

REPORT
OF THE
ENTOMOLOGICAL SOCIETY
OF ONTARIO,
FOR THE YEAR 1882.

Printed by Order of the Legislative Assembly.



Toronto :
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1883.

Actias luna ..
Adoxus vitis ..
Aeschna heros ..
Aletia argillacea ..
Anax junius ..
 Annual Address of
 Annual Meeting,
 Ontario
Anomoea laticlavata
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 " ceparum
 " radicum
 Apple tree pest, a n
Asparagus beetle ..
Aspidiotus conchifo

Birds, revised check
 Book notices
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 Bowles, G. J., artic

Cabbage butterfly, I
 " " II
 Catocala of Illinois
Cecidomyia destruct
 " legumin
 " strobiloi
 " trifolii
 " tritici ..
Ceresa bubalis ..
 " diceros ..
Chelimorpha argus
Chlamys plicata ..
Chrysomela clivicol
 " elegans
 " multigru
 " philadel
 Chrysomelidae ..
Cicada canicularis ..
 " imperatoria
 " pruinosa ..
 " rimosa ..
 " septendecim
Clastoptera obtusa
 " protus
 Claypole, E. W., ar
Clisiocampa constrict
Cockchafer ..
Codling moth ..
Colaspis flavida ..
 Colorado potato beet
Conotrachelus nenuq
Coptocycla aurichalc
Coscinoptera domini
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THIRTEENTH ANNUAL REPORT
 OF THE
ENTOMOLOGICAL SOCIETY
 OF
ONTARIO,

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

PREPARED FOR THE HONOURABLE THE COMMISSIONER OF AGRICULTURE
 BY THE OFFICERS AND MEMBERS OF THE SOCIETY.

1882.

To the Honourable the Commissioner of Agriculture:

SIR,—I beg to submit to you, herewith, the Annual Report of the Entomological Society of Ontario, prepared in compliance with the provisions of our Act of Incorporation. The audited Financial Statement is submitted, as well as the transactions of the annual meeting, which was held this year in the City of Montreal, on August 24th. The Society is greatly indebted to your courtesy in enabling them to meet in Montreal, as an opportunity was thus afforded of obtaining the presence of a large number of scientists, who were attending the session there being held, of the American Association for the Advancement of Science.

I have, also, the honour to submit, herewith, for your approval, illustrated reports of various insects, which have been prepared by members of the Society.

In order to make these reports more useful and their information more accessible to those interested in them, the society has thought it advisable to prepare an index of the whole series that have been issued by the Department, and I trust that it will meet with

your approval. It will bear good evidence, that, through the Department, a vast amount of practical information has been given to the public respecting the habits and life history of the various insect friends and foes that abound in every part of the Province.

I am glad to be able to report that our Society still maintains the publication of the *Canadian Entomologist*.

During the year an application was made to the members of the Society by the Minister of Marine and Fisheries of the Dominion to furnish specimens, illustrating the natural history of insects serving as food for fishes, or which are destroyers of spawn, it being desired to exhibit them at the great International Fisheries exhibition to be held in London, England, in 1883.

The Society cheerfully complied with the request, and it is intended to prepare some forty cases as a Canadian exhibit.

I have the honour, sir, to remain,

Your obedient servant,

EDMUND BAYNES REED,

Secretary-Treasurer.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The annual meeting was held in the rooms of the Natural History Society, Montreal, on Thursday, August 24, 1882, at 3 o'clock p.m.

The President, Mr. Wm. Saunders, of London, Ont., in the chair.

Present: H. F. Bassett, Waterbury, Conn.; Rev. C. J. S. Bethune, M.A., Port Hope; G. J. Bowles, Vice-President, Montreal; F. B. Caulfield, Montreal; Prof. J. H. Comstock, Cornell University, Ithaca, N. Y.; Prof. A. J. Cook, Agric. College, Lansing, Mich.; Wm. Couper, Montreal; T. Craig, Montreal; J. M. Denton, London; C. R. Dodge, Washington, D. C.; Prof. C. H. Fernald, State Coll., Orono, Maine; C. Fish, Brunswick, Maine; Jas. Fletcher, Ottawa; Rev. F. W. Fyles, Cowansville, P. Q.; Prof. H. A. Hagen, Mus. Comp. Zool., Cambridge, Mass.; W. H. Harrington, Ottawa; Prof. S. Henshaw, Boston, Mass.; Dr. P. R. Hoy, Racine, Wis.; J. G. Jack, Chateauguay Basin, P. Q.; Dr. H. S. Jewett, Dayton, Ohio; Prof. J. A. Lintner, State Entomologist, Albany, N. Y.; H. H. Lyman, Montreal; B. Pickman Mann, Assist. Entomologist, Agric. Dept., Washington, D. C.; Prof. C. V. Riley, Entomologist Agric. Dept., Washington, D. C.; Wm. Shaw, Montreal; E. D. Winble, Montreal; C. D. Zimmerman, Buffalo, N. Y.; E. Baynes Reed, Sec.-Treas., London, and others.

The minutes of the previous meeting were confirmed, the reading being dispensed with as they had been printed and sent to the members.

The President then addressed a few words of cordial welcome to the members present.

The report of the Council and the financial statement of the Sec.-Treas. for the past year were then read, and on motion, adopted.

REPORT OF THE COUNCIL FOR 1882.

In presenting their Annual Report, the Council desire to give some explanation as to the place and time of holding this annual meeting. Knowing that it had been determined that the American Association for the Advancement of Science would meet this year in Montreal, it seemed to your Council to be desirable to hold the annual session of the Entomological Society of Ontario at the same time and place.

The necessary application was accordingly made to the Hon. S. C. Wood, the Commissioner of Agriculture for the Province of Ontario, to sanction such an arrangement,

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it being pointed out to him that the presence of so many distinguished Entomologists from the United States would have a most beneficial effect upon the meeting, and that the interests of the great agricultural community for whose welfare this Society is chiefly maintained would be promoted by the intercourse and exchange of thoughtful and useful suggestions from so large a gathering of practical entomologists, with this request the Commissioner most cheerfully and promptly complied.

The Council, moreover, felt that the holding of the annual meeting of the Entomological Society of Ontario, in the ancient City of Montreal, was the more desired on account of the presence there of those energetic entomologists through whose unwearied efforts the Montreal Branch of our Society has been so well sustained, and whose Ninth Annual Report, to be submitted to you to-day, affords additional evidence of zeal and interest in Entomology.

The Council are pleased to be able to report that the progress of the Society still continues.

After thirteen years of existence, the *Canadian Entomologist* may now be regarded as firmly established, and the Council trust that it may continue to receive in the future the same amount of valuable additions to our store of Entomological knowledge which in past years have given it a not unworthy place as one of the chief contributors to the Entomological Literature of America.

The demand from various European Scientific Societies, and others, for complete sets of the *Canadian Entomologist*, have rendered it necessary to reprint the first and second volumes. The Society can now, therefore, furnish copies of all the volumes.

During the last session of the Dominion Parliament the Council endeavoured to obtain for Scientific Societies the admission of books for their Libraries free of duty; in this they were disappointed, but they hope at the next session to be more successful, being convinced that it is an effort in the right direction, and that its success would prove a great benefit to the various Scientific Societies of the Dominion.

The Annual Reports of our Societies are being continued, and the Ontario Government distributes large numbers of them.

In the past year the Council have caused visits to be made to various places where insects were reported to be damaging crops, etc. Inquiry was made as to amount of injury being caused, and suggested practical remedies.

The Library of the Society is increasing. It is hoped that the catalogue—the printing of which has from various reasons been delayed—will shortly be issued to the members. The Council are glad to be able to report that they have secured a complete set of the valuable publications of Prof. Townsend Glover, of Washington, D. C.

It is with regret that the Council learn that the sub-section of Entomology of the American Association for the Advancement of Science has been merged in the important section of Biology. The meetings of the sub-section in past years was a source of gratification to all attending them, and afforded excellent opportunities for furthering Entomological Science.

In the wide region, embraced by Section F., it is to be feared that the special interests of Entomology will suffer in some degree, and the Council would respectfully suggest that an effort be made to revive the Entomological Club, so that the members attending the meeting of the Association, while doing all they can to sustain Entomology in Section F. by reading of papers, etc., may have ample time for that full and free discussion of the details of our work which is so important to the progress of our special branch of Natural History.

The audited Report of our finances for the past year will be submitted to you as usual.

On behalf of the Council.

E. BAYNES REED,

Secretary-Treasurer.

Montreal, P. Q., Aug. 24th, 1882.

ANNUAL STATEMENT OF THE SECRETARY-TREASURER OF THE
ENTOMOLOGICAL SOCIETY OF ONTARIO, FOR THE
YEAR ENDING AUGUST 19TH, 1882.

Receipts.

Balance from previous year, 1881	\$ 73 92
Members' fees, sale of <i>Entomologist</i> , etc.....	253 48
Government grant, 1882	1000 00
Collector's material: pins, cork, etc... ..	38 36
Interest on Bank account	9 01
Engraving—received for electrotypes of cuts	3 25
	\$1,378 02

Disbursements.

<i>Canadian Entomologist</i> : printing, paper, stationery, etc.....	\$390 32
Library	317 17
Expenses of Report for 1881, including engraving, electrotypes and woodcuts.....	291 95
Annual vote to Editor and Secretary-Treasurer.....	175 00
Rent... ..	80 00
Insurance	12 00
Sundries: postage, etc	55 60
Balance	55 98
	\$1,378 02

We certify that we have examined the above with books and vouchers, and found the same correct. Balance in Bank and Secretary's hands, fifty-five dollars and ninety-eight cents.

CHARLES CHAPMAN, } *Auditors.*
H. B. BOCK, }

Entomological Society Rooms, London, Ontario.
August 19th, 1882.

The report of the Montreal Branch was submitted and read to the meeting:—
MONTREAL BRANCH OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The Ninth Annual General Meeting of this Branch was held on Tuesday, 16th May, 1882, at eight o'clock p.m., at the residence of H. H. Lyman, Esq., President. The following report was read and adopted:—

REPORT.

In presenting their Ninth Annual Report, your Council would congratulate the members on the continued prosperity of the Society, and the undiminished interest manifested by all in the study of our chosen branch of Natural Science.

We have held eight pleasant and instructive meetings during the year and three new members have been added to our list. We have, however, lost by resignation an old and valued member, Mr. Robert Jack, of Chateauguay Basin, who has always felt a deep interest in our success, and manifested it in many ways.

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H. H. Lym
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Adjourned.

The election
elected:
President,
Secretary-Treas
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Montreal; J. M.
Ottawa. Editor
J. S. Bethune, J
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Six original papers have been read during the year, as follows:—

1. Notes on some Species of *Hymenoptera* occurring at Montreal, by F. B. Caulfield.
2. On Instinct in Insects, by G. J. Bowles.
3. The Pickled Fruit Fly (*Drosophila ampelophila*), Loew, by G. J. Bowles.
4. On the Genera *Hepialus* and *Sthenopsis* in Canada, by G. J. Bowles.
5. Notes on the Genus *Callinorpha* in the Museums of Boston, by H. H. Lyman.
6. List of *Lepidoptera* collected by Dr. Bell, of the Geological Survey, in 1881, at Sault Ste. Marie, etc., by H. H. Lyman.

Also a selected paper by H. H. Lyman, entitled "Insects as Medicine."

Our library has been increased by a valuable donation of books, reports, etc., from the parent Society in London, Ontario, for which the cordial thanks of this Branch are justly due. We have also received "Psyche" for the current year, but have not expended any of the funds in books.

The whole respectfully submitted,

H. H. LYMAN,
President.

Montreal, 16th May, 1882.

The following were then elected to office for the ensuing year:—

H. H. Lyman, President (re-elected); W. Couper, Vice-President (re-elected); G. J. Bowles, Secretary and Curator (re-elected). Council—F. B. Caulfield, J. G. Jack, and E. D. Wintle.

Adjourned.

GEO. JNO. BOWLES,
Secretary.

The election of officers then took place, when the following gentlemen were duly elected:

President, Wm. Saunders, London; Vice-President, G. J. Bowles, Montreal; Secretary-Treasurer and Librarian, E. Baynes Reed, London. Council—Rev. C. J. S. Bethune, Port Hope; J. Fletcher, Ottawa; Rev. F. W. Fyles, Cowansville; W. Couper, Montreal; J. M. Denton, London; J. Alston Moffatt, Hamilton; W. H. Harrington, Ottawa. Editor of *Canadian Entomologist*, Wm. Saunders. Editing Committee—Rev. C. J. S. Bethune, J. M. Denton, E. B. Reed. Auditors—H. B. Bock and C. Chapman, London.

The President then delivered his annual address, for which he was unanimously tendered a vote of thanks, together with a request to publish it in the *Canadian Entomologist*.

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

GENTLEMEN,—For the first time in the history of our Society, we meet within the limits of the Province of Quebec. Although belonging to Ontario, and sustained in our work mainly by the liberal aid granted us by the Government of Ontario, our sphere of usefulness extends throughout the length and breadth of this great Dominion, and also across the lines into the United States. We have long had an active Branch of our Society in Montreal, comprising members who have materially aided in the advancement of Entomological Science, and now at this particular juncture, when so large a body of distinguished scientists were to honour Montreal with their presence, and among them many noted Entomologists, no time, it was thought, could be more opportune than this in which to hold the Annual Meeting of our Society, and by the kind permission of the Hon. S. C. Wood, Commissioner of Agriculture for the Province of Ontario, we are privileged to meet here on this occasion.

During the past season that dreaded pest, the Hessian Fly, has prevailed to a con-

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OF ONTARIO.

Tuesday, 16th
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siderable extent in Ontario. My attention was first called to it this season during the last week in July, when the grain was ripening. On visiting the wheat fields in the vicinity of London, I found the insect very prevalent, and in some instances I believe the injury to the crop must have been fully twenty per cent. The affected stalks were lying on the ground, and the grain in the heads imperfectly developed; on pulling these they would often break at the point where the insect had been at work, that is, about the base of the first or second joint. On examining the affected stalks, the insect was found to be in what is known as the puparium or flax-seed state, from the resemblance which it bears in this condition to a grain of flax-seed. The attention of farmers was drawn to the depredations of the insect by a communication to the press, and information sought as to the extent of the evil. From letters received from various sections of the Province, it is evident that the insect prevails over an extended area, and that the sum total of the loss entailed on the agricultural community in Ontario from this cause would figure up to a large sum, probably hundreds of thousands of dollars. In 1876 and 1877 this insect appeared in considerable force, and seriously injured the wheat crop in many parts of our Province, but since that time we have enjoyed comparative immunity from it until now.

The Hessian Fly belongs to the order of *Diptera*, or two-winged insects, and is about one-tenth of an inch long, with dusky transparent wings fringed with fine hairs. There are two broods during the year. The flies which appear in the autumn, deposit their eggs, from one to twenty or more, on a plant in the cavities between the ridges of the blades or between the stalk and sheathing base near the roots of the young fall wheat. These hatch in four or five days into tiny grubs, soft, smooth and shining, which work their way down the leaf to the base of the sheath, about the crown of the root. Here they fasten themselves head downwards to the tender stalk, live upon the sap, and gradually become imbedded more or less in the substance of the stalk. When once located the larva moves no more, but growing rapidly, soon becomes plump, and when mature is about one-sixth of an inch long, greenish, and semi-transparent; before long it changes to the flax-seed state, in which condition it remains throughout the winter. Early in spring the flies are produced, which deposit their eggs about the first or second joint of the stalk, where they pass through their several stages, assuming the flax-seed state a few weeks before the wheat ripens, from which the flies hatch in August and September.

The effects of the presence of this insect in the young fall wheat is to weaken the plants, which become unhealthy, turn yellow and sometimes die. Often there is a gall-like swelling or enlargement of the stalk near the base, in and about which the insects will be found. The unhealthy plants contrast strongly with the rich green of the vigorous uninjured grain. The late brood may be easily found by separating the leaf from the stalk of the young wheat in October or November; the early brood, as already stated, in the reclining stalks, which, when very numerous, makes the wheat appear as if "lodged" in patches.

Various measures have been recommended for the destruction of this insect. Some have advised the immediate threshing of the wheat and the burning of the straw; but since most of the insects are left in the stubble this would be labour lost. Tearing up the stubble with a cultivator immediately after harvest, and raking it into heaps and burning it, is another suggestion; but this involves much labour at a time when the farmer is extremely busy, and during the process many of the insects would necessarily be shaken out of the stalks and escape. Burning the stubble in the field where practicable is a much wiser course; but it must be borne in mind that this process involves the destruction of the friendly parasites which feed upon the enemy, as well as the enemy itself. In my address to you two years ago, I expressed the opinion that we were almost wholly indebted for such immunity as we enjoy from destructive insects to the insect parasites which destroy them. Subsequent experience has confirmed this view, and any measure which involves the destruction of these useful friends should be adopted with caution. I am happy to state that from specimens reared within the past few days, I find that a large proportion of the Hessian Fly is being destroyed by parasites this season. Late sowing has been much recommended, and the results seem to

prove that on the 20th of September, sowing, however not as well fitted as the other means of application of

During the grape vines about *Loera vastatrix* young rootlets, to that cause. first be suspected besides having once in the net, have also found indicate the fine large portion of growth and yellow the small rootlets found dead, and living rootlets of the vine, these by groups of that when they have entirely left way to richer p

This insecting type, it is for cup-shaped outer surface of the leaf, and if coloured, wingle some newly hat plus lice wander establish themselves by their and increase. other thin-leavedance as to can instances are re become less suc find their way to where, with their During the winter summer advanced ground, and rising yards, where the hairs, beneath the about the base of interesting and csects of Missouri

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prove that on the whole this is the most practicable remedy—to defer sowing until about the 20th of September, by which time most of the flies will have disappeared. Late sowing, however, has the disadvantage that the plants not being so well established, are not as well fitted to withstand the severe weather of the winter. High culture is advantageous, as the luxuriant growth which the young wheat makes under such circumstances will enable it better to withstand the weakening effects of the grubs. Among the other measures recommended are pasturing the wheat fields with sheep, and the application of lime to the young wheat to kill the larvæ.

During the past few weeks I have examined the roots of a number of sickly-looking grape vines about London, Ontario, and have found the root-inhabiting form of the *Phylloxera vastatrix*, the dreaded scourge of the vine in Europe, in considerable numbers on the young rootlets, and have been able to clearly trace the diseased condition of those vines to that cause. I am convinced that this insect prevails to a greater extent than may at first be suspected throughout our Province, and that it is inflicting material injury, for besides having found it common about London, I have satisfactory evidence of its presence in the neighbourhood of Grimsby, where many vines are reported as diseased, and have also found it recently injuring the vines at Paris. There are no symptoms which indicate the first onset of this insect. It is only after the *Phylloxera* has destroyed a large portion of the roots, that the vine assumes a sickly aspect, becoming stunted in its growth and yellow in the foliage. On examining the roots of a vine so affected, most of the small rootlets—through which the vine draws the chief part of its nourishment—are found dead, and with many small knots and swellings on them. If a few freshly formed, living rootlets can be found, which may in such cases be looked for about the crown of the vine, these minute lice will usually be seen clustering upon them, often surrounded by groups of their eggs, and causing little swellings thereon. But it frequently happens that when the vines have reached this depleted condition, no insects can be found; they have entirely left them, and traversing the interlacing roots of other vines, found their way to richer pastures.

This insect occurs in two very different forms; in one, known as the gall-inhabiting type, it is found upon the vine leaves, producing in June, July and August globular or cup-shaped galls of varying sizes, of a greenish red or yellowish colour, with their outer surface uneven and somewhat woolly. The enlargement is on the under side of the leaf, and if one is cut into, it will be found to contain from one to four orange coloured, wingless lice, and a large number of very minute, oval, pale yellow eggs, with some newly hatched lice. Soon the gall becomes too thickly populated, when the surplus lice wander off through its partly opened mouth on the upper side of the leaf, and establish themselves on the same leaf or on adjoining leaves, where the irritation occasioned by their punctures causes the formation of new galls, within which the lice mature and increase. These galls are quite common, especially on leaves of the Clinton and other thin-leaved varieties, also on the wild grape; they sometimes occur in such abundance as to cause the leaves to turn brown and fall prematurely from the vine, and instances are recorded of defoliation from this cause. Late in the season, as the leaves become less succulent, the lice either perish or seek other quarters, and some of them find their way to the roots of the vines and establish themselves as already described, where, with their change of habit, there follows a slight difference in their appearance. During the winter they remain torpid, renewing their activity in the spring. As the summer advances, a portion of the root lice acquire wings, when they issue from the ground, and rising in the air, they fly or are carried with the wind to neighbouring vineyards, where they deposit their eggs on the under side of the leaves, among their downy hairs, beneath the loosened bark of the branches and trunk, or in crevices of the ground about the base of the vine. The complete life history of this insect, which is extremely interesting and curious, may be found in the 5th, 6th, 7th and 8th Reports on the Insects of Missouri, by Prof. C. V. Riley.

The gall-inhabiting type of this insect may be subdued by picking off the infested leaves and destroying them, but the root inhabiting type is a much more difficult form to deal with. Various applications to the soil have been recommended, such as bisulphide of carbon, and carbolic acid diluted with water and poured into holes made in the

this unfavourable weather, and doubtless induced and fostered by it, a species of minute fungus attacked the leaves of the apple, extending over a large portion of their surface, and often down the leaf-stalk to their base, causing a dark brown discoloration. The same fungus attacked the young fruit also, deforming a considerable proportion of the few specimens which were to be found, and these attacks resulted in a withering and curling of the leaves; the young fruit became stunted and deformed, and in many instances much of the foliage dropped to the ground. The effect of this injury, even at this advanced period in the season, is still to be seen in the sparseness of the foliage on many of the trees, in the discoloration of the leaves and the stunted growth of the branches.

It is difficult to anticipate with any certainty the effect of this disease on the fruit crop of next year, but since as a rule any interruption to the healthy growth of a tree leads to the more abundant production of fruit buds, it is probable that with a favourable season, we may have a very abundant yield in 1883.

California has for some years past been shipping fruits from her abundant surplus to all parts of the continent, and her favoured climate furnished conditions under which pears, apples, plums and grapes prospered to an extent unknown elsewhere, and for many years almost free from the insect pests which in other fruit-growing regions levy so heavy a tax on the growers. But this exemption could not be expected to be permanent. The Codlin Moth made its appearance there in 1874, and ever since then has been increasing to an alarming extent, the climate favouring its propagation with a rapidity unknown in less favoured districts, so that there are three, and in some instances four broods in a season. They attack the pears and quinces, as well as the apples, and destroy and disfigure a large quantity of fruit. California fruit growers are also suffering from the Phylloxera, Pear-tree Slug, Red Spider, Tussock Moth Caterpillar, the Currant Borer, a native Tent Caterpillar, *Clisiocampa constricta*, and a number of species of bark lice or scale insects, which attack apple, pear, peach, plum, orange, lemon, fig and olive trees, being found alike on the bark, foliage and fruit, and which multiply with amazing rapidity. Recognizing the vast importance of the fruit crop to the State, the most stringent measures are being enacted for the purpose of subduing these pests. An Act was passed by the State Legislature in March, 1881, in the interests of Horticulture and Viticulture, providing for the appointment of a State Board of Commissioners, one from each of the large fruit-growing districts, with almost unlimited powers to restrain, seize, or prohibit the importation of anything and everything likely to aid in distributing these insect pests—any suspected vines, vine cuttings, empty fruit boxes or other material likely to spread insects or contagion, and any willful violation of the quarantine regulations of this Board is considered a misdemeanor and punishable with a fine of from \$25 to \$100. These Commissioners are also charged with the duty of preparing rules to be observed by fruit growers for the extermination of insects, and suitable powers are given them to enforce the carrying out of these rules. In reference to the Codlin Moth, every apple grower is compelled to scrape the rough bark off his apple trees every spring, to collect and burn the scrapings, and apply, after scraping, an alkaline wash—the constituent parts of which are specified—to the tree. All boxes in which apples, pears or quinces have been stored or shipped are required to be dipped in boiling water containing a pound of commercial potash to each 25 gallons, for at least two minutes. These measures look to the destruction of the pupa. But, further, bands of cloth or paper of a specified width must be fastened around each apple, pear and quince tree, before the fifteenth day of May in each year, and examined every seventh day afterwards throughout the season, and all larvæ or pupæ destroyed. Precautionary and remedial measures are being enforced in reference to many other destructive insects, and any laxity or omission on the part of fruit growers in carrying out the instructions of the Commissioners is punishable by fine. The chief officer of the Commission is required to visit, examine and report upon the fruit growing interests in the various sections of the State, appoint resident inspectors for each county to enforce the regulations adopted by the Commission, and to experiment on the best methods of subduing insects and diseases destructive to fruits, and disseminate the information so obtained. For the carrying out of these objects an appropriation is made by the State of ten thousand dollars a year.

Those interested in Economic Entomology will, I am sure, watch with much interest the effect of such vigorous legislation, and if measures of this character can be successfully enforced there, why not elsewhere? There seems to be a necessity for the general adoption of some stringent measures which would prevent the careless and lazy from making their grounds the breeding places of noxious insects which prey upon and destroy the crops of their more thrifty neighbours.

I have the honour to be,

Yours very sincerely,

WM. SAUNDERS.

There being no further business, the meeting of the Entomological Society of Ontario was then adjourned.

The meeting then resolved itself into an informal gathering of the Entomological members of the American Association for the Advancement of Science, then in session in the city of Montreal.

On motion, Mr. W. Saunders and Mr. E. B. Reed were requested to act as Chairman and Secretary respectively of the meeting.

Some discussion took place respecting the Entomological Club of the A. A. A. S., when it was moved by Dr. Hagen, and seconded, and duly carried:

Resolved,—That Prof. J. A. Lintner be requested to take the necessary steps to call further meetings of the Entomologists present at this session of the Association, at such times and places as might be determined upon, and also to provide for similar meetings for Entomological discussions at the future gatherings of the Association.

PEA FUNGUS.

Mr. Geo. McCloskie, of Princeton, N. J., asked for some information about a peculiar fungus-like growth on pea roots, referred to in Mr. Saunders' address. The Chairman gave it as his opinion that it was a fungus.

Samples were shown exhibiting the pea as affected by this disease.

COTTON WORMS.

Mr. Jas. Fletcher asked if there was any further information respecting the habits of the Cotton Worm Moth, *Aletia argillacea*, he believing that from its frequent occurrence in Ontario in such a perfect condition, it must breed in Canada; he was aware that the larva had never been found here and that Prof. Riley had in his able paper on this moth, expressed his conviction that the moth did not breed in Canada.

Prof. Riley stated that so far as he knew from repeated observations and experiments, the cotton plant, *Gossypium*, was the only food plant of this insect; he thought that the peculiar formation of close-fitting scales of the wings would account for the apparently fresh condition of the moths found in Ontario, and he believed that the insect possessed ample powers to fly such a distance as that from the Southern States to Canada. There might be a probability that the insect bred in the Northern States, but he was still of the opinion that the moth was a purely Southern species.

Dr. Hoy stated that he had found in Wisconsin a specimen of the moth at the end of August, with the fore and hind wing on one side of the body in a deformed and crippled state, evidently showing that it must have very recently emerged from the chrysalis. He also stated that a female moth had been captured near his residence about the middle of June. He thought the insect must breed in the North sometimes.

Prof. Comstock confirmed Dr. Hoy's statement as to the finding of the crippled moth, but thought, however, that the moth generally bred in the South.

Prof. Fernald said he had seen fresh specimens taken in September, in Maine.

The Chairman said that occasionally fresh moths and butterflies might be captured in

entirely new appearance; of *Euptoieta* never before among the larvae, no such moth in Ontario matter was or Mr. Fletcher insect, the larva plant.

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entirely new localities, but that generally some probable reason could be given for their appearance; as, for instance, he remembered that many years ago two fresh specimens of *Euptoieta columbina* had been found at St. Catharines, Ont., a place where they had never before or since been observed, but that they had probably found their way there among the large number of fruit and other trees imported from the States; still, however, no such probable reason had been suggested for the appearance of the Cotton Worm Moth in Ontario, in such frequent numbers and at so many different localities. The matter was one of great interest.

Mr. Fletcher said he hoped the members would continue their observations of this insect, the larva of which, if found in Canada, would probably feed on some *Malvaceous* plant.

Prof. J. A. Cook stated that from the European larch he had taken about 250 cocoons of *Samia Columbia*, and found among them one peculiar cocoon, very similar to that of *Columbia*, which eventually produced a *cecropia*.

Dr. Jewett thought it was probably a case of hybridism, as he himself had taken hybrids of *Gloveri* and *cecropia*.

Dr. Hagen had seen cocoons of *cecropia* so similar to those of *Columbia* that it would be very hard to discriminate between them.

Dr. Hagen also gave a very interesting account of an expedition to the Northwestern Territories from which, in company with Prof. Henshaw, he had just returned.

In the north of Washington Territory he found the forests and country generally in splendid condition, and comparatively free from any insect pests.

In other parts he had found the Yellow Pines most seriously affected by the attacks of *Pieris marsupia* (?), large tracts of forests being entirely devastated—and large trees being attacked as well as the younger ones. The Butterfly appeared there last year for the first time—eggs were found on July 24th. The larva has the habit of dropping from the trees by a thread, a peculiarity only noticeable in a very few of the *Rhopalocera*.

A tree once attacked never seems to recover, and the only way to check the ravages of the insect is to cut down those trees affected.

In Montana the cattle feed out all the year round on the "bunch" grass, which is of inestimable value to that country. A curious fact to be noticed is that wherever timothy and blue grass is introduced it seems to kill out the bunch grass, so that the advance of civilization may in fact entirely alter the economy of the country.

The grasses do not seem to be troubled as yet with any pests.

The Colorado potato bug is merely known in certain localities.

The fruit trees are troubled only by flies and ants, so that the territory is nearly free from noxious pests.

Prof. Henshaw said the expedition was one of great interest.

A curious feature was the late hours at which insects appeared to feed, many of them after sundown.

Papilio machaon was found in great numbers.

Carabidae were found in dry places, whereas in the East they usually preferred moist situations.

The genus *Callopteryx* was also found. This was especially noticeable as it had never been known to occur west of the Rocky Mountains.

After this a considerable time was spent in informal discussion and examination of interesting specimens brought by members from various parts of the continent, and the meeting then adjourned.

POPULAR PAPERS ON ENTOMOLOGY.

ENTOMOLOGY FOR BEGINNERS.

THE SOUTHERN CABBAGE BUTTERFLY—*Pieris protodice*.

BY W. SAUNDERS, LONDON, ONTARIO.

In figure 1 we have represented the male, and in figure 2 the female of the Southern Cabbage Butterfly, an insect by no means confined to the South, although much more abundant there than in the more northerly portions of America. This insect enjoys a wide geographical distribution, extending south-west as far as Texas, west to Missouri, north-west to the Red River, and along the east from Connecticut to the Southern Atlantic States. A few years ago it was not uncommon around London, and occasionally quite plentiful about the shore of Lake Erie at Port Stanley; but of late years it has become a rare insect with us, and we have not

met with a specimen on the wing for several years. The English Cabbage Butterfly, *Pieris rapa*, seems to have taken its place entirely.

The butterfly is a very pretty one, as will be seen by the figures. The ground colour in both sexes is white, with black spots and black and dusky markings which are much more numerous in the female than in the male. Although so rare in Ontario that it has never, as far as we know, been reported as injurious, it is frequently very destructive to the south of us. According to Mr. Riley, it is abundant in Missouri, and often proves exceedingly injurious, sometimes destroying in a single district thousands of dollars worth of cabbages.

The caterpillar when full grown (figure 3, *a*), is about an inch and a quarter long, of a bluish-green colour, with four longitudinal yellow stripes and many black dots; when first hatched it is of an orange colour with a black head. The chrysalis, shown at *b* in the figure, is about seven-tenths of an inch long, of a light bluish-grey colour speckled with black, with the ridges and prominences edged with buff or flesh-colour, and having larger black dots.

The insect hibernates in the chrysalis state, and where common may be found on the wing during the months of July, August and September.

THE GREAT LEOPARD MOTH—*Epantheria scribonia* Stoll.

The larva of this insect is comparatively abundant in the autumn throughout most of the Northern United States and in many parts of Canada. It is found feeding on various species of plants, but most commonly on the wild Sunflower, *Helianthus decapetalus*. It is about two and a half inches long, with a shining black head shaded with reddish on the sides, and a brownish black body. Each segment has an irregular transverse row of tubercles from which spring tufts of rigid shining black hairs, while the

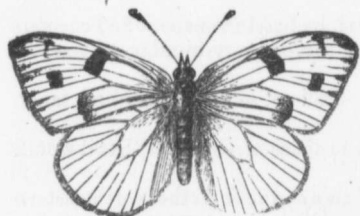


Fig. 1.

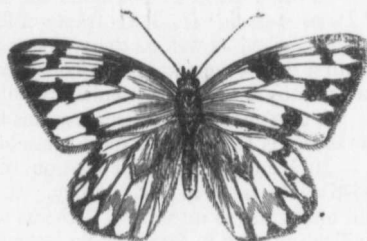


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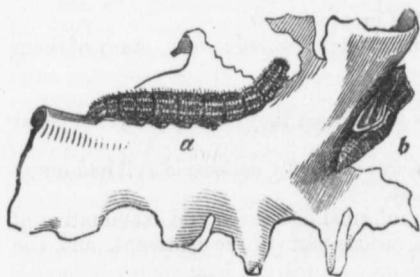


Fig. 3.

spaces between the bands be These bands it is coiled up from reddish short hairs.

This larva



Fig.

The chrysalis with a beautiful surface, which off; it has a flat at its hinder end is tipped with a

After remaining fortnight in the appears as a beautiful moth (after Riley) *a* female, *b* the male are white, ringed spotted with dark shown in the thorax has ten spots with a black along the middle extremities. The abdomen.



spaces between each segment from the fourth to the tenth inclusive are banded with red, the bands being widest and most conspicuous from the sixth to the ninth inclusive. These bands are a striking feature in the appearance of the caterpillar, especially when it is coiled up as shown in figure 4 (after Riley). The colour of the under side varies from reddish to yellowish brown, feet reddish, prolegs brown, thickly clothed with short hairs.

This larva attains its full growth in the autumn and hibernates during the winter under logs, the loose bark of decaying trees, or other suitable hiding places. By the genial warmth of spring it is aroused from its torpid condition and feeds for a few days on grass, or almost any other green thing it may meet with. It then constructs a loose cocoon, within which it enters the chrysalis state.

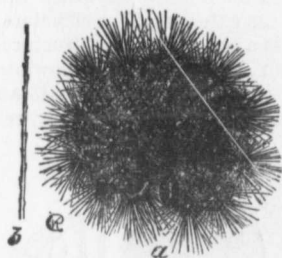


Fig. 4.

The chrysalis is black with a beautiful bloom on its surface, which is easily rubbed off; it has a flattened projection at its hinder extremity, which is tipped with a few bristles.

After remaining about a fortnight in the pupa state, it appears as a unique and very beautiful moth. In figure 5 (after Riley) *a* represents the female, *b* the male. The wings are white, ringed, streaked and spotted with dark brown as shown in the figure. The thorax has ten or twelve black spots with a bluish white centre; the upper portion of the body is steel blue, streaked along the middle and sides with yellow or orange; legs white, ringed with black at the extremities. The male differs from the female mainly in his smaller size and narrower abdomen.

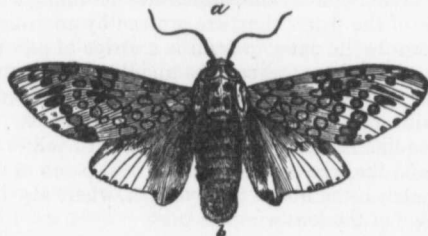
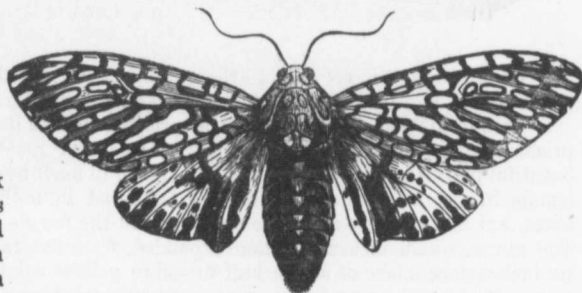


Fig. 5.

THE POLYPHEMUS MOTH—*Telea Polyphemus*.

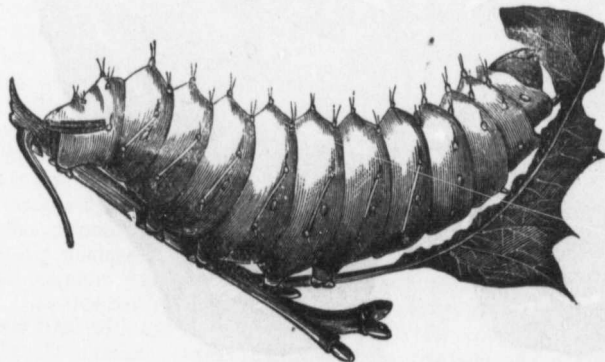


Fig. 6.

The caterpillar of this insect is also known as the American Silk Worm, in consequence of its having been extensively reared for the sake of its silk. When full grown the larva presents the appearance shown in figure 6, is over three inches in length, with a very thick body. It is of a handsome light yellowish-green colour, with seven oblique pale yellowish lines on each side

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of the body; the segments, which have the spaces between them deeply indented, are each adorned with six tubercles, which are sometimes tinted with orange and have a small silvery spot on the middle, and from each one of which arise a few hairs. The head and anterior feet are pale brown, the spiracles pale orange, and the terminal segment bordered by an angular band resembling the letter V, of a purplish-brown colour.

When mature the caterpillar proceeds to spin its cocoon within an enclosure usually made by drawing together some of the leaves of the tree it has fed upon, some of which are firmly fastened to the exterior of the structure. The cocoon, fig. 7, is a tough pod-like structure, nearly oval in form and of a brownish-white colour, and within it the larva changes to an oval chrysalis of a chestnut brown colour, represented in fig. 8.



Fig. 7.

Usually the cocoons drop to the ground with the fall of the leaves, and in this state the insect passes the winter.

Late in May or early in June the prisoner bursts its prison house, when there is revealed a large and most beautiful moth, the male of which is well shown in fig. 9, the female in fig. 10. The antennæ are feathered in both sexes, but more widely so in the male than in the female.

The wings, which measure, when expanded, from five to six inches across, are of a rich buff or ochre yellow colour, sometimes inclining to pale grey or cream colour, and sometimes assuming a deeper, almost brown colour. Towards the base of the wings they are crossed by an irregular pale white band, margined with red; towards the outer margin is a stripe of pale purplish white, bordered within by one of deep, rich brown. Near the middle of each wing is a transparent eye-like spot, with a slender line across the centre; those on the front wings are largest, nearly round, margined with yellow, and edged outside with black. On the hinder wings the spots are more eye-like in shape, are margined with yellow, with a line of black edged with blue above, and the whole set in a large oval patch of rich brownish-black, the widest portion of the patch being above the eye-spot, where also it is sprinkled with bluish atoms. The front edge of the fore wings is grey.

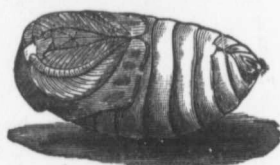
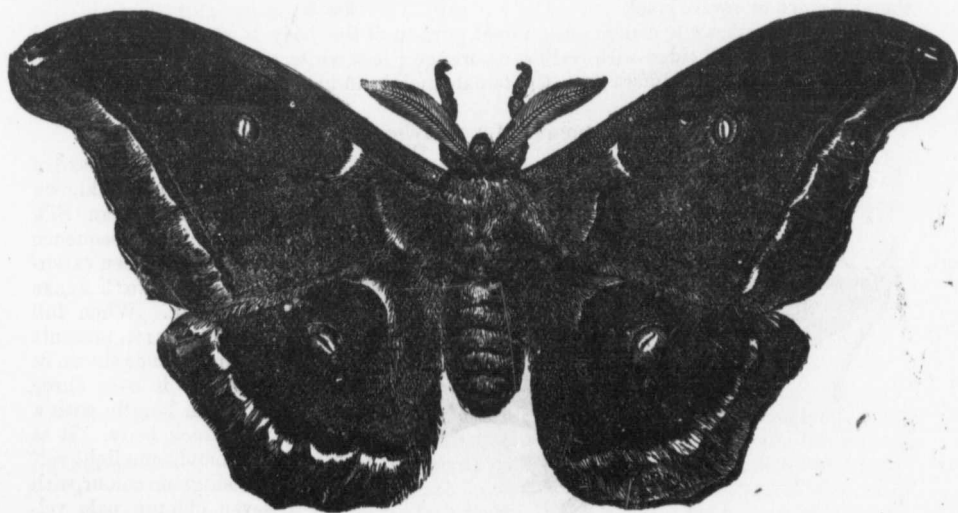


Fig. 8.



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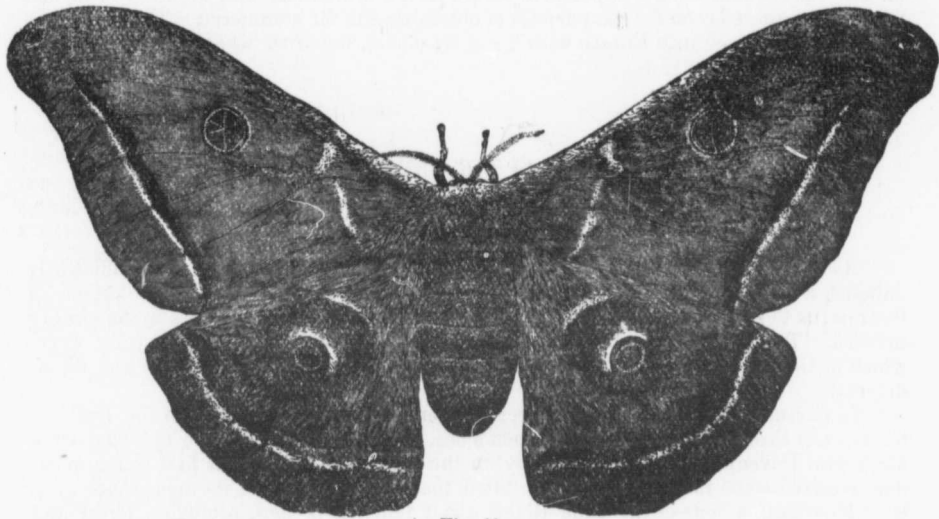


Fig. 10

This lovely creature flies only at night, and when on the wing is of such a size that it is often mistaken in the dusk for a bat. Within a few days the female deposits her eggs, glueing them singly to the under side of the leaves, usually one only on a leaf, but occasionally two or even three may be found on the same leaf.

The egg is about one-tenth of an inch in diameter, slightly convex above and below, the convex portions whitish, and the nearly cylindrical sides brown. Each female will lay from two to three hundred eggs, which hatch in ten or twelve days.

This insect is subject to the attack of many foes, particularly while in the larval state. A large number fall a prey to insectivorous birds, and they also have insect enemies. A large ichneumon fly, *Ophion macrurum*, see fig. 11, is a special and dangerous foe. This active creature may often be seen in summer on the wing, searching among the leaves of shrubs and trees for her prey. When found she watches her opportunity, and places quickly upon the skin of her victim a small oval white egg, securely fastened by a small quantity of glutinous substance attached to it. This is repeated until eight or ten eggs are placed, which in a few days hatch, when the tiny worms pierce through the skin of the caterpillar and begin to feed on the fatty portions within. The *Polyphemus* caterpillar continues to feed and grow, and usually lives long enough to make its cocoon, when, consumed by the parasites, it dies; in the meantime the ichneumons, having completed their growth, change to chrysalids within the cocoon, and in the following summer, in place of the handsome moth there issues a crop of ichneumon flies. It is also subject to the attacks of another parasite, a tachina fly. Should the insect ever appear in sufficient numbers to prove troublesome, it can be readily subdued by hand-picking. This larva feeds on a variety of trees and shrubs, such as plum, oak, hickory, elm, basswood, walnut, maple, butternut, hazel, rose, &c.

As this moth has been found to be easily propagated, extensive experiments have been tried with the view of producing silk for commercial purposes from the cocoons. The silk is rather coarser than that of the common silk worm, *Bombyx mori*, has a continuous thread and can be readily unwound. A measure of success has attended these

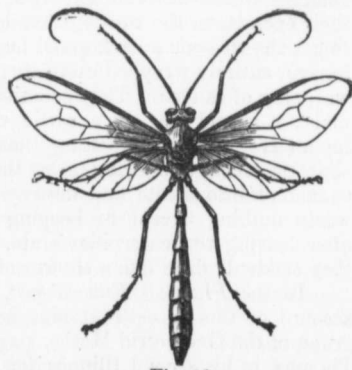


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efforts, but not sufficient, it appears, to secure their continuance, and we know of no one now raising these larvæ for the purpose of obtaining silk for commerce. The insect has also been introduced into France with a similar object, but with what success we have not learned.

A NEW APPLE TREE PEST.

By CHARLES R. DODGE, WASHINGTON, D. C.

As if the apple tree with its sixty or more insect enemies were not sufficiently afflicted, a distant relative of the Canker-worm has been making itself so notorious in Georgia, as to give apprehension of the total destruction of apple orchards in the locality infested. The insect complained of is *Eugonia subsignaria* Pack., a measuring worm which at times has been a veritable nuisance upon shade trees in New York and Philadelphia.

In pursuance of my duties as a Special Agent of the Census Office (in the fruit interest), and through subsequent correspondence, the following facts were obtained from Mr. Adam Davenport, of Fannin County, in the state named. In his first communication, received some months since, it is stated that the worm made its appearance upon Rich Mountain, a spur of the Blue Ridge, about four years ago, attacking forest and fruit trees; and that it had since spread over a large area, doing great damage. Apple trees in June last were as destitute of leaves as in mid-winter, the fruit growing to the size of marbles and falling off.

A late communication—with the replies to a series of questions—shows the destruction to be even worse than at first reported. I give Mr. Davenport's own words:—

"The insect made its appearance four years ago upon Rich Mountain, since which time it has been spreading in a northern semi-circle, at the rate of about fifteen miles a year. It is by far the most interesting insect that has plagued this country since the first white settlement. So wonderfully prolific that in two years it literally covered every tree, bush and shrub, and with the exception of a few varieties, stripped them of their leaves.

"The egg hatches about the first of May, and the caterpillar, which is dark brown, lives about forty days, transforms to a chrysalis, lives in this state about ten days, and emerges a milk-white miller. For two weeks before the first transformation the fall of their excreta, in the woods, resembles a gentle shower of rain, and from its abundance tinges the streams a dark green hue. I have seen trees that had been stripped of their foliage, entirely wrapped up in their silken webs, resembling, when covered with dew, a wrapping of canvas. They constitute a great feast for all insectivorous birds and animals; it is said that even cattle and sheep eat them with great greed. They have an instinctive way of protecting themselves by losing their hold upon the limb, at the slightest touch, and swinging by their web in the air. For this reason they are easily shaken off into sheets and destroyed. However, they are so numerous, this remedy is worth nothing except in keeping them off very small trees. This instinct is not lost after leaving the caterpillar state, for if a bird alights upon a tree above the millers, they suddenly drop like a shower of snow to the ground for protection."

In the *Practical Entomologist*, volume 1, page 57, an anonymous writer gives an account of this insect's attacks on elms in Philadelphia. Dr. Packard, in his *Monograph of the Geometrid Moths*, page 528, mentions only elm as a food plant; but Prof. Thomas, in his second Illinois Report, page 243, says: "I have not noticed them feeding upon that tree, but have twice found them feeding upon apple, upon the leaves of which I have reared them to the perfect insect. In neither case were they numerous." Prof. Comstock makes brief mention of the insect in his recent report as *United States Entomologist*, quoting Mr. Davenport, as above, to the effect that the worms were destroying forests of hickory and chestnut, and were damaging fruit trees. This statement doubtless refers to the season of 1880.

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The infested district in Georgia is not less than sixty miles long by forty wide, and embraces Union County on the east, Gilmer on the west, and Polk County, Tennessee, on the north. They have been injurious two years, but in the summer of 1881 they were most destructive.

It is stated in the *Practical Entomologist* that the eggs are deposited in masses of fifty upon the limbs of the tree. A piece of apple bark before me presents an irregular patch over three inches long, and one-fourth to one-half inch broad, the eggs closely crowding upon each other. As there are many hundreds, they have doubtless been deposited by a number of moths, which attests the truth of Mr. Davenport's statement regarding their falling in showers like snow.

They are deposited for the most part on the under side of the limbs on the top of the trees, and not only upon the bark, but the tufts of moss are covered by clusters of them. The eggs are smooth, dull, irregularly ovoid, slightly flattened upon the sides, rounded at the bottom, while the top is depressed, with a whitish rim or edge, forming a perfect oval ring; colour yellowish brown, resembling brown glue; length of examples before me, .04 inch; width, lying upon the flattened side, .03 inch; thickness, or smallest diameter, .02 inch. They are deposited in curved or straight rows of a dozen or more (or less), these lines forming masses often of many hundreds.

The name *Kugonia subsignaria*, is given on the authority of Mr. Davenport, supported by his descriptions in answer to my questions, as I have had no means of determining the species. There is no doubt in my mind, however, of the insect's identity.

THE HOP-VINE BORER.

The casual reader, calling to mind only the half dozen hop-vines usually seen about the kitchen garden, or trailing upon some farm out-building, can hardly realize the possible losses to hop growers by insects. According to the last census (for 1879) New York State alone had over 39,000 acres in hop yards, producing nearly 22,000,000 lbs. of hops, which, at an average of 28c. per lb., would aggregate a value of over \$6,000,000. Bearing these figures in mind, with an annual loss of 10 per cent. from only one insect—the hop borer—(and 25 to 50 per cent. of injury has been reported) a loss of \$600,000 would result in this single State.

With such a destructive agent in the hop field, is it not a little singular that there is little or nothing "in the books" on the subject, and that the pest is in all probability an unknown and undescribed species? I am not able to give its name—Prof. Comstock writes me he is working it up—but as I have accumulated a mass of interesting data on the subject in my census work, I deem it proper to make known now the experience of intelligent growers in different sections of the country, for the benefit of those who have not yet learned how to fight the pest, leaving the scientific name and details of habits and natural history to be supplied hereafter.

The only mention that I can find of an insect boring into the crown of the hop plant, in the manner set forth by numerous correspondents, occurs on page 33 of the Report of the Entomological Society of Ontario for 1872, by Rev. C. J. S. Bethune. As an appendix to his paper on Hop Insects, he gives descriptions of an unknown larvæ feeding "upon the crown of the root," and which he was unable to rear. The size of the larvæ and the general points of description agree so well with the unscientific descriptions given by my correspondents, the growers, that I unhesitatingly pronounce them to be the destructive hop borers, which are the subject of this paper.

The pest has been known to cultivators of the hop for many years—indeed it is reported from Oneida County that it has always been known in the locality—and other hop growing districts have felt its presence for longer or shorter periods. In Juneau County, Wisconsin, it was first noticed in 1867, while the observer in Waupaca County had not noticed it prior to 1881. The percentage of destruction varies in different sections from almost nothing—where kept under control, or yards are new—to 25, 50, and even a greater percentage where the yards are old, badly infested, or not looked after. These facts lead a New York grower to state, in his opinion, that it is best to abandon yards after six or eight years' culture, and change to new ground, for "grubs will get

into a yard after two or three years, gradually increase, and in eight or ten years spoil the yard." Other growers contend that only the yards of the ignorant and shiftless are ever damaged to any extent by the borer.

I shall not attempt to give a description of the larva here, further than to say that all correspondents agree in the statement that it is an inch and a quarter to an inch and a half in length, and three-sixteenths to one-fourth inch in diameter at maturity, whitish or light gray in colour with a dark head.

As soon as the vines start from the ground in May and June, and when but a few inches high, the mother insect begins the attack by depositing her eggs upon them. The subsequent injury is thus described by Mr. Pierpont, a large grower of Ontario County:—

"The warm sun hatching the egg deposited in the head of the hop vine, soon after it is out of the ground, it soon becomes a lively worm about one-fourth of an inch in length, subsisting upon the sap of the vine. It leaves the head of the vine soon after hatching, enters the ground, bores to the centre of the vine and works up an inch or two, finally locating where the vine starts from the crown, eating at this point and at the crown until the vine is nearly or quite destroyed, and the crown weakened by water getting in, causing decay, and finally the destruction of the entire hill."

Another report states that the insect begins work in the latter part of June by eating into the tender vines where they start from the old crown or bed root; and unless prevented, will eat the vine entirely off, thus destroying the crop; "many times they poison the root so that the whole hill dies." Old yards die from this cause more than any other, as the borer prevails more in old than in newer ones.

Another grower states that the damage commences about the last of May or first of June, when "the head of the vine will appear slightly bent or curved, if compared with sound ones. The grub, after feeding a little time in the heart of the head drops to the ground and makes its way into the heart of the vine below the surface of the ground, working deeper as it grows larger. The vine wilts and finally dies."

There is great diversity of opinion among growers as to the best means of ridding a yard of these pests. A few take for granted that there is no remedy, leaving skunks to carry on the warfare alone; and right here it may be stated that growers east and west speak most favourably of the friendly offices of this much despised animal in the hop yard. Salt is mentioned by many growers as a remedy. It is put on after the vine has become somewhat toughened, from middle to last of June, salt on the tender new stalks killing them in a short time. Lime, ashes, sulphur, etc., are also recommended, but doubtless do little real good. Some growers emulate the skunks by digging out the grubs, often doing more damage than the pests themselves.

Mr. Pierpont says an experienced tyer of hops can tell at a glance the head containing a worm, which is crushed in an instant, but this process can only be practiced for a few days, as the worms leave the head soon after hatching. Next to the crushing process a useful remedy is to hill the hops as soon as possible and give the yard thorough cultivation. The hilling causes fibrous roots to put out above the operations of the grub and save to some extent the crop.

The most detailed statement of experience, and it seems to me the best remedial agency or means of prevention, is furnished by Mr. J. F. Clark, a grower of Otsego county, New York, who writes as follows:

When the vines are well up the poles, and at the first hoeing about the last of May or first of June, the dirt should be carefully worked away from the vine by the hoe; all the dirt remaining between the vines must be carefully worked out with a sharpened stick, so that all the vines will be left bare as low down as where they leave the bed root; thus they become toughened by the weather, and are not so attractive to the grub. Immediately after this operation, a good handful of the following compost should be applied directly around the root and vine: Take equal parts of salt, quicklime and hen-manure; place the lime on the floor first, and throw on water enough to thoroughly slack it; immediately spread the salt on top, following with the hen-manure. When the lime is well slacked, mix the whole thoroughly, and in a couple of weeks it will be ready for use, as above. Do not hill up the hops until the latter part of July or first of

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With regard to species of *Drosophila* common to European Dipterist, and by our American entomologists find no reference to *Naturalist*, vol. 2, p. apples, preferring to in every direction, a use. Dr. Packard, "Fly," which is believed *Entomologist*, also *Drosophila*, and which about half its value,

Professor Lintner ably in their habits, seems often to occur European *D. cellaris* beer, and also in d occupy about eight

August, and the yard will not suffer any from grubs, but will remain clean and free from weeds the remainder of the season. When yards are hilled earlier than stated above, the grub sometimes works in them more than in late hilled ones.

To return to the skunks. They seem to have acquired the digging-out process to perfection—far better than the hop grower—as they are able to dig around the hills without the least injury to the vines. In Juneau county, Wisconsin, this little fellow—with an appetite for juicy grubs only equalled in degree by the pungency of his perfume—is the only positive remedy, as he works about the hop-hills or roots, cleaning out the worms in a few nights. One grower says: "I have seen ten acres where not a dozen hills would escape their little noses."

It is worthy of note that in a majority of cases the growers report the borer as the most injurious insect in the hop yard, not excepting the hop-aphis.

THE PICKLED FRUIT FLY—*Drosophila Ampelophila* (Loew).

By G. J. BOWLES, MONTREAL.

In August, 1879, I met with a small Dipterous fly, *Drosophila ampelophila* Loew, in considerable numbers, and as the subject is of interest to entomologists, I give the



Fig. 12.—*Drosophila ampelophila*: Fly and Wing. Magnified 10 diameters.



Fig. 13.—*Drosophila ampelophila*. a, Larva; b, Pupa. Magnified 7 diameters.

result of my observations. I have to thank Professor Hagen, of Cambridge, for the determination of the species and other information, and also Professor Lintner, of Albany, for a copy of his article in the *Country Gentleman* of 1st January, 1880, on this insect, and from which I have largely drawn.

With regard to the genus, Professor Lintner says: "Twenty-five North American species of *Drosophila* are catalogued, which have all, with the exception of three species common to Europe and America, been described by Dr. Loew, the distinguished Prussian Dipterist, and Mr. Walker, of the British Museum. They have not been studied by our American entomologists, and consequently nothing is known of their habits. I find no reference to a single determined species by any of our writers." In the *American Naturalist*, vol. 2, page 641, an unknown species of *Drosophila* is noticed as infesting apples, preferring the earlier varieties. The larvæ penetrate the interior of the apple in every direction, and if there are several working together, render it quite unfit for use. Dr. Packard, in his *Guide*, page 415, figures an unknown species as the "Apple Fly," which is believed to be the above species. Mr. Walsh, in vol. 2 of the *Practical Entomologist*, also gives a brief notice of a larva supposed to be that of a species of *Drosophila*, and which also was injurious to an apple crop in Vermont to the extent of about half its value, by boring the fruit in every direction.

Professor Lintner further says: "The different species of *Drosophila* vary considerably in their habits, as we learn from European writers; and, indeed, the same species seems often to occur under apparently quite different conditions. The larvæ of the European *D. cellaris* occur in fermented liquids in cellars, as wine, cider, vinegar and beer, and also in decayed potatoes. *D. aceti* Kol. infests decayed fruits. Its larvæ occupy about eight weeks in attaining their growth, and their pupal state lasts for

ten or twelve days. The flies appear in May and June. *D. funebris* has been reared from pupa taken from mushrooms. It is sometimes known as the vinegar fly. Another European species, *D. flava*, is stated by Curtis to mine the leaves of turnips, raising blister-like elevations on their upper surface."

The present species, *D. ampelophila*, is described by Loew in *Centuria Secunda* (Dipt. Amer. Sept. indigena), No. 99, page 101. It is exceedingly common (Professor Hagen states) in the southern parts of Middle Europe and in Southern Africa, but the only localities given for it in America, in Loew and Osten Sacken's Catalogue, are the district of Columbia and Cuba. Professor Lintner, however, has bred it in New York; it also occurs in Pennsylvania, and now Montreal must be added to the list. I also think, from observations made in Quebec, that it, or an allied species, is found there. At any rate, this immense area of distribution for such an insignificant insect is very remarkable.

Like the other species of this genus, and so many other dipterous insects, the larva of *ampelophila* feeds on decaying or fermenting vegetable matter. Professor Lintner bred it from pickled plums; in Pennsylvania it fed on decaying peaches, and I found it in pickled raspberries. An earthenware jar had been nearly filled with this fruit and vinegar, prepared by the good housewife for the purpose of making that favourite drink (in Canada at least) called raspberry vinegar. On opening the jar about ten days afterwards (16th August, 1879) it was found to be swarming with the larvæ and cocoons of the insect. Hundreds of the larvæ were crawling on the sides of the jar and the under side of the cover, while pupæ were found abundantly, singly and in clusters, particularly where the cover touched the top of the jar. The short time required for the production of so many individuals was surprising. I half filled a covered tumbler with the pickled raspberries and larvæ, and they continued to produce flies for several weeks. I regret not having more attentively observed the exact time required for the different stages, and can only say that its growth from the egg must be very rapid, and its pupal state does not last longer than ten or twelve days.

The larvæ (fig. 13 a) when full grown, are nearly one-fourth of an inch long, somewhat tapering towards the head, which is small; and are sparsely covered with minute hairs, particularly on the divisions of the segments. They have no feet, but can travel quite rapidly on glass, seeming to retain their hold by a glutinous condition of the skin, and moving by extending and contracting their bodies. They seemed to exist with ease either in the vinegar or the air, moving through the former in search of food, and sometimes coming out of it, and either resting or moving about on the glass sides of the vessel. Their bodies were quite transparent, and under the microscope their internal organs could easily be seen. At both ends of their bodies are curious projections or tubercles, which are also seen in the pupa.

The puparium (fig. 13 b) is about three-sixteenths of an inch long, oval in shape, and yellowish-brown in colour, with the tubercles at head and tail before referred to.

The fly (fig. 12) measures about one-eighth of an inch in length, with a large rounded thorax, long legs, and broad iridescent wings. The whole insect is yellowish in colour, and very hairy, even to the proboscis. Some of the hairs on the head bear three or four branches. The wing forms a very beautiful object for the microscope.

Last year the flies were attracted to some raspberry wine in process of fermentation, hovering about the jars and alighting upon the corks, evidently seeking for an opening through which they might pass to lay their eggs. It is doubtless in this way that fruit is attacked by this or some allied species. The minute fly effects an entrance beneath a not closely-fitting lid, and deposits its eggs on the fruit, or upon the side of the jar, whence the young larvæ make their way to the fruit, or find their sustenance in the liquid.

During the past summer I was desirous of again testing the matter. A few raspberries, with a small quantity of vinegar, placed in a pickle bottle with a loose cover, were quite sufficient. A fortnight afterwards a number of larvæ were seen in the bottle, and several pupæ were attached to its sides. Absence from home, however, interfered with the carrying out of the experiment. It could easily be tried this season by some

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The outline drawings were made under the microscope, and give a fair idea of the insect. Every part of the fly is covered with hairs of different lengths, as indicated in the figure. The branched hair on the head is faithfully copied from a specimen, but in others it was not so largely developed. The wings are beautifully edged with hairs, and the membrane is also studded with them. The fly was drawn in the position given, so as to show its extremely long legs, and the curious shape of the thorax and abdomen.

"LONG-STINGS."

BY W. HAGUE HARRINGTON, OTTAWA, ONT.

Among the conspicuous insects which attract the attention of even non-entomologists, there are few more interesting in their structure and habits, as well as in their relations to other groups, than the large "long-sting" ichneumonids with their long triple "tails." Our two largest species belong to the genus *Rhyssa* (of the Hymenoptera), and as, so far as I am aware, no accounts of them have yet been published in the ENTOMOLOGIST, a brief description of their appearance and habits may not be undesirable.

They may be easily distinguished from their relatives (often their victims), the "horn-tails"—Uroceridæ—as they are much more slender in body and appendages. The female, readily determined by the extraordinary development of the ovipositor, has the abdomen stouter than that of the male, with the posterior segments dilated and curved under, and bearing the ovipositor, which is constructed essentially of the same parts as is that of a "horn-tail," only that they are greatly lengthened.

The head, in shape like a short segment of a cylinder, slightly convex before and concave behind, bears on its rounded front a pair of large eyes, from between which spring the long slender antennæ. The head is joined by a small neck to the thorax, which is strongly built and supports two pairs of long narrow wings, as well as the six very long and slim, yet strong, legs. The segment of the abdomen which adjoins the thorax is much less in diameter than the succeeding ones.

The male has a long cylindrical abdomen tapering gradually to the extremity. This, in connection with the prominent head and narrow wings, gives him, especially when in flight, a considerable resemblance to a dragon-fly, from which, however, he is at once distinguished by his long antennæ and shorter hinder wings.

In these insects, as in the Uroceridæ, the hinder-wing has upon its anterior margin a row of minute hooks with which to hold the posterior border of the front one. The number of the hooks is, however, much less, there being only about a dozen scattered along the outer half of the wing.

Of our two species the larger and handsomer is *R. atrata*, of which my specimens vary in length from a little over one and one-quarter inches to nearly two. The head is a rich yellow, with the exception of the eyes and a slight band, bearing the ocelli, on the vertex. The slender antennæ, about an inch long, are also yellow, as, likewise, are the extremely long legs, with the exception of the upper joints of the posterior pairs. The thorax and abdomen are black. The wings, which expand from two to two and three-quarter inches, are transparent, but with a dark smoky tinge. The female is furnished with an ovipositor from four to five and one-half inches in length; flattened and scarcely stouter than a hair.

R. lunator is more common, at least in this vicinity, and varies much more in size, the largest specimens being fully twice as big as the lesser ones. The body varies in length from three-quarters of an inch to one and one-half inches, and bears at its posterior extremity an ovipositor projecting from one and one-half to three and three-quarter inches.

The head is yellow with a dark band, in which are inserted the three ocelli, between the eyes, parallel to which runs another dark line which almost encircles the head.

Lines also run from the base of the antennæ to the mandibles. The slender antennæ are dark at the base but get lighter toward the tip. The thorax and abdomen are dark brown, ornamented with lines and borders of yellow, which is also the colour of the legs. The wings (front pair) expand from one and one-quarter to two and one-half inches, and have a quadrangular dark patch on the anterior border.

The larvæ of both "long-stings" feed upon those of the Uroceridæ and other wood-borers, in which the female ichneumon deposits her eggs by means of the long ovipositor. The method of performing this operation may often be witnessed during the summer by visiting beech trees in which Tremex larvæ are at work, but it is difficult to describe clearly its accomplishment and the different postures of the insect during the progress of her laborious and dangerous duty. A series of good drawings would best convey a correct idea of the process, but I do not know of any book in which such are to be found, while some illustrations are very inaccurate. For instance, I saw the other day in a text book of zoology an ichneumon depicted with her ovipositor fully inserted in the tree and with the *side-pieces or sheaths sticking straight out behind her*. Such an attitude is altogether unnatural, and I am convinced that in that position she would be powerless to extract the ovipositor.

Selecting a suitable tree, if we find no ichneumons at work, we may shortly see one flying strongly and noisily through the sunny woods and settling upon the bark where perforations mark the exits of previous occupants. Here she runs around until she finds a promising spot, as, for instance, the hole made by a Tremex in depositing her egg. Placing herself so that the tip of her abdomen will be above the orifice to be probed she makes herself as tall as possible, and, by elevating her abdomen and curving under the ovipositor, succeeds in inserting the tip of the latter in the hole.

If the dorsal surface of the abdomen be examined, there will be observed, between the sixth and seventh segments, a gap closed by a whitish membrane. This marks an admirable contrivance to enable the insect to use her seemingly unwieldy weapon, for the membrane is capable of being so dilated as to form a cavity in the posterior part of the abdomen, in which can be coiled a large portion (more than one-third) of the ovipositor, which thus becomes perpendicular under the insect, where it is guided and supported by the sheaths which bend up in loops over her back. By vigorous muscular contractions of the sac, the delicate ovipositor is slowly forced down the larva's burrow, often to its full extent. If a larva be reached an egg is deposited in it, and the ovipositor is slowly withdrawn in a similar manner. This, however, the insect is frequently unable to accomplish, and remains struggling until some bird or tree-toad snaps her up, or she perishes from exhaustion.

I have seen a large *R. atrata* with her ovipositor (five and one quarter inches long) inserted four and one-half inches into a beech, so firmly that it was only by careful and vigorous pulling that I extracted it uninjured.

The insects are to be found during the latter part of the summer; *R. lunator*, as already mentioned, being much the more abundant.

On the last day of June, 1879, while collecting in a grove just beyond Rideau Hall, I stopped to examine a dead tree for bark and fungi beetles, and was bottling a fine *Penthe pimelia*, when the rustling of insect wings above me attracted my attention. Looking up I saw several specimens of *lunator* flying about the trunk, and a circuit of the tree with closer inspection showed many others walking about on the bark or in various stages of the act of ovipositing. The tree was a large one, about two feet in diameter, from which the top had been broken off at a height of thirty or forty feet. The rugged bark was dotted all over with *lunators*, often massed in rows or patches, so that there must have been several hundred upon the tree, forming an unusual and most interesting spectacle. The great majority were females, but a number of males were also present. While I was consigning to my bottle a few specimens, a large woodpecker settled upon the opposite side of the tree and began to rapidly thin the ranks of the helpless insects, whose mission, like that of the woodpecker, is the destruction of wood-boring larvæ.

A year later, being in the same locality, I visited this tree and found again a number of ichneumons engaged in the performance of their duty, and also saw sticking out

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FIELD NOTES—1881.

The earth covered by its first mantle of snow reminds one that the collecting season is virtually ended, and the lengthening evenings allure one to the study fireside to go carefully over note books and collections and to read the recorded labours of fellow Entomologists.

A few memoranda from my own note book may perhaps not be barren of interest to some of the less experienced readers of the *Entomologist*. I find that almost the first insect of spring was the Mud-wasp, *Polestes annulatus*, which appeared with a few flies and spiders about the 15th of March. This wasp is very abundant here, and from the pulverized macadam of the streets thousands of its mud cells are constructed every summer under the window-sills and numerous cornices of the Parliament Buildings, about which the wasps linger until the end of October. Toward the end of March a few bees and a number of small beetles, as *Amara interstitialis*, appeared. *Pieris rapæ*, the cabbage butterfly, was observed on April the 1st, but from this date to the 8th of the month a severe cold spell (thermometer touching zero) reduced insect appearances to the minimum again. At its conclusion they emerged in still greater variety and number; *Vanessa antiopa* flitted about in sunny glades of the wood; *Cicindela purpurea* enlivened the fields, and its relatives, *C. vulgaris* and *C. sex-guttata*, the roads. Mosquitoes came in full force a fortnight later, and on the 24th I obtained a number of Buprestidæ upon young pines, viz., 1 ♂ and 2 ♀ *C. virginensis*, and 14 ♂ and 18 ♀ *C. liberta*. I was somewhat surprised to find them so early in the year, yet could have taken many more. They were generally paired, in several instances copulating. Some *Pissodes* were also seen, and these were with few exceptions copulating. Great numbers of saw-flies were also upon the pines. A few days later I captured specimens of *A. striata*, and by the beginning of May all orders of insects were well represented. On the sixth *Serica sericea* was abundant on the foliage of wild gooseberry bushes. *Chrysomela elegans* were also unusually numerous, but I could not find upon what it fed. *Platycerus quercus*? was found eating the buds of maples and other trees. The buds were often completely eaten out, and the beetles hidden from view therein. In some buds a male and female were found copulating. This beetle was new to my collection, but I found them frequently again during the summer when using a beating net. During May the curious larvæ of certain Lampyridæ were often seen in damp woods, crawling on the trunks of trees, such as cedar, or affixed by the tail to the bark, undergoing their metamorphoses in a similar manner to the larvæ of the Coccinellidæ. Some reared at home emerged as *Photinus angulatus*. The larvæ, and to a less degree, the pupæ, emitted a strong greenish glow from two of the posterior segments; the imago being, of course, one of our common "fire flies." Some of the larvæ were thickly covered beneath with small ticks, of a bright vermilion colour, which had their pointed heads plunged between the armoured segments of the larvæ. They were not easily dislodged, but walked rapidly when free. By these little parasites the larvæ were so weakened as to perish before completing their transformations. The warm weather of mid-May brought forth increased hosts of insects, and the sultry air, especially in the neighbourhood of lumber yards, swarmed with Scolytidæ, etc. Toward the end of the month I took a trip, with three friends, to the Wakefield Cave, about twenty miles north of the city; and in my spare moments collected a number of insects in that vicinity. Cicindelidæ especially abounded on the sandy hill-side roads, and I captured three species which are rare, or not found about here, viz., *C. 12 guttata*, *C. longilabris* and *C. limbalis*. On my way back I took a specimen of *C. sex-guttata* having only two spots (the anterior one on each elytron). Although called Six-spotted Tiger Beetles, very many have eight spots, and specimens with ten spots are frequently taken. In a beech grove at Chelsea, *Ithycerus curculionides* was very abundant; several could be seen on nearly every tree; many pairs were copulating. Where do the larvæ live? On the 31st of May several specimens of *C. Harrisii* were taken on pine saplings, and *H. Pales* and its long-snouted relatives were in full force. On June 4th, *Saperda vestita*, *Oberea amabilis*, *B. nasicus*, *C. nenuphar*, *A. quadrigibbus*, and many

other weevils, elaters, etc., were noted. At an excursion of the Ottawa Field Naturalists' Club to Montebello (45 miles down the river), on 26th June, I captured 129 species of Coleoptera, a considerable percentage of which were new to me. Carabidæ were particularly abundant under drift-wood and dead leaves on the damp, shady shore, and 35 species were taken. Chrysomelidæ, Elateridæ and Curculionidæ were next in number with 15, 13 and 13 species respectively. After midsummer my opportunities for collecting were few, and my notes correspondingly scanty. I will merely mention the capture at Aylmer and Hull, on Oct. 2, *Aletia argillacea*, the cotton moth; both specimens were in perfect order, not in the least rubbed or worn. In Oct., 1880, I took several specimens about the city, also apparently recently emerged.

ENTOMOLOGICAL NOTES FOR THE SUMMER OF 1881.

By PROF. E. W. CLAYPOLE, YELLOW SPRINGS, OHIO.

I came only last year on the premises where I am now residing, and though I had a small crop of cherries, they were so badly infested with the weevil (*Conotrachelus nenuphar*) that only a few quarts could be found free from the grub and fit for canning. This year a fair crop was promised, the spring was late and the danger of frost little. I proposed therefore to make war upon the enemy, and as soon as the blossom was over prepared a large sheet of cheese-cloth, and for about three weeks jarred the trees before breakfast almost every morning. As the result, I have now nearly 2,000 weevils peacefully reposing in a bottle, after a composing draught of benzine. Only about 10 per cent of my cherries this year were unfit for use. I carried the war into the orchard, and simply by way of experiment, jarred some of the early apple trees and captured a great many of my enemies. I am more than repaid for my labours both on the cherry and apple trees by the quality of apples, when last year with a larger crop, I only obtained knotty, gnarly fruit. I have this year round, smooth, well shaped apples. I have never heard that anything has been done, at least in this neighbourhood, to trap the weevils on the apple trees. Those who live in the north have no idea of the mischief wrought here by the weevil in the orchards.

A word for the mole. In digging potatoes this year I observed the runs of a mole in all directions through the ground. It was a piece of old sod and very much infested with white worms, the larvæ of the Cockchafer (*Lachnosterna fusca*). Many of the potatoes had been partly eaten by these worms, but I observed that wherever a mole-run traversed a hill of potatoes no white worm could be found, even though the half-eaten potatoes were proof of his former presence. The inference is fair that the mole had found him first and eaten him, and very likely the mole's object in so thickly tunnelling this piece of ground was to find these grubs.

Now it would be very easy to trump up a charge against the mole on the evidence of these facts. There was the "run" which nothing but a mole could make, and there were the gnawed potatoes; put the two together and kill the mole. Many a man has been punished on less conclusive circumstantial evidence. But it is perfectly easy to distinguish the work of a mole from that of a white worm, if one will only take the pains. I have many times found the latter coiled up in the potato he was eating, but I have never seen the mark of teeth such as the mole possesses on a potato. Nor do I believe the mole ever meddles with potatoes, or corn.

Abundance of Certain Insects.—The Southern Cabbage Butterfly (*P. protodice*) is exceedingly abundant here this summer. I have been able to count scores on the wing at one time.

The potato worm, or larva of *S. 5-maculata*, is troublesome on the late potatoes this month (September) and soon strips a plant of its leaves. However, he is easily dealt with, as he is at once betrayed by the castings on the ground, and a little "poison-dust," such as I use for the beetle, soon makes an end of him. I have tried "Buhach" on this insect, but find the former much easier of application and more effective. The latter

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The same of the cabbage. 3,000 heads of is a serious dra I can sprinkle in order "to put some part of London through a fine

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Insect hunting be considered very in plenty which I specimens of a F Edwards determined which is in the S is *multiguttis* of C surely, that so has own. Its season one specimen of three specimens, captures, I received They are exactly *Goes debilis* was *n discoidea*, although markings of the season, when the quite common, especially in great abundance might not secure months of July and of September the plentiful. Those represented than I for the first time. *Scopelosoma Pettigera*, are rare. I took one new to me

diluted with ten parts of flour had little effect on the worms, but when used neat it stopped their feeding and killed two of them in a couple of days. But there is the trouble of looking up the creature (green on a green ground) in order to put the powder "where it will do the most good," whereas one need only shake the powder-tin over the plant and pass on, leaving the worm to poison itself.

The same is true of the Cabbage Butterfly (*P. rapæ*) in the early stages of growth of the cabbage. I have used Buhach, and a friend of mine is now using it on a plot of 3,000 heads of cabbage, but the time spent in finding the green worm on the green leaf is a serious drawback, and while the plant is very young I prefer using the "poison-dust." I can sprinkle a whole bed while I am finding the worm on a dozen cabbage heads in order "to put salt on his tail." The "poison dust" to which I refer is made by mixing one part of London Purple and sixty parts of ashes and passing the mixture several times through a fine sieve. I may add that I find this a very efficient remedy for the turnip fly.

NOTES ON LAST YEAR'S COLLECTING.

BY J. ALSTON MOFFAT, HAMILTON, ONT.

No one I think can have been long engaged in collecting insects without having noticed the remarkable diversity in the products of different years, not only in quantity, but in kinds. Each summer seems to bring its own particular species to the front, so that if a person wishes to get a moderately correct idea of the insects of any locality, it is necessary for him not only to hunt diligently all the season, but every season for a considerable length of time; and if he has from any cause missed one, he may be sure he has missed something which it may be years before he will again have an opportunity of securing, or securing in the same abundance. The causes of these variations seem as yet to a great extent a mystery.

Insect hunting could not be said to be good in this locality last summer. It might be considered very poor, yet it produced its new things for the collection, and some things in plenty which had hitherto been scarce. On the 12th of May I came across some specimens of a *Pieris* which I thought were poor specimens of *oleracea*, but which Mr. Edwards determined to be *Virginensis*. On the 23rd I took a very attractive *Chrysomela*, which is in the Society's Coll. in London as *C. labyrinthica*, but which the authorities say is *multiguttis* of Crotch's Check List, of which *scalaris* is synonym. Rather remarkable, surely, that so handsome and distinctly marked an insect should not have a name of its own. Its season lasted about four weeks, during which I secured over a dozen. I took one specimen of *Stenosphenus notatus* Oliv. Of this species I captured in May, 1879, three specimens, the first I ever took, and that year, a week or two previous to my captures, I received from Mr. Reinecke, of Buffalo, a pair labelled Dallas, Texas. They are exactly similar. The *Cerambycidae* were ten days later than usual this year. *Goes debilis* was numerous, and I took my first and only specimen of *S. pulcher*. *Saperda discoidea*, although never plentiful, is interesting from the great difference in size and the markings of the sexes. I had always found two or three females to one male until last season, when the males were most numerous. There were several species of *Leptura* quite common, especially *vibex*, which I had not seen before. *Gaurotes cyanipennis* was in great abundance, but although you could bring a dozen down with one stroke, you might not secure more than two or three, they were so quickly on the wing again. The months of July and August were barren of anything worthy of note. In the second week of September the fall moths began to appear, and up to the end of October were quite plentiful. Those attractive genera, *Scopelosoma* and *Lithophane*, were more fully represented than I had seen them since the fall of 1877, when I took eight or ten species for the first time. A few *S. Graefiana* and *L. Bethunei* can be found every year, but *Scopelosoma Pettiti* and *ceromatica*, and *Lithophane semiusta*, *pexata*, *signosa*, *petulca*, *querquera*, are rare. Some of these choicer species were easily secured again last fall. I also took one new to me, *L. ferrealis*, whilst a friend here, Mr. J. Johnston, took *S. tristigmata*

and *L. cinerosa*, which we were enabled to identify through the kindness of Mr. R. Thaxter, of Cambridge, Mass. Mr. Kyle, of Dundas, secured *L. Georgii*, which I have not yet met with. It may be worthy of note that Mr. Johnston took a specimen each of *Plusia striatella* and *Charocampa tersa*, the first taken here of either species.

Mr. Thaxter kindly determined the following for me:

Dryopteris rosea,	Hadena Miselioides,
Limacodes inornata,	Dianthoecia meditata,
Gortyna cerina,	Orthodes cynica,
Calledapteryx dryopterata,	Paristichtis perbellis,
Mamestra eloniplina.	

The last four were taken the previous year at Long Point.

THE DEVELOPMENT OF ATTACUS LUNA.

On the evening of the 12th of April, being at the residence of Mr. J. Johnston, a noise proceeding from his hatching box attracted his attention. Upon looking for the cause, he found a Luna just emerged, the fifth from a batch of nine cocoons which he had raised from the egg. Its body and wings seemed to be quite dry, and were a pure downy white, with the exception of the costal band, which appeared disproportionately large, and a minute dark spot for the eye spot. This beautiful moth is well

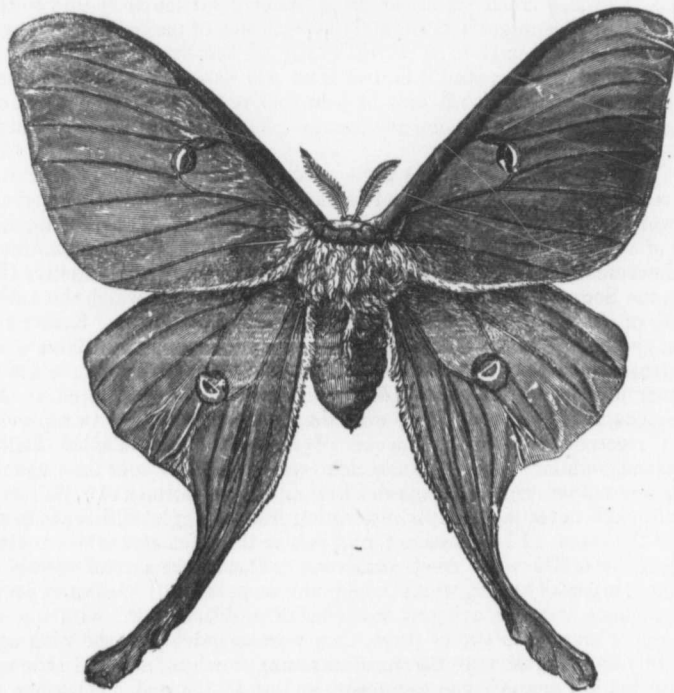


Fig. 14.

represented in figure 14. It was remarkably active and did a great deal of rapid traveling before it came to rest, which it did at last quite suddenly on the end of a twig, and then never moved except to better secure its foothold. Mr. Johnston placed it in a suitable position under the full light of the lamp, that we might watch its progress to maturity. The first change noticed was the appearance of a bright green spot near the

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base of the front wing, and as that enlarged the wing expanded, very slowly at first, but more rapidly as it increased in size, the green colouring matter flowing along between the upper and lower membrane of the wing, becoming more delicate in its shade as it spread first along the front of the wing, and had reached the apex before it extended through the inner half; but by the time it had touched the extremity of the whole outer angle the size, form and colour of the wing were complete.

In the meantime the hind wing had not yet doubled its original size, with the part from which the tail was to come showing as a slight break on an otherwise even edge; the same routine was followed in the development of the hind wing as that of the front, and by the time the broad part of the wing had attained its full size, the tail was a little more than half an inch long and very much crumpled. This was the last part to expand, but as the fluid passed into it, it also took size and form. The whole time occupied in the operation, from first seeing it until it was completed, was about an hour and three-quarters.

For the benefit of those of our readers who may not be familiar with this insect in its earlier stages a larva nearly full grown is shown in figure 15. It is a very handsome caterpillar of a bluish-green colour with a pale yellow stripe along each side of its body, the spaces between the segments traversed by lines of the same colour and each ring adorned with small pearly warts from every one of which arises a small cluster of short hairs.

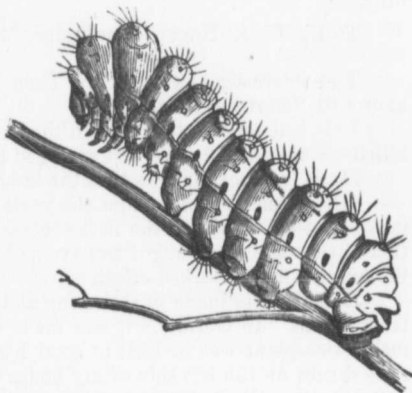


Fig. 15.

EXPERIMENTS WITH YEAST IN DESTROYING INSECTS.

By DR. H. A. HAGEN, CAMBRIDGE, MASS.

We are indebted to Dr. H. A. Hagen, of Cambridge, for the following letter and the subsequent remarks on this interesting subject:

KINGSNORTH, Ashford, Kent, Dec. 27, 1881.

Dear Sir,—I beg to thank you very much for your letter, dated Nov., 1880, respecting the application of yeast for destroying insect pests. During the past season I have endeavoured to follow the instructions contained therein, and as you express a wish to hear of my success or failure, I will attempt to describe my experiments as clearly as possible. As soon as Aphides became noticeable, I procured some German compressed yeast, dissolved an ounce in a little warm water, added a little coarse sugar, and set it to ferment. In about twenty-four hours I added sufficient water to make up a gallon, and with this syringed a cherry tree attacked by black Aphides. This was on the 16th of June. Four days later I found the tree almost clear of living Aphides, though their dead bodies, or cast skins (I could not ascertain which, although I asked the assistance of an entomological friend) smothered many of the leaves. One remarkable point in this experiment was that a small branch of the tree, loaded with Aphides, hung over a window, and, at the request of my wife, I abstained from syringing it. Here the insects remained perfectly healthy, and after a few days were seen to work down the tree and attack the young shoots that had been washed clean. On June 29th I again dressed the tree, and this time destroyed or drove away every Aphide. I may add that the larvæ of several Aphidivorous insects were present on the tree, and did not appear greatly affected by the application. Encouraged by the apparent success attending the application, I commenced operations, June 20, on a second cherry tree. This, however, was heavily leaved, and I could not make so much impression, but they evidently did not like

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the dressing, for they disappeared entirely soon after the second application. I also tried the yeast for Aphides on Guelder Rose (*Viburnum*), Elder (*Sambucus*), Field Bean, and some other plants; also for Currant Grub, but could make no decided mark anywhere. With respect to the Currant and Gooseberry Grubs, the liquid ran from off their bodies clean, and I found it almost impossible to saturate them with it. If the syringing was persisted in, they would release their hold and fall to the ground, but very shortly crawl up again. To conclude, I was delighted with the apparent success of my first experiment, but all subsequent trials were so discouraging that I fear yeast is too uncertain in its action to supersede many of the washes we have already in use. Again thanking you for your kind letter, I beg to subscribe myself, sir, Yours most respectfully,

THOS. H. HART.

To Dr. H. A. Hagen, Cambridge, Mass., U. S. A.

This interesting letter by Mr. Thos. H. Hart, who owns nurseries and greenhouses, allows the following conclusions:

I. It is doubtless true that in the experiments of June 16 and 20, the Aphides were killed, as upon the branch not syringed they remained in perfect health.

II. It is doubtless true that the later experiments were a failure.

III. It seems evident that the yeast has not contained *Isaria*, or other fungi obnoxious to insects, to which the first success could be ascribed; otherwise the later application of the same fluid ought to have had the same effect, or even by the multiplication of the fungi, a more marked effect.

Experiments made in Germany and here had exactly the same result, first success, later failure. In Germany it was made on a jasmine, in a flower pot, and the previously rather sick plant was in 1881 in good health and perfectly free of Aphides. Some currant shrubs on the left side of my house were entirely free through the whole year (without fall generation) after the experiment, though similar shrubs on the right side of my house were badly infested with currant worms; I had here purposely not applied yeast. After all I believe it can be concluded that a *certain stage* of the yeast solution is needed to make it effective, and that after this stage it becomes indifferent. That yeast solution has killed insects seems to be undoubtedly proved, and it remains only to find out the stage in which its application is successful. It is sure that success, even in a small number of experiments, cannot be annihilated by failure in other experiments.

THE CABBAGE BUTTERFLY, *Pieris Rapæ*, IN NEBRASKA.

By G. M. DODGE, GLENCOE, DODGE Co., NEB.

I am sorry to note the appearance of *P. rapæ* in Nebraska. August 3rd, 1881, I first saw a living specimen; needless to add that it was busily engaged in a cabbage patch. Others soon appeared, and before cold weather set in it had become quite abundant and larvæ in an advanced stage of growth were found in November. Probably the butterfly crossed the Missouri in the summer of 1880. We are here thirty-five miles west of the river, a distance that could hardly be traversed in one season. It also appears that the cabbage crop has been almost totally destroyed in the eastern part of Dodge County and farther east, while here a partial crop has been secured notwithstanding the visit of the imported pest, supplemented by an unusual abundance of the Cabbage Plusia. August 1st, 1873, when I left my former home in Bureau County, Illinois, *rapæ* had not yet reached that place; therefore in less than eight years its westward progress upon this parallel has taken it across the State of Iowa and the Mississippi and Missouri Rivers.

The question naturally arises—Will the insect stop short when he reaches the grassy plains of Western Nebraska, or will it press onward to the cabbage gardens of Utah and the Western slope? By the aid of man it might soon cross the plains, even if it subsisted wholly upon cabbages; but being not averse to other cruciferous plants, it will find its way made easy. A mustard-like plant of this family with pink flowers grows along the embankment of the Union Pacific Railway, nearly if not quite through-

out the whole of the State. The specific name of the cabbage fly and radish fly is not covered as prey in the preceding article in 1860, has been in tortuous channels two counties above some Anthomyia mining the leaves and figures, habits, and that puparia and flies been recently made American species (xiii) of the CAN. this family, below Mr. Meade finds, collections at Michigan—two believed to seem somewhat at the same time, surface. The description in my forthcoming

Among our leaf-miners. See the specific name of the cabbage fly and radish fly is not covered as prey in the preceding article in 1860, has been in tortuous channels two counties above some Anthomyia mining the leaves and figures, habits, and that puparia and flies been recently made American species (xiii) of the CAN. this family, below Mr. Meade finds, collections at Michigan—two believed to seem somewhat at the same time, surface. The description in my forthcoming

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On the evening of seven o'clock flies, from a foot in direction, a south of the majority of course they generate the rest again. obstacles.

The next day species very abundant home previously, newspapers, and here, had observed

* { *Eschima heros*, 1
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out the whole distance from Omaha to Ogden. At Ogden Junction it is the most abundant of wild plants. If this plant furnishes a suitable food, *P. rapæ* will have little difficulty in surmounting all obstacles that bar its progress toward the valley of the Salt Lake.

LEAF-MINING ANTHOMYIDÆ.

By J. A. LINTNER, ALBANY, N. Y.

Among our American species of Anthomyidæ, none have hitherto been known as leaf-miners. Several are depredators on the roots of garden vegetables, as indicated by the specific names of *Anthomyia ceparum*, *A. brassicæ* and *A. raphani* (the onion fly, cabbage fly and radish fly); some occur in excrements, and one, a few years ago, was discovered as preying upon the eggs of the Rocky Mountain locust. During last year and the preceding a species (*A. betæ*) which had been almost unknown since its publication in 1860, has been seriously damaging the leaves of beets in England, by mining them in tortuous channels and large blotches, causing them to shrivel, dry up and die. In two counties alone, 1,624 acres of mangolds were infested (Ormerod). This last summer some Anthomyiæ larvæ were discovered by me in Middleburgh, N. Y., extensively mining the leaves of the garden beet (*Beta vulgaris*). Judging from published descriptions and figures, I believed it to be identical with the European species of the same habits, and that it had been a recent importation thence. Examples of the eggs, larvæ, puparia and flies were sent by me to Mr. R. H. Meade, of Bradford, England, who has been recently making special study of the Anthomyiids, and particularly of the North American species, as may be seen in a paper in the March number of the last volume (xiii) of the CANADIAN ENTOMOLOGIST, giving the result of his study of the collections in this family, belonging to the Museum of Comparative Zoology at Cambridge, Mass. Mr. Meade finds, among the examples which I sent to him, reared by me from my larval collections at Middleburgh, no less than three distinct species—all differing from *A. betæ*—two believed to be undescribed—and one identified as *Chortophila floccosa* Macq. It seems somewhat remarkable that all these should have been obtained from larvæ feeding at the same time, upon a small garden bed of beets, containing about fifty square feet of surface. The description and general history of the new species will probably be given in my forthcoming Annual Report.

MIGRATION OF DRAGON-FLIES—*Aeschna heros** (Fabr).

By A. H. MUNDT, FAIRBURY, LIVINGSTON Co., ILL.

On the evening of August 13th, 1881, I observed them between the hours of five and seven o'clock. The air for miles around seemed literally alive with these dragon-flies, from a foot above ground to as far as the eye could reach, all flying in the same direction, a south-westerly course, and the few that would occasionally cross the track of the majority could all the more easily be noticed from the very regular and swift course they generally pursued; but even these few stray ones would soon fall in with the rest again. Very few were seen alighting, and all carefully avoided any movable obstacles.

The next day very few were seen on the prairies, and these mostly of another species very abundant in this country—*Anax junius* (Drury)—which were probably at home previously, and in a few days I could see none others but the latter. A few newspapers, and also a few correspondents from twelve to fifteen miles east and west of here, had observed and mentioned their flight. Although their course was precisely in

* { *Aeschna heros*, Fabr.
 { *Aeschna*.

that direction, Prof. Forbes, of the State Normal Museum, writes that "no observations had been made there regarding the migrating of this insect," and he kindly identified the last-named species for me; however both have been carefully looked up and identified as being separate, by other well informed Entomologists, all agreeing with me that the above names are correct.

Whether their migrating was instinctive, or forced by the Manitoba wave, then reported in Chicago papers as having arrived in that direction, after a spell of very warm weather; or caused by the dry season, the ponds having become so exhausted as to afford no pasturage for their larvæ, seems a matter of conjecture; most likely the latter, however, as the cold wave reached here but very slightly.

BOOK NOTICES.

THE HESSIAN FLY, its ravages, habits, enemies and means of preventing its increase, by A. S. Packard, jr., M.D.; being Bulletin No. 4 of the Department of the Interior, U. S. Entomological Commission, 8vo., pp. 48, illustrated by two plates containing many figures, one wood-cut and a map.

A synopsis of all that has been published in reference to this destructive insect, with such additional facts as the members of the Commission have been able to collect.

A TREATISE ON THE INSECTS INJURIOUS TO FRUIT AND FRUIT TREES IN CALIFORNIA. By Matthew Cooke, Chief Executive Horticultural Officer; 8vo., pp. 72.

This useful pamphlet treats of the Codlin Moth, which has now taken up its permanent residence in California, making apple and pear growing in some sections very uncertain; the Pear Slug, the Red Spider, the Tent Caterpillar, Currant Borer, and several species of Scale Insects which attack the apple, pear, peach, plum, orange, etc., illustrated by a number of wood-cuts. It appears that our California friends are now seriously affected by insect pests, from most of which they had until of late been free. The fruit interests of this State are so highly important that very active measures are being taken to keep these insect pests within bounds, and an Act has been passed by the State compelling the general adoption of such remedial measures as shall from time to time be found of value. We shall watch with interest the effect of such legislation, and sincerely hope that it may result in a marked abatement of the evils complained of.

BULLETIN No. 7 INSECTS INJURIOUS TO FOREST AND SHADE TREES. By A. S. Packard, jr., M.D. Issued by the Department of the Interior, U. S. Entomological Commission; 8vo., pp. 275, with 100 illustrations.

The object of this Bulletin, as stated in the introduction to it, is to give to the public a brief summary of what is up to this time known of the habits and appearance of such insects as are injurious to the more useful kinds of trees. Beginning with the insects injurious to the various species of Oak, the author treats of those which injure the Elm, Hickory, Butternut, Chestnut, Locust, Maple, Poplar, Linden, Birch, Beech, Tulip Tree, Horse Chestnut, Wild Cherry, Ash, Alder, Willow, Pine, Spruce, Balsam, Juniper, Tamarack, Arbor Vitæ, and others. A large proportion of the work is occupied with descriptions of those insects which injure the more important forest trees such as the Pine and Oak. This is a most useful synopsis of our knowledge in this department, and its issue will no doubt greatly stimulate the progress of Entomology in this practical direction, for while it shows that much has been done in some of the most important departments, in many others our knowledge is extremely scanty. This work is conveniently arranged, and like the other works of this distin-

guished author, who are interest insect foes.

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guished author, well written in a plain and popular style, and will commend itself to all who are interested in preserving our forests and useful shade trees from destruction by insect foes.

(A FRAGMENT OF A) GUIDE TO PRACTICAL WORK IN ELEMENTARY ENTOMOLOGY. An outline for the use of students in the Entomological Laboratory of Cornell University, by J. Henry Comstock; 8vo., pp. 35.

This work is divided into two chapters, the first of which treats of the terms denoting the position and direction of parts in insects, the second of the external anatomy of a grasshopper, *Caloptenus femur-rubrum*. A useful guide to all those entering on the study of Entomology.

TENTH REPORT OF THE STATE ENTOMOLOGIST OF THE NOXIOUS AND BENEFICIAL INSECTS OF THE STATE OF ILLINOIS. By Cyrus Thomas, Ph. D.; 8vo., pp. 244, illustrated with two plates and 79 wood cuts; containing articles on the army worm, *Leucania unipuncta*; a new Corn Insect, *Diabrotica longicornis*; the Relation of Meteorological Conditions to Insect Development; Descriptive Catalogue of Larvæ; the Larvæ of Butterflies and moths; and the Hessian Fly.

This Report contains much that is new in reference to these several subjects, and is a valuable contribution to Entomological literature.

A BIBLIOGRAPHY OF FOSSIL INSECTS. By Samuel H Scudder, 8vo., pp. 47.

A complete list up to the present time of all known works and papers on fossil insects arranged in alphabetical order.

SYNOPSIS OF THE CATOCALÆ OF ILLINOIS. By G. H. French, Carbondale, Ill.

Contains references to fifty-eight species, followed by instructions for capturing Catocalæ, 8vo., pp. 11, with one wood-cut.

REVISED CHECK LIST OF NORTH AMERICAN BIRDS, with a Dictionary of the Etymology, Orthography, and Orthoepy of the Scientific Names. By Dr. Elliot Coues; 1ge. 8vo. Estes & Lauriat, Boston.

Such a book from such a pen cannot fail to come into the hands of a great many Ornithologists, and the circulation of so valuable a work will greatly tend to render this much neglected part of the science more widely studied and understood. The first part of the book is devoted to notes and general explanations on Etymology, Orthography and Orthoepy. The second part contains the Revised Check List proper, and on the latter part of each page the names divided into syllables and marked for pronunciation and accentuation, with copious notes on the derivation. In regard to the nomenclature, the author has in many instances in this work taken a stand opposed to that of some eminent Ornithologists of the present day, which is much to be regretted in view of the desirability of uniformity in this matter. The printing is excellent, and done on fine heavy paper, and the proofs have evidently been most carefully read, altogether forming a very attractive volume and a valuable addition to the Ornithologist's library.

ON LUMINOUS INSECTS.*

BY GEO. H. BOWLES, MONTREAL.

Scattered here and there throughout the Organic world we find certain species possessing the remarkable power of giving light—not the light generally associated with the phenomena of combustion, but usually a mild phosphoric glowing or sometimes a succession of brilliant coloured flashes.

One of the most familiar instances of luminosity, is that which is due to the mycelium of fungus pervading decaying substances such as wood, peat or fermenting leaves.

The light is often seen at night in damp places in the woods and by the side of lanes. It usually proceeds from old roots or stumps, the substance of which, during the day, presents a whitish yellow appearance, but at night, throws forth a mellow, ghostly light, quite startling when first seen.

Besides the humble fungi, several plants in the higher groups are said to be luminous. The daughter of Linnæus in 1762 noticed radiations of light proceeding from a cluster of garden Nasturtiums (*Tropæolum Majus*). This appearance has also been observed in the Marigold, Poppy, and other plants as well as in certain mosses.

In the lower orders of the animal kingdom, luminosity is not uncommon. That beautiful phenomenon, a phosphorescent sea, is generally ascribed to the presence in the water of innumerable multitudes of microscopic beings termed *Rhizopoda*.† As we rise higher in the scale numbers of creatures are found endowed with this remarkable property,‡ and when the class *Insecta* is reached, we see species provided with a luminous preparation, which fully equals in proportion to size, the light given by our common modes of over-coming darkness.

It would be hardly right to overlook the Centipedes, though not true insects, as one species at least is capable of diffusing a very strong light. This species, *Scolopendra electrica*, is found in England, and is by no means uncommon. Though its light is seldom seen, in consequence of its living in holes, or under clods of earth. The light proceeds from the whole body, not being restricted to certain parts as in insects. Other species of this genus are said to be luminous. One described by Linnæus *S. phosphora* is a native of Asia.

Among the true insects the most familiar examples are our common Fire-flies, belonging to the family *Lampyridæ* Leach. These little creatures may be seen in great numbers on warm summer evenings, especially in marshy places. The perfect beetle is soft and flat, with a horny, semi-transparent shield projecting over the head. The light-producing organs are situated in the three last segments of the abdomen, and are of a light sulphur colour. Patches of this colour also extend on either side of the head beneath the over-hanging Thorax. When the insect is taken in the hand a constant gleam of light proceeds from the abdominal glands, whether it comes from the head too is questionable.

When on the wing the light is intermittent, flashing for a second and then being extinguished, appearing again shortly in another place as the insect flies.

The genus *Photinus* includes the greater number of our luminous species. The females are provided with wings unlike certain foreign *Lampyridæ*, and both sexes equally possess the power of giving light.

Phosphorescence has been noticed in the larvæ of several American Fire-flies. Specimens of *Photuris pennsylvanicus* (*DeGeer*) have been found to emit a brilliant light from their anal segments,§ and it is not unlikely that many, if not all, of those that

* A late article in the English *Mechanic* Vol. XXX, p 559, states that a fungus (*Asaricus Pleurotius emerici* u. c.) has been found in the Andaman Islands, the entire substance of which is luminous. The specimens were quite young and scarcely fully developed.

† One in particular, *Noctiluca Miliaris*.

‡ *Polypes, echinoderms, medusæ, &c.* Even the common earth worms are said to evolve a shining light.

§ *Canadian Entomologist*, Vol. I, p. 39, and Vol. II, p. 38.

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* General Zoology,
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possess the property in their perfect state have it, though, perhaps, in a less degree in their early stages.

The light-giving *Lampyridæ* are represented in Great Britain by the common English glow-worm *Lampyris Noctiluca*. This species has so often been described that its general characteristics are well known to every one. It is common in the south of England, but is rare in the northern parts, and Scotland. The perfect insect is herbivorous, feeding only upon the tender leaves of plants; but in the larval state they are voracious in their habits, devouring snails, slugs and soft-bodied insects.

It is slightly luminous in its preparatory stages. But the perfect female alone can be said to possess the property to any extent. Indeed it was formerly supposed to be peculiar to this sex, but the male has now been ascertained to give a feeble light.

Lampyris Italica,* though truly a continental species, is taken occasionally in England, both sexes being luminous.

Another *Coleopterous* family, the *Elateridæ*, contains species endowed with the property of light emitting in a much greater degree than *Lampyris*. The members of the genus *Pyrophorus* are natives of the South, and like all "Click-beetles," are dull sombre-looking creatures, of moderate size.

Pyrophorus noctilucus is a dark, rusty, brown beetle, about an inch and a half long. A native of the West Indies and Central America. Figure 16 represents this interesting insect both at rest and on the wing. The light chiefly proceeds from the transparent,



Fig. 16.

eye-like spots on either side of the thorax. A fainter light is also said to come when the insect is flying from two patches beneath the body, but according to Kirby and Spence this is incorrect. They say: "There is a luminous patch in the posterior and inferior region of the metathorax, in a somewhat triangular and depressed cavity, ordinarily concealed by the elytra, but when these are expanded in the act of flying, giving out a more considerable, but more diffused, light than the thoracic reservoirs; in fact, the whole body is full of light, which shines out between the abdominal segments when stretched, and being strongly reflected by the two basal abdominal segments, gives an

* General Zoology, Shaw, 1806, Vol. VI, part I, p. 77-78.

appearance of the two luminous patches there, which DeGear has described, but which do not actually exist.*

These elaters, we are told, are used by the natives of the tropic countries where they are found, as lamps, enabling them to perform their evening household duties by their light, as well as for purposes of decoration. Brazilian ladies, at the present day, fasten them in their hair as ornaments.

Many other luminous elaters are found all the way from the Southern States to Chili; but of their occurrence in the perfect state as far north as this, I have not been able to find any record—though in the early numbers of our journal, the *Entomologist*,† mention is made of the capture in Ontario of a luminous larvæ supposed to belong to the genus *Melonactes*. Unfortunately it was not reared to the imago, and the species to which it belonged is therefore in doubt.

Several other species of *Coleoptera* are thought to be luminous. *Buprestis ocellata*, is described as emitting light from the ocelli in its elytra; and one of the Longicorn beetles (*Dadoychus flavocinctus*) allied to *Saperda*, is supposed to have phosphorescent organs in the third and fourth segments of its abdomen.‡

Besides the *Coleoptera*, another insect order is said to contain luminous species. I mean the order *Hemiptera*. To one of its families, *Fulgoridæ* Leach, belong two insects that are stated to be in possession of luminous properties far exceeding those of the insects before described.

The best known of these insects, *Fulgora lanternaria*, was first described by Madame Merian in her work on the "Insects of Surinam." She states positively that she herself saw numbers of these lantern-flies§ shining at night with great brilliancy, and that the light proceeding from one of them was sufficient to easily read a newspaper by.

The accuracy of this statement has been questioned by many writers. An experienced Entomologist, who resided for a number of years in Surinam, denies that the insect gives any light whatever, while some of the residents declare that it does,|| and others again that it does not. Kirby and Spence think that "these contradictory statements may be reconciled by supposing that one of the sexes is luminous and the other is not."¶

It is not unlikely that the luminosity may be merely occasional, perhaps being limited to particular seasons or the time of pairing. At any rate the subject requires further investigation before a decisive verdict can be given either way.

The other species is a native of China, and is called the candle-fly (*Fulgora candelaria*). Of its luminosity there is still greater doubt than of that of the American species. By some it is supposed to be the insect collected by a species of "ploceus or weaver bird to decorate its nest, to which they are attached by means of clay, whether for the purpose of food or light remains to be proved."**

Other insects, besides those already enumerated, have been stated by various writers to be luminous. Kirby and Spence mention the case of a country-man pursuing a "Jack o' lantern," which being captured turned out to be a mole-cricket (*Gryllotalpa vulgaris*, Latr.), †† and in another instance a farmer describes a luminous object which he knocked down as being exactly like a "Maggy long-legs" (*Tipula Oleracæ*). ‡‡

* Kirby and Spence—"Introduction to Entomology," London Ed., p. 540.

† *Canadian Entomologist*, vol. 1, p. 2 (a full description is given). Also see Annual Report of Entomological Society of Ontario for 1872, p. 74. A luminous larvæ is mentioned by Baron Osten Sacken as being taken at West Point, N. Y.—described and figured Proceedings Entomological Society, Philadelphia, 1862, p. 125, Pl. 1, fig. 8.

‡ Kirby and Spence—p. 542.

§ *F. lanternaria* is called by the Dutch "scare-sleep," from the noise it makes towards evening. It is also called "porte-lanterne," or "lantern-bearer."

|| It affords "sufficient light for almost any purpose"—See "Narrative of a Five Years' Expedition Against the Revolted Negroes of Surinam," Capt. J. G. Stedman, vol. 2, p. 37.

¶ Kirby and Spence—p. 543.

** "Nat. His. of Insects." New York: Harper Bros., 1840—p. 130.

†† Kirby and Spence—p. 544. ‡‡ *Ibid.*—p. 546.

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This would lead us to suppose that other common and well-known insects may be found to possess the property on investigation.

Kirby and Spence suggest that in some cases phosphorescence may be caused by disease, more particularly applicable to *Noctiluca*, is that it serves to direct the male insect to the abode of its wingless mate.

With regard to the use of the light to its possessor opinions are divergent. In the case of the *Elateridae*, one theory is that it may serve to defend them from their enemies by alarming them,* and this may not be far from the truth, as an animal would require a great deal of pluck to swallow one of these specks of living flame.

Its purpose in the lantern-flies it would be rash to conjecture until the fact of their luminosity is fully proven.

Even of its use in the *Lampyridae* little is known. The most satisfactory explanation, more particularly applicable to *Noctiluca*, is that it serves to direct the male insect to the abode of its wingless mate.

But with our American species this explanation hardly holds good, as both sexes can fly, besides being equally luminous.

I have seen it stated † that the *Lampyridae* are distasteful to many insectivora. May not the light then serve as the brilliant colours of some caterpillars are supposed to do, as a warning of their offensiveness to creatures that would devour them? thus deterring the insect eater from swallowing an unpalatable morsel, and at the same time protecting these soft-winged beetles better than the shelly armour of most other members of their order.

The light in the *Lampyridae* and *Elateridae* has been ascertained to proceed from a soft, yellow substance, thickly permeated with air tubes, which is closely applied to the transparent parts of the body through which it is seen.

In the glow-worm, besides this substance, there are two small oval sacs, formed of a fibre wound spirally, as in the tracheae, which contain a yellowish matter capable of affording a more powerful and permanent light than that of the adjoining parts.

Until lately the cause of insect luminosity was supposed to be the combination of some phosphoric matter in combination with the oxygen inspired by the animal. But latterly investigators have ascribed it to physical rather than chemical action, and it is now thought to be explained by the vibratory or undulatory theory of light. Rapid molecular vibrations, set up by the action of light-waves in the particles of a phosphorescent body, are supposed to be communicated to the theoretical ether which is thought to fill all space. The principle being that these vibrations produce light as the vibrations of air generate sound.

To enter more fully into this question is not in the scope of the present paper, nor is it, strictly speaking, in the domain of the Entomologist, still the subject is one that may profitably occupy our leisure moments during the coming summer, and those of our members who possess powerful microscopes may do good service by examining the phosphorescent organs of insects and giving us the result of their investigations. The field is almost unexplored, and as yet we have to confess our ignorance of the causes which produce many of the phenomena that I have but touched upon.

* Kirby and Spence—p. 549.

† I think by Mr. A. R. Wallace, in *The Contemporary Review*.

HOUSE-FLIES.

W. HAGUE HARRINGTON, OTTAWA.

It will be necessary to define what a fly is, for the name is very commonly applied to many insects which belong to very different orders. We have, for instance, saw-flies, butter-flies, fire-flies, dragon-flies, and shad-flies, belonging respectively to the *Hymenoptera*, *Lepidoptera*, *Coleoptera*, *Neuroptera*. All of these have four wings, in common with the majority of insects; whereas the true flies have only two and constitute the order of *Diptera*, which name is formed from the Greek words *dis*, twice, and *pteron*, a wing. Although the order is not generally a favourite one with Entomologists, its study will reveal a great many curious and important facts in connection with insect life. Its members are not so handsome nor as large as those of the *Lepidoptera* and *Coleoptera*, nor do they construct complex dwellings like the *Hymenoptera*, yet their larvæ are found living under the most varied and wonderful conditions, and not unfrequently greatly affecting man's welfare, as do often also the perfect insects.

All insects (by the classification used in this country) are divided into seven orders according to the character of the wings, and these orders are again arranged in two series—one having mouth-parts adapted for biting and masticating their food, the second having the analogous parts modified to form a sucking apparatus. The *Diptera* belong to the latter.

It has been estimated that there are about 10,000 species of flies indigenous to North America, of which not more than one-fourth have been described, so that plenty of material yet remains for investigation, and doubtless many new species would reward an industrious collector in any section of Canada.

No other insects, perhaps, occur in such profusion as do flies. As soon as the first mild days arrive, clouds of small gnat-like forms appear, and as the season progresses new species are continually emerging. At times the air seems literally full of these minute beings, which swarm alike in woods or over fields and waters, very frequently making their presence felt as well as seen.

In the larval state they occupy a very important place in the economy of nature, and while some species—such as the hessian-fly and wheat-midge—are most inimical to man's interests, the majority subsist by destroying substances which otherwise might remain to infect and contaminate the air. The aquatic species—such as the black-flies—live principally on decaying vegetable or animal matter in the water, while the greater number of terrestrial forms subsist upon similar substances, which they rapidly consume.

So rapidly does this consumption proceed that Linnæus, referring to the flesh-flies, stated that three of them with their progeny could eat up a dead horse as quickly as a lion could.

Notwithstanding that house-flies abound everywhere, or at least where man has his habitation, comparatively few persons know the most simple facts concerning their life-history and transformations. Even among Entomologists there is much of vagueness in regard to these matters, owing partly to few having fully investigated the habits of the house-fly, and partly to its being often confounded with allied species. There appeared last year, in a popular magazine, an article taken from "Science Gossip," and professing to treat of the development of *Musca domestica*—as the house-fly is named by Entomologists—in which it was stated that the larvæ were reared in meat upon which the fly had deposited its eggs. This shows at once that the description was really that of the development of one of the meat-flies; for, so far as I am aware, the house-fly has never been known to deposit its eggs upon meat.

The house-fly of this country is now known to be identical with that of Europe, although the late Dr. Harris described it under the name of *Musca harpyia*. Even in Europe but little attention has been given to its habits since its name was bestowed upon it by Linnæus.

Packard, whose life-history was given described the var is his description

"In consideration appear in the month discovered their life years, and then in of July and August Reamur in the year to hatch some ch flies, which having dance of larvæ was in a sand-box had had made cocoon flies, such as those manure, but only is in a complete form which I hatched dry manure nor is

The second volume contained excellent Bonché, appeared Insects") were described Keller's work, was published, but I have (published in 1858 which reproduces shows us that the illustrations of various tions drawn by the

As recently a American naturalist and described its life Society of Natural figures, and to it I

Every one has and investigations there accumulate they reared them successfully Packard was that fresh horse manure number of about 100 more pointed at the inch long and 1/16 of an inch wide meat-fly which we that the earlier em having transparent in 24 hours, and that of all flies are called too big for his jacket is slenderer than in hours, when another and attains a length bearing minute, two probably representing

Packard, writing in 1873, stated that there were only three works in which its life-history was given. The first was published by DeGeer, in 1776, and satisfactorily described the various stages, but did not give the time occupied by each. The following is his description of the manner in which he discovered the habitat of the larvæ:—

"In considering the enormous abundance of these domestic flies, which especially appear in the months of July and August, it is astonishing that no person has hitherto discovered their larvæ. I searched uselessly for them myself everywhere during several years, and then it was only chance that caused me to discover them in the same months of July and August of the year 1750, when having, according to the instructions M. de Reamur in the 'Art of Hatching Domestic Birds,' made one day a heap of horse manure to hatch some chickens, I saw flying upon and all around it a great number of these flies, which having aroused in me the curiosity to stir up the heap, I found in it abundance of larvæ with the head of a variable form; and having enclosed several of them in a sand-box half filled from this same dung-heap, I observed that some days after they had made cocoons of their own skin, from which came out afterwards true domestic flies, such as those which I have just described. The larvæ of this species live then in manure, but only in that which is very warm and moist, or to say it better, that which is in a complete fermentation, as was that which immediately surrounded the cask in which I hatched successfully some hen's eggs; at least I have never met with them in dry manure nor in the earth."

The second work was published several years later by a German named Keller, and contained excellent figures of the larvæ and pupæ. The third, also by a German named Bonché, appeared in 1834, but the figures in it (copied in the "Guide to the Study of Insects") were drawn so poorly as to be unrecognizable. Packard, not having seen Keller's work, was of impression that the poor figures of Bonché were the only ones published, but I have before me a little book, entitled the "Earthworm and House-fly" (published in 1858 by James Samuelson, assisted by J. Braxton Hicks, M.D., F.L.S., etc.), which reproduces Keller's figures from a copy of his work in the British Museum, and shows us that they were excellent ones. There are also some very fine microscopic illustrations of various parts and organs of the house-fly in the little treatise just mentioned drawn by the author.

As recently as 1873 the transformations of the house-fly had not been given by any American naturalist; but in the autumn of that year Packard worked out its life-history, and described its different stages in a paper published in the Proceedings of the Boston Society of Natural History. This paper was accompanied by a large plate of excellent figures, and to it I am indebted for many of my facts.

Every one has noticed that flies are particularly numerous in the vicinity of stables, and investigations have proved that it is in the decomposing vegetable matters which there accumulate that the eggs of the fly are deposited and that the larvæ live. Keller reared them successfully in a jar of moist decomposing wheat, but the material used by Packard was that which furnishes the majority of flies with a breeding place, viz., fresh horse manure. In the crevices of this substance the fly deposits her eggs to the number of about 120. These eggs are elongate, oval cylindrical; a little smaller and more pointed at the anterior than at the posterior end. Each is from $\frac{1}{100}$ to $\frac{1}{80}$ of an inch long and $\frac{1}{100}$ of an inch in diameter, being slightly smaller than the egg of the meat-fly which we see attached to meat. In colour it is a chalky white, and opaque, so that the earlier embryonic changes cannot be observed, as in the case of many insects having transparent eggs. With suitable conditions of heat and moisture the egg hatches in 24 hours, and there slips out an active, semi-transparent little maggot (as the larvæ of all flies are called) $\frac{1}{70}$ of an inch in length. About 24 hours later the larva, grown too big for his jacket, casts it aside, and now measures from $\frac{1}{100}$ to $\frac{1}{70}$ of an inch, and is slenderer than during the preceding stage. This second stage lasts from 24 to 36 hours, when another moult takes place, after which the larva lives three or four days and attains a length of from $\frac{1}{4}$ to $\frac{1}{3}$ of an inch. The larva has a small conical head, bearing minute, two-jointed antennæ, and below them three small fleshy tubercles—probably representing or foreshadowing some of the future mouth-parts, of which there

are now only a pair of black, horny mandibles. The segment immediately behind the head, known as the prothoracic segment, bears a spiracle, or breathing orifice, and others are situated in the anal, or posterior segment.

When the larva is full grown its body contracts and changes in shape, becoming what is known as a *puparium*. That is, the larva does not spin a cocoon in which to pupate, but uses for this purpose its own skin, which becomes detached and hardened, and within which the pupa forms and remains for from 5 to 7 days. This puparium is of the shape of a grain of rice, from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long, and of a dark reddish-brown colour.

At the end of the time just mentioned the insect frees itself from the pupa-skin and pushes its way out of its case, the anterior end of which splits off at the junction of the thorax and abdomen, and falls back like the lid of a box. On emerging from his band-box the fly, however, not yet ready to set out on his tour of visits and explorations; his clothes do not fit him comfortably, nor is he yet the trim, natty little chap that we are familiar with. His wings are soft, small and baggy, barely reaching to his waist, and pressed against his sides. He is also pale, indeed nearly white, with perhaps a slightly jaundiced appearance, due to his underground life and recent close confinement in a dark cell. But he walks or runs rapidly about, respiring quickly and strongly, and in an hour or so his wings expand and stiffen, the proper colours develop, and blithe and agile he leaves his lowly birth-place in search of adventures.

Before describing the fly in this final and perfect state, I will recapitulate its life-history as already given.

The eggs laid are about 120 in number, and in about twenty-four hours the larvae are hatched. There are three stages of the larval state, and consequently two moults. The first stage lasts about one day. The second stage lasts about one day. The third stage lasts three or four days. The entire larval state lasts from five to seven days. The pupal state lasts from five to seven days. The period from the time of hatching to the exclusion of the fly lasts from ten to fourteen days in warm weather.—(Packard).

We thus see that from the time the egg is deposited until the fly arrives at maturity only about a fortnight elapses; and when we consider that the fly, unlike many insects, does not die immediately after depositing her eggs, but survives to perform that operation, perhaps, twice or thrice again, it will not be difficult to account for the rapid manner in which the swarms increase toward the autumn. It was calculated by Keller that if a fly deposited eighty eggs, and that only half of these produced females, she might in one season be the progenitrix of upwards of *two millions*. Other authors have arrived at a much larger number as the possible offspring in one season, but the smaller one will suffice to show how rapidly they are capable of increasing.

Although the common house-fly is so abundant, it so closely resembles allied species that it is very difficult to distinguish it from some of them. The structural differences by which entomologists recognize it are those of the mouth-parts, and venation of the wings.

The following is its description as taken from Packard:—

“The body of *M. domestica* is black; the head has a longitudinal, reddish, oval, smooth area on the vertex, with the orbits and adjacent regions golden (or silvery in some lights); the hairs are black, and the antennæ and plume are black; the thorax is black, tinged with golden grey on the sides, with three dorsal, grey, longitudinal bands, the middle one most distinct, the two lateral ones partially interrupted in the middle and continued on to the scutellum; there is a broad, lateral, golden-grey band interrupted by the sutures; the base of the first abdominal segment has a yellowish band interrupted in the middle; on the middle of the end of the two succeeding segments is a triangular, mesial, golden spot, with an oblique, irregular band on each side, and farther down the sides golden; terminal segments golden; base of wings, scales, and halteres yellowish-white; legs black. The male differs from the female in the front between the eyes, being about one-third as wide as in the latter, while she is rather the smaller. Length, .22 to .32 inch.”

This description, if borne in mind, will assuredly enable you without difficulty to

detect the culprit person.

The body of and Abdomen.

The head bears 4,000 hexagonal facets from the adjacent There are also three of the head, between the fly sees in air escapes an untimed short, being completely dilated and much plume. When the cis, so as to be near

The mouth parts ing structures of the gnawing mandible sucking up liquids parts, such as the The maxilla and mandibles are of ligament, which is bent tongue, or labium, parent membrane, disk. This expansion supported upon a ing a sucker-like su modified tracheæ with hairs, and they give by the fly in scraping means that it teases the perspiration as fly also tastes and s he seems also to a and searches thence to him.

The proboscis shown by Dr. Thon A. S.), on the “Head of a common minute snake-like ar of an inch in length ination proved the s taking up spores of mals themselves; t

These facts suggest whether flies might tion practically, he quantity of the spor

“The flies at first morning of the third of the common house and the following Monday following day I placed tion of spores, comb sugar and most of th

detect the culprit when he pilfers from your sugar bowl, or commits an assault upon your person.

The body of the fly consists of three sections, named respectively the Head, Thorax and Abdomen.

The head bears a pair of large, semicircular compound eyes, each having about 4,000 hexagonal facets, each of which lenses corresponds to a single eye, being isolated from the adjacent ones by a dark pigment, and being connected with the optic nerve. There are also three simple eyes or ocelli, arranged in the form of a triangle upon the top of the head, between the compound eyes. Thus liberally endowed with organs of sight, the fly sees in almost every direction without change of position, and by their aid often escapes an untimely end. From the front of the head spring the antennæ, which are short, being composed apparently of only three joints, but really of six: the third is dilated and much larger than the others, while the fourth, fifth and sixth form a kind of plume. When the insect is at rest the antennæ are folded down at the base of the proboscis, so as to be nearly hidden from sight.

The mouth parts are, however the most curious and interesting structures of the head, being modified from the biting or gnawing mandibles of the larva into an organ capable only of sucking up liquids. (See fig. 55). In this proboscis the hard parts, such as the lancets of other flies, are almost obsolete. The maxilla and single-jointed palpi are small, and the short mandibles are of little use, leaving only a fleshy, tongue-like organ, which is bent up under the head when not in use. This tongue, or labium, consists of a tubular bag, formed of thin, transparent membrane, dilated at its extremity into a large sucking disk. This expansion is divided into two broad muscular leaves, supported upon a frame-work of modified trachæ, and presenting a sucker-like surface, with which liquids are lapped up. The modified trachæ which sustains the expanded sucking-disk end externally in projecting hairs, and they give to the fleshy disc the properties of a minute rasp, which is employed by the fly in scraping or tearing delicate surfaces. As Newport states:—"It is by this means that it teases us in the heat of summer when it alights on the hand or face, to sip the perspiration as it exudes from and is condensed upon the skin." With this organ the fly also tastes and sips the delicacies of our tables, for, with the maggots grovelling form, he seems also to a great extent to abandon the lowly and depraved tastes of his youth, and searches thenceforth for sweets and dainties, the pursuit of which often proves fatal to him.

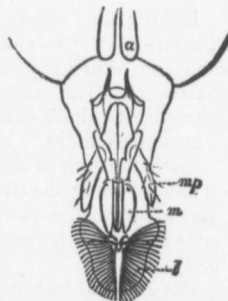


Fig. 55.

The proboscis of the fly is also fitted for other and more dangerous services, as shown by Dr. Thomas Taylor in a paper, (read before the Montreal Meeting of the A. A. S.), on the "House-fly as a Carrier of Contagion." While engaged in dissecting the head of a common house-fly, he noticed emerging from the ruptured proboscis a very minute snake-like animal—a species of anguillula—measuring about eight one hundredths of an inch in length by two one thousandths of an inch in diameter. Subsequent examination proved the sucking-tube of the proboscis to be of sufficient diameter to admit of taking up spores of cryptogams, eggs of trichinæ and anguillulæ, or even the latter animals themselves; thirteen of these having been found in the proboscis of a single fly.

These facts suggested to Dr. Taylor the importance of ascertaining, by experiments, whether flies might not be carriers and distributors of noxious germs. To test the question practically, he placed in a large glass receiver several hundred house-flies and a quantity of the spores of the red rusts of grasses, (*Tricholoma*) with the following results:

"The flies at first did not seem to esteem the spores as suitable food, but, on the morning of the third day I found that the rust was replaced by larvæ and remains of eggs of the common house fly. The eggs were deposited and hatched between Saturday noon and the following Monday morning, 9 o'clock, or in about forty-eight hours. On the following day I placed in the receiver about a quarter of an ounce of the same description of spores, combined with sugar. The flies partook of this confection, consuming the sugar and most of the spores. In about twenty-four hours after the flies had partaken of

this mixture I killed and dissected a number of them, and found the small intestines intensely coloured, of a deep reddish orange shade, representing the digested spores of the tricholoma. I observed in the contents a few well defined orange spores, but none of them appeared to have germinated. Fastened between the hairs on the limbs of each of the flies examined I found a number of the spores, and the efforts of the fly to get rid of them only resulted in attaching them more firmly to it. They might, however, be brushed off by objects with which they were brought in contact, while their germinating powers would long outlast the life of the insect itself. It was evident from this experiment that flies were capable of conveying such spores to plants and other bodies. On the other hand, the fact that by far the greater part of the spores were consumed, in the one case by the larvæ of the fly, and in the other (*i.e.* when mixed with sugar), by the fly itself, shows that this insect may destroy microscopic germs as well as disseminate them, and indicates that in some cases its agency in keeping down their number may more than counterbalance its action in contributing to their dissemination."

Having thus briefly and imperfectly considered the organs of the head, we find, on examining the second section of the body—the Thorax—that it bears the organs of locomotion, which consist of three pairs of legs, a pair of wings, and a pair of halteres or balancers. The most important of these are the wings, which are not large, when compared with those of many other insects, yet suffice to enable the fly to sustain a swift and prolonged flight.

The vibrations of the wings during flight are exceedingly rapid,—about 330 strokes each second being the usual rate, when the insect is flying swiftly. Thus the fly is able to dart about with a swiftness surprising in so small a body, and which, if possessed by a horse in ratio to its magnitude, would enable it to traverse the earth with inconceivable velocity.

The *halteres, balancers or poisers*, as they are indifferently called, are two small club-shaped organs, which occupy the position of the second pair of wings in insects of other orders, and which may be considered as merely modified or rudimentary wings. They are kept in a constant vibration during the insect's flight, which they serve to regulate, as has been proved by experiments. The possession of these little organs enables the diptera to change the direction of their flight far more quickly than other insects, as may be seen by watching the erratic movements of flies hovering in the air. These balancers are more easily seen in some of the larger species, such as the *tipula* or daddy-longlegs, which sometimes enters our houses from the neighbouring fields. In the house-fly, as in many species, they are partially hidden beneath a pair of protecting horny scales, which project from the sides of the thorax.

The legs are divided into five parts, or joints; first, the *coxa* or hip, by which the leg is articulated to the body, then a short, round joint called the *trochanter*, next the *femur* or thigh, then the *tibia*, and lastly the *tarsus* or foot. This latter merits particular attention, on account of its peculiar powers. It is subdivided into five joints, the last of which bears the apparatus which permits a fly to crawl so easily on the most perfectly polished surfaces, even when it is beneath them. On examining the last joint, that bearing the claws, it is found to be expanded into two large *pulvilli* or pads, thickly set with minute hairs or filaments, each of which terminates in a small fleshy bulb, kept moist by a viscid exudation. Although very minute, they are so numerous that the foot adheres firmly enough to sustain the fly in his pedestrian excursions overhead.

The abdomen, or remaining section of the body, presents no external appendages for present consideration, so that we will turn for a moment or two to the internal structure of the fly, merely to mention the principal features. Directly under the dorsal surface or back of the insect is attached the dorsal vessel, or heart, a tubular vessel, running the full length of the abdomen and being constricted as it enters the thorax. This tube is situated in a cavity in which the blood collects on completing the circulation of the body, and is furnished with valvular orifices, which permit of the returned blood entering the heart, but which permit none to escape therefrom. The heart is also constricted at several points, and divided into a series of chambers, separated by valves, through which the blood is continually forced forward from one chamber to another, and finally dis-

tributed to the extr (there being no spe

Below the head which may be divid^{ed} intestine; each havin^g isfactorily describe

Under this, al^{so} ever, on entering th^{at} together above it, e^{ach} distributed to the di^{fferent} ganglion, supplying ganglia are found fr

The respiratory ment from the anal and nervous system minute breathing or solid particles by an circumference. Th^{at} from which it is con^{stituted} organs of the body. forces its way betweⁿ capacious air-sacs or two much smaller o

The foregoing iⁿ fly, of which the m^{ost} state, the more are^{ly} of life.

A much disput^{ed} and ability to bite pe^{ople} would answer in the been so bitten. Fro^m mandibles, it hardly of the little book alr^{eady} amination and descr^{ibes} bles, "are employe^d are the weapons tha^t thus assails us, espec^{ially} species, although it s^{ome} familiar with these iⁿ its long horny beak, sliding in a groove, are small and incon^{spicuous} slight, but perceptibl^e held by the insect.

One naturally a^{ssumes} fined to them, but ex^{ists} universally distribute^d In the May number^s West, showing that^{hese} pitched tents would s^{uffer} *M. domestica*. As th^{ese} are sometimes destro

"While camping^g flies seemed about to faces of the roofs and multitudes of diptero^{ids} alarm of the women

tributed to the extremities of the body, from which it returns through irregular channels (there being no special vessels for its conveyance), to the dorsal cavity.

Below the heart and occupying the median line of the body is the alimentary canal which may be divided into four parts:—the gullet, the crop, the stomach, and the intestine; each having a special structure and appendages, which it is not possible to satisfactorily describe here.

Under this, along the floor of the body is located the nervous column, which, however, on entering the head splits into two branches which embrace the gullet, and knit together above it, expanding into a bilobed ganglion, or *brain*, from which nerves are distributed to the different organs of the head. In the thorax is situated another large ganglion, supplying the appendages of that segment, while in the abdomen smaller ganglia are found from which ramifications extend in every direction.

The respiratory system is also a complicated one, and differs more in its arrangement from the analogous organs of higher animals, than do the circulatory, nutritive and nervous systems. Along the under surface of the body are placed several pairs of minute breathing orifices, called *stigmata* or spiracles, protected from the intrusion of solid particles by an intricate network of five ramifying filaments proceeding from the circumference. Through these spiracles the air enters into lateral trachæ or air tubes, from which it is conveyed by smaller branches which ramify to all parts, and to all organs of the body. By means of these minute air-vessels the blood is oxygenized as it forces its way between them in returning to the dorsal cavity. The fly has also two capacious air-sacs or pouches in the base of the abdomen, and according to some authors, two much smaller ones in the front of the head.

The foregoing is but a meagre outline of the structure and organs of the house-fly, of which the more closely we study its anatomy, either in the larval or perfect state, the more are we struck by the admirable adaptation of its structure to its mode of life.

A much disputed point in connection with the house-fly is whether it has the habit and ability to bite persons, as some other flies do. Perhaps the great majority of people would answer in the affirmative, and conscientiously attest that they had themselves been so bitten. From the formation of the fly's proboscis, with its feebly developed mandibles, it hardly seems probable that the skin could be punctured. Yet the authors of the little book already mentioned (*Earth-worm and House-fly*) after microscopic examination and description state that the lancets, representing the maxillæ and mandibles, "are employed to puncture the objects from which the fly sucks the juices," and are the weapons that annoy us. However this may be, it appears that the culprit who thus assails us, especially during showery weather and late in the season is a distinct species, although it so closely resembles *M. domestica* as to deceive all but entomologists familiar with these insects. Its name is *Stomoxys Calcitrans*, and it is distinguished by its long horny beak, which, as pointed out by De Geer, has a long and very sharp lancet sliding in a groove, while the fleshy sucking discs at the extremity of the proboscis are small and inconspicuous as compared with those of the house-fly. There is also a slight, but perceptible difference in the wings, and in the position in which they are held by the insect.

One naturally associates the house-fly with the habitations of man, but it is not confined to them, but extends its range over the whole country, and may be found almost universally distributed, and prepared to welcome the first human visitor to any locality. In the May number of "Psyche" appeared a short article by a Collector in the far West, showing that even in the secluded cañons of the Rocky Mountains the newly pitched tents would soon become disagreeably filled with flies, chiefly and unmistakably *M. domestica*. As the article gives an interesting account of the manner in which flies are sometimes destroyed by wasps, I will quote a portion of it.

"While camping in Santa Fé Cañon, N. Mexico, in August, 1880, this plague of flies seemed about to be unusually formidable. On the very first night the lower surfaces of the roofs and ridge-poles of the tents were fairly blackened by the immense multitudes of dipterous pests. The next morning it was observed, somewhat to the alarm of the women and children of the party, that large numbers of so-called yellow-

jackets (*Vespa occidentalis*, Cr.) were entering the tents. For some time it was supposed that the object of the new-comers was to forage for sugar and other camp supplies. But before night it was noticed that the numbers of flies in the tents had been perceptibly reduced, and on the second morning it was discovered that the wasps were intent on the acceptable task of removing our troublesome guests. There were generally as many as forty or fifty wasps in each tent at once, and each wasp was observed on leaving the tent to be carrying out the body of a fly, not for burial, nor as food for its captors, but for storage in the nests of the wasps, and undoubtedly as food for their young. Each captured fly, before removal from the tents, was deprived of its wings and legs, and on several mornings we were awakened from our slumbers by these severed members dropping upon our faces. The wasps were unremitting in their labors from daylight to dusk, and in four or five days the flies had ceased to be troublesome by their numbers, the wasps having gained upon them almost as rapidly as they entered the tents. Occasionally a specimen of *Vespa maculata* (Linn.) was observed co-operating with *V. occidentalis*, Cr., in the removal of the flies."

Although flies are able to live for several months, but a small percentage of them survive to die of pure old age. Dangers imperil their existence at every stage; a great proportion of the eggs, pupæ and larvæ are devoured by other insects, birds and fowls, or destroyed by floods and droughts; while such as reach maturity find spiders, birds, poisons, traps and deadly enemies on every side, to thin their ranks, so that of all the mighty armies of Summer, barely a corporal's guard survives until the Winter. Late in the autumn the stragglers are seen, dingy and dragged, feebly crawling about the walls, and all unlike the trim, active insects that danced on tireless wing in the summer sunbeams. Some even manage to survive the winter, by hibernating in crevices, and come forth on the approach of spring, looking still more worn and decrepit, to continue the race.

One enemy which attacks them in their old age must be specially mentioned, as its effects often arouse some curiosity in those who observe them. In the autumn many dead bodies of flies, still in the attitudes of life, are seen adhering to the mirrors, curtains and other articles in our rooms. On closer inspection a small cloudy spot will be seen to surround each, and the abdomen to be much distended, with broad whitish zones separating the segments.

A touch of the finger makes the body crumble into dust; the whole of its contents having been consumed by the fungus which is the cause of these appearances. This "fungus is a species of the genus *Seprolegnia*, formerly called *Sporondonema*, *Empusa*, or *Achlya*. It consists of short jointed threads, two or five millimeters long, growing from the bodies of flies usually in autumn. These threads enlarge in the outer end or last joint, which becomes filled with swarm spores, that, as soon as mature, burst their envelope, move about for a few hours, then come to rest, generally near the parent filament, and immediately begin to grow.

The reason that the fly remains standing where he dies is that, as the fungus consumes his internal organs, he becomes too enfeebled to overcome the adhesion of his feet to his last resting place, and the viscid exudation from the filaments of the pulvilli harden and cement them so firmly to the spot, that even after death "the fly sticks to the wall."

It has been estimated that the whole population and habits of this large race to mankind.

In the recognized state only two winged species. And we pursue the common member termed.

The same author estimates 24,000. Prof. Paclt estimates 2,500 species of North American living North American known species below.

According to the constitute one of the respect to numbers of species; and which from the earliest age since few species exist majority of them are formations of many many cases to the many of them reveal ated attacks of their and indirectly upon

Flies can at once wings; these are true have two little projections "balancers." These by the hind wings, a much difference of of balancers; some thin to the respiratory organ the flight of the insect.

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The head of a fly neck; the eyes are enlarged in some species take

The larvæ of flies worm-like shape; accentuated head; but in the are often headless, and

The metamorphosis. Like that of the other parts being free as it goes its change within forms a firm protective

DIPTERA. — TWO-WINGED FLIES.

BY EDMUND BAYNES-REED, LONDON, ONT.

It has been estimated by competent authority that the insects comprise about four-fifths of the whole animal kingdom ; it is therefore natural that the history of the lives and habits of this large portion of animated nature should be of vast interest and importance to mankind.

In the recognized scientific classification of insects those possessing in the perfect state only two wings are known as *Diptera*, from two Greek words, *dis*, two, and *pteron*, wing. And we purpose in this paper to give a brief outline of the history of some of the common members of this great family of *Diptera*—or flies, as they are more usually termed.

The same authority quoted above estimates the number of species of *Diptera* at 24,000. Prof. Packard, in his Guide to the Study of Insects, states, "There are about 2,500 species of North American flies described, and it is probable that the number of living North American species amounts to 10,000. In Europe there are also about 10,000 known species belonging to about 680 genera.

According to the distinguished Entomologist, Westwood, "The two-winged insects constitute one of the most extensive orders of the *Ptilota* (winged insects), not only in respect to numbers of *distinct species*, but also to the swarms of individuals of the *same species*; and which from their constant attendance upon man have attracted his attention from the earliest ages. It is not, however, from their size that this has been the case—since few species exceed an inch in length—nor is it on account of their beauty, for the majority of them are of dull colours; their forms, too, are rarely elegant, and the transformations of many are unknown. They owe their notoriety, if we may so speak, in many cases to the disgusting habits and appearances of their preparatory state—where many of them revel in filth of every description—and to the annoyances caused by the reiterated attacks of their numberless tribes in the perfect state, both directly upon ourselves, and indirectly upon our living and dead property of almost every kind."

Flies can at once be easily recognized from other insects by their having only two wings; these are transparent. Instead of the hind wings common to other insects flies have two little projecting appendages, which have received the name of "halteres," or "balancers." These characteristic organs may be observed in the place usually occupied by the hind wings, and are kept by the insect in nearly constant vibration. There is much difference of opinion among Entomologists as to the special functions or uses of these balancers; some thinking they are organs of hearing, others believing they are appendages to the respiratory organs, and some being of opinion that they serve simply to regulate the flight of the insect.

Flies are suctorial insects, and, quoting again from Westwood, "their mouth is formed only for imbibing fluid matter; when, therefore, such fluid is enclosed in peculiar vessels, the internal pieces of the sucker are employed as lancets to pierce the envelope, and afford a passage to the fluid, which ascends by power of suction, produced by the fleshy lips of the insect into the mouth."

The head of a fly is very distinct, and is attached to the body by a very slender neck; the eyes are exceedingly large, with numerous facets; and those of the male fly in some species take up nearly the whole of the head.

The larvæ of flies are footless, fleshy grubs, of a whitish colour, and a cylindrical, worm-like shape; according to Packard, in some of the higher families they have a distinct head; but in the family of *Muscidae*, to which the common house-fly belongs, they are often headless, and are then called maggots.

The metamorphosis, or change into the pupal state, is most complete in all the *Diptera*. Like that of the *Hymenoptera*, the enclosure consists of a thin, transparent covering, the parts being free and easily recognizable; in many species, however, the insect undergoes its change within the larval or caterpillar skin, which then becomes hardened and forms a firm protecting case for the pupa.

Most *Diptera* lay eggs, but a few produce living larvæ, and are then called *Viviparous*, in contradistinction to the egg layers, which are termed *Oviparous*. Some few species also retain the larvæ in the interior of their body until they have reached the pupal state, and then discharge them in that condition—these are called *Pupiparous*.

One of the most noticeable features of this great family of insects is their very great profusion, and the large number of species they embrace. In all parts of the world, and at almost all seasons of the year, they seem to furnish an inexhaustible supply. The numerous class of insectivorous birds depend largely on them for their subsistence.

Another, and most important duty they fulfil is that of acting as part of nature's great army of scavengers, and removing the innumerable quantities of decaying animal and vegetable matter that are to be found on every hand. Indeed were it not for the great assistance thus rendered by hosts of insects, acting in many cases invisibly to us, it is doubtful if human life could be sustained with any degree of health or comfort.

In this great work, assigned by a beneficent Creator to the insect world, the *Diptera* or flies play a most important part; their enormous fecundity and their marvellous rapidity of generation adapting them specially for this work.

On the other hand there is no doubt that much annoyance and irritation are caused both to man and beast by the attacks of flies. With the sonorous boom of the mosquito sounding in our sleepless ears, it is difficult to philosophise calmly on the operations of this blood-thirsty insect, and to believe that there may be even a remote possibility that the attacks of this persistent and persevering fly may be conducive to our health.

To what a world, too, of untold misery is that unhappy animal subjected in the season of "fly-time," who, like Burns' "Maggie" of poetic fame, possesses "scarce a stump" to defend itself against the persecution of its irritating tormentors.

There have been trying occasions, we strongly suspect, when some of us would have been only too glad to have been able to have afforded proof to demonstration that Lord Monboddo's celebrated caudal theory was founded on fact, and that our personal comfort, as well as our landed possessions, would have been greatly enhanced by an actual and veritable enjoyment of an "estate in tail."

According to the late Prof. H. Loew, all *Diptera* have been for many years past divided into two large sections—*Nemocera* and *Brachycera*.

The first section of *Nemocera*, or thread-horned *Diptera*, have antennæ with more than six joints, and the palpi with either four or five joints. The second section of *Brachycera*, or short-jointed *Diptera*, have not more than three distinct joints of the antennæ, and the palpi have not more than two joints, and often only one.

This section embraces by far the largest number of species.

SECTION I.—NEMOCERÆ.

In this are comprised those comprehensive families known popularly as Gnats or Mosquitoes, and Daddy-long-legs, or the *Culicidæ* and *Tipulidæ*, to use scientific names.

Our well known acquaintance, the Mosquito—known unfortunately to most of us by painful experience—will stand as a representative of a very large and interesting family who are found in every part of the world—both in arctic and tropical regions as well as in more moderate climes. Loew's catalogue of *N. A.* species comprises a list of 32. Figure 17 represents a female Mosquito, *Culex pipiens* Linn; the males are harmless, leaving all the biting to their more irritating wives.



Fig. 17.



Fig. 18.

Fig. 18 shows the mouth parts of the female, and the formidable lancet she employs

on her work. The gether aquatic—fe water. In this sta operations the mala

The *Tipulidæ*, long-legs. These, o found in great num very often cause a g

The flies have them to pass easily in the ground, and t

In this section in their earlier state plants; some "only growth of a bud or i

These insects an



Fig. 19. Wings of the midge. The wh

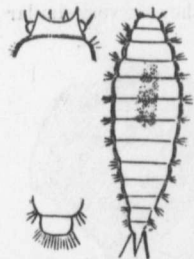


Fig. 22. Larvæ.



Fig. 25. Clover-

on her work. The eggs are laid in boat-like masses on the water and the larvæ are altogether aquatic—feeding generally on decaying vegetable matter at the bottom of the water. In this state they may be considered as essentially beneficial, checking by their operations the malaria arising from stagnant water.

The *Tipulidæ*, or crane flies, are well known to all under the familiar name of Daddy-long-legs. These, of course, are only the typical members of this large family, and are found in great numbers in wet meadow lands; the larvæ feed on the roots of grass, and very often cause a great deal of damage.

The flies have a slender cylindrical abdomen, and long slender legs, which enable them to pass easily over the higher blades of grass; the eggs are deposited by the female in the ground, and the larvæ live and undergo their transformations there.

In this section we also find a large family of insects of very small size, some of which in their earlier state reside in gall-like excrescences which they produce upon various plants; some "only produce a folding of the leaf, swelling of a leaf-rib, or arrest the growth of a bud or stalk."

These insects are known as *Cecidomyiides*, or midges. Those well-known pests, the Hessian fly and the wheat midge have been well described in former reports by the Rev. C. J. S. Bethune, and their life history has been carefully related, we will therefore only refresh our readers' memories by reproducing their likenesses.

Fig. 19 represents a highly magnified specimen, with the wings expanded, of *Cecidomyia tritici*, Kirby, the wheat midge.

Fig. 20 shows the same insect with the wings closed. The eggs are laid (Fig. 21) in the blossom of the wheat; and produce in about a week the larvæ, of which Fig. 22 is a highly magnified representation.

Fig. 23 shows a wheat kernel affected by the midge. The wheat midge has transparent wings, while those of the Hessian fly, (Fig. 24), *Cecidomyia destructor*, Say., are dusky, as will be seen by reference to Fig. 24. The wheat midge attacks the ear, while the Hessian fly attacks the stalk.

CLOVER MIDGES.

Fig. 25 is another midge known as *Cecidomyia trifolii*, Low, or the clover-leaf midge; the larva attacks the white clover, living within the folded leaves. According to Prof. Comstock "such leaves on being opened were found to contain from one to twenty whitish, or pale orange maggots, resembling much the larvæ of the clover seed midge, but being somewhat smaller. The younger maggots were nearly white, while the older ones were of a decided orange hue."

The clover seed midge, *Cecidomyia leguminicola*, Lint. as well as the clover leaf midge, were described by Mr. Wm. Saunders in last year's report.

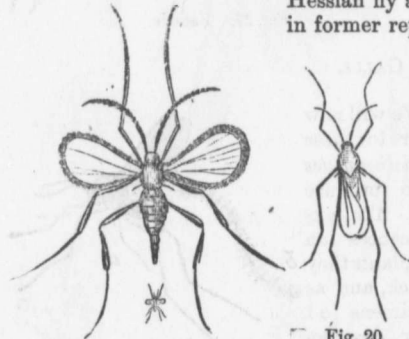


Fig. 19. Wings open.

Fig. 20. Wings folded.



Fig. 21. Eggs.

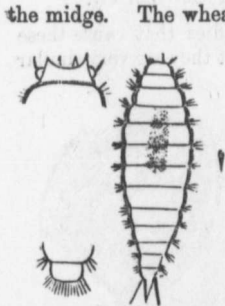


Fig. 22. Larvæ.



Fig. 23. Wheat leaf.

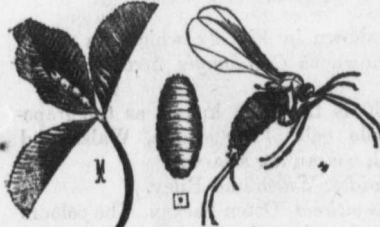


Fig. 25. Clover-leaf Midge.



Fig. 24. Hessian Fly.

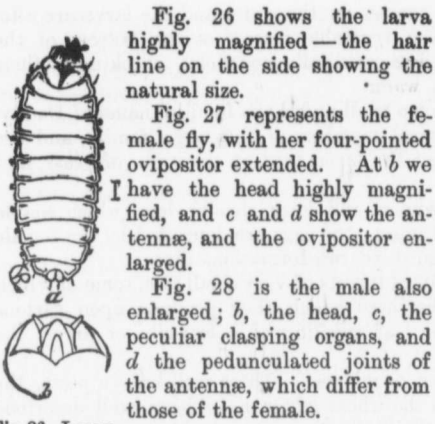


Fig. 26. Larvæ.

Fig. 26 shows the larva highly magnified—the hair line on the side showing the natural size.

Fig. 27 represents the female fly, with her four-pointed ovipositor extended. At *b* we have the head highly magnified, and *c* and *d* show the antennæ, and the ovipositor enlarged.

Fig. 28 is the male also enlarged; *b*, the head, *c*, the peculiar clasping organs, and *d* the pedunculated joints of the antennæ, which differ from those of the female.

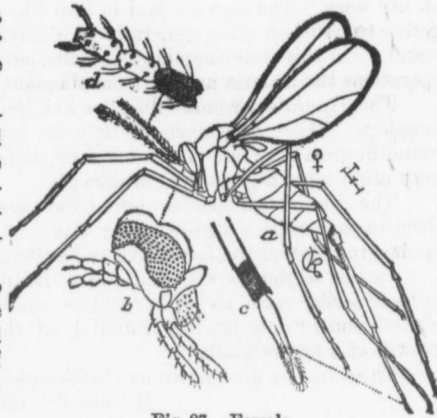


Fig. 27. Female.

GRAPE-VINE GALLS.

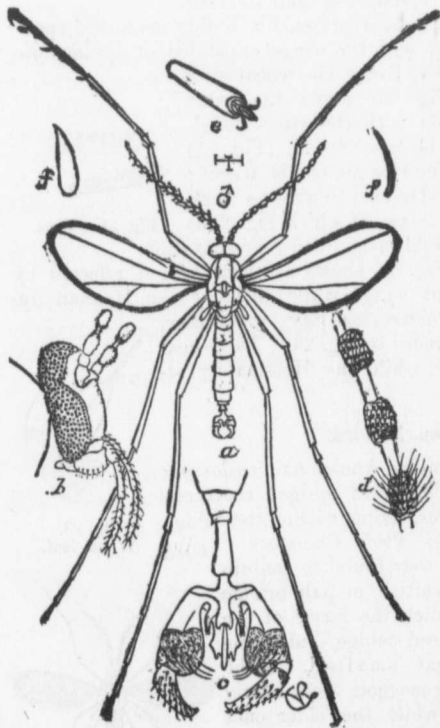


Fig. 28. Male.

We will now refer to these *Cecidomyides* who produce gall-like excrescences on the plants they attack, and as specimens of their destructive work—we refer to the grape-vine galls. The flies that cause these are not yet described, but they are very similar

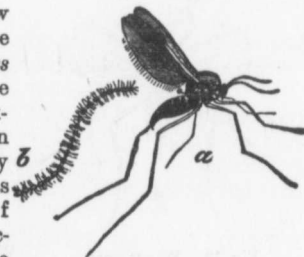


Fig. 29. Gall Fly.



Fig. 30. *Vitis Pomum*.

to that shown in Fig. 29, which is a willow gall, known as *Cecidomyia Strobiloides*, O. Sacken.

Fig. 30 is the form known as the grape-vine apple gall, *Vitis-pomum*, Walsh and Riley.

This gall is divided into numerous cells, each containing a larva.

Fig. 31 is the grape-vine filbert gall, *Vitis-coryloides*, Walsh and Riley.

Fig. 32 shows the grape leaf trumpet gall, *Vitis-viticola*, Osten Sacken. The colours of these galls are bright crimson; they are generally found on the upper side of the leaf—the galls are hollow, and contain a pale orange larva.



Fig. 31.



Fig. 32.



Fig. 31. *Vitis-coryloides*.

Fig. 33 is the grape-vine tomato gall, *Vitis-tomatos*, Osten Sacken. This gall is made by a little fly, named *Lasioptera Vitis*, which, as well as the gall, were both described by Baron Osten Sacken.



Fig. 32. *Vitis-viticola*.

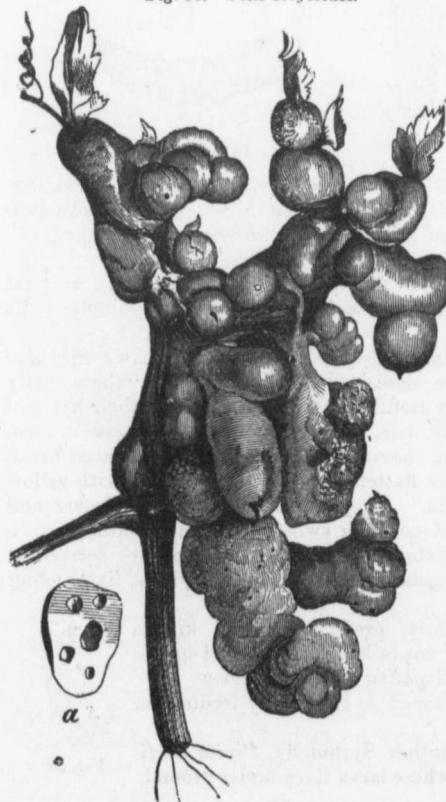


Fig. 33. *Vitis-tomatos*.

Another species of midge is shown at Fig. 34, which represents *Diplosis resinicola*, Osten Sacken, the resin-inhabiting Diplosis. The larvæ are found feeding in companies of thirty and forty, in the pitch ex-

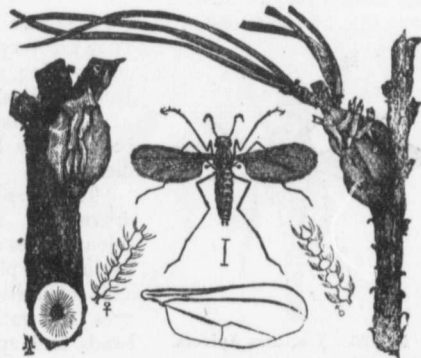


Fig. 34. *Diplosis*.

uding from the pine tree. These are pale orange, becoming brighter just before pupating. "When about to give out the adult the pupa works its way to the surface of the resin, and protrudes half its body, so that there is no danger of the midge becoming fastened in the sticky gum. Dried lumps of resin, fairly bristling with protruding pupa skins, are a common sight on trees affected by these insects."

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This midge has been observed in Florida, and at Ithaca and Tarrytown, New York State, and it is quite possible it may occur in Canada.

The history of another family belonging to this section of Diptera is a curious one. The family is called *Sciara*, and belongs to the genus of the Tipulidæ. Several species are known to occur in Canada. The larvæ are noticeable for their peculiar habit of congregating together and exhibiting the strange phenomenon of an assembly of larvæ without feet marching in procession.

Prof. Packard says "They are more gregarious than the other genera, and have the singular propensity of sticking together in dense patches, generally under the bark of trees. When full grown they sometimes march in procession in a dense mass, sometimes several feet long and two to three inches broad and half an inch in thickness, whence the Germans called them 'Army Worms.'"

SECTION 2.—BRACHYCERA.

We now come to the second great division or classification of Diptera, known as the short-horned flies.

The *Tabanidæ*, or Horse Flies, a well-known group—the insects of which are remarkable for their strength, daring and courage. Fig. 35 represents a common species, *Tabanus atratus*, Fab. Its large size and powerful bite render it formidable. Like the mosquito it is only the females which bite, the males being innocuous, and living on the juices of flowers. In its larval state, according to the late Mr. Walsh, the talented entomologist, it is useful to man, as it feeds on snails and the larvæ of root-eating insects.

The *Asilidæ*, or Robber Flies, are stout, strong insects, with long bodies. They are very rapacious, seizing and flying off with the insects they capture.

Fig. 36 shows one of these robbers, named *Trupanea apivora*, Fitch, or the Bee-killer.



They are very destructive to the hives, capturing the bees on the wing, one having been observed by Professor C. V. Riley of Washington, to kill 141 bees in one day.

The *Bombilidæ* are pretty, hairy flies, with an oval body and a long proboscis. They are exceedingly swift fliers.

The *Syrphidæ*, known as the hoverers, hawk flies and drove flies, are described by Packard as "those gaily coloured flies so useful to agriculturists, from their habit of feeding on plant lice, closely resemble the wasps in form and colouration, having hemispherical heads, large broad eyes, and rather flattened bodies, ornamented with yellow bands and spots." They hover in the hot sun over and

above the flowers, resting upon them to feed on their sweets. The larvæ either live in the water, where the body ends in a long extensile breathing tube; or are terrestrial living in decaying wood, or parasitically in nests of bees, or, as in *Syrhus*, live among plant lice.



Fig. 37. *Syrphus*.

The species of *Eristalis* produce the well known aquatic larvæ known as "rat-tailed." A kindred species is shown at Fig. 37, *Heliophilus Latifrons*, Loew.

Fig. 38 shows the larvæ of a *Syrhus* fly feeding on aphids.

Fig. 39 represents another *Syrhus* fly, *Pipiza Radicans*, Walsh and Riley, whose larva lives under ground,



Fig. 38.

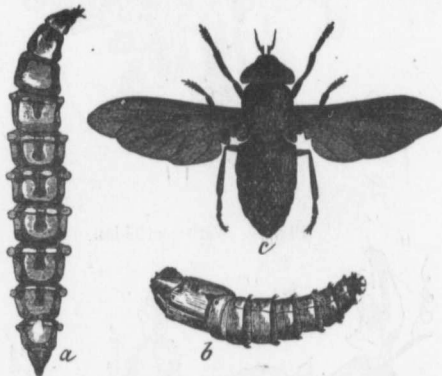


Fig. 35. *Tabanus Atratus*.

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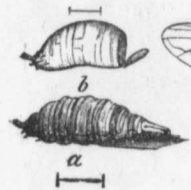


Fig. 39.

The Horse breech

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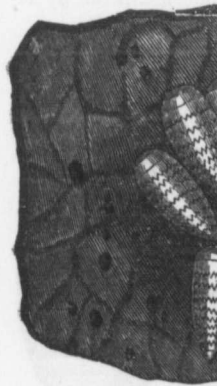


Fig. 43. Larvæ

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We now arrive

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and feeds both on the apple-root louse, *Eriosoma Pyri*, and the grape-root louse *Phylloxera Radicola*.

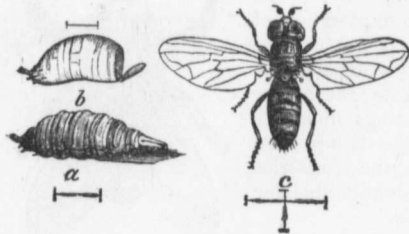


Fig. 39. Syrphus Fly.

The Horse breeze fly, *Æstrus Equi*, Fab. Fig. 40, male; Fig. 41, female.

The eggs are laid on the hairs of the animal (See Fig. 42), and being licked off by the tongue, are thus conveyed into the stomach of the horse, and attaching themselves to the sides of the stomach (see Fig. 43), pass through this stage of their existence. Another fly, *Æstrus bovis*, Lat., the ox-bot fly is shown at Fig. 44, while at Fig. 45 is shown the fly just emerging from its cocoon, and a view is also given highly magnified, of the ovipositor, or instrument, by which the female deposits her eggs.



Fig. 40. Horse-breeze Fly.

Fig. 41. Female.



Fig. 42. Eggs of Horse-breeze Fly.

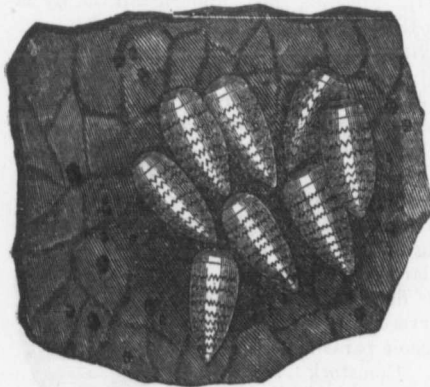


Fig. 43. Larvæ of Horse-breeze Fly.



Fig. 44. Ox-bot Fly.

The sheep bot fly, *Æstrus Ovis*, Linn. is shown at Fig. 46. This fly attacks the nostrils, depositing her eggs there.

All these bot and breeze flies are greatly dreaded by the animals they attack, and their appearance causes great commotion amongst them, and very often produces a regular stampede—the animals endeavouring by their terrified flight to escape their insect tormentors.

We now arrive at our last division of this section, the *Muscida*. This is a large family, and contains a great number of species. The typical member is *Musca domestica*, the common house fly, and its history will be found more in detail in another part of this report. To its ranks belong the celebrated "Tsetse Fly," *Glossina Morsitans*,



Fig. 45. Ox bot Fly Larva.

Westwood. This little fly, not bigger than the common house fly, is the great obstacle to the exploration of Central Africa. "It is not dangerous to man, to any wild animals, nor to the pig, the mule, the ass or the goat. But it stings mortally the ox, the horse, the sheep, and the dog, and renders the countries of Central Africa uninhabitable for these valuable animals."

The genus *Tachina*, of which Fig. 47 represents a species, is parasitic in caterpillars.

Tachina doryphora, Riley, feeds on the larvæ of the potato beetle.

The Red-tailed Tachina Fly, *Nemoraea leucania*, Kirkp., Fig. 48, is parasitic on the army worm moth, *Leucania unipuncta*, Haworth. The fly deposits her eggs upon the fore part of the body of the worm. Prof. Comstock says "That as many as eighteen eggs are laid on a single worm, but the usual number is about five. These eggs are so ingeniously placed that the worm can by no possibility reach them with its jaws, or get rid of them in any other way. Mr. Howard says that he has searched for hours in a field infested with army worms without finding a single full-grown worm that did not carry one or more of these eggs upon its back." In Fig. 32, just underneath the fly is

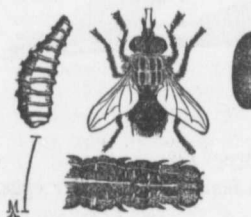


Fig. 48.

shown the forepart of an army worm exhibiting the placing of the parasitic eggs.

Sarcophaga, the Flesh Fly, is one of the viviparous species alluded to before.

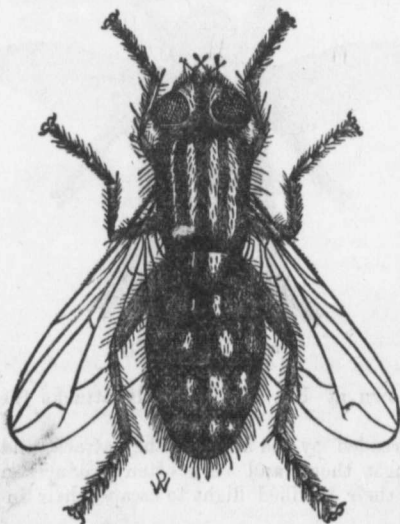


Fig. 49. Flesh Fly.

insects to be found in the leaves of *Sarracenia*, the pitcher plant. Fig. 51 represents the insect in all its stages.

The *Anthomyia* are to be found about flowers, and their larvæ live on decaying



Fig. 46. Sheep bot Fly.



Fig. 47.

Fig. 49 is an enlarged representation of *Sarcophaga carnaria*, Linn. The flesh fly and Fig. 50 shows the maggot.

The female is exceedingly prolific. The entomologist, DeGeer, vouching for the development of 20,000 larvæ in one female.

These flies sometimes deposit their larvæ on living animals, and thus become parasites.

Prof. Comstock says that "specimens of a flesh fly were reared from pupa of the Cotton worm, *Aletia Argillacea*, Hubner. These proved to be specimens of

Sarcophaga Sarracenia, Riley, a probable American variety of that wide-spread scavenger, *S. Carnaria*, a species common to Europe, America, and Australia, certainly and probably elsewhere to be found. *Sarracenia* was first described by Prof. Riley as feeding upon the dead



Fig. 50. Larva of Flesh fly.

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Fig.

Another species *thomyia Ceparum* attacks the root of figure shows the c pupa in the centre.

The larvæ of a *myida Zea*, of I corn, and the rad by *Anthomyia Rap*.

Fig. 54 repres on the root; other



Fig. 53.

and sheep ticks. This closes ou

The numerous are universally phy as destructive insect "Golden Apples," portion of the speci

Although the discovered which ex vast majority of the they are to be feare and enlarge the area

vegetable matter, and are all parasitic. Fig. 52 represents *Anthomyia Radicum*, Linn., var. *Coleopteri*, the Anthomyid egg parasite which was found by Prof. Riley to be parasitic on the eggs of the Rocky Mountain locust. In its parasitic capacity it has been most useful.



Fig. 51.

Another species, the onion fly *Anthomyia Ceparum*, Bouche, Fig. 53, attacks the root of the onion. The figure shows the onion bulb with the pupa in the centre.

The larvæ of another fly, *Anthomyia Zeæ*, of Riley, attacks seed corn, and the radish is also infested by *Anthomyia Raphani*, Harris.

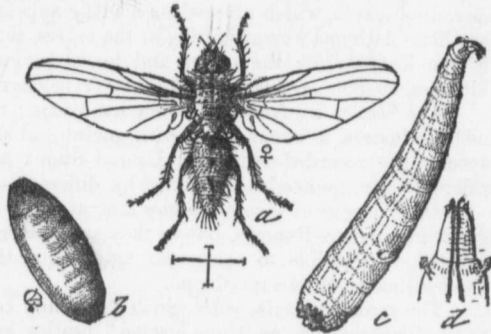


Fig. 52.

Fig. 54 represents another onion fly, *Ortalis Flexa*, of Wiedmann; the maggot feeds on the root; other of the same species feed on the leaves, and afterwards the fruit, of

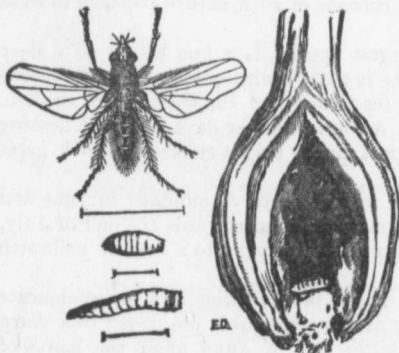


Fig. 53. Onion Fly.

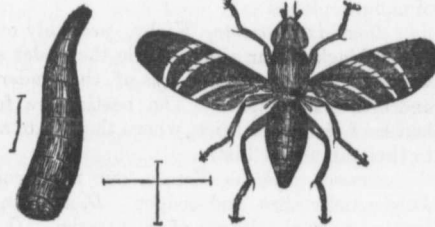


Fig. 54.

the cherry, olive, and orange.

The remaining members of this section of the flies are those which are known as *Pupiparous*, and consist of the *Hippoboscidae*, the forest flies

and sheep ticks.

This closes our list, brief as it has necessarily been, of this great group of insects.

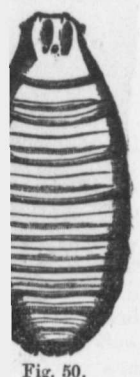
CHRYSOMELIDÆ—LEAF-EATERS.

By W. HAGUE HARRINGTON, OTTAWA.

The numerous species which are comprised in this extensive family of Coleoptera, are universally phytophagous, or plant-feeding beetles, and many of them are well known as destructive insects. The family name is derived from two Greek words signifying "Golden Apples," and has been applied to this group of beetles because so large a proportion of the species have rounded forms and bright colours.

Although the family embraces several thousand known species, none have yet been discovered which exceed an inch in length, and few, if any, attain that size, while the vast majority of them are small, and often very minute. It is not from their size that they are to be feared, but from the very rapid rate at which they increase in number, and enlarge the area of their depredations.

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In shape they are oval or oblong, with numerous short and robust species. The eyes are prominent, and the antennæ comparatively short. The larvæ of the larger species are found feeding upon leaves, and are stout, cylindrical, fleshy grubs, with thoracic legs. They are frequently highly coloured, but the majority are not pleasing objects, and many species cover themselves with a coat of the excreted fragments of devoured leaves, which gives them a filthy appearance. The larvæ of many small species are little flattened worms mining in the leaves, that is they feed upon the inner substance of the leaf, leaving the upper and lower surfaces untouched, and making disfiguring blotches, such as are also caused by larvæ belonging to other orders.

The beetles are frequently very handsome; resplendent with gay colours and bright metallic lustres, or ornamented with quaint and striking markings. About five hundred species are recorded from the United States and Canada, and in both countries considerable damage has been inflicted by different species.

Descriptions of several species and accounts of their operations have already been given in previous Reports, but as they are scattered through the different numbers, and perhaps inaccessible to some who may receive this, a brief review of them (as they are reached) may not be superfluous.

The genus *Donacia*, with which the family commences, approaches in some respects to the *Cerambycidae*, or "long-horned" beetles, and serves as a partial link between that family and the *Chrysomelidae*. The beetles of this genus differ from those of most other genera in having longer and more cylindrical bodies and longer antennæ. The larvæ are said to live in the stems of water-plants, and to make a leathery cocoon in the earth before transforming. I have often found empty cocoons of such nature attached to roots of aquatic plants.

Donacia proxima, Kirby, probably our largest species is a fine beetle of a deep bluish-black colour above, while the under surface is silvery-white, being densely covered with short hairs. The thighs of the hinder legs (as in many of the species) are swollen, and bear a short tooth. The beetles are found on hot summer days upon the floating leaves of the water-lilies, where they mate and sport in the bright sunshine, which gives to them an added lustre.

Donacia subtilis, Kunze, our most common species is very abundant in June and July upon rushes and sedges. *D. aequalis*, Say, may be found towards the end of July, feeding upon the leaves of *Sagittaria*. *D. pubescens*, Lee., owing to a coat of yellowish hair, lacks the lustre of the previous species.

Hæmonia nigricornis, Kirby (*Melsheimeri*, Lac.), is a smaller and more delicate beetle, of a yellowish colour, and having the tip of the wing-cover prolonged in a sharp spine. It occurs somewhat abundantly in the latter part of June upon the leaves of *Potamogeton natans*, where it is, from its colour, very inconspicuous. It seems equally at home in the water as in the air. I have seen, and captured, specimens paired beneath the surface of the water, while other individuals, also completely submerged, were feeding upon the epidermis of the leaves. It walks easily upon the surface from plant to plant, and has the habit of running a little distance upon the water and taking flight therefrom, instead of directly from the leaf upon which it has been.

Leaving the aquatic species, we come to a small, slender beetle, very common upon flowers in spring and early summer. This insect, *Orsodachna Childreni*, Kirby, varies remarkably in coloration, and several of its varieties were formerly described and known as separate species. It ranges in colour from a tawny-yellow to black, and one well-marked variety has the head and elytra black, while the thorax is red.

Syneta tripla, Say, is a pretty reddish or yellowish beetle, found in May or June feeding upon the leaves of beech, elm, etc.

Lema trilineata, Oliv., is about as long as the last species, but is broader and more stoutly built. It is an orange-red beetle, with black eyes, feet and antennæ. There are also two black spots upon the thorax, and the elytra bear three broad, black stripes, which give to the beetle its specific name. (See Fig. 56.) It is found abundantly upon potato plants throughout Canada, and is popularly known as the "Three-lined potato beetle." The eggs are deposited upon the under side of the leaf



Fig. 56.

(see Fig. 57d), upon covered with man... be found feeding... They attain their f... they descend to the cells, formed of sm... gummy exudation... fortnight the rath... may be found in al... and a portion of S...

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Fig

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Coscinoptera... case-bearer, is a c... of an inch long... stages in Fig. 59... shows the larva ex... dragging its case... fragments of lea...

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Fig. 56.

(see Fig. 57d), upon which the dirty-yellowish larvæ, covered with mantles of their own excrements, may be found feeding in mid-summer. (See Fig. 57a.) They attain their full size in about two weeks, when they descend to the ground and transform in earthen cells, formed of small grains cemented together by a gummy exudation from the mouth. In about a fortnight the rather handsome beetles emerge, and may be found in about potato patches during August and a portion of September.

Crioceris asparagi, Linn., the European asparagus beetle, is a closely allied species, which has followed to America the celebrated food-plant from which it derives its name. It was figured in the Reports for 1880 and 1881, but as no description of the beetle was then given, I will insert it here as given by Miss Ormerod, in whose valuable "Manual of Injurious Insects" it is the first species described. Fig. 58 shows the beetle, larva and egg, all much magnified; the natural length of the egg and beetle is shown by the lines at the foot of the figure. The eggs are attached by one end along the young shoots, as figured. The grubs are of a dirty olive or slate colour; are fully fed in a fortnight, when they descend into the ground, transform in parchment-like cocoons, and in two or three weeks emerge as perfect beetles. These are about a quarter of an inch long, blue-black or greenish, the body behind the head red, with two black spots, the wing cases are ochreous-yellow, with a line down the centre of the back, a branch from each side, and a spot at base and tip of each wing-case.

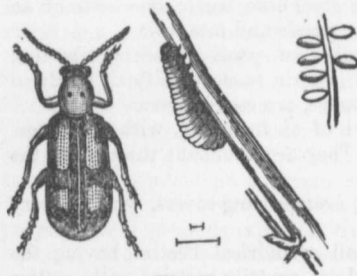


Fig. 58.

The beetles on emerging from the ground lay their eggs, and the insect is found in all stages, from about the middle of June to the end of September.

This beetle appeared in eastern New York more than twenty years ago, and threatened at one time to destroy the extensive asparagus plantations on Long Island. Its depredations were soon checked, however, and its spread prevented. Our Report for 1880 gave methods of dealing with the larvæ, but did not mention the application of freshly slacked lime, which is stated by Mr. A. S. Fuller (Am. Ent., page 4) to be the most practicable and effectual method. The best time to dust the plants, with the finely powdered lime, is while the dew is still on them, or after a shower. The lime almost instantly kills every larva it touches, and those that escape may be destroyed by a second application. So effectual was this process found, that about one application every alternate season sufficed to keep the insect in check.

Anomæa laticlavata, Forst., is a stout beetle, slightly more than one-quarter of an inch long and half as wide. It may be considered as belonging to the aristocracy of the Chrysomelidae, for its specific name of *laticlavata* means, in Latin, having a broad purple stripe—a mark of distinction borne by senators, military tribunes, and the sons of distinguished families. The abdomen, legs, eyes and antennæ are blackish, the head, thorax and elytra are ochraceous, while a broad purplish black stripe runs down the back, and a narrow one along the margins of the elytra. Found upon willows, cherry, etc., in June and July.

Coscinoptera dominicana, Fab., the Dominican case-bearer, is a cylindrical beetle, nearly one-fourth of an inch long, and is well represented in all its stages in Fig. 59 (after Riley). In the figure, *a*, shows the larva extracted from its case; *b*, the same dragging its case, which is composed of chewed fragments of leaves; *c*, beetle enlarged to show



Fig. 57.

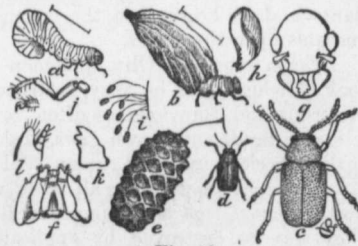


Fig. 59.

punctures; *d*, same natural size; *e*, the egg enlarged; *f*, head of larva, underside; *g*, head of male beetle; *h*, jaw of same; *i*, eggs natural size, showing the curious manner in which they are attached to leaves; *j*, leg of larva; *k*, jaw of same; *l*, maxillæ of same.

The genus *Chlamys* contains beetles differing greatly in general appearance from those previously described. They are short and thick set, resembling when at rest dried buds or bits of bark on account of their curiously knobbed and wrinkled elytra and thorax. The larva (Fig 60) like that of the preceding species constructs for itself a sac which it bears about with it while feeding on the leaves, like a snail carries its shell. The larva (figure *a*) is a small stout grub, having the posterior end recurved in the sac, from which the head and legs protrude. The case is composed of small pellets of vegetable matter.

Chlamys plicata, Fab., "is a little oblong, cubical, roughly shagreened, metallic greenish beetle, found in abundance upon leaves southward." A variety known as *C. polycoeca*, Lac., is found here in June, and is of a dull brown or coppery colour.

Monachus saponatus, Fab., is an almost globular steel-blue beetle, one-tenth of an inch long, taken upon alders and plants growing in low woods and meadows.

The genus *Cryptocephalus* contains a great number of small cylindrical beetles, having the head withdrawn in the thorax, whence the generic name signifying "buried head." The larvæ, like those of *Coscinoptera* and *Chlamys*, are case-bearers.

C. maculatus, Say, is a bluish-black beetle, one fifth of an inch long, with an orange-red spot on the tip and shoulder of each wing-cover. They are abundant throughout the summer on pines, and less frequent on other trees.

C. luteipennis Mels., is a smaller species, having orange wing-covers, which is very abundant upon willows.

Pachybrachus is another extensive genus of small cylindrical beetles, having the head less retracted within the thorax. *P. tridens*, Mels., prettily mottled with yellow and brown; appears in numbers upon willows.

Another beetle frequently found upon willows is *Adoxus vitis*, Linn., a black insect of robust form, and about one-fourth of an inch long; the elytra are a dark reddish-brown. The word *vitis* being the Latin for vine, this beetle may, perhaps, be found upon grape-vines, although I do not remember to have seen any statement to that effect.

The next member, under present classification, of the Chrysomelidæ is *Fidia viticida*, Walsh, the Grape-vine Fidia (Fig. 61), which also derives its name from the same source. It is slightly longer than the preceding species, but of very similar shape; its colour is chestnut-brown, and it is covered with short whitish hairs, giving to it a hoary appearance. It is very injurious to grape-vine leaves in the Western States, riddling them with large holes, and when numerous reducing them to mere shreds.

Glyptoscelis pubescens, Fab. (*hirtus*, Oliv.), is a coppery, and, as its name denotes, pubescent or hairy beetle, the hairs not being very close. It is one third of an inch long, and appears upon the leaves of pines in May and June.

Upon Dog's-bane and Indian hemp, about the end of July, may be found numbers of a very beautiful beetle named *Chrysochus auratus*, Fab., both names signifying golden. Its colour is a brilliant green, when seen in a dull light, but when crawling upon the plants under a bright sun the colours are iridescent, and they appear like rubies and emeralds upon the leaves.

Paria aterrima, Oliv., common here upon different plants, is said by Prof. J. A. Cook (Michigan) to be very destructive to strawberries, for though small they are so numerous and voracious as often to defoliate the plants. The larvæ are white, with yellowish heads and brown jaws, are about one-fifth of an inch long, and transform in a small, spherical, earthen cocoon. The beetle is about one-eighth of an inch long, and varies in colour, some being all black, while others—perhaps the greater number—have the head, antennæ, legs and wing-covers yellowish, the latter having each two black spots. They may be destroyed by applications of Paris green or London purple, but these poisons should not be used after the berries have formed.



Fig. 60.



Fig. 62.

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Soldier-Bug, Fig. 64
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Fig. 61.



Fig. 64.

Riley, a two-winged
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belonging to the
(Coccinellidæ), of v
(Fig. 68). Notwit





Fig. 62.

One of our allied beetles, *Colaspis flavida*, Say., feeds also in the larval state upon the root-lets of the strawberry. Fig. 62 represents the larva, Fig. 63 the mature insect.

We now come to the extensive genus *Chrysomela* (golden apples), which contains our largest beetles of this family. The most generally known, as well as the most generally hated of these is *C. decem-lineata*, Say, the ten-lined chrysomela, or as it is more commonly called the Colorado potato beetle. This insect has already been described and frequently mentioned in our Reports, and its appearance and habits are so well known to all agriculturists that only a very brief account of it must be given here. Over sixty years ago, in 1819 or 1820, it was discovered by Say along the Upper Missouri, near the base of the Rocky Mountains, where it fed upon *Solanum rostratum*, a wild plant belonging to the same genus as the cultivated potato (*Solanum tuberosum*). Its discoverer had probably no idea that at some future day it would so far extend its range and prove so noxious an insect, but as the country became settled it was found transferring itself to the potato fields, where it obtained a more abundant and constant supply of food, and where it increased in numbers proportionately. By 1861 the beetles had become so numerous in Kansas that over two bushels of them were gathered in one garden. During the last twenty years they have rapidly extended their range eastward, and in the past summer they have been reported from Nova Scotia. While they still cause much trouble and a certain amount of loss to potato growers, they are no longer feared as they were when their ravages were first made known. Paris green and London purple, when properly applied, have proved efficient destroyers, while planting early ripening species of potatoes, ensures their maturing before the beetles become numerous enough to do much injury to them. Gradually also insect enemies have increased in kind and number, among which may be named *Podispus spinosus*, Dallas, the (Spined Soldier-Bug, Fig. 64); *Perrillus circumcinctus*, Say (the Belted Soldier-Bug, Fig. 65); *Harpactor cinctus*, Fab. (the Many-banded Robber-bug, Fig. 66); *Lydella doryphora*,

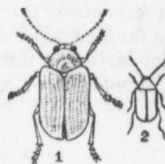


Fig. 63.



Fig. 64.



Fig. 65.



Fig. 66.



Fig. 67.

Riley, a two-winged fly, of which the larvæ are parasitic in the grubs of the beetle; *Lebia grandis*, Hentz (Fig. 67, where it is shown magnified, and also of the natural size); and other beetles belonging to the Carabidæ, and several species of Lady-birds (Coccinellidæ), of which the largest is *Mysia 15-punctata*, Oliv. (Fig. 68). Notwithstanding the aid thus rendered to man it will

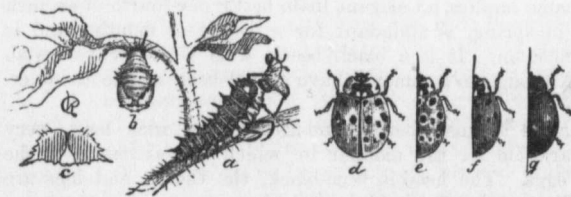


Fig. 68.

be a very long time before the beetles are so far exterminated as to be rarities. The patches of yellow eggs upon the leaves, the loathsome yellowish-red, black-spotted larvæ destroying the tops, and the beetles crawling in striped yellow and black

jackets about the fences and roads, or sailing with pink wings through the air, will long be familiar objects. Fig. 69 shows this insect in its several stages—*a*, the eggs; *b, b, b*, the larvæ at different periods of growth; *c*, the pupa; *d, d*, the beetle natural size; *e*, a wing-cover much enlarged.



Fig. 69.

C. clivicollis, Kirby (*Labidomera trimaculata*, Fab.), is a handsome beetle, about the size of the preceding species, found upon the common milk-weed during the autumn. It is of an oval, rounded-convex shape, and of a deep bluish-green or greenish-black colour, the feet being purplish. The elytra are orange, with a broad bluish band across the back and a large bluish spot near the tip. The markings vary greatly in outline, and the band is often interrupted so as to form two irregular spots on each wing-cover.

C. multiguttata, Stal., (*Scalaris*, Lec.), is a somewhat smaller beetle, varying in size, found throughout the season on various trees, as the elm, the linden, and especially the willows and alders. Its eggs are laid on the underside of the leaves. The larvæ are short, stout grubs, about half an inch long, whitish, with a black line along the top of the rounded back, and a row of black spots on each side of the body. The beetle is greenish, with yellowish legs and antennæ; the elytra are yellowish with many green dots varying in shape, and a broad band runs down the back where they meet, and gives off three or four branches on each side, forming as it were steps, whence the name *Scalaris* from a Latin word meaning a ladder. There are said to be two broods, the first in April, May, and June, and the second in September and October. A very beautiful variety of this species (*C. labyrinthica*, Lec.) is sometimes found, which differs so much in colouration as to seem a distinct species; it also appears to be slightly larger. The body of the beetle is of a deep black, with a slight bluish tinge, as are also the legs and antennæ. The elytra have a jagged, irregular border of white, and there are two rows of four white spots upon the back. The margin and spots vary, however, in different specimens, and are more or less joined together. I captured several specimens in 1878; but did not meet with it again until I took one last summer.

C. philadelphia, Linn., is a smaller beetle of very similar appearance to *C. multiguttata*, which feeds upon pine leaves in May and June.

C. elegans, Oliv., is, as its name implies, an elegant little beetle one-fourth of an inch long, which appears very early [in spring, is abundant for a couple of months, and is occasionally taken late in the autumn. It is a black beetle with white or yellowish stripes upon the wing-covers. Although so common I have as yet been unable to determine upon what it feeds.

Gastrophysa polygoni, Linn., is a small beetle, one-fifth of an inch long; very abundant all summer, and remarkable for the manner in which the abdomen of the gravid female is distended with eggs. The head is blue-black, the thorax and legs are rufous, and the elytra are a brilliant and metallic blue.

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Fig. 71.

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Plagioderella lapponica, Linn., is more elongated and flattened than species of the genus *Chrysomela*. It is one-fourth of an inch long; black; the elytra, orange with black spots, and is found upon alders and willows. The larva is of a dingy yellowish-white colour, with black head and legs. Upon the sides and back are rows of small dusky tubercles; the outer-dorsal rows being more distinct and capable of emitting from their tips a milky, pungent fluid.

P. Scripta, Fab., a very closely allied species, (by some held to be but a variety of the last) has proved itself a very destructive insect in the Western States; especially in the prairie regions, where it has become a grievous pest on account of its depredations on the cottonwood. This tree is grown very extensively as a shade and ornamental tree, and for fuel, and vast groves are stated to have been utterly destroyed by repeated defoliations. The eggs are laid in clusters, of from ten to one hundred, on the young leaves in the spring and quickly develop. There are two or three broods during the summer.

Monocesta coryli, Say., (corylus being the latin for a hazel, or filbert tree,) is known in the United States as the Great Elm-leaf Beetle, and is occasionally very destructive to the red or slippery elm. Its eggs are laid on the under side of the leaves in June, and from them issue in a few days brown, or yellowish brown larvæ, which, growing rapidly, "eat the leaves into rags." About the end of July they enter the ground and pupate.

The genus *Diabrotica* contains a number of species, of which *D. vittata*, Fab., the Striped Cucumber Beetle, is a well-known gardener's pest. It was well figured and described in the Report of 1878. The little lemon-yellow beetle (Fig. 70), with a black head and three black stripes on the wing-covers, makes its appearance as cucumbers, squashes and melons commence to show above ground. It feeds upon the young leaves, and at the same time deposits its eggs near the roots of the young vines. From these hatch out slender white grubs having small brownish heads, and slim, pale-brown thoracic legs. Burrowing into the stems just below the surface of the ground (the plants being thereby weakened and often destroyed), the larva reaches maturity in about a month from the deposition of the egg, and is then one-third of an inch long. Leaving the plant it pupates in a little cell in the earth, and emerges after a couple of weeks as a beetle, which feeds upon the young shoots and buds. There are two or three broods during the season, the last remaining in the ground all winter as pupæ. An effective, and not expensive, method of protecting the young plants is to cover them with wooden frames having gauze tops.



Fig. 70.

A larger but less common species is that known as *D. 12-punctata*, Oliv., or Twelve-Spotted Diabrotica, which derives its name from twelve black spots upon the elytra (Fig. 71). It is stated by Packard to be injurious to the leaves of the dahlia.



Fig. 71.

Within the past few years a beetle belonging to this genus, and closely allied to our cucumber beetle, has become noted in Illinois, Missouri and other Western States as a corn pest. The larvæ of *D. longicornis*, Say, the Long-horned Diabrotica, are very similar in size and appearance to those of our cucumber beetle, and feed on and in the roots of the young corn-plants, causing them to wither and die. The beetle is of a uniform pale greenish-yellow, without any markings. The application of lime and ashes around the young corn is proposed as a preventative.

Several species of the genera *Galeruca* and *Galerucella* are found in Canada, they are similar in form to Diabrotica, but, generally a little smaller and of a darker colour. *Galeruca rufosanguinea*, Say, is well described by its specific name which means blood-red. It is one-fifth of an inch long and is found upon various trees. Last June it was abundant on choke-cherry.

Galerucella marginella, Kirby, has been described by Packard as found in all its stages upon Myrica gale in August. The larva is shining black and the beetle closely resembles the following species, except in being darker.

G. xanthomelina, Schr., (the imported elm beetle) is said to feed upon the elm in such numbers as often to wholly defoliate the trees. In 1879, the elms of Newburg, N. Y., a town celebrated for its fine avenues of this handsome tree, were almost stripped by these beetles. The larvæ are thick, cylindrical, blackish grubs, producing greyish-yellow beetles distinguished by three black dots on the thorax, and a black stripe on the outer edge of the elytron.

G. sagittariae, Kirby, is a dark brownish species (with the exception of a yellowish line around the margin of the wing-covers), which I have found about the middle of September abundant upon the leaves of the water-lily, in the larval, pupal, and perfect stages. It is also given by Packard as occurring upon the willow.

We now come to a large group consisting of several genera of small—often minute—beetles having the thighs of the hind pair of legs much enlarged and very powerful, by which the beetles are enabled to jump a great distance (in proportion to their size) when disturbed. From this characteristic they are known as Halticas, or Flea-beetles.

The genus *Oedionychis* contains a number of species, of which *O. quercata*, Fab., is a common one. It is a dark beetle, of oval form and variable markings. Its name associates it with the white oak, and it is found upon other trees as well.

Another extensive genus is *Disonychia* which contains some of our handsomest Flea-beetles. *D. glabrata*, Fab., a pretty little beetle with yellow and black striped wing-covers; *D. collaris*, Fab., a bluish-black beetle with a red thorax, and *D. triangularis*, Say, closely resembling the latter, except that it bears three black dots upon the yellowish thorax, may be found in October sheltering themselves under cornices of buildings, or in crevices, etc. They may also be found early in spring under stones, loose bark, etc., where they have hibernated. *D. alternata*, Ill., a large handsome species is rare here.

Graptodera chalybea, Ill., is well known to grape growers as the Grape-vine Flea-beetle. In some seasons it is very abundant, and inflicts a considerable amount of injury. The greatest loss is caused by such beetles as have hibernated under loose bark, fallen leaves, and stones, or in crevices, outbuildings, or other refuges from cold, and which appearing early in April bore into and feed upon the bursting buds. Afterward they feed upon the young leaves, on which during May the female deposits clusters of small orange eggs. Soon hatching, the little dark-coloured larvæ (Fig. 72 *a*), proceed to riddle the leaf, and when very numerous may completely devour it; *b*, shows one enlarged, the faint line indicates the natural length. At the end of a month the larva descends from the vine and pupates in a small earthen cell (Fig. 72, *c*), from which the beetle (*d*, enlarged) emerges about three weeks later. It then feeds upon the leaves, but does, however, comparatively trifling damage. Such beetles as do not fall a prey to various enemies seek, on the approach of cold weather, a sheltered retreat in which to spend the winter. There is only one brood each summer. The best method of checking their ravages is to collect them (as proposed by Mr. L. O. Howard, Asst.-Entomologist to Department Agriculture, Washington) upon sheets drenched with coal oil.

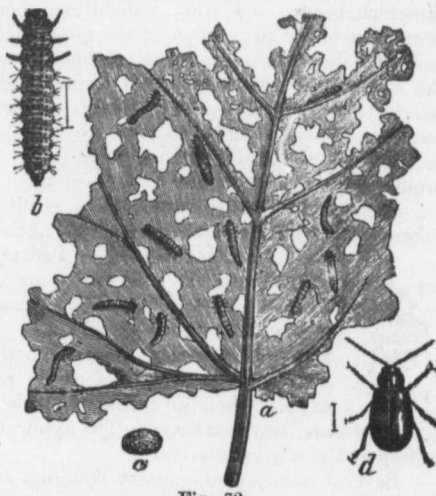


Fig. 72.

Phyllotreta vittata, Fab. (*Haltica striolata*, Ill.) the Striped Turnip-flea-beetle is one of our very commonest insects. It may be found at any time during the season, from the first mild days of spring until the end of October. During the earlier months it appears in swarms upon various plants, and upon fences, etc. The larva (Fig. 73, *a*) is a slender white grub, one-third of an inch long, feeding upon roots underground, where, in a little earthen cell, it changes to a naked white pupa (*b*). About a fortnight later it emerges as a little black beetle (also shown in Fig. 73), less than one-tenth of an inch long, but readily determined by the waved, yellowish or reddish stripe on each wing-cover, the stripe sometimes being interrupted so as to form two spots. The beetles feed upon the seed-leaves of turnips and cabbages, as well as upon other veget-



Fig. 73.

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Epitrix cucun turnip beetle above the leaves of the pla black, with yellowis They feed upon the are found througho eating holes in the l

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ables, and are thus very injurious; while the plants are also weakened and killed by the larvæ feeding upon the roots. In England there are several allied species very destructive to turnips, but the larvæ mine in the leaves instead of feeding upon the roots.

Systena marginalis, Ill., a slender, yellowish beetle, one-fifth of an inch long, with a narrow black line down the sides, is often very common upon elms, hickory, etc. I found them especially abundant last season late in September upon some small oaks, the leaves of which were much eaten. The beetles were at this time nearly all paired, and were much more sluggish than they were three weeks previously, when I had noticed a great number on some sweet-hickories.

Epitrix cucumeris, Harris, the Cucumber Flea-beetle, is about the size of the turnip beetle above described, and of similar habits, except that the larvæ mine the leaves of the plants. The beetles (Fig. 74) are about one line in length, are black, with yellowish antennæ and legs, and have the elytra roughly punctured. They feed upon the seed-leaves of cucumbers, thus killing the young vines, and are found throughout the summer upon turnips and various garden vegetables, eating holes in the leaves.



Fig. 74.

There are a great number of small species belonging to the above and allied genera, of very similar habits, and often injurious to cultivated as well as to wild plants. During the winter such specimens as are to perpetuate the race seek refuge in crannies and crevices of walls and fences, under stones or loosened bark, in tufts of moss, among fallen leaves, in hollow stems of plants, etc. There, sheltered from the wet, they withstand the severe frosts of our long winters, and come forth in the first warm days of spring to renew their depredations. In the interval between their awakening and the appearance of the cultivated vegetables upon which they feed, they subsist upon various species of wild plants. We thus see, in regard to these insects as well as to many others, the evils which may result to crops from leaving rubbish heaps and neglected corners about the fields for insects to winter in, or to obtain sustenance in the early season. Of course numbers of them hibernate in waste and wooded tracts, whence they invade the fields and gardens in spite of every care; still it will pay to keep gardens and fields free from stone and rubbish heaps, from strips of weeds and brambles along the fences, and neglected spots of any kind.

Odontota (Hispa) rosea, Web., is very different in appearance from the previously described species, not having their oval or rounded shape. The wing-covers are truncated posteriorly, instead of being rounded off, and form a parallelogram, to the anterior end of which is applied the base of the triangle formed by the tapering thorax and small head. The short stout antennæ project in the form of a V. The beetle, about one-fifth of an inch long, is of a tawny-reddish colour above, with irregular darker spots and lines upon the elytra, the legs are yellow. Each wing-cover has three raised lines, with the intervening spaces deeply punctured. The larvæ mine in the leaves of various trees, those of the apple among others, and are, when full-grown, about one-fourth of an inch long. They pupate in the leaves, and about a week afterward the beetles come forth from their mines, and may be found upon oaks, hawthorns, etc. There is a smaller and darker variety of this species, of which I took several specimens last season on elms.

Chelomorpha argus, Licht. (*Cribraria*, Fab.), is an interesting beetle, and is among the largest of our Chrysomelidæ. Some specimens appear nearly as large as potato beetles, but they are not nearly so stoutly built. They are known as tortoise beetles from the great resemblance they bear in figure to those reptiles. The sides of the thorax are flattened, and project so as to hide the head, while the ample elytra also entirely hide the body. The under surface of the body, and the legs are black, but the thorax, and elytra are ochraceous-yellow, the former having six small black dots, the latter fifteen, varying in size. The beetle feeds upon various plants. Packard mentions it as "found in all its stages on the leaves of the milk-weed late in July and early in August, and in one instance it occurred in abundance on the leaves of the raspberry." It feeds here upon convolvulus very frequently. The larva is a broad and thick yellow grub, three-fourths of an inch long, and partially covered by its cast larval-skin. The pupa (attached to a leaf) is more broad and flattened; it is of a dark colour, but covered with a whitish powder. Two stout spines project from each side of the thorax, and five smaller ones from each side of the abdomen.

The family of the Chrysomelidæ terminates with the Cassidiidæ, a group of beetles deriving their name from the Latin word *cassida*, a helmet, and they are commonly known as Helmet beetles, from their fancied resemblance to that portion of a warrior's armour. Some of the species are very beautiful, the colours being delicate and brilliant. The wing-covers and the sides of the thorax protrude so as to entirely cover the legs and head when the beetle is at rest, but the margins are so thin as to be quite transparent.

Coptocycla (Cassida) aurichalcea, Fab., the Yellow Helmet beetle, is often found upon morning glories, and is shield shaped, and of a beautiful golden-yellow colour. The larvæ feed upon the leaves of the morning glory, and are of a broad, oval, flattened form. The tip of the abdomen is armed with two diverging spines, forming a fork, with which the larva heaps upon its back, as a protective covering, its excrement and cast larval skins.

We have now hastily reviewed this large and interesting family, as represented in Canada, and endeavoured to describe the appearance and habits of some of the more common of the species. Much, however, remains to be learnt in connection with the life-histories of many of the species. A few beetles have also been mentioned which may not have yet reached this country, but which have proved troublesome in the United States within recent years.

NOTES OF THE YEAR.

BY WM. SAUNDERS, LONDON, ONT.

The Grape Phylloxera.

Phylloxera Vastatrix.—This tiny but formidable foe to the grape vine, which has during the past few years attracted so much attention in Europe and America, has appeared in its worst form, viz.: the root-inhabiting type, in Ontario, and is doing a considerable amount of damage in our vineyards. Early this spring the writer received from Mr. A. H. Pettit, of Grimsby, samples of fibrous roots from diseased vines, which had every appearance of being affected by the Phylloxera, but the specimens were so dried up that if there had been any lice on them they could not be discovered. Request was made for fresh specimens in moist earth, but none were obtained.

On the 19th of July, in company with Mr. J. M. Denton, of London, I visited the vinery of Mr. Richard Stephens, in Westminster, about a mile from London, where we found a number of Concord vines growing in heavy clay soil, which were suffering much from some cause; the foliage had become very yellow and some of the vines appeared to be dying. On examining the roots, we could find but few living, and the fibrous roots were covered with the little knotted swellings so characteristic of Phylloxera. On digging around some vines that were less diseased, a number of the lice were discovered on the young, fresh roots, puncturing them, imbibing their juices, and causing disease and death.

On the following day, another vinery was visited, near London, where the vines were planted on sandy soil, when the same form of Phylloxera was detected on Rogers 15 and some seedling grapes, but, in this instance, the disease was much less pronounced. On examining the roots of these vines, the insects were found in the egg state, and also as larvæ of various sizes in comparative abundance. In the vinery of Mr. Stephens' the insects must have been at work for several years past, to have caused the extent of injury which we saw; but, in the other case, the invasion appeared to be a more recent one. It was gratifying to find, on Mr. Stephens' grounds, a very active, friendly insect, a small mite *Tyroglyphus phylloxera* which feeds upon the Phylloxera, busy at work on its useful mission.

Since this insect is now known to be at work in Ontario, and probably to a greater extent than we are at present aware of, a condensed account of its life history will probably be interesting to our readers. The figures are from Prof. Riley's excellent reports, and the facts given, mainly gleaned from the writings of this and other authors.

Its progress is making districts. has become a national inquiry into; large who shall discover alarming progress among vines undoubtedly been carried to the United States, and endure the attacks appeared on the P varieties are largely disastrous to grape that some grape sequence of the European vineyard exercised over this States.

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Its progress in Europe has been most alarming, inflicting untold losses in the wine-making districts. The destruction it has occasioned in France has been so great that it has become a national calamity which the Government has appointed special agents to inquire into; large sums of money have also been offered as prizes to be given to any one who shall discover an efficient remedy for this insect pest. At the same time it has made alarming progress in Portugal, also in Switzerland and some parts of Germany, and among vines under glass in England. It is a native of America, from whence it has doubtless been carried to France; it is common throughout the greater portion of the United States, and in one of its forms in Canada, but our native grape vines seem to endure the attacks of the insects much better than do those of Europe. Recently it has appeared on the Pacific slope in the fertile vineyards of California, where the European varieties are largely cultivated, and hence its introduction there will probably prove disastrous to grape culture. Already many vineyards are seriously affected, and it is said that some grape growers have had to root up hundreds of vines and destroy them, in consequence of the roots being so crowded with the lice. After the sad experience of European vineyardists it is not surprising that the grape-growers of California are much exercised over this subject. The phylloxera has also occurred in several of the Southern States.

This insect is found in two different forms: in one instance, on the leaf, where it produces greenish red or yellow galls of various shapes and sizes, and is known as the type *Gallaecola*, or gall-inhabiting; in the other and more destructive form, on the root, known as the type *Radicalicola*, or root-inhabiting, causing at first, swellings on the young rootlets, followed by decay, which gradually extends to the larger roots as the insects congregate upon them. These two forms will, for convenience, be treated together.

The first reference made to the gall-producing form was by Dr. Fitch, in 1854, in the Transactions of the New York State Agricultural Society, where he described it under the name of *Pemphigus vitifoliae*. Early in June there appear upon the vine leaves small globular or cup-shaped galls of varying sizes; a section of one of these is shown at *d*, figure 76; they are of a greenish red or yellow colour, with their outer surface somewhat uneven and woolly. Figure 75 represents a leaf badly infested with these galls. On opening one of the freshly formed galls, it will be found to contain from one to four

orange-coloured lice, many very minute shining, oval, whitish eggs, and usually a considerable number of young lice, not much larger than the eggs, and of the same whitish colour. Soon the gall becomes overpopulated, and the surplus lice wander off through its partly opened mouth on the upper side of the leaf, and establish themselves either on the same leaf or on adjoining young leaves, where the irritation occasioned by their punctures causes the formation of new galls, within which the lice remain. After a time the older lice die, and the galls which they have inhabited open out and gradually become flattened and almost obliterated; hence it may thus happen that the galls on the older leaves on a vine will be empty, while those on the younger ones are swarming with occupants.

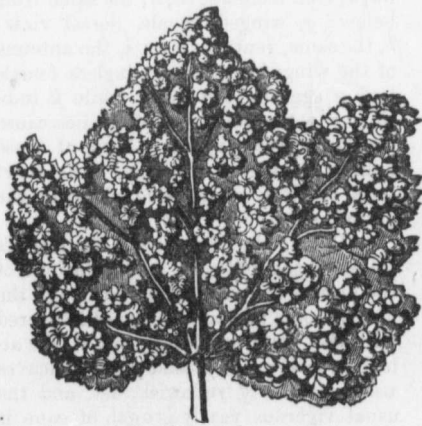


Fig. 75

These galls are very common on the Clinton grape and other varieties of the same type, and are also found to a greater or less extent on most other cultivated sorts. They sometimes occur in such abundance as to cause the leaves to turn brown and drop to the ground, and instances are recorded where many vines have been defoliated from this cause. The thin leaved varieties of grape suffer most, those with thick leathery foliage being seldom injured to any considerable extent. Such varieties as Concord, Hartford Prolific, Moore's Early, and Rogers' Hybrids

are rarely injured by this leaf-inhabiting form of the insect. The number of eggs in a single gall will vary from fifty to four or five hundred, according to the size of it; there are several generations of the lice during the season, and they continue to extend the sphere of their operations during the greater part of the summer. Late in the season, as the leaves become less succulent, the lice seek other quarters and many of them find their way to the roots of the vines, and there establish themselves on the smaller rootlets. By the end of September, the galls are usually deserted. In figure 74 we have this type of the insect illustrated; *a* shows a front view of the young louse, and *b* a back view of the same; *c* the egg, *d* a section of one of the galls, *e* a swollen tendril; *f, g, h*, mature egg-bearing gall lice, lateral, dorsal, and ventral views; *i*, antenna, and *j* the two-jointed tarsus.

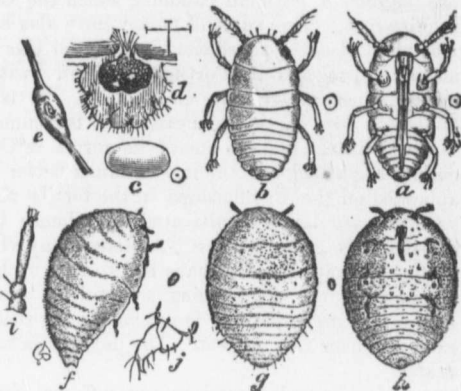


Fig. 76.

When on the roots, the lice subsist also by suction, and their punctures result in abnormal swellings on the young rootlets, as shown at *a* in figure 77. These eventually decay, and this decay is not confined to the swollen portions, but involves the adjacent tissue, and thus the insects are induced to betake themselves to fresh portions of the living roots, until at last the larger ones become involved, and they, too, literally waste away.

In figure 77 we have the root-inhabiting type, *Radicicola*, illustrated: *a*, roots of Clinton vine, showing swellings; *b*, young louse as it appears when hibernating; *c, d*, antenna and leg of same; *e, f, g*, represent the more mature lice. It is also further illustrated in fig. 78, where *a* shows a healthy root, *b* one on which the lice are working, *c* root which is decaying and has been deserted by them; *d d d* indicates how the lice

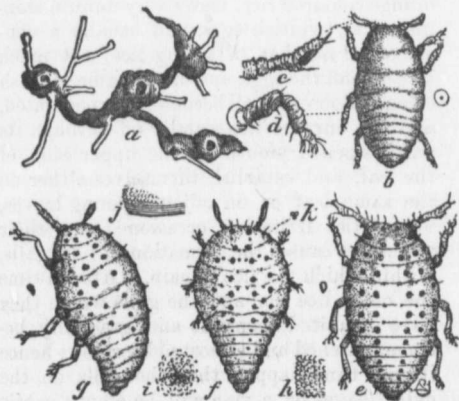


Fig. 77.

are found on the larger roots; *e*, female pupa, seen from above; *f*, the same from below; *g*, winged female, dorsal view; *h*, the same, ventral view; *i*, the antenna of the winged insect; *j*, wingless female laying eggs on the roots, while *k* indicates how the punctures of the lice cause the larger roots to rot. Most of these figures are highly magnified; the short lines or dots at the side showing the natural size.

During the first year of the insect's presence the outward manifestations of the disease are very slight, although the fibrous roots may at this time be covered with the little swellings; but if the attack is severe, the second year the leaves assume a sickly yellowish cast, and the usual vigorous yearly growth of cane is

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healthy material to feed on. During the winter many of them remain torpid, and at that season assume a dull brownish colour, so like that of the roots to which they are attached that they are difficult to discover. They have then the appearance shown at *b* in figure 77. With the renewal of growth in the spring, the young lice cast their coats, rapidly increase in size, and appear as shown at *e, f, g*, in the figure; soon they begin to deposit eggs, these eggs hatch, and the young shortly become also egg-laying mothers like the first, and like them also remain wingless. After several generations of these egg-bearing lice have been produced, a number of individuals about the middle of summer acquire wings. These also, are all females, and they issue from the ground, and rising in the air, fly or are carried with the wind to neighbouring vineyards, where they deposit eggs on the underside of the leaves among their downy hairs, beneath the loosened bark of the branches and trunk, or in crevices of the ground about the base of the vine. Occasionally individual root lice abandon their underground habits and form galls on the leaves.

The complete life history of this insect is very curious and interesting, but would occupy too much space to fully detail here. Those desirous of pursuing this portion of the subject further, and of informing themselves as to the different modifications of form assumed by this insect in the course of its development will find the desired information given with much minuteness of detail in the 5th, 6th, 7th and 8th Reports on the Insects of Missouri, by C. V. Riley.

Remedies: This is an extremely difficult insect to subdue, and various means for the purpose have been suggested, none of which appear to be entirely satisfactory. Flooding the vineyards where practicable seems to be more successful than any other measure, but the submergence must be total and prolonged to the extent of from twenty-five to

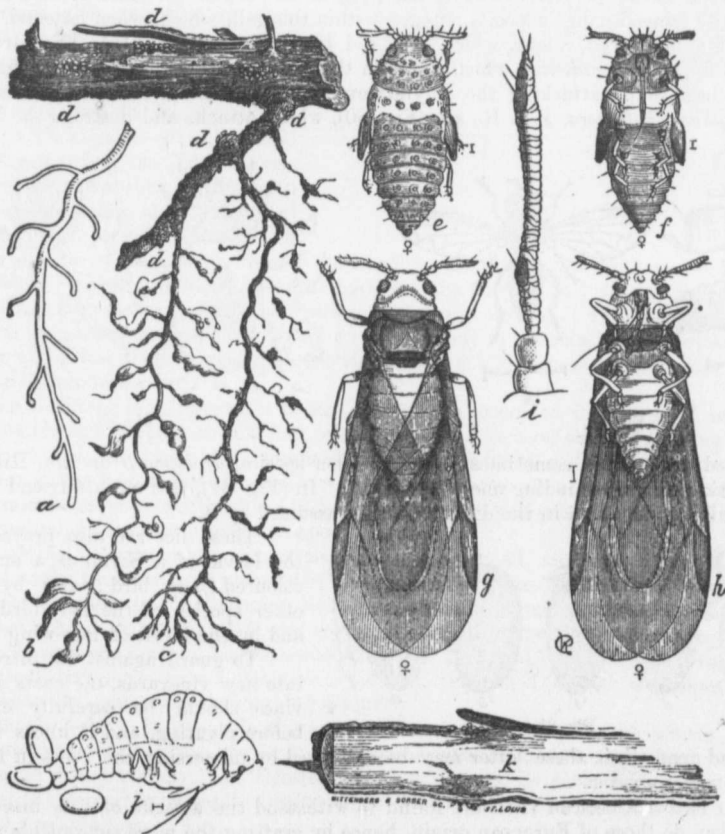


Fig. 78.

thirty days ; it should be undertaken in September or October, when it is said that the root lice will be drowned, and the vines come out uninjured.

Bisulphide of carbon is claimed by some to be an efficient remedy ; it is introduced into the soil by means of an augur with a hollow shank, into which this liquid is poured ; several holes are made about each vine, and two or three ounces of the liquid poured into each hole. Being extremely offensive in odor and very volatile, its vapour penetrates the soil in every direction, and is said to kill the lice without injuring the vines. This substance should be handled with caution, as its vapour is very inflammable and explosive. Carbolic acid mixed with water, in the proportion of one part of acid to fifty or one hundred parts of water, has also been used with advantage, poured into two or three holes made around the base of each vine with an iron bar to the depth of a foot or more. Soot is also recommended, to be strewed around the vines.

It is stated that the insect is less injurious to vines grown on sandy soil ; also to those grown on lands impregnated with salt.

Since large numbers of these insects, both winged and wingless, are known to crawl over the surface of the ground in August and September, it has been suggested to sprinkle the ground about the vines at this period with quicklime, ashes, sulphur, salt or other substances destructive to insect life. The application of fertilizers rich in potash and ammonia have been found useful, such as ashes mixed with stable manure or sal-ammoniac.

A simple remedy for the gall-inhabiting type is to pluck the leaves as soon as they show signs of the galls, and destroy them.

Several species of predaceous insects prey on this louse. A black species of Thrips with white fringed wings deposits its eggs within the gall, which, when hatched, produce larvæ of a blood red colour, which play sad havoc among the lice. The larva of a Syrphus fly, *Pipiza radicum*, which feeds on the root louse of the apple, see figure 79, has also been found attacking the Phylloxera. Another useful friend is a small mite, *Tyroglyphus phylloxera*, P. & R., see (Fig. 80), which attacks and destroys the lice, and

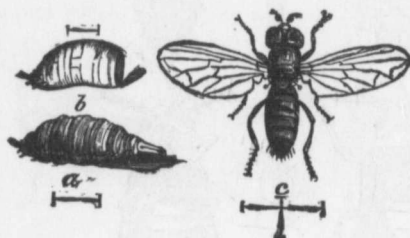


Fig. 79.

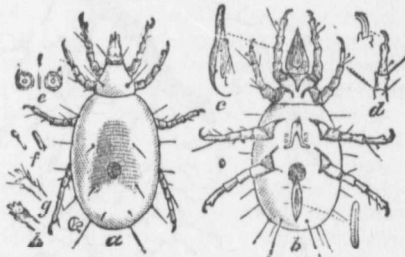


Fig. 80.

associated with this is sometimes found another species, *Holophora arctata*, Riley, of a very curious form, reminding one of a mussel. In (Fig. 81), this minute friend is represented highly magnified in the different forms assumed by it.

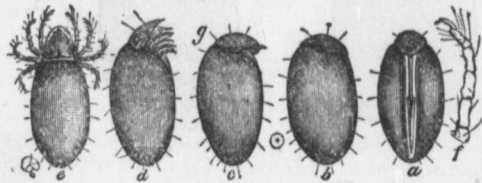


Fig. 81.

are found upon them, these latter may be destroyed by immersing the roots in hot soap suds or tobacco water.

Our native American vines are found to withstand the attacks of this insect much better than do those of European origin, hence by grafting the more susceptible varieties

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The Grape Berry Moth—Lobesia botana.

This is another grape pest which has appeared in our midst of late and promises to be a troublesome insect to contend with. It is an imported species, one which has long been injurious to grape culture in the south of Europe. The exact period of its introduction to America is not known, and it is only within the past few years that attention has been called to its ravages. When abundant it is very destructive ; in some instances it is said to have destroyed nearly fifty per cent. of the crop.

During the past season it has been very abundant in the neighbourhood of London, there being very few vines the fruit of which has not been more or less injured. The young larvæ have usually been first observed early in July, when the infested grapes show a discoloured spot where the worm has entered. See (Fig. 82 c). When the grape is opened and the contents carefully examined there will usually be found in the pulp a small larva rather long and thin, and of a whitish green colour.

Besides feeding on the pulp it sometimes eats portions of the seeds, and if the contents of a single berry are not sufficient, two, three, or more are drawn together as shown in the figure and fastened with a patch of silk mixed with castings, when the larva travels from one to the other, eating into them and devouring their juicy contents. At this period its length is about an eighth of an inch or more ; the head is black and the next segment has a blackish shield covering most of its upper portion ; the body is dull whitish or yellowish green. As it approaches maturity it becomes darker in colour and when about one-third of an inch long is full grown, see *b*, figure 82. The body is then dull green with a reddish tinge and a few short hairs, head yellowish green, shield on next segment dark brown, feet blackish, pro-legs green.

When the larvæ is full grown it is said to form its cocoon on the leaves of the vine, cutting out for this purpose an oval flap, which is turned back on the leaf forming a snug enclosure which it lines with silk ; frequently it contents itself with rolling over a piece of the edge of the leaf, and within such retreats the change to a chrysalis takes place. The chrysalis is about one-fifth of an inch long and of a yellowish or yellowish brown colour, from which the moth finally escapes.

The perfect insect which is shown magnified, *a*, figure 21, measures when its wings are spread nearly four-tenths of an inch across. The fore-wings are of a pale, dull bluish shade with a slight metallic lustre, becoming lighter on the interior and posterior portions, and ornamented with dark brown bands and spots. The hind wings are dull brown, deeper in colour towards the margin, body greenish brown. It is said that there are two broods of this insect during the year. We have never seen them at any other time than in the autumn when the grapes are approaching maturity.

REMEDIES—As it is probable the most of the late brood pass the winter in the chrysalis state attached to the leaves, if these were gathered and burned a large number of the insects would perish. The infested grapes might also be gathered and destroyed. This insect is attacked by a small parasite which doubtless does its part towards keeping the enemy in subjection.

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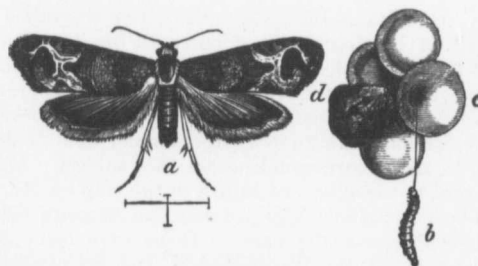


Fig. 82.



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The Clover Seed Midge—Cecidomyia leguminicola.

This new insect pest to which we referred at some length in the Report for last year, seems to be rapidly spreading. It has destroyed a considerable portion of the seed grown in the neighbourhood of London, an injury felt this year more than it would usually be on account of the light crop, resulting from an unfavourable season.

As stated last year, this insect is no doubt being spread by the dissemination of infested clover seed. The larva is very small, not more than one-hundredth of an inch long, and of a reddish or orange-red colour. When the seed is threshed these larvæ are mixed with it, and they remain in the larval condition all winter with the seed, and are sown with the seed in the spring. Once in the ground the insect finds all the conditions necessary for its full development, and before long it issues as a fly and enters on its work of destruction, producing two broods during a year. Farmers should exercise caution in the selection of their seed; and seedmen should carefully examine the seed they sell, otherwise they may seriously injure the prospects of their customers by introducing and disseminating this pest in districts hitherto free from it.

The Hessian Fly—Cecidomyia destructor Say.

On 26th of July last, my attention was called to the wheat growing in the neighbourhood of London by one of our most intelligent and successful farmers, Mr. John Wallis, of lot 32, con. 4, London township, who had found evidences in his own fields of injury caused by an insect, which, on examination, proved to be the Hessian Fly. I at once called general attention to the subject by addressing the farmers of Ontario through the London and Toronto newspapers under date of July 28th, and soon became involved in an extensive correspondence on this subject. My impression as stated at the time with regard to the extent of injury to the crop on Mr. Wallis's farm, was, that it would prove to be a loss of about 20 per cent., an estimate which results have since shown to be rather under than over the mark. There were many other wheat fields about London worse than those of Mr. Wallis, and if with his careful farming—involving proper rotation of crops and thorough manuring—his loss was so large, it must have been much larger in proportion on many farms less judiciously managed.

As indicating the area over which the insect prevailed, the following extracts from correspondence are submitted: Mr. John Morrison jr., of Oban, Lambton Co., says, "In reply to your letter in the *Weekly Globe*, I would say, that our own fields are badly infested with the Hessian Fly, more than half the crop, I should judge, being injured; other fields I have seen about here are not quite so bad but still injured apparently to the extent of from 20 to 40 per cent."

Dr. C. P. Pitcher, of Jerseyville, sent me samples of wheat containing the larva of the Hessian Fly from his district, and writes, "the enclosed samples of the work of the Hessian Fly I cut from a field of wheat on the farm of Mr. Zenus Weaver, in the Township of Ancaster, Co. Wentworth. Had my attention not been drawn to the subject by your letter in the *Globe*, I should not have investigated the matter. There is a considerable proportion of the wheat in this district crinkled down from this cause."

Mr. Roland W. Gregory, of St. Catharines says, "I herewith send you statement of my experience with the Hessian Fly in my present crop. About the middle of September last, I sowed a field of about seven acres of wheat, which I had fallowed and covered with manure, the field as I thought being in an excellent condition for a crop of wheat. The season being very dry and the soil not uniform in its character, varying from light sand to sandy loam, clay loam, and clay, the wheat did not come up evenly. On that part of the field where the wheat came up first and looked well in the fall, the Hessian Fly commenced working, and in the latter part of November I found one plant on which I counted nineteen of the small maggots, while in that portion of the field where the soil was poor the wheat came up later and escaped the fly, and the crop is now very heavy. In that part of the field so badly infested with it, nearly every stem had the insect in it in the flax-seed state."

Mr. James August as follows: damage amongst neighbours, tell appeared to be about it until I some stalks, and herewith sample rectness of my flax seed state.

Judging from the estimate for loss to the farmer must be a very large weight and appearance of the healthy ones sent a plump number taken from less firm, and we late sowing as result last, Mr. Wallis ground as that or value of this record so as to give the impression it promises an abundance

HOMOPTERA

The Cicadae under the name of It is to this Although now generally used for any objectionable thing disagreeable "bug-bear." Perhaps account of the disfigurement have the power of

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Mr. James Hammond, of Hammond P. O., Perth Co., writes under date of 7th of August as follows: "I noticed some time ago that something was doing considerable damage amongst my fall wheat (silver chaff variety). I mentioned the fact to some of my neighbours, telling them that it appeared to be cut at, or near the ground, but they appeared to be equally ignorant with myself as to the cause, and I thought little more about it until I saw your letter in the last issue of the *Weekly Globe*, when I examined some stalks, and find from your description that it is the genuine Hessian Fly. I enclose herewith samples of the insect in stalk, from which you will be able to judge of the correctness of my conclusion." These stalks from Mr. Hammond contained the insects in the flax seed state.

Judging from these letters which may be taken as fair samples of the correspondence, the estimate formed was, I think, rather under than over the mark, and the aggregate loss to the farmers of Ontario from the depredations of this insect during the past season must be a very large sum, as the area of land under wheat was very extensive.

Through the kindness of Mr. John Wallis, I have been enabled to compare the weight and appearance of the grain in the ears of the injured stalks with that of those of the healthy ones. I find that 100 of the kernels from the healthy plants which presented a plump appearance and a firm structure weighed 120 grains, while the same number taken from diseased stalks present a shrivelled appearance and a structure much less firm, and weighed only 59 grains, a difference of a little more than 100 per cent. By late sowing as recommended in my annual address to the Entomological Society in August last, Mr. Wallis now has a field of fall wheat in excellent condition, occupying the same ground as that on which the wheat was most injured last season. In order to test the value of this recommendation, he has departed from his usual course of rotation of crop so as to give the insects a fair chance, and judging from appearances at the present time it promises an abundant yield.

HOMOPTERA.—THE HARVEST FLIES AND THEIR ALLIES.

By JAMES FLETCHER, OTTAWA, ONT.

The Cicadæ or Harvest Flies belong to that order which is known to Entomologists under the name of Hemiptera, (from two Greek words $\eta\mu\iota$ = half, and $\piτερόν$ = a wing).

It is to this order of insects, alone, that the name—bug—properly belongs. Although now generally applied to all kinds of insects, it appears formerly to have been used for any object of terror, real or imaginary, and also as a term of contempt for something disagreeable and hateful; we have a remnant of its original meaning in the word "bug-bear." Perhaps the name was applied more distinctively to the Hemiptera on account of the disgusting odour which many of the Heteropterous members of the order have the power of emitting when disturbed.

In their earlier stages the Hemiptera have what are known as Incomplete Metamorphoses—that is, they do not entirely change their conditions during each of the different periods of their existence, as the Lepidoptera and Coleoptera do, where there is first of all the egg that hatches into an active larva which when full grown passes into a quiescent pupal state, previous to the fully developed imago condition.

The pupæ of the Hemiptera are active and very similar to the larvæ; in fact the only noticeable change which takes place in the form of these insects, from the time the egg hatches until they attain the perfect shape, is a gradual development of their wing covers and wings, and the growth of their bodies which makes it necessary for them to frequently cast their skins. When all the transformations have been completed, the imagines (perfect insects) generally possess four wings; the superior pair or hemelytra which are attached to the mesothorax, have the basal part or *corium* opaque and of a leathery consistence and the apical portion membranous and transparent; the inferior pair are attached to the metathorax and are entirely membranous and generally transparent and capable of being folded when the insect is in repose.

The whole of these insects are *Suctorial*—that is, live on fluids. To enable them to do this their mouth parts consist of a more or less slender beak or *promuscis*, which varies

according to the food or the circumstances under which they live. Those species which feed on animal food or under bark, have shorter and thicker beaks than those which derive their nourishment from vegetation, and as the former are for the most part beneficial and feed on other insects, this is a very important distinction for everyone to become familiar with. The beak consists of the labium, which is so modified as to form a hollow sheath, by having its two sides turned up, so that a deep groove is left in the middle of its upper surface, which acts both as a canal up which the juices on which the insect feeds flow, and also as a sheath for four delicate sharply pointed *setæ* or bristles which are actually the jaws and maxillæ modified for a special use. It is with these instruments that the insect punctures the plant or animal from which it derives its food.

The insects comprised in this order are of the most anomalous shapes, and there are embraced within its limits some of the most curious and wonderful forms of insect life. Their geographical range is very wide, for there is hardly any part of the globe of which the land and water do not produce their own peculiar forms. The number of species classed within this order is said to reach nearly 10,500, which are about equally divided between the two sub-orders into which the Hemiptera are divided. These two sub-orders are called Hemiptera-heteroptera and Hemiptera-homoptera, which again are divided into divisions and sub-divisions, and the latter of these are distributed into families which contain the various genera and species.

It was Latreille who divided the Hemiptera into these two divisions: "The Homoptera are the higher in rank, as the body is more cephalized, the parts of the body more specialized, and in the Aphidæ which top the series, we have a greater sexual differentiation, the females being both sexual and asexual, the latter by a budding process, and without the interposition of the male, producing immense numbers of young which feed in colonies. The Heteroptera, on the other hand, have the body less compactly put together, the abdomen and thorax are elongated, the head is small compared with the rest of the body, and the species are large (a sign of degradation among insects) and several families are aquatic, indicating a lower grade of development, while representatives of these were the first to appear in geological times. Their affinities are with the Orthoptera and Neuroptera, while the Homoptera whose bodies are more cylindrical ally themselves with the first and higher series of sub-orders."—(Packard).

For convenience sake we will take a short glance at the Heteroptera first, and then pass on to the Homoptera.

In the Hemiptera-heteroptera (*ἕτερος* = various, *πτερά* = wings) the hemelytra are thick and opaque at the base, but membranous and translucent at the tips; they lie horizontally on the top of the back and cross each other obliquely so that the translucent part of one overlaps the same part of the other. The underwings which these cover are entirely membranous; the head is horizontal and bears on its front part the articulated promuscus or beak which is bent down and carried underneath the breast. Between the wings there is a scutellum which is generally triangular, but which is sometimes so large as to cover the

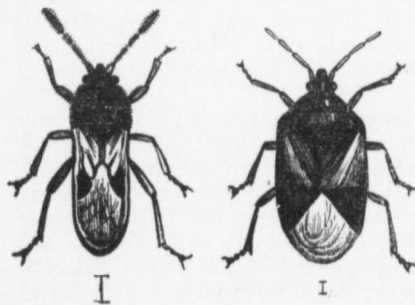


Fig. 83.

whole of the upper side of the body, leaving only the margins of the fore-wings visible. (See figure 83). The modes of life among these bugs are very varied; animals, birds, insects and plants are all liable to their attacks, and they are sometimes exceedingly destructive. For the most part they are found upon the plants on which they subsist; but others again feed on weaker insects found in similar situations. They continue active and require food during all their stages. The larvæ are distinguished by the total want of any appearance of wings; whilst in the pupæ the rudiments of these limbs appear on the back of the thorax. All of these insects have ocelli or

simple eyes on the front of the head between the two large compound eyes, but these, like the wings, are only developed in the perfect state.

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(2.) Aur

1. *Hydra*

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Within the forms, and some examination can Musical Cicadæ, hoppers and Lea the destructive extraordinary Co excrescences than

None of the sidered this such into three section

1. Trimeræ.

2. Dimeræ.

3. Monomeræ.

The great entomologist, Latreille, divided this order into two primary sections to which he applied the names of *Geocoris* or Land Bugs, and *Hydrocorisa* or Water Bugs. Westwood, however, improved on this arrangement by calling the former of these *Aurocorisa*, or Air Bugs, because there were certain species (*Hydrometridæ*) which had to be included in it, but which do not live on land, but pass the greater part of their time on the water, although they never dive below the surface. These species were also included by Latreille in his *Geocorisæ* and called *Ploteres*. Westwood's arrangement of Latreille's system was as follows:—

- (1.) *Hydrocorisa*, or those which reside in water.
- (2.) *Aurocorisa*, or those which breathe the free air.

1. *Hydrocorisa*.—There are many species of water bugs which differ very much in appearance, but they all have the antennæ very short and concealed in cavities beneath the eyes, their legs are modified according to their mode of life: the anterior pair are short and fold close to the body, forming a pair of claw-like organs with which they seize their prey; the other legs, particularly the last pair, are generally elongated and ciliated with stiff bristles which spread out when the limb is driven backward through the water and so act as the blade of an oar; of course when drawn forward they pass through the water easily. The eyes are often of a large size. Nearly all the species in this group are of a dull inconspicuous colour. They have to come to the surface of the water frequently to obtain a supply of atmospheric air, which they carry down to the bottom again in different ways; among the *Notonectidæ* it is carried in a space beneath the closely fitting hemelytra and the upper surface of the abdomen, where it is retained by means of rows of hairs. It is into this cavity that the spiracles or mouths of the breathing tubes open.

2. *Aurocorisa*.—In this section the insects may be generally recognized by the greater length of the antennæ, and by the legs being fitted for running and walking and not for swimming. Good examples of these insects are found in the destructive Squash Bugs and Chinch Bugs, as well as in the useful Spined Soldier Bugs and Rapacious Soldier Bugs. This, too, is the section which boasts the possession of that highly objectionable creature, the bed-bug (*Acanthia lectularia*), but it also includes the *Reduvii*, a family of cannibal insects, one species of which, *R. personatus*, is known in Europe to feed on these, and which family is represented in Canada by some useful species.

The other sub-order of the Hemiptera is called Hemiptera-homoptera ($\delta\mu\acute{o}\varsigma$ = like, $\pi\tau\epsilon\rho\alpha$ = wings), or same winged, because both the upper and under pairs of wings are of a similar character; both pairs are membranous, generally transparent and net-veined, the upper larger than the lower. The wings do not lap over each other when the insect is in repose as is the case among the Heteroptera, but are much deflexed at the sides and lie over the back like the roof of a house. The body is generally thick and convex, rather than depressed, and this partly accounts for the deflexed position the wings take when not in use. With few exceptions the antennæ are very short and bristle like. The face is either vertical or slopes obliquely under the body, so that the beak, which is composed of three joints, two short ones and one very long one, is set rather far back and issues from the under surface of the head close to the breast. In nearly all it is long and slender, as they all feed entirely on vegetable juices.

Within the limits of this sub-order are included some very grotesque and curious forms, and some which at first sight are apparently very dissimilar; but which, on a careful examination can easily be recognised as belonging to the same group. There are the Musical Cicadæ, the well-known Lantern-flies, the active, strangely-formed little Tree-hoppers and Leaf-hoppers, the Cuckoo-spit insects or Frog-hoppers, the lively Psyllidæ, the destructive Aphides or Plant-lice, with their remarkable transformations, and the extraordinary Coccidæ, or scale insects, which bear a closer resemblance to vegetable excrescences than to living animals.

None of the species have more than three joints of the feet, and Mr. Westwood considered this such an important character that he based his system upon it, dividing them into three sections:—

1. Trimera. Tarsi three jointed; antennæ minute, setigerous; wings areolate.
2. Dimeræ. Tarsi two jointed; antennæ, filiform, 5 to 10 jointed; wings sub-areolate.
3. Monomera. Tarsi one jointed; antennæ, 6 to 25 jointed; wings not areolate.

In the first of these divisions the Cicadae or Harvest flies find their appropriate place—in fact the first section of Westwood's arrangement corresponds with Linné's genus Cicada, or Latreille's family Cicadares. The name of the Cicadae is supposed by some to be a hybrid word derived from the Latin *Cicum* = a thin skin, and the Greek *αδειν* = to please, in reference to its song; others derive its name from the Latin words *Cito Cadat*, implying that the perfect insects are short-lived. The Cicadidae are the largest insects in the sub-order. In Westwood's *Arcana Entomologica*, Pl. 51, there is a figure of a gigantic species (*Cicada Imperatoria*, Westwood) which measures eight inches and a quarter between the tips of the outstretched wings, and in my own collection I have a very beautiful Indian species which measures six inches. This latter belongs to a group of the Cicadidae, in which the wings are opaque and more or less coriaceous; the upper wings are of a dull, reddish black, with the veins of a slightly lighter shade, and across the middle of them there is a broad white band three-sixteenths of an inch wide; the rest of the upper surface is black, with the exception of a bright orange band across the prothorax. The eyes and the abdomen are a rich brown and the underwings a deep velvety black.

The Cicadidae have the head short and broad with two large prominent eyes and three ocelli placed in a triangle between them; usually the wings are completely membranous, of a uniform consistence and delicately transparent, with few but distinct nerves. There are, however, a few exceptions to this rule, as in the Indian genus *Polynura*, where the apical division of the wings is very thickly reticulated; and in a small group of the Cicadae where the hemelytra are wholly, or in part, of a coriaceous nature. The abdomen is short and pointed, and the legs are short, the anterior femora are much thickened and toothed beneath. The ovipositor of the female is a very interesting object. This organ, which is the instrument with which the female places her eggs in a safe and proper asylum to wait until they are hatched, is lodged in a sheath which lies in a groove of the last ring of the abdomen. It is of equal thickness throughout, except at the tip, where it is slightly enlarged and angular. On each side it bears a set of nineteen sharp teeth, very fine at the point, and from that gradually increasing in size. The sheath is composed of two horny pieces, slightly curved, and ending in the form of a long spoon, so that the concave or hollow part may receive the convex or rounded part of the ovipositor. On examining this auger, for such it really is, under the microscope, it will be found to be three pieces most beautifully fitted together—two outer ones which have an alternate and separate motion, and on the outside edges of which the rows of teeth before mentioned are situated, and another fixed single piece, in between the other two, at the back, to which they act as a sheath, but which in turn supports and keeps them in their proper place by means of two internally-dilated lateral grooves, which receive the dilated edges of the serrated pieces, and in which these slip up and down. This last supporting dorsal-piece has a deep groove down its centre, and it is thought to consist of two separate pieces firmly soldered together, but which have not the slightest motion independent of each other. This instrument is composed of a hard horny substance called chitine, the same as are the stings of bees and wasps, and the ovipositors of Ichneumon flies. The auger of the Cicada then consists of two sharp saws which work alternately, and a central supporting dorsal-piece which holds them in their place and strengthens them. This instrument somewhat resembles the saw of the saw-flies, but as it has slightly different work to perform it bears corresponding modifications. It would, however, be impossible to conceive anything more exactly fitted for their required uses than these beautiful organs are.

The most peculiar characteristic of this family however consists in the structure of the musical instrument with which the males make the trilling sound for which they have been famous since ancient times. These organs are internal, and consist of two stretched membranes which are acted upon by two strong muscles, and the sound issues from two holes beneath two special expansions of the metasternum, which both cover up and protect these tympana or sound organs, and also act as sounding boards. The song varies much in the different species, and it would appear that the voice of the European one must have a much more grateful tone than that of his American cousin which we know, for we read in Kirby and Spence that the song of the Cicada has been a favourite theme in the verses

of every Grecian
Entomologica'

These insect
priests—"They
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they were addre
One bard entrea
nymphs, and to
Sweet prophet of
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Virgil accuse
As far as our own
gist, could persuad
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slowly at first, and
to descend rapidly
throat, that he had

of every Grecian bard from the time of Homer to Anacreon. In Westwood's "Arcana Entomologica" the following translation of Anacreon's ode to the Cicada is given:—

Happy creature! what below
 Can more happy live than thou?
 Seated on thy leafy throne,
 (Summer weaves thy verdant crown,)
 Sipping o'er the pearly lawn
 The fragrant nectar of the dawn;
 Mirthful tales thou lov'st to sing,
 "Every inch" an Insect King:
 Thine the treasures of the field,
 All thy own the seasons yield;
 Nature plants for thee the year,
 Songster to the shepherds dear:
 Innocent, of placid fame,
 Who of men can boast the same?
 Thine the lavished voice of praise,
 Harbinger of fruitful days;
 Darling of the tuneful nine,
 Phœbus is thy sire divine;
 Phœbus to thy notes has given
 Music from the spheres of heaven:
 Happy most as first of earth;
 All thy hours are peace and mirth;
 Cares nor pains to thee belong,
 Thou alone art ever young;
 Thine the pure immortal vein,
 Blood nor flesh thy life sustain;
 Rich in spirits—health thy feast;
 Thou'rt a demigod at least.

These insects are also emblematically represented in the hieroglyphics of Egypt as priests—"They were called Tettix by the Greeks by whom they were often kept in cages for the sake of their song. Supposed to be perfectly harmless and to live only on the dew, they were addressed by the most endearing epithets and were regarded as all but divine. One bard entreats the shepherds to spare the innoxious Tettix, that nightingale of the nymphs, and to make those mischievous birds—the thrush and blackbird—their prey. Sweet prophet of the summer, says Anacreon, addressing this insect; the muses love thee; Phœbus himself loves thee, and has given thee a shrill song; old age does not wear thee out; thou art wise, earth-born, musical, impassive, without blood; thou art almost like a God. So attached were the Athenians to these insects that they were accustomed to fasten golden images of them in their hair, implying at the same time a boast that they themselves, as well as the Cicadæ, were *Terræ filii*. They were regarded indeed by all as the happiest as well as the most innocent of animals—not, we will suppose, for the reason given in the couplet by the saucy Rhodian bard, Xenarchus, where he notices the peculiarity of the males alone being possessed of the power of singing, and says:—

'Happy are the Cicadæ's lives,
 Since they all have voiceless wives.'

That the Grecian Cicadæ had more musical notes than ours is proved by the fact that its song and the music of the harp were both called by the same name *τερεσισμα*. The Cicada was the emblem of the Science of Music, which was accounted for as follows:—When two rival musicians, Eunomus and Ariston were contending on the harp, the former broke a string and would have been beaten but a Cicada flew down, and settling on his harp, supplied with his voice the missing string and gained him the victory. At Surinam there is a species which is still called *Lierman*, from a supposed resemblance between the sound of the harp or lyre and its song.

Virgil accuses a species found in Italy of bursting the very shrubs with its voice. As far as our own species are concerned, too, I fear no one but an enthusiastic Entomologist, could persuade himself that he found anything very pleasing in the song. I know of nothing more similar to that of *C. pruinosa*, the Frosted Harvest fly, than the noise of a scissors-grinder's wheel. The short carol seems to be produced with a tremendous effort, slowly at first, and gradually rising in intensity of pitch, until at a certain point it begins to descend rapidly, so that one might suppose, if the chorister made the noise with his throat, that he had been seized by that member and were being strangled.

The Dog-day Cicada, or Frosted Harvest fly, which is known under the name of *C. canicularis*, as well as that given above, is by far the commonest species in Canada. It is a large handsome fly, sometimes over two inches in length from the front of the face to the end of the hemelytra. The head is black and prettily variegated with green and brown markings; it is very wide, short and transverse; the eyes are prominent, and the thorax is broad and also ornamented with green and brown markings. The wings are transparent and slightly hyaline. The outer edge and the veins of the basal portion are green for about one-third of their extent and deep brown for the remainder; towards the apex of each hemelytron there is a brown W shaped mark. This insect, which is to be heard on hot days throughout the whole summer, is tolerably common in Canada, but is somewhat difficult to capture. In passing through the rocky country between Lake Superior and Manitoba about the middle of last September, I heard many of these flies trilling out their shrill notes. The specific name *pruinosa* = frosted, is given on account of the newly-evolved imagines being thickly covered beneath their abdomens with a white powdery matter, which gradually gets rubbed off as the insects get older.

In the United States this Cicada is carried off by large burrowing wasps or hornets as food for their young. These wasps are exceedingly handsome and are called *Stizus grandis* and *S. speciosus*. I have a specimen of the former of these which was captured in the act by Mr. A. H. Moore in the Smithsonian grounds at Washington. It measures one inch and three-quarters from the forehead to the tip of the abdomen, and possesses a large formidable sting with which these insects paralyze their victims previous to storing them away as food for their progeny. In the American Entomologist, vol. 1, N.S., there is a most interesting account of the instinct displayed by *S. speciosus* in availing itself of a favourable wind to transport its victims to its burrows, which, on account of their large size compared with its own, it would be unable to do without some assistance.

Cicada rimosa, Say.—The Creviced Harvest fly is the smallest species we have; it generally appears a few weeks previous to *pruinosa*, and in the United States at the same time as *C. septendecim*, which it resembles somewhat and with which it has been frequently confounded. It has the outer edge of the wings, parts of the legs and the edges of the abdomen of a yellowish brown, but not so bright as in *septendecim*, and the eyes are dark. In size, too, it is much smaller.

Cicada septendecim, L.: the Seventeen-year Locust.—This remarkable insect, concerning which so much has been written, is also said to have been found in Canada. It is a slighter insect than *C. pruinosa*, and its colours are much brighter; the body is black and the eyes reddish orange, the legs and under-side of the abdomen are orange, as are also the outside edges and veins of the wings.

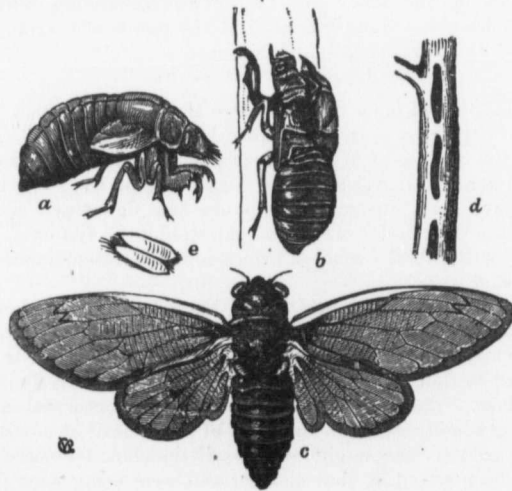


Fig. 84.

Fig. 84, copy idea of the appearance of the honey-yellow in through the rest of the appearance of the jointed antennae considerably from that represented by the ovipositor; its name implies, this fact.

Prof. Riley, interesting point appearances. However, occur in the same the southern form pective ranges the ally *C. tredecim*. propriety of Linn make the dates of ing at the end of he gives a full of the largest seventhirteen year bro particular broods, till the year 2089.

There are absolute time of maturing, which appears with points from the voice, appears a described by Dr. considered to be such.

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Fig. 84, copied from Prof. C. V. Riley's first report of Missouri, gives a very good idea of the appearance of this insect in its various stages: *a* represents the pupa which is honey-yellow in colour; *b*, the cast-off skin from which the perfect insect has emerged through the rent in the back. When the larva is first hatched from the egg it presents the appearance shown at Fig. 86, and is an active little creature which moves its long eight jointed antennæ as dexterously and rapidly as does an ant; the mature larva differs considerably from the newly-hatched one, but principally in having shorter antennæ; *c* represents the fully developed fly, and *d* a piece of a young branch which has been bored by the ovipositor of the female for the reception of her eggs, which are shown at *e*. As its name implies, this insect generally requires seventeen years to complete its transformations; this fact was pointed out many years ago by the botanist Kalm.

Prof. Riley, who has given this species a great deal of study, and discovered many interesting points in its history, was the first to work out the problem of its periodical appearances. He found that there are also thirteen year broods and that both sometimes occur in the same locality, but that in general terms the thirteen year brood might be called the southern form, and the seventeen year the northern form; at the two limits of their respective ranges these broods overlap each other. The shorter-lived form he called provisionally *C. tredecim*. It was the existence of this brood which caused Entomologists to doubt the propriety of Linné's name, until Prof. Riley cleared the matter up, because they could not make the dates of its periodical visits correct when calculating each appearance as occurring at the end of every seventeen years in any one locality. In his first Missouri Report he gives a full account of his investigations, and relates that "it happened that one of the largest seventeen year broods occurred simultaneously with one of the largest thirteen year broods in the summer of 1868. Such an event, so far as regards these two particular broods, has not taken place since the year 1647, nor will it take place again till the year 2089.

There are absolutely no specific differences between the two broods other than in the time of maturing. Another interesting discovery was, that there is a dimorphous form which appears with both these broods. It is much smaller and differs in many important points from the ordinary form. The colour is much darker, it has an entirely different voice, appears a fortnight sooner, and the two forms never copulate. This form was described by Dr. J. C. Fisher in 1851, as *C. Cassinii*, but the specific differences are not considered to be sufficiently well defined to give it the rank of a species.

The perfect insects make their appearance in the United States in the beginning of June, and last for about a month, and as they generally appear in vast numbers, they do considerable damage. Local changes take place so rapidly now, and these flies take so long to perfect themselves, that frequently roads are built and paths made in places where, perhaps seventeen years before, when they were hatched from the egg, it was virgin soil. This contingency frequently makes it necessary for them to bore through hard roads and between stones well beaten down; and that they do this, the honeycombed state of the ground bears ample testimony. When the larvæ, in which stage the insect passes the greater part of its life, is full grown, it works its way up towards the surface, and then turns to the pupa state, which only lasts a few days. When they are ready to emerge they leave their burrows as evening draws on, and crawl up on to some object elevated above the ground, such as a fence or the stem of a plant; this they grasp firmly with their claws, the skin of the back bursts and ten minutes afterwards the perfect insect has entirely freed itself of all encumbrance; the wings soon develop, but it is not for three or four days that the muscles harden sufficiently for them to assume their characteristic rapid flight and shrill song. As is the case with several other insects the males make their appearance some days before the females, and also leave sooner. The skin of the pupa (Fig. 84 *b*) retains its perfect shape for many months after the fly has left it. Those of *C. pruinosa* are very common here in a dry rocky wood. Prof. Riley also figures a remarkable chamber built up by the larva of this species in localities where the soil was low and swampy, and in which was found the pupa awaiting the time of its change to the winged state. These

chambers were first noticed by Mr. S. S. Rathvon at Lancaster, Pa., and are from four to six inches above the ground, with a diameter of one inch and a quarter. (See fig. 85.) When ready to emerge the insect backs down to an orifice which it left in the side of the structure, even with the surface of the ground, issues forth and undergoes its transformations in the usual manner. After pairing the females deposit their eggs in the twigs of different trees—oak, hickory, and apple chiefly, but also in many other kinds, and even sometimes in coniferous trees. The eggs are placed at the bottom of grooves bored by means of the ovipositor. The insect settles on a branch of moderate size, which she clasps on both sides with her head towards the end, then bending down the piercer at an angle of 45 degrees, thrusts it obliquely through the bark and fibres into the very centre of the twig; after this nidus is finished she deposits the eggs in two rows with a narrow

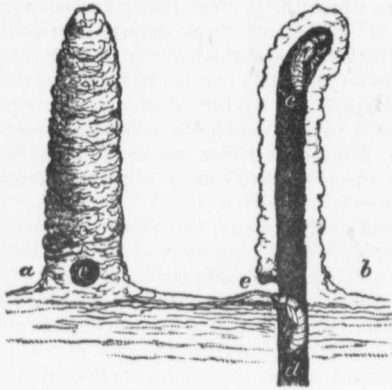


Fig. 85.

strip of wood left between them; there are from ten to twenty eggs in each groove. It takes about fifteen minutes to prepare a groove and fill it with eggs. There are sometimes as many as twenty grooves made in a branch by one insect, and each female has a stock of from 500 to 700 eggs. It frequently happens that these branches bearing the eggs, are so weakened by the operation, that they are broken off by the wind, and fall to the ground; when this is the case the eggs never hatch, for, like those of many of the gall flies the moisture of the living wood is necessary for their proper development, as shown by the fact that they are much larger just before hatching than when first deposited about six weeks before. When hatched, they throw themselves fearlessly from the tree to the ground, and from their small size, one line in length, they are very light and receive no injury. The newly-hatched insect is shown in fig. 86. They immediately burrow down into the ground and feed on roots. There are numberless stories in the newspapers every year about people being stung by the Cicadas, but none have ever been satisfactorily proved.



Fig. 86.

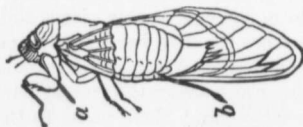


Fig. 87.

If these tales be true the injuries could, of course, only be inflicted by the beak, fig. 87 *a*, or by the ovipositor *b*, but I fancy that these tales are about as true as the newspaper accounts of the "frightful poisonings" yearly laid at the door of the larva of the Tomato Sphinx:

"The song of this species is in one uniform musical key, which is *C* sharp."

Of the Fulgoridæ or Lantern flies there is a small species found in the United States called *Scolops dulcipes*, which has the front part of the head much prolonged and projecting upward like a thin curved horn. Prof. T. Glover found it not uncommon in July and September in the neighbourhood of Maryland Agricultural College. None have so far been recorded from Canada.

Among the Cercopidæ are found several strange genera, including the Tree-hoppers, Frog-hoppers and Leaf-hoppers. The Tree-hoppers (*Membracis* of Harris) are dull-coloured little insects which are to be found on the stems and leaves of plants during the summer and autumn months. Many of them have very grotesque forms with the face nearly vertical, the thorax tapering to a point behind, and so much enlarged as to cover the greater part of the upper side of the body; it is too frequently ornamented with blotches or stripes of another colour. These insects are well protected from detection by their enemies, both by their habits and by a striking resemblance which frequently exists

between their shape and the leaves of the plants on which they are found. They are mostly of a green colour, and the enlarged thorax and the like processes resemble the leaves of the plants on which they have of sitting. —upwards towards the green species which they climb the bark and stem for hours together, their movement is sufficient to cause them to settle, and they settle in a class of insects which are so fugitive that many of them, when setting boards, are taken in the net of which an illustration I may mention that Mr. Harrington, a convenient pattern

Enchenopa bivittata and most curious larva of a partridge with small clusters on the stems of birds. Sometimes they are found on thorns or excrescences of the thorax, the insect is separated by a blade more than four lines long. One of the most remarkable four anterior tibiae, found on several trees

Smilia vau, E. butternut. It is a crest over the body. It is of a brown color.

Entilia carina plentifully on the cypripedium families beneath the leaves on the back, the species colours vary much: the posterior angle of broad subterminal vein

Ceresa bubalus, beautiful green. It is one on each side of the body, which fact it takes into account when disturbed. It is said to be deposited on the female in the bark puncturing the bark

C. diceros, Say.

from four to diameter of 85.) When down to an he structure, ound, issues tions in the females de- rent trees— also in many in coniferous e bottom of ositor. The oderate size, th her head n the piercer it obliquely o the very is finished ith a narrow ve. It takes ometimes as as a stock of eggs, are so the ground ; gall flies the own by the ad about six

between their shapes or marking and those portions of the plants which they infest. They are mostly angular in outline, some have the upper surface, which consists chiefly of the enlarged thorax, rough and dark coloured like the bark of a tree; others have horn-like processes resembling the thorns of a plant; this simile is further carried out by a habit they have of sitting still for hours on the stem of a plant with their heads all turned one way—upwards towards the end of the shoot. Some again are protected by their colours, as the green species which are found among foliage, or the brown and mottled ones which frequent the bark and stems of trees. Although, as stated above, they will sit still without moving for hours together, they are by no means asleep and are very difficult to capture. A slight movement is sufficient to make them spring from their resting-place with great quickness, and they settle again so suddenly that it is no easy matter to follow them. There is no class of insects which proves so well as these do the advantage of an Entomologist being to a certain extent an artist, for the colours of many of these interesting little insects are so fugitive that many of them lose their brightness almost before they are moved from the setting boards, and for a thorough study, paintings of them as caught are essential. We have several species in Canada, of which the following are some of the most interesting of those taken in the vicinity of Ottawa. They were most of them taken in the beating net, of which an illustration was given in the Canadian Entomologist for 1878, at page 62. I may mention that this net has received a thorough trial at the hands of my colleague, Mr. Harrington, and myself, and we have found it most satisfactory, and by far the most convenient pattern yet brought to our notice.

Enchenopa binotata, Say: the two-spotted Tree-hopper.—This is perhaps the prettiest and most curious little insect we have of this order. Its shape, in profile, is exactly that of a partridge with outstretched neck and head. It also has the habit of congregating in small clusters on the stems of the plants it feeds upon, and as there are generally specimens in all the different stages of growth, they may be likened to a brood of those birds. Sometimes the perfect insects form in single file along a branch, when they look like thorns or excrescences of the bark. The long neck-like extension is only a prolongation of the thorax, the head of course is underneath and furnished with a promuscis or beak for sucking sap. The general colour is a dark brown, and there are two yellow spots separated by a black space on the ridge of the back (thorax). The total length is not more than four lines from the apex of the wings to the tip of the thoracic protuberance. One of the most remarkable characteristics of these insects is found in the shape of the four anterior tibia, which are very broad and flat. It is not an uncommon species, and is found on several trees such as hickory, butternut, locust and *Celastrus scandens*.

Smilia var., Harris.—The V-marked Tree-hopper is also found on the hickory and butternut. It is about three lines in length with the thorax, which forms an arched crest over the body, rounded in front and keeled from the middle backwards to the tip. It is of a brown colour, and has its back ornamented with V-shaped marks.

Entilia carinata, Forster: the keeled Tree-hopper.—This species I have found plentifully on the common sun-flower (*Helianthus annuus*) clustered together in small families beneath the leaves. They are about one-fifth of an inch long and have two humps on the back, the space between them being in the shape of a complete semi-circle. The colours vary much: in some specimens it is a light cinnamon with wavy lines running to the posterior angle of the very large thorax. In others it is a dark reddish brown with a broad subterminal white band, the front is almost perpendicular and black.

Ceresa bubalus, Fabr.: the Buffalo Tree-hopper.—The colour of this species is a beautiful green. It is very triangular in shape, and has a pair of sharp curved spines, one on each side of the thorax, which somewhat resemble the horns of a buffalo, and from which fact it takes its specific name. It is a very active species, and flies a long distance when disturbed. I have taken it on young apple-trees and rose-bushes. The eggs are said to be deposited in a curved row, in a series of punctures made by the ovipositor of the female in the bark of several trees. It has been accused of injuring grape-vines by puncturing the bark of the stems for this purpose.

C. diceros, Say.—The two-horned Tree-hopper much resembles the last in shape and



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size, but has a brown spot on each side of the thorax behind the horns, and a bar across the middle of the back and the posterior tip, of the same colour.

Telamona ampelopsidis, Harris.—Is a rather large Tree-hopper, sometimes measuring half an inch in length. It is found on the Virginian Creeper (*Ampelopsis quinquefolia*) and is very much the same colour as the bark of that plant. The thorax is raised up in the middle into a square hump and is crossed with three, more or less distinct, brown bands. I have taken this insect in the month of July.

In some of the Cercopidæ the face slopes downwards towards the breast; the thorax is of moderate size, and never extends much beyond the base of the wing-cases, and does not conceal the head when viewed from above.

The Frog-hoppers (Amphrophora), also called Cuckoo-spits, are those insects which have the habit of enveloping themselves in the remains of the liquid food which they suck from plants and then eject again in the form of a frothy substance with which they entirely cover themselves, in the same way that the larvæ of some beetles, to a less extent, cover their bodies with the remains of their solid food. In the perfect state, to which they attain late in the summer, they are very active insects, mostly of dull colours, and are to be found in grass and low herbage; one species, however, *A. parallela*, Say, is the insect which forms the small masses of foam, which may be seen on the young branches of pine trees in June and July. It is an oval brown insect about half an inch long with a white spot in the middle of each hemelytron. The popular names of these insects are taken from an absurd idea, which actually dates back to the days of Aristotle, and which is fully believed in by many people even to-day that the frothy excrementitious secretion was the spittle of the cuckoo or the frog.

Clastoptera proteus, Say, is a pretty little short and broad insect, roundish in shape and about two lines in length, having the head and thorax black with three bright yellow stripes; the hemelytra are of a peculiar shape, being deeply grooved in the middle and having the apices turned abruptly down; they are also marked with two short oblique yellow stripes, running from the shoulders to the middle of the back, and at the tip of each wing-cover there is a black spot. This species is said to feed on the cranberry and blueberry.

C. obtusa, Say, found on hickory, is a rather larger species of a much less conspicuous colour, being brownish grey, and having the hemelytra veined and spotted with brown towards the apex.

The Leaf-hoppers (Erythroneura).—There is no better known example of this genus than that dreadful little pest—the grape-vine leaf-hopper *E. vitis*, which in some years will entirely spoil a whole crop of grapes by destroying the leaves just when the berries are half formed. This annoying little fly is almost rendering impossible the cultivation of the ornamental Virginia Creeper in this city.

The grape-vines do not appear to have suffered so much, although the havoc among



Fig. 88.

these has been very great. The insect that causes all this mischief is really a most beautiful little creature. It is yellow with two red bands across the wings. (See Fig. 88). In the larva state it is bright crimson and has a very curious sidelong motion like a crab. The perfect fly nearly always settles underneath the leaf and sucks the sap from the parenchyma by means of its little trunk. The leaves first turn white, in patches, and then fall off. When large numbers of these flies spring from the leaves, as they will if the foliage is moved, they make quite a perceptible sound like rain. I have found them exceedingly difficult to combat, and really think the only way is to disturb them at night and hold a torch for them to fly into. There are a great many species of this genus in Canada, one of which is very troublesome to the apple. These flies are generally, but erroneously, called Thrips.

The second set of feet. In this section the head and in the texture. There are small insects of various kinds are known described. They are short and triangular in front of the face of the eyes.

The larvæ of *mamma*, Riley, living in a Montreal specimen informed me of its food, namely, in a word under the head of "The Flea-lice on Hackberry (*Celtis*) with their nearest relative." The egg, glued in place by the young fly till it has acquired a certain size and drop, then by the pupa works its way through the galls made by the *P. celtidis grandis* (which is an exception to the rule) less filled with a substance of *P. celtidis-mamma* rough bark of the adjacent trees. On the males are about the wings are deflexed at the tips, are traversed but once an

to show the general structure of the nerves are very delicate; the antennæ are jointed, the eight basal ones entirely

The second section of the Homoptera is known as Dimera, or those with two jointed feet. In this section we find very much smaller insects with antennæ longer than the head and in the winged individuals four wings ordinarily all of the same membranous texture. There are only two genera Psyllidæ and Aphidæ. The Psyllidæ or Flea-lice are small insects found on leaves and in some species raising galls. Although several kinds are known to occur, almost every tree having its own species, very few have been described. They have rather long antennæ terminated by two slender bristles; the beak is short and triarticulate, and the eyes are lateral and prominent as in the Cicadæ. On the front of the face are three ocelli placed in a triangle, the posterior ones quite close to the eyes.

The larvæ and pupæ have the body very flat, and in some species as *Psylla celtidis-mamma*, Riley, live in galls. I exhibited at the last annual meeting of the Society in Montreal specimens of the galls and pupæ of this species, and Prof. Riley then kindly informed me of its proper name, and told me where the only printed description could be found, namely, in an article written by himself for Johnson's "New Universal Cyclopædia," under the head of "Galls." For the benefit of our members I reproduce this in full:—"The Flea-lice produce galls of various shapes and sizes on the stems and leaves of the Hackberry (*Celtis*). In life habits they differ from all the other gall insects, and agree with their nearest relatives, the Plant-lice, only in being the architects of their own galls. The egg, glued in spring to tender leaf or twig, soon hatches, and under the irritation caused by the young *Psylla* the gall soon embeds it. Within this gall the insect dwells till it has acquired the pupa state, which is generally by the time the leaves begin to turn and drop, then by means of certain, horny spines or thorns at the end of its body, this pupa works its way out of its prison, and once out soon gives forth the perfect fly. The galls made by these Flea-lice are generally woody. Most of them are yet undescribed. *P. celtidis grandis* (Riley, M.S.) makes on the leaf-stalks a large grayish yellow swelling, which is an exception in being polythalamous. The few cells it contains are more or less filled with a white flocculent matter secreted by the insect." The perfect insect of *P. celtidis-mamma* appears in September and passes the winter in the crevices of the rough bark of the hackberry on which it underwent its preparatory stages, and adjacent trees. On November 24th last, I collected several specimens in a torpid state. The males are about one-eighth of an inch in length, and the females about one-third larger. The wings are deflexed at the sides of the body, and the hemelytra, which are rounded at the tips, are traversed by three strong nerves (the costal, median, and sub-median), each divided but once and disposed as shown in Fig. 89, which is another species, but serves

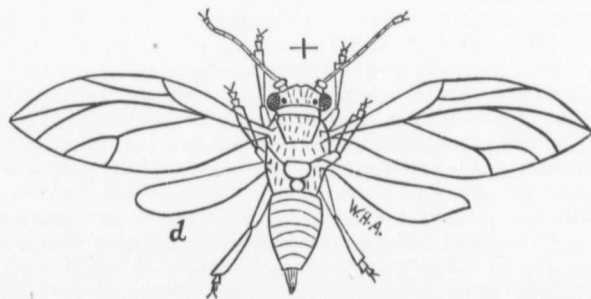


Fig. 89.

to show the general arrangement; the underwings are much more transparent and the nerves are very delicate. The colour is grey like the bark of the trees on which they are found; the antennæ which are terminated by two pairs of bristles are composed of ten joints, the eight basal ones yellow striped with black at their upper ends, and the two terminal ones entirely black. The femora are black for the greater part of their length,

as are the tarsi entirely; the tibiae are yellow. The thorax is black with a white median stripe, and the wing-cases are prettily mottled with brownish dots which form a dark triangular spot, in the middle of each, with the base on the costal margin; there is also a dark spot at the junction of each nerve with the margin, which has the effect of leaving a more or less distinct sub-terminal white band. The colours vary considerably, but seem to be darker in the females. The abdomen of the male is terminated by several bristle-like appendages, and that of the female by a conical ovipositor. In general appearance, although little more than one line in length, these insects much resemble miniature Cicadae. I found that many of the galls of this species also were polythalamous, one which I opened containing four pupae. The occurrence of this insect at Ottawa is somewhat interesting. The three trees of *Celtis occidentalis* upon which the galls occur are the only specimens of that tree which I have found in this locality, during four years of constant botanical investigation. Prof. Macoun, too, tells me that with the exception of a small grove at Belleville these are the only specimens he has heard of east of Toronto. It is evident then that it is quite uncommon, and yet these trees were so thickly covered with galls that the leaves in many instances had more than a dozen galls on their undersides, and had much more the appearance of bunches of berries than of foliage. How did these small insects which only feed on this tree traverse so great a distance from one locality to another? The gall is mammiform, having a thick fleshy outer coat, and inside this a thin woody one; the cavity inhabited by the flat larva is narrow, and the centre of the gall is filled up with a solid mass of the same nature as the outside wall. When the pupae are mature they work their way up through the top of the galls, which are all on the underside of the leaves, and come out on the upper surface.

The other genus in this division is *Aphis*. These exceedingly injurious insects which attack almost every form of vegetation, are too well known to need any elaborate description. The word *Aphis* is derived from a Greek word meaning to exhaust. Although most of these insects are of small size, very few exceeding one or two lines in length, yet they make up for their want of size by their vast numbers; the rapidity with which they increase is almost beyond credence. "Réaumur has proved that one individual in five generations may become the progenitor of nearly six thousand millions of descendants." (Harris, p. 235).

In the autumn the perfect Aphides pair, and the female lays an egg on the branch of a tree which hatches the next spring. The newly-born larva immediately begins its work of depredation, piercing the young leaves and shoots with its sharp beak. It grows rapidly and soon arrives at maturity. The Rev. J. G. Wood, in "Insects at Home," gives the following concise history of their lives:—"These insects are prolific almost beyond belief. As a general rule, insects lay eggs which are hatched, pass through the state of larva and pupa, and then become perfect insects. But the Plant-lice go on a very different plan. Sometimes as if to show that they are amenable to law, they do lay eggs; but this is the exception and not the rule, which is somewhat as follows, though varied every now and then by these most eccentric of insects: A female *Aphis* takes her place on a branch—say of the rose—plunges her beak into the tender bark and begins to suck the sap. After a short time she begins to produce young Aphides at an average of fourteen per diem. These young creatures are just like their mother, only less, and immediately follow her example by first sucking the sap of the plant and then producing fresh young. As to the opposite sex it is no business of theirs. The extent to which this peculiar mode of increase (gemination) can be carried may be imagined from the fact that a single female *Aphis*, isolated from the other sex, began to produce prolific females, which, in their turn, produced others, and so on for four years, during the whole of which time not a male *Aphis* had been suffered even to approach them. It is in consequence of this remarkable mode of production that the twigs and buds become so rapidly covered with Aphides, the quickly succeeding generations crawling over the backs of their predecessors so as to arrive at an unoccupied spot of bark in which they can drive their beaks. Thus, at the beginning of a week, say on Monday, a rose-tree may be apparently free from Aphides, or have at the most six or seven of the 'blight' upon it, but by Thursday the whole plant will be so thickly covered with Aphides that scarcely a particle of the bark can be seen."

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No part of a plant seems to be exempt from their attacks; driving their sharp beaks through the epidermis, they suck the sap from the leaves, the young twigs, the roots, and even the rough bark of the stem. A good representation of a too common species, *A. mali*, the apple blight, is given at Fig. 90, and illustrates the structure of most of these insects; we have the winged male of the natural size and the same with the female magnified. The best remedy for all the small insects which affect the bark and foliage of trees, is undoubtedly a frequent application of a solution of whale oil soap thrown on to the foliage by means of a syringe. The bark-lice which swarm on apple-trees in the autumn may be easily cleaned off by means of a thorough scrubbing with soap-suds; the addition of flour of sulphur to this mixture will prevent fungoid diseases making way where the Aphides have injured the bark. Many of the species make galls on different plants as on the poplar. The injuries done by these minute flies, I have said, is very great. Kirby and Spence state that the damage done to hops alone in England often made as much difference as £200,000 in the duty on hops in one year. I have myself occasionally seen in the south of England, what gave promise of being a splendid crop of hops, rendered worthless by a species of *Aphis*, in the short period of about a fortnight. It is to this family that the dreaded *Phylloxera* belongs which has absolutely rendered the cultivation of the vine impossible in some parts of France, and I know from personal information that a large grape-grower in one of the best champagne districts in that country had, in 1880, on account of this insect, simply to give up vine-growing, grub up his vineyards, and burn the vines.

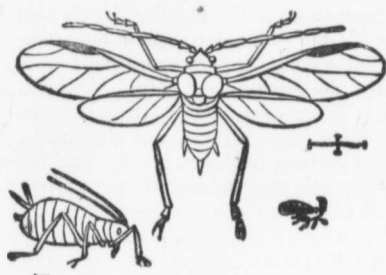


Fig. 90.

Our President has so ably described this insect in its different forms in several papers during the past year or two that further reference to it is unnecessary.

In the last division, Monomera, which have only one joint in the tarsus, we find those extraordinary insects the Coccidæ, or Scale insects, as they are called, on account of the peculiar shape of the females, which in different species take different forms; some are oval and more or less convex, some shaped like a boat turned bottom upwards, some kidney shaped or globular; and one of the best known, the oyster-shell bark louse, takes the shape its name implies. Westwood remarks truly: "These form one of the most anomalous tribes of insects with which we are acquainted, and which already prove that annulose animals may exist, which become more and more imperfect as they approach the winged state, and which in that state lose all trace of articulation in the body as well as of articulated limbs (as in the female Coccid), leaving, in fact, inert and fixed masses of animal matter, motionless and apparently senseless, and which resemble nothing more nearly than the vegetable excrescences called galls."

The females undergo only a partial transformation, and never possess wings; the males on the other hand have a complete metamorphosis, with a quiescent pupal state, in which the rudiments of the antennæ, wings, etc., are perceptible, and have the legs arranged on the breast with the anterior pair directed forwards, a peculiarity not occurring in any other insects. The mature female retains the beak, but does not acquire wings, and the male has two wings, but the mouth parts disappear.

The eggs are hatched beneath the protecting scale, which was formerly the mother's body; they soon make their escape, as active little six-footed grubs, with slender beaks and two long bristles at the end of the body; and in some species, as *C. adonidum*, the Mealy Bug of the greenhouse, are covered with a white powdery covering. Most species, however, are naked. At this stage both sexes are alike.

As soon as they leave the scale they move along the branches towards the tip, and fix their beaks in the bark of the twig. From this time they remain motionless, fastened to the epidermis of the plant by means of small white downy threads emitted from the undersides of their bodies, they lose the caudal bristles, a scale forms over them, and they increase rapidly in size.

In this condition they pass through the winter, and it is not until the following spring that the sexes are developed. Some of the scales will then be noticed to increase in size, and these are the females. Under the smaller scales the transformations of the males take place, and they are remarkably different from those of the females, for in this sex there is what is not found in any other member of this order, a complete metamorphosis. These males remain under the scales (their outer skins) from which they detach themselves, until they evolve as perfect insects. After the insects have paired, the body of the female dries up, the whole substance apparently being consumed by the enormous number of eggs she lays. Many of these insects are exceedingly injurious to vegetation, and are difficult to combat. We have several species in Canada, but there is little positive knowledge concerning them. It is a very curious thing how they migrate from one tree to another. They will appear suddenly on trees which have been without them for years. This year, and from the amount of downy material in which it envelops its eggs, a very conspicuous species has appeared for the first time on a Virginian creeper near my house. There were, perhaps, a dozen females this year, and on examining the young, shoots a few days ago, I found them well stocked with the half-grown scales. This species seems to answer the description of one Harris mentions on page 256, a thorough investigation of which he was prevented from carrying out by its premature destruction by fire, together with the grape-vine upon which it was feeding.

The *Aspidiotus conchiformis*, oyster-shell bark louse, attacks many different trees, but chiefly the apple. It has also been found on the currant, plum, pear, cherry, and apricot. Fig. 91 represents a twig of an apple tree covered with these scales. This is becoming a very injurious pest in Ontario, and unluckily gardeners seem to have got an idea that nothing can be done to stop its ravages, so let it take its chance. I have been frequently told that it was useless to apply the soap wash, on account of the insect being protected by a scale. This of course is not the case. If a strong mixture of whale-oil soap, with tobacco in it, is syringed on the trees four times through the month of June, it can be kept well in hand, because then the young larvae are unprotected by a scale.



Fig. 91.

Although the greater number of the Coccidæ are so injurious, yet there are some among them which produce commodities of very great commercial value. It is from the female scales of *C. lacca*, a species of this family which attacks *Ficus indica*, that the Indian product lac is obtained. This substance has many uses in the economic arts; it is the chief ingredient in sealing wax and several varnishes, and is also the basis of French polish. In India it is mixed with sand to form grindstones; dissolved in water and mixed with ivory black it makes a good ink. It is also from this insect that the colouring matter called lac-lake is prepared, which has been used as a substitute for cochineal. The East India Company are said to have saved in a few months \$70,000 in the purchase of scarlet cloth dyed with a mixture of this colour and cochineal conjointly, and this without any inferiority in the colour obtained. These scales are known as stick-lac when they are unseparated from the twigs upon which they formed; seed-lac when removed and pounded, and a part of their colouring matter extracted in water; lump-lac when melted down into cakes; and shellac when strained and allowed to harden in thin laminae or flakes. But the most valuable of these insects is, perhaps, the Cochineal (*C. cacti*), which attacks a kind of indigenous cactus (*Opuntia cochinillifera*) found in Mexico where it is called nopal, and which is cultivated in plantations called nopalleiros, for the express purpose of feeding these insects. It is one of the most remunerative industries of the country. It has been calculated that 70,000 dried insects are required to make a pound of cochineal. In 1866 England imported 32,757cwt., valued at £594,818, and exported 21,238cwt., the annual consumption being about 12,000cwt. The price in 1870 was about 3s. a pound. In 1871 the imports into the United States were 1,849,842lb, valued at \$1,184,255. Many attempts have been made to introduce this insect into other countries. The East India Company even offered a reward of £6,000 to anyone who would introduce it into India. It was introduced into the Canary Islands about 1830,

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and after the failure of the grape in 1850, became the principal article of export. In 1870 the exports reached 6,000,000lb, worth on the spot \$3,200,000. In 1844 the French succeeded in introducing it into Algeria, and the Dutch have introduced it into Java.

The literature on this family is most meagre, and, in fact, until Prof. Comstock published his article in the United States Department of Agriculture Report of 1880, nothing systematic of any consequence had been done. This gentleman is making a thorough investigation of this difficult but interesting subject, and as it is necessary to have a large series of specimens, it is in the hands of everyone to assist him, for if any person who noticed a plant infested by these insects were to send a note and specimens to him I am sure he would be glad to receive them, and they might possibly do much good by putting into the hands of a specialist, species unknown to science, upon which he would experiment in the same careful and thorough manner which is so manifest in all his work. It is satisfactory to know that after a great number of experiments, Prof. Comstock has found that, for all these insects the most effectual remedy is that very economical one—common soap.

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