. Frederick Smith, the renowned English Hymenopterist, is no more ; he died on the 16th of February, in the 74th year of his age, from exhaustion consequent on a painful and dangerous surgical operation. He was born in London, England, in 1805, and in early life was apprenticed to Mr. W. B. Cooke, an eminent landscape engraver, where he acquired a very thorough knowledge of the engraver's art, which was of great use to him in after life. While still a young man he became an ardent collector of bees and ants, and also devoted some attention to the collecting of Coleoptera ; but it was not until 1837 that the first paper from his pen was published, giving an account of the natural history of one of the Gall Flies. From 1842 to the time of his death his publications were very numerous and of great value. A most industrious man, a painstaking and methodical student, and an accurate observer, he has done very much to advance our knowledge of the Order in which he especially laboured. By his death Entomology loses a sincere and talented advocate and an earnest votary, and Entomologists will greatly miss a friend who was ever ready to impart his knowledge to others.

United States Entomological Commission.

The Entomologists composing this commission have during 1879 devoted their attention mainly to an investigation in reference to the Hessian Fly, an insect which has entailed untold losses on the agricultural community both in this country and the United States. Early in the year the following circular was issued and widely distributed among Entomologists and farmers. A large amount of information has in this manner been gathered and we look forward with much interest to the appearance of the report on this important subject.

Department of the Interior—Office of the U. S. Entomological Commission.

Providence, R. I., June, 1879.

Dear Sir,—The Commission desires your co-operation in obtaining facts concerning the habits of the Hessian Fly, with statistics of losses occasioned in your town or county by its attacks ; and accounts of the remedies best calculated to prevent its increase, and to destroy it. In brief the habits of the Hessian Fly are as follows : In May and June two or three small reddish-white maggots may be found embedded in the crown of the roots of the wheat, at or near the surface of the soil, causing the stalks and leaves to wither and die ; the maggots harden, turn brown, then resembling a flax-seed, and change into little *black* midges with *smoky* wings, half the size of a mosquito, which appear in spring and autumn, and lay from twenty to thirty eggs in a crease in the leaf of the young plant. Specimens of the fly may be obtained by sweeping the wheat when three or four inches high, with a gauze net. Please send me specimens of the fly, eggs, maggot

and "flax-seed," in vials of alcohol, which notes as to the date when found, and full information as to the insect enemies and parasites.

The *Wheat Midge* is apt to be confounded with the Hessian Fly. It is a small, mosquito-like fly, *orange yellow*, with clear wings, which hovers over fields of young wheat in June. It attacks the heads of the wheat, laying its eggs when the wheat is in blossom. On hatching, the maggots crowd around the young kernels of wheat, causing them to become shrivelled. The maggots in July and August descend into the ground, spinning a round cocoon smaller than a mustard seed, remaining an inch below the surface till the following June.

Information regarding the following topics is respectfully solicited ; to be forwarded at the close of the season :

1. When, where, and how are the eggs deposited ?
2. When does the maggot appear ?
3. When is the "flax-seed" state of the Hessian Fly, or the seed-like cocoons of the Wheat Midge assumed ?
4. At what date do the Midges appear in spring and autumn ?
5. Look for minute parasites in the eggs and maggots. They may be bred by placing the eggs and maggots with the wheat in bottles covered with gauze, and the parasitic flies preserved in vials of alcohol,
6. Give statistics as to abundance and losses in your town.
7. State the best preventive remedies, as deep ploughing or burning in the fall, or the rotation of crops.

Specimens of wheat affected by these insects, and of the eggs, maggots and flies, together with their parasites, in alcohol, are requested. When mailed, the alcohol can be poured out, and cotton soaked in alcohol will keep the specimens wet until received. Packed in a tin box they can be sent through the mail. Address as below.

Respectfully yours,
A. S. Packard, Jr., Providence, R.I.

CANADIAN CUT-WORMS.

By G. J. Bowles, Montreal.

The term "Cut-worm" is popularly applied to certain caterpillars or larvæ which have the habit of cutting the stems of young plants, either just above or just below the surface of the ground. The name is also often given to the larva of the May-beetle, (the "white grub,") and to wire-worms, &c.; but it is especially appropriate to the caterpillars of some of the night moths belonging to the genera *Agrotis*, *Hadena*, *Mamestra*, &c., which are noted for the destructive habit above referred to.

In Europe there are many species of these insects, which at times prove very injurious to vegetation. Some despoil the fields of wheat and other grains, others attack the vine-yards, others again devastate the meadows, while others do great damage to root crops and garden vegetables. These belong principally to the genus *Agrotis*, and in the same genus are placed several of the American moths which produce our cut-worms.

The natural history of these worms is thus given by Mr. Riley, in his first Report, (Missouri) :

"The parent moth attaches her eggs to some substance near the ground, or deposits them on plants, mostly during the latter part of summer, though occasionally in the spring of the year. Those which are deposited during late summer, hatch early in the fall, and the young worms, crawling into the ground, feed upon the tender roots and shoots of herbaceous plants. At this time of the year, the worms being small and their food plentiful, the damage they do is seldom noticed. On the approach of winter they are usually about two-thirds grown, when they descend deeper into the ground, and,

curling themselves up, remain torpid until the following spring. When spring returns, they are quite ravenous, and their cutting propensities having fully developed, they ascend to the surface and attack the first green succulent vegetation that comes in their way. When full grown they descend deeper into the earth, and form for themselves oval chambers, in which they change to chrysalids. In this state they remain from two to four weeks, and finally come forth during June, July and August as moths, the chrysalis skin, being in most cases so thin, that it is impossible to preserve it. These moths in time lay eggs, and their progeny goes through the same cycle of changes."

The worms vary in size and markings, but they are all smooth, naked, and greasy looking, and are of some shade of green, grey, brown or black, with a polished, scaly head, and a shield of the same colour on the top of the first and last segments; while most of them have several minute shiny spots on the other segments, each spot giving rise to a minute stiff hair. They also have the habit of curling up when disturbed.

The moths are of sombre colours, and fly generally at night, often entering lighted rooms, even in large cities. The upper wings always have two more or less distinctly marked spots, one round, the other kidney-shaped, and the lower wings are generally grey or white, without spots.

The history of American Cut-worms has engaged the attention of some of our best entomologists:—Fitch, Harris and Riley, amongst others, have studied them closely; the last mentioned, however, being the only one who has fully surmounted the natural difficulties in the way of rearing the larvæ, caused by their restless and peculiar habits. In the Report already quoted, Mr. Riley has given the life history of ten species, all of which are found in Canada, and as a knowledge of the habits of our species is of considerable importance to our people, I shall briefly notice in detail those which are most numerous and destructive.

As to the injuries caused by these caterpillars, they are so well known that it is hardly necessary to recapitulate them. It is chiefly during May and June that they are found to be most destructive, at the time when the young corn and other plants are a few inches high, and the stems of cabbages and other garden vegetables are young and succulent. Even the flower garden suffers from their attacks, and our balsams, pinks and other flowers, are ruthlessly destroyed by them. And (what is of more interest to our fruit-growers) some species (which are also found in Canada) have the habit in early spring, of ascending fruit trees and destroying the young buds, both of the leaves and blossoms, thus disappointing the hopes of the fruit-grower, and sometimes killing the trees.

Agrotis devastator.—*Brace.*

The Devastating Dart Moth—Larva—The Glassy Cut-worm.—Riley.

This is one of the most common of our Cut-worm moths, and is distributed over a wide area, being not only found in Canada, but also all over the Northern and Western United States.

The eggs are doubtless laid in the autumn, as when the worms are found in May, they are nearly full grown. Mr. Riley calls it the "Glassy Cut-worm," from its translucent glassy green body, in contrast with a very distinct hard polished dark brown shield on the first segment, and a bright venetian-red head. There are several small spots on each segment of the body, and it is very sparsely studded with hairs. This Caterpillar, figure 2, after Riley, is the "Cabbage Cut-worm" of Harris, and often does great injury in gardens. Their depredations are carried on for four or five weeks in May and June, and they appear as moths from the latter part of June until September. The larva feeds on wild plants as well as cultivated, for Mr. Riley found the specimen from which he reared the moth, "under a wild endive plant, on the leaves of which it had evidently been feeding."

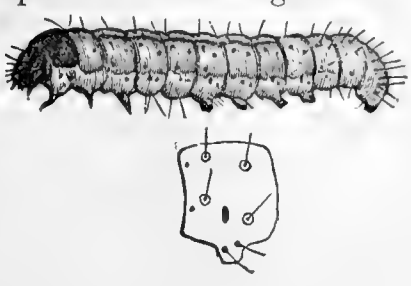


Fig. 2.

The moth is about $1\frac{3}{4}$ inches across the wings; the fore wings are dark ashen grey, with a satiny lustre, and are crossed by four narrow wavy whitish bands, edged on each side with black, there is a transverse row of white dots, followed by a row of black, arrow-headed spots between third and fourth bands, and three white dots on the outer edge near the tip; the ordinary spots are edged with black and white, and there is a third spot of oval shape and blackish colour, near the middle of the wing and touching the second band. The hind wings are light brownish grey, with a blackish border. (*Harris*) As is usual with moths of this genus, there is considerable variation in the intensity of these markings.

AGROTIS TESSELATA.—*Harris.*

The Checkered Rustic Moth—Larva—The Striped Cut-worm.—Fitch.

Common in Canada and the Northern States. This moth is evidently the same as that so fully described by Dr. Fitch in his Ninth Report (New York), as *Agrotis nigricans* Linn. variety *maizi.* The worm is notorious for its depredations in cornfields, as the name —*maizi*—given to it by Dr. Fitch, indicates. It cuts off the plant about half an inch or an inch *above* the surface of the ground, and thus many of the plants, though severed, may survive the injury, and send up new leaves from the stump.

The striped Cut-worm, as Fitch calls it, is from an inch to an inch and a half in length. Its ground colour is dirty white or ash grey, sometimes tinged with yellowish, the shield on top of first segment is shining black, with three whitish longitudinal stripes, a whitish line along middle of back, between two black ones, and on each side of the body three dark and two pale stripes, sometimes another whitish stripe below the lowest dark one, and all the under part of the body pale white. Head black with a white stripe along the middle. (*Fitch*).

These worms attack the corn during the month of June, and after changing to chrysalids in the ground, come forth in the moth state from the middle of July to the end of August.

The moth is about $1\frac{1}{3}$ inch. in expanse, and is dark ash coloured, with but faint traces of the ordinary bands. It may be easily identified by the two ordinary spots on the fore wings being large and pale, and separated by a square black spot. There is also a triangular black spot in advance of the smaller pale spot, and a small black spot near the base of the wing. The hind wings are brownish grey, with a blackish border. It is a variable insect.

HADENA ARCTICA.—*Boisduval.*

Hadena amica.—Harris. *Hadena amputatrix.*—Fitch.

Larva—The Yellow-headed Cut-worm.—Fitch.

Very common in Canada, East and West, also over the northern United States. It is a larger moth than those previously described, and has greater pretentions to beauty.

This is another of the Corn Cut-worm moths. Dr. Fitch has named the caterpillar the Yellow-headed Cut-worm, and describes it and its habits at great length in his Ninth Report. The worm is of a smoky or livid brown colour, with a yellow or chestnut coloured head, and a horny shield of the same colour on the first and last segments of the body. It grows to a larger size than other Cut-worms, and is peculiarly destructive because it severs the plant about an inch *below* the surface of the ground, thus destroying it irremediably. They also attack the corn till a later period than the preceding species.

According to Harris, this worm has also the habit of climbing bushes and young trees, to devour the buds, thus combining the habits of the ordinary Cut-worms with those of the climbing species described by Mr. Riley.

The moth appears during July and August, and is a large one, measuring nearly two inches across the expanded wings. The fore-wings are of a deep spanish brown, variegated with grey. The small ordinary spot has a grey border. The kidney spot is large, grey,

and very conspicious. There is a broad wavy pearl-grey or blue-grey band across the hinder part of the fore wings, and also a narrow wavy band between the oval spot and the shoulder. The hind wings are ash-coloured, with brownish margins, and have a pale border, and a central blackish spot underneath. The body is brown and rust-red *Harris*). The moth flies at night and often enters lighted rooms in the evening.

AGROTIS TELIFERA.—*Harris.*

The Lance Rustic—Larva—The Greasy Cut-worm.—Riley.

Very common in Canada, from June until October ; and also at least as far west as Missouri.

The greasy cut-worm, when full-grown is about one inch and a half in length, and generally of a dull leaden brown, sometimes inclining to black. It has a faint dirty yellowish line along the back, a more distinct one on each side, and below each of these, two other indistinct pale lines. It has also eight or nine black shiny spots on each segment ; the head is light brown with a dark spot on each side, and dark brown above, and the shield on neck is dark brown, except a stripe above on each side. The sides and posterior portions of the body are studded with short white bristles.

This worm is one of the most injurious of its kind, possessing the *cutting* propensity in a very marked degree. In the Western States it is extremely destructive to corn, tomatoes, tobacco, and many other cultivated plants, cutting them off about an inch above the ground, and attacking plants of quite a large growth. It seems to act almost from mere wantonness, one worm often ruining several plants in a single night, by severing them one after the other. It is a very general feeder, and will thrive on apple or grape leaves, when it can get nothing else.

Fig. 3.

The moth, figure 3, (after Riley) first described by Harris, is rather a large insect, being about one and a half inches in expanse. It closely resembles the *Agrotis suffusa* of Europe, so much so that Mr. Norman in his list of Canadian Noctuidæ (Can. Ent. 1875) calls it by the latter name. (Mr Grote, in his Check List, places both these names as synonyms, and calls the moth *Agrotis ypsilon*, Rott.) The following is the description by Harris :—The fore wings are light brown, shaded with dark brown along the outer thick edge ; and in the middle also in the female ; these wings are divided into three nearly equal parts by two transverse bands, each composed of two wavy dark brown lines ; in the middle space are situated the two ordinary spots, together with a third oval spot, which touches the anterior band ; these spots are encircled with dark brown, and the kidney spot bears a dark-brown lance-shaped mark on its hinder part ; (whence the name of the moth), the hindmost third of the wing is crossed by a broad pale brown band, and is ornamented by a narrow wavy or festooned line, and several small blackish spots near the margin. The hind wings are pearly white, and semi-transparent, shaded behind and veined with dusky brown.

Mr. Riley states that he found the worms two thirds grown on the 22nd of May, and that it becomes a chrysalis at the end of that month, though the moth does not make its appearancce (in Missouri) until July. Mr. Norman's note on the species is : "Swarming at sugar, flowers and light, from 2nd June until October." I myself took a fine fresh specimen this year at Montreal, on the 1st October, at sugar. These facts seem to indilate that there are two broods of the insect each year, if not more.

AGROTIS SUBGOTHICA.—*Haworth.*

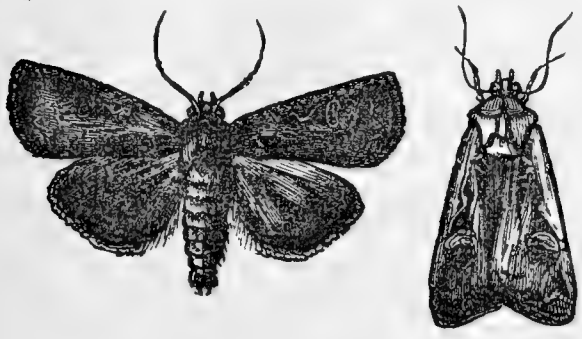
The Gothic Dart Moth—Larva—The Western Striped Cut-worm.—Riley.

Common in Canada, and the Northern and Western States. It was first described in the year 1810 by Mr. Haworth, and is supposed to be an English insect ; but as it is

quite rare in England, and very common in America, Dr. Fitch and Mr. Riley are of the opinion that it is an American Insect, the eggs or larvæ of which have been accidentally carried to England.

The caterpillar of this moth much resembles that of *Agrotis tesselata*, described on a previous page. The ground colour is a dirty white or ash-grey, and it has three broad dark lines and two light narrow ones on the sides, and a light line edged on each side by a dark one along the centre of the back. The head is black. Mr. Riley, (who describes the worms as above), found them in an orchard and gives them the name of the "Western Striped Cut-worm."

Their habits are not yet clearly made out but they are probably similar to those of the next mentioned species, which Mr. Riley considers distinct, but Mr. Grote looks upon as identical.



a. Fig. 4. *b.*

The markings of the moth are very conspicuous and somewhat resemble those of *Agrotis tesselata.* In figure 4 *a* represents the moth with the wings expanded, *b* with the wings closed. The fore-wings are greyish brown along the front edge, the two spots are of the same colour, and the black intermediate spot, which is square in *tessalata*, is rhomboidal in this species, and joined to the triangular spot on the inner side. There is also a large black spot below the kidney-shaped one, and a long blackish dash, extending from the base of the wing, about half-way down the wing near the inner edge, divided into three spots by two narrow diagonal brown lines. Between this dash and the series of spots near the outer edge of the wing is a light brown stripe, narrowest at the base. The insect expands about an inch and a half, and appears during August and September.

Agrotis jaculifera.—*Guenee.*

The Dart-bearing Rustic Moth—Larva—The Dingy Cut-worm—Riley.

Mr. Riley has reared this insect from a cut-worm, which differs from that of the preceding species, *(subgothica)* only in the following particulars: It is never so large, it is generally darker and of a more dingy colour, the longitudinal lines are less distinct, and the back is of a more decided pale buff. The worms were found in the garden, and the species had proved quite destructive in the vicinity.

The moth, like its very near relation, is common in Canada and appears in August and September. The wings are marked in almost exactly the same way as *subgothica*, but are much brighter in colour, although the larva is so much more dingy in appearance than that of the former species. The lighter parts of the fore wings are almost silvery, instead of brown, and the darker parts of a more decided black. The inner edge of the wing is also much lighter. Mr. Riley also states that the chrysalis differs from most of the others in being of a very light honey yellow, shaded with brown. The moth is taken in July, August, and September.

Agrotis inermis.—*Harris.*

The Unarmed Rustic Moth—Larva—The Variegated Cut-worm.—Riley.

Common over Canada, the Northern and Western States. This moth is one of the largest of its genus, and so closely resembles the *Agrotis saucia* of Europe, that many entomologists consider them identical.

We are indebted to Mr. Riley for a lengthened history of the insect, comprising many interesting details. The caterpillar, (which he calls the "Variegated Cut-worm") is, when full grown, nearly two inches in length. It is mottled with dull flesh colour, brown and black, and has elongated velvety black marks on each side of the body. The head is

light grey and mottled. The worm is a very general feeder, thriving on cabbage and grape-vine leaves, and even on the wild mulberry; while some which had hatched in a drawer, were found in a half grown state, having fed entirely on some apples which happened to be in it at the time. The eggs of the insect have been found early in Spring on cherry and apple twigs, and also on the leaves of the white mulberry, near St. Louis, Missouri. This fact leads Mr. Riley to think that, in the Western States, the moth is double brooded, as these eggs must have been laid by a female, which had passed the winter either in the chrysalis or moth state, and the transformations of the insect are completed by the spring brood in about thirty-five days. In Missouri the moths appear during the latter part of June, which would allow ample time for a second brood before winter. In Ontario, Mr. Norman records the capture of the moth on the 14th August.

The worms have the climbing faculty to some extent, lying concealed during the day under the surface of the ground, and ascending vines and other plants during the night for the purpose of feeding.

The moth expands about $1\frac{3}{4}$ inches, and is marked as follows: The fore wings are light brown, shaded in the middle and towards the hinder margin with dusky brown; they are crossed by four more or less distinct, wavy bands, each formed of two blackish lines; the kidney-spot is dusky; and there are several blackish spots on the outer thick edge of the wing. The hind wings are pearly white in the middle, shaded behind and veined with dusky brown. The thorax is reddish brown, with the collar and shoulder-covers doubly edged with black. The abdomen is grey (*Harris*). It is a very variable species, as regards the depth of colour.

Agrotis messoria.—*Harris.* The Reaping Rustic Moth.

Agrotis Cochranii (*?*) Riley—*Larva.—The Dark-sided Cut-worm.*—Riley.

This moth is described by Harris as the American representative of the Corn Rustic (*Agrotis segetum*) of Europe. It is in the list of the Entomological Society of Ontario, but I cannot say whether it is abundant in Canada or not. It is found in the Province of Quebec, but is not common.

Mr. Riley has described a moth under the name of *Agrotis Cochranii*, which Mr. Grote considers to be the same as *messoria*. In case they should prove to be identical, I give some extracts from Mr. Riley's very valuable article on *Cochranii*, on account of the peculiar habits of the larvæ, a knowledge of which is important to our fruit-growers.

The Caterpillar is one of the "climbers," and does great injury to the orchards in Michigan, and States further west, being most injurious in those growing upon light, sandy soils. The general colour of the worm is dingy ash-grey, bnt it is characterized more especially by the sides being darker than the rest of the body. When young, it is much darker, and the white, which is below the lateral band, is then cream-coloured and very distinct. It grows to a little more than an inch in length. (*Riley.*)

The following graphic account of the depredations of this caterpillar is from the pen of Mr. Cochran, of Calumet, Illinois; and is commended to the notice of the fruit growers of Ontario.

"In the beginning of the evening its activity is wonderful; moving along from limb to limb swiftly, and selecting at first only the blossom buds, to one of which having fastened, it does not let go its hold until the entire head is eaten out, and from this point, so thorough is its work, no latent or adventitious bud will ever again push. From a six-year old fruit tree, I have, on a single night, taken seventy-five of these worms, and on the ensuing evening, found them well nigh as plenty on the same tree. When all the blossom buds of a tree are taken, it attacks with equal avidity the leaf buds. It is no unusual thing to find small trees with every bud that had pushed, from first intentions utterly destroyed, and frequently young orchards the first season planted, on sandy grounds, lose from 50 to 75 per cent. of their trees; sometimes those remaining will be so badly injured as to linger along a few years, fruiting prematurely each season, and then die, utterly drained

of their vital principle by this dreadful enemy. * * * It is far more destructive to fruit trees than any other insect, infinitely more so than the canker-worm, but unlike the other depredators of our orchard trees, it is easily kept in check, and at small expense permanently eradicated."

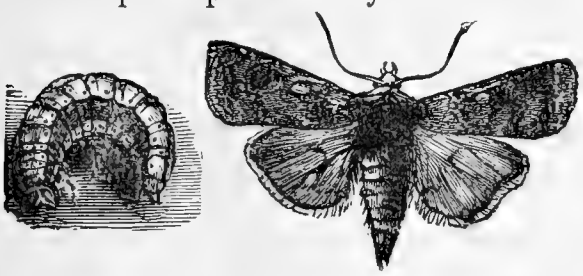


Fig. 5.

Figure 5 (after Riley), represents both the larva and perfect state of this insect. The moths appear during July and August, and expand about an inch and a half.

Mr. Harris describes *messoria* as follows:—"The fore wings are reddish gray, crossed by five wavy blackish bands, the first two of which, and generally the fourth also, are double; the two ordinary spots, and a third oval spot near the middle of the wing, are bordered with black. The hind wings are whitish, becoming dusky brown behind, and have a small central crescent and the veins dusky. The head and thorax are chinchilla-grey; the collar is edged with black; and the abodomen is light brownish-gray."

Agrotis scandens.—*Riley.*

The Climbing Rustic Moth—Larva—The Climbing Cut-worm.—Riley.

This moth, described by Mr. Riley in his First Report, is also on the list of the Entomological Society of Ontario. It is very common in the Western States, and the larva is very injurious to apple and other fruit trees, devouring the blossom and leaf buds in early spring, in the same manner as the species last described.

Even though it may not be common in Ontario, a knowledge of its habits is necessary, as our fruit-growers are often not aware of the reason why so many of their trees dwindle away and at last perish; and in many cases the loss may be caused by the attacks of this cut-worm, or others of similar habits.

The full-grown worm is nearly an inch and a half in length, and of a very light yellowish grey colour, variegated with dirty bluish green spots, and when filled with food it has a much greener appearance than at other times. In depth of shading, however, it is variable; and the young worm is of a more uniform dirty whitish yellow, with the lines along the body less distinct, but the shining spots more so than in the full-grown ones. There is a well-defined line along the back, and two lines along each side, less distinctly marked. The head and shield in first segment are tawny; the latter has a small black spot on each side, and the head has two in front and two eye spots on each side. (*Riley*).

The following is an account of its habits:—They hide under the surface of the ground during the day, but soon after dark begin ascending the trees to feed, remaining there the greater part of the night. When filled with food, they seem to suspend themselves to the limb by a thread, and drop to the ground. They seem to commence with the terminal buds, and when these are all gone, betake themselves to the side buds, thoroughly destroying all that they attack, so that the tree, if a small one, is often fatally injured. Apple, pear, peach and cherry trees are subject to their attacks and they are also very partial to grape vines. Like the preceding species, they are most abundant in orchards growing on light soils, and less frequent as the soil is more clayey; the light soil affording them easier access for purposes of concealment during the daytime.

The worms appear early in spring, and descend into the earth to become chrysalids about the end of May, coming forth as moths during June and July.

The perfect insect is about an inch and a half in alar expanse, the fore wings are a light pearly bluish grey, deepening towards the hind margin, and the hind wings are pearly white. The usual markings are generally indistinct, with the exception of the kidney spot and sub-terminal line. A black stain at the lower part of this spot forms a most distinctive character, but the peculiar colour of the moth easily separates it from other species of its genus. At the same time it is, like nearly all the Agrotidæ, somewhat variable in colour.

AGROTIS CLANDESTINA.—*Harris.*

The Clandestine Owlet Moth—Larva—The W *Marked Cut-worm.*—Riley.

Very common in Canada, the Northern and Western United States.

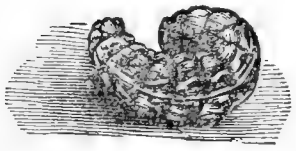


Fig. 6.

The larva of this moth fig. 6 (after Riley) is one of the climbers, but does not possess the habit to a marked degree. Though it has been caught eating apple buds, it seems to prefer low bushels, such as currants, &c., and its more congenial food is garden vegetab es. The bill of indictments against this worm is a heavy one, as ithas been found to attack wheat, young corn, buckwheat, young pumpkins, beans, cabbages, and many other garden plants. In feeding, it frequently drags its food under stones or into the ground, so that it may devour it at leisure.

The general colour of the worm is ash grey, inclining on the back and upper sides to dirty yellow, and it is finely speckled over with black and brown spots. Along the back is a fine light line, a light sulphur yellow line on each side, with a band of dirty brownish yellow beneath. The distinguishing feature is a row of black velvety marks along each side of the back, on all but the thoracic segments, and bearing a general resemblance, looking from tail to head, to the letter W, whence Mr. Riley has given it its name. Head black, with a white line in front like an inverted Y, and white at sides. It is about $1\frac{1}{4}$ inches in length. (*Riley.*)

The moth appears at the end of June. It is dark ash grey, with the usual wavy bands faintly traced. The two ordinary spots are small, narrow, and generally connected by a fine black line. The hind wings are dirty brownish white, somewhat darker behind. It expands about an inch and three-quarters. The wings, when closed, overlap on their inner edges, and cover the top of the back so flatly and closely that the insects can get into very narrow crevices. During the day they hide under the bark of trees in the chinks of fences, or the clapboarding of buildings. This peculiarity led Harris to give the moth its specific name of *clandestina.*

HADENA SUBJUNCTA.—*Grote and Robinson.*

The Subjoined Hadena—Larva—The Speckled Cut-worm.—Riley.

This moth, placed by Mr. Riley among the Cut-worm moths of Missouri, is also found in Canada. The caterpillar, when full grown, is about an inch and a half long, grey, with a tinge of rust colour on the middle of each segment, and is minutely speckled as with pepper and salt. It has an interrupted white line on the back with a similar one on each side and two spots on the back on the fore part of each segment. The head is light shiny brown. It feeds voraciously on cabbage leaves during the night, lying concealed and motionless in daytime.

The moths appear early in August, and are very distinct in appearance from those already described. They are of a dull flesh-coloured shade, marked with greyish brown and black. The ordinary spots are large, with a distinctly marked ring around them; and the abdomen is crested at the base. A full description of the insect is given by Mr. Riley, in his first Report, page 85, which is copied from that of Messrs. Grote and Robinson. It is not very common in Canada.

CELÆNA RENIGERA.—*Stephens.* C. HERBIMACULA.—*Guenee.*

The Figure 8 *Minor—Larva—The Small White Bristly Cut-worm.*—Riley.

The moth bearing this name is a pretty little insect, the fore wings being brown, variegated with lilac-grey, and mossy-green, and having a deep brown spot about the middle, and a silvery line, somewhat resembling the figure 8, around the kidney spot. It is much smaller than those previously mentioned, and has the wings broader and rounder in proportion.

The full-grown larva is a dirty-white cut-worm, about three-fourths of an inch long, covered with stiff yellow bristles, and is often found in flower gardens, where it is supposed to feed on the roots of flowers. During August it becomes a chrysalis in the ground, from which it issues as a moth in September, according to Mr, Riley, but Mr. Norman (Canadian Eutomologist, 1875) records it as very common at St. Catherines, Ontario, from 23rd June until October, and thinks there are two if not more broods of the insect each year.

Other Cut-worms.

In the preceding pages we have noticed twelve species of these caterpillars, the histories of which have been studied out. The reader will acknowledge that practical Entomology is deeply indebted to Mr. Riley, when it is stated that ten of these histories are the result of his researches. No doubt there are others which are injurious, but their economy is yet unknown. Among these is one which Mr. Riley calls the "wheat cut-worm," the moth of which he has not, as yet, succeeded in rearing. He gives an account of it in his first report, and it may, perhaps, be found in Canada.

Remedies Against Cut-worms.

Natural.—The means which nature has provided to check the increase of these worms, are, as in other cases, the attacks of predatory insects. Some of our well-known friends, belonging to the beetle, bug and ichneumon tribes, prey upon them and do good service. One of the most efficient is the larva of the fiery ground beetle (*Calosoma calidum*, Fabr.), which has been styled the "cut-worm lion," on account of the energy and activity it displays in hunting them. The larva is a flattened, black worm-like creature, with six legs on the fore part of the body, and a pair of sharp hook-like jaws projecting from the head, giving it quite a formidable appearance. It seeks the cut-worms even under the soil, and when it discovers one, fixes its jaws in the worm's throat with the grip and pertinacity of a bull dog, never letting go its hold until the larva succumbs and dies. It then feeds upon the contents of the body, and after a rest, goes in pursuit of a fresh victim.

Another beetle which preys upon them is the murky ground bettle (*Harpalus caliginosus*, Say.), and several others of the Carabidae are known to have similar habits.

Among the bugs, the spined soldier bug (*Arma spinosa*, Dallas) devours the worms bodily, and is very serviceable in thinning the numbers.

There are also several of the *Hymenoptera*, which in the larva state live internally upon them, producing four-winged flies, some very small (*Miciogaster*), others quite large, as the yellowish brown Ichnumeon, (*Paniscus geminatus*, Say.)

Poultry, particularly chickens, are also an efficient help in destroying them.

Artificial.—In order to keep cut-worms in check by artificial means, a knowledge of their habits is essential. Thus we know that they always feed at night, and in the day time conceal themselves under, but near the surface of the ground, in the immediate vicinity of the plants they have attacked. A slight search is sure to reveal them, and when found they are of course easily destroyed. This, though troublesome, is the most efficacious mode of preventing their ravages.

Ashes and lime spread around the plants have been recommended, but their usefulness is questionable. Soot seems to be more obnoxious to them. Fall ploughing is also supposed to be a remedy, and has been extensively practised, but it must be done very late in the season, when the worms are benumbed with cold, otherwise they will again descend into the soil to the depth necessary for their protection from the winter.

A curious fact in the history of these worms, is, that they cannot crawl up a perpendicular bank of earth. This fact has been utilized against them, and many have been

entrapped in smooth holes made with a stick around the hills of corn or other plants infested by them. Another plan is to strike a single deep furrow with the plough around the field or garden to be protected, with the land side made perpendicular and without breaks, thus forming a barrier which they cannot surmount and preventing them from entering from the adjacent land.

Against the climbing cut-worms, vigilance is the main requirement for success. They also feed at night, and many may be picked off the trees after dark, with the help of a lantern. Some other plans have been devised, which are easily tried, and are so lucidly explained by Mr. Riley, that I add his remarks in full:—

"From the orchard planted upon light, warm soils, they 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. A small strip of tin, three inches wide, carefully secured around the body of the tree, will effectually prevent their ascension; if the tin is old and rusty it will require to be a little wider. Each night, after the swelling of the bud, an hour or two after midnight a slight jar of the tree will bring every one on it down, when they can be caught in a spread sheet and destroyed. This will have to be followed up till the bud has unfolded into the leaf, after which there is no longer anything to be apprehended from the worm. The reasons why the clay is so efficient, are two-fold: 1st. The worms seem to have an instinctive dislike to crawling over it; 2nd. In dropping from the tree on to the hard surface they are frequently disabled, and whether disabled or not, they cannot immediately burrow into it as into sand, and they are all the more exposed to their numerous midnight enemies, which are ever watching for them."

SPIDERS.

By the Rev. C. J. S. Bethune.

[In the following paper, the writer lays no claim whatever to any originality; he has simply endeavoured to compile from various sources an account of the natural history of spiders that, he trusts, may afford interesting information to the general reader. The books from which he has mainly drawn his information are Emerton's "Structure and Habits of Spiders," (Salem, Mass., 1878); Rev. J. G. Wood's "Illustrated Natural History;" Kirby & Spence's "Entomology;" and Moggridge's "Harvesting Ants and Trap-Door Spiders." The illustrations are all reproductions of the wood-cuts in Emerton's excellent work, for permission to use which he is indebted to the publisher, Mr. S. E. Cassino, of Salem.]

1.—Introductory.

What is a Spider? is the first question that naturally arises when we begin to talk about the life-history of the class. Most persons would probably reply at once that a spider is an insect. This is undoubtedly correct in the popular acceptation of the term insect, and also accords with the derivation of the word (Latin—*in* and *seco*, I cut), signifying an animal whose body is divided into two or more segments almost entirely detached from each other. Spiders, however, are not true insects, though they belong to the same great division of the animal kingdom called the *Articulata*. As we stated in a former Report (1872, "Beneficial Insects," page 427), insects are distinguished by the following characteristics:—1st. They have their bodies divided into *segments*. 2nd. They breathe through openings in their sides *(spiracles)* from which proceed *tracheæ* or wind-pipes. 3rd. They have distinct heads, with jointed *antennæ*, or feelers. 4th. When adult they have *six articulated legs*. 5th. They go through a series of metamorphoses,

ending in a *winged* state. A spider differs from an insect in almost all these particulars: 1st. It is divided into only *two* segments. 2nd. It breathes, as a rule, through *sacs in the abdomen.* 3rd. It has no distinct head separate from the thorax, and possesses no *antennæ.* 4th. It has *eight* articulated legs. 5th. It undergoes no distinct metamorphoses, and never attains wings. On all these accounts, then, we cannot scientifically call a spider an insect, though it is often convenient to use the term in ordinary conversation. A spider technichally belongs to the class Arachnida, which includes also the scorpions and mites; from the two latter orders it is distinguished especially by its spinning organs and its faculty of making cobwebs and silk cocoons for its eggs.

2.—Anatomy.*

The common round-web spider, *Epeira vulgaris*, Hentz, will serve as well as any other species to show the anatomy of spiders in general. Figure 7 shows the under side of the spider; Figure 10 the upper side; and Figure 11 an imaginary section through the body, to show the arrangement of the internal organs. To begin with Figure 7, the body is seen to be divided into two parts connected only by the marrow joint, A, just behind the last pair of legs. The front half of the body, called the *Thorax*, contains the stomach, the central part of the nervous system, and the large muscles which work the legs and jaws. The hinder half, the *Abdomen*, contains the intestine, the breathing organs, the principal circulating-vessels, the organs of reproduction, and the spinning-organs. Connected with the thorax are six pairs of limbs, four pairs of legs, B B B B, a pair of palpi, C, and a pair of mandibles, D.

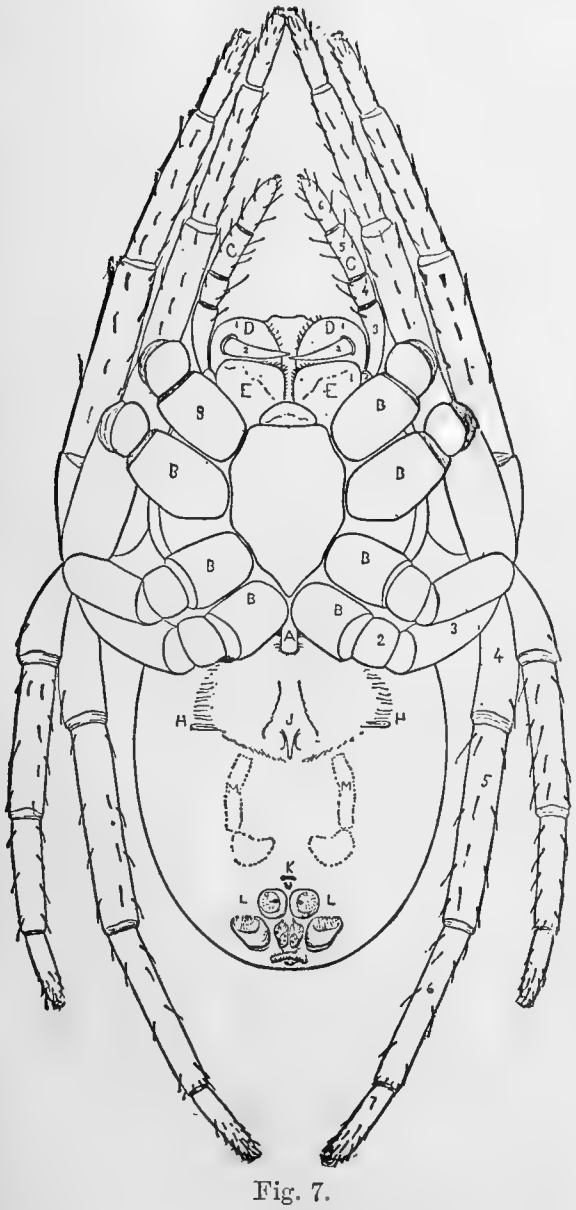


Fig. 7.

The *Legs* are used chiefly for running, jumping and climbing; but the front pair serve often as feelers, being held up before the body, while the spider walks steadily enough on the other six. One or both of the hinder legs are used to guide the thread in spinning; the spider at the same time walking or climbing about with the other six or seven. The legs are seven-jointed; and on the terminal joints are three claws, Fig. 8, A, B, C, and various hairs and spines. In many spiders a brush of hairs takes the place of the middle claw, as in the jumping-spiders, Fig. 9. Spiders with these brushes on their feet are able to walk up a steep surface or under a horizontal one, better than those with three claws. The legs of most spiders have amongst the hairs moveable spines, which, when the spider is running about, extend outward at a right angle with the leg, and when it is resting are closed against the skin.

In front of the legs are the *Palpi*, Fig. 7, C C,—a smaller pair of limbs, with six joints, and only one claw, or sometimes none. They are used as feelers, and for handling food, and in

* As the writer has stated at the outset that this paper is merely a compilation, he does not think it necessary to indicate by quotation marks, or otherwise, those portions that are taken verbatim from the authors referred to. Those who are familiar with their works will have no difficulty in verifying the passages should they desire to do so.

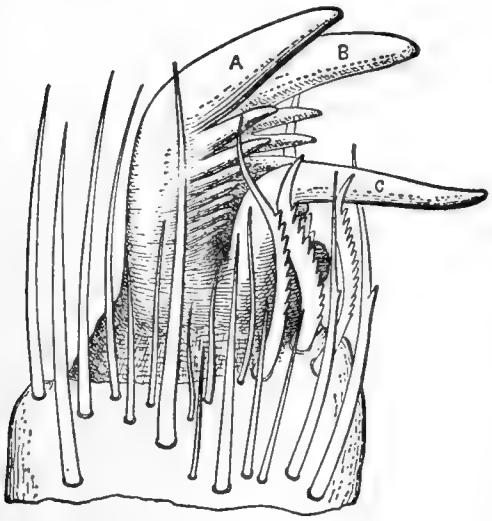


Fig. 8.

the males carry the very curious palpal organs, which are employed in the fertilization of the female. The basal joints, Fig. 7, E E, of the palpi are flattened out, and serve as chewing organs, — they are called *maxillæ*.

The front pair of limbs, the *Mandibles*, Fig. 7, D D, have two joints, the basal one is usually short and stout, and furnished on the inner side with teeth and hairs; the other is a small, sharp claw, which can be closed against the basal joint when not in use. (See also Figures 19 and 20.)

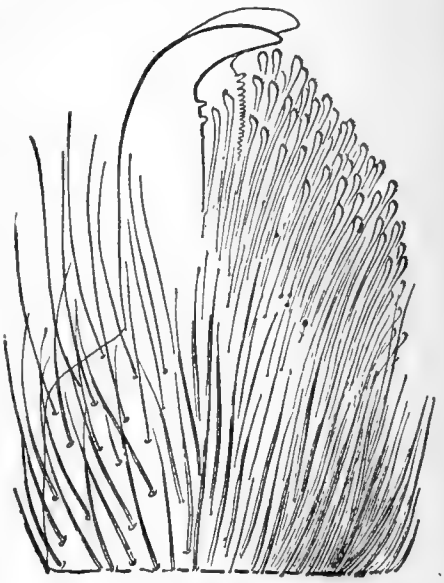


Fig. 9.

The *Abdomen*, or hinder half of the body, is furnished, just behind the legs, with two hard, smooth patches, which cover the front pair of breathing-organs, the openings to which are two little slits at Fig. 7, H. At the end of the body are the spinnerets, which will be described further on. There are three pairs of them; but many spiders close them together when not in use, so as to cover up the middle pair. Sometimes the third pair of spinnerets have several joints and extend out behind the body like two tails. In front of the spinnerets is a little opening, Figure 7, K, which leads to air-tubes that give off branches to different parts of the abdomen. At M, Figure 7, are usually two coloured bands, or rows of spots, marking the course of muscles attached to the skin at various points along these lines.

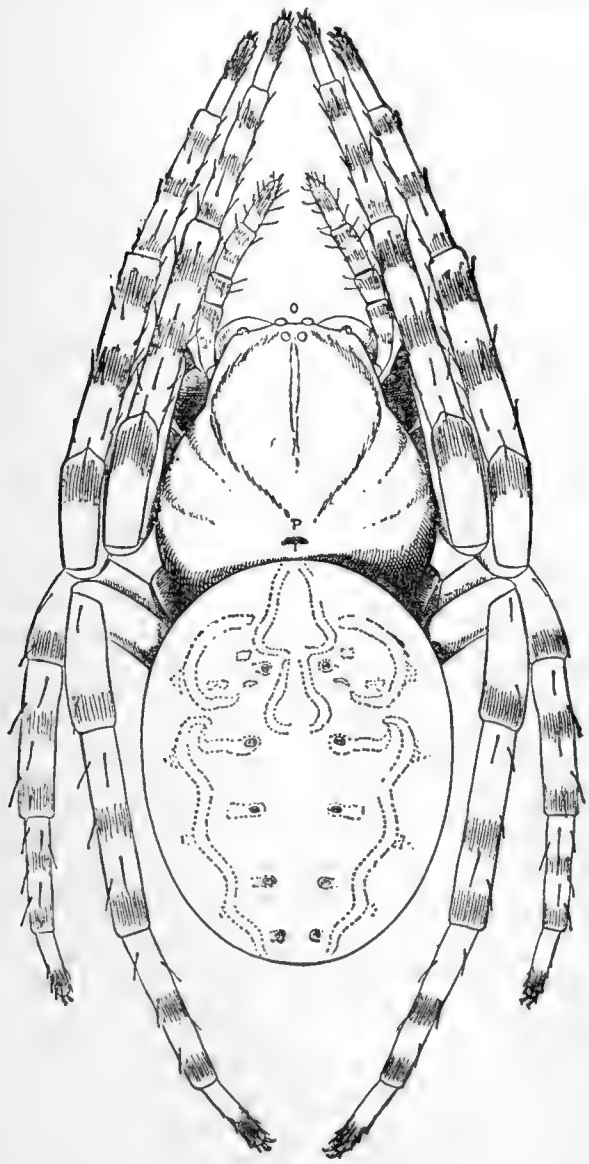


Fig. 10.

Let us now turn to figure 10, which represents the upper surface, or back of the same spider. The head is not separated from the rest of the body, as in insects, but forms one piece with the thorax. On the front of the head are eight simple eyes, O, which are differently arranged in different spiders. At the back of the thorax is a groove, P, under which is attached a muscle for moving the sucking stomach, Figure 11, D. From this point radiate shallow grooves, that follow the divisions between the muscles of the legs. On the abdomen are several pairs of dark smooth spots which mark the ends of muscles extending downward through the abdomen. The markings of this spider are very complicated. The spot on the middle of the front of the abdomen is a very common one, and in some spiders extends the whole length of the body. The waved lines on each side are also common, and in long-bodied spiders often form two bright-coloured stripes, or rows of spots, running nearly straight the whole length of the abdomen.

The following illustration, Figure 11, will convey to the reader a sufficient idea of the arrangement of the internal organs of a spider, without any more detailed description.

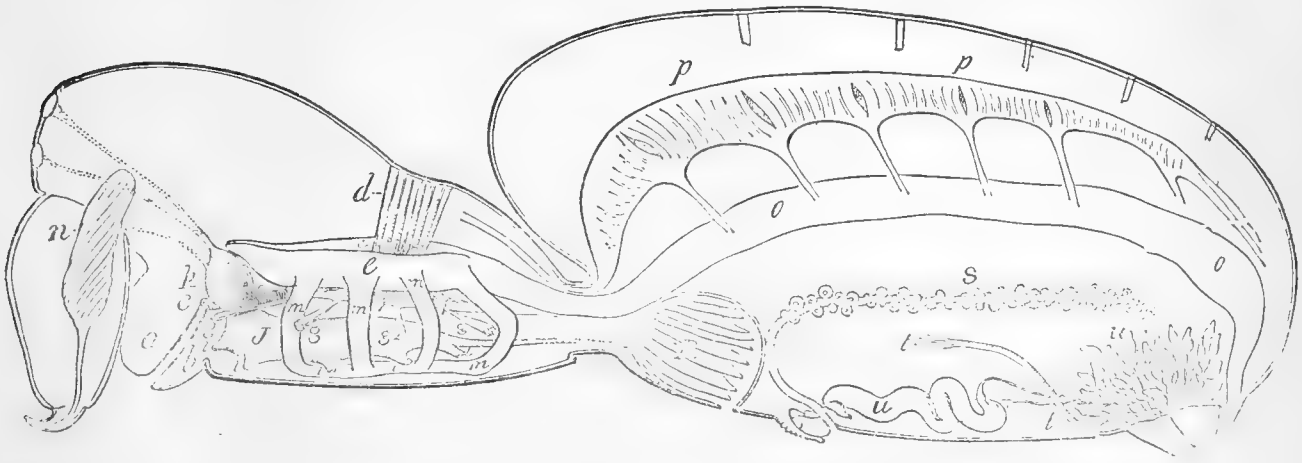


Figure 11.

Section of a spider to show the arrangement of the internal organs; *a*, *b*, upper and under lips of the mouth; *c*, *c*, the œsophagus; *d*, *f*, upper and under muscles of the sucking stomach; *e*, stomach; *g*, *g*, ligaments attached to diaphragm under the stomach; *f*, lower nervous ganglion; *k*, upper ganglion; *l l*, nerves to the legs and palpi; *m*, branches of the stomach; *n*, poison gland; *o*, intestine; *p*, heart; *R*, air-sac; *S*, ovary; *t*, air-tube; *u*, spinning-glands.

3.—Classification.

To enter into a minute account of the classification of the Arachnida would be very tedious, and occupy an undue amount of space. We shall therefore content ourselves with mentioning some of the more important families of spiders, and describe some of their characteristics.

The largest known spiders belong to the family *Mygalidæ*. They may be at once distinguished by the shape of their mandibles and the terrible claws which proceed from them. In most spiders the claws are set sideways (as in *Epeira* Figure 7, D.), but in this family they are bent downwards, and strike the prey as a lion would clutch his victim with his curved talons. The body is usually very hairy and dark-coloured. Most species have only four spinnerets, one pair of which are long and are turned up behind the abdomen; they have four air-sacs under the front of the abdomen, instead of two, as other spiders. The eyes are collected together on the front of the head. They live only in warm countries. Figure 12 represents *Mygale Hentzii*, a species found in Texas and Arizona. Many wonderful stories have been told about the ferocity of these huge spiders, their power of catching and eating small birds and other animals. These accounts were generally discredited and looked upon as mere "travellers' tales," but of late years fresh evidence has been produced by naturalists in proof of the former stories. The following description by Mr. H. W. Bates in his interesting work, "The Naturalist on the River Amazon," (page 83), sets forth the truth regarding these monsters :—

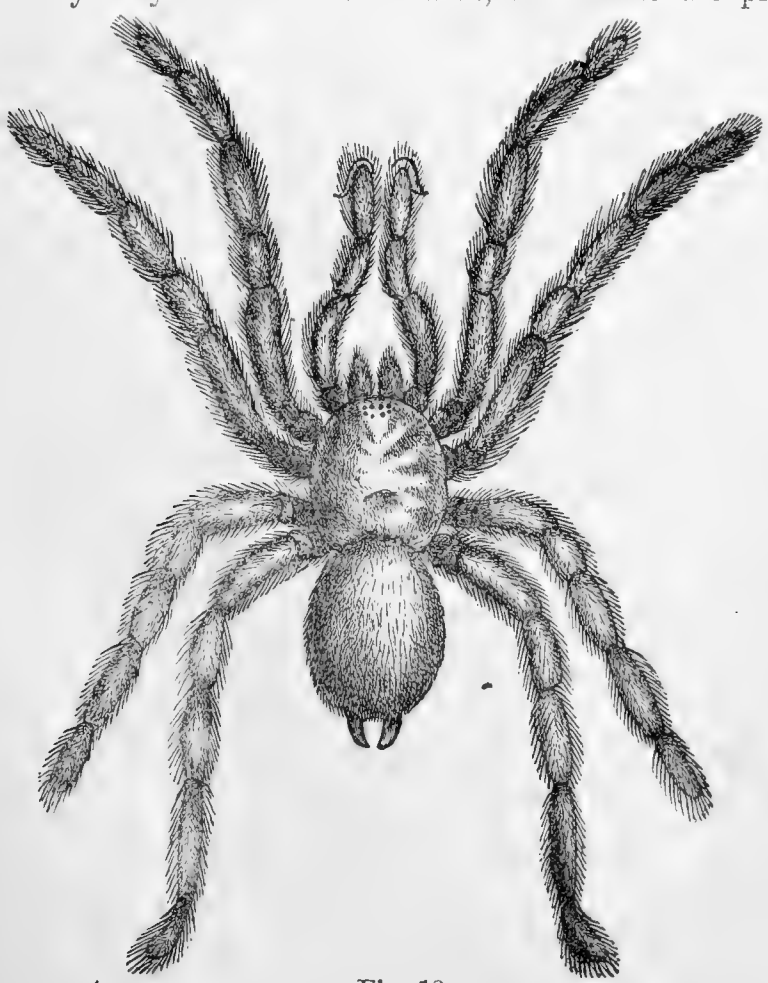


Fig. 12

"At Cameta," he relates, "I chanced to verify a fact relating to the habits of a large hairy spider of the genus Mygale, in a manner worth recording. The individual was nearly two inches in length of body, but the legs expanded seven inches, and the entire body and legs were covered with coarse grey and reddish hairs. I was attracted by a movement of the monster on a tree-trunk, it was close beneath a deep crevice in the tree, across which was stretched a dense white web. The lower part of the web was broken, and two small birds, finches, were entangled in the pieces. One of them was quite dead, the other lay under the body of the spider not quite dead, and was smeared with the filthy liquor or saliva exuded by the monster. I drove away the spider and took the birds, but the second one soon died. I found the circumstance to be quite a novelty to the residents hereabouts. The Mygales are quite common insects ; some species make their cells under stones, others form artistic tunnels in the earth, and some build their dens in the thatch of houses. The natives call them crab spiders. The hairs with which they are clothed come off when touched and cause a peculiar and almost maddening irritation. Some Mygales are of immense size. One day I saw the children belonging to an Indian family who collected for me, with one of these monsters secured by a cord around its waist, by which they were leading it about the house as they would a dog!"

Other writers relate that the spiders of this family attack humming-birds, lizards, cockroaches, ants, etc.

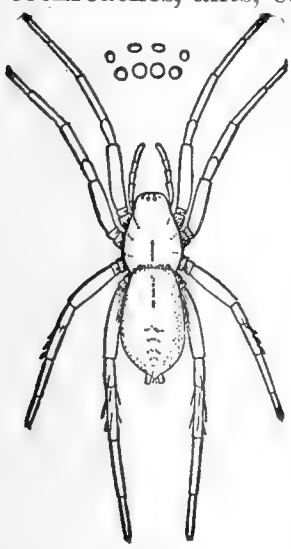


Fig. 13.

The *Dysderidæ* constitute a small family of spiders which are chiefly remarkable for possessing only six eyes, instead of the normal number of eight. They are usually found under stones or in holes in the earth ; they lie with their legs drawn up under them, but are able to move very quickly when so inclined. Very few species are known and none are common in America ; a few have been observed in Europe.

The family of the *Drassidæ* is spread over the greater part of the world ; they vary very much in shape, colour and habits. Most of them are dull coloured, while they all have the habit of concealing themselves in silken cells that they construct under stones, in chinks of walls, or on plants. They are active creatures, and catch their prey by chasing them, as they construct no webs. Figure 13 represents a species of *Drassus ;* the double row of circles above represents the mode in which the eight eyes are arranged on the front of the head. Their feet have two claws and a bunch of flat hairs : the spinnerets usually project a little beyond the abdomen.

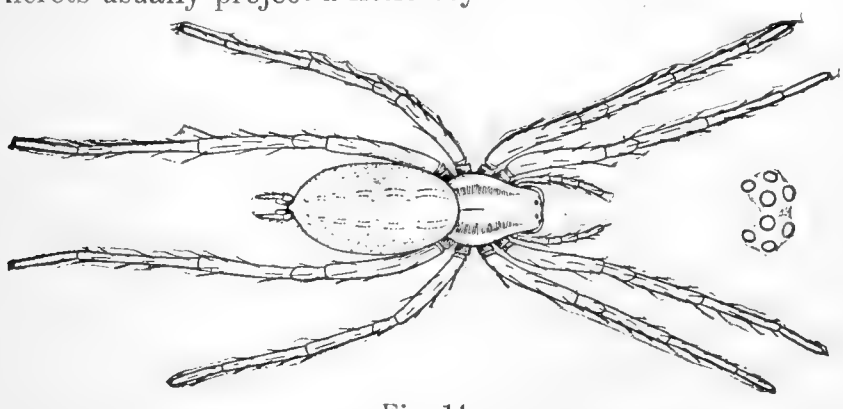


Fig. 14.

The *Agalenidæ* are long-legged, brown spiders, with two spinnerets longer than the others and extending out behind the body. Figure 14 represents *Agalena nævia*, the common grass spider. The members of this family are very numerous on grass-fields and commons, where they made flat webs with a funnel-shaped tube on one side in which the spider waits, see figure 23. Many of the species are prettily marked ; they lay their eggs in dish-shaped cocoons, which are attached to grass or other herbage, and are usually covered with little bits of dead leaves, pieces of earth and other substances in order to conceal them from enemies.

The next family, *Ciniflonidæ*, much resemble the preceding, but are distinguished by their peculiar spinning organs. They live in crevices in rocks, walls and stones, or under loose bark, and near their hiding-place they weave nets of a most elaborate structure, not flat like garden-spiders but enclosing large spaces in comparison with the small size of the builder. The web is most intricate in its arrangements, and is connected

with the hiding-place of the spider by means of a silken tunnel, through which the creature darts when it feels the vibration of an insect in its web, and to the bottom of which it retreats when danger threatens. The species of this family are very numerous, building their webs on stone buildings, often to their great disfigurement, in cellars, the corners of windows, &c. They are, no doubt, familiar to every observer.

The *Lycosidæ*, or Wolf-spiders, live on the ground and take their prey in fair chase, instead of catching it in webs. They are mostly found among herbage, low bushes, fallen leaves, and similar localities, and if they should feel alarmed, they run for safety under stones, mosses, rocks, and into any accidental crevice in the earth. They are fierce and determined hunters, chasing their prey wherever it may seek shelter. Some of them are semi-aquatic in their habits, and are not only able to run fearlessly upon the surface of the water, but can descend along the aquatic plants until they are deeply immersed, breathing by means of the air which is entangled among the hairy clothing of their bodies. They have long legs, the hind pair being the longest; the head is high, and the eyes are arranged in a peculiar manner, as shown at the bottom of Fig. 15, which represents a species of *Lycosa*.

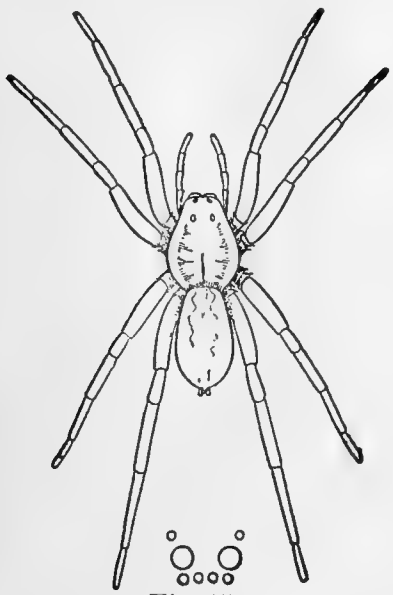


Fig. 15.

The celebrated Tarantula spider belongs to this genus. It is so called from the town of Tarentum, in Italy, where it is very common. There was a deeply rooted belief among the inhabitants of that town and neighbourhood that if any one were bitten by this spider, he would be instantly afflicted with an extraordinary disease called tarentismus, which exhibited itself in one of two extremes, the one being a profound and silent melancholy, and the other a continual convulsive movement of the whole body. It was also thought that this disease could only be cured by music, and that a certain tune was needful in each particular case. The disease undoubtedly existed and spread with great rapidity through the neighbouring towns and villages, affecting hundreds of both sexes who came within the sphere of its influence, but the poor Tarantula spider had no more to do with it than the cattle grazing in the fields or the birds chirping in the trees. It was evidently a nervous disease like chorea and hysteria at the present day, which tends to propagate itself among all exposed to its influence.

Another species of *Lycosa* frequents dry and uncultivated soils, and sinks in the ground a little pit of a depth varying with its size and the length of its residence. The interior of the cell it strengthens with a web. At the entrance of this burrow it sits watching for its prey, and as soon as an unfortunate insect passes within range, it darts forward, seizes it in its talons, and bears the victim away to its den, where it feasts in peace and solitude.

The females of this genus are extremely fond of their eggs and young. The eggs are enveloped in silken cocoons of a globular form, which the mother always drags about with her, bumping them over stones and rough ground without injury to the delicate organisms within. As soon as the young are hatched and emerge from the cocoon, they transfer themselves to the body of their parent, where they cling in such numbers that sometimes she is hardly visible under her swarming brood. They remain with their mother during the winter, and in the following spring disperse to seek their own living.

The *Attidæ*, or jumping spiders, are the next on our list of families. The body is usually short and the head square. The arrangement of the eyes is very peculiar, as they are set on the head in the form of a semi-circle, with two very large eyes in the middle of the curve; this give the spiders of this family a much more animated look than is usual among the Arachnida. The legs are short, the front pair being often stouter than the others. They can run easily backwards or sideways as well as forwards, and jump a long distance. Figure 16 represents the common grey jumping spider *(Salticus)* much magnified. Many of this family of spiders are very common; they are usually found upon walls, among stones, or under leaves; a sunny window-sill is also a favourite locality for them. When one of them sees a fly, or other insect, which it wishes to devour, it

sidles along quietly in the direction of its intended victim, keeping a most careful watch, and ever drawing nearer to its prey. As the fly moves, so moves the spider, until the two appear to be animated by one common will. Slowly, but surely, it makes its way towards the unsuspecting fly, and then with a leap so quick that the eye can scarcely follow the movement, it springs upon its prey, rolls perhaps over and over, and in a few moments emerges victorious from the contest, its victim dead or dying in its grasp. Even on a perpendicular wall the spider will make these leaps. It is sure not to fall to the ground as it always draws a silken cord behind it as it moves, and so, whenever it leaps upon its prey, it is able to mount up again to its former post.

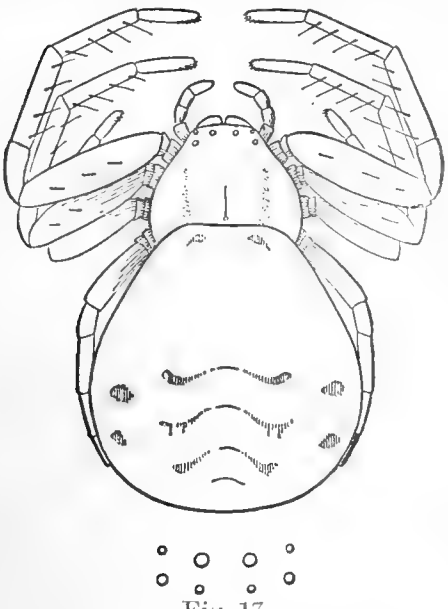


Fig. 17.

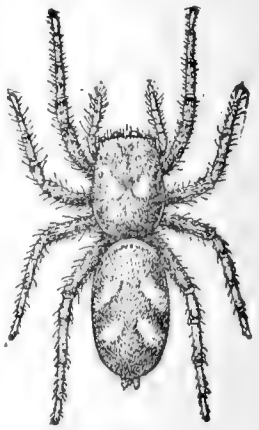


Fig. 16.

The family *Thomisidæ*, or Crab-spiders, are like the preceding, dependent for their subsistence upon their bodily powers and activity. The body is usually flat, and wide behind. The front two pair of legs are longer than the others, and so bent that the spider can use them when in a narrow crack. Some of them, like crabs, walk better sideways than forwards. Like the running and jumping spiders, they make no webs for catching food. Fig. 17 represents a species of *Thomisus*, showing at the bottom of the cut the arrangement in two rows of the eight small eyes. As in many other families of spiders, the males are very much smaller than the females.

The next family, *Theridiidæ*, contains the largest number of species, but the spiders comprising it are usually small, with large rounded abdomens and slender legs. They usually live upside down, holding on by their feet to the underside of their webs, as in fig. 18, which represents the common house *Theridion*, much enlarged. They make large cobwebs of different shapes for different species, and depend for food on what is caught in them. They are found in all parts of the world, and vary very greatly in their habits. Some live under stones, others are abundant in houses, hiding themselves in shady corners, while the greater number prefer the open air, the fields and commons, spinning their elaborate webs over the bushes, trees, or herbage. Their appearance and habits must be familiar to every one.

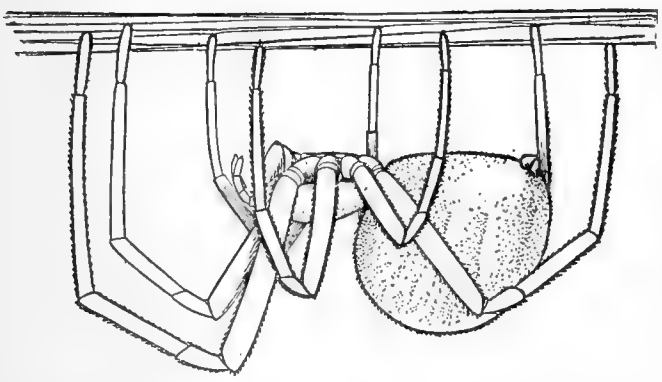


Fig. 18.

The last family on our list is the *Epeiridæ*, or round-web spiders; it contains some of the strangest members of the race. The individuals are usually large, with flat heads, and eyes wide apart, and with short round abdomens. The upper and under surfaces of a common species, *Epeira vulgaris*, are represented in figs. 7 and 10. They make webs formed of radiating lines crossed by other adhesive ones in a spiral or in concentric loops, as in fig. 24. They live in the web, hanging head downwards, or upside down in a hole near by. The webs are usually stretched perpendicularly from branch to branch of a tree, or in the angles of verandahs, fences and other outdoor localities.

4.—Biting Apparatus.

Almost every one, we imagine, looks upon spiders with a certain degree of abhorrence on account of the supposed poisonous character of their bite, and the ferocious, bloodthirsty disposition ascribed to them. The popular opinion regarding them is, no doubt, immensely exaggerated; they do, of course, possess a biting apparatus and a poison gland that we shall presently describe, but we do not think they are at all inclined to

make use of these except against their natural prey, viz., flies and other insects. Though we have often been shewn marks and swellings on the limbs of children that mothers and nurses ascribe to spiders, we have never caught a spider in the act of attacking a child, nor have we found that others have done so. While we do not for a moment deny that spiders may attack human beings, we should like a little more direct evidence before we condemn the whole race.

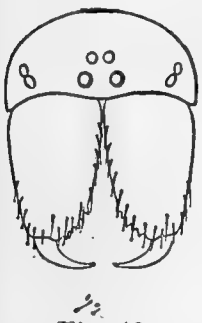


Fig. 19.

The biting apparatus is shewn in fig. 19, which represents the head and mandibles of *Epeira vulgaris*, seen from in front. When not in use, the claw is closed up against the mandible between the rows of teeth; but, when the jaws are opened to bite, the claws are turned outward, so that their points can be stuck into anything between the jaws. Fig. 20 is the claw still more enlarged, shewing a little hole near the point at *a*, out of which is discharged the poisonous secretion of a gland in the head, fig. 11, *n*. The ordinary use of the mandibles is for killing and crushing insects, so that the soft parts can be eaten by the spider; and in this they are aided by the maxillæ, fig. 7, *e*. They will sometimes chew an insect for hours, until it becomes a round lump of skin, with all the blood sucked out of it; this is then thrown away, the spider swallowing only such bits as may happen to be sucked in with the liquid portion.

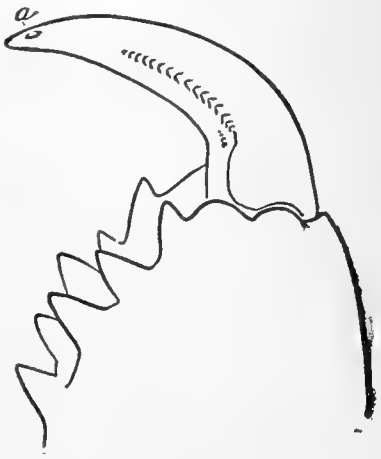


Fig. 20.

"If let alone"—to quote Emerton—"no spiders bite anything except insects useful for food; but, when attacked and cornered, all species open their jaws and bite if they can; their ability to do so depending on their size and the strength of their jaws. Notwithstanding the number of stings and pimples that are laid to spiders, undoubted cases of their biting the human skin are very rare; and the stories of death, insanity and lameness from spider-bites, are probably all untrue."

On the opposite side we may quote the Rev. J. G. Wood, who says: "I can state from personal experience that the bite of an angry spider inflicts a really painful injury, not very dissimilar to the sting of a wasp. I have seen a lady's hand and arm swollen so as to be hardly recognizable as belonging to the human figure, in consequence of a bite inflicted by a large spider on the back of her hand."

Many experiments have been tried to test the effect of the bites of spiders on animals. Doleschall shut up small birds with two species of Mygale, both large and strong spiders (see fig. 12); and the birds died in a few seconds after being bitten. One of the spiders was left for ten days without food, and then made to bite another bird, which was injured, but in six hours recovered. The same author was bitten in the finger by a jumping spider. The pain was severe for a few minutes, and was followed by lameness of the finger and gradually of the hand and arm, which soon went away entirely.

Bertkau allowed spiders to bite his hand. On the ends of the fingers the skin was too thick, but between the fingers they easily pierced it. The bite swelled and smarted for a quarter of an hour, and then itched for some time, and for a day after itched whenever rubbed, as mosquito bites will. He also experimented on flies, which died in a few minutes after being bitten.

Mr. Blackwall, to test the poison of spiders, made several large ones bite his hand and arm, and at the same time pricked himself with a needle. Although the spiders bit deep enough to draw blood, the effect of their bite was exactly like that of the prick of the needle. No inflammation or pain followed, and both healed immediately.

Several spiders were placed together, and made to bite one another. The bitten ones lived always some hours, and died from loss of blood; and one spider, that had been bitten in the abdomen so that some of the liver escaped and dried on the outside, lived over a year, apparently in good health.

A large spider was made to bite a wasp near the base of the right front wing, so as to disable it; but it lived thirteen hours.

A bee was bitten by a large spider, but lived three days.

A grasshopper was bitten, and held in the jaws of a spider for several seconds; but it lived in apparent health for two days.

Insects of the same kind were wounded in the same places with needles, and died in about the same time as those bitten. From these experiments Mr. Blackwall was led to believe that the secretion from the spider's jaw is not poisonous, but that insects die, when bitten, from loss of blood and mechanical injury.

Dufour kept a Tarantula that soon learned to take flies from his fingers without biting him. Spiders of very different species may soon be taught to take food from the hand or a pair of forceps, or water from a brush, and will come to the mouth of their bottle and reach after it on tip-toe. Many stories are also told of spiders coming out of their holes to listen to music, and of their being taught to come out and take food at the sound of an instrument.

We may quote here the account of an observer of what a spider can eat in a day :—
'In order to test what a spider can do in the way of eating, we arose about daybreak in the morning to supply his fine web with a fly. At first, however, the spider did not come from his retreat, so we peeped among the leaves, and there discovered that an earwig had been caught and was now being feasted on. The spider left the earwig, rolled up the fly, and at once returned to his "first course." This was at half-past five a.m. in September. At seven a.m. the earwig had been demolished, and the spider, after resting a while, and probably enjoying a nap, came down for the fly, which he had finished at nine a.m. A little after nine we supplied him with a daddy-long-legs, which he ate by noon. At one o'clock a blowfly was greedily seized, and then immediately, with an appetite apparently no worse for his previous indulgence, he commenced on the blowfly.'

5.—Spinning Apparatus.

That, which more than anything else, distinguishes spiders from other animals is the habit of spinning webs. Some of the mites spin irregular threads on plants, or cocoons for their eggs; and many insects spin cocoons in which to pass through the change from larva to adult. In the spiders, the spinning organs are much more complicated and used for a greater variety of purposes,—for making egg-cocoons, silk linings to their nests, and nets for catching insects. The spider's thread differs from that of insects, in being made up of a great number of finer threads laid together while soft enough to unite into one.

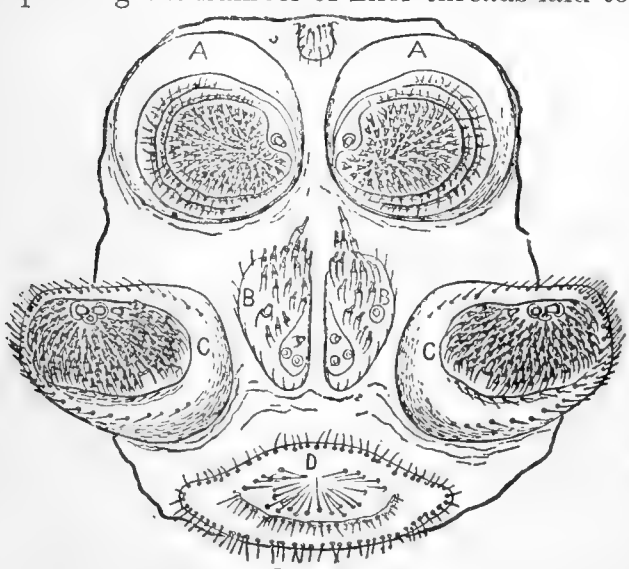


Fig. 21.

The external spinning-organs are little two-jointed tubes on the ends of the spinnerets, Fig. 7, L. Fig. 21 represents the spinnerets of the same spider, still more enlarged to shew the arrangement of the tubes. There is a large number of little tubes on each spinneret, and in certain places a few larger ones. Each tube is the outlet of a separate gland.

When the spider begins a thread it presses the spinnerets against some object, and forces out enough of the secretion from each tube to adhere to it. Then it moves the spinnerets away; and the viscid liquid is drawn out and hardens at once into threads,—one from each tube. If the spinnerets are kept apart a band of threads is formed; but if they are closed together the fine threads unite into one or more larger ones. If a spider is allowed to attach its thread to glass, the end can be seen spread out over a surface as large as the ends of the spinnerets, covered with very fine threads pointing towards the middle where they unite. The spinning is commonly helped by the hinder feet, which guide the thread and keep it clear of surrounding objects, and even pull it from the spinnerets. This is well seen when an insect has been caught in a web, and the spider is trying to tie it up with threads. She goes as near as she safely can, and draws out a band of fine threads, which she reaches out toward the insect with one of

her hind feet; so that it may strike the threads as it kicks, and become entangled with them. As soon as the insect is tied tightly enough to be handled, the spider holds and turns it over and over with her third pair of feet, while with the fourth pair, she draws out, hand over hand, the band of fine threads which adhere to the insect, as it turns, and soon cover it entirely.

It is a common habit with spiders to draw out a thread behind as they walk along; and in this way they make the great quantities of threads that sometimes cover a field of grass or the side of a house. We often see the points of all the pickets of a fence connected by threads spun in this way by spiders running down one picket and up the next, for no apparent purpose.

Spiders often descend by letting out the thread to which they hang; and are able to control their speed, and to stop the flow of thread at will. They sometimes hang down by a thread, and allow themselves to be swung by the wind to a considerable distance, letting out the thread when they feel they are going in the right direction.

Spiders in confinement begin at once to spin, and never seem comfortable till they can go all over their box without stepping off their web. The running spiders, that make no other webs, when about to lay their eggs, find or dig out holes in sheltered places, and line them with silk. Species that live under stones or on plants, all line their customary hiding-places with web to which they hold when at rest. Several of the large running spiders dig holes in sand, and line them with web, so that the sand cannot fall in; and build around the mouth a ring of sticks and straws held together by threads.

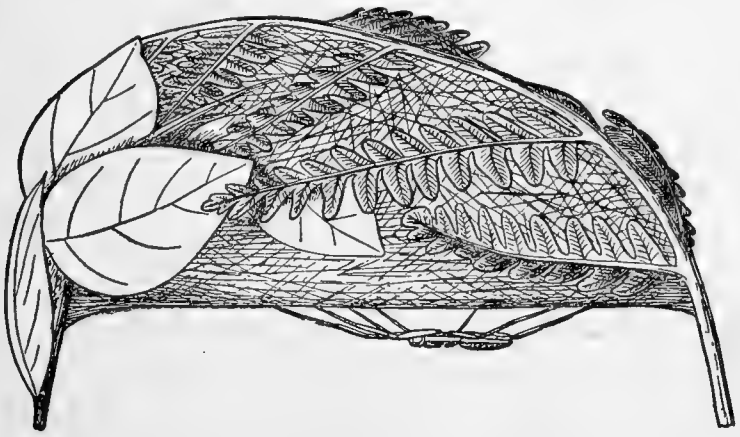


Fig. 22.

Some spiders make a great, irregular nest constructed of grass and leaves drawn together with silken threads. Fig. 22 represents a nest of this kind made by a *Dolomedes*: it is four or five inches in diameter and contains the egg-cocoon. The young hatch and ramble about in this nest for some time; the parent spider remains near, usually holding on under the nest, as represented in the illustration.

6.—Cobwebs.

The simple nests and tubes that have been already mentioned are, for the most part, made by spiders which spin no other webs. The larger and better known cobwebs for catching insects are made by comparatively few species. On damp mornings in summer the grass-fields are seen to be half covered with flat webs, from an inch or two to a foot in diameter, which are considered by the weatherwise as signs of a fair day. These webs remain on the grass all the time, but only become visible from a distance when the dew settles on them. Fig. 23 is a diagram of one of these nests, supposed, for convenience, to be spun between pegs instead of grass. The flat part consists of strong threads from peg to peg, crossed by finer ones, which the spider spins with the long hind-spinnerets, swinging them from side to side and laying down a band of threads at each stroke. At one side of the net is a tube leading down among the grass-stems. At the top the spider usually stands, just out of sight, and waits for something to light on the web, when she runs out and snatches it, and carries it into the tube to eat. If anything too large walks through the web, she turns round and retreats out of the lower end of the tube, and can seldom be found afterwards. In favourable places these webs remain through the whole season, and are enlarged, as the spider grows, by additions on the outer edges, and are supported by threads running up into the neighbouring plants.

Similar webs are made by several house-spiders, the mode of construction of which is thus described by Kirby and Spence:—

"The weaving spider which is found in houses, having selected some corner for the site of her web, and determined its extent, presses her spinners against one of the walls, and thus glues to it one end of her thread. She then walks along the wall to the opposite side, and there in like manner fastens the other end. This thread, which is to form the outer margin or selvage of her web, and requires strength, she triples or quadruples by a repetition of the operation just described; and from it she draws other threads in various directions, the interstices of which she fills up by running from one to the other, and connecting them by new threads until the whole has assumed the gauze-like texture which we see.

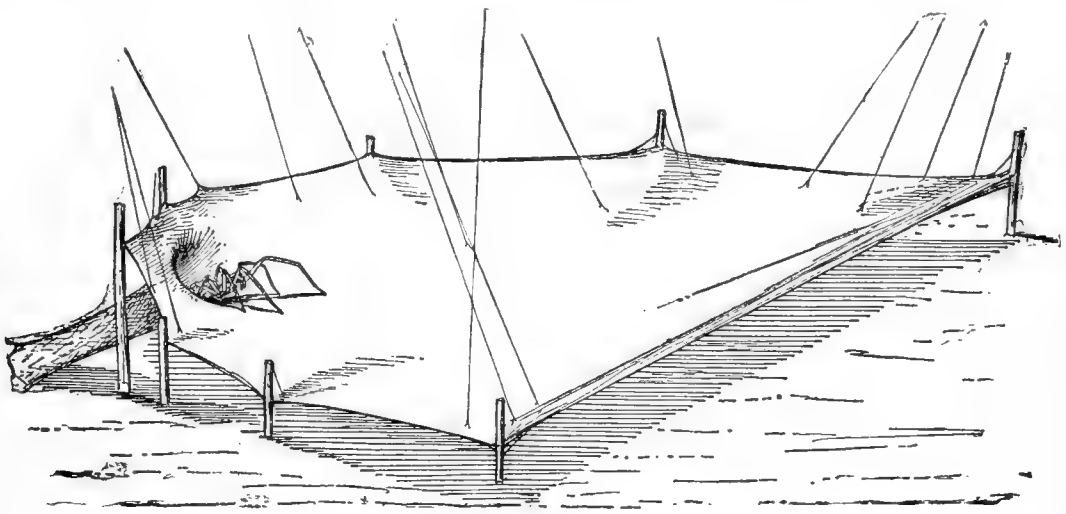


Fig. 23.

"The webs just described present merely a simple horizontal surface, but others more frequently seen in out-houses and amongst bushes possess a very artificial appendage. Besides the main web, the spider carries up from its edges and surface a number of single threads, often to the height of many feet, joining and crossing each other in various directions. Across these lines, which may be compared to the tackling of a ship, flies seem unable to avoid directing their flight. The certain consequence is, that in striking against these ropes they become slightly entangled, and, in their endeavours to disengage themselves, rarely escape being precipitated into the net spread underneath for their reception, where their doom is inevitable.

"But the net is still incomplete. It is necessary that our hunter should conceal her grim visage from the game for which she lies in wait. She does not, therefore, station herself upon the surface of her net, but in a small silken apartment constructed below it, and completely hidden from view. 'In this corner,' to use the quaint translation of Pliny by Philemon Holland, 'with what subtiltie does she retire, making semblance as though she meant nothing less than that she doth, and as if she went about some other business! nay, how close lieth she, that it is impossible to see whether any one be within or no!' But thus removed to a distance from her net and entirely out of sight of it, how is she to know when her prey is entrapped? For this difficulty our ingenious weaver has provided. She has taken care to spin several threads from the edge of the net to that of her hole, which at once inform her by their vibrations of the capture of a fly, and serve as a bridge on which in an instant she can run to secure it."

These webs, if let alone, are repeatedly enlarged till they are a foot or two wide, and remain till they collect dust enough to tear them down by its weight.

Many spiders that make cobwebs live under them, back downwards, and many are so formed that they can hardly walk right side up. The webs of *Theridion* (Fig. 18), usually have at some part a tent or thicker portion under which the spider stands, and from this run irregularly simple threads, crossing each other in all directions and held in place by threads above and below. Such loosely constructed webs are often made in houses, in corners of rooms, under furniture and in cellars. The same spider occasionally spins out of doors on fences, but never on plants. When it has caught an insect and tied it up, it gradually hoists it up into its nest, sometimes a considerable distance.

7.—Geometrical Webs.

These familiar structures are the work of the family *Epeiridæ* (Figs. 7 and 10). The process of making them can be observed in any garden ; it is, of course, very different from that described above in the construction of cobwebs. The net is usually fixed in a perpendicular or somewhat oblique direction, in an opening between the leaves or branches of some shrub or plant, in a window-frame or fence, or some such open wooden structure, where there is a hole or crack in which they can hide when necessary.

"It is obvious," to quote Kirby and Spence's description, "that round the whole extent of the net, lines will be required to which can be attached those ends of the radii that are furthest from the centre. Accordingly the construction of these exterior lines is the spider's first operation. She is careless about the shape of the area which they enclose, but is guided by the distance or proximity of the points to which she can attach them. She spares no pains, however, to strengthen and keep them in a proper degree of tension. With the former view she composes each line of five or six or even more threads glued together ; and with the latter she fixes to them from different points a numerous and intricate apparatus of smaller threads. Having thus completed the foundations of her snare, she proceeds to fill up the outline. Attaching a thread to one of the main lines, she walks along it, guiding it with one of her hind feet that it may not touch in any part and be prematurely glued, and crosses over to the opposite side, where, by applying her spinners, she firmly fixes it. To the middle of this diagonal thread, which is to form the centre of her net, she fixes a second, which in like manner she conveys and fastens to another part of the lines encircling the area. Her work now proceeds rapidly. During the preliminary operations she sometimes rests, as though her plan required meditation. But no sooner are the marginal lines of her net firmly stretched, and two or three radii spun from its centre, than she continues her labour so quickly and unremittingly that the eye can scarcely follow her progress. The radii, to the number of about twenty, giving the net the appearance of a wheel, are speedily finished. She then proceeds to the centre, quickly turns herself round, and pulls each thread with her feet to ascertain its strength, breaking any one that seems defective and replacing it by another. Next, she glues immediately round the centre five or six small concentric circles, distant about half a line from each other, and then four or five larger ones, each separated by a space of half an inch or more. These last serve as a sort of temporary scaffolding to walk over, and to keep the radii properly stretched while she glues to them the concentric circles that are to remain, which she now proceeds to construct. Placing herself at the circumference, and fastening her thread to the end of one of the radii, she walks up that one, towards the centre, to such a distance as to draw the thread from her body of a sufficient length to reach to the next ; then stepping across, and conducting the thread with one of her hind feet, she glues it with her spinners to the point in the adjoining radius to which it is to be fixed. This process she repeats until she has filled up nearly the whole space from the circumference to the centre with concentric circles, distant, from each other about two lines. She always, however leaves a vacant interval around the smallest first spun circles that are nearest to the centre. Lastly, she runs to the centre and bites away the small cotton-like tuft that united all the radii, which being now held together by the circular threads, have thus probably their elasticity increased ; and in the circular opening resulting from this procedure, she takes her station and watches for her prey."

Some species, however, do not entirely surround the radii of their nets with concentric circles, but leave one radius free, which serves as a sort of ladder for access to the net. Others, again, spin spiral lines from the centre to the circumference, as shewn in Fig. 24. In this case, when the radii are finished, the spider begins at the centre to spin a spiral line across them, *a*, *a*, *a*, in Fig. 24; the turns of the spiral being as far apart as the spider can conveniently reach. She climbs from one radius to the next, holding her thread carefully off with one of the hind-feet till she gets to the right point, and then turns up her abdomen and touches the radius with her spinnerets, thus fastening the cross-threads to it. The figure shows her in this position. When this spiral has been carried to the outside of the web, she begins there another and closer one of thread of a different kind. While the first thread was smooth, the latter is

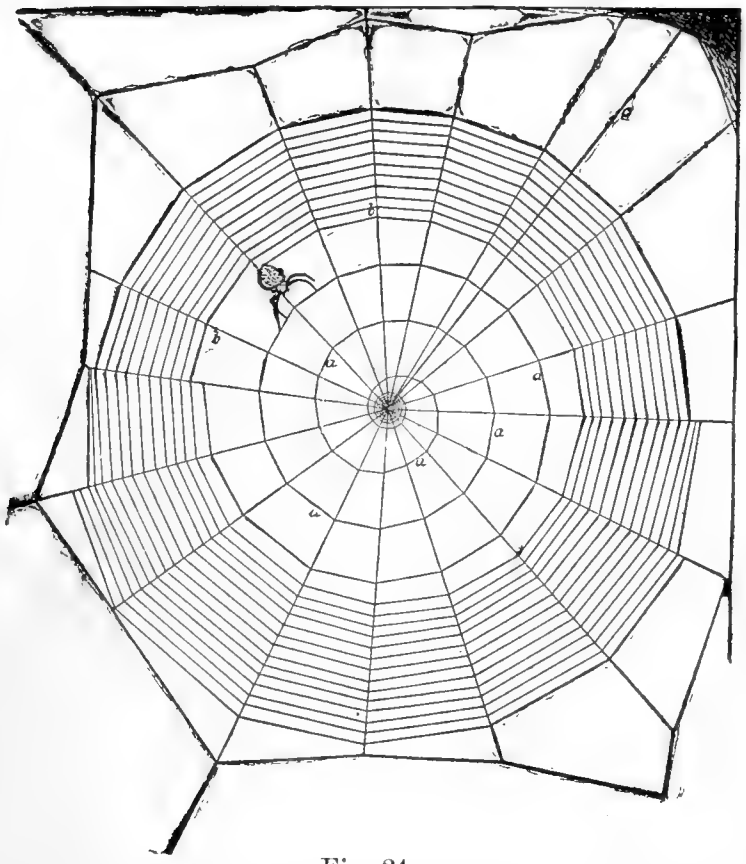


Fig. 24.

covered with a sticky liquid which soon collects on it in drops, and makes it adhere to anything that touches it. After going round a few times this spiral would come in contact with that first spun, but as the spider comes to the first she bites it away. By beginning thus at the outside, the spider is able to cover the whole web with adhesive threads, and, without stepping on it, take her usual place in the centre. She usually is careful enough to spin beforehand a thread from the centre to her nest, and sometimes stays there, with one foot on the thread, so as to feel if anything is caught in the web. When she feels a shake, she runs down to the centre, feels the rays to see where the insect is, and runs out, and seizes it, or ties it up as already described. We have described the web as consisting of one regular spiral; but this is seldom the case. It is usually wider on one side than the other, or below than above, as in Fig. 24, where outside the spirals are several loops going partly round the web. The web of Zilla consists entirely of such loops going three-quarters round the web, and returning, leaving a segment without any cross-threads, in which is the line from the centre to the spider's nest. Most of the *Epeiridæ* are brightly coloured, and make no attempt at concealment when in the web. Others have odd shapes and colours, and hang in the web in such positions that they look like anything but animals. Some species draw up their legs against their triangular abdomens, and look like bits of bark fallen into the web. Others are long and slender, and when at rest, either in the web or out, lay their legs close together before and behind their bodies, so as to look like straws. Others have oddly shaped abdomens under which the rest of the body is concealed.

As the spider stands in her web, and feels a slight shake, such as would be caused by a sudden wind, she draws her legs together, pulling the rays tighter, and so making the whole web steady. If, however, the spider is frightened, and has no time to escape, she throws her body back and forth as a man does in a swing, and thus shakes the web so rapidly, that the spider can hardly be seen. The most usual habit, when alarmed, is to drop to the ground, and lie there as if dead.

8.—Flying Spiders.

Every one has, no doubt, observed in summer and autumn long threads with one end attached to the bushes, and the other blowing out in the wind; or bits of cob-web (often termed "gossamer") carried along by the currents of air, with occasionally a little spider attached to them. To account for these, various fanciful theories have been invented. The old and very absurd notion was that gossamer was made of dew scorched by the sun! Others imagined that spiders were able to force the thread from their spinnerets, like water from a syringe, in any direction they chose.

If a spider be put on a stick surrounded by water, she manages in course of time to escape by means of a thread carried across to some object beyond. To find out how this was done, Mr. Blackwall tried some experiments. He put spiders on sticks in vessels of water, and they ran up and down, unable to escape as long as the air in the room was still. But, if a draught of air passed the spider, she turned her head toward it, and

opened her spinnerets in the opposite direction. If the draught continued, a thread was drawn out by it, which at length caught upon something, when the spider drew it tight and escaped on it. If the air was kept still, or the spider covered with a glass, she remained on the stick till taken off.

These experiments have been repeated, and show that the spider does not shoot or throw the web in any way, but takes advantage of currents of air, and allows threads to be blown out to a considerable distance.

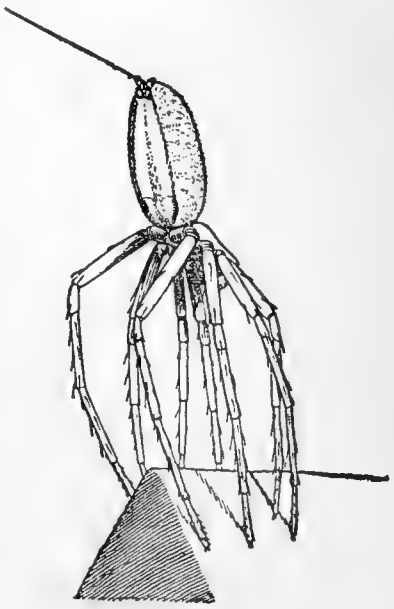


Fig. 25.

There is a still more curious use of this method of spinning threads; that is, in flying. Small spiders, especially on fine days in the autumn, get up on the tops of bushes and fences, each apparently anxious to get as high as possible, and there raise themselves up on tiptoe, and turn their bodies up, as in Fig 25, with their heads toward the wind, and spinnerets open. A thread soon blows out from the spinnerets, and, if the current of air continues, spins out to a length of two or three yards, and then offers enough resistance to the wind to carry the spider away with it up into the air. As soon as she is clear, the spider turns around, and grasps the thread with her feet, and seems to be very comfortable and contented till she strikes against something. Sometimes they rise rapidly, and are soon out of sight; at other times they blow along just above the ground.

This habit is not confined to any particular kinds of spiders, but is practised by many small species of *Erigone*, and by the young of many spiders of all families, that when adult would be too large for it. The majority of spiders that fly in autumn are the young of several species of *Lycosa*, that seem to spend the greater part of October in trying to get as far above ground as possible. The best places to watch for them are garden-fences, where they often swarm, and can be seen more distinctly than on bushes.

It is still unexplained how the thread starts from the spinnerets. It has been often asserted that the spider fastens the thread by the end, and allows a loop to blow out in the wind; but in most cases, this is certainly not done, only one thread being visible. Sometimes, while a thread is blown from the hinder spinnerets, another from the front spinnerets is kept fast to the ground (fig. 26); so that when the spider blows away, it draws out a thread behind it entirely independent of the one from which it hangs. Sometimes, instead of a single thread, several are blown out at once, like a long brush.

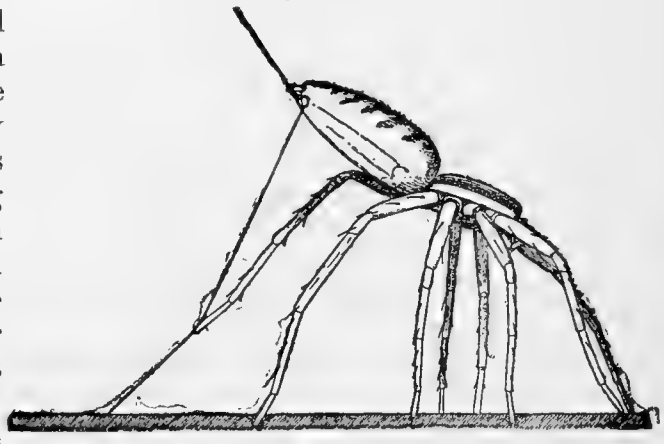


Fig. 26.

9.—Water Spiders.

One of the most curious and interesting of the spider family is the *Argyroneta aquatica*, or Water-spider, which lives for the greater part of its life beneath the surface of water. Kirby and Spence give the following description of its habitation:—

"It is built in the midst of water, and formed, in fact, of air! Spiders are usually terrestrial, but this is aquatic, or rather amphibious; for though she resides in the midst of water, in which she swims with great celerity, sometimes on her belly, but more frequently on her back, and is an admirable diver, she not unfrequently hunts on shore, and having caught her prey, plunges with it to the bottom of the water. Here it is she forms her singular and unique abode. She would evidently have but a very uncomfortable time were she constantly wet, but this she is sagacious enough to avoid; and by availing herself of some well-known philosophical principles, she constructs for herself an apartment in

which, like the mermaids and sea-nymphs of fable, she resides in comfort and security. The following is her process. First she spins loose threads in various directions attached to the leaves of aquatic plants, which may be called the frame-work of her chamber, and over them she spreads a transparent varnish resembling liquid glass, which issues from the middle of her spinners, and which is so elastic that it is capable of great expansion and contraction; and if a hole be made in it, it immediately closes again."

The next operation—that of filling the nest with air—is thus described by Mr. Bell (Journal of the Linnæan Society): "After the nest has been made as large as half an acorn, she goes to the surface, and returns (in the instance observed, as many as fourteen times successively), and each time brings down a bubble of air which she lets escape into her nest. The bubble is held by the spinnerets and two hind-feet, which are crossed over them, and is obtained in the following manner:—The spider climbs up on threads or plants nearly to the surface, and puts an end of the abdomen out of water for an instant, and then jerks it under, at the same time crossing the hind legs quickly over it. She then walks down the plants to her nest, opens her hind-feet, and lets the bubble go."

To go on with Kirby and Spence's account:—"In about a quarter of an hour she has transported as much air as suffices to expand her apartment to its intended extent, and now finds herself in possession of a little aërial edifice, I had almost said an enchanted palace, affording her a commodious and dry retreat in the very midst of the water. Here she reposes unmoved by the storms that agitate the surface of the pool, and devours her prey at ease and in safety. Both sexes form these lodgings. At a particular season of the year the male quits his apartment, approaches that of the female, enters it, and enlarging it by the bubble of air that he carries with him, it becomes a common abode for the happy pair. The spider which forms these singular habitations is one of the largest European species, and in some countries is not uncommon in stagnant pools."

The water-spiders run about on aquatic plants and catch the insects which live among them. They lay their eggs in the nest, and the young come out and spin little nests of their own, as soon as they are big enough. The hairs, with which their bodies are covered, keep the skin from becoming wet as they go through the water; and in the nest, which is like a diving-bell, they are as dry as if it were under a stone, or in a hole on dry land.

The Rev. J. G. Wood states that the water-spider "is a tolerably common species in England, being especially fond of inhabiting quiet and rather deep ditches, when it is well sheltered, and the stream is not rapid enough to endanger the security of its domicile. It is necessary that the water-plants to which the nest is fixed should be sufficiently firm to prevent the nest from being swayed to one side, as, in that case, the air would escape, and the water make its entrance. Owing to the vast number of these spiders that have been sent to the London markets—where they are sold to those who possess fresh-water aquaria—the species is not now nearly so plentiful as used to be the case, and, indeed, it has been almost extirpated from several localities where it was formerly seen in great numbers."

10.—Trap-Door Spiders.

Comparatively little was known about these very curious spiders until the publication of Mr. Moggridge's very interesting work, in which he records with great minuteness the observations he made in the south of France.

The following illustration, Fig. 27, represents the principal kinds of nests that these spiders construct. The most northern genus of this family, *Atypus*, makes a strong silken tube, part of which forms the lining of a hole in the ground, and part lies above the surface, among stones and plants, Fig. 27, A. The mouth of the tube is almost always closed, at least when the spider is full-grown.

Another genus, which lives in warm countries, makes tubes lined with silk and closed at the top by a trap-door. A common species in California, *Cteniza Californica*, is brought thence by travellers. It digs its hole in a fine soil that becomes, when dry, nearly as hard as a brick; but the spider probably works when the ground is wet. The holes are sometimes nearly an inch in diameter, and vary in depth from two or three inches to a foot. The mouth is a little enlarged and closed by a thick cover that fits

tightly into it, like a cork into a bottle. The cover is made of earth fastened together with threads, and is lined, like the tube, with silk, and fastened by a thick hinge of silk at one side, Fig. 27, B. When the cover is closed it looks exactly like the ground about it. The spider, when alarmed, holds on the inside of the door with its mandibles, and the two front pairs of feet; while the third and fourth pairs of legs are pressed out against the walls of the tube, and hold the spider down so firmly that it is impossible to raise the cover without tearing it.

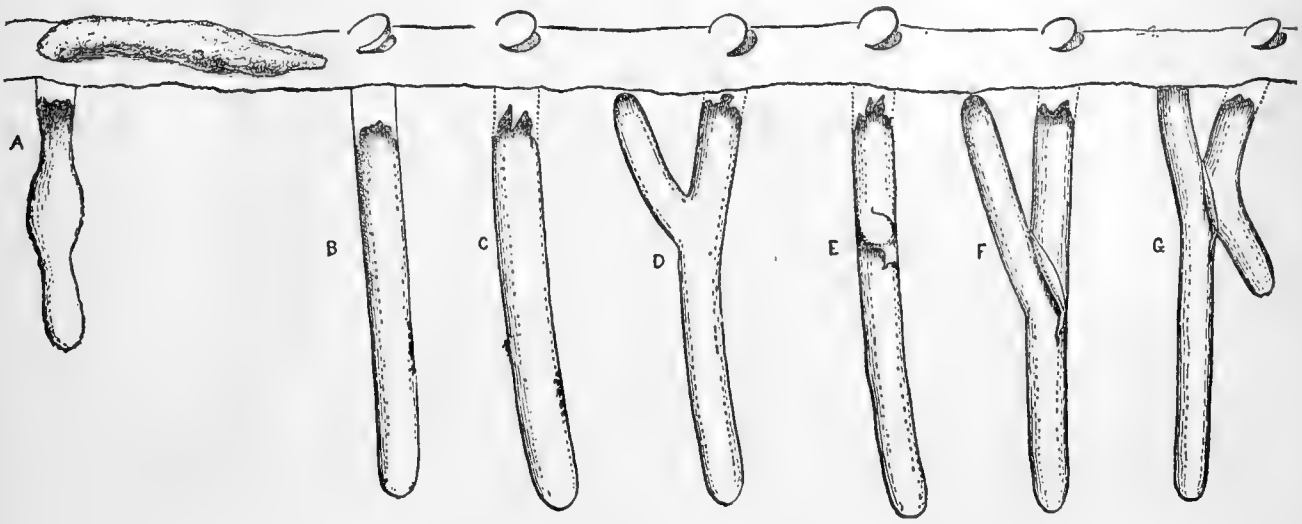


Fig. 27.

Trap-door nests: A, nest of Atypus; B, nest with thick door; C, nest with thin door; D, branched nest; E, nest with two doors; F, branched nest with two doors; G, nest with two branches.

One of the European species, described by Moggridge, makes a thin lid to its tube, and lets it rest on the top of the tube, Fig. 27, C, covering it with leaves, moss, or whatever happens to be near at hand, so that it is not easily distinguished.

A second species differs by constructing two or three inches down the tube another door, Fig. 27, E, hanging to one side of the tube when not in use; but, when one tries to dig the spider out from above, she pushes up the lower door, so that it looks as if it were the bottom of an empty tube.

Another species digs a branch obliquely upward from the middle of the tube, closed at the junction by a hanging-door, which, when pushed upward, can also be used to close the main tube, Fig. 27, F. What use the spider makes of such a complicated nest, nobody knows from observation; but Mr. Moggridge supposes that when an enemy, a parasitic fly, for instance, comes into the mouth of the tube, the spider stops up the passage by pressing up against the lower door; but, if this is not enough, it dodges into the branch, draws the door to behind it, and leaves the intruder to amuse himself in the empty tube. The branch is sometimes carried up to the surface, where it is closed only by a few threads; so that, in case of siege, the spider could escape, and leave the whole nest to the enemy.

In these nests the spiders live most of the time, coming out at night, and some species in the daytime, to catch insects, which they carry into the tube and eat. The eggs are laid in the tube, and the young are hatched and live there till they are able to go alone, when they go out and dig little holes for themselves. As the spider grows larger the hole is made wider, and the cover enlarged by adding a layer of earth and silk: so that another cover is made up of a number of layers, one over the other, on top of the original little cover.

Moggridge relates (page 118) how a *Nemesia Meridionalis* constructed a trap-door in captivity, after he had placed it on a flower-pot full of earth, in which he had made a cylindrical hole. "She quickly disappeared into this hole, and during the night following she made a thin web over the aperture, into which she wove any materials that came to hand. The trap-door at this stage resembled a rudely constructed, horizontal, geometrical web, attached by two or three threads to the earth at the mouth of the hole, while in this web were caught the bits of earth, roots, moss, leaves, etc., which the spider had thrown

into it from above. After the second night the door appeared nearly of the normal texture and thickness, but in no case would it open completely, and it seemed that the spider was too much disgusted with her quarters to think it worth while to make a perfect door."

These spiders are accustomed to put on their door moss like that which grows around it, so as the more effectually to conceal it from observation. In one case where Moggridge had cut out a little clod of mossy earth about two inches thick and three square on the surface, containing the top of the tube and the moss-covered cork-like door of a *Nemesia*, he found on revisiting the place, six days later, that a new door had been made, and that the spider had mounted up to fetch moss from the undisturbed bank above, planting it in the earth which formed the crown of the door. Here the moss actually called the eye to the trap which lay in a little plain of brown earth made by his digging.

The food of the European trap-door spiders consists largely of ants and other wingless insects, and they have been known to eat earth-worms and caterpillars. Mr. Moggridge has often seen them, even in the daytime, open their doors a little, and snatch at passing insects, sometimes taking hold of one too large to draw into the tube. One time he and some friends marked some holes, and went and watched them in the night. The doors were slightly open, and some of the spiders' legs thrust out over the rim of the hole. He held a beetle near one of the spiders; and she reached the front part of her body out of the tube, pushing the door wide open, seized the beetle, and backed quickly into the tube again, the door closing by its own weight. Shortly after, she opened it again, and put the beetle out alive and unhurt, probably because it was too hard to eat. He next drove a sow-bug near another hole; and the spider came out and snatched it in the same way, and kept it. None of the spiders came entirely out of their holes, and they were only a little more active than in the daytime.

11.—Growth of Spiders—their Eggs and Cocoons.

Persons unfamiliar with spiders find it hard to tell young from old, and male from female. This is caused, in part, by the great differences between different ages and sexes of the same spider, on account of which they are supposed to belong to distinct species.

The adult males and females are only distinguished from each other, and from the young, by the complete development of organs peculiar to each sex.

The males are usually smaller than the females, and have, in proportion to their size, smaller abdomens and longer legs. They are usually darker coloured, especially on the head and front part of the body; and markings which are distinct in the female run together and become darker in the male. In most species these differences are not great; but in some no one would ever suppose, without other evidence, that the males and females had any relationship to each other. The most extreme cases of this kind are *Argiope* and *Nephila*, where the male is about a tenth as large as the female.

The female of one of the common crab spiders is white as milk, with a crimson stripe on each side of the abdomen; while the male is a little brown-and-yellow spider, with dark markings of a pattern common in the family to which it belongs.

When the female is prepared to lay her eggs, she makes a little web and drops them upon it; then she covers them over with silk, forming a cocoon, in which the young remain till some time after they are hatched. The laying of the eggs is seldom seen, for the spider does it at night and in retired places, and often in captivity refuses to lay at all.

Many spiders make their cocoons against a flat surface, where they remain attached by one side. *Attus mystaceus* spins, before laying, a thick nest of white silk on the under side of a stone. In this she thickens a circular patch on the upper side, next the stone, and discharges her eggs upward against it. They adhere and are covered with white silk.

Epeira strix spins, before laying, a bunch of loose silk; she touches her spinnerets, draws them away a short distance, at the same time pressing upward with the hind feet; then she moves the abdomen a little sideways, and attaches the band of threads so as to form a loop. She keeps making these loops, turning round, at the same time, so as to form a

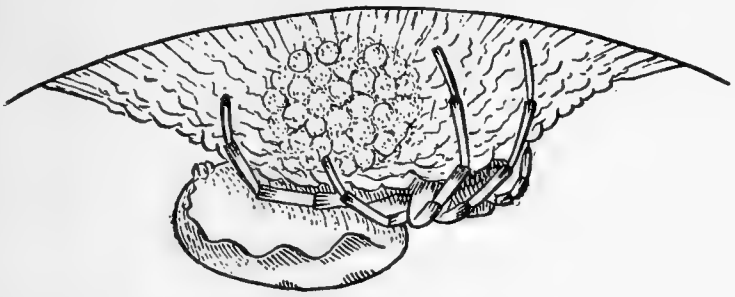


Fig. 28.

rounded bunch of them, into the middle of which she afterwards lays the eggs, as in Fig. 28. The eggs, which are like a drop of jelly, are held up by the loose threads till the spider has time to spin under them a covering of stronger silk. *Epeira vulgaris* makes a similar cocoon upward, downward, or sidewise, as may be most convenient.

Most of the *Theridiidæ* make cocoons of loose silk, held up in the webb by numerous threads. Some hang the cocoon by a stem, Fig. 29.

The large species of *Argiope* makes a big pear-shaped cocoon hanging in grass or bushes, Fig. 30. A stem of loose brown silk is first made, and under this the eggs attached (at any rate this had been done in onewhich had been abandoned unfinished) ; then a cup-shaped piece is made under the eggs ; the bunch of loose silk is spun over all, and finally the paper-like shell.

Fig. 29

These cocoons are made late in the summer and the young stay in them till the next season. Many cocoons of irregular shape may be found in cellars and other retired places during the winter ; the eggs contained in them are hatched in the following spring.

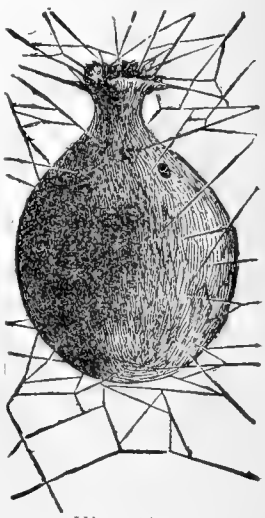


Fig. 30

The hatching occupies a day or two. First the shell, or rather the skin, cracks along the lines between the legs, and comes off in rags ; then the creature slowly stretches itself and creeps out. It is now pale and soft, without any hairs or spines and only small claws on its feet ; but in a few days it gets rid of another skin and begins to look like a spider. The eyes become darker coloured, marks on the thorax become more distinct, and a dark stripe appears across the edge of each segment of the abdomen; the hairs are long and few in number. Before the next month, the brood usually leaves the cocoon and for a time they live together in a web spun in common. As the spider grows large it has to moult from time to time ; as many as nine moults have been observed in a species of *Tegenaria* that lives for several years.

Many species, and among them some of the largest, live only one year, hatching in the winter, leaving the cocoon in early summer and laying eggs and dying in autumn. Other species seem to require two years for their growth ; hatching in summer, passing their first winter half grown, growing up the next summer, but laying no eggs till the second spring. Some species are found adult at all seasons, and may live several years. After spiders have passed their second moult, they usually live in the same places, and follow the same habits, as the adults.

Several house spiders have probably been imported, like rats, and are found all over the world ; while other very common species never spread beyond the countries where they are most abundant.

THE PEA WEEVIL *(Bruchus Pisi)*.

By W. Saunders, London.

The pea weevil, or pea bug as it is more commonly called, has become a very serious evil in Ontario, and prevails at present to such an extent as to entail enormous losses on the farming community, since peas are cultivated over a greater or lesser area on almost every farm. This insect, which is believed to be a native of America, was first noticed in Pennsylvania, attacking the pea early in the present century, and from thence has gradually spread over the whole of the Northern United States and Canada ; it has also been carried to Europe where it has firmly established itself in the southern portions, and in

England, although it is not nearly so abundant and destructive in Europe as it is with us.

This beetle, Fig. 31, *a*, is a little more than one-tenth of an inch long, of a rusty, blackish colour with a whitish spot on the hinder part of the the thorax, and several of the same colour on each wing case behind the middle; also a white spot shaped somewhat like the letter T on the tip of the body. In the cut, the insect is much magnified; the small outline figure at the side shews the natural size.

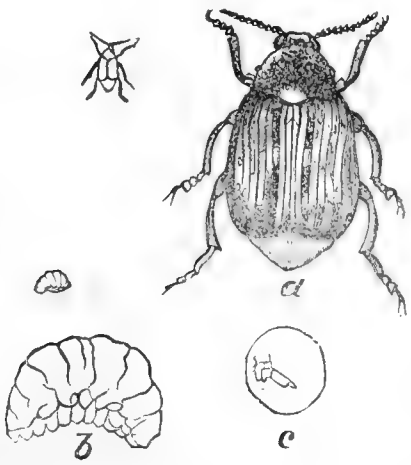


Fig. 31.

As soon as peas are in bloom the pea weevils are on the wing, and when the young pods are formed the females deposit their eggs on the surface, fastening them with a glutinous fluid, secreted from their bodies. These eggs are very small, much longer than wide, pointed in front and blunt behind, and of a yellow colour. The young larva, which is hatched in a few days, is of a deep yellow colour with a black head. It eats its way at once through the tender pod, and directly into the first pea it meets with, the wounded portion closing up in the growing pod, and leaving but a mere speck in the pea to mark the place of entrance. The larva feeds on the growing pea and consumes its substance, usually avoiding any injury to the germ, so that infested peas will generally germinate as readily as those which are free from the bug. The soft, whitish fleshy grub, Fig. 31, *b*, when full grown, eats a circular hole on one side of the pea, not quite through to the surface, but leaves the thin skin unbroken. It then changes to a chrysalis, and finally to a beetle within the pea, and when the beetle is ready to escape it has only to eat its way through the thin skin which the larva had left covering the hole.

Few persons are aware how many insects they unconsciously devour while indulging in the luxury of early green peas. In this instance, as in many others, "Where ignorance is bliss, 'tis folly to be wise." Some console themselves with the idea that the fat little creatures having fed on nothing but green peas, are only green peas in a modified form, and besides this they are cooked. A very small discoloured spot on the pea indicates the presence of an occupant, and if the pea be opened at this point the whitish footless grub will be found within.

Sometimes, especially during an unusually warm season, many of the weevils will escape from the peas in the fall, but usually they remain in them during the greater part of the winter, and many do not issue until after the peas are sown as seed in the ground. Hence we see how easily this pest may be introduced into a district hitherto free from it, by sowing infested peas. All seed peas should be carefully examined, and as the insects diminish the weight of the peas in which they lodge nearly one half, an expeditious and moderately safe way of separating the sound from the unsound peas is to throw them into water when most of the good peas will sink while the infested ones will float

A very effectual remedy, and one which would be very successful were it generally adopted, is to keep seed peas in tight vessels in a dry place over one year before planting them, during which time, if any of them contain bugs, these will escape and perish without having opportunity to propagate.

It has also been recommended to scald the peas about to be sown by dipping them for a moment or two in hot water before planting, by which means the weevils are killed and the sprouting of the peas quickened.

As the duration of this insect in the beetle state is limited, peas sown late are much more likely to escape injury than those planted early. Harris, in his "Insects Injurious to Vegetation," mentions an instance of a gentleman who sowed his peas on the 10th of June for six years in succession, and never found an insect in them during that period.

A very effectual method of getting rid of this pest from any section of country would be for the farmers to mutually agree to sow no peas for one year. At a recent meeting of the County Council in London, Mr. Henry Anderson, of Westminster, presented a memorial to that body, setting forth the importance of this subject, and asking the Council to petition the Legislature to pass an Act giving County Councils the

power to prohibit entirely the growing of peas in any one section for a season. Such a course faithfully carried out and followed by a careful selection of seed the next season, would doubtless almost, if not entirely, eradicate the pest from such district for a time, and thus effect a large saving to the community; hence it is most desirable in the interest of our farmers that some such permissive restrictive measure be enacted. Unfortunately, in this instance, either from want of proper information on the subject, or perhaps underrating its importance, the Council declined to take action in the matter.

SCARABÆIDÆ—DIGGERS.

By James Fletcher, Ottawa, Ont.

The members of the family of beetles, which bear the above name, have been objects of peculiar interest to mankind for thousands of years. This is chiefly owing to the fact that the typical species of the family to which it belongs, played such an important part in the religion of the ancient Egyptians, and also on account of those very habits which gave rise to the devotion and adoration lavished upon it by that remarkable people.

These beetles belong to a division of the insect world to which Latreille gave the name of *Lamellicornes* or leaf-horned, which corresponds with the Linnæan genera *Lucanus* and *Scarabæus*, and are easily distinguished by having the antennæ, which are generally short and nine or ten jointed, terminated by a large club-shaped organ, composed of, as a rule, three of the apical joints, which are formed into a series of flat plates, and open like the rays of a fan or the leaves of a book, or of which the basal joint of the club is hollowed so as to form a kind of cup receiving the subsequent joints; in others the terminal joints form a kind of comb. The form of these insects is robust and heavy, and the males are often to be known at first sight by the presence of singular horns on the head and thorax, and by the great size of the mandibles. So different an aspect is given to the males by these organs that, in some instances, it seems almost incredible that they can belong to the same species as the females, and it has frequently happened that the two sexes have been recorded as two different species.

This division is one of very great extent, and embraces within its wide, but clearly defined limits, insects of the most various characters. It comprises the largest and handsomest of the beetle race, and at the same time some individuals very small and sombre in appearance. Strangely enough, too, it includes within its ranks some of the most beneficial and some of the most destructive of all insects; hence, as well as from the immense number of species, and the consequently important *rôle* they must perform in the economy of nature, they were placed by Linnæus and Fabricius at the head of the *Coleoptera*, or sheath-winged insects (κολεος—a sheath, and πτερα—wings.) This arrangement, however, has not been adhered to by later authorities, and they are now placed immediately before the *Buprestidæ*.

The majority of these insects, and especially the gigantic species, to be mentioned later, are inhabitants of the tropics.

The two Linnæan genera, above named *Lucanus* and *Scarabæus*, constitute the two primary groups into which the *Lamellicornes* are divisible, and to which Dumeril gave the sectional names

Priocera (*Lucanus*), club of antennæ serrated.

Petalocera (*Scarabæus*), club of antennæ lamellated.

The first of these or the family Lucanidæ, *Leach*, corresponds to the Linnean genus *Lucanus*, and is distinguished by having the antennæ abruptly bent into an angle about the centre, generally composed of ten joints, and terminated by a pectinated, fissile, or sub-serrated club. A striking characteristic, too, of this family is the exserted and unusually developed mandibles of the males, which gives them a most ferocious aspect, and from which the popular names of stag-beetles, horn-bugs and flying-bulls have originated. These organs in some instances (*e.g.*, *Chiasognathus Grantii* of Chili), equal the entire length of the body. They are capable of biting with great force, and the females, notwithstanding that they are furnished with very small mandibles in comparison to their

larger mates, are considerably the more formidable of the two, their short, thick, sharp-pointed mandibles, being provided for the purpose of boring holes in bark to deposit their eggs, are very strong.

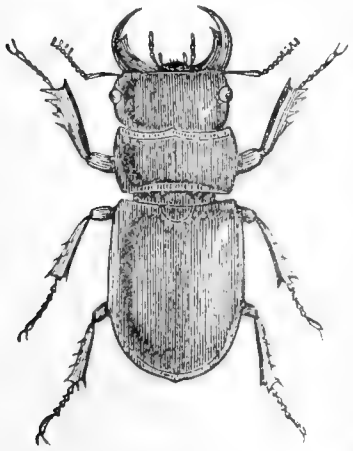


Fig. 32.

This family is represented in Ontario by a small number of insects, the most typical of which is *Lucanus dama*, Thunb. (Fig. 32), which is a large, smooth, brown beetle, of little more than an inch in length. The jaws of the male are very long, and finely pointed and are curved like a sickle and bear on their inner edge, near the middle, a small sharp tooth. The head, to bear these large mandibles, is necessarily large; in the female it is much smaller and narrower, and is densely covered with punctures which give it a rough appearance. The eggs, which are yellow and oval, are laid in a hole, made by the female, in the bark of a tree, near the root, about the end of July, when this beetle should be sought for. The grubs live in the trunks and roots of several sorts of trees, but chiefly in old apple trees, willows and oaks; they are long, thick, nearly cylindric white grubs, of a very fleshy consistency, closely resembling, in general appearance, the larvæ of the *Scarabæidæ*, but they are distinctly separated by certain characteristic points in their internal structure, and by their bodies being destitute of the transverse foldings so conspicuous in the latter. The larvæ of the Lamellicornes are remarkable for having their bodies curved, so that the end of the abdomen is drawn under the body, which prevents them from crawling on a flat surface and necessitates their always lying on their sides. The larva of *Lucanus dama* has a horny rust-coloured head furnished with two powerful jaws, which it employs in gnawing the wood, upon which it feeds and which it reduces to a kind of tan. The antennæ are short. It has six reddish articulated legs, which are attached to the first three segments of the body. When mature it forms a cocoon out of the minute chips and debris which it has itself made during its life. In this cocoon it undergoes its transformation to the pupa and perfect insect. In the pupa state the large mandibles or horns of the male are folded down over the breast. Rösel, who studied thoroughly the European representative of this family (*Lucanus cervus*) and discovered that the male and female were one species and not two, as previously believed, says that that insect lives six years as a larva. The injury which they cause is sometimes considerable, as they bore not only into the solid wood but also into the roots of trees.

It is supposed that the larvæ of these insects are what were eaten by the Romans, as a great delicacy, under the name of Cossus.

The name of *Pectinicornes* or "comb-horned," has been proposed for this family, but so far it has not been generally accepted by entomologists.

The *Petalocera* of Dumeril (*Scarabæus* of Linnæus) or second division of Lamellicorn insects, is one of immense extent, being divided into more than 700 genera, comprising some 6000 species. They are distinguished from the foregoing family by having the antennæ not abruptly bent into an angle, eight, nine or ten jointed and terminated by a large mass, composed of several, generally three, plates, which shut and open at will. In some species these plates are flat, so as to be placed side by side, in others the basal one is hollowed so as to form a sort of box in which the intermediate plate is enclosed. The mandibles do not exhibit any striking sexual variations; but the head and thorax of the males in some of the groups, are armed with horns and protuberances of the most bizarre and diversified appearance, of which it is very difficult to conceive the uses. The antennæ of the males too, are occasionally developed more than those of the females. The mentum is large and horny. The body is generally more or less convex, the legs robust and as a rule toothed on the outer edge.

These insects are almost all of them vegetable feeders, the greater part subsisting upon it when in a state of decay. Some in the perfect state feed upon leaves and flowers, and their *larvæ* upon the roots of grass, etc., often causing great damage. In the colours of these insects we find a conformity to their habits; those that burrow under ground are generally of black and obscure hues, while those that frequent leaves and flowers are often splendidly attired. The origin of the name Scarabæus is doubtful; the word never occurs

but in the writings of Latin authors; yet Fabricius and Olivier give its derivation from the Greek σκάπτω—to dig, which MacLeay doubts, considering it to be of Etruscan origin, adding that it may have been obtained from the Greek σκαριφαομαι—the verb διασκαριφῆσαι being properly applied to the actions of animals which scratch or dig up the earth with the claws. Pliny gave a description of the sacred beetle of the Egyptians under the name *Scarabæus*; and in later times Linnæus applied it in a general way to the whole of the Lamellicorn beetles, placing the gigantic horned species, at the head of the genus. The Rev. J. G. Wood writes as follows:—"The Latin word Scarabæus is nothing but a corruption of the Greek word καραβος—a crab. It was also employed to designate the cuttle-fish, on account of its mode of crawling, the name being composed of two Greek words, signifying 'to walk on the head.'" By Aristotle, it is applied to an insect which is evidently the stag-beetle; but Linnæus was the first who gave it to the ground-beetle, and it has been so universally employed that it will continue to hold its place.

It is possible that the name may have been applied to these beetles by Pliny, from the fact that the female of the sacred Scarabæus, when it is rolling the balls of dung, in each of which it has deposited an egg, to the place where it has dug its burrow, does so by walking backwards and pushing the ball before it. Now from the size of the ball, generally over an inch-and-a-half in diameter, it actually has almost to stand on its head when it places its feet on the top to roll it.

It would be impossible to do more, here, than mention briefly some of the most interesting sub-families and species of this extensive family of insects, the members of which exhibit such great variations in the form and arrangement of the various organs of the body, although preserving a characteristic appearance, and conjoined with it the lamellate antennal club and fossorial legs.

They have been conveniently divided into three divisions by De Geer.

1. Those which live upon or beneath the surface of the earth, or "ground beetles."

2. Those which in the perfect state are found upon and devour the leaves of trees, or "tree-beetles."

3. Those which in the perfect state frequent flowers, or "flower-beetles."

To the first group belong the most useful of insects, who in providing for the perpetuation of their species, at the same time till and manure the soil and dispose of offensive matter. This will be better understood by a glance at their life histories.

In Ontario we sometimes meet with a fine ground beetle, named *Canthon lævis*, Drury, which belongs to the same sub-tribe *(Ateuchini)* as the Egyptian Scarabæus, to which it bears great resemblance. A noticeable feature of these insects is the length of their hind-legs, and the proximity of the bases or coxæ to the end of the body. This peculiar structure is of particular service to them. Their mode of depositing eggs is very remarkable. The female having discovered a deposit of fresh cow-dung, at once seeks for a suitable place, and digs out a pit about 18 inches deep; she then returns and gathers together exactly so much of the material as will amply supply one grub with food, and in the centre of this she deposits an egg. She then proceeds to form it into a round ball; at first it is quite wet and soft, but by turning her back to it she works it backwards, in the hot sun-shine, by means of her long hind-legs, over dusty or sandy soil, and it gradually becomes rounder and harder, by taking up some of the dry dust as it goes along. When she arrives at the hole, she previously prepared, if her ball is dry and hard enough, she drops it in and covers it up; but if it is not sufficiently hard, she takes it for another short circuit, during which it picks up more dry dust and gains the required consistency, and then brings it back to the hole and buries it. If the day is wet or even cloudy, these insects will not work at all. Occasionally intervening objects render this task of transportation exceedingly difficult; but she works away with the utmost patience and determination, and is generally successful; sometimes as a last resource when obstacles of unusual magnitude have to be surmounted, she will call in the aid of one or two other beetles. It is curious, too, how cheerfully they seem to work for each other, and although it is almost impossible to induce one of these insects to abandon the ball which contains her egg, yet if when two females are engaged in depositing eggs at the same time, the balls are changed, neither seems to be aware of the deception, and they labour as contentedly for each other's egg as if it were their own.

There are also several species of another sub-tribe (*Coprini*), closely allied to the *Ateuchini*, which possess somewhat similar habits. They differ chiefly by frequently having the heads of the males armed with a large curved horn, and by having the middle and hind tibiæ gradually thickened, which unfits them for transporting the balls of material which serve for the food of the larvæ; though some of the species do construct balls, they bury them in the place where they are formed. Notwithstanding that these insects live in such unclean localities, they are remarkable for their constant state of glossy cleanliness; this is due to an oily fluid which they secrete, and which prevents all the nasty things they live amongst from collecting upon them or staining their coats.

The type of this group (Scarabæidæ), is the renowned *Ateuchus Sacer*, or Sacred Scarabæus, of the Egyptians, perhaps the most celebrated of insects. It was worshipped by them as a god, and dried specimens of the actual beetles or models of all sizes and in every possible material, from the commonest stone to the most precious metals, have been frequently discovered in Sarcophagi, or rolled up in mummies and other ancient relics found among the monuments on the borders of the Nile. For common use they were made very small, and some were pierced so as to form necklaces for the women, others were used as seals, as is shewn by the inscriptions beneath them. Plutarch states that the military caste made use of the figure of a Scarabæus as a seal, and Horappollon explains this by asserting that this insect peculiarly represents man, since (as was formerly believed) "there are no females of its species." A male wishing to procreate, said the Egyptians, takes some of the dung of an ox, and having fashioned it into the shape of the world, rolls it with its hind legs from east to west, and places it in the ground, where it remains twenty-eight days. On the twenty-ninth day the ball is exhumed and thrown into the water, where it opens and another male comes forth. Some of the models of the Scarabæus which have been found are of very large dimensions—one in the British Museum, carved in granite, is about four feet in length. There are several smaller specimens cut from marble, porphyry, agate, lapis-lazuli, garnet and gold.

Representations of it are to be found everywhere throughout the whole land of Egypt, carved upon the temples, tombs, monuments and obelisks.

The reverence shewn to these insects seems to have been called forth by many causes in their imaginative minds. Being an agricultural people, and knowing the habits of the Scarabæus, they worshipped it, because they could appreciate how, by the manner in which it provided for the welfare of its own offspring, it also benefited them by fertilizing the ground, and removing from the surface obnoxious matter. Its sudden appearance in great numbers on the sandy margins of the Nile, after the fall of the water every year, together with its extraordinary motions whilst rolling along its globular balls of dung, were regarded as mystically representing the resurrection of the soul, and the motions of the earth and sun. It, with the earthen ball containing an egg in the centre, was also regarded as an emblem of fecundity, and to this day, the beetle is eaten by the women of Egypt. On account of the shape of the egg-ball, and the wonderful care bestowed upon it by the parent beetle, it was employed as an emblem of the Creator's watchful care over the world.

In addition to these, a short mention must be made of two other families of ground beetles which are much commoner, and which from that account perform the useful work of their kind much more fully than the above-named interesting species. These two families are the *Geotrupidæ* or earthdiggers, and the *Aphodiidæ*, or cow-dung frequenters. They do not form balls of the food for their larvæ, but burrow straight through the mass and down into the earth below ; they then bring down some of the material from above, and deposit an egg in it, in the same way as the others. Two well known instances of these families are *Geotrupes blackburnii*, a small, blackish beetle with a green lustre, of about one-half or three-quarters of an inch in length, and *Aphodius fimetarius*, a small cylindric-shaped insect, with coral-red elytra, which is always to be seen about manure heaps in spring, and although it is one of the commonest of our insects, was only introduced from Europe a comparatively small number of years ago.

To the second division of the Scarabæidæ, namely, the "Tree-beetles," belong a large number of insects, which are perhaps even more injurious than their near relatives, the ground beetles, are beneficial. These are of much greater interest to the farmer than

any other class, and as several of them are of large size and very common, they annually destroy an enormous amount of produce. The greatest amount of injury is done during the larval state, which they spend in the ground consuming the fibrous roots of plants. The most injurious of these beetles, on account of the great amount of damage they have done, have already called forth very full descriptions in our annual reports, consequently, it is not worth while again to take up space by describing them. Among the most prominent are :

The May-bugs or Chafers, which were all included by Fabricius in the genus *Melolontha*, a word used by the ancient Greeks to distinguish the same kind of insects, which were supposed by them, as the name implies, to be produced from or with the flowers of apple trees. They are, I have no hesitation in saying, the most injurious insects in the world. The accompanying figure (33) gives a faithful representation of these insects in their different stages, and they may be easily recognized from it; they are already too well known, I fear, to farmers. In fig. 33, No. 2 the larval stage, known as the "White Worm," which is the greatest depredator, is also represented. It is a soft white worm with six legs and a brownish head; the body is very fat, and is about an inch and a half long. It lives for several (as a rule three) years in this stage, during which time it destroys everything that comes within its reach in the way of roots of plants. It has been found to be very injurious to the roots of strawberries, potatoes, corn and other vegetables, but particularly so to grass. They have been known to abound in such prodigious numbers that they ate all the roots of the grass in a pasture, and the plants could be rolled up from the surface as if they had been cut off by a turf-cutter's spade. The pupa stage of this insect is also shewn. The insect itself is scientifically known by the name of *Lachnosterna quercina*, Knoch. A full and most interesting account of this insect is to be found in the Annual Report of 1872, and in the same report also will be found an article by Mr. Saunders treating of the "Rose-bug," *Macrodactylus subspinosus* Fab. (fig. 34), an insect also belonging to this division, which has proved very destructive to grape vines in some localities.

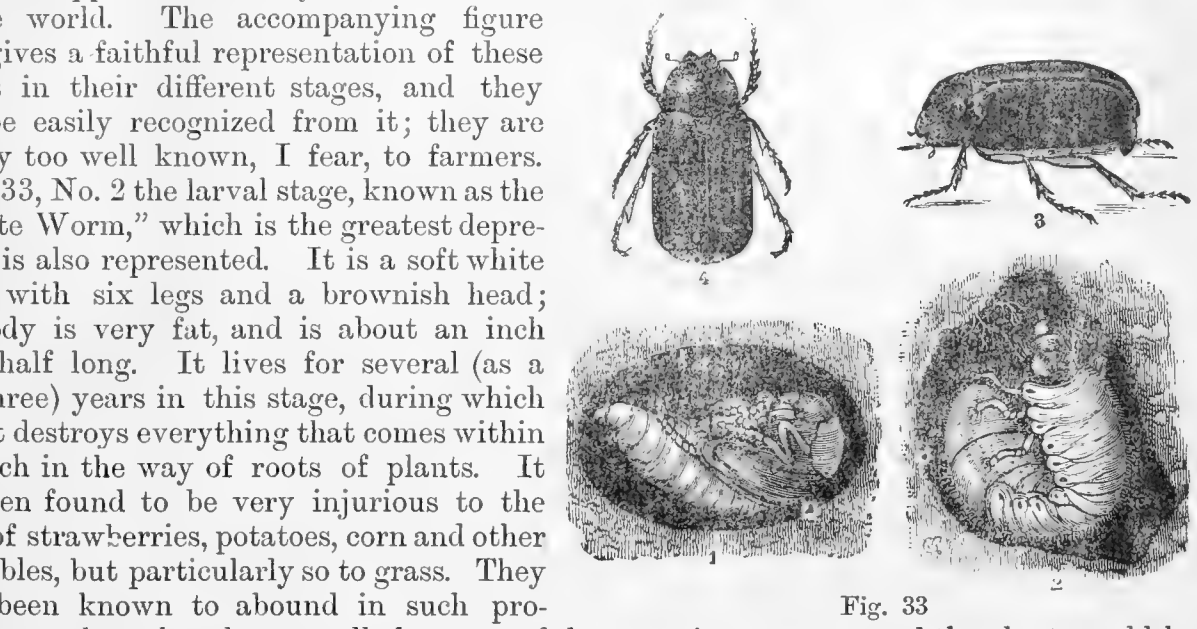


Fig. 33


Fig, 34

There is another beetle which feeds entirely on the wild and cultivated vines, but never occurs, I believe, in sufficient numbers to cause very material damage; this is the spotted vine beetle or *Pelidnota punctata*, Linn. It is a large handsome beetle, of which Fig. 35 is a life-sized representation, the colour of the smooth elytra or wing cases is reddish-brown and each of them is decorated with three conspicuous black spots. The thorax, which is of a deeper colour, also bears two more rather smaller ones. The jaws and scutellum are both black and its legs and under surface are of a dark metallic green. The Larva, Fig. 35, *a*, is a large fat grub much like the white-worm but may be at once identified by a distinct heart-shaped swelling, Fig. *d*; on the last segment; the colour too, is of a purer white, and the skin is less wrinkled. It has been found feeding upon the rotten stumps and roots of pear trees. Towards the end of the summer the larva forms a cocoon of chips

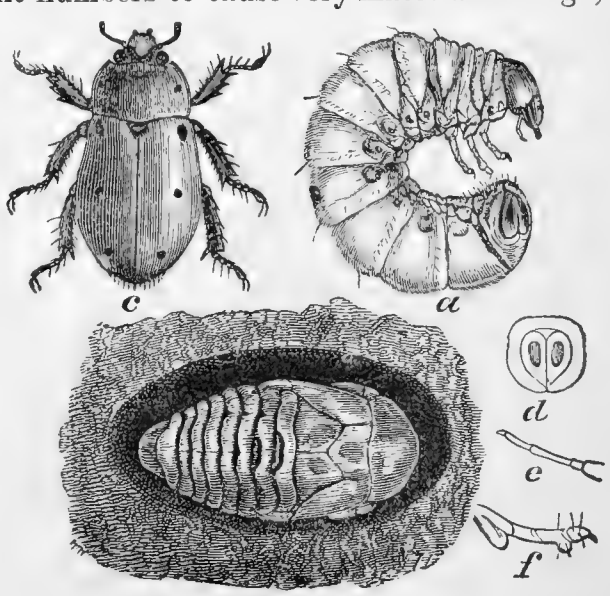


Fig. 35

of wood and about a fortnight after, the perfect insect emerges, and may be found on grape vines in Western Canada, during the months of July, August and September. To this division belongs the beautiful Goldsmith Beetle, *Cotalpa Lanigera*, of which an interesting account appeared in the February number of the *Entomologist*, written by Mr. Saunders. As many of the readers of the Annual Report do not read that periodical I insert it.

"This is, without doubt, the most beautiful of our leaf-eating beetles. It is nearly an inch in length (fig. 36), of a broad oval form with the wing cases of a rich yellow colour, with a pale metallic lustre, while the top of the head and thorax gleams like burnished gold of a brilliant reddish cast. The under surface has a polished coppery hue and is thickly covered with whitish wool; this latter characteristic having suggested its specific name *lanigera* (wool-bearer).

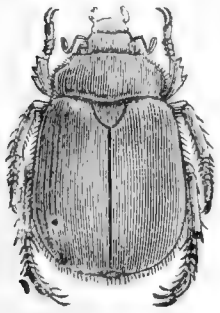


Fig. 36.

"This insect appears late in May, and during the month of June. It is distributed over a very wide area, embracing most of the northern United States and Canada, and although seldom very abundant, it is rarely that a season passes without more or less of them being seen. During the day, they are inactive, and may be found clinging to the under side of the leaves of trees, often drawing together two or three leaves—which they hold with their sharp claws—for the purpose of concealing themselves. At dusk they issue from their hiding places and fly about with a buzzing sound among the branches of trees, the tender leaves of which they devour; the pear tree, the oak, poplar, hickory, silver abele and sweet gum all suffer more or less from their attacks. Like the May bug, this beautiful creature is often attracted by light, and flies into open windows on summer evenings, dashing in a bewildered sort of way against everything it meets with to the great alarm of nervous inmates. In some seasons they occur in considerable abundance, and may be readily captured by shaking the trees on which they are lodged in the day-time, when they do not attempt to fly, but fall at once to the ground.

"The beetle is short-lived. The female deposits her eggs in the ground during the latter part of June, and having thus provided for the continuance of her species, dies. The eggs are laid during the night singly and at different depths, the number probably not exceeding twenty in all. They are very large for the size of the beetle, being nearly one-tenth of an inch in length, of a long ovoid form and white tranluscent appearance.

"In less than a month the young larva is hatched; it is of a dull white colour, with a brown polished horny head, and the extremity of the abdomen lead colour. The mature larva is a thick, whitish, fleshy grub, very similar in appearance to that of the common May bug, familiarly known as 'the white grub.' It lives in the ground and feeds on the roots of plants, and on this account it is sometimes very destructive to strawberry patches.

"Several years are required to bring this grub to maturity; finally it reaches its full growth in the fall, and changes to the perfect beetle early the following spring." I have never met with this insect nor the spotted vine beetle in this part of Ontario.

The last division, of "Flower Beetles," is very poorly represented in Canada, and the individuals rather small. They are, however, striking in appearance. They belong chiefly to the genus *Cetonia* and its allies, and are easily distinguished from the other scarabæians by their lower jaws, which are generally soft on the inside and are provided with a flat brush of hairs with which they collect the pollen and juices upon which they feed. Most of the brightly coloured kinds are diurnal, the dull ones nocturnal. Of the Canadian diurnal flower beetles, the Euryomias are perhaps the most typical. This genus was separated from the Cetonias by Lacordaire on account of the structure of the oral organs. We have two in our fauna; *E. inda*, Linn (Fig. 37), a rare insect in this part of Canada; but common enough in the West and in the United States to occasionally do much damage to the peach crop, by boring into the fruit just when it is ready for the market. The other species, *E. fulgida*, Fab., is also common in Western Canada; I have taken it in numbers near London, Ont., on the flowers of *Viburnum pubescens*, Pursh, in the month of June.

Fig. 37.

Of the nocturnal flower-beetles the two Osmodermas may be mentioned. These are large insects, remarkable for giving out an odour like that of Russian leather. They conceal themselves during the day in crevices of bark and hollow trees, where they feed upon the sap that flows from the bark. The name is derived from two Greek words—ὀσμή, an odour, and δέρμα, the skin. *O. scabra*, Beauv., or the rough Osmoderma is rather the smaller of the two, and is about three-quarters of an inch long, with wide roughly-granulated elytra, and a considerably narrower thorax. When resting with their legs extended and almost straight, they have a very stilted, unlife-like appearance. The colour is deep purplish-brown, with a bronze lustre. The larvæ, which resemble those of the May-bug, may be found in the decayed portions of living apple and cherry trees, where they considerably quicken the work of destruction already begun. *O. eremicola*, Knoch, or the Hermit Osmoderma, is slightly larger and of a deep mahogany brown colour, perfectly smooth and highly polished. The male may be known by the presence of a deep pit in the middle of the thorax. In other respects it is like the last.

There is a very remarkable group of *Cetonidæ*, known by the name of Goliath beetles, to which Linnæus gave the name *Goliathus*, and placed them first in the whole of his arrangement of coleoptera. As the name implies, they are of very large size, some reaching the gigantic proportions of over four inches in length. What adds to their size, too, is that they are correspondingly broad.

A most interesting account of these beetles is to be found in the Rev. J. G. Wood's charming book, "Insects Abroad." He describes *Goliathus Druryii*, one of the largest and most beautiful, as follows:—

"Its length is four inches and a quarter, and the breadth exactly two inches. The head, which is furnished with two curious projections, is greyish-white, except the horns, which are black and deeply-punctured; the thorax is black, and upon it are drawn a number of creamy-white stripes; the elytra are warm chocolate with a velvet-like surface, surrounded with a belt of the same creamy-white as that upon the thorax—below, it is black with a mixture of green; the tibiæ of the first pair of legs are much flattened and deeply punctured; they are of a reddish hue. Those of the hind pair are furnished on the inner side with a dense ridge of golden hairs with a silken gloss; the tarsi are black. For many years this was the rarest of insects, only one specimen was known, which was picked up dead, floating in an African river. Of late years, however, several have been brought to England from the west coast of Africa, and among others a magnificent specimen of a cocoon containing the perfect insect. This is now in the British Museum, and is about the size of a swan's egg. It has very thin walls, but is strengthened round the middle exteriorly by a remarkable raised belt.

NOTES ON VARIOUS INSECTS.

By Wm. Saunders, London.

In the following remarks, reference will be made to some insects which, on account of their frequent appearance, or their curious or beautiful structure, are objects of interest to every observer of nature, and also to insects to which the writer's attention has been specially called during the past year.

Dytiscus Harrisii (fig. 38). This is one of the carnivorous water beetles, known as "Diving Beetles" or "Water Tigers," a strong, sturdy creature of an oval flattened form, with oar-like swimming legs, covered with long hairs. It is very active in the water, darting and diving about in different directions with great rapidity, the form of its body with sharp sides enabling it to cut through the water with great ease. They may well be called the sharks of the insect world, for there are few things that live in the water which are safe from their attacks. They are especial enemies of the larvæ of other aquatic insects; they feed also upon tadpoles, molluscs and small fish, and when pressed by hunger they do not hesitate to devour one another. They may be kept in an aquarium and fed on water insects and small pieces of raw meat, which they suck greedily.

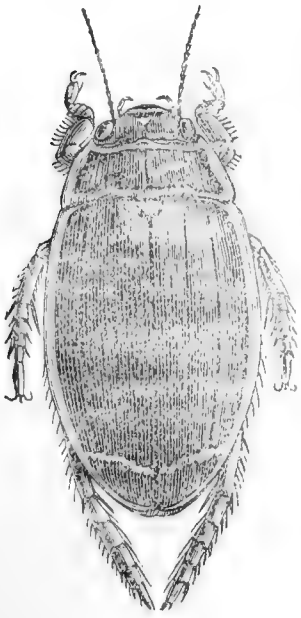


Fig. 38.

Fig. 38 represents this species very correctly ; it is black with a broad margin of pale yellow on each side, and stripes of the same colour across the front of the head and on both the front and hind margins of the thorax ; there is also an irregular yellow line crossing the wing covers near the tip. The under side is somewhat paler with reddish markings. Examples of this insect are often brought to us during the summer by persons who have found them in tubs or barrels of water and who were puzzled to know how they could get there. Beneath their hard wing covers they have a large pair of membranous wings, by the use of which they can fly with great ease ; by this means they are enabled to travel from pond to pond in search of their prey. When wishing to change their location they crawl out of the water (usually towards evening) either up some reed or other water plant, or to the margin of the pond, and suddenly open their wing covers, expand their wings and rise into the air almost perpendicularly to a great height. Their descent is nearly as sudden and direct, and they often, when descending, drop into the water with considerable force. It would appear that they are enabled to distinguish the water from a considerable height by its glassy surface, for sometimes they have been known to drop with violence upon glazed garden sash, which they had evidently mistaken for water.

The female lays her eggs in the water, where they soon hatch into young larvæ, possessing the ferocious disposition and voracious appetite of their parents. The larvæ grow rapidly, and when mature are about two inches long, with large flattened heads armed with sickle-like jaws, with which they seize other insects and hold them while they suck their juices ; they sometimes quickly snip off the tails of young tadpoles, and are known to attack young fishes and suck their blood. Many years ago, when searching with a dip-net in a pond for the larvæ of Dragon-flies, we caught one of these savage creatures, and supposing it could be as safely handled as the libellulæ larvæ, took hold of it, when it quickly turned and buried its sharp jaws in the flesh of one of our fingers, making the blood flow quite freely. These larvæ breathe through their tails, which they protrude into the air for that purpose, When full grown and about to assume the pupa state, the larva leaves the water, and burying itself in the earth, constructs there a round cell within which it undergoes its change, and if this occurs in summer, it appears in two or three weeks as a perfect beetle ; but if in autumn it remains in the chrysalis state all winter, transforming to a beetle in the spring.

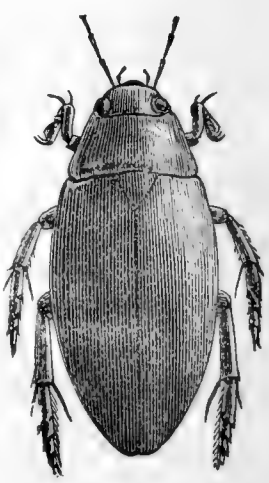


Fig. 39.

Fig. 39 represents another of our large water beetles, *Hydrophilus triangularis*. This species is entirely black, and so strong and muscular as to be difficult to hold in the hand when captured. The relationship of this tribe of insects (*Hydrophilus*) with the preceding one (*Dytiscus*) is very close. There is much similarity of form and a close resemblance in habits ; their method of swimming, however, is different, for while in *Dytiscus* both paddles are moved simultaneously, in *Hydrophilus* they are moved alternately, hence the stroke of the latter is much less effective. We are not aware that anything has been written on the early stages of *Hydrophilus triangularis*, but in Europe the life history of a closely allied species, *Hydrophilus piceus*, has been carefully traced by several observers, and there is little doubt but that our species has similar, if not identical habits. The female of *H. piceus* has the singular habit of spinning a silky cocoon for her eggs, one side of which is furnished with an upright, bent, horny point, an inch long, which is supposed to be serviceable in conveying air to the interior. These eggs, some fifty or sixty in number, are placed in an upright position and in regular order in their receptacle, which is round and flattened and attached to some water plant at the surface of the water. In warm weather the larvæ are hatched in from twelve to fifteen days, when they escape at the lower part of the cocoon, which is closed only by a few threads. They undergo three moultings, and when full grown measure nearly three inches

in length. The head is horny and of a very singular form, its lower surface being convex, while its upper surface is flattened. Its sharp and formidable jaws are well adapted for seizing and securing its prey. They are said to attain their full growth in July, when they leave the water, bury themselves in the earth, where they undergo their changes in a manner similar to that of *Dytiscus.*

The Tiger Swallowtail (*Papilio turnus.*)

Fig. 40

This beautiful insect has been more than usually common in some districts of our Province during the past year, and always attracts attention from its size and its majestic flight, floating through the air as it does in the most stately manner. The butterfly, Fig. 40, measures about four inches across, when its wings are expanded; the body is black above, margined with pale yellow, the wings yellow banded with black, the hind pair powdered on their outer margin with patches of blue scales.

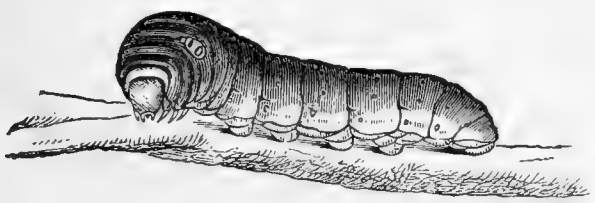


Fig. 41.

The caterpillar (Fig. 41) is rather a strange looking creature, of an olive green colour, with a whitish bloom and a prominent eye-like spot on each side of the fourth segment. It feeds chiefly on the apple, cherry, thorn and basswood. For a more detailed description of this insect we refer our readers to the report of our Society for 1873.

The Achemon Sphinx (*Philampelus achemon*).

Fig. 42.

In our report for 1872 we published a description of this insect which is a very beautiful and attractive creature in the perfect or moth state (Fig. 42), and a very odd looking object as seen in the larval condition. Quite recently Dr. John H. Garnier, of Lucknow, Ont., has written us in reference to this insect, which he has found injuring his grape vines. He found several of the larvæ feeding on a Rebecca vine, for

which they seem to have a marked preference. He fed them in confinement and put in leaves of Rebecca, Delaware, Massasoit, Concord, Creveling, Salem and Martha, but they would eat only Rebecca leaves.

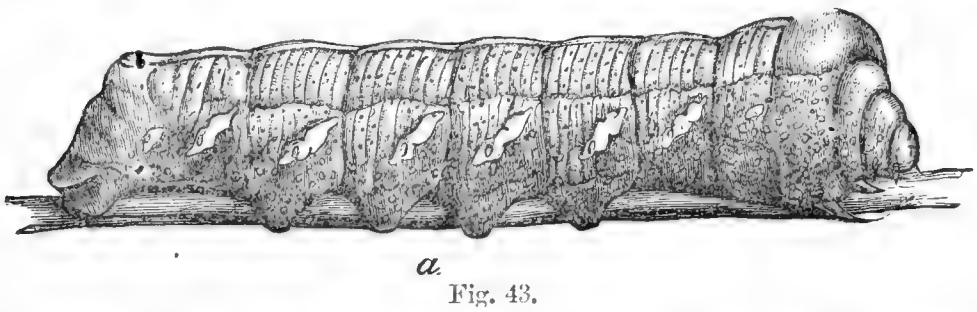


Fig. 43.

The caterpillar (Fig. 43) varies much in colour. When young it is usually green with a long curved horn rising from the last segment but one, but as it becomes more mature, in moulting the horn disappears, and its place is occupied by a dark polished tubercle; the colour also changes frequently to a pale straw or reddish brown, shading at the sides into a rich brown. It has six irregular cream-coloured spots along each side.

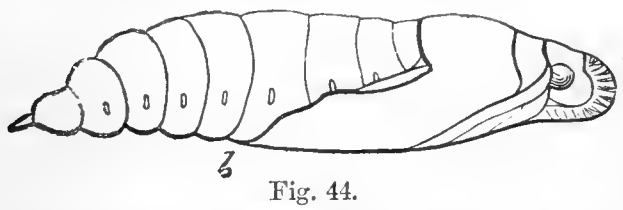


Fig. 44.

When full grown it descends to the ground, and burrowing underneath, changes there into a chrysalis, Fig. 44, of a dark shining mahogany brown colour.

The moth (Fig. 42), which appears towards the latter end of June, is of a rich brownish-grey colour, variegated with light brown, and with the dark spots, shewn in the figure, deep brown. The hind wings are pink, with a band of dark spots and a broad grey border behind.

Catocala ultronia.

In the genus Catocala is included a number of very beautiful moths, many of them of large size, and restricted in their distribution to the northern portions of America. Most of them have the hind wings red, banded with black, and hence have received the common appellation of "Red under-wings." Some few species, however, have the red ground replaced by white, or by plain black, or dark brown edged with white, but these latter are greatly in the minority and much less frequently met with than those with red hind wings. The fore wings are usually of varying shades of rich gray or brown.

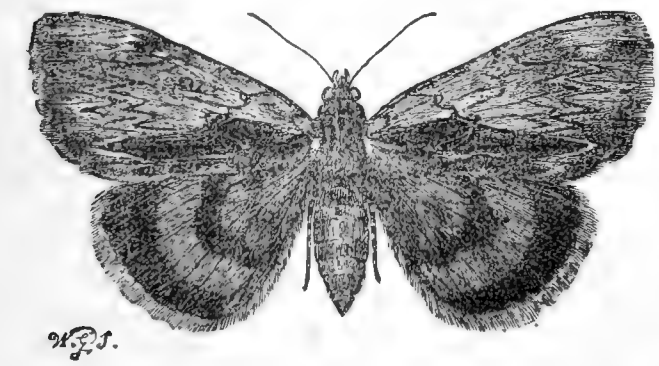


Fig. 45.

In *Catocala ultronia* (Fig. 45) the fore wings are of a rich umber colour, darkest along the hind margin, with a broad diffused ash-coloured band along the middle, not extending to the apex, which is brown; there are also several zigzag lines of brown and white crossing these wings. The hind wings are deep red with a wide black band along the outer margin and a narrower band of the same colour across the middle. The ciliæ which border the wings are partly white and partly brown.

The larva feeds on the leaves of wild plum and is also found attacking the cultivated varieties. When full grown, which is about the 20th of June, it is nearly two inches long, a leech-like creature with its body thickest in the middle and tapering towards each end. When at rest it adheres so closely to the bark of the branch and so nearly resembles it in colour, that it is difficult to detect. The body is of a dull greyish-brown, studded with brownish dots and rows of dull reddish tubercles. On the top of the ninth segment or ring there is a stout fleshy horn, nearly upright, about one-twelfth of an inch long, pointed and similar in colour to the body, but with an irregular greyish patch at each side. On the twelfth segment there is a low fleshy ridge margined behind with deep reddish brown and an oblique stripe of the same colour extends forward nearly to the

spiracle on this segment. The terminal segment is flattened and has a number of small pale reddish and blackish tubercles scattered over its surface. Along the sides of the body close to the under surface there is a thick fringe of short fleshy-looking hairs of a delicate pink colour.

The under surface is also of a delicate pink, of a deeper shade along the middle, becoming bluish towards the margins with a central row of nearly round black spots which are largest from the seventh to the eleventh segments inclusive. The anterior segments are greenish-white tinted with rosy pink along the middle, with a dull reddish spot at the base behind each pair of feet.

When about to change to a chrysalis the larva makes a rough enclosure by drawing together fragments of leaves and fastening them with silken threads, within which it undergoes its transformation and appears as a moth in about three weeks afterwards.

The moth is on the wing during the greater part of July and August, is attracted by light and comes freely to sugar. All the insects of this family are night-flyers and expose their brilliant hind wings only in flight. When at rest the grey or dull brown upper wings overlap and cover up the gaily-tinted under wings like a very flat roof.

The Io Moth.—*(Saturnia io.)*

The caterpillar of this moth is very pretty and is well represented in Fig. 46. It is of a very delicate pea-green colour, with a broad white stripe on each side, bordered with lilac below. The body is covered with spreading clusters of green bristles tipped with black, and when the larva is handled these bristles sting like nettles. Judging from the number of communications we have had concerning this insect during the past year it must have been very common in many quarters.

Fig. 46.

While quite young these caterpillars feed in flocks, and have then the curious habit when moving from place to place of marching in regular procession like files of soldiers; when full grown, they lose this habit and feed singly. They are very general feeders and will eat corn, willow, hazel, sassafras, wild cherry, elm, and a number of other trees and plants. When full grown the larva crawls to the ground, where, among loose leaves and rubbish, it forms a rough outer covering, and within this a slight cocoon of tough brown silk.

The moths are very handsome, and are remarkable for the difference between the sexes both in size and colour. The male (Fig. 47) is the smallest, and of a deep yellow colour, with darker reddish lines and spots. The hind wings are broadly shaded with purple next to the body; near the hinder margin is a curved purplish band, and within this again is a smaller one of a dark purple or violet colour. In the centre of this last band, and in the middle of the wing is a large round blue spot with a whitish centre and a broad, border almost black. The body is a deep yellow, a little darker on the thorax; the antennæ are broadly toothed.

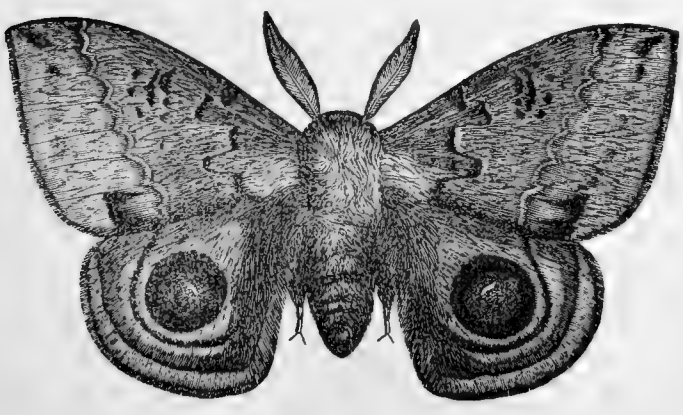


Fig. 47.

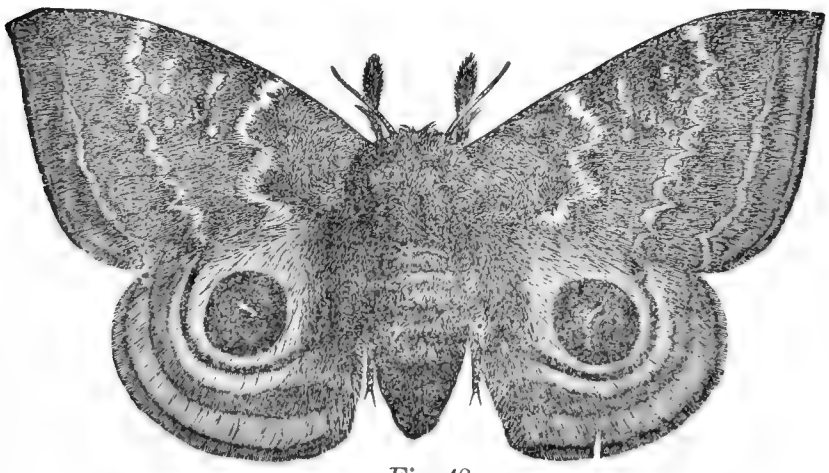


Fig. 48.

The female (Fig. 48) is larger than the male, and varies much in colour, from a deep purplish brown to an ochreous red. The fore wings are covered by similar wavy lines; the inner margin is of a darker colour; the hind wings are marked very similarly to those of the male. These moths fly only at night.

THE AMERICAN CURRANT BORER (*Psenocerus supernotatus*).

The accompanying cut (Fig. 49) represents an enlarged view of a native currant borer, *Psenocerus supernotatus;* the small outline figure shews the natural size. It is a beetle belonging to the family of longicorns, *Cerambycidæ*, which doubtless had its home originally among the wild currant bushes of our woods, but a more extended and inviting field having been opened for it by the planting of the cultivated varieties in our gardens, it has taken kindly to them, and although not so destructive as the imported currant borer, *Egeria tipuliformis* (Fig. 50), has in many instances, proved quite troublesome. In nearly all our gardens numbers of the currant stalks annually perish, and were it not for the vigorous growth of new shoots from year to year, the bushes would soon be destroyed. If one of these stalks is split asunder, the cause of its death is manifest, for through its whole length it is found to be more or less eaten away, the hollows being filled in places by a fine sawdust-like powder. This is sometimes the work of the imported currant borer (Fig. 50), and sometimes the work of the native species (Fig. 49).

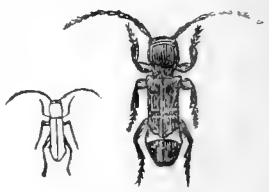


Fig. 49.

Fig. 50.

Early in June the parent beetle of the native currant borer deposits her eggs upon the currant stalks, where they soon hatch into tiny grubs, which burrow into the heart of the stem, and feeding on its pith, reach full growth before the close of the season. They are footless grubs, which measure, when full-grown about half an inch in length. The head is scarcely half as broad as the body, is of a dark brown colour, with black jaws. The body is whitish with some brown dots along each side, and is slightly clothed with very fine short hairs. When full-grown, and about to change to a chrysalis, the larva gnaws a channel through the woody fibre to the outer bark, so that when changed to a beetle it can make its escape by merely rupturing the bark. The cavity thus made is filled with little chips to prevent the bark from being prematurely broken, and below this stuffing the insect constructs a bed of short, woody fibres, packing the passage below with a finer material resembling sawdust. Within this enclosure, which is about half an inch in length, the larva changes to a chrysalis, and reposes until the fully formed beetle is ready to emerge; then gradually drawing away the obstacles to its egress, it finds its way to the end of the passage, and gnawing a small round hole through the bark, effects its escape.

The Beetle is black with the edges of the wing covers and the thorax pale chestnut brown. On each wing cover there is a rather large white spot beyond the middle, and two smaller anterior spots, which are sometimes ash-grey and sometimes yellowish. The antennæ, which are shorter than the body, are pale brown, thickly clothed with short ash-grey hairs. The under side is black and sparsely covered with short grey hairs.

Dr. Fitch describes two parasites which he found attacking this pest in the larval state, one a small ichneumon fly, the other that of a small two-winged fly. Hence, secluded as it seems to be within the centre of the currant stem, it is unable to escape the acute instincts of its enemies, who searching it out, feed on its body and cause its death.

As these worms remain in the dead stalks throughout the winter, their destruction is easily compassed by breaking off all the dead wood to the surface of the ground and burning it.

The imported currant borer is a pretty little wasp-like moth with a bluish black body crossed by three narrow golden bands. It flies only during the warmer part of the day and is very active in the hot sunhine. The female lays her eggs singly near the buds, and when hatched the young larvæ eat their way to the central part of the stem as in the insect just described, but instead of being footless this grub has sixteen feet, which are of a brown colour while the body is fleshy white.

ON THE *ELATERIDÆ* OR CLICK-BEETLES.

By W. Hague Harrington, Ottawa.

This extensive and interesting family of *Coleoptera* has hitherto had but little attention devoted to it in these Annual Reports. Yet, it is one which deserves more than the passing mention or description of a species, and the present paper is intended to call the attention of our Agricultural readers to a large group of insects, which are now in some measure destructive, and which may become far more so in the future. The facts will be presented in as plain and untechnical a manner as is consistent with the scientific requirements of the case.

These beetles belong to the thirty-fifth family in Le Conte's classification of *Coleoptera*, and are a sub-division of the *Serricornes* of Latreille, being classed with the *Sternoxi* (sharp-breasted). They are very nearly related to the family *Buprestidæ*, which were so fully described in last year's Report by Mr. Fletcher, differing, however, from the Buprestians in being much more flattened and elongated, and less hard. They also have the hinder angles of the thorax prolonged in sharp points, which prevent any lateral movement of it. The thorax in most cases is very loosely articulated to the meso-thorax, allowing considerable motion upward or downward of the front part of the body.

The pro-sternum (breast-bone) of the Buprestians was mentioned as being prolonged backward into a point or spine, and this spine-like pro-sternal process forms one of the most striking characteristics of the click-beetles. Our great teacher in scientific nomenclature, Linnæus, gave to these beetles the name Elater, (from a Latin word meaning to "bound,") but this name is now strictly limited to one of the many genera comprised in the *Elateridæ*.

The family is one very easy to determine, as the species preserve a marked resemblance to each other, varying but little in general shape, and going to no extremes in size or colouring. Glancing at a collection of them, it will at once be seen that there is a preponderance of dull black or brownish species, with occasional touches of red or yellow, but none are so brilliant as forcibly to individualize themselves by mere gay tints. Roughly, they may be said to vary in size from a quarter inch to two inches.

They have been named click-beetles, skip-jacks, spring-beetles, snap-bugs, clickers, snap-beetles and blacksmiths, from their power of leaping from their back, or from the clicking noise which attends such a performance. By the celebrated Swammerdam they were called grasshopper or locust-beetles.

As already stated, they belong to the great tribe of Serricornes, or "saw-horned" beetles, so named because the inside of the antennæ presents a notched appearance, from the joints having the tips more or less projecting. Their antennæ are eleven-jointed, except in a few rare instances where an extra joint is found, and are placed widely apart. In some genera they can be laid back under the thorax in grooves excavated along the margins of the pro-sternum so as to be beautifully hidden and protected. The great majority of genera have these members of moderate length, and but slightly serrate; but in some few genera they are longer and pectinate, especially those of the males.

Click-beetles have rather short and slender legs, which can be folded very closely to the body when the insect is alarmed. One of their most marked peculiarities of structure is the spine into which the pro-sternum is produced. It is to be found between the first

pair of legs, and usually lies so hidden in a groove excavated for its reception in the meso-sternum, that its use and importance might at first sight not be apparent. When, however, the beetle falls, or is placed upon its back on a surface too smooth for any projection to be reached with its short legs, the service rendered by this curious piece of mechanism will soon be seen, for when the beetle has vainly endeavoured to right itself by the use of its feet, and finds itself as helpless as a turtle in a similar predicament, it bends back its thorax and head until its arched body rests only on the back of the head and the tips of the elytra (wing-covers). By this movement the spine is released from the groove or socket into which it so neatly fits; then by smartly bending up the thorax again the projection is forced back into its receptacle. This is not so easily accomplished as its withdrawal. It appears to catch for an instant upon the margin of the groove, but by reason of its elasticity bends and springs in with a sudden jerk, producing the snap or click which is heard. The consequent sudden impact of the elastic elytra on the hard surface tosses the beetle several times its own length into the air, the height being greater as the substance on which it rests is smoother and harder. If it does not fall upon its feet the operation is repeated until the desired effect is accomplished.

Elaters may be roughly classed in two groups according as the larvæ are found feeding on the roots of plants (usually under ground) or in old and decaying wood, or under bark. The majority of the first, and a few of the second class are decidedly obnoxious insects, while the rest are more or less beneficial.

The eggs of the root-feeders are thought (although the fact has, so far as I know, never been actually determined by observation), to be laid on or among the roots or stalks of plants, either in the ground or just at its surface. They are very minute globular, or partly oval bodies of a yellowish-white colour and produce almost invisible slender grubs, which even when full grown are seldom more than an inch long.

In England these grubs have received the name of "wireworms," from their slenderness and hardness, and the same term is applied to them in this country. It is also incorrectly applied sometimes to the millepedes or myriapods, such as the *Julus*, which is found under stones or in wet wood, etc., and is often from two to three inches long. These are not true insects and are easily distinguished from the larvæ of the clickers by their many feet, the *Julus*, for instance, having over fifty pairs.

The larvæ of elaters more nearly resemble in shape the well known meal-worms, or grubs of the beetle called *Tenebrio molitor*. They have twelve segments besides the head, and have six true legs; also a prop-leg or tubercle on the least segment. They are semi-cylindrical, being rounded above and flattened beneath, and are cased in a very hard, horny covering, which affords them a most efficient protection from the attacks of their smaller enemies, and also enables them to burrow easily and rapidly through light soils.

Such larvæ as live in decaying or old wood are broader and more flattened and in some cases much larger than the earth burrowers. The eggs are probably laid in crevices of the bark or wood in which they undergo their transformations. These larvæ may be said to be beneficial in so far as they, with those of many other tribes of insects, aid in destroying and removing the decayed and prostrate vegetation, and thus make way for new growths.

I am not aware that any very marked damage has as yet been inflicted upon the crops in Canada by the larvæ of these beetles, but in the British Islands they have been accused of committing alarming depredations on grain, root crops and garden produce of various sorts. Much attention has been given to them by Curtis in his exhaustive treatise on "Farm Insects," and also by many other well-known entomologists. A number of species are described, four of which appear to be specially obnoxious and destructive. The larvæ live some years, perhaps as many as five, and moult, as do caterpillars, three times before entering the pupa state. This change takes place in a small cell some distance under ground, and in a few weeks the beetles emerge to a higher but much briefer existence, and are found upon various flowering plants, etc.

The four species so notorious for their ravages belong to the genera *Athöus* and *Agriotes* of *Eschscholtz*, which are represente l in this country by a number of species, having probably similar habits to their old world kindred.

There is scarcely any land free from them or any crop that is not subject to their voracity. They occur wherever grass will grow, being particularly harboured among clover roots, and are always prevalent in meadow and pasture-lands, seeming to thrive best in the vicinity of swamps and woods. When lands are broken up the first crops sown are often almost totally destroyed by the larvæ which infest it and remain in it for some years afterwards.

Young oats, wheat, rye, barley, etc., suffer much from being partially or entirely cut off below the surface; the wireworms destroying manifold the amount actually devoured. Wood says that while only eating one-tenth as much as a similar sized caterpillar, each wireworm destroys ten times as many plants. Hops, cabbages and many root-crops are also injured; turnips, perhaps, more than any, as they are cut off when young, and have the roots badly eaten into when larger, as many as twenty or more grubs having been found at one turnip.

Conflicting opinions are held as regards the liability of potatoes to be attacked. Some even propose the use of slices of these tubers, among other substances, as traps to entice the wireworms to in gardens. On the other hand evidence has been often adduced to prove that land sown with potatoes was in a great degree cleared of infesting larvæ, which it was asserted do not touch the potatoes and are consequently starved out.

In gardens, the wireworms destroy salads, etc., and the gardener has also often to lament the loss of his beautiful flowers, such as carnations and lobelias. The list of cultivated plants attacked by them could be greatly lengthened, and it is fortunate for Canadian farmers and gardeners that as yet they are not so abundant and destructive here. Nevertheless considerable damage is done to many crops on this continent, and the late esteemed Dr. Asa B. Fitch (one of the greatest of American Entomologists) has treated of wireworms—see his 11th Report—almost as exhaustively as Mr. Curtis. It appears that Indian corn, one of the largest and most important crops grown in North America, is the greatest sufferer, especially when (as is usually the case), it is the first crop planted in new land, or when the season is cold, wet and late. The seed corn is attacked by the wireworm, which bores its way into the kernel and is often found half buried therein when the hills are examined. Upwards of thirty or forty have been found in a single hill, and nearly the whole of the seed planted is sometimes destroyed. The still more valued cereal, wheat, does not escape serious attacks, and, as in England, *all* crops are more or less liable to be damaged. An exception may be made in favour of buckwheat, which has been strongly asserted to rid the land of them, but there are doubts as to its efficacy in so doing, as well as many objections to it as an uncertain and inferior crop. All kinds of grasses, from the choicest timothy to the coarsest swamp sedges seem to be the chief and favourite diet of wireworms; so that grass and meadow lands are badly infested for a year or two after being broken up.

Dr. Fitch was of opinion that the wireworms of this country do not live more than two years (instead of five), as it is only for that length of time that new fields are so much infested with them.

As the country becomes more densely settled, and, through the breaking up of the waste lands, they are gradually deprived of their natural food-plants, they may come to be equally abundant and voracious amongst us as in England, so that it may be well briefly to mention the measures adopted to destroy them there.

For gardens or small lots hand picking is most strongly recommended as the surest way of ridding them of these vermin; but where labour is so scarce and dear as in this country, such a measure is hardly feasible. By this method 18,000 wireworms were gathered from a field of one and a half acres, and in another instance over 60,000 from an area of three acres. Women or boys were employed to traverse the rows of plants, loosen the soil around the roots, put all the wireworms into jars, or other suitable vessels, and press down the soil around the roots.

One of the most successful remedies on a large scale is a mixture consisting of two parts of quicklime, three parts of soot, and one part of coarse or refuse salt. This is used as a top-dressing, being applied immediately after compounding, and should be well rolled in. It has the advantage of being perfectly harmless to the crops. Indeed it is a most excellent and powerful fertilizer, as well as a destroyer of all kinds of insects and many

weeds. Refuse from gas-works, nitrate of soda, rape-cake, and chloride of lime, mixed and spread with manures are highly recommended, and the sowing of soda-ash or guano broadcast when planting.

A previous crop of white mustard is claimed to clear the land of them, presumably by starving out, for the roots of the mustard are extremely acrid, and of course occupy the soil to the exclusion of any more nutritive ones. A close grazing by sheep seems beneficial where pastures are badly infested, perhaps because the surface is trodden down too hard for the larvæ to work through, or because the beetles are prevented from laying their eggs, or have them destroyed. The same result is also obtained by compacting the surface by heavy rollers.

There are also means of striking directly at these pests which at the same time are of more general utility, and whose adoption cannot be too strongly urged. Aside from any mere questions of a taste for order, neatness and beauty, the practical wisdom and advantages of keeping land thoroughly worked and cleaned are plain to everyone ; it does not pay to leave neglected a single square yard of the farm.

The larvæ of these beetles, in common with hosts of other insects, find a pleasant refuge in the uncultivated patches left about the farm, and under or among stones and other rubbish. Farmers cannot bear this too constantly in mind, and they should strive to have their fields, as well as gardens, free from all unnecessary disfigurements of such kinds. The entomological collector may delight in the rank growth of all manner of shrubs and plants along the fences and ditches of his neighbours, for he generally finds a rich variety of specimens thereon ; but what is his gain is usually the owner's and the country's loss.

Leave no such strips along the fence-rows, nor of stubble in the fields. Let all loose boards, stones, logs, brush and rubbish of every kind be removed, and thus, as far as possible, prevent insect foes, from harbouring about the fields ; there will be plenty of them without furnishing such breeding and hiding places.

Above all, learn to protect all their natural enemies, among the most powerful of which are the birds. It is really disgraceful (and saddening to such as love and value these bright little creatures) to see the merciless way in which they are shot and trapped around this city (Ottawa), and I fear the same indiscriminate "slaughter of the innocents" takes place all over the land. All those that are known to be insectivorous should be vigorously protected and encouraged, even if occasionally they do exhibit a tendency to a vegetarian diet and pilfer a few berries and seeds.

Robins, thrushes, blackbirds, sparrows, etc., may be always seen searching and pecking vigorously among the grass for elaters and other insects, while numerous species are searching for them in all other situations. It has been estimated that an English rookery, of 10,000 rooks, consumes annually about 200 tons of worms and insects. Now, our much-abused crow, a brother of the rook, is just as active and voracious a bird, and feeds its young (according to Fitch) almost solely on elaters and their larvæ. Thousands of these are probably consumed by the young crow before it even leaves the nest to hunt for them itself.

Toads and frogs live also mainly upon insects, and being nocturnal in their habits—as are so many insects—they form the night relay, working to save the crops while the birds are at rest. Turkeys, ducks and other poultry may profitably be allowed to run in grain fields at suitable seasons, while among root crops they can seldom do any harm, and devour immense numbers of all kinds of insects.

In breaking up new land it is well to burn the turf, and the destruction of many insects, in their various stages, is undoubtedly accomplished by the process of burning so generally in use in this country.

When the elaters reach the perfect state, they are entirely harmless beetles (except that they lay the eggs for future broods), and are found upon flowers, grass, stumps, trees, fences, etc., and when they are approached they have a very common habit of dropping from their resting-place, so that it is often almost impossible to find them. They walk slowly, but can fly well, and do so both by day and night, seldom, however, making long flights, rather preferring to remain in the vicinity of their former feeding grounds.

As it is not proposed to attempt in this paper any scientific classification or descrip-

tion of the many genera and species comprised in the family *Elaterida*, the remainder of this paper will be devoted to a few brief remarks on some of the more interesting foreign and native ones.

Westwood states that the Elaters are less rich in species than the Buprestians, but that they are more generally distributed. About four hundred and fifty North American species are given by Le Conte in his classification, of which, perhaps, one-fourth are found in Canada. During the past summer I collected in the immediate vicinity of Ottawa fifty species, while of Buprestians I only obtained about half that number.

There are perhaps no click-beetles that in form, size or markings are striking when compared with many other families of beetles; they vary but slightly in shape, are of moderate size, and of dull hues generally. One genus, however, (*Pyrophorus*, containing 30 or more species) is indeed worthy of notice from the power of light-emitting possessed by its members. If sombre by day they are the brightest of all insects when darkness shrouds the world. I have before me a specimen of *P. noctilucus*, the celebrated "fire-fly" of the West Indies and Central America, called by the Spaniards *cucujo*. Figure 51 represents this insect both at rest and on the wing. It is nearly an inch and a-half long, (the elytra being exactly an inch from base to tips,) and has a tawny grey appearance, caused by a covering of short yellowish hairs on a black surface.

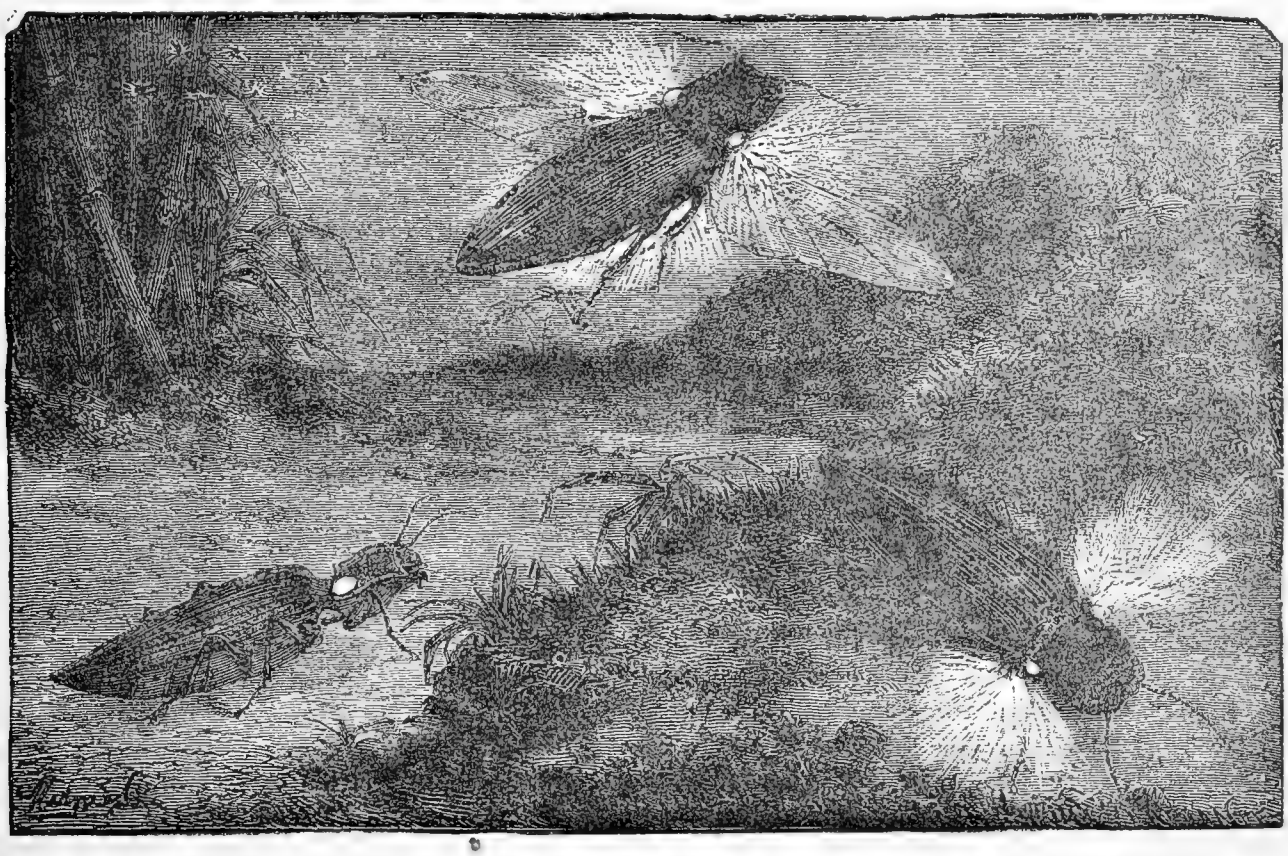


Fig. 51.

Its most important features are two smooth, convex yellow spots, or tubercles, on the thorax—one on either side—from which at night, when the beetle is alive, streams a strong greenish light, far surpassing that of our own "fire-flies," or, correctly speaking, "fire-beetles." When the beetles are on the wing another patch beneath the body emits a bright orange-tinted light.

These beetles and their larvæ feed on the sugar-cane and do great damage to the plantations, being in some places very numerous, so that the air at night is starred in every direction with their myriad meteor-like fires. The natives, ever ready to connect the visible with the unseen, call them, not unpoetically, the vehicles of departed souls, or in other places they are said to be the souls themselves flitting about the earth they have left, so that to kill one might be to crush the soul of a departed friend. Such beliefs in connection with certain insects, snakes, and other animals have often been prejudicial to savage welfare by protecting obnoxious creatures from destruction.

P. pysoderus is a much smaller beetle, being but three quarters of an inch in length. Its colour is a dark brown; the hinder angles of the thorax are produced in acute spines, and the tubercles are not prominent. It is common in the Southern States and emits a light equal in intensity to that of our native "fire-flies," but constant instead of intermittent.

In the Phillipine Islands is found a very large species of Elater, called *Oxynopterus* (sharp-winged) Cummingii. It is a large, reddish beetle and the male has fine pectinate antennæ. The prosternal spine is stated by Wood to be as large as a crow-quill, and three-fourths of an inch long, so that its powers of leaping and clicking must be well marked.

The genus *Pachyderes* is distinguished by having the thorax twice as broad as the elytra; *Semioti* has the tips of the elytra spined; and the males of *Macromalocera*, from Swan River, Australia, have the antennæ as long or even longer than the body.

Of seventy species found in Great Britain, the largest is *Ludius ferrugineous*, a dirty red beetle about an inch long.

Turning now to Canadian beetles, the first sub-family is named *Eucnemidæ*, and comprises a few small compressed beetles found under bark or on leaves, and rather uncommon. Wood says that the prothorax in these species fits too tightly against the base of the elytra to admit of them leaping, but Le Conte claims for some a feeble power to do so. The second sub-family *Cerophytidæ* consists also of a few species of small beetles, living under bark, and rarely, from their size and habits, seen or captured.

The third and last bears the family name—*Elateridæ*—and includes all of our remaining species. Of these the largest and most striking examples are contained in the genus *Alaus* (meaning "dull" coloured). There are four species found in Northern America, viz.: *Melanops*, *Gorgops*, *Occulatus* and *Myops*, of which the two last (at least) are found in Canada. *A. occulatus* (Fig. 52), must be familiar to nearly all my readers, and is the largest of our Elaters, varying in length from one and a quarter inches to one and three quarters.

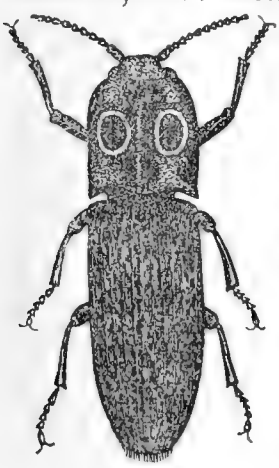


Fig. 52.

Its general colour is a deep glossy black; the under surface of the body, and the legs being thickly powdered with white. The broad, almost square, thorax is also powdered (but usually much rubbed), with the exception of two large, oval spots of a rich black velvety appearance, and rimmed with white so as to seem like great staring eyes, often causing the thorax to be mistaken for the head by those ignorant of an insect's construction. These beautiful markings have determined its specific name; for *occulatus* is simply the Latin form of "eyed." The elytra are marked by longitudinal, impressed lines, and are sprinkled with bright white spots, of the same powdery substance which covers the rest of the body.

In early summer it is found crawling slowly, or sunning itself on trees, fences, buildings, paths, etc., and is easily captured. In Duncan's "Transformations of Insects" the larva is shown crawling on the ground, and the pupa in a cell beneath the surface, but Dr. Harris states that "it undergoes its transformations in the trunks of trees." He found them in old apple trees—the larvæ feeding upon the wood. The following is a portion of his description:—

"These larvæ are reddish-yellow grubs, proportionately much broader than the other kinds, and very much flattened. One of them, which was found fully-grown early in April, measured two inches and a half in length, and nearly four-tenths of an inch across the middle of the body, and was not much narrowed at either extremity. The head was broad, brownish and rough above."

Soon after the grub was found it cast its skin and entered the pupa state, and at the proper time emerged as a beetle.

A myops is a somewhat smaller and less robust beetle, and varies more in size, some in my collection being only one inch long. In general appearance it is much like *occulatus*, but is not nearly so handsome an insect. The markings are less distinct, the colouring more greyish, and the eye-like spots on the thorax are much smaller and duller, whence it has received its name of *myops*, or the "short-sighted" *alaus*.

It is much more common in this neighbourhood than *occulatus*. To show how readily

these thoracic markings are mistaken for the elater's eyes, and the loose articulation of the thorax for the neck, I may just mention that a friend of mine brought me, one day this summer, a fine large *myops*, which he had just found on his window-sill, remarking that he was afraid it was dead, because "its neck seemed broken." I told him to lay it on its back upon my table, and the sudden snap with which it nearly sprang into his face quite startled him. The Indian name for an elater (according to Dr. Fitch) is "neck-breaker," or "the insect that breaks its neck," which gives a very good idea of its chief characteristic.

Perhaps the most abundant of our elaters is a dark brown one, about half an inch long, named *Melanotus communis*. The larvæ feed in wood, transform in the autumn, and the beetles winter under bark or in crevices, and are very common in spring. *Limonius plebejus* is also a brownish beetle, which is even more numerous in this vicinity.

Occasionally large glossy black elaters are found under stones in damp localities. These belong to the genus *Melanactes* and are remarkable for having luminous larvæ. Several species of Corymbites are numerous on pine-trees in summer, as *C. æripennis*, *C. hieroglyphicus* and *C. triundulatus;* the latter is also said to feed on the flower of the rhubarb. *C. vernalis*, a pretty beetle with a black thorax, and yellow elytra marked by five black spots, may be found sometimes in large numbers on blossoms of the choke-cherry.

In the fourth volume of the *Canadian Entomologist*, an interesting account of the wheat wire-worm, *Agriotes mancus*, is given by Mr. J. Pettit, of Grimsby, Ont., a very careful observer. Mr. Pettit says:

"For many years an insect, familiarly known among farmers as the 'wire-worm,' has committed ravages from time to time among the wheat crops in different parts of the Province. As the history of this insect has not hitherto been traced out, I am happy to be able to make public through the pages of the *Canadian Entomologist*, the following description of its larval and pupal states.

"In the fall of the year 1870, so unusual an amount of damage was inflicted upon the wheat crops in this vicinity by this wire-worm that I was led to try and breed it to the perfect state with a view to ascertaining what species it was the larva of. By digging about the roots of the wheat plants, I obtained about a dozen specimens (Fig. 53) which were placed with a few wheat plants in a large flower-pot, where they were kept supplied with food by planting occasionally a small quantity of wheat. With the first cold weather they ceased to eat, and were then placed in a sheltered situation until the return of warm weather in spring, when they were restored to the breeding-cage. They soon gave evidence of being alive, and possessing unimpaired appetites; their rapid consumption of the wheat plants rendered it necessary to renew the supply quite as often as before. They were fed in this way until the month of July, when my absence from home caused them to be neglected; on my return there was not a vestige of food left. Thinking that the worms had probably died of starvation, I paid no further attention to them until the 26th of August, when, on removing a part of the earth from the pot, a pupa (Fig. 54) was disclosed, and on the 3rd of September the first imago appeared, which proved to be a specimen of *Agriotes mancus* (Say). As only two more specimens came out during the remainder of September, I turned the earth out of the pot and carefully examined it. The inspection revealed seven specimens of the imago in the little cells in which they had transformed, and one larva.

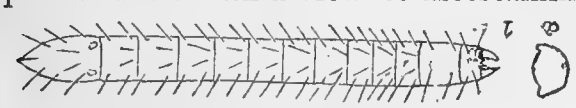


Fig. 53.

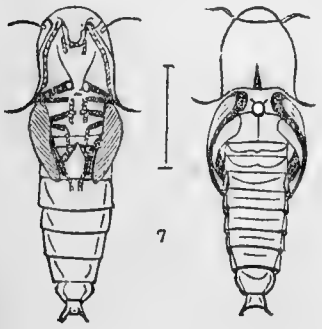


Fig. 54.

"Among the larvæ collected, I had noticed one less than half the size of the others and evidently much younger, which would account for the one still in the larval state. It had attained, however, a size fully equal to that of the others when first brought in during the previous autumn; and hence I have formed the opinion that the larval state does not last longer than three years. This opinion has since been strengthened by the observation of a large number of larva which appeared readily separable into *two sizes*, corresponding

to those originally collected for breeding. Westwood, in his 'Modern Classification of Insects,' (vol. 1, 238), states respecting the larva of an allied species (*A. obscurus*) which, in Europe, feeds upon the roots of wheat, rye, oats, barley and grass, that according to Bjerkander, a Swedish naturalist, 'it is five years in arriving at the perfect state.' Curtis, in his 'Farm Insects,' (page 16,), makes a similar statement upon the same authority, and adds that those which he had himself fed for ten or twelve months scarcely increased in size during that time. As already stated, however, I am of opinion that our species is by no means so long lived, but that it attains maturity in three years, a period quite long enough, the agriculturist must think, in which to inflict damage upon the crops."

Fig. 53 shews the larva or worm magnified to about twice its natural size, and Fig. 54 the chrysalis under and upper side, also magnified—the hair line between them gives the natural size.

The perfect beetle is about seven-twentieths of an inch long, the body black, punctured with minute dots, and covered with very short hair, the head is large and black, the antennæ and feet reddish.

Adelocera is a genus comprising rather large beetles of a roughish, and often frosted, or rusty, appearance. Their larvæ feed in decaying wood and are generally found upon stumps, trees or fences.

The last genus which I shall mention here, viz.:—*Pityobius*, is remarkable from having twelve-jointed antennæ, which in the males are beautifully bi-pectinate; that is they have on each side spines, or branches, projecting from the joints. There are only two species known in Canada—*P. anguinus* and *P. Billingsii*—and the beetles are exceedingly rare, while but little is known of their habits.

P. anguinus "is of a dull black colour, with short brown hair." *P. Billingsii* (named after its discoverer, the late Mr. Billings, of Ottawa), has rich and rather glossy black elytra, longitudinally lined, and wider than the thorax. The head and thorax are also deep black but are roughened; the legs and under parts are less black. The head is nearly square above; the eyes are very prominent, being far more conspicuous than in any other of our elaters, which I have seen.

The specimen now before me is about one and a quarter inches long and is decidedly the handsomest click-beetle in my collection. It is probably the second specimen captured and the only one now in a Canadian collection. The larva of this beetle lives in decaying wood, for I found a pupa almost in the heart of an old rotten log, two years ago. Unfortunately the wood in which I kept it was allowed to become too dry, and in consequence the elytra never expanded properly and the specimen was destroyed.

Let me conclude with a few words of advice, which have often been spoken by others, but which will bear repeating. Every farmer and gardener will consult his best interests by paying close attention to all the insects which he finds about his land, and by striving to learn something of their habits. When a strange insect or larva is discovered, endeavour to place a specimen in the hands of the nearest entomologist, who will be always glad to inform you whether its habits are injurious or beneficial to plant-life, or, if they are unknown to him, to try and find out what they are.

THE PLUM CURCULIO (*Conotrachelus nenuphar*).

By B. Gott, Arkona.

[Figure 55 represents this insect in its various stages, *a* the larva, *b* the chrysalis, *c* the perfect beetle all magnified. The hair lines at the sides shew the natural size.]

For some considerable time past I have closely watched the operations of this familiar insect, and my only apology for bringing again this hackneyed theme to the notice of the public, is that the growing importance of the subject appears to demand it. I purpose to shew in this paper that our fruit is at present in more danger from the depredations of this insect, than from any other single enemy operating on it. Notwithstanding all that has been said and written about this pest, and the good advice which has been given for its destruction, yet comparatively little is done systematically

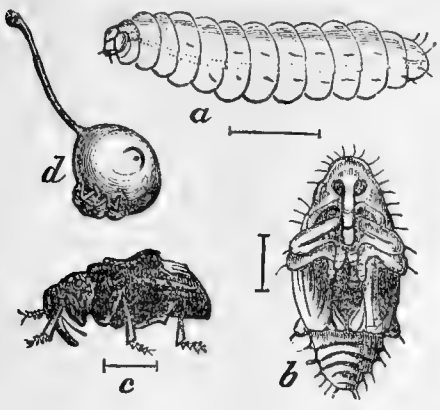


Fig. 55.

to destroy it. With the view therefore of directing special attention to the losses resulting from neglect of the remedies at hand, I shall as briefly as possible review the whole subject of this insect and its work, as well as the remedies which have been suggested for it. This insect was first described by Herbst, a German Entomologist, as early as the year 1797. It is a foreign aggressor but the date of its introduction is not known. It is thus ably described by Dr. Harris, in his "Insects Injurious to Vegetation," a work that should be in the hands of every fruit-grower and agriculturist:

"This weevil, or curculio as it is often called, is a little rough, dark-brown or blackish beetle, looking like a dried bud when it is shaken from the trees, which resemblance is increased by its habit of drawing up its legs and bending its snout close to the lower side of its body, and remaining for a time without motion, and seemingly lifeless. It is from three-twentieths to one-fifth of an inch long, exclusive of the snout, which is rather longer than the thorax and is bent under the breast, between the fore legs, when at rest. Its colour is dark-brown, variegated with spots of white, ochre-yellow and black. The thor ax is uneven; the wing covers have several short ridges upon them, those on the middle the of back forming two considerable humps of a black colour, behind which there is a band of ochre-yellow and white. I have found these beetles as early as the 10th of March, and have frequently caught them flying in the middle of the day. They begin to sting the plums as soon as the fruit is set, and continue their operations till the middle of July, or as some say, until the first of August. In doing this the beetle first makes a small crescent-like incision with its snout in the skin of the plum, and then turning round, inserts an egg in the wound. From one plum it goes to another until its store of eggs is exhausted, so that where these beetles abound not a plum will escape being stung." There is some difference of opinion among Entomologists as to the number of broods matured in a season, but I think that with us there is but one brood, and these the result of insects emerging from the ground in early spring.

Its relation to fruit culture is very intimate, and the whole aspect of fruit growing is affected more or less by the existence of this troublesome foe, to the great discouragement of plum, apricot and nectarine culture, estimable fruits where they can be successfully grown. We cannot, as some have done, tolerate this insect as a serviceable thinner of the fruit, for we have found it to be a most relentless destroyer. The female insect makes a crescent shaped incision in the fruit and deposits there a tiny egg which soon hatches; the young and tender grub at once works its way to the germ of the fruit and revels in its nutritive juices. The seed germ being mutilated, a vital point is attacked, the fruit loosens its hold on the tree and soon falls to the ground. This is exactly what is needed by the larva for its development and subsequent escape. If the fruit had dried up and maintained its hold on the tree the grub would probably have perished. On the ground the fruit is kept cool and moist and as soon as the grub is fully grown it leaves the fruit and enters at once under the soil where it is shortly changed to a chrysalis and patiently waits in obscurity its perfect development.

Its rapid increase is a matter of concern to all growers of the plum as it is spreading rapidly over every part of the Province where this fruit is grown. At a recent meeting of the Fruit Growers' Association of Ontario one of the members present observed that "A few years ago there were no curculios at Goderich, now they are there in full force; and plum growers are discouraged. It is not yet at Owen Sound, but it will be by and by." Thus it is gradually widening its field of operation and annually increasing in numbers. On my own grounds as well as on those of my neighbours, this fact has been painfully evident during the past year; not a tree has escaped, and even the peach, cherry, pear and apple were attacked.

So far as we know in this country the curculio is almost exempt from the attacks of insect enemies. In the report of the Entomological Society for 1876 mention is made of two parasites which have been discovered by Prof. Riley operating on this insect in

Missouri, namely, *Sigalphus curculionis* (Fig. 56) and *Porizon conotracheli* (Fig. 57). I am not aware that these friendly insects have yet been taken in Ontario, but it is quite possible that they may be working unobserved among us. A detailed description of both these insects may be found in the Report for 1876.

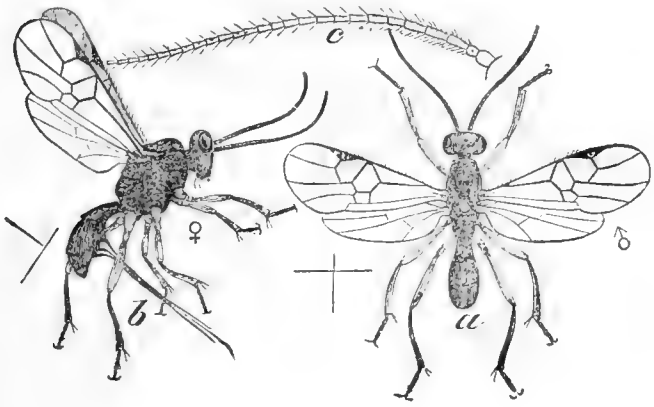


Fig. 56.

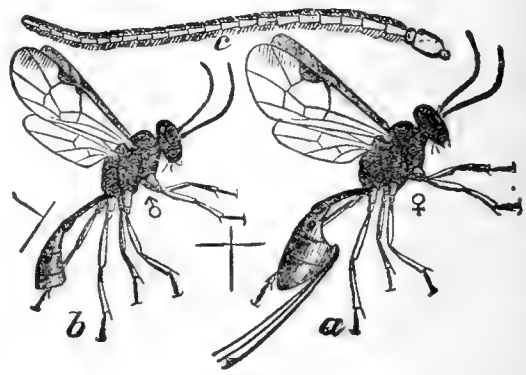


Fig. 57.

As already stated the curculio does not scruple, in the absence of the plum, to attack the peach, pear and apple. I was greatly amused during last season in watching the *little Turk* at his work upon our young pears and apples. I had a favourite pear tree the fruit of which I had never before seen, which blossomed nicely and set some five specimens, leading me to hope that I should be able to test their qualities when mature, but in a few days, lo the crescent! the familiar distinguishing mark of our fruit enemy was already seen upon them, and in time they all fell prematurely from the boughs. In many instances the same insect was noticed working upon the apples. As I was gathering in my winter apples, a few days ago, I came to a Northern Spy tree, a very large proportion of whose fruit was exceedingly ill-shaped, especially all around the lower branches. The fruit was disfigured by deep indentations and corresponding swellings or knobs. Upon examination it was found that those indentures on the fruit contained the mark of the familiar crescent of the plum curculio which probably will account for their deformed appearance. It would appear that the insect had cut the tender skin of the young fruit, which had interfered with the circulation and development in that place. The egg deposited had not hatched, or if it had the little grub had died. The crab-apples were by far the worst affected; scarcely a sample matured on many fine trees, and a number of fine young Tetopsky apple trees were totally deprived of their promising crop by the same enemy. Under such circumstances constant vigilance is necessary to secure a crop of fruit, and if the annual increase of insect life goes on unchecked it is easily seen that good fruit will become scarce and more expensive.

The remedies which have been recommended are numerous, and may be divided into two classes, viz., those that kill and those that merely deter. Under the first class may be mentioned jarring the trees and gathering up the insects. This is by far the best remedy at present known. P. Barry, in his excellent work "The Fruit Garden," says that this method was first recommended by David Thomas, forty years ago, and that on their extensive grounds it is successfully carried out. Mr. Downing also speaks highly of jarring, and recommends that it be repeated daily as long as the insects continue to make their appearance. Repeated trials have proven beyond question that this rather tedious mode is a very effectual one if persisted in. At a late meeting of the Fruit Growers' Association of Ontario, at Sarnia, Mr. James Lambert, of Sarnia, said: "He had tried the jarring plan with three trees and these were breaking down with fruit." Page 33, of 1878. In the November number of the *Gardener's Monthly*, just at hand, it is related of Mr. Cobleigh and Mr. Willard, of Geneva, N. Y., who are noted and extensive plum growers, "They practice shaking the trees, but their method is different from any one we have met with before. They have two light frames on which light muslin is spread. They look like huge barn doors but they are very light. These are placed under the trees when they are to be shaken. Then they have a long handled sort of crutch; the arm-rester as we would say if it were a crutch, being nicely padded to prevent injury to the bark. This is pushed up and the branches jolted and the "little Turk" comes down and is killed by the boys when it falls on

the muslin. This is better than the old plan of striking on the trunk. It has to be done every day, and it would be as well twice a day. Mr. Cobleigh finds it takes two hours and-a-half to shake 1,600 trees. Abundant evidence is forthcoming to establish the efficiency of this remedy.

Another method suggested is to plant the trees in swine or chicken yards, a plan which has also been highly recommended. At the meeting of the Fruit Growers' Association already referred to, Mr. James Dougall, of Windsor, said, "I find that a hen and her chickens cooped under the trees, devour a great many curculios, and secure me a crop of plums." We would, however, rather allow the fowls free roving over the fruit yard at will. The Hon. Mr. Vidal, of Sarnia, said that "Mr. Baubee made a hen-yard around his plum trees, and had no more trouble with the curculio." Mr. Barry says "planting the plum orchard adjoining the hog-pen is probably the easiest and best way of securing a crop of plums." Mr. J. J. Thomas in his admirable work, *The American Fruit Culturist*, page 155, says, "experience has thoroughly established the efficiency of this method" (the confinement of swine among the trees of the plum orchard), and adds, "geese and hens are to a limited extent useful in repelling or destroying the curculio." Again the late Dr. Kirtland, of Cleveland, Ohio, says, "This insect in one season destroyed every plum on my farm, excepting the crop of one tree in my swine lot; that tree is bending under its load of fruit." Here we have excellent evidence of the efficiency of this remedy; we would say, plant your plum trees together in a lot by themselves, and securely fence them, then as they begin to bear fruit, keep a sufficient number of hogs or fowls in the yard during the curculio season. Some cultivators are in favour of keeping hogs thus confined in the orchard during the whole of the summer season, as it is thought they greatly benefit the soil by their constant rooting and stirring of it. These two are doubtless the most valuable and efficient remedies known.

Careful picking up of the fallen fruit should, in every case, be attended to where hogs or fowls have no access, and this before the larvæ of the curculio have had time to escape into the ground. After being gathered they should be burnt or otherwise boiled or steamed and given as food to swine.

The second class of remedies are those which merely deter the insect from attacking the fruit. Planting the plum trees on hard, clay soil has been recommended as a preventative measure. Mr. Downing says, "we have never known an instance of the curculio being troublesome in a heavy soil." This statement has been confirmed by observation in my own neighbourhood, where I have noticed that on heavy clay soils a crop of plums can usually be secured, and there are hundreds of acres of just such soil where I believe that thousands of bushels of fine fruit might be annually produced.

It has also been recommended to plant plum trees close beside water-courses to prevent the attacks of curculio, and there are many who have faith in it; we have seen trees so planted perfectly loaded with fine fruit, although there was no water flowing at the time. There are some, however, who deny the efficacy of this measure. J. J. Thomas says "it was formerly supposed that the instinct of this insect would prevent it from depositing eggs on branches hanging over water, but recent experiments prove that it possesses no such sagacity."

Covering the ground under the tree with lime, plaster, ashes or salt have been used to prevent the attacks of curculio, and in many cases with apparent success. Very recently Mr. M. Watson, of Thedford, told me of a friend of his who had tried plaster; he covered the ground under the tree with it and saved his crop of plums. There is also evidence that salt is useful when properly used. Mr. Downing refers to instances where it has been used with complete success; he says, "the best method of applying salt for the plum weevil is to strew it pretty thickly over the surface when the punctured plums commence to drop." The use of lime is advocated in a similar manner; some also are in favour of ashes.

Employing offensive odours in the form of smoke from oil or tar has also been well spoken of, but these measures are of very doubtful efficacy, and if the insects were thus driven from one part of the fruit crop they would usually take to another.

Making the ground hard and difficult to penetrate under the trees by plastering with mortar or paving with stones or shells are measures which have been advocated. Mr.

A. Watson in the *American Home Garden*, says that the most promising remedy is to "pave closely under the tree with clam or oyster shells, the instinct of the insect leading it to avoid depositing its eggs in fruit from which, when they drop, its progeny can find no safe retreat." Mr. Downing speaks of plum trees growing in hard trodden court-yards which usually bear plentiful crops. Some have also recommended the use of chips and small pieces of wood placed around the trees as traps for the curculio, but it is very doubtful if any of these methods will ever take the place of jarring.

NATURE PRINTED BUTTERFLIES.

By James Fletcher, Ottawa, Ont.

The season of warm days, flowers, and butterflies is over now, and the look-out is cold, bleak and bare. Apparently there is little for the scientific lover of nature to do in the way of collections at this time of year; such however is far from being actually the case, as all who have collected will testify. It is in fact one of the busiest seasons for collectors. All the treasures gathered during the summer months have to be *gone through*. In the first place those known have to be taken out and sorted away into their proper places in the cabinet; the remainder then have to be re-sorted and divided up into sets according to the families to which they appear to belong, and after this they have to be examined critically and if possible identified. It frequently happens that a collector of butterflies has an opportunity of capturing a large number of some local species, in one day, and finds it impossible or irksome to set them all before they become too dry, as they will in a very short time in hot weather. When they are once dry, too, one is apt to think that as they can get no worse they may safely be put aside until some more convenient occasion to be relaxed and set up, but this convenient occasion, like a good many others, is sometimes very long coming, and many valuable specimens are thus lost. An accident which occurred to the glass of one of my butterfly cabinet drawers lately, was the means of reminding me of a process shewn me some years ago by a Captain Lloyd, of the English Navy. The accident referred to was the breaking of the cover of one of my cases which contained some rare butterflies, in consequence of which it was impossible to close the door of the cabinet tightly. My horror can be better imagined than expressed when, upon opening the door and pulling out this drawer, about a fortnight afterwards, I found that there was not a single perfect specimen in it—a mouse had got in and what was once a neatly arranged case of butterflies was now nothing but a chaos of nibbled bodies, loose wings, pins, and labels. I had not the heart at first to throw out these fragments and so wipe out entirely the pleasing recollections each brought up in my mind of rambles through the woods and in the country; so carefully gathering up the wings I put them away in a little box. The idea then struck me of printing them as I had seen my old friend do them—and as I think it would be a very convenient way for Entomologists and agriculturists to send butterflies for identification, when spare duplicates are to be had, I am induced to send a description of the *modus operandi*. Take the insect in your left hand, holding it beneath the thorax, then with a pair of sharply-pointed scissors cut off the wings as close to the body as possible; occasionally, unless the scissors are very sharp, some of the muscles are torn away from the thorax with the wings, these must be carefully removed; arrange the wings in pairs and put them with the body on one side in some convenient place where they may be easily got at when you are ready for them. Now take a piece of white paper of the size required, and fold it in two like a sheet of note paper, then with a camel-hair brush lay on a thin wash of perfectly clear gum arabic, fold down the upper half and pass the hand lightly over it so as to spread the gum evenly between the two sides; now re-open it, and taking up the wings with the tip of the brush, the lower ones first, arrange them carefully in the position wanted, leaving space enough intervening between the two pairs to paint in the body afterwards. Spare no pains in arranging the wings; this corresponds with "setting" for a cabinet. I have seen many good collections of insects, made by amateurs, rendered almost useless by the want of a little thought on this point. The proper position for a but-

terfly to be set in is that which it takes when sunning itself. Copy nature, and you cannot go wrong. When the wings are quite even, gently fold down the upper half of the paper and put your specimen under a heavy weight or in a press until quite dry—I generally leave mine for some hours at least. When it is quite dry take it out and place it against a window-pane, so that the butterfly may be clearly defined against the light. Now, very carefully draw a line with a black lead pencil round the edge of the wings, then lay it down on an even surface, and paint with clean water all over the part outside and up to the outline. After a few minutes the water will saturate the paper and dissolve the gum; the two sides will, then separate easily, and this being done it will be found that on one side is a perfect representation of the upper side of the butterfly, on the opposite another of the under side, and loose between these a perfectly clear horny membrane; the explanation of this is, the upper ends of the scales are adhering to the gum, and what we now look at are the lower ends or roots. When painting with water, to dissolve the gum, great care must be taken not to let it run over the outline on to the wings, or else the scales will not adhere to the paper, but will remain on the membrane.

The work is not yet finished, however; a most important part has still to be done; this is the filling in of the body and antennæ; the easiest way to do this is with a fine pen and some water-colours. Place the body, from which the wings were severed, before you and copy it, taking particular notice of any characteristic markings, as for instance, the colour of the eyes, legs, or antennæ. When finished, cut it out with a pair of sharp scissors, paste it in an album and write a short description of its capture, giving the date, locality and any other interesting circumstances connected with it. I have found it is easier to put in the antennæ after the prints are gummed into the collection as on account of their fragility, they are difficult to cut out neatly. Should the collector happen to be an artist, a most beautiful collection may be made in this manner by painting pretty designs with flowers for each species, and gumming the butterflies in, in natural positions; of course too, its scientific value will be materially increased if those plants are introduced to which the insect is most partial, and when possible, a sketch of the larva and pupa is added.

The chief advantages of this process are, the ease with which it is done; the great convenience with which the specimens are preserved or transmitted through the post for identification or exchange; their great durability, for they will stand much rougher handling than specimens preserved in the ordinary way; and more important than all these the fact that if you have only one specimen, you can shew both the upper and under sides at once, and also the membranous skeleton of the wings, which can thus be very easily examined and makes a beautiful object for the microscope; moreover, if you have only an imperfect specimen it is possible to preserve a good likeness of it by filling in the wanting parts with water-colours; and further, it does not matter how old your specimens are; I have some prints which I have taken from butterflies collected in India more than twenty years ago which are quite as good as others printed on the same day that the insects were caught here.