ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF THE

PROVINCE OF ONTARIO,

FOR THE YEAR

1880.

Printed by Order of the Legislative Assembly.

Toronto:
PRINTED BY C. BLACKETT ROBINSON, 5 JORDAN STREET.
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ELEVENTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO,

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

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

1880.

To the Honourable the Commissioner of Agriculture:

SIR,—On this, the closing period of another year in the history of our Society, I have the honour to present you with our Annual Report. The year has been marked by an unusual freedom from any alarming invasion by insect pests, nevertheless the total loss caused by injurious insects to crops of various sorts has been considerable. In this Report is embodied illustrated papers by our members on injurious, beneficial and other insects, of such a character as will, we believe, prove instructive to the general public and increase the interest already felt in the operations of our Society.

Our monthly journal, the *Canadian Entomologist*, continues to be received with favour, both in Europe and America. Its issue has been regular; and the twelfth volume is now nearly completed. During the year our library has been materially increased, and many new illustrations of insects obtained with which to embellish our Journal and Report, and thus render our work of much greater benefit to the general public than it would otherwise be.

The accounts, duly audited, are herewith submitted, also the list of officers for the coming year.

Thanking you for the kindly interest you have always taken in the operations of our Society, and the substantial encouragement given, which has enabled us to carry on our work without embarrassment,

I have the honour to be,
Your obedient servant,
WM. E. SAUNDERS,
Secretary pro tem.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The annual meeting of the above Society was held, according to announcement, in the city of Hamilton, on the evening of Tuesday, the 28th of September, in the City Hall. A number of those especially interested in Entomology from various parts of the Province were present.

The Report of the Council was read and adopted; also that of the Secretary-Treasurer, which showed a satisfactory state of the finances.

ANNUAL STATEMENT OF THE SECRETARY-TREASURER OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO, SEPTEMBER, 1880.

Receipts.

Balance from 1879	$152 62
Members' fees and sale of ENTOMOLOGIST	329 94
Merchandise, pins, cork, etc.	57 01
Advertisements	26 15
Interest	14 56
Government grant	1,000 00
	$1,580 28

Disbursements.

Printing ENTOMOLOGIST	$288 00
Mailing "	19 50
Insurance	10 63
Rent	90 02
Annual vote to editor and secretary	150 00
Sundries, freight, etc	35 27
Postage	35 16
Expenses of sending collection to Ottawa	12 85
Library	136 75
Paper for ENTOMOLOGIST	72 20
Report expenses	129 75
Engraving	141 44
Expenses of council and delegation to A. A. A. S.	61 00
Merchandise—cork	42 91
Balance	354 80
	$1,580 28

ABRAHAM PUDDICOMBE, CHARLES CHAPMAN. } *Auditors.*

REPORT OF THE COUNCIL.

The close of a decade in the history of our Society, as an incorporated institution, prompts your Council to a retrospective glance over the work accomplished. Ten years ago we were weak and feeble; our numbers were few, and a small eight-paged journal, published irregularly, sufficed to chronicle all our doings. At that time it was with us a constant struggle for existence as a Society, when a few generous hearts contributed liberally of their own private means to sustain a work prompted by public need and designed for public benefit. Through the energy of our members and the kindly aid of, at first the Provincial Agricultural Association and subsequently of the Ontario Government, we were soon enabled to emerge from this struggle and to feel that we were established on a firmer basis, with a great field for labour open before us. In this department our members have laboured heartily, looking for no reward beyond the pleasure which arises from the consciousness of doing a good work.

We may point with justifiable pride to the goodly pile of useful literature published by our Society during this period. Ten Annual Reports have been presented to the Government, which have been printed and widely disseminated as a part of the Report of the Commissioner of Agriculture for the Province of Ontario. These Reports of our Society have been full of matter of great importance to the agriculturist and the fruit-grower, since most of the insect enemies to field crops and fruits have been systematically treated of in them, and the remedies best fitted to control or destroy the pests explained. The Reports have been much sought after and have no doubt accomplished much good.

The *Canadian Entomologist*, the monthly organ of our Society, has now nearly completed its twelfth volume, the last ten of which have averaged about 250 pages octavo, nearly all original matter. In these are recorded the observations of our members on all parts of the continent on insect life in its various forms. The life histories of a large number of species have been given in detail, and a vast amount of other material of much value in promoting the interests and advancing the science of Entomology presented. Our journal is held in high esteem abroad as well as at home, and was for some years the only journal devoted exclusively to Entomology on the continent of America. During the past year the *Entomologist* has contained many very valuable papers; among those especially worthy of mention are the contributions of Mr. W. H. Edwards on the life histories of the butterflies of North America. We are pleased to learn that he is still pursuing his investigations in this department, and that he will continue to give the readers of the *Entomologist* the details of his discoveries.

Recognizing the important work our Society is doing, and with the object of further aiding our endeavours, the Ontario Government have added during the past year to our annual grant the sum of $250, which will enable us to illustrate more freely the articles to be published in our reports and in our journal, and to carry on the ordinary operations of our Society without embarrassment.

Besides the publication of the annual reports which are chiefly written for the general public in a popular style, and the *Canadian Entomologist*, which is a scientific record of work done by the members of the Society, but which also usually contains a paper written expressly for beginners in the study of the science, the Society has had prepared and issued to all its members extensive classified lists of the names of all insects in the different orders of which authentic records of their capture within the Dominion could be found. The value of these lists is very great. They are of the greatest assistance in providing the collector with the proper one, from among the many synonyms which, unluckily, such a large number of our insects possess; besides this they give the proper sequence of the different genera of which the orders are composed, and are thus exceedingly useful in arranging a collection. Moreover, they act as a record by which collectors know what has been done in the way of collecting by their predecessors, and when a new species is found it can at once be recorded; by this means many have been added to our lists.

The branches of our Society at Montreal and London continue to prosper. In Montreal, Messrs. Bowles, Lyman & Couper, have prepared and read some valuable papers on their investigations, and in London much good and useful work has been done.

The Council regret that the office of Secretary-Treasurer was left vacant in the early part of this year, owing to the removal from London of Mr. J. H. Bowman, but since his departure, and at the request of the Council, the work has been performed very efficiently by Mr. W. E. Saunders. We take pleasure in calling attention to the satisfactory condition of our funds, as shown by the statement of the Secretary-Treasurer.

Submitted on behalf of the Council.

W. E. Saunders,
Sec.-Treasurer pro tem.

MONTREAL BRANCH OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

SEVENTH ANNUAL REPORT OF THE COUNCIL.

At the close of the seventh year of the Society's existence, your Council beg to present their annual report. The retrospect of the year in Entomological matters, is a pleasant one. Nine meetings have been held, the attendance at which has been good, and the intercourse of the members has been both agreeable and iustructive. Besides the eight papers, whose titles are hereafter given, many valuable observations on insect life have been recorded in our minutes, which will be of great assistance to us in the future.

Your Council would also notice that during the summer of last year, several enjoyable collecting excursions were participated in by the members, resulting in the discovery of several species of insects hitherto unknown in this locality. On the whole, it is with great pleasure that your Council report the Society to be satisfactorily progressing in the study of our science.

The papers read during the year are as follows :

1. "A description of the male Alypia MacCullochii, Kirby."—By Wm. Couper.
2. "Notes on a species of Cossus taken at Montreal."—By F. B. Caulfield.
3. "The milk plant, its insect parasites, red and black in colour."—By Wm. Couper.
4. "How to preserve specimens of insects."—By G. J. Bowles.
5. "On luminous insects."—By Geo. H. Bowles.
6. "Montreal Hymenoptera."—By Wm. Couper.
7. "Notes on rearing Lepidoptera."—By H. H. Lyman.
8. "Some of the insects that frequent the orchard and garden."—(Rev. F. W. Fyles). Selected by G. J. Bowles.

The study of the Hymenoptera of Montreal has been taken up by Mr. Couper, whose capacity and experience render it certain that the task will be well performed, and result in a great increase in our knowledge of that interesting order. Your Council would recommend the members to follow his example, and, during the coming season, give special attention to other divisions which hitherto we have almost neglected, namely, the Diptera, Orthoptera, Hemiptera and Neuroptera.

The following works have been added to the Society's library during the year :—

"Monograph of the Diptera of North America." Part 3, 4 plates, by H. Loew.

"New species of North America Coleoptera." Part 1, by J. L. Leconte.

"The Coleoptera of Kansas and Eastern New Mexico." 2 plates, J. L. Leconte.

"Synopsis of the Melolonthidae of the United States." J. L. Leconte.

"Catalogue of Coleoptera adjacent to the Boundary Line between the United States and Mexico." 1 plate, J. L. Leconte.

"Revision of the Buprestidae of the United States." 1 plate, J. L. Leconte.

"Report of the Entomological Society of Ontario for 1879."

"Report of the Fruit Growers' Association of Montreal, 1879."

The following were presented by the Royal University of Christiana :—

"On the Mollusca of the Arctic Regions." One large volume and two pamphlets.

"A list of Norwegian Lepidoptera taken in 1876."

The Secretary and Treasurer's cash statement is submitted herewith, and shows the finances to be in a satisfactory condition.

In conclusion, your Council would express the hope that the members will not relax their efforts during the present season, and that the result of the summer's campaign will be even more favourable than that of last year.

The whole respectfully submitted.

Geo. J. Bowles,
President.

Geo. H. Bowles,
Secretary.

Montreal, 17th May, 1880.

The President then delivered his annual address, for which he received the thanks of the members present.

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

Gentlemen,—The past season has not been very eventful in Ontario in matters relating to insect life. No unusual armies of insect enemies have devastated our crops, and our farmers and fruit-growers, in spite of the few perennial foes, which are always more or less troublesome, have realized a bountiful harvest.

Early in the season cut worms were very numerous in the neighbourhood of London, more abundant than I ever remember seeing them before. They destroyed innumerable cabbage plants and other herbaceous plants and flowers; among the latter, pansies seemed to possess great attraction for them. I saw many fine plants of this flower, of the previous year's growth, eaten close to the ground, both leaves and stalks, and from about the roots of a single plant found in several instances from thirty to fifty of the nearly full-grown larvæ. Fortunately their period of activity does not last long, and before the end of June most of them were quietly sleeping in the chrysalis state.

The question of insectivorous birds, and their influence on the insect world about us, is attracting much attention, and the more the subject is discussed the more evident it becomes that very little indeed is *known* in reference to it; that our ideas as to what should guide us are largely inherited, or otherwise based on sentiment, rather than resting upon well ascertained facts. I am well aware that to plead in favour of the birds is a popular course to follow; but the true student of nature is ever seeking after truth, and whether the facts he discovers are in accord with long cherished opinions and popular fancies, or are directly opposed to them, are questions of little moment. The facts, whatever they may be, are what we want.

Insectivorous birds may be conveniently divided into three classes: First, those which take their food entirely on the wing; second, those which feed partly on the wing and partly from trees and shrubs, and on the ground; and third, those which take no food on the wing, but feed entirely either on the ground or from trees or shrubs. In the first class, besides some rare birds which we do not need to mention here, the following are found common in most parts of our Province: the swallows, *Hirundinidæ;* kingbird, *Tyrannus Carolinensis*; pewee, *Sayornis fuscus*, and nighthawk, *Chordeiles popetue*. The food of these birds consists chiefly of flies, a large proportion of which cannot be said to be either noxious or beneficial; many of them in the earlier stages of their existence live in the water, where they devour decaying vegetation, or feast on the lower and simpler forms of animal and vegetable life. The larvæ of many others are scavengers, devouring decaying or putrescent animal and vegetable matter, and hence well deserve to be classed with beneficial insects. In the same class of friendly species will rank a considerable number of others which are parasitic on the bodies of caterpillars, also the rapacious species which sustain themselves by devouring the weaker and less vigorous of their race. A few rare exceptions, of which the wheat midge and Hessian fly may be noted as examples, are very injurious to field crops, while the mosquito and black fly are universally branded as enemies to the human race. These birds also devour a few butterflies and moths, but

these, with few exceptions, are harmless. The question, then, to what extent these purely insectivorous birds are beneficial to the farmer or fruit-grower, reasonably admits of much difference of opinion, for while they do devour a few of our tormentors, they probably destroy a much larger number of beneficial insects, the main bulk of their food, however, consisting of harmless species. Doubtless they serve a purpose in maintaining a proper balance among the insect hosts, and between animal and vegetable life, but that their service in these departments is so all-important as some would urge admits of grave doubt.

The birds of the second division, namely, those which take their food partly on the wing and partly from trees and shrubs, or on the ground, are not entirely insectivorous. The remarks just made in reference to the first class will apply also to this, as far as their food is taken on the wing, but on trees or shrubs, or on the ground, they consume insects of entirely different classes, chiefly beetles and the caterpillars of moths and butterflies. The beetles admit of a similar division to that of the flies already noticed; the larger number are harmless, a large proportion of the remainder are beneficial, and a few are injurious. Most of the caterpillars of moths and butterflies are harmless, feeding in limited numbers on a great diversity of shrubs and trees of little or no economic importance. A few may be said to be beneficial, in consequence of their feeding on troublesome weeds, such as thistles, etc., while a few others are decidedly injurious. Among the common birds in this second class I would mention the yellow warbler or spider bird, *Dendroeca æstiva;* the red start, *Setophaga ruticilla;* the red-eyed, and yellow-throated vireos, *Vireo olivaceus* and *V. flavifrons;* the various species of woodpecker, *Picidæ* and the blue bird, *Siala sialis.*

The birds comprised in the third class are only partially insectivorous. Among the common species are the cat-bird, *Galeoscoptes Carolinensis;* robin, *Turdus migratorius*, and brown thrush, *Harporhynchus rufus;* the sparrows, *Fringillidæ;* the cuckoos, *Coccidæ;* the nuthatch, *Sitta Carolinensis;* chickadee, *Parus atricapillus;* kinglets, *Sylviidæ;* meadow-lark, *Sturnella magna;* Baltimore oriole, *Icterus Baltimore*, and the wren, *Troglodytes ædon.* Besides these there are the blackbirds, *Icteridæ*, which in the spring devour more or less insect food, but feed chiefly on grain and seeds during the remainder of the year. Nearly all birds, excepting the rapacious species, feed their young on such soft food as worms, caterpillars, soft-bodied insects and fruit, and, from the time that young birds are hatched until they acquire the power of flight, a very large quantity of insect food is undoubtedly consumed; but the question of the greatest practical importance to the agriculturist is how far are the birds a help in keeping in check *injurious* insects. With the object of obtaining light on this point, I have, with the help of my son, W. E. Saunders—who has for some years paid special attention to this matter—examined the contents of the stomachs of a large number of birds, and I must frankly confess that the larger the experience gained in this direction the more I have been convinced that but comparatively little help is got from birds in keeping in subjection injurious insects.

When the cut worms were so common with us this spring that any bird with a very little effort might have had its fill of them, the contents of a number of stomachs were examined, especially those of the robin, but not a single specimen of this larva was found in any of them. It has been urged that some birds devour the larvæ of the plum curculio by picking them out of the fallen fruit, but I have failed to find any confirmation of this statement, indeed never found a curculio larva in the stomach of any bird excepting once in that of a robin, who had evidently swallowed it by accident when bolting a whole cherry. As for the robin having any claims upon the sympathies of man for the good he does, I fear that but a very slight case can be made out in his favour. Of fruit he is a thief of the worst kind, stealing early and late, from the time of strawberries until the last grapes are gathered; not content to eat entirely the fruit he attacks, but biting a piece out here and there from the finest specimens, and thus destroying a far greater quantity than would suffice to fill him to his utmost capacity. At the time of writing, flocks of the most pertinacious specimens are destroying the best of my grapes, while alongside is a patch of cabbages almost eaten up with the larvæ of the cabbage butterfly—nice, fat, smooth grubs, easily swallowed, but no such thing will Mr. Robin look at as long as good fruit can be had. His tastes are so expensive that to gratify them is to deprive the fruit-grower of a large portion of his profits, hence the sooner the robin ceases to be protected by legislation the better it will be for all lovers of fruit.

The insect world is composed of myriads of specimens which from their varied structure and habits admit of being classified into families, each distinct and usually easily recognizable to the practiced eye of the Entomologist. A large portion of this innumerable host is appointed to prey upon and devour the other portions, and thus it appears to me, that apart from any consideration of insectivorous birds, the insect world would and does, to a large extent, take care of itself, and when an injurious species increases beyond its normal limits, its natural insect enemies, having an unusual amount of material to work on, soon become sufficiently numerous to reduce the number of the injurious insect to its normal proportions again. As an illustration, take the now common cabbage butterfly, *Pieris rapæ*. This insect was in some way brought from Europe to Quebec a few years ago. From Quebec it has since spread over an immense area extending now from Alabama to the waters of Lake Superior, eastward to the Atlantic, and westward many hundreds of miles, and over all this district it has done immense damage to the cabbage crop. Throughout this area insectivorous birds of all sorts prevail; the butterfly is conspicuous, not very strong in flight, and during the day almost constantly on the wing; the larva feeds in exposed situations, is of that smooth character which birds are said to prefer, and although similar in colour to its food plant, is not difficult to detect. Here, then, is an instance where a comparatively feeble insect, particularly vulnerable to attack, has rapidly spread over a large portion of this continent, with little or no opposition from insectivorous birds. Indeed I have never yet found or known to be found a single example either of the butterfly or its larva in the stomach of any bird. In its native home in Europe it is seldom so very destructive as here, for the reason that a small four-winged fly, *Pteromalus puparum*, an insignificant looking little creature, is a parasite on the larva of this butterfly, and hunts its victims with the greatest assiduity; alighting on their backs and thrusting its slender ovipositor through the skin of the larva, it deposits a number of eggs there, which hatch into tiny grubs, and those feed upon and eventually destroy the caterpillar. By the constant efforts of this little parasite the cabbage butterfly is prevented in Europe from becoming a very serious pest. Fortunately this little friend has also been introduced here from Europe, although in what manner is not known, and is rapidly spreading, following in the wake of its prey, and where the parasite has fairly established itself, this butterfly, with its numerous progeny of green caterpillars, soon dwindles in numbers so materially as shortly to cease to be so grievous an evil. The butterfly spreads faster than its enemy and is usually several years in advance of it, but we may confidently anticipate that sooner or later this small fly will do for us what it has done for Europe—keep this troublesome insect within due limits. Many other similar examples might be given.

Further, the help of friendly parasitic insects is so much more efficient because it is in most instances discriminating. As far as is known, the little parasite referred to attacks only the larva of the cabbage butterfly, and in like manner many other parasitic species are restricted in their operations to a single species, while in other instances they are confined to a genus or a group of similar species. This is not so with insectivorous birds; they in most instances devour alike the useful and the injurious species, and the question may well be raised in many instances whether the good they do is not more than counterbalanced by the number of useful insects they devour. Recent observations on the family of thrushes, by Mr. S. A. Forbes, of Illinois, seem to show that their insect food consists largely of beetles belonging to the *Carabidæ*, a family every member of which is useful, since they, as far as is known, feed both in the larval and beetle states exclusively on other insects.

The field here open is a wide and inviting one, on which I trust some of you will enter. I have but touched upon it; as the results of more extended observations are recorded the opinions here expressed may need modifying. I desire to do justice to the birds.

During the month of August last, it was my privilege to visit the Great Manitoulin Island, also Sault Ste. Marie and the district adjoining. Although prevented by an accident from indulging in free locomotion, still I saw much that interested me. On Manitoulin Island I found many of the species of butterflies common in the more southern portions of Ontario; a few moths were also captured. On the shore of Elizabeth Bay,

near the western extremity of the island, a full-grown larva of *Attacus luna* was picked up, and on inquiry I learned that earlier in the season that beautiful moth was quite common in that neighbourhood.

In the department of Economic Entomology some items of interest were gleaned. The pea crop throughout this district is an important one, and I made a diligent search in many fields for indications of the presence of the pea bug, *Bruchus pisi*, but could find no traces of it. Satisfactory evidence was furnished me, in at least two instances, of the sowing of seed brought into the island which was badly infested by this weevil, yet I was assured that neither during the season following nor in subsequent seasons did the crop suffer from this pest. The pea crops growing in these particular localities were also examined by me. Hence it would appear that the climatic or other conditions prevailing in this district are so unfavourable to this destructive pest that it is unable to survive. Should this exemption prove permanent, the cultivation of the pea there will doubtless be rapidly extended, as there will be a large demand at good prices for seed peas from this section, since so many portions of the Province are now so overrun with the pea bug that it is difficult to get seed fit for sowing; and, for the same reason, such seed peas will be readily purchased for planting in the Western States.

For many years the district extending from Goderich to Collingwood has, in consequence of its exemption from curculio, been extremely favourable for plum culture, and here immense quantities have been grown and shipped to other parts of Canada and the United States, Goderich being for many years an important centre for the production and shipment of this fine fruit; but within a brief period this foe has invaded Goderich in such force that to grow plums successfully there, warfare must now be maintained against this pest similar to that practised in the more southern sections of the Province. This enemy has now advanced as far as Southampton, and before many years we may reasonably expect that the favoured district at present exempt, from Owen Sound to Collingwood, will be similarly invaded. Thinking that the Manitoulin Island, from its insulated position, might possibly offer in the future a fine field for this department of fruit industry, I examined carefully, whenever opportunity offered, for evidence of the presence of this insect. In the neighbourhood of Manitowaning I found two trees of Lombard, a blue plum, the name of which I could not ascertain, and two wild plums, all fruiting, but could find no traces of the work of the curculio; but on a farm in about the centre of the island, three miles from Gore Bay, I found on a wild plum tree which was fruiting in the farmer's garden a number of stung plums, and on opening one of them found the larva of the plum curculio nearly full grown. Since wild plums are found in many parts of the island, it is probable that the curculio will be found in other districts there. I saw several wild plum trees at the Sault Ste. Marie, but had no opportunity of examining the fruit satisfactorily; from what I saw I was led to believe that there was no curculio in that region. The cultivation of fruit both on the Manitoulin Island and at the Sault is so entirely in its infancy that it is difficult to form any decided opinion as to the probable future of this department of industry in those districts.

In many sections, forest fires have destroyed a considerable proportion of the original woods, leaving many of the larger trees standing scorched and dead. From these much marketable lumber could be got, were it not for the destructive work of the wood-boring beetles; these troublesome creatures have bored through the trees in every direction, and thus made the timber obtainable from them worthless for market, and useful only in the construction of barns, sheds, etc., on the property of the owners. Both of the large species of long-horned beetles, *Monohammus confusor* and *scutellatus*, appear to be abundant, the latter I think most common; some of the small wood-boring beetles belonging to the family *Scolytidæ* are also very numerous.

The cabbage butterfly, *Pieris rapæ*, has within the last two or three years spread over the whole of the area I visited, and is playing sad havoc with the cabbage crop. In Manitoulin Island I found a specimen or two of the Colorado potato beetle, and made further search among growing potatoes, but could find no more. I was informed that this beetle had been seen occasionally for several years past, but that it had not made any headway in any part of the island. Another insect was found attacking the potato vines, although not injuring them very much. I refer to a species of blistering beetle, *Epicauta*

pennsylvanica, called here the black bug. In some potato patches it was quite abundant, and the leaves were partially devoured, but nowhere did I see them in sufficient numbers to materially injure the crop. Since the larva of this insect does not feed on the plant, and the insect consumes the potato vine only while in the perfect or beetle state, no serious injury is likely to result from its presence. Its larval habits are such that if abundant one year it is almost sure to be correspondingly scarce the following season.

In the garden of Mr. J. C. Phipps, the Indian Agent of the Government at Manitowaning, I was surprised to find that the oyster-shell bark louse, which injures apple trees, was not only abundant on the apple trees, but the stems of both black and red currant bushes were also thickly clad with them to such an extent as to have killed a number of them. I had never before seen this destructive insect attack the currant, but it has been occasionally observed on currant bushes in the United States.

For several years past I have had occasion to refer to the depredations of the forest tent caterpillar, *Clisiocampa sylvatica*, which has devastated our gardens, orchards and forests; it has now happily almost disappeared, a result brought about, I have no doubt, mainly through the agency of parasitic flies, several species of which have been preying on them extensively. In some sections of the Province the rose-bug, *Macrodactylus subspinosus*, has been abundant and injurious. In East Flamboro' I am informed that they were very destructive to the sweet cherries, devouring the fruit, and that they also injured the grape crop by eating the bunches shortly after blossoming. Some grape growers have also suffered considerably from the attacks of the grape vine flea-beetle, which devours the buds just as they are swelling in the spring.

At the late meeting of the Entomological Club of the American Association for the Advancement of Science, in Boston, our Society was represented by Mr. H. H. Lyman, of Montreal, and the Rev. C. J. S. Bethune, whose able report of the important proceedings of the Club will be read with interest. It is gratifying to learn that the good work done by the Club has given it such a standing that the Association has seen fit to establish it as a permanent Sub-section, and the more important papers read will in future be published in the yearly volume of proceedings.

During the year the New York State Legislature has appointed J. A. Lintner, of Albany, N.Y., as State Entomologist. New York was the first State in the Union to look after the interests of agriculture in this direction and appoint an officer for the special purpose of reporting on noxious insects. The many reports of the late Dr. Fitch, extending over a lengthened period, are well known and much valued; his successor, Mr. Lintner, is a man peculiarly fitted for the position—a most patient and accurate observer, a skilled Entomologist; with an experience in this department of some thirty years, he brings to the task all the necessary qualifications. Seldom has there been an appointment so judiciously made, and I feel sure that great good will result from it.

Since I last addressed you a special Commission has been appointed by the Ontario Government to inquire into the agricultural resources of the country, and the progress and condition of agriculture therein, and recognizing the important and intimate connection of Entomology with agriculture, the Government has seen fit to appoint your presiding officer as one of the Commissioners. In performing the duties devolving upon me in this position I shall endeavour to give to Entomological matters, bearing on agriculture, that prominence which their importance demands.

WM. SAUNDERS.

The election of officers was then proceeded with, which resulted as follows:

President.—Wm. Saunders, London.
Vice-President.—Rev. C. J. S. Bethune, M.A., Port Hope.
Secretary-Treasurer.—E. B. Reed, London.
Librarian.—W. E. Saunders, London.
Council.—J. A. Moffat, Hamilton; James Fletcher, Ottawa; R. V. Rogers, Kingston; G. J. Bowles, Montreal; J. M. Denton, London; W. H. Harrington, Ottawa; and Wm. Couper, Montreal.

Editor.—Wm. Saunders.

Editing Committee.—Rev. C. J. S. Bethune, E. B. Reed, J. M. Denton.

Auditors.—Chas. Chapman, A Puddicombe.

After the routine business was concluded, Mr. Bethune offered some remarks on the moth of the cotton worm, *Aletia argillacea.* Twelve years ago he found it extremely abundant, late in the season, on ripe plums. He had not taken the insect again until this autumn, when they were found to be quite common in his garden. The opinion which had been advanced by Prof. Riley, of Washington, that the examples of the moth taken in these northern sections had flown northward from their breeding places in the south, he did not concur in, but believed that the insect must feed on some malvaceous plant in our midst, since the specimens he had captured were very perfect, and looked as if they had just escaped from the chrysalis. He referred to the fact of this insect having been found common in many of the Northern States, as well as in Canada.

Mr. Reed stated that he had taken this insect also in London.

Mr. Moffatt exhibited a number of interesting insects which had been captured by him at Long Point and at Ridgeway, among others *Papilio cresphontes*, *P. marcellus*, *P. philenor*, *Darapsa versicolor* and *Junonia cœnia.*

Mr. Denton reported the capture of *J. cœnia* and *Libythea Bachmani* at Port Stanley; also of *Thyreus Abbotii* at London.

Mr. Moffatt stated that this beautiful sphinx, *T. Abbotii*, had been comparatively common in Hamilton, and that a number of the larvæ had been reared.

Mr. Fletcher reported having captured two specimens of *Erebus odora* at Ottawa, one of them so perfect that he thought it was impossible that it could have flown for any distance, and thinks it must have bred in the neighbourhood.

Mr. Saunders referred to several other instances of the capture of this rare moth in Canada during the past few years.

Mr. Fletcher referred to the fact that during the last year there were published a number of papers on popular Entomology, and he hoped to see them continued, as he believed they were doing good service in making our valuable monthly journal more popular. Several of the members present promised to prepare papers of this character during the coming year.

Mr. Young, of Hamilton, asked for information on the best manner of preserving caterpillars, and inquired if any of the members had any experience in blowing them.

Mr. Reed stated that he had tried and failed. Mr. Fletcher had the same experience to relate, and had found that the only satisfactory method was to draw and colour them from nature.

Mr. Fletcher thought that most of our collections were deficient in specimens illustrating nature; that while we had spread specimens, we should also have them as at rest, and where possible, the larvæ, chrysalids and eggs.

Mr. Reed asked a question in reference to *Anisota rubicunda*, which he had found common on maple about London, but very hard to rear; he wished to know the experience of other collectors. Several of the members present stated that they also had found it difficult to rear them.

Mr. Young had reared a brood of them from butternut and beech, and found them to prefer beech to any other food. Mr. Bethune had also found them on beech trees.

Mr. Fletcher had found a small fly attacking beans this year; the larva had eaten the stem of the bean and bored into the root, and finally produced a small fly somewhat resembling a house fly.

Mr. Saunders had found several years ago a very similar fly, probably the same species, attacking the stems and roots of young cabbage plants. On comparing the fly with the description given in Curtis' Farm Insects of the root-eating fly, *Anthomyia radicum*, often so troublesome in Europe, he thought it probable that it was the same species. Mr. Saunders also reported the capture of *P. cresphontes* very early in spring, finding the larva nearly full grown in June, which became a chrysalis, and from which the perfect insect escaped in about a fortnight. He had also taken the full grown larva late in the fall, which had passed the winter in the chrysalis state, from which facts he drew the inference that this species is double-brooded in Canada.

Mr. Fletcher reported having found the larva of *Ceratomia quadricornis* about Ottawa, and finds it a difficult insect to rear.

Mr. Young had fed a brood of the larva of *Telea polyphemus* on black birch, on which they seemed to thrive remarkably well.

Mr. Kyle, of Dundas, stated that he had found *polyphemus* feeding on witch hazel (*Hamamelis virginica*), and *promethea* feeding on ash and lilac.

Mr. Moffatt had found *promethea* also on wild cherry, as well as on ash, sassafras and lilac.

ANNUAL MEETING OF THE LONDON BRANCH.

The Annual Meeting of the London Branch of the Entomological Society of Ontario was held on Tuesday, the 20th day of January, at eight o'clock in the evening, at the rooms of the Society; the President, Mr. J. M. Denton, in the chair.

Mr. Saunders reported on behalf of the Committee on Rooms, that new rooms could be secured very advantageously, situated in the Victoria Hall Buildings, and recommended that steps be at once taken to secure them. On motion, the report of the Committee was received and adopted.

The Annual Report of the Secretary-Treasurer was read, showing a small balance to the credit of the branch.

The election of officers followed, when the following gentlemen were elected :—

President.—J. M. Denton.

Vice-President.—A. Puddicombe.

Secretary-Treasurer.—W. E. Saunders.

Curator.—C. Chapman.

Council.—Messrs. H. B. Bock, E. B. Reed and W. Saunders.

Auditors.—J. H. Bowman and H. B. Bock.

Mr. Saunders reported the donation of two boxes of *Micro-lepidoptera* for the collection of the Society, by V. T. Chambers, Esq., of Covington, Kentucky; also two magnificent specimens of *Samia gloveri*, by A. H. Mundt, Esq., of Fairbury, Illinois.

The following additions to the library were also reported: from the Department of the Interior, Washington, "Hayden's Report on the Survey of Idaho and Wyoming," and "Prof. Riley's Report on the Silkworm."

W. E. Saunders,
Secretary-Treasurer.

ANNUAL MEETING OF THE MONTREAL BRANCH.

The Seventh Annual General Meeting of the Montreal Branch of the Entomological Society of Ontario was held on Monday, the 17th May, 1880, at the residence of the Vice-President, Mr. H. H. Lyman.

An interesting paper was read by Mr. Couper on the milk-weed (*Asclepias tuberosa*) and some of its insect frequenters. The paper drew attention to the curious fact that the colours of the different insects feeding upon this plant were, almost without exception, red and black.

The Secretary-Treasurer read his Annual Report, which showed the finances to be in a most satisfactory condition.

The election of officers then took place, resulting as follows :—

President.—G. J. Bowles.

Vice-President.—G. B. Pearson.

Secretary-Treasurer.—Geo. H. Bowles.

Curator.—F. B. Caulfield.

Council.—Messrs. H. H. Lyman, Wm. Couper and Robert Jack.

A short time was pleasantly spent in examining several cases of rare *Lepidoptera* belonging to Mr. Lyman, after which the meeting adjourned.

Geo. H. Bowles,
Secretary-Treasurer.

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

The annual gathering of the Entomologists of North America, in connection with the meeting of the A. A. A. S., took place this year at Boston, Mass., and was the most important that has ever been held, both as regards the largeness of the attendance, the number and value of the papers read, and also as regards the general interest taken in the proceedings. So highly indeed was it esteemed that the Standing Committee of the Association formed the Club into a Sub-section of Section B., (Zoology, Botany, etc.), and will publish its proceedings in the annual volume of transactions.

The first session was held in the lecture-room of the Museum of the Boston Society of Natural History, at two o'clock, p.m., on Tuesday, August 24th, 1880; the President, S. H. Scudder, of Cambridge, Mass., in the chair. There were over sixty persons present during this first meeting, and at least one hundred in all must have attended the various sessions of the Club. Among those present were the following Entomologists of note:—Dr. J. A. Lintner, Dr. John L. LeConte, Dr. John G. Morris, Prof. C. V. Riley, Dr. H. A. Hagen, A. R. Grote, Prof. Packard, S. S. Haldeman, B. P. Mann, Prof. C. H. Fernald, Prof. A. J. Cook, Dr. C. S. Minot, Rev. H. C. McCook, E. P. Austin, E. L. Graet, H. F. Bassett, J. D. Putnam, Dr. E. L. Mark, E. Burgess, Dr. Martin, J. G. Henderson, Prof. Morse, Dr. Hoy, O. S. Westcott and J. H. Emerton. The Entomological Society of Ontario was represented by the Rev. C. J. S. Bethune, of Port Hope, and H. H. Lyman, of Montreal.

After the meeting had been called to order, the President, Mr. Scudder, delivered the following address on "Problems in Entomology:"—

Annual Address of the President.

It is the good fortune of your President on this occasion to welcome you to his native heath, where our favourite science has been longer, more uninterruptedly, and, perhaps, more zealously cultivated than anywhere else in the new world. Here, in the last century, Peck studied the cankerworm and the slug-worm of the cherry, and, in late years, *Rhynchaenus, Stenocorus*, and *Cossus*—all highly destructive insects. Here lived Harris, who cultivated Entomology in its broadest sense, and whose classic treatise was the first important Government publication on injurious insects. Here, to-day, we have two Associations for our work, consisting, it will be confessed, of nearly the same individuals, and not many of them, but meeting frequently—one in Boston, the other in Cambridge. Harvard acknowledges the claims of our study in supporting not only an instructor in Entomology at its Agricultural School, but a full professor of the same in the University at large.

Harris attributed to Peck his special interest in Entomology, and his first paper, that on the salt-marsh caterpillar, appeared in the *Massachusetts Agricultural Repository* only four years after Peck's last, in the same magazine, on cherry and oak insects. How many of us have drawn our first inspirations from Harris? Yet probably not one of our local Entomologists ever saw him. The general direction of Harris' studies doubtless arose from the predilections of his instructor; and the unprecedented growth of economic Entomology in this country, where it flourishes as nowhere else, must be credited primarily to the influence of Harris' work. With every temptation which the wealth of new material about him could give, or which a very extensive correspondence with naturalists devoting themselves almost exclusively to systematic work, like Say, would naturally foster, he wisely followed the bent given his studies by his early training under Peck, and left a better example and a more generous and enduring influence.

In our own day, the spreading territory of the United States, the penetration of its wilds, and the intersection of its whole area by routes of travel, the wider distribution and greatly increased numbers of local Entomologists, as well as the demand for our natural products abroad, have set also before *us* the same temptation to study only new

forms and to cultivate descriptive work, to the neglect of the choicer, broader fields of an ever-opening science. It is this danger to which I venture briefly to call your attention to-day, not by way of disparaging the former, but rather in the hope that some of our younger members, who have not yet fallen into the ruts of work, may be induced to turn their attention to some of the more fruitful fields of diligent research.

We should not apply the term descriptive work merely to the study of the external features of insects. The great bulk of what passes for comparative anatomy, physiology and embryology, is purely descriptive, and is only to be awarded a higher grade in a scale of studies than that which deals with the external properties, when it requires a better training of the hand and eye to carry it out, and greater patience of investigation. We pass at once to a higher grade of research when we deal with comparisons or processes (which, of course, involve comparisons). All good descriptive work, indeed, is also comparative; but at the best it is so only in the narrowest sense, for only intimately allied forms are compared. In descriptive work we deal with simple facts; in comparative work we deal with their collocation. "Facts," said Agassiz, one day, "Facts are stupid things, until brought into connection with some general law."

It is to this higher plane that concerns itself with general laws that I would urge the young student to bend his steps. The way is hard; but in this lies one of its charms, for labour is its own reward. It is by patient plodding that the goal is reached; every step costs and counts; the ever-broadening field of knowledge exhilarates the spirit and intensifies the ambition; there is no such thing as satiety—study of this sort never palls.

It is hardly necessary to point out that so-called systematic work never reaches this higher grade unless it is monographic; unless it deals in a broad way with the relationship and general affinities of insects. It is not my purpose to call attention here to the needs of science in this department, as they are too patent to escape observation; but if one desires a model upon which to construct such work, one need not look further than the "Revision of the Rhynchophora," by Drs. LeConte and Horn. Rather than linger here, we prefer to pass directly to some of the obscurer fields of study.

When we compare the number of insect Embryologists in America with that of their European colleagues, the result is somewhat disheartening and discreditable; although perhaps the comparison would not be quite so disproportionate were some of our students to publish their notes. But take all that has been done upon both sides of the water, and what a meagre showing it makes. Of how many families of *Coleoptera* alone have we the embryonic history of a single species? Of two of the four families of butterflies, the fertile eggs of which are perfectly easy to obtain, nothing is known. In short, one may readily choose numbers of typical groups whose embryonic history would be a great acquisition to science. Here is a broad field. From the special range of my own studies let me recommend to any one eager for this work to choose the eggs of our common copper butterfly, which she will lay to order on sorrel, and the earlier stages of which can be obtained from the parent at two or three different times of the year; or the eggs of any of our common skippers, which deposit on grass, and which are equally easy to obtain, although only once a year. Or, if we turn to *Orthoptera*, the eggs of our common *Oecanthus*, concealed all winter in raspberry twigs, are more transparent and more easily obtained than those of any other cricket; and our knowledge of the embryology of any of the *Gryllidae* is very fragmentary, and of this particular tribe, *nil*. Better still, perhaps, would be the choice of our common walking-stick, as it belongs to a bizarre and isolated type, now known to be of very ancient ancestry, and of whose embryonic history nothing has been published. I have, indeed, a few incomplete notes upon this insect, but they relate wholly to a late period of development, and were made before the time of the microtome, when work over such coarse-shelled eggs was very difficult and unsatisfactory. The eggs may be readily procured, the insect being abundant in scrub-oak fields; the mother drops the eggs loosely on the ground, and from imprisoned specimens I have procured scores in a single season. Any one who will glance over the history of what has been done in insect embryology will be able to select a hundred examples as important and as easy to obtain as those already named, and by concentrating his work upon them will do better service than in an aimless selection of what may come to his hand.

In following the post-embryonal history of insects there is work for all. While allied forms have in general a very similar development, there are so many which are unexpectedly found to differ from one another, that every addition to our knowledge of the life histories of insects is a gain, and they are to be praised who give their close attention to this matter. Here is a field any Entomologist, even the most unskilled, may cultivate to his advantage and with the assurance that every new history he works out is a distinct addition to the science. The importance of an accumulation of facts in this field can hardly be over-estimated, and those whose opportunities for field work are good, should especially take this suggestion to heart. Nor, by any means, is the work confined to the mere collection of facts. How to account for this extraordinary diversity of life and habits among insects, and what its meaning may be, is one of the problems of the evolutionist. There are also here some especially curious inquiries, to which Sir John Lubbock and others have recently called attention, and to which, in this country, Mr. Riley has contributed by his history of *Epicauta* and other *Meloidæ*. I refer to the questions connected with so-called hypermetamorphosis in insects. In these cases there are changes of form during the larval period greater than exist between larva and pupa, or even between larva and imago, in some insects. There are also slighter changes than these which very many larvæ undergo; indeed, it may safely be asserted that the newly-hatched and the mature larvæ of all external feeders differ from each other in some important features. The differences are really great (when compared to the differences between genera of the same family at a similar time of life) in all lepidopterous larvæ, as well as in all *Orthoptera* which have come under my notice. No attempt to co-ordinate these differences, or to study their meanings, or to show the nature of their evident relationship to hypermetamorphosis has ever been attempted.

Not less inviting is the boundless region of investigation into the habits of insects and their relation to their environment. The impulse given to these studies by the rise of Darwinism, and the sudden and curious importance they have assumed in later investigations into the origin and kinship of insects, need only to be mentioned to be acknowledged at once by all of you. The variation in coloration and form exhibited by the same insect at different seasons or in different stations, "sports," the phenomena of dimorphism, and that world of differences between the sexes, bearing no direct relation to sexuality; mimicry also, phosphorescence and its relations to life, the odours of insects, the relation of anthophilous insects to the colours and fructification of flowers, the modes of communication between members of communities, the range and action of the senses,* language, commensalism—these are simply a few topics selected quite at random from hundreds which might be suggested, in each of which new observations and comparative studies are urgently demanded.

The fundamental principles of the morphology of insects were laid down by Savigny in some memorable memoirs more than sixty years ago; the contributions of no single author since that time have added so much to our knowledge, notwithstanding the aid which embryology has been able to bring. Nevertheless there remain many unsolved problems in insect morphology which by their nature are little likely to receive help from this source. Let me mention three:

The first concerns the structure of the organs of flight. The very nomenclature of the veins shows the disgraceful condition of our philosophy of these parts; the same terminology is not employed in any two of the larger sub-orders of insects; names without number have been proposed, rarely, however, by any author with a view to their applicability to any group outside that which formed his special study; and a tabular view which should illustrate them all would be a curious sight. A careful study of the main and subordinate veins, their relations to each other, to the different regions of the wing, to the supporting parts of the thorax and to the alar muscles, should be carried through the entire order of insects; by no means, either, neglecting their development in time, and possibly deriving some assistance in working our homologies by the study of their hypodermic development.

* Notice Meyer's beautiful studies on the perception of sound by the mosquito.

The second concerns the mouth parts. The general homologies of these organs were clearly and accurately enough stated by Savigny, though one may perhaps have a right to consider the last word not yet said when one recalls Saussure's recent claim to have found in *Hemimerus* a second labium. What I refer to, however, is another point: it relates to appendages of the maxillæ and the labium. Considering the labium as a soldered pair of secondary maxillæ we have at the most, on either pair of maxillæ, three appendages upon either side. These appendages, as you know, are very variously developed in different sub-orders of insects, or even in the same sub-order; and it has at least not been shown, and I question if it can be done, that the parts bearing similar names in different sub-orders are always homologous organs. Here is a study as broad and perhaps as difficult as the last.

The third is the morphological significance of monstrosities, especially of such as are termed monstrosities by excess. The literature of the subject is very scattered, and the material much more extensive than many of you may think. At present this subject is, so to speak, only one of the curiosities of Entomology, but we may be confident that it will one day show important relations to the story of life.

After all the labours of Herold, Treviranus, Lyonet, Dufour, and dozens of other such industrious and illustrious workers, is there anything important remaining to be done in the gross anatomy of insects? some of you would perhaps ask. Let the recent work of some of our own number answer, which has shown in the *Hemiptera* and *Lepidoptera* the existence of a curious pumping arrangement by which nutritious fluids are forced into the stomach. It is certainly strange that after all that has been said as to the mode in which a butterfly feeds, that no one should have dissected a specimen with sufficient care to have seen the pharyngeal sac which Mr. Burgess will soon show us. No! the field is still an open one, as the annual reviews clearly show. The curious results of Floegel's studies of the brain, the oddly-constructed sense-organs found by Graber and Meyer (earlier noticed briefly by Leydig) in the antennæ of Diptera, the important anatomical distinctions discovered by Forel in different groups of ants, the strange modification of the tip of the spiral tongue in *Ophideres*, which Darwin, Britenbach and Künckel have discussed, and, above all, the extensive investigations of the nervous system in insects generally, which Brandt has recently undertaken, the exquisite memoir of Grenacher on the structure of the compound eye, and the keen researches of Graber in various departments of insect anatomy, show, by what has been accomplished, how many harvests are still unreaped. The microtome, too, has put a new instrument of precision into the hands of the investigator in this field.

We might in the same way point out some of the special needs in the study of the finer anatomy or histology of insects, but the pressure of other duties borbids a further pursuit of the subject. Enough surely has been suggested, even in this hasty sketch, to show that we cannot yet rest upon our oars, but must push forward undaunted into still unknown waters. If these few words shall arouse in any one a higher ambition, leading to better work, their aim will have been accomplished.

On motion of the Secretary, B. P. Mann, the minutes of the last meeting of the Club were adopted as printed in the *Canadian Etomologist.*

The President read portions of a letter from Mr. Wm. Saunders, of London, Ont., explaining his absence owing to a severe accident, and expressed the great regret felt by all present that Mr. Saunders was not with them, and that his absence was occasioned by so unfortunate a cause.

The election of officers then took place (by ballot) with the following result :—

President.—Dr. John G. Morris, of Baltimore, Maryland.
Vice-President.—C. V. Riley, of Washington, D.C.
Secretary.—B. P. Mann, of Cambridge, Mass.

Mr. A. R. Grote, of Buffalo, N.Y., delivered an able and interesting lecture on certain generic characteristics of the *Noctuidæ*, which, it is to be hoped, he will prepare for

publication. At the close of his remarks he expressed his anxiety that describers of *Noctuids* should refer particularly to those parts on which generic characters are based.

Prof. A. J. Cook, of the State Agricultural College, Lansing, Mich., gave an account of recent investigations in Apiculture. Among many interesting facts he stated that if the wings of the virgin queen be clipped, or the entrance to the hive be so contracted that she cannot fly forth, or, again, if she be reared where there are no drones, she will not be sterile, but from her eggs only drones will be produced; that the fate of the drones in a hive depends on the prosperity of the colony—with a rapid increase of bees and honey they are safe, but if there is a period of adversity in these respects, unless caused by the loss or sterility of the queen, they are speedily destroyed by the workers; that worker bees are imperfectly developed females; that bees possess and employ the sense of smell, and that they have a good knowledge of locality. In answer to a question from Dr. Morris respecting the alleged robbery of fruit by bees, whether they will not perforate ripe fruits if starved for a time, Prof. Cook replied that he had not tried starvation, but he had placed punctured grapes before bees and found that they would sip the juice with zest, but when he replaced the fruit with sound specimens they did not attempt to touch them.

Mr. Scudder then exhibited some illustrations of rare fossil insects, prepared for publication in Dr. Hayden's report, and a large volume of lithographed plates, coloured drawings, etc., of Diurnal Lepidoptera in all their stages, which he had had made to illustrate his proposed great work on the Butterflies of North America.

Mr. J. D. Putnam, of the Davenport Academy, presented some notes on the North American Galeodes (*Solpugidæ*), and exhibited specimens in illustration.

The Rev. H. C. McCook, of Philadelphia, gave a most interesting lecture on the life history of the honey ants of the Garden of the Gods, Colorado, and illustrated it with specimens of the insects and a great number of very large water-colour drawings. He described fully the chambers excavated by the ants, the insects themselves in all their forms, their nocturnal habits, and their feeding upon the saccharine juice exuded from the galls of the scrub-oak. He stated that the workers are undeveloped females, and that the honey-bearers are a changed form of the worker major with a greatly enlarged crop, in which they store the honey. Mr. McCook has not yet committed his observations to writing, but, we understand, that he will eventually publish them in the proceedings of the Academy of Natural Sciences at Philadelphia. It is impossible to give here even a synopsis of the vast amount of information that he afforded upon this interesting subject.

Prof. Riley remarked, in connection with this subject, that many galls secrete saccharine matter, and that sometimes the gall-insects themselves are entrapped in it; that the ants probably get their honey also from the species of *Coccus* that frequents the scrub-oaks of Colorado; and that almost all species of ants are able to expand their abdomens when necessary.

Dr. Haldeman observed that the reason why hills were constructed by some ants and not by others was probably because some might have the proper materials conveniently at hand and others not. He urged Entomologists to domesticate ants in order to study their habits, most of which are as yet very imperfectly known.

Mr. Bassett stated that very many species of galls are infested by ants; that he has observed a gall on scrub-oak swarming with ants, and with *Cetonia Inda* and other honey-loving insects.

Dr. John L. LeConte, of Philadelphia, Pa., read a paper on a collection of *Coleoptera* obtained from a few hickory twigs. Some hickory trees on a friend's estate, near Philadelphia, were observed to be diseased, and therefore cut down. Some of the twigs were sent to him, and from them he obtained no less than twenty-two species of *Coleoptera*. He expressed a strong hope that some competent Entomologist should prepare a list of the insects that infest forest trees, and that it should be appended to the report about to be issued by the U. S. Commission on Forestry.

Dr. Morris stated that he also had obtained a considerable number of species of beetles from twigs.

Mr. Haldeman said that the hickory was more infested with insects than any other tree.

Dr. LeConte next read a paper on the so-called "Lightning Bugs" (*Lampyridæ*).

Mr. Austin remarked that when a fire-fly is at rest there is a faint ray of light visible, proceeding from the edge of the segments of the abdomen; when the insect is emitting the flashes of light it moves these segments, and so reveals more of the light.

Mr. Martin stated that he had observed a fire-fly in a spider's web, and that it emitted very rapid flashes of light at first, but that they gradually diminished in brilliance till at length they died out.

On motion, the meeting then adjourned till 8 o'clock, p.m.

Tuesday Evening Session.

At 8 o'clock, the Entomological Club met at the Hotel Vendôme, Dr. J. G. Morris in the chair.

Mr. H. F. Bassett, of Waterbury, Conn., gave an account of the "Structure and Development of certain Hymenopterous Galls." He exhibited specimens of galls produced on plants and trees, and spoke of the alternation of two forms belonging to one species. The seminator deposits its eggs in the young acorn, and from the sting or puncture the gall grows, having the appearance of another acorn. This falls to the ground in September, and remains twenty-one months, at the end of which time the gall-flies are produced, which are all females. These females lay their eggs in the buds of the trees in the spring, and from these galls are formed, out of which are developed flies of the both sexes. All galls may be divided into two classes:—First, those formed in autumn, which do not develop till the next or a succeeding year, the imagoes or perfect insects hatched from them being always females; and secondly, those formed in the spring, the progeny of which are of both sexes. He considered that the woolly substance that covers these galls is an excessive development of the pubescence of the leaf, and thought that the growth of the galls is produced by the action of the poison that is infused by the parent insect when making the sting or puncture, because he often could find in a gall no trace of any larva.

Prof. Riley expressed his opinion that galls are formed both by the poison injected with the egg, and by the irritant action of the larva. He spoke also of the sweet exudation on galls, and remarked that honey-dew is in some cases the natural exudation of the plant, independent of the action of insects upon it.

Prof. C. H. Fernald, of Orono, Me., exhibited three volumes recently published by Lord Walsingham, on "North American Micro-Lepidoptera, Tortricidæ," illustrated with coloured plates, and forming part of the British Museum Catalogues for 1879; also, by the same author, a volume on the "New and little-known Species of North American Tineidæ," and another on "The Pterophoridæ of California and Oregon." He then proceeded to read a paper on the Classification of *Tortricidæ*, illustrating his remarks by some wings prepared for the microscope. These slides, which beautifully exhibited the venation of the wings, were mounted with glycerine boiled gently over the lamp; the wings were bleached by Dimmock's process.

Dr. H. A. Hagen, of the Museum of Comparative Zoology, Cambridge, Mass., read a paper on the importation of the Hessian fly. The generally accepted theory, from which the insect derives its common name, is that the insect was brought from Europe to America, about a century ago, in the straw used for bedding by the Hessian troops employed by the British Government in the war of the Revolution. This theory Dr. Hagen rejects, and in a sketch of the history of the movement of these troops, he showed that the lapse of time during their transportation was considerably greater than that of the term of the normal development of the fly from the egg. He stated that there was some evidence of the existence of the fly in America before the arrival of the Hessian troops, and that it was unknown in Central Europe till recently; there was, however, some evidence that it may have appeared in certain places on the Mediterranean coast at an earlier period. He even thought it possible that the fly might have been imported *from* America into the Mediterranean region of Europe by American trading vessels. His conclusions, as stated in a long and very interesting paper, in which he quoted many German and British official records, may be summed up briefly as follows: 1. It is impos-

sible that the fly could have been imported by Hessian Troops, as proved by the historical records. 2. The fly must have been in America long before the arrival of the Hessian troops. 3. The fly was not known in Germany before 1857, and is probably an indigenous American insect.

Prof. Riley stated that he had so often noticed a retardation of development in insects, that he should not be surprised if this had been the case with the Hessian fly, when imported. Again, that the "flax-seed state" of this insect lasts so long that it might have crossed the Atlantic during that phase of its existence.

Dr. Hagen replied that Dr. Asa Fitch had already proved the impossibility of this.

Prof. Riley accepted the theory that the fly is indigenous to America, and Dr. Hagen stated that he believed that it is indigenous to both Europe and America.

The meeting then adjourned.

Wednesday Afternoon Session.

The Club met for an hour, at 5 o'clock, p.m., in one of the rooms of the Massachusetts Institute of Technology, a large and commodious building, which was almost entirely given up to the work of the Association.

The short time at the disposal of the Club was occupied by the continuation of the Rev. H. C. McCooks lecture on the Honey-ants of the Garden of the Gods, Colorado; the first portion of which he delivered on the previous afternoon. At its conclusion, some remarks were made by Prof. Cook and others, on birds *versus* insects.

Thursday was devoted by the the Association to a visit to Cambridge. Many of the Entomologists took the opportunity of visiting the rooms of the Cambridge Entomological Club, where they were received by Mr. B. P. Mann, the Secretary.

Friday Afternoon Session.

The Club met in their room in the Institute of Technology at 4 o'clock p.m., Mr. A. R. Grote, Vice-president, in the chair.

Dr. LeConte moved that, owing to a resolution passed at the general session of the Association that morning, the Entomological Club do now organize as a permanent Sub-section of the Association. He proceeded to congratulate the Club on the honour thus conferred upon it. It was due to the importance of the subject and the large attendance of Entomologists, no less than to the number of interesting papers offered for their discussion. The resolution was unanimously adopted, and the Club at once organized as a Sub-section with the officers elected on the first day of meeting.

Mr. E. Burgess, of Boston, gave an account of the structure of the mouth organs of Butterflies, describing especially and illustrating with diagrams on the black-board, the proboscis, etc., of the *Archippus*. Remarks were made upon the paper by Dr. Hagen and Messrs. Mann, Cook and Riley.

Dr. Hagen read a paper on the anatomy of *Prodoxus decipiens*, in which he confirmed Mr. Riley's statements.

Prof. Fernald read a paper on *Phoxopteris angulifasciana*, a small tortrix feeding upon clover.

Mr. O. S. Wescott, of Racine, Wis., gave by request an account of a moth trap for collecting insects by light, which he had employed with much success. Dr. Hoy and Mr. Mann also described insect traps that they had found useful.

Mr. Westcott gave an account of the mode of building its web by a geometrical spider, and stated that the insect when forming the concentric lines across the rays measured the distance from the next parallel line by means of its second right fore-leg before attaching the thread to the ray.

Prof. Cook, in answer to a question, stated that he had found a mixture of honey and beer equally efficacious with the ordinary mixture for sugaring.

Mr. Grote remarked that he had found the Colorado potato beetle feeding upon a large cultivated variety of Datura, and feared that it would probably soon prove a serious enemy to the tobacco plant, another member of the family *Solanaceæ*.

Prof. Riley stated that he had found the Colorado beetle in South Carolina.
The meeting adjourned at 6 o'clock.

Monday, August 30th.

The Sub-section of Entomology met at the Institute this morning, Dr. J. G. Morris in the chair. For the first time the titles of the papers to be read, with the names of the officers, were published in the Association programme for the day.

Prof. Fernald gave a brief description of his method of preparing and mounting the wings of *Micro-lepidoptera.*

Mr. B. P. Mann gave an account of the contributions of the Cambridge Entomological Club and the progress of Entomology.

Prof. C. V. Riley described the life-habits of several bee-flies (*Bombyliidæ*), and made some remarks on tree-crickets and on the early stages of *Blepharocera.*

Dr. Hagen exhibited a specimen of *Passalus cornutus,* which was entirely destitute of any trace of elytra, but possessed wings and all other parts quite perfect. He stated that it was impossible that the elytra had been artificially removed and that he considered this to be a very rare natural deformity.

Rev. C. J. S. Bethune, in the absence of Dr. Hoy, who was to have read the next paper on the occurrence of *Aletia argillacea* in Wisconsin, stated that he had learned in conversation with Dr. Hoy that this moth had occurred in immense numbers on ripe melons near Racine, Wis., and that he had himself in the autumn of 1865, taken a great quantity of the moths feeding on fallen plums and apples, but that ordinarily the moth was not at all common in Ontario.

Prof. Riley considered that the *Aletia* flew to the north when superabundant in its natural home in the cotton growing regions of the south ; that it fed there on some malvaceous plant, lived a year, but not probably longer, and then was no longer to be found in northern localities until another emigration took place when it again became numerous. He did not think that it could possibly live for more than a few generations in the Nothern States or Canada.

Mr. Mann was of opinion that it must live for years in the north, finding some suitable food plant, though like very many other insects it was frequently scarce and then suddenly appeared in great numbers.

Dr. Lintner stated that he had found the moth at an altitude of 1800 feet on the Adirondack Mountains, and that Dr. Hoy had informed him that he had taken the larva in June at Racine.

Dr. E. L. Mark described some points in the anatomy of the *Coccidæ.*

The list of papers having been exhausted, the Section now adjourned to meet next year in Cincinnati, Ohio.

POPULAR PAPERS ON ENTOMOLOGY.

Entomology for Beginners.

By James Fletcher, Ottawa, Ont.

Entomology seems to be gradually throwing off the veil of contempt under which it has been so long hidden. The Botanist has always to a certain extent been deemed a philosopher from the important part plants play in Pharmacy ; the Geologist and Mineralogist, too, from the possibility of their discovering precious metals have been treated by the outside unscientific world as sages worthy of some respect. Entomologists, however, have not thus been honoured by the masses. The question would be asked—What tangible results can come from collecting flies and bugs and sticking pins through them ? and in vain the amount of damage done by insects year by year might be estimated and pointed out. This state of affairs, though, I believe, is now at an end. The claims of the science on all agriculturists and horticulturists are daily becoming more apparent. The institution of the United States Entomological Commission, and the success that has

attended that organization from the happy choice of such men as Messrs. C. V. Riley and A. S. Packard as directors, has perhaps done more than anything else to open people's eyes to the fact that after all there is something in Entomology. In Canada, too, much good work has been done. In 1868 two Entomological magazines were started, our own important organ, the CANADIAN ENTOMOLOGIST—in August, for Ontario; and *Le Naturalist Canadien*, edited by the Abbé Provancher, in December, for Quebec; to these is chiefly due the progress the science has made in Canada. The editors of the CANADIAN ENTOMOLOGIST—Rev. C. J. S. Bethune (1868-1873), and since that time our present esteemed editor—have always by their many charming and descriptive papers evinced a desire to make the study of Entomology as fascinating and easy as possible for beginners, while at the same time they have paid full respect to their scientific readers. *Le Naturalist Canadien* is published in the French language. It was commenced in December, 1868, from which time the Abbé Provancher has fought bravely, and almost single-handed, against all obstacles, striving by its means to create among the French Canadians a love for the natural sciences, particularly Entomology. I am very sorry to see by the December number, that on account of the grant which the Editor received from the Government having been discontinued, his valuable work may possibly be stopped: this would be a great pity, and every Entomologist ought to give a hand in helping him out of his difficulty. The magazine has been of great value to the farmers of Lower Canada, who in its pages have always received courteous answers on any subjects in the many branches of natural history affecting agriculture.

In the eleven volumes of the ENTOMOLOGIST now published, or in the Annual Reports of the Society, descriptions of nearly all the common Canadian insects, and illustrations of many of them, will be found. I would particularly call attention to a paper in the Annual Report of 1872 by Rev. C. J. S. Bethune, entitled "Beneficial Insects." This gives an outline sketch in a concise manner of the different divisions into which insects are divided and the distinguishing points of each.

With the above mentioned volumes and Dr. Packard's Guide to the study of insects, a very complete knowledge of the rudiments of entomology can be obtained; the rest can only be learned by observation and experience in the field. Undoubtedly the first and most important step of all is to commence a collection. Study can only be carried on satisfactorily from the actual specimens, which should be examined alive whenever possible, and full notes taken of any striking peculiarities observed; when preparing specimens for the cabinet, the one idea which has to be born in mind, and upon which the whole value and beauty of the collection depends, is that they may appear natural, and a knowledge of how to effect this can only be attained by observing living specimens.

THE CALOSOMAS OR CATERPILLAR-HUNTERS.

These insects belong to the family called *Carabidæ*, which is a large and difficult family to study, or even to define and limit exactly. The insects belonging to it are remarkable for their graceful forms, and at the same time for their cruel and predacious habits, both in the larval and perfect states. It is this last trait which makes them such useful auxiliaries to the horticulturist.

Fig 1.

The better known of the two represented here is called *Calosoma calidum*, Fabr., (fig. 1) or "The Glowing Beautiful-bodied Caterpillar-hunter." As an exception to the general rule, its English name is more formidable than the Latin; but so important a personage is its bearer that I will not deprive him of a single letter of his title, and indeed am almost tempted to add to it the words "most useful." It well merits its appellation, *Calosoma* (*Kalos*—beautiful, and *Soma*—a body). Fig. 1 gives a life size representation of it. The colour of the polished elytra or wing-covers is a deep blue-black, and the six rows of dots with which they are adorned are of a fiery burnished red, for which reason it has been called by the specific name of *calidum*. The legs in our figure are two thick and clumsy, but it must be well known to

everyone. It may generally be found in early summer, in damp pastures, either hidden under stones or running in the grass in search of caterpillars and other soft-bodied insects. Jaeger, who first called the members of this genus caterpillar-hunters, says "they may be found every morning and evening upon the branches of trees, looking out for caterpillars and devouring them." They do not, however, restrict themselves to caterpillars, for they will attack and devour a perfect June-bug when fresh from the pupa state and soft, with apparently the same relish as their special dainty, a fat cut-worm. In the larval state they are equally rapacious; they lurk in holes in the ground or under sticks and stones in the daytime, and only leave their retreats as night draws on to go in search of prey. Every spring I have several of these useful and luckily common beetles brought to me by kind friends who have found them in their gardens. To the inquiry "Is this of any use to you?" I have always the answer ready, which somewhat surprises them: "No, but it is of particular use to you; take it carefully back and put it in your garden again; it is the best friend you have there, for it feeds entirely upon your enemies, the wire-worms, cut-worms and white-worms."

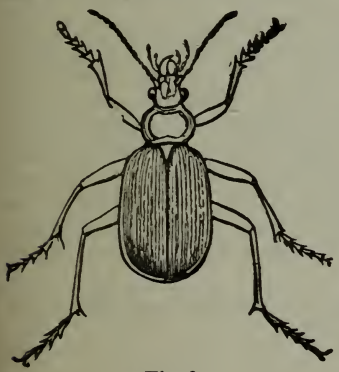

Fig. 2.

I am sure that through the agency of this beetle alone I have been able to gain more respect for the science of Entomology among horticulturists than from all the rest put together.

Much resembling this beetle in shape, but of a very much more striking appearance, is its near relative, *Calosoma scrutator*, Fabr., the "beautiful-bodied searcher," fig. 2. The colour of its wing-covers is bright metallic green, garnished with longitudinal lines and sparcely punctured; round the margin runs an effective line of coppery-red. The head, thorax and legs are almost black; the margin of the thorax having a greenish tinge. The under side is of a deep burnished blue-green hue. Its habits are the same as those of *C. calidum*, but it is a much rarer insect. I have never seen a live specimen; but they are occasionally found in Ontario, and dead specimens are said to be frequently washed up on the outer shore of Toronto Island after a southerly gale.

The Common Woolly Bear *(Spilosoma virginica)*.

By W. Saunders, London, Ont.

The caterpillars known under the common name of "woolly bears" belong to the family of Arctians, and most of the species in the moth state are very pretty objects. The commonest of all the species is *Spilosoma virginica*, a pure white moth which appears on the wing in May, when it deposits its clusters of round yellow eggs on the under side of the leaves of many plants. In a few days these hatch into minute hairy caterpillars, which for a time feed in company, and devour at first the under side of the leaf only, so that it assumes a scorched and withered aspect. In a short time, however, they part company, each one choosing his own course, and blessed with good digestive powers, they eat freely of all parts of the leaf. The full grown caterpillar (fig. 3, *a*) is nearly two inches long, thickly clothed

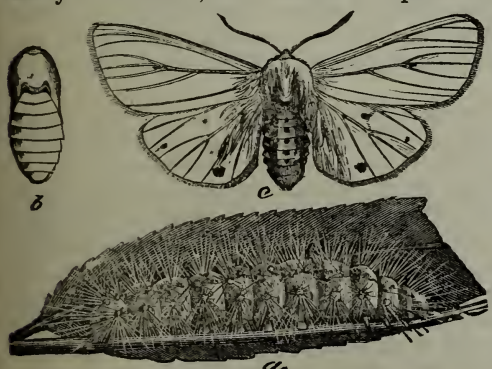

Fig. 3.

with hair usually of a yellowish colour, but not always so, for some are light brown and others a darker brown. The head and feet are usually yellow, and the hairs arise in little tufts from small yellow tubercles arranged nearly in rows across the body. In the spaces between the segments there are darker lines, sometimes brown or dark brown, and occasionally nearly black ; there is a dark line along each side, and the under surface is also of a dark shade.

When full grown the caterpillar seeks some sheltered nook in which to change to a chrysalis, attached to the under side of a board, under the bark of a tree or in some crevice in a fence, wherever it is dry and secluded. Having fixed on a suitable locality, the larva proceeds to divest its body of the covering of hairs, and with these woven together with silken threads, it constructs the slight cocoon which is to shelter the chrysalis, and here in a short time the change takes place. From the chrysalis (*b*, fig. 3), which is of the usual brown colour, in a week or two the perfect moth appears, soon to deposit fresh patches of eggs, from which in a few days the second brood of larvæ are hatched, which attain maturity and enter the chrysalis state before winter comes, and remain in this quiescent condition until the following spring.

The moth (fig. 3, *c*) measures when its wings are expanded from one inch and a half to two inches. The figure represents a female ; the males are somewhat smaller. Both sexes have the wings snowy white with a few black dots which vary much in number in different specimens ; in some there are two on each front wing and three on each hind wing, as in the figure, while in others the spots are almost wanting, and there is every gradation between these extremes. On the under side the spots are more distinct than on the upper, and sometimes the white surface is slightly tinged with yellow. The antennæ are white above, dark brown below, the head and thorax white. The abdomen is orange coloured, sometimes streaked across with white, and has three rows of black spots, one above and one on each side ; the under side of the abdomen is white, sometimes tinged with orange.

This species is attacked by several parasites, which destroy immense numbers every year ; were it not for this we should soon be overrun with them.

Tiger Beetles.

By R. V. Rogers, Jr., Kingston, Ont.

There are probably over ninety thousand different species of Beetles in the world, and first and foremost of this mighty legion stand the Cicindelidæ. Well, therefore, might they demand our attention from their high position in the Coleopterous world alone, but they have many other claims on our consideration. They are cosmopolitan—no pent-up Ithaca contracts their powers ; they are beautiful ; they are fierce ; they are blood-thirsty ; they are useful ; and the family name is an old one—known to scientists and men of letters in the days when Jupiter and Juno were king and queen of heaven, to the inhabitants of old Rome.

The family is divided into several branches ; in Canada we have only the representatives of one branch, but it is the original one, the Cicindelas. In the United States there are a couple of other branches as well, which reside principally far to the west.

There is much in a name. The patronymics Smith, Barber, Wright, tell the origin of the family at once ; so *Cicindela* informs us that those that are so called are "bright and shining ones," while the English cognomen of tiger beetle lets all Anglo Saxons know that it is a creature that lives by preying on the blood of others. Brilliant, beautiful and elegant in shape are these beetles, and they appear to revel in the merry, merry sunshine ; on every bright summer day they are to be found running and flying about sunny banks, sandy places, and wherever the god of day beats down his life-giving rays ; most of them avoid vegetation, as it would check their rapid progress ; some species, how-

ever linger in grassy spots among scattered trees. They are among the most predaceous of the Coleoptera; "they act like the tigers among mammalia, the hawks among birds, the crocodiles among reptiles, or the sharks among fishes." In some of them activity, as well as brilliancy of colouring, is carried to the greatest perfection. In the tropics some few genera are found which alight only on the leaves of trees, but further north they are all terrestrial. The species are more numerous in the temperate and sub-tropical regions, and gradually disappear from view as we journey towards the north pole, until in the latitude of Manitoba (as we are told) but two or three are to be found.

Let us take our *instrumenta belli* and go in quest of some of the dozen species we have in Canada (in North America there are about one hundred). Let us hurry before yonder cloud obscures the sun, for then—like chickens in an eclipse—they will retire to their homes. Here is a likely spot, and there are some specimens of our commonest species *(C. vulgaris)*. Go for that one! He sees us as quickly as as we spy him, and is off, flying rapidly for a few yards and then coming suddenly to the ground with his head towards the enemy. Again and again we start him; at length he tires of the chase and takes a longer flight than usual; we know his little plan, and hurry back to where we first saw him in time to see him alight all unsuspectingly, and we easily take him captive in our toils. Let us examine him. He savagely moves his mandibles and tries to pinch, but his bite is inoffensive and not very painful. Some of them give forth a rather strong scent. This one is a little over an inch long, but barely a quarter of one broad; his head is very large, for he has brains; his jaws are very strong, for he has an appetite, and long and curved—a couple of scimitars, in fact, by which he cuts and carves the quivering carcasses of his prey. His eleven-jointed antennæ are graceful, long and slender. 'Tis true that his back is of rather a dull purple colour, but beneath he is resplendent in a beautiful bright brassy green. Each wing cover is adorned with three whitish irregular stripes. His legs are long and slender, just the things on which to hunt the active insects which he feeds upon.

Michelet speaks of the beauty of one of the next of kin of the captive in our fingers thus glowingly: "The rich and living aliment of the unfortunate insect victim apparently communicates to the Cicindela its glowing colours. Its entire body is embellished with them; on the wings a changeful besprinkling of peacock's eyes; on the fore parts numerous meanders, diversely and softly shaded, are trailed over a dark ground. Abdomen and legs are glazed with such rich hues that no enamel can sustain a comparison with them; the eye can scarcely endure their vivacity. The singular thing is, that besides these enamels you find the dead tones of flowers and the butterfly's wing. To all these various elements add some singularities, which you would suppose to be the work of human art, in the

Fig. 4.

Fig. 5.

Fig. 6.

Oriental styles, Persian and Turkish, or as in the Indian shawl, where the colours, slightly subdued, have found an admirable basis, time having gradually lent a grave tone to their sweet harmony."

When we have let go our common Cicindela, *Cicindela vulgaris* (fig. 4), let us look at the pictures of his—not sisters—but of his cousins and his aunts.

The purple tiger beetle *(C. purpurea* Riv.) is figured as No. 5. It is nearly the same size as *vulgaris*, and is often to be found in its company. Its general colour is a

beautiful metallic purple; sometimes, however, it assumes a greenish garb. On either wing cover there is a bent reddish line extended from the outer almost to the inner margin, a dot lower down and another at the extreme tip of the inner margin. It rather delights

Fig. 7.

Fig. 8.

Fig. 9.

in chilly weather, and often appears before the snow is well gone. Mr. Bethune says (Rep. Ent. Soc., 1873) that he has caught it in numbers in April, and on one occasion as early as the 17th March, before the snow was gone.

The six-spotted tiger beetle (*C. sex-guttata*, Fabr.), fig. 6, is a most beautiful insect of a most brilliant metallic green, flecked with three small white spots on each wing cover; Packard calls these markings "golden dots."

The hairy-necked tiger beetle (*C. hirticollis*, Say), fig. 7, is a common species closely resembling, though smaller than, *C. vulgaris;* it is distinguishable by having whitish hairs on its neck.

C. generosa, Dej., (fig. 8), is more strongly marked than the species already mentioned, and is considerably larger.

C. 12-guttata, Dej., is smaller than *vulgaris*, brownish, and decorated with twelve smaller reddish spots.

C. punctulata, Fab., is about the size of *C. 12-guttata*, and has a row of smaller dots along the inner margin of the wing covers, and a couple of irregular lines on each wing cover.

The tiger beetle may well be called a beneficial insect, and is a valuable and should be a valued friend of man, although some of the species living at the sea-shore feed upon small shrimps, to the loss of humanity. Although it does not, like that brilliant murderess, the Dragon-fly (to quote again the gushing Michelet) clear the atmosphere of the gnats and flies that torment mankind, still with its crossed daggers, which serve it for jaws, it accomplishes a swift and almost incredible havoc among the smaller insects. We should take care of it and respect it. It is an efficacious auxiliary to the agriculturist. The farmer by killing tiger beetles becomes the friend of those insect hosts that fatten on his labours—the preserver and protector of those little enemies which devour his substance. The ferocity of these insects is remarkable. They quickly tear off the wings and legs of their victim, and suck out the contents of its abdomen. Often, when they are disturbed in this agreeable occupation, not wishing to leave it, they fly away with their prey; but they cannot carry a heavy burden to any great distance.

They are true children of earth. The eggs are laid in the earth, and in the earth the grubs are hatched, and in the earth they spend their days, and in the earth they prepare their shrouds, and enwrapped therein sleep their pupa sleep through the long winter, and with the returning warmth of spring crawl out of their earthy chambers to run and sport on earth, seldom using their new found wings to fly away from their beloved mother.

The grubs are curious creatures—hideous hunchbacks (fig. 9), but possessed of brain and stomach. They live in the same localities as their parents, the anxious mother having wisely deposited her eggs where food will be most easily attainable by the larvæ. Let us examine a grub. LeConte says we can easily procure one in spring by placing a fine straw

down one of their holes, for the grub will push it out, and rising above ground in his efforts may be captured. Here is a hole, and down goes a straw. Master Cicindela does not like vegetables, and so seeks to reject it with his broad head ; when he shows himself we quickly seize him. A perfect Daniel Quilp we find him, with head enormous, flat, metallic colour, armed with long curved jaws. The legs are six in number, and on the back, half way between the legs and tail, "are two curious tubercles, each terminating in a pair of recurved hooks." The head and first division of the body are horny, the rest of the creature is soft. "The larva has all the desire for slaughter evinced by its parents, but its delicate skin, long body and short legs, not only prevent it from chasing prey, but from attempting a struggle with an insect of any size; nevertheless this imperfectly armed creature manages to obtain its food without exposing itself to much risk. With its short, thick, spiny legs it loosens the earth, and then using its flat head as a shovel, and turning itself into a Z, hoists up the clay and upsets it around the mouth of its intended hole. With head and legs, perseverance and time, it sinks a shaft as large in diameter as a lead pencil, and about a foot in depth. (Dr. Duncan says that in England *C. campestris* runs a horizontal gallery as well.) The loose earth around the opening gives way on the approach of any insect and precipitates it into the jaws of the Cicindela, which then descends into its cavern and there at its leisure devours its food." The insect crawls in its tunnel with ease, and if it wishes to remain set fast it sticks the back of its body against the sides and rests safely with the aid of its hooks. In this position it can poke its head out of the ground, thus closing the entrance of its tunnel and awaiting until some ant or other insect passes over. The top of the larva's head forms the floor of the cavity, and when an insect touches it the larva descends at once and with great precipitation, and thus the victim falls into the hole. When fully grown the larva closes up the mouth of its abode, and in quiet and solitude undergoes its metamorphosis, lying dormant during the winter months.

The Tomato Worm *(Sphinx quinque-maculata*, Haworth.)

By the Rev. C. J. S. Bethune, Port Hope, Ont.

Almost everyone, I imagine, has had at some time or other his wonder and curiosity excited by the strange-looking pupa of the tomato worm, as it is familiarly termed. It is frequently discovered when digging potatoes in the autumn, or disturbing the soil where tomatoes have been grown. This singular object, which is very correctly represented in the figure, is about two and a half inches long and half an inch in diameter, of a chestnut brown colour, and round in shape, tapering towards both ends ; from one end, which is the head of the specimen, there proceeds a long curved proboscis like the handle of a jug ; the other end is divided into broad rings, and terminates in a point. To one who had never seen anything of the kind before, this object must at first prove a great puzzle ; but a little careful examination will remove some of the mystery. It must be alive, for the tail end moves ; but it cannot walk or crawl, and is quite helpless. If we examine it more closely, we find that the rings that move when the creature is touched are very like the rings of a large caterpillar, while at the other end we can trace the eyes, antennæ, and even the short wings of a moth, but all enclosed in a hard brown shell. These things show us that it is an insect in its helpless pupa state ; the long jug-handle is the case which contains its tongue for sucking out the nectar from flowers. If we keep it in some damp earth till the next year, there will emerge from it a large handsome moth, of an ashen-grey colour, relieved by five bright orange-yellow spots on each side of its body ; its wings expand fully five inches in length, and its body is about the same length as the pupa or chrysalis ; its tongue is of immense length, about double that of the body—when at rest it is coiled up like a watch-spring beneath the head of the insect. The name of the creature is the five-spotted sphinx [*Sphinx (Macrosila) quinque-maculata*, Haworth].

The larva or caterpillar of this insect, when fully grown, is larger than it is shown in the figure, being as thick as a man's little finger, and over three inches in length. It feeds on the leaves of both the tomato and potato plants. It varies so much in colour

that people often suppose that a number of different species of "worms" are attacking their plants. It is frequently of a bright green marked with white, and having along each side a series of seven oblique greenish-yellow stripes; again it may be found with its general colour dark green, dark brown, blackish green, and other shades, even to deep black. On the last segment of the body there is a curved horn or tail. The accompanying wood-

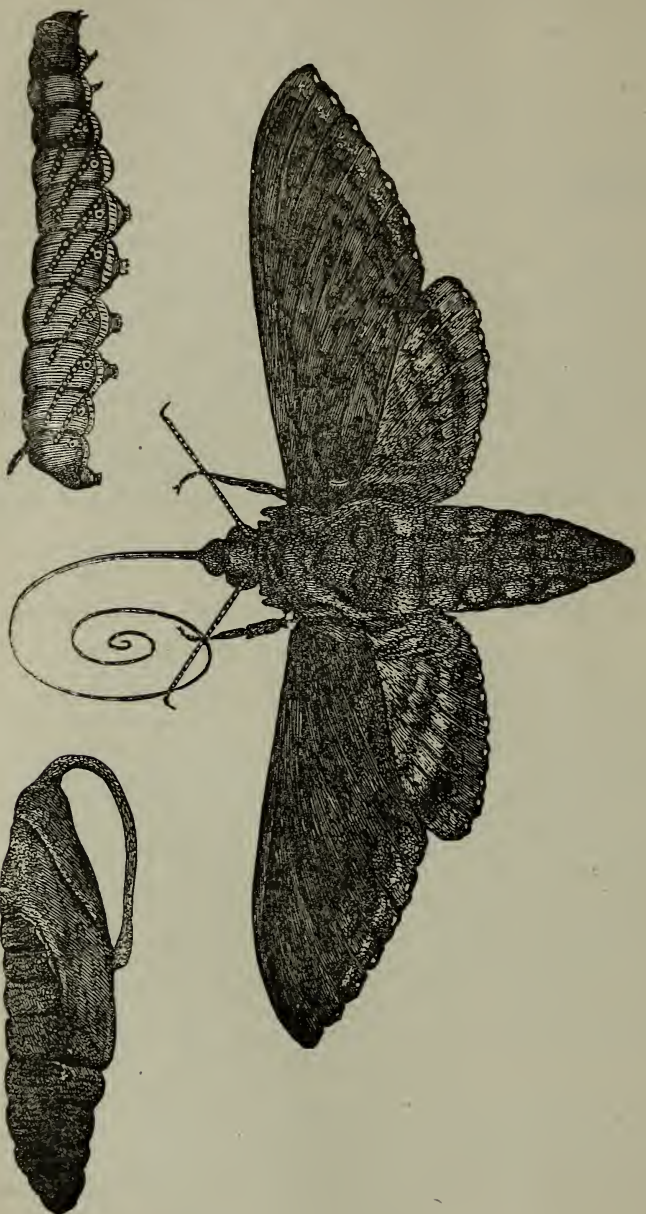

Fig. 10.

cut (fig. 10) affords so satisfactory a representation of the three stages of the insect that it is unnecessary to enter into a minute detailed description.

The larva is found feeding during July and August. It often so closely resembles the foliage on which it reposes, the bands on its sides mimicking the ribs of the leaves,

that it cannot always be detected; its presence, however, may usually be traced by the singularly marked cylindrical pellets of excrement on the ground, and the stripped leaf-stalks of the plant. When fully grown the larva descends into the earth, and there makes a chamber for itself in which to change to its pupa state. Fortunately the insect is not a very common one, its numbers being kept in check by a small ichneumon-fly; otherwise from its size and voracity it would prove most destructive. Very rarely are more than a few specimens seen in a tomato or potato patch. In the summer of 1878, however, as I recorded in the CANADIAN ENTOMOLOGIST (vol. x., p. 218), it was so abundant that a market-gardener who lives near me gathered four bushels of the caterpillars off an acre and a quarter of tomatoes in one day! That year some of the insects attained to the moth or imago state in October, but generally the pupa remains quiescent in the ground till the following season, and the moth appears in June or July. I have now in my possession a living chrysalis of this insect that belonged to the abundant brood of 1878. It was given to me by Mr. David Smart, of Port Hope, who found it, with a large number of others, in his garden. He kept the chrysalids in a box of earth in his cellar all last year; no doubt the coolness prevented the development of the imago. He and I are now both watching with much interest for the appearance of the moths from our specimens, as two years in the pupa state is by no means a common occurrence. That the pupæ are still alive is shown by the readiness with which they move the segments of the abdomen when handled or disturbed.* Notwithstanding the extraordinary abundance of the larvæ in 1878, there were but few to be seen last year in this neighbourhood.

An account of the "tomato worm" will hardly be complete without some reference to the supposed poisonous character of the larva. Some ten years ago, when in charge of the Entomological department of the *Canada Farmer*, I took the trouble to trace up some of the stories then very common in the newspapers about cases of poisoning and death from the effects of the bite or sting or venomous spittle of this insect! The result of my inquiries in many instances proved to be exceedingly amusing. In every case I found that no one could give any information whatever as to even the name of the person who was supposed to have died from the effects of this insect, nor could I obtain a single authentic instance of injury from it. This was, of course, what was to be expected, as the caterpillar is physically incapable of injuring anyone with its bite—much less with its tail or horn, or imaginary sting. In all probability these stories have originated in the fact that persons have been severely affected by getting some of the juices of the tomato plant into an open cut or sore, and then ignorantly have attributed their trouble to the venom of the ugly but innocent caterpillar.

MIGRATORY INSECTS.

By G. J. Bowles, Montreal, P.Q.

The migratory instinct, common to so many species of birds, and even of mammalia, is also exhibited by many species of insects. In the case of birds and animals it has mostly to do with variations of climate, or the necessity of suitably providing for the raising of their young; in the case of insects the causes of migrations are not so evident, and observation is required in order to decide the point, if, indeed, it can be decided at all. The subject is still in obscurity, though the efforts of American Entomologists have thrown a little light upon it with regard to some species. And it is of great interest, not only to Entomologists, but also to tillers of the soil, as some of the insects which exhibit this migratory instinct are among the most injurious to the crops of the farmer and fruit grower.

THE LOCUST.

Chief among the migratory insects stands the locust, considered as a group. On each of the continents, both of the old and new worlds, some species of the locust tribe have from time to time been notorious for this habit, not only on account of the countless numbers in which they have appeared, but also on account of the terrible destruction they

* The Moth emerged from the pupa referred to on the 27th of May, after being nearly two years in that state.

have caused. As far back as the time of Moses their ravages are mentioned, for one of the plagues brought upon Egypt just before the departure of the children of Israel was the plague of locusts. In Asia, Africa and Europe their invasions have been recorded in history, both ancient and modern. To show the magnitude of the effects consequent on their migrations, I give a few instances, as taken by Dr. Packard from different historical sources. The first account, after Joel in the Bible, whose descriptions apply to Egypt, Syria, Palestine and Asia Minor, is the statement of Orosius that in the year of the world 3800 certain regions of North Africa were visited by monstrous swarms; the wind blew them into the sea, and the bodies washed ashore "stank more than the corpses of a hundred thousand men." Another locust plague, resulting in a famine and contagious disorders, according to St. Augustine, occurred in the kingdom of Masinissa, and caused the death of about 800,000 persons. Pliny states that the locusts visited Italy, flying from Africa. In Europe locust invasions have been recorded since 1333, when they appeared in Germany. Mouffit states that in 1478 the country about Venice was invaded, and 30,000 people died of famine. In France swarms appeared at the close of the Middle Ages. In 1747 there was a great invasion of Southern and Middle Europe. Before and after this date vast swarms were observed in Asia and Africa. In Russia, whose southern plains form the home of the locust, vast numbers have often appeared and done great damage. In China records exist of the appearance of these insects in devastating numbers 173 times during a period of 1,924 years. The three great causes of famine in China are placed as flood, drought and locusts.

The new world has also its migratory locusts, equally destructive with those of the old. The Rocky Mountain locust, of which we all have heard so much, is not the only species. Central and South America have also their peculiar locust. Their ravages have been noted by the old Spanish chroniclers of Mexico and the adjacent countries from the time of the first conquest. In 1632 parts of Mexico were overrun with them, and in 1738 and '39 there was an invasion by them of the coasts of Oaxaca, after which a famine occurred in Yucatan. In 1855 and '56 Honduras and Guatemala were invaded, and a famine and pestilence of fever followed. And in 1835 Chili and the eastern part of South America were infested with vast swarms of locusts.

The Rocky Mountain locust *(Caloptenus spretus)* having been a subject of observation by the most eminent Entomologists of the United States, we know more about its habits and economy than about those of any other species. The terrible devastations it has committed in the Western States have led to this result. When an insect destroys the crops in one year to the estimated value of $45,000,000, it is about time to study its history and habits. Mr. Riley has published a most interesting book on the subject, and from this I have culled a few of the most striking items. Its home is on the elevated plateau of the Rocky Mountains, whence it migrates in favourable seasons to the west and south for hundreds of miles, laying waste the crops wherever it alights and doing terrible damage. It breeds in the regions to which it migrates, and the next generations migrate again north and west towards the "metropolis" of the species, and gradually die out on the way, while those that remain in the place of their birth also die out, so that the species becomes extinct in these localities in a few years.

The observations made, so far, give no special reasons for these migrations, unless it be the unusual abundance of the species and the consequent scarcity of food in its native regions. One or two favourable seasons cause the insect to increase to an immense extent, and when they find the supply of food failing them, they mount into the air in countless millions, and, favoured by a westerly or north-westerly wind, sail off towards the settlements in search of "fresh fields and pastures new." Such is the principal reason given by Packard, though he says possibly the reproductive instinct may also be concerned. And he does not think that these movements can be the result of a real migratory instinct, because their migrations (as well as those of the locusts of the old world) are periodical, long intervals sometimes existing between them, so that the development of a migratory instinct would be impossible. If once partially implanted, the long succession of non-migratory years would effectually break up the germs of such an instinct.

Another curious fact in connection with these locusts is, that the generation born in the region to which the species has migrated the previous year, shows a tendency to return

north and west towards the primal habitat. This has been proved by repeated observation. One reason for this is found to be the prevalence of favourable winds at that particular season in the regions where these locusts are produced; for locusts, and indeed, all migratory insects, are dependent to some extent upon the winds for assistance and direction in their migrations. This is true for locusts all over the world; they are brought by the wind and taken away by the wind. A striking instance of this fact is given in the account of the great Egyptian plague of locusts in the Book of Exodus.

So with our American migratory locust. The general direction of the winds on the eastern slopes of the Rocky Mountains and on the plains is, during July and August, west or northwest. These are the months during which the locusts come down from their mountain home to invade the cultivated plains of the border States. And when the generation of which these are the parents attain the winged state, in the following June, it has been found that the prevailing winds are from the south and southeast, and thus are favourable to the flight of the locusts in a northerly or westerly direction.

As regards their powers of flight, it has been proved by experiment that the locust, when it has a favourable wind (and it rarely flies at any other time), does not fly faster than the wind, but merely uses its wings to sustain itself in the air, and allows the breeze to waft it along. An observer proved this by ascending to the top of the State University of Nebraska when a swarm of locusts was passing, and letting loose among the flying grasshoppers small bunches of cotton. He found that the cotton sailed along quite as fast as the grasshoppers did.

Their numbers are inconceivably great. A British officer who saw a swarm in Syria estimated their number at 180,000,000,000,000. The clouds of them seen in the west have often exceeded 50 miles in length by 20 in breadth, with a depth of from a quarter of a mile to a mile; 1,500,000 bushels of their dead bodies were estimated to be lying on the shores of Salt Lake, in Utah, after a visitatiou of their hordes. And their eggs are found in the ground in numbers of from 100 to 15,000 to the square foot, in localities favourable to their deposition. Such are some of the reliable statistics gathered regarding the Rocky Mountain locust.

A curious and fortunate fact with regard to the locust is that it does not become acclimated in the regions to which it migrates. The hordes from the north, fresh from the invigorating air of the mountains, are much stronger and more vigorous than their progeny born the succeeding year in the plains of Missouri and the other Western States. Professor Aughey, of the State University of Nebraska, tested their muscular strength by attaching their hind legs to a delicate spring balance and observing the degree of strength they exerted. He invariably found that the locusts from the mountains were stronger than those born in the plains. He also found that the mountain insects could live without food for several days longer than the others. Their eggs are also injured by the moister climate, so that it is estimated that fully one-half become addled and never hatch. These circumstances tend to so reduce their numbers in the new habitat that in a few years the species dies out.

b

Fig. 11.

This locust is a near relation of our common Canadian locust *(Caloptenus femur-rubrum)*, fig. 11. The latter has often been injurious to the crops, particularly of grass and hay, but has little tendency to migrate. It has a vast range, from Labrador to the Pacific coast, including the Western States and Mississippi Valley as far south as 35°.

Leaving the locusts, we will pass to the more pleasing duty of noticing some migratory insects which are comparatively harmless, and are far more beautiful than any of the Orthoptera.

Many of the butterflies are inclined to migrations, particularly the whites and yellows *(Pieris, Colias* and *Callidryas)*. These genera, with a few exceptions, are not very plentiful in temperate regions, but have their home in warm climates. So from equatorial and South America, and from the southern parts of Europe have come reports of vast migrations of these butterflies. Bates, in his "Naturalist on the River Amazon," gives an interesting account of the uninterrupted procession of butterflies belonging to the genus *Callidryas* which he saw passing from morning to night in a southerly direction across the

Amazon. In these cases migrations may perhaps be connected with the question of food, or of the continuance of the species.

A butterfly which is well known in Canada, and which has a very wide range, is noted for its migratory habits; it is the *Danais archippus* (fig. 12). Hardly a season passes

Fig. 12.

but we read of its migrations. Newspapers in the Southwestern States, and the weather signal officers, were constantly reporting the passage over Iowa, Kansas, Missouri and Texas of swarms of this butterfly during the months of September and October last. Even in Canada they are sometimes seen in great numbers on their way either north or south. I myself have seen the shore of Lake Ontario, near Brighton, strewn with hundreds of their dead bodies, cast up by the waves, and which no doubt had formed part of a swarm which from weakness or some other cause had perished while flying across the lake.

Mr. Riley gives an interesting account of the causes which may lead to the migrations of this butterfly in his third report. He says:—"It would be difficult to give any satisfactory reason for this assembling together of such swarms of butterflies. As I have abundantly proved by examination of specimens, the individuals composing the swarms of our Archippus butterfly comprise both sexes; if anything the females prevail. The flights almost always occur in the autumn, when the milk-weeds *(Asclepias)*, upon which the larva of this butterfly feeds, have perished. The instinct to propagate is, therefore, at the time in abeyance. The butterflies, unable to supply themselves with sweets from flowers, are either attracted in quantities to trees that are covered with honey-secreting plants, or bark lice; or else they must migrate southward, where flowers are still blooming. The Archippus butterfly hibernates within hollow trees and other sheltered situations. Southerly timber regions offer most favourable conditions for such hibernation. Under the most favourable conditions a large majority perish. A small portion of the females survive the winter. Such hibernating individuals, upon waking from their winter torpor, make at once for the prairie, where the milk-weeds most abound. Faded, and often tattered, they may be seen flying swiftly over such prairies.

"I have no doubt but that they travel thus for many hundred miles, keeping principally to the north, and ere they perish, supplying the milk-weeds here and there with eggs. A fresh brood is produced in less than a month, and these extend still farther north, until we find the species late in the growing season as far up as the Saskatchewan country, where it can scarcely successfully hibernate, and from whence the butterflies instinctively migrate southward. We can thus understand how there are two, three or more broods in southerly regions, and only one towards British America.

"The exceptional flights noticed in the spring, and which, so far as recorded, take place quite early and in the same southerly direction, find a similar explanation. They may be looked upon as continuations of the autumn flights. Hibernating in the temperate belt, they are awakened and aroused upon the advent of spring, to find the milk-weeds not yet started, and they instinctively pass to more southern regions. There is a south-

ward migration late in the growing season in congregated masses, and a northward dispersion early in the season through isolated individuals."

It will thus be seen that Mr. Riley looks upon the migration of *D. archippus* as something analogous to the southern movement of the birds on the approach of winter, the object in both being the preservation of the species; in the case of the insect to obtain a suitable place for hibernation, as well as a continued supply of food until the time of hibernation arrives; in the case of the bird to secure food when it would be difficult or impossible to get it in a northern climate. The instinct of the butterfly might therefore be looked upon as a true migratory instinct, in contradistinction to that of the locust, which is of a lower order.

There is another butterfly which displays this instinct to a large extent. I refer to the well-known *Pyrameis cardui*, or painted lady. It is a cosmopolitan butterfly, being found in all parts of the world—a result, no doubt, of its migratory habits, conjoined to a faculty of acclimatization. Though I have never actually seen a migration of this insect, I have had no doubt for years past that one did take place in the vicinity of Quebec, I think in 1865 or '66. I had been looking out for the insect for several years, but never saw a single specimen till one summer, when it suddenly became the most common butterfly in the neighbourhood. They could be seen by dozens everywhere. Next year it was not to be found, nor did it return during my stay in Quebec, up to 1872.

I have an idea that others of the genus *Pyrameis*, as well as the species of the allied genera, *Grapta* and *Vanessa*, have these migratory habits to some extent. The same phenomenon, that of scarcity, then extreme abundance for one season, and then disappearance, took place with regard to *Vanessa j-album*. They were so abundant one summer that I even saw them drinking spruce beer from the old applewomen's kegs on the Upper Town Market, Quebec, while next season the only specimen I found was a poor dilapidated individual which I took snugly tucked away under the coping of a fence, where it had evidently passed the winter.

As I said before, the fact of *Pyrameis cardui* being found in all the four quarters of the globe is no doubt due to its migrating propensity. A further proof of this is found in the well-known fact that our *archippus*, originally confined to America (though ranging from Canada to Bolivia), has lately spread over some of the islands of the Pacific to Queensland and New Guinea, and over the Azores to Europe, such extension of habitat necessarily indicating great power of long-sustained flight. Since the Milk-weeds are not plants of commercial value, it is highly improbable that the species has been carried in any of its preparatory states in ships. The fact remains, however, that it has been found as a new inhabitant of those countries. Its powers of flight will hardly be doubted by any one who has attempted to catch it on the wing. But a stronger proof was the exhibition of a *D. archippus* some years ago, by Mr. Pearson, of Montreal, which had been captured on board a ship on the Atlantic, hundreds of miles from land.

On some Long-horned Beetles.

Clytus.

By R. V. Rogers, Jr., Kingston, Ont.

Among the Coleopterous hosts there is a family called Long-horns, or Capricorns, in vulgar parlance; or *Cerambycidæ*, when we are talking learnedly. They derive these names from the fact that they possess very long antennæ (sometimes longer than their bodies), which are generally re-curved like the horns of a wild goat (the Latin *Caper*). They form a very large family; already 4,000 of them are known and recognized by the scientific world. They comprise some of the largest, most showy, as well as most destructive, of the beetles; one of African origin—*Prionus Hayesii* by name—is five inches long and one broad, with antennæ of seven inches and legs of four. The Long-horns are world-wide, and their abundance is in proportion to the richness of vegetation of different countries, so that South America, India, Ceylon and the Moluccas contain a great number of the most beautiful and the largest capricorns.

They have earned the name of Borers because they are, in fact, "animated gimlets," and spend their lives while in the larval state in perforating and feeding upon trees; some live and carry on their operations in the trunks, others in the branches; some devour the wood, others the pith; some are found only in shrubs, some in the stems of herbaceous plants, others confine their attentions to the roots. Some are to be found only on one species of plants, others have a wider range. Some bore straight holes, others branch off at divers angles, others make tracks as various as those of an engraver, while some are regular screws. The Germans, lovers of music, as they are, call these beetles "Fiddlers," because they give forth, especially when annoyed or taken in the hand, a squeaking or rasping noise produced by rubbing the joints of the thorax and abdomen together. Some of the family are not only musical-boxes, but scent bottles as well, and emit a fragrant odour not unlike that of otto of roses.

The members of this family, as a rule, are very handsome, and readily attract notice by their elegant forms and resplendent attire, that is, when of full age; when young—in the creeping age—they are ugly in the extreme. Harris tells us that the various members of the family resemble each other in the following respects: the antennæ are long and tapering. The body is oblong, approaching to a cylindrical form, a little flattened above, and tapering somewhat behind. The head is short and armed with powerful jaws. The thorax is either square, barrel-shaped or, narrowed before, and is not so wide behind as the wing-covers. The legs are long; the thighs thickened in the middle; the feet four-jointed, not formed for rapid motion, but for standing securely, being broad and cushioned beneath, with the third joint deeply notched. Most of these beetles remain upon the trees and shrubs during the day time, but fly abroad at night. Some of them, however, fly by day, and may be found on flowers, feeding on the pollen and blossoms.

Fig. 13.

The pride of our Canadian forests, the maple tree, suffers much from the attacks of *Clytus speciosus* (fig. 13), the largest of our native members of the family. This beautiful beetle is easily recognized; it is about in inch in length, and the third of one in breadth. The head is yellow with antennæ and eyes of reddish black. In shape the body is somewhat cylindrical, a little flattened above and tapering behind. The thorax is black with two yellow transverse spots on each side. The wing covers for more than half their length are black, for the rest they are yellow; they are gaily ornamented with bands and spots arranged as follows: A yellow spot on each shoulder, a broad yellow curved band or arch, of which the yellow scutel forms the keystone, on the base of the wing covers; behind this a zig-zag yellow band forming the letter W; across the middle another yellow band arching backwards, and on the yellow tip a curved band and a spot of a black colour; the legs are yellow.

The under side of the abdomen is reddish yellow, variegated with brown. The female has the advantage of her mate in size, but her antennæ are somewhat shorter. She possesses a pointed tube at the end of the abdomen, through which the eggs are passed from her body into the cracks and crevices of the bark. The tube can be contracted or extended at the will of the fair owner and to suit the emergency of the case.

The parent lays her eggs on the bark of the maple in July or August. As soon as the grubs are hatched they burrow into the bark, and there find protection during the cold of winter. When the warm days again return the larvæ begin again their labours, penetrating deeper and deeper into the heart of the tree, sometimes tunnelling as much as three inches into the solid wood, they make long and winding galleries up and down the trunks. A carpenter is known by his chips, so their presence is readily detected by the little heaps of sawdust that they throw out of their work-shops. If in time a stiff wire is inserted into their holes they can be easily put an end to by impaling. They are long, whitish, fleshy, deeply marked by transverse cuts; their legs, although sixteen in number, are merely rudimentary promises of legs, and for ornament, not use; they are of no avail for the purpose of locomotion. Not by means of their eight pairs of legs, but by alternately contracting and extending the segments of their bodies, do these worm-like creatures force their way along, and in order to assist their progress each segment is furnished with fleshy tubercles capable of protrusion, and which being pressed against the sides of their

retreats, enable them to thrust forward by degrees the other segments (Ent Rep., 1872, p. 36).

The head is the box of tools with which they saw and cut their way through the wood; their work "is done slowly but effectively, and their gnawing teeth, though slow in action, are as resistless as the mordant tooth of time."

About midsummer these busy little carpenters who have never seen the light of day, unless by accident, strike—not for higher wages but for a higher stage of existence; they labour no more, but in the innermost recesses of their living homes fold themselves up snugly for their pupa sleep. At first the nymph is soft and whitish, but gradually it hardens and darkens till at last it lies enwrapped in a filmy veil, beneath which all the external parts of the future beetle are visible. The wings and the legs are folded calmy on the breast, while the long antennæ are turned back against the sides of the body and then tucked up between the legs. When at length it has become matured, it breaks its slumbers, forces its way through the bark, and comes out of its dark and narrow retreat to see the world and enjoy for the first time the glorious light of day and the pleasures of legs and wings, and love and passion, and to propagate its race.

Clytus pictus Drury, or the Painted Clytus, is another of our common species. Its form is very similar to that of *C. speciosus*, and it varies from six-tenths to three-fourths of an inch in length. Harris thus describes it: It is velvet black, and ornamented with transverse yellow bands, of which there are three on the head, four on the thorax, and six on the wing-covers, the tips of which are also edged with yellow. The first and second bands, on each wing-cover are nearly straight; the third band forms a V, or united with the opposite one, a W, as in *speciosus*; the fourth is also angled, and runs upwards on the inner margin of the wing-cover towards the scutel; the fifth is broken or interrupted by a longitudinal elevated line, and the sixth is arched and consists of three little spots. The antennæ are dark brown, and the legs are rust-red.

Clytus Robiniæ, Forster.—According to Walsh, the male of this species differs from *C. pictus* in having much longer and stouter antennæ, and in having its body tapered behind to a blunt point, while the female is not distinguishable at all. This insect does great injury to the locust and acacia trees, and appears in the perfect state in September. Harris confounds this with *Clytus pictus;* in fact, it was long considered by Entomologists to be identical with it. It has sometimes been known as *Clytus flexuosus*, Fab.

During comparatively late years *Robiniæ* has been extending its sphere of operations. For a long time it was known only in New York. Some thirty years ago it appeared in Chicago, and in 1863 it was seen two hundred miles further west. In 1855 it was first observed in Montreal; in 1862 it was very destructive to the locust trees around Toronto; In 1873 Mr. E. B. Reed saw it in enormous numbers in London, Ont. Now it seems to be quite at home in all parts of Ontario. Harris, speaking evidently of this, though under the name of *C. pictus*, says: "In the month of September these beetles gather on the locust trees, where they may be seen glittering in the sunbeams, with their gorgeous livery of black velvet and gold, coursing up and down the trunks in pursuit of their mates, or to drive away their rivals, and stopping every now and then to salute those they meet, with a rapid bowing of the shoulders, accompanied by a creaking sound, indicative of recognition or defiance. Having paired, the female, attended by her partner, creeps over the bark, searching the crevices with her antennæ, and dropping therein her snow-white eggs, in clusters of seven or eight together, till her whole stock is safely stored. The eggs are soon hatched, and the grubs immediately burrow into the bark, devouring the soft inner substance that suffices for their nourishment until the approach of winter, during which they remain at rest in a torpid state. In the spring they bore through the soft wood, more or less deeply into the trunk, the general course of their winding and irregular passages being in an upward direction from their place of entrance. For a time they cast their chips out of their holes as fast as they are made, but after a while the passage becomes clogged, and the burrow more or less filled with the coarse and fibrous fragments of wood, to get rid of which the grubs are often obliged to open new holes through the bark. The seat of their operations is known by the oozing of the sap and the dropping of the saw-dust from the holes. The bark around the part attacked begins to swell, and in a few years the trunks and limbs will become disfigured and weakened by large porous tumours,

caused by the efforts of the trees to repair the injuries they have suffered. . . . The grubs attain their full size by the 20th of July, soon become pupæ, and are changed into beetles and leave the trees early in September. Thus the existence of the species is limited to one year."

Space will not permit me to speak of the other members of this interesting and beautiful family—*nobilis*, *luscus*, *campestris*, *undulatus*, *longipes*, etc., each one of which is well worthy of a full description and biography.

Some Notes on Coleoptera for Beginners.

By C. G. Siewers, Newport, Ky.

In answer to a query in the March *Entomologist* as to the rearing of larvæ of wood-boring beetles, I would say that it is very difficult to do after they have been removed from their burrows. Try damp sawdust of the same wood. The better plan where infested timber is found, is to saw into short lengths, pack in tight box and cover with a wet cloth. Many kinds cannot bore in dry wood. Many Buprestidæ perish from inability to perforate the bark of dead trees which has sprung loose from the wood and become hardened by the sun. They then fall an easy prey to ants, roaches and caribs. Where wild grape vines abound, cut them off at the ground in May or June, and let them hang; in early spring saw them into short lengths and box them, and some rare beetles may be taken. Grubs under stones put away in the same ground in tin or glass, kept moist; found under logs, use the log debris, and add some sawdust. Finding two very large grubs with black heads under a log late in the fall, I put them away in a tin can with log refuse and sawdust, and found a male ash beetle and a dead pupa in July. This beetle, *Xyloryctes satyrus* (Fab.), is taken under the roots of ash trees, and falls a victim to its curiosity, for if you begin to dig for them they will come out to see what is going on. I took fifteen from one tree in that way. April and May are generally devoted to searching in logs and dead trees for beetles, when many nymphs can be collected, which can generally be hatched out in a week or two. June and July are the great beating months. I have discarded the beating net for the inverted umbrella, and so will any one who has tried both, as beating the low limbs of trees around the edges of wood will yield tenfold the quantity and variety that bush and weed beating will. Woods protected from cattle and hogs, and full of vines and bushes, are best. Little is got by beating in the interior of woods. Insect life swarms along the edges. Examine the trunks of trees, and where flat stones abound scoop out cavities under them, where Cychrus and various caribs may be trapped; Cychrus are snail-feeders, and some bait traps with snails strung on strings through the shell. The beans of the honey locust yield *Spermophagus Robiniæ*; the fungus puff-ball, *Lycoperdina ferruginea*; all kinds of fungus swarm with beetles, also *Staphilinidæ*. *Pselaphidæ* are taken on the under side of stones, but mostly by sifting around decayed stumps on to a white cloth. Beat wild plum trees and haws when in blossom. Where beetles are found, by carefully replacing stones and bark more may be taken, as their scent remains. I was glad to take a single specimen of that rare and handsome longicorn, *Dryobius sexfasciatus*, in one season, but in the summer of 1878 I found five under one piece of bark of beech; so last season, when I found a small colony under bark on a dead maple, I tied the bark on again, and took seventeen more at different visits. Various beetles are also found on fruit and flowers. In closing, I would advise beginners to put small insects on paper slips or wedges, and not pin them with a No. 2 pin, as it cannot be inserted in cork without plyers, and is very liable to buckle. No. 3 enters cork readily, is not too large for paper slips, and about right for larger specimens. Further, do not use Spaulding's glue; it will turn your wedges brown, as it contains a discolouring acid. Make your own liquid glue—better at one-fourth the cost. Dissolve light coloured glue or isinglass in the usual way: then, while hot, stir in alcohol, or a light coloured, strained vinegar, till it is thin enough, and decant into a bottle. It can then be thinned with a little water, or by warming.

A New Enemy of the Black Spruce, Abies Nigra.

By Dr. H. A. Hagen, Cambridge, Mass.

An enemy of *Abies nigra* sent to me by Mr. C. S. Sargent, from the Arboretum of Harvard University, induced me to compare the literature about the enemies of this tree. To my surprise, all that is published consists of two very excellent papers by Mr. Ch. H. Peck, Albany. One, "The Black Spruce," read before the Albany Institute, May 4, 1875, 8v., pp. 21 ; the other in the New York State Museum's Report of the Botanist, No. 30. I do not remember to have seen these papers recorded in entomological serials. There are noted two vegetable parasites, *Arceuthobium pusillum* and *Peridermium decolorans.* Of insects are recorded a plant-louse near *Adelges coccineus,*and some Hemipterous gall imsect ; also, two beetles, *Hylurgus rufipennis* and *Apate rufipennis.*

The twigs sent to me contained numerous pale spots, the consequence of some dead leaves, three or more, one near the other. The examination of those leaves showed on every one at the base, sidewards, a small round hole. The interior of the leaf was hollow, in some cases only the lower half, where the enemy had not yet finished the work. I discovered directly a small caterpillar, belonging to Tineidæ and probably to the Argyresthians, as the destructive enemy. The biological collection contains no enemy of the black spruce, and no similar destruction of pines, except a somewhat related twig of *Pinus Canadensis,* quoted also as probably done by an Argyresthian larva. In Mr. Chambers' valuable list no Tineid living on spruce is recorded.

The European literature contains only one fact similar to the American. It is recorded that *Cedestis farinatella* hollows the leaves of pines. But until now no American species of *Cedestis* is known. Probably the moth will be raised and the mystery solved; at all events, I desire to draw the attention of entomologists to this enemy. Perhaps it may be more common than is supposed, Prof. Peck stating as a fact that the spruce trees in some parts were said to be dying at an unusual rate, as if affected by some fatal disease. To judge by analogies, the attack made by *Hylurgus* and *Apate* is only a consequence of the previous attacks by other enemies.

Notes of the Swarming of Danais Archippus and Other Butterflies.

While spending the winter of 1875-76 in Apalachicola, Florida, I found one of these *archippus* swarms in a pine grove not far from the town. The trees were literally festooned with buttterflies within an area of about an acre, and they were clustered so thickly that the trees seemed to be covered with dead leaves ; fig. 14 will enable the reader to form some idea of their appearance thus grouped. Upon shaking some of the trees a cloud of butterflies flew off, and the flapping of their wings was distinctly audible. They hung in rows (often double) on the lower dead branches, and in bunches on the needles. I find by my note book that visiting the flock towards evening, it was receiving additions every moment. I caught a net full off a bunch of dead needles, and walking away to some distance and letting them go, all but three returned to the flock. The question as to where they came from seems a very interesting one. I was told by Dr. A. W. Chapman that there was hardly milkweed enough in all Florida to produce one of these flocks, which doubtless do not confine themselves to Apalachicola. During my visit I found two more flocks

Fig. 14.

not far from the first, but neither of these was as large. I should mention that I often observed examples among them *in coitu*.

I have seen *archippus* flocking at the Isles of Shoals, N.H., towards evening, in very much the same manner, having flown nine miles from the mainland. I have also seen clusters of *Vanessa J-album* on tree trunks at dusk in New Hampshire, which seemed to present a parallel to the *archippus* flocks, though of course on a very small scale.

R. Thaxter, Newtonville, Mass.

The assembling of *D. archippus* is perhaps not so frequently noticed as their passing over localities in flocks. Several years ago I saw them congregating in a bit of woods in the neighbourhood of the city which I was visiting at the time. At least every other day they were hanging in a listless kind of manner to the underside of branches in immense numbers, with their wings closed, and not noticeable unles disturbed, very few being on the wing. Their favourite resting place seemed to be dead pine twigs, which would be drooping with their weight, and in more than one instance I saw one too many light and the twig snap, and send a dozen or more into the air to seek for another perch. In going to and from the woods I have seen several of them at once coming from different directions, high in the air, sailing along in their own easy and graceful way, all converging to the one spot. I did not see them depart. I went one day and could not find one in the woods; and as there were thousands, perhaps hundreds of thousands of them, it would have been a fine sight to see them go. The following year they were remarkably scarce, and it was three years before they were even moderately plentiful.

J. Alston Moffat, Hamilton, Ont.

A very remarkable gathering of *Danais archippus* came under my observation, at Racine, Wisconsin, in the first week of September, 1868. The insect appeared in great numbers, and gathered in several swarms about trees in the vicinity. The day was cloudy, but without rain. Shortly after noon the swarms seemed to gather, and settled upon a tree in my garden, a well-formed black oak about 15 inches in diameter at the trunk, and perhaps 40 feet high. The swarm covered the southern aspect of this tree so abundantly that the green of the leaves was quite obscured by the brown of the wings of the butterflies. A few sailed back and forth through the air as if seeking a place to alight, when the wings of those sitting, opening and shutting as if by a single impulse, caused the prevailing colour to shift from the dark hue of the upper surface to the lighter colour of the lower surface. They remained until after nightfall, but were gone when we looked for them in the morning. No attempt was made to capture or count them, but the swarms must have contained some thousands.

S. H. Peabody, Champaign, Ills.

During the first week in July I found *Melitæa phæton* in considerable quantities in a small clearing in Dow's swamp, about one mile south of this city. The swamp is densely wooded with tamarack and a thick undergrowth of *Myrica gale*, *Salices*, *Alnus incana*, etc., besides many herbaceous plants, and among them (but not at all plentiful) *Chelone glabra*. Upon inquiry, I find that this clearing was the exact locality where the late Mr. B. Billings found this butterfly in 1870.

J. Fletcher, Ottawa.

Prof. J. E. Willet, of Macon, Georgia, writes under date of 19th January, 1880: —"I saw *Callidryas eubule* passing here in great numbers during Sept., Oct. and Nov., 1878, from N.-W. to S.-E. About noon, when they were most abundant, there would be half a dozen visible all the time, crossing a 15-acre square of the city. They pursued an undeviating course, flying over and not around houses and other obstructions. They flew near the ground, and stopped occasionally to sip at conspicuous flowers. A geranium

with scarlet flowers, and set in the open yard, attracted most that flew near it. Papers in southern Georgia noticed the great numbers passing at different points ; and a friend in southern Alabama sent me specimens of the same, saying that they were subjects of speculation there. About March, 1879, there was a similar migration from S.-E. to N.-W., but in diminished numbers. I saw the fall migrations again Oct. and Nov., 1879, but in smaller numbers than in 1878. A lady of southern Georgia told me that her husband called her attention to the fall migration twenty-six years ago, and that she had observed it every year since. *C. eubule* is found here in small numbers at other seasons of the year."

In the course of the last two or three years several accounts have appeared in *Nature* of the flight of Lepidoptera in large numbers. I observed a similar phenomenon in 1870, which may present sufficient interest to be put on record. In the summer of that year, in the month of August as well as I remember, I was crossing the harbour of this city in the 3 p.m. trip of the steam packet-boat between the city and Moultrieville, on Sullivan's Island, at the entrance of the harbour, a summer resort of the inhabitants of our city. The distance is between four and five miles, and when about half way or perhaps two-thirds, the steamer passed through an immense stream of butterflies crossing the harbour towards the S.-W. They were all of the genus *Callidryas*, whether *C. eubule* or *C. marcellina* (if indeed they be different species) I could not determine. The wind was light, and from the rapid motion of the vessel, it was difficult to say whether the insects were aided or opposed by it in their transit. As the vessel passed obliquely through the stream, their rate of motion could not be determined, and the dimensions of the stream only roughly estimated ; it seemed to be six or eight yards wide, about as many high, and extended a hundred yards or more on each side of the vessel. Whence they came or whither they went could not be ascertained ; they seemed to be crossing the harbour in a direction nearly parallel to the general travel of the coast.

Lewis R. Gibbes, Charleston, S. C.

APPOINTMENT OF STATE ENTOMOLOGIST FOR NEW YORK.

We learn with much pleasure that our esteemed friend and valued contributor, Mr. J. A. Lintner, of Albany, N.Y., has received the appointment of State Entomologist. A better qualified man for the position could not, we believe, be found. Mr. Lintner has for the past thirty years devoted a large portion of his time to the study of Entomology, and paid especial attention to that practical department of the science which treats of insects injurious to agriculture. The enormous loss occasioned yearly by destructive insects, is now well known, and every means discovered to prevent or lessen these ravages results in a large yearly gain to the cultivators of the soil. The special business of the State Entomologist will be to endeavour to ascertain how this desirable end can best be accomplished. We anticipate good results from this judicious appointment.

OTTAWA FIELD NATURALISTS' CLUB.

TRANSACTIONS NO I.

The records of the first year's efforts of this active and enterprising organization fill a goodly octave pamphlet of sixty-two pages, which is adorned with two excellent plates. From the annual report of the Council, contained therein, we learn that the Club has a membership of over eighty, and that five excursions, for the purpose of collecting objects of natural history, have taken place during the year, with an average attendance of thirty. During the winter months a successful series of soirees were held, seven in number, at

each of which interesting papers were read by members, and the specimens collected on the excursions exhibited. Many of the papers are published in the Transactions; also a list of plants collected in the Ottawa district by the energetic Vice-President, Mr. James Fletcher.

In the successful maintenance of this Natural History Club, Ottawa has set a noble example, which we trust will be speedily followed by similar organizations in other cities of our Province.

OBITUARY.

Professor Samuel Stehman Haldeman, of the University of Pennsylvania, a distinguished naturalist and philologist, and at one time President of the American Philological Association, died on Tuesday evening, September 10th, at his residence in Chickis, near Columbia, Pa., aged sixty-eight years.

Professor Haldeman has long been noted also for his devotion to Entomology. He attended the late meetings of the Entomological Sub-section of the American Association for the Advancement of Science, at Boston, in August, and took an active part in the discussions. At that time he seemed to be in good health and spirits. By his genial disposition and open generous bearing he has endeared himself to a large circle of friends, who will sincerely mourn his loss.

NOTES ON SOME RARE INSECTS CAPTURED IN ONTARIO DURING 1880.

By Wm. Saunders, London, Ont.

Libythea Bachmani.

Twelve years ago, in August, 1868, a specimen of this butterfly was captured on the beach, in Hamilton, by Miss Mills, and a record of this capture, with some observations on the insect, appeared in the November number of the Canadian Entomologist for that year. We have no evidence of its having been found before this, and no records of any such capture since, until the present season, when a good specimen was taken by Mr. J. M. Denton, at Port Stanley.

In fig. 15, we give a representation of this species, which is remarkable for its very long palpi—fully one-fifth of an inch in length, and presenting the appearance of a beak; brown above, whitish below.

Fig. 15.

The wings are angular, and expand about an inch and three quarters. The fore wings are dark brown, with three white spots arranged in a triangle near the tip; the upper inner one largest, oblong, and irregular in form; the lower one is also oblong, but smaller, and the outer one smallest. Beyond the middle of the wing there are two large fulvous spots, the upper one elongated and pointed at both ends, the lower one oblong, irregular, and divided near the middle by a dark brown nervule. The hind wings are dark brown above, with a large, irregular, fulvous patch across the middle.

The under side of the fore wings is paler than the upper, with the same white spots and fulvous markings, the latter somewhat larger than above. The hind wings have a wide brown border on the hind margin, within which they are bluish, iridescent and streaked with brown.

I am not aware that any description of the larva of this butterfly has ever been published.

Papilio Philenor.

This beautiful butterfly, common in the Southern States has usually been very rare in Canada. The general appearance of the insect is given in fig. 16, but it is impos-

Fig. 16.

sible with a woodcut to give any idea of the brilliancy of the colouring. The fore wings are black, with a rich greenish metallic reflection, and a row of white spots, absent in the male, near the hinder margin which is slightly undulating and partly edged with white. The hind wings are of a brilliant metallic bluish green, with six white spots and some streaks of the same colour on the margin.

The under side of the fore wings is of a dull black colour, with the white spots more distinct. The hind wings are very brilliant, with the exception of a large patch at the base, they are of a beautiful steel blue colour, with a curved row of seven orange coloured spots bordered with black, and the upper ones partially edged with white. There is a small yellow spot at the base and a few whitish dots about the middle of the wing, while the marginal bordering of white is replaced by a series of yellowish white spots, growing larger as they approach the upper part of the wing. The male is more brilliant in colour than the female.

This lovely insect is produced from a rather handsome though peculiar looking caterpillar (fig. 17) about two inches long when fully grown, of a black colour with a purplish

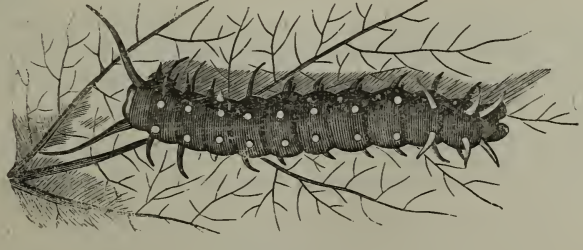

Fig. 17.

hue. Immediately behind the head there are two long movable fleshy horns and a number of shorter horns, and orange coloured tubercles on the remaining segments. The eggs are laid by the butterfly, on different species of *Aristolochia*, chiefly on the Dutchman's pipe (*Aristolochia sipho*) and the virginia snake root (*Aristolochia serpentaria*). The larvæ feed in company and when plentiful will sometimes entirely consume the foliage of the plants on which they feed.

Fig. 18 represents the chrysalis of this insect, which is fastened at the hinder extremity to a mass of silken threads and has a band of the same material extending entirely around the chrysalis, beyond the middle.

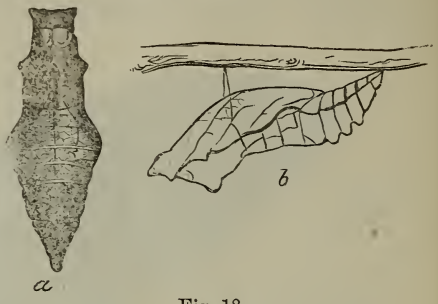

Fig. 18.

In the August number of the *Canadian Naturalist and Geologist*, for 1858, an account is given by the Rev. C. J. S. Bethune, of the appearance of a very unusual number of these butterflies, in West Flamboro'. The writer says, "these butterflies appeared in countless numbers about the lilac trees, as long as they continued in blossom, and then suddenly disappeared. They lasted from the 7th to the 18th of June, but very few appearing after that date." He also says, "I have caught but two in Toronto, though they were numerous there also.

No such good luck has befallen any entomologist in Ontario since that time. Within these twenty-two years several specimens have been taken about Toronto, and two or three some fifteen years ago at Woodstock. There are no records of the capture of this butterfly here for many years past, but this season a specimen was caught by Mr. J. A. Moffat, at Ridgeway, Ontario.

Junonia Lavinia (*Cœnia*).

The first recorded occurrence of this butterfly in Ontario, is found in the November number of the *Canadian Journal*, for 1861, where an account is given by me of the capture of three specimens, at Port Stanley, two by Mr. Wm. Edwards and one by myself. During the same season it was found in the townships of Ellis and Logan, about ten miles north of Stratford. For very many years past I have not heard of a single specimen being taken in Ontario, until this season, when it was captured by Mr. Moffat, at Ridgeway, and by Mr. Denton at Port Stanley.

It is a very pretty insect. The general colour of the upper surface is brown. On the fore wings there is a broad whitish band, extending nearly across the wing and enclosing near the hinder angle a large black eye-like spot, with a central bluish dot and encircled by a yellowish brown ring. In some specimens a second and very small spot is situated near the tip outside the band. There are also two smaller, short, red bands bordered between the white band and the base of the wing.

On the hinder wings there are two conspicuous eye-like spots, the under one much smaller than the upper, and both encircled by a yellowish ring, bordered with black. Between these eye-spots and the hind margin is placed a band of red, margined externally by one or more dark lines.

The under side is paler than the upper, with the markings less distinct.

The caterpillar is said by Boisduval to feed on *Linaria canadensis*. It is black and spinous with two lateral white lines, the upper of which is marked with a row of reddish spots.

Papilio Cresphontes.

In our report for 1878, reference was made to this handsome swallow-tail butterfly, and a figure given of it, but as this report may not be available to many of our readers, we shall reproduce it here (see fig. 19). Since 1878 it has become more common, and has

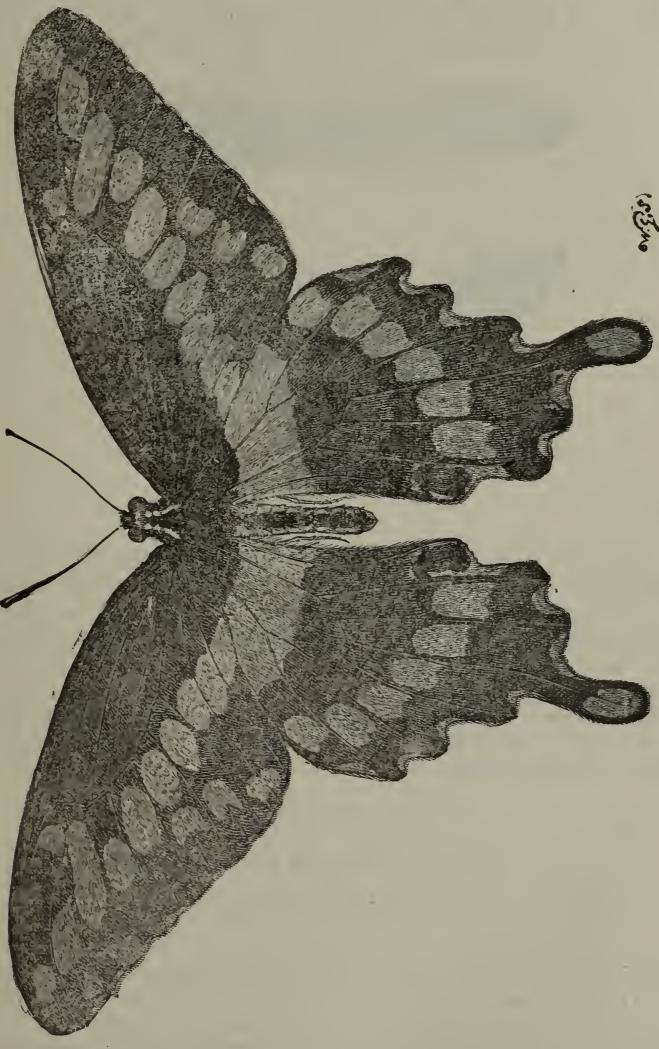

Fig. 19.

been reared from the larva by collectors in Hamilton, as well as by myself. They have been found chiefly on prickly ash (*Xanthoxylum fraxineum*), and on *Dictamnus fraxinella*. This year I found the caterpillars, nearly full grown, in June, which shortly entered the chrysalis state, and produced the butterflies in about a fortnight afterwards. I have also taken the full-grown larvæ late in the fall, which passed the winter in the chrysalis state, from which facts the inference may be fairly drawn that this butterfly is double-brooded in Ontario.

The wings of this stately insect are black, streaked and spotted with yellow, as shown in the figure. The caterpillar is a very singular looking creature; it is brown, with large,

irregular patches of white; the chrysalis is brown, marked with blackish points. For a more minute description the reader is referred to the report for 1878.

The Abbot Sphinx (*Thyreus Abbotii*).

This pretty sphinx moth has been captured in London, during the present season, by Mr. J. M. Denton; it has also been taken in Hamilton, by Mr. Moffat and Mr. David Little, and is reported as having been common there. The caterpillar (see fig. 20) feeds on

Fig. 20.

the grape vine, and also on the Virginia creeper (*Ampelopsis quinquefolia*). In place of the horn at the tail which caterpillars of this family usually have, there is, in this instance, a polished knob or tubercle. The colour of the larva varies from a dirty yellowish to a reddish brown, marked transversely with fine black lines, and lengthwise with patches of a dark brown shade. There is also a dark line along each side. The under surface is paler, with a reddish tinge along the middle.

The moth (fig. 20) is of a dull pale brown colour, the fore wings variegated with brown of a much darker shade; the hind wings are yellow, with a broad blackish border. Both wings are notched on the margin.

NOXIOUS INSECTS IN ENGLAND.

By the Rev. C. J. S. Bethune, M.A., Port Hope, Ont.

By the kindess of the writer, Miss E. A. Ormerod, F.M.S., I have recently received her "Notes of Observations of Injurious Insects" for the years 1877, 1878 and 1879. These reports contain so much of interest and value that I have thought it desirable to give to our readers some extracts from them that bear upon our own insect enemies, and at the same time draw attention to the valuable work that is being quietly done in England by a band of volunteer workers who, apparently, receive no recognition or encouragement from the Government or the general public. The plan pursued has been to send out a circular in the spring of the year, to a large number of observers scattered over Great Britain, and to recommend to them a list of insects for observation during the season. The replies sent in in the autumn are carefully collated by Miss Ormerod, and the systematized results published during the winter in an octavo pamphlet, illustrated with excellent wood cuts. It is pleasing to observe a steady growth in these reports; that for 1877 contains 19 pages and 12 cuts; that for 1878, 27 pages and 20 cuts; and the last, 44 pages and 27 cuts—

some of the latter are, of course, reproductions of those that appeared in the earlier issues. The insects treated of are those which are injurious to field and garden crops, to timber trees and fruit.

1. The first insect treated of in the reports for 1877-78 is one that is very familiar to us here :—

The Turnip Flea-Beetle

Fig. 21.

or 'fly' *(Haltica nemorum)*. Figure 21 represents this insect magnified. During both years it seems to have caused much damage in many localities. "At Knebworth an example is given of the value of surrounding weeds to the farm insects as a means of support till the crops are ready for attack, in the appearance of the turnip-fly first on charlock (mustard) in fields where turnips had grown the previous year, and then causing great injury to the kohl-rabi and turnips"—an argument for clean farming. The following is a curious "remedy" :—"The plan followed is to drive a large flock of sheep on the attacked field early in the morning, whilst the dew is still on the leaf, and, with the help of a dog, to keep them in constant motion, and well up in a body, so as to tread over all the field in turn. Treated in this way no injury is done to the crop ; but if much ground has to be gone over, it should be taken on different days, as it would injure the sheep to keep them long without food, or to harass them by the continued driving early in the morning. In this case the extent of ground was 37 acres, and from four hundred to five hundred sheep were put on. The fly at the end of June was so strong as to threaten clearing the crop, and it had almost been decided to plough it up ; but this treatment, which embodies disturbing and killing many of the insects by the treading, and which also makes the leaves distasteful for oviposition, both by rubbing of the sheep and the coat of dust scattered in dry weather, saved the plants and was followed by a good crop." Another and simpler remedy for use on a small scale is "sprinkling the young turnips with road dust, which preserved them entirely from injury." An observer states that "where the weather was highly favourable during the sowing season of May and June for a quick and healthy growth, the plants were thus run past the stage at which 'the fly' attacks them, and less injury was inflicted than had been observed for many years. He draws attention to anything that promotes healthy, rapid growth, till the young plant is well into the rough leaf, being the best preventive of the fly, and that, could the remedy be applied, probably heavy waterings in the evening in dry weather might be of service, and notes, in the shape of special applications, caustic lime, soot, and guano, which have each their advocates, applied in the morning when the dew is still on the plant, or gas-water applied in the evening, and also benefit from the use of a small quantity of salt."

Another observer notices that where the fly was particularly destructive the previous year there charlock (mustard) was prevalent. "This weed is common throughout the country, more or less plentiful according to agricultural care, some fields being comparatively free, showing where one farm ends and another begins." [These remarks might be made of several parts of Ontario, especially of the counties of Northumberland and Durham.] He draws attention to the benefit of eradicating the food-plant of the fly during the years when the land is unoccupied by turnips, and thus preventing, or in some degree checking, its annual multiplication.

From all the observations there is noticed "the advantage of a rapid, vigorous growth in resisting the attack of the fly, whether brought about naturally by plentiful rain, or artificially by manure containing the superphosphates or other chemical constituents required, and a word may be added as to the physical effects of rain and dew on the insect. A single drop is enough to clog the legs temporarily, and put an end to its leaping powers for the time being."

2. The Onion Fly (*Anthomyia ceparum*)

is an insect that has found its way across the Atlantic and shown itself very destructive at times in the Eastern States and elsewhere on this continent ; the following extracts

may therefore be of use as well as interest. (In figure 22, we have this insect represented in both the larval and perfect forms.) "The eggs of the fly were first observed on the 21st of May, laid where the leaves divide, the larvæ hatching after a few days, and feeding on the seed-blade till they reached the root, then striking into the bulb, if formed, otherwise into the root, and soon destroying the plant. The soil was mostly light, and in high cultivation, and pulverized gas-lime scattered amongst the onions was found to act well in keeping off the insects. Watering the onions with the liquid from pig-sties, run into a tank specially arranged for the purpose, was found to answer still better. Several who adopted this plan secured good crops, whilst in the cases where it had not been followed the crops were for the most part destroyed." Another observer mentions that "he finds deep cultivation in autumn, with a good manuring and sowing in drills on a firm, well-trodden surface in spring, to be the surest means of securing a good crop free from attacks of the maggot." Miss Ormerod mentions that she "tried sowing two kinds of onions in rows along a bed of which half had been prepared in the usual way with farm-yard manure, and half deeply trenched with no manure added. Both kinds of onions on the manured ground did fairly and were uninjnred, but on the unmanured gronnd the plants made no way, and were attacked by the maggot."

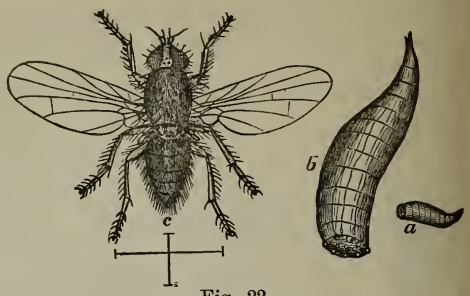

Fig. 22.

3. Cabbage Butterflies (*Pieris brassicæ* and *rapæ*).

It is somewhat singular to notice that so little is said in the three Reports about our very familiar pest, *Pieris rapæ* (see figures 23 and 24), which has come to us from the "old country," while much attention is paid to its congener, *P. brassicæ*, a larger white butterfly which seems to be very destructive. In 1877 it was noticed that "the amount of appearance of cabbage butterflies varied much with the amount of shelter provided for the previous stage of pupation." Where cabbages were chiefly grown in fields few were found, but large numbers were observed to infest sheltered gardens. "A search under dry eaves, rough boardings or palings, and in the sheltered nooks which abound in garden ground, but are comparatively absent in open field cultivation, will at times bring scores and hundreds of pupæ to light, and serve to diminish the pest appreciably."


Fig. 23.


Fig. 24.

In 1879, at Dalkeith, *P. brassicæ* appeared in rather formidable numbers after the fine weather set in. The consequence was a severe attack of the caterpillar, especially in cottage gardens surrounded by weedy hedges and other harbours for insects, where the common cabbages, savoys, etc., were completely riddled by the vermin, and rendered totally unfit for human food. The best remedy is hand-picking the caterpillars, but this is tedious. A sprinkling of fine salt is very serviceable, carefully applied by turning up every leaf so that a small portion of the salt shall touch every grub. An application of finely-powdered lime in a caustic state, or even caustic soot, will get rid of the grubs, but both are objectionable with regard to the after use of the vegetables. *P. rapæ* was "moderately plentiful" last year in some localities, but apparently it was nowhere so numerous as it is with us over thousands of square miles.

4. Wire-Worms, or Click-Beetles *(Elateridæ).*

Fig. 25.

Figure 25 represents one of our commonest elaters, the eyed elater, *Alaus oculatus.* Several species are noticed as attacking various crops, especially barley. Among the remedies employed we may quote :—"A solution of carbonate of soda, in the proportion of about two ounces to sixteen quarts of water, applied three or more times from the beginning of May to the beginning of June is found a good way to clear the ground." An observer notes "wire-worms in considerable numbers attacking barley sown after dead fallow. He drilled Lawes' turnip manure with the bulk of the field, and on this the barley grew rapidly away from the wire-worm ; whilst on two pieces, each seven feet wide, left across the field without the manure, more than half the plants were destroyed. This difference is noted as having been observed on previous occasions. Stirring the land well is considered the best remedy with root crops. Amongst corn (wheat) crops rolling with a heavy roller, or if possible, on the lighter soils with a clod-crusher, is the usual remedy. In one case the object is to solidify the surface and so stop the wire-worms working ; in the other (the root and green crops) to stimulate growth in the young plants, besides disturbing the larvæ."

In the last Report it is stated that the wire-worms did "much damage on some light-land farms, and the young barley after fallow, and where the land was in bad condition ; but where the barley succeeded a good crop of roots, fed on the land by sheep, or where there was plenty of manure in the soil, the plants grew too vigorously to receive much injury. On heavy clay land the soil was so close that the wire-worm could hardly exist."

5. The Wheat Midge *(Cecidomyia tritici).*

Our dreaded pest is the same insect as that here referred to as prevalent in England. See figure 26. In 1877 it was reported as unusually abundant in Hertfordshire and unusually absent in Essex. It is noteworthy that "in the latter county the chaff is used for cattle, whilst the custom prevailed in some parts of the west of England of throwing the chaff in heaps to decay, thus providing the maggot with good shelter during the winter to develop in the following June, and so infest the neighbourhood."

Fig. 26.

In 1878 it was again unusually abundant at the same place in Hertfordshire "in all the early wheat, many ears having from 10 to 15 kernels quite destroyed, besides others being deformed ; the later crops were not so much affected." The same year it was also abundant in parts of Devonshire. A writer relates that the wheat in his experimental field "stood up well at the time of cutting, but that just before blooming, portions were covered by small flies which deposited their eggs in the ear, and these developed into small orange-coloured maggots, which fed on the young grain. The unmanured crop came into ear some days later than the manured crops, and escaped injury from the fly, whereas the plot manured every year with fourteen tons of farm-yard dung suffered severely, and yielded only about two-thirds as much grain as in 1868, when the weight of straw was about the same as this year. It is, "of course," he adds, "very difficult to estimate the damage done to a crop by the ravages of an insect, but that in the permanent wheat field undoubtedly suffered considerably from that cause. The yield of grain was not only much less than would be expected from the bulk of straw and its upright condition at the time of cutting, but also much less than would be judged from the amount of produce and proportion of grain to straw in the neighbouring field."

In 1879 the same observer in Hertfordshire mentions that the midge "was abundant in all the earlier wheat fields, and did much damage, but little to the later crop; wheat ears did not make their appearance till about June 29th instead of June 12th, which may account for the date of the attack." Another observer, in the county of Norfolk, states that "a little patch of wheat, a quarter of an acre, sown in the autumn, suffered much from the wheat-midge; whilst another quarter of an acre close alongside, which, owing to wet and frost, was not sown till spring, was not injured by it." A third observer notices that "on June 27th the wheat-midge was especially abundant, whilst there were as yet no wheat ears in which it could lay its eggs, and that no damage took place from the ravages of the larvæ." The foregoing observations completely justify the remedies that I suggested for this pest in my account of the wheat-midge in the Report for 1871.

6. The Wheat Aphis *(Aphis Granaria)*

in 1879 attacked with extreme severity a field of 110 acres of wheat in Cheshire. (In figure 27 we have a representation of an aphis closely resembling the wheat aphis, highly magnified.) The observer mentions the aphides as first appearing in the early part of August and shortly afterwards they were not as observable; but about September 8th they were again noticeable in as great or greater numbers than before. The ears they had previously attacked had become perfectly white, as if blasted, and at the time of writing, September 16th, every green head in the field appeared full of them. It was estimated that what ought to have given four to five good quarters of wheat (about 30 to 40 bushels) would not yield more than ten to twelve bushels per acre, and that of very inferior quality." During the same year the aphis swarmed, in Yorkshire, both on wheat and barley, doing much injury.

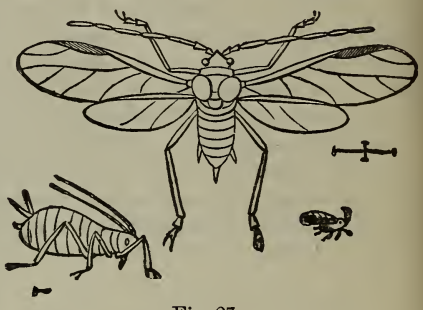

Fig. 27.

7. The Crane-Fly or Daddy Long-legs *(Tipula oleracea, etc.)*

is oftentimes a very destructive insect in England; several species are known in this country to commit much damage to grasses and crops. In 1878, near Dumfries, the larvæ of the crane-fly caused the worst insect attack of the season in the district. Hundreds of acres of corn (wheat) are mentioned as being completely destroyed. In 1879, at those spots in the same neighbourhood where it was so destructive in the previous year, it was scarcely noticeable, whilst in others in the same locality it was present to a most injurious extent. "According to report the worms had been counted at the rate of 12, and even up to 24, per square foot; and this insect is considered as without doubt the worst pest of the district." In Northumberland, Cheshire, Lancashire, and other localities, this insect was reported to be very injurious. The following account records an instance of a remarkabiy bad attack occurring in a fair-sized garden in the beginning of April, 1876. "The lawn was completely bared, and the larvæ were in such numbers that there was no difficulty in collecting them in barrowfuls; 57 larvæ were counted at one daisy root. Handpicking was useless, and a quantity of ducks were turned in, the soil being stirred into shallow furrows from time to time to allow them to reach their prey. Eventually the ravages ceased almost as suddenly as they had begun, but not until every piece of grass in the garden was bared, as if it had been cut with a turfing iron and left to die on the spot. Grass seeds were sown in the late spring, and their growth encouraged by a judicious use of nitrate of soda and dissolved bone manure. This soon restored the turf, and the *tipula* has hardly been noticeable since." "Looking at the partiality of *tipulæ* larvæ for damp ground, and that of the perfect crane-flies for rough neglected herbage, and their dislike to saline presence, it seems as if something might easily be done by draining, removal of lurking places, and dressing with chemical manures, at least to diminish this trouble, and the fondness of birds for the grubs shows a direct mode of destruc-

tion, whether by general encouragement of insectivora in the fields, or the more limited application available in the garden."

8. The Pear-Tree Slug Worm *(Selandria cerasi)*

is a very familiar insect in Canada, (fig. 28); though I cannot say that our species is identical with that found in England, *Eriocampa adumbrata*, it is at any rate very

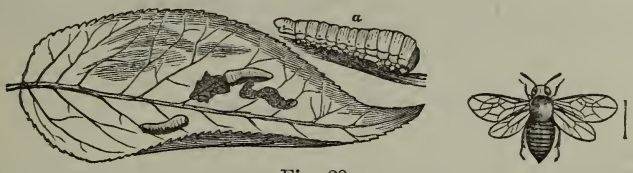

Fig. 28.

similar to it, both in appearance and habits. In 1878 this insect did much damage in the district round Dalkeith. "The easily applied remedies of a dusting of caustic lime, or a heavy syringing of the tree with strong soapsuds, are generally very effective in getting rid of this pest." A full account of this insect is given by Mr. Saunders in our Report for 1874.

9. The Gooseberry or Currant Saw-fly *(Nematus ribesii)*,

our well-known pest (fig. 29), is recorded as being very prevalent, both in 1878 and 1879. In this country we are able to keep it in check by the use of powdered white hellebore, and I have never heard of any ill effects being produced by the employment of this poison. A writer, however, relates that on one occasion "I dusted my bushes with white powdered hellebore, and ten days after (being dry weather from the time they were dusted) a tart was prepared of berries from these bushes. After partaking of the tart we all got seriously ill, but recovered, and next day we were all right. Since that period I never again made use of hellebore for destroying caterpillars on berry bushes. The remedy I have used ever since instead of hellebore, with equal success, is flour of sulphur. It is easily applied by dusting it over the bushes with a pepperbox while they are under the morning dew; or, if during dry weather, the bushes ought to be watered and then dusted. It is only necessary to dust the lower part of the bushes if taken in time. The use of sulphur is perfectly safe, and berries may be used at any time after its application."

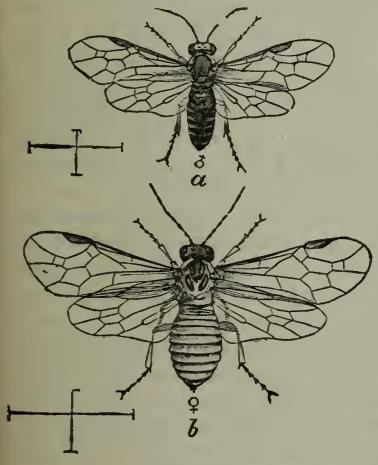

Figure 29.

10. The Asparagus Beetle *(Crioceris asparagi)*

Fig. 30.

is an insect that has come over from England, and become very destructive on Long Island and in other parts of the State of New York. In fig. 30, this insect is shown in in its various stages. It is quite common, apparently, throughout England. The following remedies are set forth: —"The mixture consists of half a pound of soft-soap, quarter of a pound of flour of sulphur, and about the same quantity of soot, well mixed together in a pail of warm water. In this the infested shoots were dipped; and on inspection the next day it was found to have cleared the larvæ. The plants

were syringed afterwards with warm water (merely to clear off the dirt left by the dipping), and soon resumed a healthy appearance, and were thus saved from an unusually severe attack; the *Crioceris*, when brought under treatment, being present on almost all the plants and stems, and noticeable by thousands in the larval stage, as well as in the egg." Another writer states: "I stopped what was becoming a destructive attack by syringing the plants with warm water, just bearable to the hand; this sent off the larvæ, or loosened them so as to fall to a shake; and throwing soot liberally through the damp shoots to the ground destroyed the fallen grubs. This treatment, repeated once or twice in the course of the season, completely saved the plants, and the soot gave a luxuriant and healthy growth."

11. Insect Migrations.

The following account of an extraordinary migration of insects is so interesting that I need make no excuse for transcribing it here: "The swarm appears to have been composed, at most of the successive points noted, of the moth *Plusia gamma*, and of the painted lady butterfly, *Vanessa cardui*. It appears to have started from the north-west of Africa, and travelled in a north-east direction, was observed at Algiers about April 15th to 20th, 1879; it reached Valencia, and was spread over Spain, and also present in the Balearic Isles from April 26th to May 3rd, and crossed the Eastern Pyrenees on May 26th and 27th. It next appeared in the south-east of France, Switzerland and Northern Italy; and on the morning of June 5th, thousands of living specimens were found on the snow at the Hospice of St. Gothard. It was then distributed over Germany and Austria at dates of appearance noted as being from June 7th to 16th. Another column crossed the Mediterranean to Sicily, and spread northwards over Italy in June. The more westerly end of the migratory swarm reached Strasburg from June 3rd to 9th; Paris and its environs were apparently not reached till June 15th. The appearance on the south coast of England was noticed on June 10th; and the moths were subsequently observable throughout the three kingdoms. *Plusia gamma* was unusually abundant near Norwich on June 12th and 13th; and it was also noticed on the 13th in Essex. Subsequently it occurred in enormous quantities at many localities, the numbers, however, diminishing (as far as appears from the observations sent in) as the points of observation became more northerly. At Exeter, an observer states that he never saw anything to be compared with its numbers; towards the end of September the larvæ literally swarmed on every garden plant, defoliating the plants, as well as riddling the leaves. Another, writing from Chichester, mentions that serious injury was caused by the larvæ of *Plusia gamma* to the field peas, whole fields being stripped of their leaves, and the growth of the pods consequently checked. On August 5th great numbers of the larvæ were collected; two days later they spun up, the moths developing on the 14th, the pupal state thus lasting only a week or ten days. The moth was also noticed as unusually abundant in Buckinghamshire, Hampshire, Kent and in various other counties. "Before the appearance of the moth and caterpillar—it is noted—the sugar-beet crops in Saxony were in excellent condition, and would in ordinary circumstances have yielded a harvest of from nine to ten tons per acre; the actual yield where the caterpillars had been was only three tons."

A great many other insects are, of course, referred to in these interesting Reports, but the foregoing have been selected for notice here, inasmuch as they are more or less familiar to us on this side of the Atlantic. It would be an immense help to the effective study of practical entomology, and consequently of great value to the agriculturists and fruit growers of this country, if some similar plan could be carried out here. There would require to be one or more willing and competent observers in each county of the Province, who should note down particulars respecting a certain number of noxious insects, and send in their reports to some central office at the close of the season, making mention especially of any unusual depredations that might have occurred in their neighbourhood. By some such system as this we should get a large quantity of information that could easily be digested and put in proper shape for annual publication.

RHYNCHOPHORA—WEEVILS.

W. Hague Harrington, Ottawa.

The weevils are beetles belonging to that division of the *Coleoptera* known as *Tetramera* in the classification of early authors, and so distinguished because the beetles included in it have apparently only three-jointed tarsi or feet; the penultimate joint being so small and so closely connected to the preceding one as to be invisible without a magnifying glass. The greater number of these beetles can be readily separated from those of other families by their snouts or beaks, which in many species are so elongated and attenuated as to give their bearers somewhat of the appearance of lilliputian six-legged elephants. (See figure 31, which represents the apple curculio, *Anthonomus quadrigibbus.*) This well marked feature in their structure has gained for them their common name of "snout-beetles," and their scientific appellation of *Rhynchophora*, derived from the Greek, and signifying "beak-bearing." If we carefully examine one of these insects we will see that the head is lengthened into a proboscis, at the end of which are situated the mouth-parts, so reduced in size as to be almost invisible to the naked eye.

Fig. 31.

On the sides of the rostrum (to use the scientific name for this proboscis) are set the antennæ, usually slender and long; sharply geniculated or elbowed in many species, and commonly knobbed. They can be folded back so closely against the base of the snout, which is often grooved to contain them, as to be quite hidden. The beetles have hard, rounded bodies; some love the sunshine, others lie hidden all day and when night falls creep forth from their hiding places to continue their depredations, or fly about in search of new fields. The legs are often short and not well fitted for rapid progress, or for digging. Many have ample wings to carry them about, but in some species these useful appendages are wanting, or are so short as to be useless as organs of flight.

So far as known to me *all* the snout-beetles are vegetable feeders, and the great majority of them may be styled "obnoxious insects"; many being veritable pests to agriculturists and arboriculturists. They attack trees and plants of every kind and in every part; roots, stems, bark, twigs, pith, leaves, buds, flowers, fruits and seeds are all subject to the depredations of these long-headed foes, which, though minute, exist in such countless numbers as to make the total loss inflicted by them severely felt.

Weevils when young are short, fleshy, whitish grubs, without legs, and effecting what slight progress they require by the aid of their hunched segments, by the shape of which they may be easily known from the maggots of flies. Their heads are scaly or horny, and furnished with sharp mandibles to nibble the hard substances in which so many of them dwell, and in which they thus construct cells or short burrows. In these cells the majority of species pass also the pupa state, emerging only as fully developed beetles to spend a brief existence in the outer world. It is in the grub state that the weevil commits its depredations, for then it is invariably concealed in that part of the plant on which it subsists, secure despite its utter helplessness, and finding its proper nutriment in the walls of its prison. Trees are stunted and warped by having their young shoots devoured; fruit and nuts are caused to drop prematurely and decay; rice, corn, wheat and other cereals become mere empty husks, while peas, beans, and a great variety of seeds are destroyed by enemies so tiny that the hollowed shells form the house in which the full grown larva transforms to a perfect insect.

Our own weevils are inconspicuous both in size and colouring; in fact nearly all of them are small and dull looking beetles. In tropical countries, however, snout-beetles are found of very formidable dimensions, and some are most brilliantly marked and painted; of these I will mention a few examples presently.

The *Rhynchophora* are divided into two families, the *Bruchidæ* and the *Curculionidæ* (which unwieldy family has recently been subdivided into several smaller ones, but the

purposes of this paper will be equally as well served by adhering to the former classification). The great bulk of the weevils are included in the latter family, only some three hundred species of *Bruchidæ* being known, about fifty of which inhabit America north of Mexico. They derive their name on account of their nibbling or "biting" propensities. Their depredations are chiefly confined to the various members of the *Leguminosæ*—pod-bearing plants—and are marked among peas, beans and many seeds which among foreign nations and tribes are important articles of food or export. Figure 32 represents the well-known pea weevil (*Bruchus pisi*), both larva and beetle, magnified and of natural size, and figure 33 the American bean weevil (*Bruchus fabæ*).

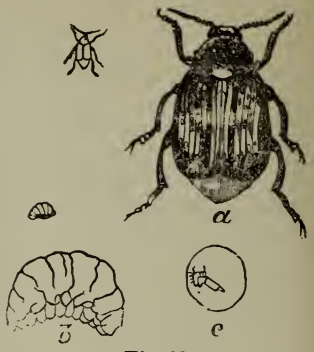

Fig. 32.

They are small active beetles, short and stout, of which the too-familiar pea-weevil is a good example, and are recognized by the manner in which the head is folded against the

Fig. 33.

breast. The eleven-jointed antennæ are short and inserted close to the eyes. Some foreign species attain considerable size, one Australian fruit-eating species being considerably larger than our biggest weevil.

It seems almost superfluous to give any account of our pea-weevil (*Bruchus pisi*) after the able account of it by Mr. Saunders in the Annual Report for 1879, but as it is typical in structure and habits of this family I shall devote a few lines to it. Apparently a native of North America, it long since reached the southern portions of Europe, and is mentioned as having been so numerous in some districts of France in 1780 as to have seriously affected the health of the peasants who had partaken freely of the worm-infested peas. Mr. Curtis, in his admirable treatise on Farm Insects, written twenty years ago, expresses the hope that the climate of Great Britain will not suit the economy of this pest, and states that he has frequently found the beetles in imported peas.

The beetle is nearly oval in shape; from two to two and one-half lines in length and dull in colour, being black when divested of the dense covering of short hairs with which it is clothed. These hairs are rusty brown above and gray beneath, while the elytra (wing-covers) are marked by several white dots. The weevils pair in early summer when the pea-fields are in bloom, and as soon as the young pods are developed the female deposits her eggs thereon. A few days later the larvæ are hatched and eat their way into the nearest pea, in which they live usually until the next spring, when, having undergone all their changes, they come forth ready to attack the new crop. A method recently given by a correspondent of the *American Entomologist* to destroy the weevils in seed-peas is to immerse the latter for a few minutes before planting in a mixture of kerosene and water, which is said to effectually destroy the insects without injury to the peas. The following paragraph which appeared in a recent issue of the *Daily Globe*, contains a valuable suggestion as to the treatment of seed peas :—

"An entomological occurrence in THE GLOBE office suggests an easy method of annihilating the pea weevil—an insect whose ravages are rapidly driving the farmers of some parts of Ontario to abandon pea culture in despair. A note in this column, a few weeks ago, about a new pea pest (not the weevil) brought half a dozen consignments of 'buggy

peas' with requests that the senders be informed whether their's was the new pest or the old one. The boxes containing the peas—which were all infested with the common weevil *Bruchus pisi*—were placed in a room which is somewhat over-supplied with steam pipes, and in which the temperature occasionally rises above 90 degrees. After a day or two in this room the regular transformation of the beetles from the pupa to the perfect state took place. On opening the boxes, they were found alive with weevils which had abandoned the holes in the peas, and were looking around for young pea pods in which to lay their eggs. In this lies the lesson. It is a pretty well settled fact in entomology that the function of egg-laying is not a voluntary one on the part of the female insect. Given the requisite temperature, and the process of egg-laying must go on whether the eggs be fertilized or not, or whether there be a proper place on which to lay them or not. It follows, almost to a certainty, that the pea weevil can be annihilated in a very simple manner. In the natural state the eggs of the weevil are laid on the outside of the young pea pods. The larva hatch out and burrow through the pods into the peas, one larva to each pea. Once there, they feed till they have attained their full growth, when they go into the pupa or chrysalis state. In the latter state they remain all the fall and winter. In the spring the weevilly peas are sown with the insect still in the pupa state. It remains underground till the soil has become warm, and then it changes to the perfect state, comes forth, and proceeds to perpetuate the species as before. Now, it appears from what happened to our consignments of pea bugs that the insects can be easily inveigled out of their holes during the winter when there are no green pea-pods for them to lay upon. Once out of the pupa state, it cannot go back again. If, then, farmers will during the winter place their seed peas in a warm room for a few days, the weevils may be brought out of their holes and killed, or left to die."

Bruchidæ from their habits are insects very liable to be carried from one country to another in the seeds used alike for food by man and weevil, and if the climate and food found in their new quarters be at all favourable, they quickly make themselves at home therein. As an example of the way in which such insects are imported it may be mentioned, that eight species were collected among foreign exhibits at the Centennial Exhibition.

The second division of the weevils is an enormous one, containing many hundred genera and many thousand species—the number of the latter named and described being 10,000 or more—while the list is being lengthened continually by the discovery of new ones, of which there must remain a great number, for a large proportion of the species are so small and inconspicuous as easily to escape early collectors in countries where many larger and more brilliant coleoptera can be easily obtained.

According to a recent "Check list of the Coleoptera of America north of Mexico," there are over eight hundred species, of which nearly half have been added within the last seven years. In Great Britain, where numerous collectors have thoroughly worked the ground, about five hundred species are known, and undoubtedly, when our own country has been more exhaustively searched, the Canadian list now numbering but little over one hundred forms, will be enormously swollen. I have obtained in the vicinity of this city over fifty kinds, some of which occur in large numbers.

Our snout-beetles are all small, many very minute; the largest is scarcely an inch long, while many are but one-twentieth of an inch. If then we consider the damage inflicted in this country, we can form some idea of the ravages that are wrought in more tropical countries where the weevils attain to a great size; compared to these our largest species are as sparrows to turkeys.

In Java is found an enormous black weevil, called *Protocerus colossus*, which measures three inches in length and is stout in proportion. With its immense front legs and strong, knobbed snout, it is a formidable looking beetle, and must do great harm to the trees on which it feeds. An allied Brazilian species is called *Rhina barbicornis* from its long hairy snout, which gives it a very fierce look. Some foreign weevils are as remarkable for their varied and brilliant colouring as for their size. The most commonly known is perhaps the diamond beetle of Brazil *(Entimus imperialis)* often used as a breast pin or similar ornament. It is a black insect, closely lined with rows of glittering geeen dots, and presents in its perfect state a magnificent appearance. A near relative of this beetle is *E.*

splendidus, clad in black bossed armour adorned with gold and green. A third species of these Brazilian gems—*Rhigus schuppellii*—wears a coat of green mail studded with golden knobs. Many other strangely formed or ornamented weevils are found in the south, of which but two examples can be given. The first is a large black beetle found in New Holland named *Gagatophorus Schonherri*. "There is scarcely any portion of the upper surface of this insect, which is quite smooth, those parts which are not knobbed being grooved. The upper part of the head has a wide and rather deep groove. The thorax is rounded and covered with knobs, which are comparatively scanty on the disc, but become very numerous and crowded on the sides. These projections are without any apparent order, but those of the elytra are arranged in three distinct rows. The elytra are very large and are turned over the sides rather abruptly. On the edge, where they are folded, is a row of nine knobs, so long and pointed that they may well be called spikes. Next comes a row of seven knobs, and next to the suture is a third row of four knobs, these last being placed rather irregularly (Wood's "Insects Abroad"). *Xenocerus lineatus* might well be mistaken for a longicorn beetle, so extraordinarily long are the antennæ of the male. The beetle is of a chocolate brown colour, marked with white lines, and is hardly an inch long, while its antennæ are more than two inches in length and very delicate.

Among our native weevils are two species belonging to the *Attelabidæ*. They are small beetles found upon the leaves of oak, etc., and are said to make a sort of little nest, in which to lay their eggs, by cutting and rolling up a portion of the leaf of some tree.

The largest weevil I know to be found in Canada is the one named *Ithycerus novaboracensis*. It is a stout-bodied beetle, from two to three-fourths of an inch in length; the largest ones (females) being one-fourth of an inch across the wing-covers. The snout is broad and the rather short club-tipped antennæ are inserted near the jaws. The thorax is short, about as wide as long, and marked by three longitudinal white lines. The elytra are wide and ample, being turned down well at the sides, and they are marked by parallel white lines, interrupted by slightly raised black spots. The colour of the beetle is black, but a scanty clothing of short white hairs gives it a grayish appearance. I have often found it during June upon beech trees, and the sexes copulate at this time. It is mentioned by Fitch as eating the buds and gnawing the twigs of apple trees in May and June.

Hylobius pales is one of the destructive weevils found upon our pine trees, and is very common throughout the lumbering districts. In Ottawa during the early summer they appear in great numbers, crawling on the sidewalks and on buildings and fences. Its length is about three-eighths of an inch, and its colour a deep brown, approaching almost to black. The rounded thorax is closely punctured, and the elytra have rows of impressed dots as if stitched, and also slight irregular markings made by white hairs, which in many specimens are rubbed off. The long snout is stout and strong, as are the legs, with which the beetle can cling tightly to its captor's finger, as it has a habit of doing, pressing at the same time with its snout, of which the mandibles are too small to pierce the skin. During May and June the beetle lays its eggs in holes bored in the bark of pine trees, and the grubs burrow between the wood and bark, loosening the latter and thus causing decay. I have found this beetle, early in May, with its snout buried in the base of the tube of the Mayflower *(Epigea repens)* in the same manner as bees perforate flowers to gather honey and pollen.

H. stupidus is a larger and heavier beetle, nearly half an inch long. The scutel is yellow, and there are scattered patches of hair of the same colour upon the body and wing-covers. It is much less numerous than the former species.

Pissodes strobi (fig. 35), the white-pine weevil, is smaller than the above described species, but is even more destructive in its habits. One of the most important uses to which our noble pines are adapted is for the construction of ships' masts and spars, for which purpose it is absolutely necessary that they be straight and faultless. Now, this weevil delights to select the leading or topmost shoot of the thrifty young pines, as the object of its attack. It bores holes in the bark, at irregular intervals, the whole length of the shoot; in each of these it lays an egg, and as soon as the larva is hatched, it eats downward toward the centre of the twig, and burrows in the pith. In the cell thus formed

Fig. 35.

it undergoes the necessary transformations, and emerges the following spring as the perfect beetle. For a month or two after the eggs are deposited, the growth of the shoot is unaffected, but as the grubs increase in size, and reach the centre, it begins to wilt and shortly dies and withers. One of the lateral or side shoots, curves upward frequently, and takes the place of the destroyed leader, but a crook is thus caused which greatly lessens the value of the tree. The only way to prevent their ravages, is by cutting off all the dead shoots, while the insects are still in them, and burning them. When these beetles are very numerous they also attack the side shoots.

There are other species of this genus, very similar in appearance to *P. strobi*, which are found assisting it in its ravages, and which are sometimes abundant.

Another weevil found upon pines, from the middle of May to the middle of June is *Polydrosus elegans*, which, as its name denotes, is a very graceful and beautiful beetle. It differs from the preceding species in shape, its body being narrow and more cylindrical, while the head is not prolonged into a slender snout, but is lengthened only slightly, and flattened, the mouth being wide, and having inserted near its sides the antennæ. The colour varies from a silvery gray to a creamy buff, and I have several specimens, usually males, of a most delicate glistening green. Their colouring is caused, not as in preceding species, by a covering of short hairs, but by a coating of minute iridescent scales, resembling in shape grains of rice. When denuded of these fragile scales, which are easily rubbed off, the beetle is jet black.

The numbers of the genus *Anthonomus* are, as indicated by the name, "flower-dwellers," and are found upon trees or plants when in blossom, and as the fruit is setting. Several species occur in Canada, one of which, *A. quadrigibbus* (see fig 31), is a small, rough, robust beetle of a reddish brown, with a slender beak almost as long as its body. It is often abundant upon the hawthorn, and when disturbed folds its legs, tucks carefully away its antennæ, and looking for all the world like a withered bud, drops to the ground. This habit of simulating death and of taking on the appearance of a dried bud, seed, or bit of moss or dirt, is common to many weevils. The little beetle in question is sometimes called the apple weevil, because it punctures that fruit at times, with from one to twenty holes.

An allied species, *A. suturalis*, the cranberry weevil, is a minute reddish weevil, which in the United States attacks the cranberry vines, and, as it is found in Canada, may probably do so here also, although I have seen no record of its operations. The female is said to bore a hole in a bud, and after depositing an egg therein, cut it off, so that it falls upon the ground and decays, while the grub grows and transforms within it.

Conotrachelus nenuphar, the plum weevil, is too well known (especially after the full account of it by Mr. Gott, in last year's Report), to require more than a brief mention here. In fig. 36 we have this insect shown in its several stages of larva, chrysalis and beetle.

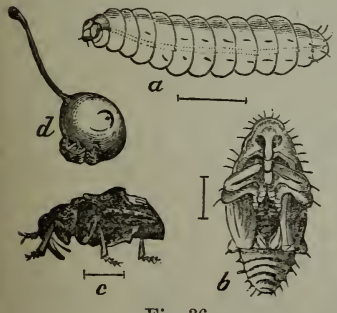

Fig. 36.

From its extended ravages, and the crescent-shaped mark which it makes when depositing its egg in the young plum, it has been, not inappropriately, named the "little Turk." The grub, when hatched, eats towards the germ of the fruit, which then dies and falls prematurely to the earth, where it is kept moist while the worm attains its full growth. When arrived at maturity, the grub leaves its wasted larder, to pupate in the earth, from which it emerges the following spring, as a small, rough, dark, mottled beetle. Jarring the trees once or twice daily, during the season when the beetles are depositing their eggs (that is when the plums have reached the size of peas), and thus causing them to fall down upon sheets spread beneath the trees, is apparently the best method of exterminating this pest, which is spreading rapidly throughout the country, and destroying great quantities of fruit. Various other plans are however advocated, for the best of which I will refer you to Mr. Gott's report.

The plum weevil when abundant also attacks other fruit; including apples, pears, peaches, apricots, nectarines and quinces in its list of dainties. It causes some to fall prematurely, and mutilates and scars many others, so as to render them unfit for market.

Plums are not largely grown in this vicinity, but at several places in the woods where trees are growing wild (in abandoned clearings, etc.), I have found this beetle, and in such places it is left to increase unmolested, and is secured against extermination.

The plum weevil has been accused of causing the disease on trees, known as "black knot," but although the grubs are sometimes found in these excresences, they are not the cause of the injury, but only an accidental result of it, the beetle having been deceived into depositing its eggs in the swelling part when green and soft. Farther south, where the beetle is double-brooded, it has been said to deposit its eggs in the bark of young pear limbs, the grubs which winter therein accounting for the spring brood. The plum-gouger, *Anthonomus prunicidae* (fig. 37), is also destructive to plums.

Fig. 37.

There are other species of this genus found in Canada, but none are so notorious.

Tyloderma fragariæ is a small weevil that (across the line if not in this country) attacks the strawberry, and is known as the "strawberry-crown borer," because it destroys the embryo fruit stalks and leaves in the crown of the plant. (See fig. 38, where the larva and beetle are both shown.) An insect with such a disposition may readily become a serious enemy to small-fruit growers.

Fig. 38.

Mononychus vulpeculus is a robust beetle slightly larger than the pea weevil, but differing from it in shape. The body is about as wide as long and very thick; the thorax is much narrower, while the head is small and the snout long and fine. The beetle is black above, and of a rusty yellow beneath. The grub lives in the pods of the common flag, or iris, eating through two or three seeds (which it leaves mere rings) and forming a cell in which it undergoes its changes. They are often very plentiful and scarcely a pod escapes, but, of course, the greater part of the seeds in the pod are uninjured. On the first of August last, in passing through a field of these plants, I noticed that some pods had an appearance of some internal disease, and on investigation found the source of trouble to be a small white grub, evidently a curculio larva. Aware that a weevil did infest these plants, and not having hitherto bred any specimens, I carried away a pocketful of pods for the purpose of so doing. These were placed in a small box, and not looked at again until the 19th of September, when on emptying the box I found nine specimens of *M. vulpeculus*. There were also two small moths and six ichneumon flies, four of the latter being females and two males. On opening the pods I obtained nineteen more weevils and four ichneumons, as well as two larvæ of the moth. Hardly a pod was without a tenant, while in some dwelt two or three. A day or two later I visited the patch where I obtained the pods, and found that with few exceptions the pods had burst and scattered their contents, but a few remained, and either showed holes through which insects had escaped or still contained weevils or caterpillars. The beetles probably spend the winter underground or concealed in the dead plants.

As shown by the figures above given, fully twenty-five per cent. of the insects were destroyed by the ichneumons. In the same way the plum weevil has been greatly checked in some places by an ichneumon fly called *Sigalphus curculionis* (fig. 39), which is very similar in size and appearance to the ichneumon just mentioned as parasitic on the iris-weevil.

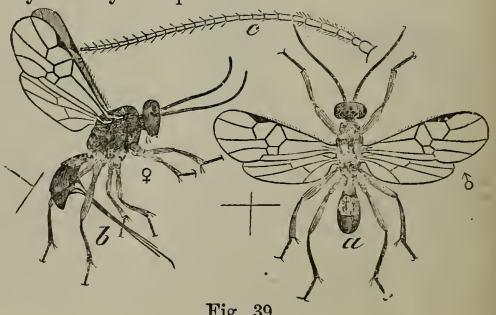

Fig. 39.

A weevil remarkable for its long slender rostrum or snout is found upon hazel-bushes in May, and more abundantly in June, about the middle of which month the beetles are frequently seen paired. It is

called *Balaninus nascicus*, the specific name being conferred on account of its snout or "nose," which, though no thicker than a bristle, is nearly as long as the body, and carries a pair of long and very delicate antennæ. The beetle is a third of an inch long, with an oval body covered with short yellow hairs. The grub lives in the hazel-nut, but leaves it when full grown to transform in the ground. In 1879 the nut crop was large and these beetles were very abundant, but last summer there were but few nuts and I only observed one weevil. This beetle, according to Fitch, also feeds on hickory nuts, and *B. rectus*, distinguished by the beak being shorter and straighter, attacks acorns. This genus, I may add, derives its name—*Balaninus*—from a Greek word signifying acorn.

Remarkable as our nut weevil is for its long, slender nose, it is far surpassed by an African beetle which has a bristle-like snout fully three times as long as its body, the latter being half an inch in length.

Cratoparis lunatus is not an injurious weevil, for, unlike the majority of its kind, it forsakes sweet flowers and succulent fruits to feast upon dry fungus, such as grows upon old beech trees. It is about a third of an inch long and of a mottled colour, exactly resembling when disturbed a bit of fungus or moss.

The members of the small group *Brenthidæ* are easily distinguished from other weevils by their remarkably long bodies, snouts not bent downwards or curved, but stretched straight out in front, and unelbowed antennæ. The only Canadian species is *Arrhenodes Septentrionis* (Hbst.), the larva of which lives in hardwood trees (most frequently oak), not only in dead trees but in living ones. The female is said to bore a hole in the bark with her long snout, and shove into the puncture an egg. The cylindrical, whitish grub bores a round hole through the bark and into the solid wood of the tree. It is a slender worm, an inch or over in length, and little more than one-tenth in diameter; changing in its burrow to a yellowish white pupa.

The beetle has a cylindrical body attached to which is an egg-shaped thorax, rounded off where it is joined to the body, and tapering gradually to the head, which is prolonged in a straight snout, hardly as long as the thorax. The snout of the female is very slender, and the jaws at the tip are so small as to be barely visible to the naked eye; that of the male is much heavier, and the jaws are strong and curved. The antennæ of the female are inserted at the base of the rostrum near the eyes, while those of the other sex are set midway between the eyes and mouth. The general colour of this beetle is a rich brown; it is very smooth and glossy, with the exception of the wing-covers, which are striated, punctured and marked with irregular, broken, yellow lines. These beetles may be taken in June among oak trees, or more readily in lumber yards among newly sawn oak lumber. I have also taken several which were attracted with other species of weevils to a bright light placed to allure moths. They vary wonderfully in size, the males (an unusual thing with insects) being largest. Ordinary specimens are from four-eighths to five-eighths of an inch long and about one-eighth in diameter, but Fitch mentions one as being only two-eighths long, and I have an enormous male, a giant of his race, measuring over seven-eighths. It is proportionately stout; the rostrum is very broad and strong, and the jaws large and powerful. It was found last summer in a cleft of a newly fallen butternut tree.

The *Calandridæ* embrace many highly destructive insects. In the West Indies is found an enormous weevil which injures palm trees and sugar-canes. Its gigantic white grubs are called by the negroes "gru-gru," and by them, as well as by many white people, are considered a very great delicacy, although those not accustomed to such unusual dainties would consider them a very distasteful kind of grub.

Our northern species are small but still capable of doing immense damage by their united efforts, and the grain weevils have a world-wide notoriety on account of their ravages. Three species of the latter are common in the States, viz:—*Calandra oryzæ*, *C. granaria*, *and C. remote-punctata;* the two last are also found in Canada. *C. oryzæ*—the rice weevil—is supposed to have spread westward from the East Indies with the grain from which it derives its name. Unfortunately, however, it does not confine itself to rice, and at the Philadelphia Exhibition was found to abound in rice, maize, and wheat from all parts of the world.

With the aid of its relative the granary weevil (*C. granaria*)—see fig. 34—it destroys vast quantities of stored grain. Curtis says that no insects in England do more mischief to

stored grain than these two weevils introduced from abroad. In warm countries, such as those of southern Europe, there are many broods during the year, and the loss caused is correspondingly great. The beetles penetrate some distance into the heap of grain; the female lays her eggs singly in the grains, and in a few months there remains nothing but a heap of empty husks, tenanted by grubs and beetles. At an entomological meeting in England, April 1870, it was stated that 74 tons of Spanish wheat when sifted yielded *over half a ton of weevils*, and 145 tons of American grain gave *one and three-quarter tons.* Fortunately these beetles do not thrive without heat, and cannot carry on their depredations in the cold of our winter, hence grain can be stored here for many months without loss.

The *Apionidæ* are a group of small pear-shaped weevils the minute larvæ of which infest different seeds.

Besides these we might mention as destructive the quince curculio (figure 40), *Conotrachelus cratægi*, which is injurious to quinces; the imbricated snout beetle, *Epicærus*

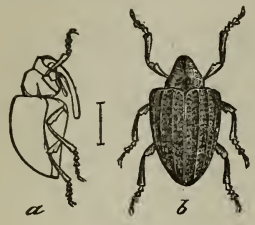

Fig. 40.


Fig. 41.

imbricatus (figure 41), which injures apple and cherry trees by gnawing the twigs and fruit; the corn sphenophorus, *Sphenophorus zeæ* (figure 42), which damages the corn crop

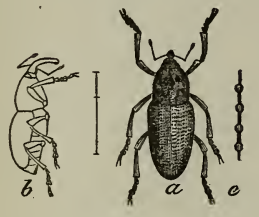

Fig. 42.

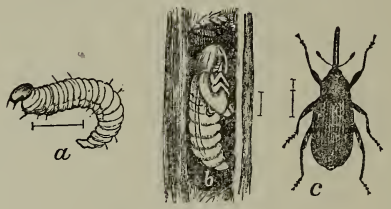

Fig. 43.

and the potato-stalk weevil, *Baridius trinotatus* (figure 43), which injures the potato.

This paper has already reached such a length as to exclude further descriptions of our weevils, species of which will from time to time be found coming into notoriety through attacks on our trees or plants. Even those now only to be met with feeding on wild plants may some day transfer their affections to a cultivated one, as has frequently been the case hitherto. Occasionally also new species may be brought into the country with imported seeds and plants. The *American Entomologist* recently warned importers of fruit plants from England to be on their guard against introducing a weevil, which has of late years been very destructive to raspberry bushes, as it would, doubtless, flourish here, there being several closely allied species already in this country.

The name of this possible visitor and dreaded foe is *Otiorhynchus picipes*, and in its native land it attacks a great variety of plants and trees, such as peas, beans, turnips, elms, lime trees, etc. The principal damage appears to be done by the full-grown weevils, which are wingless and night feeders, hiding during the day in crevices or under bark, stones, etc. They are "sometimes a dreadful pest in gardens, committing sad ravages on vines in hot-houses and on wall fruit, during the night. They likewise injure raspberry plants in spring by eating through the flowering stems and leaves, and they nibble off the bark and eat out the buds of apple and pear trees." The larvæ live in the roots of flowers and other plants, and are very destructive to them.

The ravages of weevils cannot be stayed by the same measures which avail in the case of the potato beetle and other leaf-feeding larvæ. Their grubs cannot be reached by Paris green and similar poisons; their destruction can only be accomplished by that of the substance in which they feed concealed. Failing then to reach the grubs, it remains to attack the beetles themselves, and this is often difficult of accomplishment, on account of their secluded habits and the trouble of finding them. They are also exceedingly tough subjects to kill; their hard bodies are capable of resisting much hard usage, and, to a great extent, the action of such substances as are all-powerful in the destruction of insects endowed with less vitality.

I have frequently kept plum weevils for hours, sometimes for a couple of days, in a cyanide bottle, which would kill most insects in a few minutes, and although stupefied, they would, in a short time after liberation, be as lively as ever. They are indifferent to the most powerful and offensive odours, and decoctions of tobacco, soap and lime, that easily repel most insects, are apparently but little hurtful to them.

To show the tenacity of life in snout beetles, an English entomologist mentions a curculio (of genus *Cleonus*) which, after resisting the action of laurel leaves, which are used in collecting-bottles as poison, was twice immersed in benzine, the second time for a whole night, and finally had to be killed with hot water. Another instance is where some weevils lived in and devoured coriander seed, among which were pieces of caustic stone.

One simple way to prevent the ravages of weevils is to see that all seeds are thoroughly freed from them before planting, and likewise in setting out plants or trees to observe the same precautions. Yet, sooner or later, they will find their way from adjacent fields, or even distant counties, and then resort must be had to warlike measures. Some species, such as the plum weevil, may be jarred or shaken upon sheets, or frames covered with cotton; others may be taken (some by day, some by night) with sweeping or beating nets. The best way to kill the captured ones is to put them in boiling water.

Fruits or nuts, which have fallen to the ground, should be carefully collected and destroyed before the larvæ therein have left them and entered the earth, and all substances under which the beetles might hide should be removed.

Twigs and canes infested should be cut off and burned in the autumn, or in spring before the beetles have emerged.

Powdered pyrethrum will be found very effectual in destroying weevils among such seeds as peas and beans, if dusted over them, and if well sprinkled among heaps of grain is said to thoroughly kill off the grain weevils.

But little assistance is received from birds toward exterminating weevils. Many species are concealed all day in crevices, under stones, etc., or even beneath the surface of the ground, and only come forth when the birds have ended their labours. Others so closely simulate bits of moss or dirt, or the colour of the bark or other part of the plant on which they rest, as to be safe even from the sharp eyes of our feathered friends. Nearly all are so timid that when alarmed or disturbed they fold up their antennæ and legs and drop to the ground, where they are almost invisible. The stray weevils occasionally captured by birds are not very satisfying morsels, being chiefly hard, horny shell, while the grubs, which are soft and fat, are generally secure in their cells or burrows.

ON THE CHIEF BENEFITS DERIVED BY FARMERS AND HORTICULTURISTS FROM A KNOWLEDGE OF ENTOMOLOGY.

By James Fletcher, Ottawa, Ont.

"Well! what's the use of all your bug-catching and long names to me?" is a question which in this essentially utilitarian age the entomologist has too often to answer farmers and horticulturists even here in fair Canada, where the unparalleled climate presents most

favourable conditions not only for the successful cultivation of roots, cereals, fruit and the other varied forms of produce which constitute the wealth of the agricultural classes, but also for those gigantic armies which from time to time levy such undue tribute upon their hard-earned savings, and where consequently it might be imagined they had been taught a practical answer by bitter experience. But no! such is not the case, and these "minims of creations" individually so puny and weak, but which, united, form such irresistible forces, are to-day very little more studied by the people most concerned than they were fifty years ago. The answer to the question is simply this, "To enable you to know your friends from your foes." I shall endeavour to show that everything which is generally designated by that expressive word "bug" is not an enemy which must be executed at once without a trial. It cannot but be a matter of considerable surprise to any person who turns his attention to the study of Entomology to find to what an extent, comparatively speaking, that branch of Natural Science is neglected by scientific men, for notwithstanding the large sums of money devoted yearly by wise governments towards its encouragement, and the untiring efforts made by individual students to present it to the masses in a popular form it must be acknowledged that as yet it is not studied nearly as much as it deserves.

Little attention was paid to Natural History previous to the commencement of the last century, although the writings of some of the leading philosophers of antiquity show that it was considered of sufficient importance to receive special study. Aristotle and Pliny the elder, wrote of insects largely, although, it is true, somewhat erroneously at times. They too often fell into that trap which is still set in the path of modern investigators, namely, allowing their imaginations to carry them away from the truth to build up a previously conceived theory. There are not many of whom it can be said as of Dr. Leidy, "the most distinguished naturalist of America," as follows:—"In the performance of his scientific work he has confined himself to the duty of accurately describing what he has seen. He very rarely draws inferences from his accumulated facts, and his innate truthfulness is such as to deter him from theorizing."*

The first book published in England upon insects alone is said to have been Mouffet's "Theatrum Insectorum," which appeared in the reign of Charles I, after having passed through the hands of five learned doctors, all of whom did something towards its completion, and after having taken about 100 years to finish. It was owing to the efforts of Ray and Linné, ably assisted by the their contemporaries Reaumer and DeGeer, that Entomology was raised to its proper place among the sciences. Since their time many learned men have fought hard to keep it there, until now "the laugh at Entomology is nearly spent, and known professors of the science may meet in open conclave to exchange observations without fear of becoming subjects for a commission *de lunatico inquirendo*, and may now, net in hand, chase their game without themselves being made game of."† This, however, was not the case in the last century, for we are told in Kirby and Spence's "Introduction to Entomology" that an attempt was made to set aside the will of a rational woman (Lady Glanville) on the ground of insanity, which was evinced, it was claimed, by her fondness for collecting insects.

Foremost of all the great powers in the prosecution of scientific research is undoubtedly the Government of the United States. No expense or trouble is deemed too much, but whatever advantage energy and perseverance can gain for the general good they secure. Their official publications upon scientific matters are simply magnificent, and the generosity with which they distribute them to institutions and societies, where they can be freely consulted, are as proverbial as the politeness of the gentlemen entrusted with the investigations which are thus recorded. No one ever need be at a loss for information upon any ordinary scientific point, for on writing to the Department in Washington which considers that matter, he will receive an answer by the return mail.

By means of the generous assistance of our own Government, our Entomological Society of Ontario is able to put in the hands of all the agriculturists of the Province

* Popular Science Monthly, vol. xvii., p. 691.
† Episodes of Insect Life.

information with which, at any rate it is hoped, they can fight most of the insect pests from which we occasionally suffer, and also at the same time learn to discriminate which among the countless hordes of the insect world may be ranked as allies.

The naturalist founds his studies upon the theory that nothing in nature is useless, and everything that is, must have some special function to perform or it would not exist; it is in tracing up these special adaptations to certain ends that he finds the charm which enables him to carry on the laborious investigations which are oftentimes necessary.

As every one knows, vegetable and animal life are the two re-agents which Nature employs to keep up the balance of creation, the one feeding upon or deriving its nutriment from the other. Now, these two agents are to a certain extent acted upon and kept in check by their own component parts. Whenever, owing to particularly favourable circumstances, too many seeds of any one species of plant spring up in the same place, they do not all mature, for if they did, all would be sickly from want of light and air, and the species would gradually degenerate. Consequently, it is provided that the weaker should be kept down and choked to death to make room for their more robust companions. This is similarly the case in the animal world, as for instance with insects. When, from special circumstances, any one species is abnormally multiplied, it is sure to be attacked and kept in check by some other kind, which itself may be a prey to another species. Plants through all their stages from the seed to the decaying leaf, are the original source of support to some form of animal life; wherever vegetable life is profuse, there insects abound. The green plant attracts innumerable small insects; these in their turn attract larger carnivorous species, which are again preyed upon by birds and reptiles, and the larger carnivorous animals follow. The flesh feeders, thus depending one upon the other for subsistence, have a primary dependence upon vegetable life; therefore, wherever there is the greatest variety of vegetable life there will necessarily be the greatest variety of animals, whether quadrupeds, birds, reptiles or insects.

It is estimated that insects comprise no less than four-fifths of the whole animal kingdom. While there are about 55,000 known species of animals, excluding insects, the number of these amounts to upwards of 200,000. It is therefore perfectly manifest that they must perform some very important mission in the economy of nature. "It would be easy," writes the Rev. J. G. Wood in "Insects Abroad," "to show how the very creatures which are most detested by man, and do him the most direct damage, are indeed, though indirectly, among his best benefactors. Apart from direct benefit or injury to man, the whole of the insect tribes are working towards one purpose, namely, the gradual development of the earth and its resources. The greater number are perpetually destroying that which is effete, in order to make way for something better; while others, whose business seems chiefly to be the killing and eating of their fellow-insects, act as a check to their inordinate increase, and so guard against the danger of their exceeding their proper mission."

I will borrow from the same author two more similes demonstrative of the fact that even amongst those insects which we consider most noxious we have some good friends. What more annoying creature can the mind conceive than the common mosquito? Truly is Beelzebub ("King of the Flies") rightly named if these are types of his subjects. It must be remembered, however, that devouring human beings is not the normal occupation of mosquitoes; but the former are intruders into their domains, and consequently must bear the consequences. Their real object is a beneficent one. In the deep dark forests of the tropics the air would be perfectly stagnant, and an enormous development of noisome fevers would be the consequence, if it were not for the motion caused by the wings of these minute creatures which breed there in myriads, and that of various birds and predacious insects which they attract there to feed upon them. In the larval state, too, they live in water, and feed upon the particles of decayed matter which are too small to be noticed by the larger aquatic animals. Were it not for the presence of these insects, which swarm in vast armies in all stagnant water in warm climates, thus purifying it as well as the atmosphere, such localities would be uninhabitable by any animals higher than reptiles. Again, strange as it may appear at first sight, if it were not for the existence of the many borers and wood-eating insects we could have none of those

lovely forests which give so much beauty to our landscapes, and are the source of so much wealth to the country. Let us imagine that all these insects have been destroyed at one fell swoop, and note the consequence. A giant of the forest dies, and in course of time, during some winter storm, is blown down. Where it falls there it lies, and nothing can grow from the space which it covers. Time rolls on and tree after tree falls, until the whole ground is covered with the trunks and limbs of fallen trees, and what was once a stately forest, with all its wealth of life, is now a vast wilderness where nothing can grow. How different is the beneficent operation of Nature under the present conditions; Scarcely has a tree shown signs of declining vigour than the insect hosts are at work. First of all come certain species which pick out any weak point and deposit their eggs there. The larvæ in due time hatch, and, eating into the tree, accelerate its decay. When it dies and falls to the ground it is immediately pounced upon by the large wood-boring beetles, which deposit their eggs upon the bark; these hatch into grubs armed with strong jaws with which they soon bore into and through the trunk, thus rendering it permeable to air and moisture. Smaller beetles and other insects follow in the wake of the larger, and bore out the softened decaying wood, some using it as food, others as materials for their nests. The rapidity of the work of destruction is astonishing, and, in an incredibly short time, the giant which had taken hundreds of years to mature is reduced to mere dust, which serves as a fertilizer of the soil, and enables it to produce fresh trees to fill up the gap left by the one which has gone.

It is questionable whether any good results would follow from giving statistics of the amount of damage done by insects at different times, for so enormous are the figures that could they even be appreciated they would not be believed by those who do not make a study of the matter. It was estimated by Mr. B. D. Walsh, a careful observer, that in 1861 the injury caused by insects in the State of Illinois alone amounted to twenty million dollars, and that the damage done by insects in the United States cannot be less than three hundred million dollars annually.

It may not be out of place here to say a few words with reference to scientific nomenclature. There appear very frequently in the different newspapers accounts of the depredations of insects, and, that these may be concise and explicit, it is absolutely necessary that some of the technical terms of Entomology should be used. But this is not pleasing to all the agricultural classes, "for," say they, "how do we know what such terms as hymenopterous, coleopterous, or dipterous, insects, which so frequently occur, mean?" True! as a rule they do not; but if they take an interest in their own affairs, they should make a point of finding out what they mean; no one suffers more from these hosts than they do, and it is ridiculous to think that they will remain inactive spectators when it is within their power to avert or at any rate to palliate the evil, by taking cognizance of and following the instructions given in the records of the work done by entomologists. And what does all they are asked to do amount to? Simply this, that they will learn the meaning of about at the most a score, certainly not more, of classical words. Now, let us consider what would be the result of their taking this trouble. In the first place Entomologists could write short and concise accounts, intelligible to all, and, much more important still, these accounts would not only be read and profited by, but the farmers, necessarily taking an interest in what touched them so nearly, would also communicate many of their own observations which, isolated, were useless, but being brought to the notice of one who made a methodical study of the life-histories of insects, might form a connecting link of the utmost importance in a previously broken chain of observation, on a certain insect. These observations, too, being properly expressed, could be relied on, and no confusion could arise which would decidedly not be the case unless the proper terms were employed. Curtis, in his "Farm Insects," expresses himself as follows: "It is a great mistake to suppose that scientific descriptions and correct nomenclature ought to be employed for the use of those only who are specially engaged in the study of Natural History. If insects be not thus accurately described, and their names learned carefully, the facts noticed by practical observers are generally worthless, and may tend to mislead, by the confusion of one species with another, and the consequent adoption of improper remedies. It is thus that I have found, in extensive reading on these subjects, that a very

large amount of the information given by practical agriculturists and gardeners has proved valueless in cases where, if the particular species alluded to could only have been identified, it would have been of the greatest value in furthering subsequent investigations."

But why, it may be asked, use Latin and Greek, why not use English? Firstly, because English is not spoken in all parts of the globe, while Latin and Greek are the universal languages of the learned in all countries, and secondly, because the very nature of these languages particularly adapts them for the purpose. In Natural History it is frequently necessary to distinguish very different and very approximate forms, and it is of the greatest importance that the differences perceptible to the eye should be explained by precise terms in a concise and readily understood language, and Latin has been unanimously chosen by scientific men. When, however, as is occasionally the case, that tongue is deficient in a characteristic expression, the example of the early writers is followed and application is made to the Greek, which, from the euphony of its words and the fulness of its tones, is well adapted to the construction of permanent names of orders and genera.

There has been great difference of opinion among entomologists as to what orders in the animal world the class INSECTA should include, and perhaps even more upon the division of these orders into sub-orders. As Dr. Packard's "Guide to the Study of Insects" is the only manual we have here, it will be well to follow the plan there presented in drawing a short sketch of the class.

Insects are divided into three orders :—

1. Hexapoda,

or true insects, which have six legs, and attain the perfect state; in which they generally possess wings, through a series of stages of existence, or metamorphoses, known by the names of the egg, the larva or caterpillar, the pupa or chrysalis, and the imago or perfect insect. Upon examining the body of a perfect insect, it will be seen that the portions of the body are more distinctly separated than they were during its earlier stages, and that now the segments of the body are collected into three chief regions,—the head, the thorax, and the abdomen. It is from this division of the body that the word insect is derived. Aristotle called insects ἐντομα, from ἐντεμνειν = to *cut in*, and the Roman writers, following him, called them *insecta*, from *insecare*, which also means to *cut in*, and this name has been adopted by all later authors.

2. Arachnida,

or spiders, which have the segments of the body grouped into two regions, and have eight legs, but no wings; they pass through no metamorphoses, but grow by frequent moultings of the skin.

3. Myriapoda,

or centipedes, which have the body worm-like, without wings, and the segments not grouped into regions (except in the newly hatched young), have no metamorphoses, and grow by the development of additional rings to the body.

We will turn our attention to the first of these orders. The true insects are divided up into seven sub-orders, according to the structure of their wings, and these again are grouped together into two series, according to their relative rank and affinities. The first and higher series have the body usually cylindrical, mouth parts more generally formed for sucking, metamorphoses complete, larva usually cylindrical very unlike the adult. The sub-orders embraced by this series are Hymenoptera, Lepidoptera, and Diptera.

In fig. 44, we have a representative of the Hymenoptera in the common blue digger

Fig. 44.

wasp (*Chlorion cæruleum*). Fig. 45 shows one of our butterflies, *Papilio turnus*, a

Fig. 45.

familiar species, belonging to the Lepidoptera, while the Diptera are illustrated by the red-

Fig. 46.

tailed tachina fly (*Exorista leucaniæ*), fig. 46.

The second, and lower series, have, usually, the body flattened, mouth parts adapted for biting, metamorphoses complete, larva flattened and often resembling the adult, and comprises Coleoptera, Hemiptera, Orthoptera, and Neuroptera.

A familiar example of the Coleoptera is given in the Cylindrical Orthosoma (*Orthosoma cylindricum*), fig. 47, one of our most abundant longicorn beetles, the Hemiptera are represented by a large water bug (*Belostoma grandis*), fig. 48; the Orthoptera, in fig. 49, by a common grasshopper, or locust; and the Neuroptera by a dragon-fly (*Libellula trimaculata*), fig. 50.

Fig. 47.

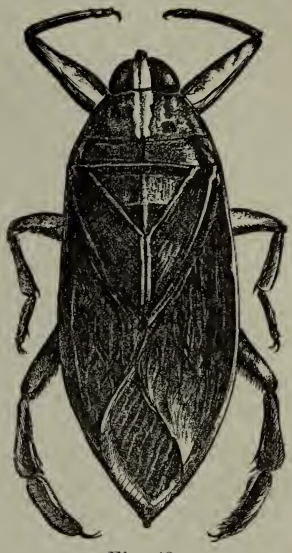

Fig. 48.

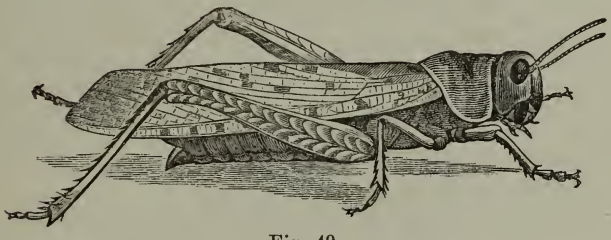

Fig. 49.

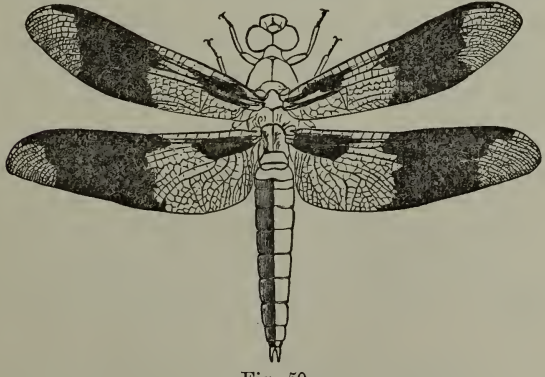

Fig. 50.

The three regions into which the segments of the six-legged insects are grouped, are known by the names of the head, the thorax and the abdomen. *The head* carries the special sense organs, as the eyes, the mouth and the antennæ. The eyes are wonderful structures, and are constructed to cover a very large field of vision; they consist, first of all, of two large compound eyes, made up of numerous small six-sided facettes, which are so numerous that Leeuwenhoec is said to have counted as many as 8000 in the eye of a fly, and Strauss 8820 in that of a cockroach; besides these two compound eyes, there are in many insects two or more simple eyes (*ocelli*) arranged across the forehead, they can be easily seen in the common Humble Bee. There are some insects which have only *ocelli* and even some with no eyes at all.

The principal organs of the mouth are six in number, two on each side of the opening, one above and one below, arranged thus ⁘, the upper single organ is the upper lip or *labrum*, the lower the *labium* or lower lip, this lower lip has a basal joint (*mentum*) supporting a more flexible part (*ligula*); the upper or inner integument of the *ligula* is usually developed into a kind of tongue, which is a distinct part (*lingua*) in the locusts and dragon flies; the superior pair of the lateral organs are the upper jaws or mandibles, which are generally hard and serve to tear the food, the inferior pair are the lower jaws or maxillæ, which are generally soft and serve to to carry the food to the gullet, to be swallowed. To the lower jaws and under lip are attached short jointed processes, called *palpi* or feelers. These oral organs are the same in all insects, although the structure is vastly different among those which obtain their food by mastication and those which obtain it by suction; by dissection and comparative anatomy however it can be shown that they are identical, only greatly modified in form, in both of these classes. In biting insects, as beetles, the side pieces are short, far apart, and have a horizontal motion, and the upper lip is a flat plate closing the mouth above; with sucking insects as mosquitoes, the same parts are elongated into lancet-like organs, are close together, and have a longitudinal motion, and the lower lip at the same time is developed into a tube, which incloses them. In Lepidoptera the three upper organs are very feebly developed, while the maxillæ are elongated into a delicate proboscis, the identification of which with the maxillæ is shown by the occasional presence at its base of a pair of minute palpi; the lower lip is soldered to the head, but is furnished with a pair of palpi, well developed and clothed with scales, which act as a protection to the proboscis. In the flea the middle lancet seems to represent the upper lip.

In bees the lower lip and maxillæ form together a sucking apparatus, but they are also provided with well developed upper jaws or mandibles.

In the front part of the face of an insect are two appendages, which vary very much in form, in the different sub-orders and genera, and even in the sexes of one species; they are called antennæ. What the exact functions are of these important organs, is not known, but it is probable they have more uses than one. Experiments have been made with moths in which it was observed that if the antennæ were removed the insect seemed unable to direct its flight. It is probable too that the olfactory nerve is situated in the antennæ. The different forms which the antennæ take have been made use of by entomologists in classifying insects.

The next division of the body of an insect is the *thorax*. This is the solid portion which bears the organs of locomotion, and comprises the three segments which follow the head. The first one is called the pro-thorax and bears the first pair of legs, the next or middle segment is called the meso-thorax and supports the second pair of legs and the anterior pair of wings, the third segment is called the meta-thorax, and to it are attached the third pair of legs and the hind wings. The wings are objects of great beauty and strength, and consists as a rule of a double membranaceous plate, traversed by more or less bony veins.

The last division of an insect's body is the *abdomen*, which consists of a series of segments attached by membranes. Each of these segments is formed of two arcs or semi-segments, one above and the other below. The abdomen is the seat of the organs of reproduction and alimentation. The senses of insects are dependent upon the nervous system, which consists of a series of nervous masses or ganglia, joined together by two

nervous threads, the whole constituting a nervous chain, from which nerves ramify to the different organs, enduing them with the various senses they possess; from the first ganglin the nerves of the eyes and antennæ are fed, and from the second the mouth. Hearing and smell are certainly possessed by insects; but by what organ they are appreciated is not ascertained. Taste the seat of which is the mouth, sight in the eyes, and touch probably in the antennæ, the palpi, and in the tarsi of the feet.

The circulatory system is well represented in insects. The blood is generally colourless, but occasionally of a greenish or reddish hue. The heart, which comprises a series of large reservoirs in the form of a long tube plainly discernible through the transparent skins of caterpillars, lies above the alimentary canal on the upper surface of the body.

Insects do not breathe, like large animals, through their mouths; but by means of breathing-holes in their sides, which connect with two great air canals (tracheæ) which run along the sides of the body, and from which smaller tubes convey the air in very small volumes to different parts of the body, and so oxygenate the vital fluid in its passage. In the Arachnida this tracheal system is considerably modified, respiration being effected among some spiders by ordinary ramified tube-tracheæ, and among others in certain sacs or cavities in the abdomen which have been called pulmo-branchiæ from an idea that they partook both of the nature of the lungs of the higher animals and the branchiæ or gills of fishes; as, however, the blood does not penetrate these sacs but is merely oxygenated in its passage by and round them, while it is being re-collected after use and previous to being sent back to the dorsal vessel or heart, these cavities are now believed to be tracheæ localized within a peculiarly furnished sac. Tube-tracheæ when examined with the microscope are wonderfully beautiful. Traversing as they do the whole bodies of insects, many of which are soft-bodied, they must necessarily be very flexible, and it might be supposed that the rapid movements of the insect might sometimes cause them to collapse, in which case the circulation of the air would be stopped. Upon examination we find that there is a beautiful and simple contrivance which renders this impossible. The tubes consist of a double integument between which runs a hair-like spirally-twisted fibre, just like the coil of wire which is sometimes put inside india-rubber speaking tubes; this adds considerably to the elasticity of the air vessels, and when these collapse through the movements of the insect, it prevents the opposite sides from adhering, and causes them to resume their tubular form as soon as the pressure is removed. There are generally nine pairs of breathing pores or openings through which the air is admitted into the tracheæ. These openings are so constructed that it is impossible for dust to enter the tracheæ. At the outside orifice is a corneous plate, and inside that is a hollow chamber, and then at the other side of that is another valve. In perfect insects nearly all the air enters through the thoracic spiracles.

"When an insect is preparing itself for flight, the act of respiration resembles that of birds under similar circumstances. At the moment of elevating its elytra and expanding its wings, which are indeed acts of respiration, the anterior pairs of spiracles are opened, and the air rushing into them is extended over the whole body, which by the expansion of the air-bags is enlarged in bulk, and rendered of less specific gravity; so that when the spiracles are closed at the instant the insect endeavours to make the first stroke with, and raise itself upon its wings, it is enabled to rise in the air, and sustain a long and powerful flight with but little muscular exertion." In the pupal and larval state respiration is performed almost equally by all the spiracles; but in the imago almost all the air enters by those in and near the thorax, so that generally a pinch under the thorax will kill most soft-bodied insects by suffocating them.

Of the seven sub-orders into which true insects are divided, the one to which the first place is accorded is called Hymenoptera or membrane-winged insects. The members of this sub-order are easily recognized by the structure of the wings which are four in number (see fig. 45), membranous and without either scales or hairs; the second pair is always smaller than the first and the wings have not so many veins. On their anterior margin they have a row of stiff hooklets by which they are securely fastened to the front wings when in use. The veins in the wings are of great use in determining the genera; there are, however, some which are wingless; but may be easily recognized as belonging to this sub-order from their transformations and general structure.

The transformations of this sub-order are the most complete of all insects; the larvæ in general form being more unlike, while the pupæ are more like, the perfect insect than in any other. The natural history of the Hymenoptera is full of interesting and instructive facts and furnishes examples of wonderful instinct and exquisite adaptation. Most of these will be observed in the care they take in providing for their young, and in laying up stores of food for winter use. It is owing to these highly developed instincts, added to the important part they play in the fertilization of many plants, in some cases being actually necessary, that Dr. Packard has placed them first in his system.

By far the larger proportion of these insects are beneficial, and feed either in the larval or perfect state upon other insects. Of beneficial insects mention must first of all be made though of the Honey Bee, concerning which alone whole volumes have been written, and afterwards of the different wasps and allied genera which feed upon and store up for the sustenance of their grubs enormous numbers of caterpillars and other insects, as well as acting as scavengers. Among the social bees, wasps and ants, there are found not only males and females but also other kinds of individuals which are necessary for the successful propagation of the species; these are called neuters and sometimes labourers or nurses; they are however essentially females, having the female organs but in an imperfectly developed and passive state, their sting being only an accessory part, which is changed into a special weapon of defence, and is the homologue of the ovipositor in fertile female insects. The worker bee, besides collecting the honey and pollen which is to serve as food for the offspring of the queen, has to carry the eggs from the queen to their proper cells and feed the larvæ when they are hatched; they are therefore indispensable for the propagation of the race.

I class wasps among beneficial insects, because the sting for which they are dreaded is never used against man, except as an instrument of defence, while its proper use is the destruction of his enemies, the caterpillars of numerous noxious species of insects.

Although some members of the wasp family do fill their cells at certain periods with honey, the food of the greater part, undoubtedly, consists of animal matter, chiefly other insects, which they either seize with their mandibles, or when it is to be stored away for the use of the larvæ, they sting to death. The poison introduced by the sting owes its virulence to the presence of a peculiar acid known as formic acid. This acid is said to be chemically very similar to chloroform, and its action upon insects stung to death is very peculiar. It does not kill them out-right, but paralyzes them, so that they live for many days, and in some cases larvæ have been known to turn into pupæ after having been stung, but have not had sufficient strength to complete their final change into *imagines*. The use of this antiseptic property of the poison is easily seen. The mother wasp, having prepared the nest for her young, fills it with insects which she stings to death; she then lays an egg and closes up the nest. Upon the grub hatching it has a larder well supplied with provisions which will keep fresh as long as required for it to complete its transformations.

The Ants do not demand much of our attention in this country as either injurious or beneficial insects, although there are a few species which are occasionally troublesome and destructive to posts and fences. The almost human aspects of ant-life, however, as exhibited by different species, provide a favourite study for the entomologist, and an investigation of them could not fail to fill even the least curious with wonder and amazement. Their dwellings are constructed on the most scientific architectural patterns; some species have their cows (aphides) which they tend with the utmost care. There are some again which make expeditions against less powerful ants, and carry them off to serve them as domestic servants, upon which they are entirely dependent, and without which they are almost helpless. Others, notably the celebrated Agricultural Ants of Texas, cultivate the ground, reap the harvest, and store up the grain. It is evidently to a species belonging to this class that Solomon refers when he says: "Go to the ant thou sluggard, consider her ways, which . . . gathers her food in the harvest." There are at least seven species of ant in Palestine which harvest the seed of grasses. In England Curtis mentions one which sometimes carries off sufficient seed from turnip fields for it to be termed an "insect pest." Perhaps the most astonishing analogy to human customs is found in a description given at page 217 of the 5th vol. of the Journal of the Linnæan Society, of some ants in New South Wales which bury their dead with funeral honours, and punish

with death those not joining in the ceremony, and then as a further mark of degradation bury them in a different place, all together in one hole.

Of all the Hymenoptera beneficial to the farmer, none bear comparison with the several species of parasitic ichneumon flies, which lay their eggs in the bodies of other insects, in which the grubs live, and from the juices of whose bodies they derive their nourishment; it is curious, too, that these unbidden guests avoid most carefully all the vital parts of their hosts, and frequently the larvæ, with their strange inhabitants, change into pupæ before the parasites are evolved. These flies are, as a rule, very characteristic in appearance, and thus easily recognized. Fig. 51 represents one of these parasites (*Macroceptrus delicatus*), with its long delicate sting, which attacks the codling moth. For the most part they bear a very long ovipositor, with which they insert their eggs into the bodies of the insects which are to form their nursery. The abdomen of this family presents an almost endless variety of forms, which are adapted to the requirements of its chief use, viz.: the support of the organs of reproduction. In *Pelecinus polycerator*, the scorpion fly, the abdomen of the female is long and slender, while that of the male is short and club-shaped. In *Rhyssa lunator*, the handsomest of all our ichneumons, the ovipositor of the female produced to the extraordinary length of between three and four inches. It may frequently be found dead upon trees, securely fastened there by this organ, which it has been unable to withdraw after having deposited an egg in the body of some larva lying hidden beneath the bark. The genus Ichneumon proper is one of very great extent and usefulness. Two of its species are very common, and have been found to be the chief checks upon the multiplication of the dreaded Army Worm (*Leucania unipuncta*). Figs. 52 and 53 show the Army Worm in both the larval and perfect conditions. These two

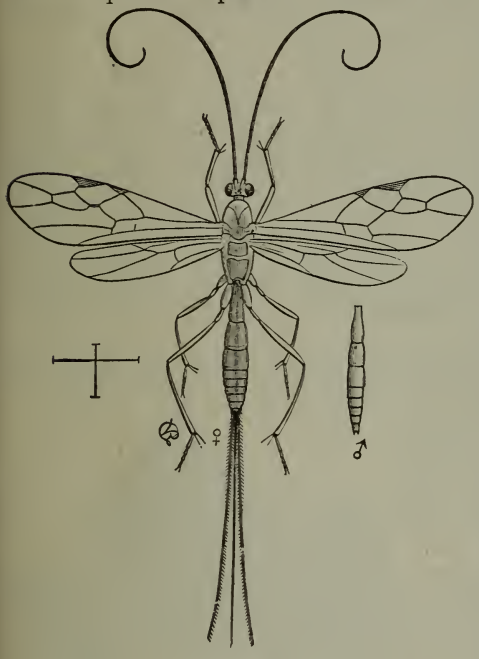

Fig. 51.

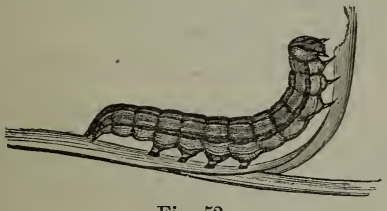

Fig. 52.

Fig. 53.

beneficial insects are *I. suturalis* and *I. paratus*. It is probably safe to say that there is no insect which is safe from the attacks of the ichneumons, and this statement also holds good even with regard to themselves.

To the genus *aphidius* belong several minute species which destroy the different kinds of plant lice.

There are even some which are parasitic upon the eggs of other insects, and which are so small that a magnifying glass is required to distinguish their forms.

Among the Chalcididæ are some exceedingly interestlng insects. All are of small size and usually of shiny colours. The small species of parasitical Hymenoptera are particularly useful to man as checking many of the injurious species of Diptera, which from

their smallness have so far baffled all efforts to counteract them, and the Chalcididæ have received a high place in the estimation of all from the discovery that they prey upon some of those species which have appeared in such numbers as sometimes to threaten the total destruction of certain crops throughout whole districts, as for instance the various species of Cecidomya, a genus which includes many of the most dreaded pests as the Hessian fly, the wheat midge, the clover leaf and clover seed midges, and also many gall-forming species.

And now we come to some injurious kinds of Hymenoptera—first of all the gall flies which are closely allied to the chalcids ; but are plant parasites. When the egg is laid in the leaf or green bark of a plant an abnormal growth of the vegetable cells is brought about which forms large tumors; upon the substance of these the larvæ feed. "These insects are examples of the uses that lie hidden in nature. Many thousand years had the gall flies been making their wonderful cells before any one discovered that the galls which disfigured the oak could be of any service to man. Yet within the gall lay the principal element of the ink which has had as important a part to play in civilization as the press itself, the latter depending almost wholly on the former. Scarcely larger than average sized hazel-nuts, the galls absolutely crowd the branches of an oak which grows plentifully in the Levant, and so it is to these insignificant insects that we owe one of the most absolute necessities of modern existence."*

The saw-flies seem to be a sort of intermediate link between the Hymenoptera and Lepidoptera ; while the perfect flies are certainly Hymenopterous the larvæ closely resemble the caterpillars of Lepidoptera, they may, howe ver, be easily known by the number of their legs which is twenty two, while true caterpillars have only sixteen,and also by a habit of curling up the hind part of the body when at rest ; when full grown they spin a hard silken coccoon. The saw, or ovipositor, is a beautiful and complicated apparatus ; with it the female makes incisions in different parts of leaves and deposits an egg in each slit. Some, however, as the common gooseberry fly (*Nematus ventricosus*) lay their eggs on the under side of the leaf (as shown in fig. 54), not inserted in the substance of it at all.

Fig. 54.

These insects are exceedingly troublesome, and have to be constantly watched and treated to "hellebore" or they will entirely denude the gooseberry and currant bushes just at the time the fruit is forming, when the leaves are most wanted. I am happy to say, however, that I have noticed this year considerable ravages among these larvæ and those of the common white butterfly, made by some fungous disease.

Another too well known saw-fly larva is the pear-tree slug (*Selandria cerasi*), which is sometimes very destructive.

There is also belonging to this sub-order a clumsy bow-legged purple and yellow fly, with clubbed anteunæ called *Cimbex Americana*, the large handsome larva of which may frequently be found feeding on birch and elm trees ; it is white, with a delicate greenish-yellow tint, and has a black line down its back and a spot of the same colour at each spiracle.

The last family is the Uroceridæ or horn-tails, so called from a long horn upon the abdomen of the males, the object of which is probably protective in adding to the already formidable appearance of these insects. In colour and movements as well as somewhat in form, they much resemble wasps. This family was fully described by Mr. Harrington in the *Canadian Entomologist* for May of this year.

J. Fletcher, Ottawa.

* Wood's "Insects Abroad."

A CHAPTER ON MITES.

By Wm. Saunders, London, Ontario.

These tiny creatures, of which there are very many species, although not usually regarded as true insects, are closely allied to them, and have been classed with them by many authors. They have been included in the order APTERA, or wingless insects, which also embraces spiders, lice, etc. Small and apparently insignificant as these mites are, some species are grievous pests, others invade articles of food, while some others are parasitic on larger insects, and often cause their death. So little is generally known in reference to the habits and life-history of these minute creatures, excepting to those few naturalists who have paid especial attention to this subject, that it is hoped that a brief sketch of the most notable of the species will prove an acceptable and interesting chapter to most of our readers, and, at the same time, convey some useful information. A considerable portion of the material we shall present has been gleaned from the excellent work on APTERA, by the late Andrew Murray, F.L.S., the first of a series of works on Economic Entomology designed to serve as hand-books to the South Kensington Museum; a series which he had undertaken, but which his life proved too short to permit him to complete. The accompanying figures have also been chiefly obtained from the above work. These have been engraved by Mr. P. J. Edmunds, of London, Ont., and are faithful representations of the original cuts.

Mites vary very much in form, size and habits, but in their structure they have always some points of resemblance to each other. While nearly related to the spiders, mites never have the abdomen pedunculated, that is, joined to the body by a narrow point of attachment, as is the case with spiders, but it is always in one piece, and united to the last of the segments which bear the legs without any marked depression between them. When mature, as a rule, they all have eight legs; in some instances the hind pair is only partially developed, but traces of them can almost always be discovered. In their earlier immature stages mites have only six legs.

The known species are very numerous, and are divided into eight different families.

1. TROMBIDIINÆ, containing
    1. TETRANYCHI, spinning mites.
    2. TROMBIDIIDÆ, harvest mites
2. BDELLIDÆ, snouted harvest mites.
3. HYDRACHNIDÆ, water mites.
4. GAMASIDÆ, insect mite-parasites.
5. IXODIDÆ, ticks.
6. HALACARIDÆ, marine mites.
7. ORIBATIDÆ, beetle mites.
8. ACARIDÆ, including
    1. HYPODERIDÆ, subcutaneous mites
    2. HYPOPIDÆ, ichneumon mites.
    3. TYROGLYPHIDÆ, cheese mites.
    4. SARCOPTIDÆ, itch and louse mites.
    5. PHYTOPTIDÆ, gall mites.

In the first section of the

TROMBIDIINÆ

we find the genus *Tetranychus*, to which the "red spider" (*Tetranychus telarius*) belongs. This is a serious pest to gardeners, and one which all those who have to do with plants under glass are more or less familiar with. Fig. 55 represents the male of this species, very much enlarged, the mite itself being scarcely visible to the unaided eye. (The small dot within the circle at the side of the figure indicates the natural size.) The characteristics of this genus of mites seem to show a special affinity with the spiders, in their habit of spinning webs, for which purpose the claws of their feet are specially adapted. The mouth has a barbed sucking apparatus, by which the sap is sucked from the minute vessels in the leaves of the plants they attack. These mites vary very considerably in colour, influenced much in this respect by the food they devour; some are greenish and marked with brown specks on the sides, others are rust-coloured, or reddish, or even brick-red, the latter being the colour with which horticulturists are most familiar. It is probable that most of the individuals acquire more or less of a reddish hue, when fully mature.

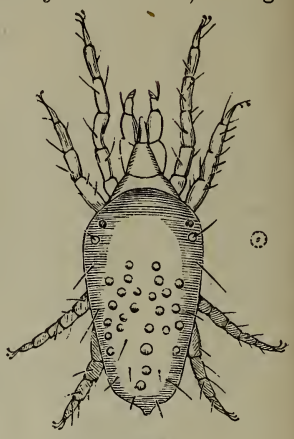

Fig. 55.

This mite spins a web on the under side of the leaves, of the finest and most delicate texture, the threads being so slender, that one fails to see them, even with the help of a magnifying glass, until after they are woven into a web or net-work. The threads are secreted from a conical protuberance situated underneath and near the extremity of the abdomen, and they are drawn out and guided by the motions of the insect, and by the action of the minute claws of the feet. In constructing the web the feet are moved quickly, and the threads are attached to the hairs and other prominences of the leaf, and under this shelter will be found a colony, consisting of many mature individuals of both sexes, and young mites of all ages, which feed and multiply rapidly. By the aid of their jaws, which are not unlike the beak of a bird, they tear away the surface of the leaf, and then plunge their beaked suckers into the wound and suck the juice.

The eggs of this mite are nearly round, colourless, and large in proportion to the size of the insect. The larva is a minute transparent object, not unlike its parent, but it has only six legs and creeps slowly. The leaves of the plants attacked soon indicate the presence of this invader by their sickly hue, the sap being sucked by myriads of tiny mouths the leaves are deprived of their natural nourishment, and soon assume a yellowish cast, with patches of a grayish or lighter shade, the under surface becomes whitish, and ff the the mite is allowed to pursue its course unchecked, the gardener soon finds his cherished flowers and shrubs much injured or destroyed.

This insect is said to pass the winter under stones, concealing themselves there when the leaves they have fed on have fallen.

The remedies used for such enemies as the red spider are various preparations of sulphur and soap, used separately or together, mixed with water, and applied to the plants with a syringe. Sulphur in any form seems useful; laying it in the form of powder upon the pipes in the greenhouse has been recommended. Plain soap and water is said to be effectual, indeed water alone freely used is regarded by some as sufficient; it is well known that the insect thrives best in a dry atmosphere. In applying these liquids, to insure success it is necessary that it be used so as to wet the under side of the leaves, if applied to the upper surface only, the mites may remain attached to the lower side with perfect security during the entire operation. The gardener is aided in his war against this pest by other mites and insects which prey upon them. The larvae of the lace-wing flies, and other friendly insects, are said to devour large numbers of them.

There are a number of other species belonging to the genus *Tetranychus* which injure plants and trees. The cucumber, the rose, the cyclamen, the vine, have each a different

mite which devotes special attention to them; another species is found only on various members of the family of Cacti; while there are still other species which affect other plants, shrubs and trees. Since the habits of all these are similar the remedies recommended for the red spider, will probably prove equally efficacious in these instances.

The Harvest Bug (*Tetranychus autumnalis*),

is of a brick red colour, and so small as to be scarcely visible to the naked eye. Figure 56 represents it in the larval or six-footed form, highly magnified. This insect has peculiarities in habit which distinguish it from those already mentioned. Though bred upon plants, such as beans and other vegetables, also on currant, raspberry, and gooseberry bushes, yet when opportunity presents, they will desert these and fasten on animals, manifesting a particular fondness for the human race, especially women and children. The mites fasten upon the skin, particularly where any part of the dress fits closely, and there adhere by their claws so firmly that they can scarcely be detached without violence. Where one of these mites fixes itself a swelling occurs about the size of a pea, sometimes much larger, accompanied with severe itching, the severity of the swelling and itching varying in different individuals. In the chalky districts of Hampshire, England, these pests are especially abundant, also in some parts of Scotland and France; they do not confine their attacks to mankind, but are troublesome also to horses, cattle, sheep, dogs, cats and rabbits. It is in the larval or six-footed form in which this species is most frequently met with, the perfect eight-footed insect being seldom seen.

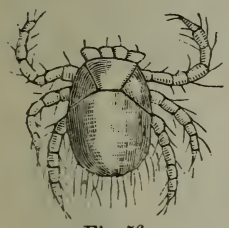

Fig. 56.

Kirby and Spence mention a similar insect which occurs in Brazil in great numbers. They insinuate themselves into the skin, and occasion intolerable itching, followed by larger swellings which subside in a day or two. Another species with similar habits occurs in Mexico.

Trombidium Irritans,

commonly known as the harvest mite, or "jigger," (fig. 57) is met with in the Mississippi valley where it is very troublesome, and produces much irritation in the skin wherever it attaches itself. Many species of harvest mites also feed on the leaves of plants, but they do not spin webs. They are also found in damp moss or on moist earth or stones, and vary in size from a pin's point to a pin's head. Those belonging to the genus *Trombidium* are parasitic in their habits.

Fig. 57.

Trombidium Parasiticum

is a minute blood-red mite which attacks the house-fly. Prof. Riley, in his Seventh Annual Report states that in some seasons in the west scarcely a fly can be caught that is not infested with a number of these blood-red mites clinging tenaciously around the base of the wings. The accompanying figure (58) represents this mite in its immature state.

Fig. 58

Trombidium Holosericeum.

This speces is found in Europe attacking the long-legged harvest spider, adhering generally behind the haunches. It is of an orange scarlet colour.

Trombidium Bulbipes

is a mite described by Dr. Packard in his Third Report on Injurious and Beneficial Insects

in Massachusetts. He found it on rose bushes in his garden where it was busily engaged devouring plant lice. It is of a scarlet red colour.

The Grasshopper Parasite *(Trombidium gryllarium).*

As in other classes of insects, mites furnish us with friends as well as enemies. In this instance we find an ally who carries on war against the grasshoppers. Harris, in his "Insects Injurious to Vegetation," page 191, draws attention to the fact that locusts in the Eastern States "are much infested by little red mites; these so much weaken the insects by sucking the juices from their bodies, as to hasten their death. Ten or a dozen of these mites will frequently be found pertinaciously adhering to the body of a locust, beneath its wing-covers and wings. A mite similar if not identical has been found at work among the swarms of locusts which inhabit the Western States. It is described by Dr. Le Baron in his first Report on the Insects of Illinois, in 1872. Figure 59 represents it in the larval condition. They are red, about one-thirtieth of an inch in length, and are found chiefly on the under side of the basal half of the under wings where they adhere so firmly that it is difficult to scrape them off with a pen-knife. The mite so attached soon swells so much that its six small legs, quite visible at first, become almost invisible, lost in the swollen body. These little mites help much to reduce the numbers of the destructive locusts; they suck the bodies of their victims until they beeome exhausted and die.

Fig 59.

Trombidium Sericeum.

This species (fig. 60) in also red. It has been found devouring the eggs of the destructive locusts in Iowa and Minnesota, creeping into the holes in which the eggs have been deposited and devouring their contents.

During the winter of 1878 an undetermined species of *Trombidium* was observed by me devouring the eggs of the moth of the forest tent caterpillar. On examining some egg clusters one evening under the microscope it was observed that at some points the glutinous coating which covers the clusters was imperfect, that a piece here and there had disappeared leaving the eggs bare, and in some cases some of the exposed eggs were empty. On cutting into the clusters they were found to be colonized by mites. The outside gummy matter is of a sufficiently porous texture to afford shelter to these little friends, who had evidently eaten into the eggs and devoured the young larvæ, and had also consumed the missing portions of the gummy covering. In the range of a single section of an egg-mass some eggs would be found uninjured, while from others there would proceed several (in some instances as many as five) active little mites, who, when thus disturbed, would run in and out of their dwelling places, at the same time keeping up a peculiar drumming motion with their tiny antennæ. Besides the smaller, younger specimens, four or five of which could find ample room and to spare within a single egg shell, there were other larger specimens apparently of the same species, but more mature. These were of a pale red colour, with bright, red eyes, more sluggish in their movements, and one such specimen would nearly fill an egg. On the outside, clusters of pale red eggs were found, supposed to be the eggs of these mites.

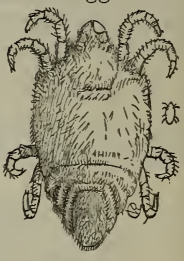

Fig. 60.

On almost every egg-mass examined some of these mites were found, and if they are thus generally distributed over the whole area inhabited by these moths they must prove a very efficient check to the undue multiplication of the species. There are mites also which prey upon the eggs of the oyster-shell bark louse, and on those of the canker worm.

Among other families of mites may be mentioned the

Snouted Mites (*Bdellidæ*),

the fresh water mites, most of whom live on water insects, there are also some species of

mites found in salt water. Besides these there are the Gamasids, many of which are parasitic on insects, while some are troublesome to birds and other animals, *Gamasus coleoptratorum* and *G. marginalis* are found on various beetles. *Uropeda vegetans* also attacks beetles. When a beetle is infested with this mite, it seems as if covered by a large number of small fawn-coloured shining convex scales, attached to various parts of the underside of the body, and on the parts infested, covering the body so completely that none of it can be seen. They are not easily detached, and when forcibly removed they do not fall off but hang by a fine thread, exuded from their bodies, which is attached to the beetle. There is also the forage mite, which is found in Europe, in great numbers amongst old hay, and which when shaken down from the rack, on the heads and necks of the animals feeding on it, occasions them much annoyance.

Dermanyssus avium

is the so-called tick, that infests domestic poultry, canaries and other cage birds. Fig. 61 gives a good idea of this creature, which is not much larger than a cheese mite. It lives especially in poultry houses, and on their inhabitants, and from these the mites sometimes migrate to the persons who have charge of them, and occasion them considerable annoyance. These mites also infest the cages of singing birds, and harbour about the crevices in the cage, and about the perch, from which they sally during the night, and burrow among the feathers of the sleeping birds and suck their blood. Other species belonging to this genus and allied genera feed on swallows, pigeons, doves and other birds, also on bats, indeed on this subject, did space permit, we might enlarge almost indefinitely, since there are species infesting almost every species of bird, beast and reptile in existence, as well as many insects, and on a variety of vegetable substances, especially mosses and fungi. One species has been found in the abdominal cavity of a dead flea, thus :

Fig. 61.

"The little fleas, that do so tease,
Have smaller fleas that bite 'em,
And these again have lesser fleas,
And so *ad infinitum*."

In the genus

Tyroglyphus

are included several interesting and well known species. *Tyroglyphus entomophagus* feeds on animal substances, being very partial to the dried insects, in the collections of the entomologist. In fig. 62 we have *Tyroglypus mycophagus*, a closely allied species, highly magnified; they are both very minute, yet easily seen with the naked eye. When once *T. entomophagus* gains access to a collection its presence is soon evidenced, by the dust which gathers on the bottom of the drawers, under or about the insects on which they are feeding. If allowed to proceed unmolested, they soon so far devour the bodies of the specimens so attacked, as to reduce them to a mere shell, which frequently falls to pieces in the handling. They are especially destructive to moths and butterflies. As soon as any appearance of dust occurs under any of the preserved insects in a case, such specimens should be at once attended to, and treated with a liberal application of Benzine, which will kill the mites without injuring the subjects infested. Insects which have not been thoroughly dried before being placed in the cabinet, are most liable to attacks, especially such as have been bred. Exposure to dampness also favours the

Fig. 62.

increase of mites, especially if associated with mouldiness ; indeed mould and mites most frequently go together.

The Commom Cheese Mite (*Tyroglyphus siro*).

This tiny creature, scarcely visible to the unaided eye, is soft, smooth and fleshy, with a whitish body, and feet furnished with suckers and claws. Fig. 63, which represents one of these mites highly magnified, will convey a better idea of its general aspect than any verbal description we can give. It lives in almost every kind of cheese when a little decayed, and particularly in the harder portions. When in a warm atmosphere they are active, constantly gnawing at the cheese and reducing it to powder. This powder is composed of little greyish balls of excrementitious matter, eggs, both empty and unhatched, larvæ, pupæ, and perfect mites, with cast skins and fragments of cheese; Exposed to a low temperature, the individuals soon gather into groups or heaps in hollow places in the cheese, and there remain in a state of torpidity until awakened again by warmth. This mite is also found in flour.

Fig. 63.

It multiplies very rapidly either in cheese or flour. A few specimens transferred from a mitey cheese to an old cheese not mitey, will soon colonize it thoroughly. They are probably harmless, since there are no records of any disease occasioned by them, although they are daily eaten in numbers too great to be estimated, and so carelessly, that hundreds of living individuals must escape the grinding of the molars and be swallowed alive.

The Scarcer Cheese Mite (*Tyroglypus longior*).

This species is found associated with the common cheese mite, but seldom in any great abundance, rarely in larger proportion than fifteen or twenty, and sometimes not more than one, to a hundred. It is very easily distinguished from the common cheese mite, by its larger size, greater length of body, and longer hairs, while very similar in its habits it is much quicker in its movements. This species also attacks the dried Spanish flies or cantharides kept by druggists, and used for blistering purposes. A French naturalist, M. M. Fumouse, has studied the life-history of this mite, by placing some of them with a sufficient supply of food between two plates of glass. The females laid oval eggs in great abundance, which hatched in from ten to fifteen days, the young mites being at first as usual six-footed. During their growth, and after casting their skins once or twice, they acquire an additional pair of legs, making eight in all, and soon reach maturity.

This species some fifty years ago acquired much notoriety on account of its having been stated that it could be produced by electricity. At that time the idea obtained in the minds of some that electricity was the source of many of the phenomena of life. Two experimenters, Messrs. Cross and Weekes, of England, endeavoured to ascertain whether organic beings could not be produced by electricity. For this purpose pumice stone kept moist by a dilute solution of silicate of potash and muriatic acid was subjected to a constant stream of electricity, and after a time some of these mites were found wandering about the apparatus, and the conclusion was at once arrived at that they had been produced through the agency of electricity. A specimen was sent to a French naturalist who had made a special study of mites, who found it to be a female of this species with its body distended with eggs, which, as he drily remarked, seemed rather an unnecessary complication in a new creation.

Tyroglyphus Malus

(fig. 64), is a North American mite, which is a friend to the fruit grower since it destroys the eggs of the oyster-shell bark louse, so injurious to the twigs of the apple tree.

Passing by the sugar mites which are found in such abundance in the commoner grades of brown sugar, we come to the family *Sarcoptidae*, which includes a class of mites

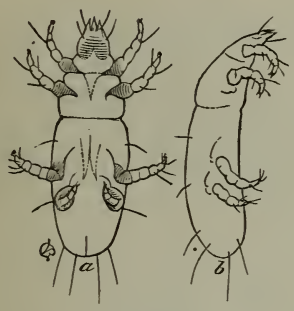

Fig. 64.

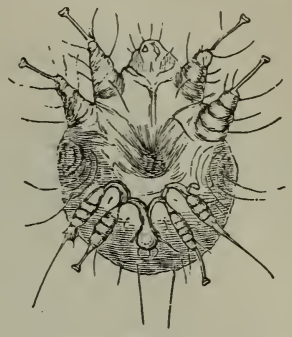

Fig. 65.

which infest animals and burrowing under their skin cause irritation and swellings. The most notable and familiar example in this class is the

ITCH MITE *(Sarcoptes scabiei)*.

Figure 65 represents a male of this species highly magnified; naturally they are so small as to be distinguished with difficulty by the unaided eye. This tiny, bristly creature lives under the human skin in little tunnels eaten away by itself. In fig. 66 we have one of

Fig. 66.

these minute channels represented with the female mite at one end. As she works her way under the skin she lays her eggs behind her, as shown in the figure, which hatch in from four to six days. It is said that one mite will lay as many as fifty eggs. The young mites have but six legs, and during their growth change their skin four times, at the final moult acquiring an additional pair of legs, or eight in all. When one of the vesicles caused by this insect is minutely examined a tiny spot will be found upon some part of its surface, this is the point where the mite has entered, and from it a faint line or streak may be traced, usually more or less curved, which is the burrow which the creature has made, and in which it lives. The burrow varies in length, and is sometimes as much as five or six inches long, and at the end, under a slight elevation of the skin, the little pest lies concealed, and if the skin there be gently raised with the point of a needle the mite may be easily extracted, as the little creature clings with its sucker-like feet to any object with which it may come in contact.

The unpleasant disease referred to is of course occasioned by this mite, and is transferred by those infected to others, sometimes by actual contact, but more frequently by occupying beds with an infected person, or after them. This is readily accounted for from the habits of the mite, which during the day hides under the skin, but is active and leaves its hiding place at night. This pest was formerly much more common than it is now, the more general and free use of soap and water has done much to render it scarce; still, sometimes, when bodies of men are crowded together, with little opportunity to attend to personal cleanliness, it appears and spreads rapidly.

ANTS.

By the Rev. C. J. S. Bethune, M.A., Port Hope, Ont.

No family of insects is more widely distributed and more generally familiar to mankind than that of the ant, while its habits of industry and activity have been proverbial amongst all nations since the days of Solomon. Some account of its natural history and curious habits cannot fail, we think, to be of interest to the readers of these Reports.*

1.—Introductory.

The insects included under the common name of ant belong to two very different orders, which present strongly marked characteristics both in structure and in habits. Our common ants in this conntry are all members of the same order of insects *(Hymenoptera)* as bees, wasps and saw-flies, and possess many of the familiar peculiarities of the first mentioned. In tropical countries there is another family of ants, known by the name of *Termites* or white ants, and equally interesting to the lover of natural history; these belong to the order *Neuroptera*, which includes dragon-flies, May-flies, caddis-flies and other well-known insects. Of these we shall not at present treat, though as the white ants have become troublesome as far north as Boston, and may possibly be found in Canada, we shall probably give some account of them on a future occasion.

The insects of the order *Hymenoptera* are distinguished by the possession in their perfect state of four membranous wings, though occasionally the wings are wanting, as in the case of certain members of the ant community. The mouth is furnished with organs for mastication and suction; the abdomen in the female is provided with an ovipositor or a sting; the eyes are generally large and prominent, occupying in some cases the greater portion of the head. The Hymenopterous insects also undergo a "complete metamorphosis"—that is, they go through four distinct changes, first the egg, secondly the grub or larva, third the quiescent pupa or chrysalis state, and lastly the perfect imago or winged insect. They are remarkable among insects, and indeed amongst all the lower tribes of animals, for the wonderful development amongst many families of social instincts of a high order, living as they do in large communities regulated by definite laws, each member of the society apparently subordinating his individuality to the welfare of the general community, and therefore performing certain definite duties of a public character.

2.—Structure.

The common ants to which we are now referring belong to the family *Formicidæ*; they are distinguished by their habit of residing in more or less numerous societies either under ground or in decayed timber, whence arises the necessity for a greater number of individuals having their sexual organs abortive, so as to be able to devote themselves without interruption to the labours of the community; for this purpose also they are destitute of wings. The males and females, possessing wings, are naturally much less numerous, being only required for the propagation and continuance of their species. There are thus three grades of inmates in each society, termed respectively, males, females and neuters.

The males have a small body, with long and slender legs and antennæ, and are furnished with wings which they retain during life. The females are much larger, with shorter and thicker legs and antennæ; they are also furnished with wings, but cast off these

* In the compilation of this paper, free use has been made of the following works:—The article "Ant" in the *Encyclopædia Britannica*, 9th edition, vol. ii; Packard's *Guide to the Study of Insects;* Kirby and Spence's *Entomology;* Westwood's *Introduction to the Modern Classification of Insects;* Moggridge's *Harvesting Ants and Trap-door Spiders;* Miss Mary Treat's *Chapters on Ants;* etc., to which the reader is referred who desires fuller information.

organs after the process of pairing is over, and they are about to lay their eggs. The workers or neuters are somewhat smaller than the males, with antennæ resembling those

Fig. 67, Female Wood Ant (*Formica rufa.*)

Fig. 68, A Neuter Leaf-cutting Ant (*Eciton drepanophora.*)

of the females, being thickened to the tips, and elbowed ; they are always destitute of wings. They often consist of two forms : one with a large cubical head, or worker major, sometimes called a soldier, and the other the ordinary small-headed form, or worker

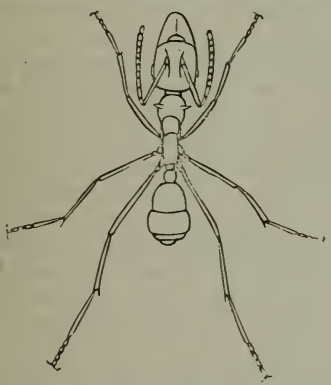

Fig. 69, Worker Major (*Ectatomma ferruginea*).

Fig. 70, Worker Minor (*Formica fulvacea*).

minor. The antennæ of the male ants possess thirteen joints each, and those of the female and neuter twelve each. The head, including jaws, is more or less triangular in shape, broader behind than the thorax in the neuters, but somewhat narrower in the males and females. The mandibles or large jaws of the females and neuters are larger than those of the males, and are frequently toothed or serrated, sometimes hooked or sickle-shaped. The abdomen of the male consists of seven joints or segments, and that of the female and neuter of six. The external sexual organs of the neuters correspond to those of the females, but the internal reproductive organs are wholly undeveloped.

During the summer the winged males and females are produced in large numbers, and they soon leave the nest to take their "nuptial flight" in the air, in the course of which the females are impregnated. The function of the male ants having been thus performed, they die ; the females, after impregnation, pull off their wings, and whilst in this somewhat helpless condition are conveyed by the neuters to new situations, where they lay their eggs and become the founders of fresh colonies.

Each fertile female or "queen" is carefully attended by a retinue of neuters, the latter, as we have seen, being simply females, whose sexual organs are undeveloped. The cause of this differentiation of sex, is probably owing to the nature of the food supplied to the ant during its larval state. Being thus exempted from all sexual functions, the duties of the neuters are confined to the performance of all the offices which conuribute to, or are connected with, the welfare and labour of the ant community. They accordingly construct the nest or home, and keep it in constant repair ; provide food and sustenance for the whole society ; act the part of nurses in carefully attending to the hatching, nutrition and rearing of the young. They are also the defenders of the colony, in that they protect the nest and its inmates from the intrusion or attacks of any foes. In the species which possess two forms of neuters, the worker-majors or soldiers devote themselves especially to the care and protection of the community, and are provided for the purpose

with large mandibles or biting-jaws, which constitute efficient weapons of attack or defence; while the worker-minors build and repair, collect food, attend to the young, and perform other household duties.

3. Ants' Nests.

Every one, no doubt, is familiar with the external appearance of many kinds of ants' nests, from the minute species which throw up little hills of sand, in our garden walks, to the large varieties which construct great mounds of rubbish in the woods and pasture lands. Few, however, have much acquaintance with the mode of construction, and the arrangement of these strange dwellings. The following account is given by Kirby and Spence:

"The nest of the large red ants, which are common in woods, at the first aspect seems a very confused mass. Exteriorly it is a conical mound, composed of pieces of straw, fragments of wood, little stones, leaves, grain—in short, of any portable materials within their reach. But however rude its outward appearance, and the articles of which it consists, interiorly it presents an arrangement admirably calculated at once for protection against the excessive heat of the sun, and yet to retain a due degree of genial warmth. It is wholly composed of numerous small appartments of different sizes, communicating with each other by means of galleries, and arranged in separate storeys, some very deep in the earth, others a considerable height above it—the former for the reception of the young in cold weather and at night, the latter adapted to their use in the daytime. In forming these, the ants mix the earth excavated from the bottom of the nest with the other materials of which the mound consists, and thus give solidity to the whole. Besides the avenues which join the apartments together, other galleries, varying in dimensions, communicate with the outside of the nest at the top of the mound. These open doors would seem ill-calculated for precluding the admission of wet, or of nocturnal enemies: but the ants alter their dimensions continually according to circumstances: and they wholly close them at night, when all gradually retire to the interior, and a few sentinels only are left to guard the gates. On rainy days, too, they keep them shut, and when the sky is cloudy open them partially.

"The habitations of these ants are much larger than those of any other species in this country, and sometimes as big as a small haycock; but they are mere molehills when compared with the enormous mounds which other species, apparently of the same family, but much larger, construct in warmer climates. Malouet states, that in the forests of Guiana, he once saw ant-hills which, though his companion would not suffer him to approach nearer than forty paces for fear of his being devoured, seeemed to him to be fifteen or twenty feet high, and thirty or forty feet in diameter at the base, assuming the form of a pyramid, truncated at one-third of its height; and Stedman, when in Surinam, once passed ant-hills six feet high, and at least one hundred feet in circumference. In the plains of Paraguay, where the ants commit great devastations, a species described by Dobrizhoffer forms conical earthen nests three or more ells high, and as hard as stone; and in the Bungo forest in New South Wales, a very small ant builds nests of indurated clay eight or ten feet high." These immense mounds are probably the work of some species of *Termites* or white ants, not of the *Formicidæ*.

"The nest of *Formica brunnea* is composed wholly of earth, and consists of a great number of storeys, sometimes not fewer than forty, twenty below the level of the soil, and as many above, which last, following the slope of the ant-hill, are concentric. Each storey, separately examined, exhibits cavities in the shape of saloons, narrower apartments, and long galleries which preserve the communication between both. The arched roofs of the most spacious rooms are supported by very thin walls, or occasionally by small pillars and true buttresses; some having only one entrance from above, others a second communicating with the lower story. The main galleries, of which in some places several meet in one large saloon, communicate with other subterranean passages, which are often carried to the distance of several feet from the hill. These insects work chiefly after sunset. In building their nest they employ soft clay only, scraped from its bottom when sufficiently moistened by a shower, which, far from injuring, consolidates and strengthens their archi-

tecture. Different labourers convey small masses of this ductile material between their mandibles, and with the same instrument they spread and mould it to their will, the antennæ accompanying every movement. They render all firm by pressing the surface lightly with their fore feet, and however numerous the masses of clay composing these walls, and though connected by no glutinous material, they appear when finished one single layer, well united, consolidated and smoothed. Having traced the plan of their structure, by placing here and there the foundations of the pillars and partition-walls, they add successively new portions; and when the walls of a gallery or apartment, which are half a line thick, are elevated about half an inch in height, they join them by springing a flattish arch or roof from one side to the other. Nothing can be a more interesting spectacle than one of these cities while building. In one place vertical walls form the outline, which communicate with different corridors by openings made in the masonry; in another we see a true saloon, whose vaults are supported by numerous pillars; and further on are the cross ways or squares where several streets meet, and whose roofs. though often more than two inches across, the ants are under no difficulty in constructing, beginning the sides of the arch in the angle formed by two walls, and extending them by successive layers of clay till they meet; while crowds of masons arrive from all parts with their particle of mortar, and work with a regularity, harmony, and activity, which can never enough be admired. So assiduous are they in their operations, that they will complete a storey with all its saloons, vaulted roofs, partitions and galleries, in seven or eight hours. If they begin a storey, and for want of moisture are unable to finish it, they pull down again all the crumbling apartments that are not covered in.

"Another species of ant (*M. fusca*) are also *masons*. When they wish to heighten their habitations, they begin by covering the top with a thick layer of clay, which they transport from the interior. In this layer they trace out the plan of the new storey, first hollowing out litttle cavities of almost equal depth at different distances from each other, and of a size adapted for their purposes. The elevations of earth left between them serve for bases to the interior walls, which, when they have removed all the loose earth from the floors of the apartments, and reduced the foundations to a due thickness, they heighten, and lastly cover all in. M. Huber saw a single working ant make and cover in a gallery which was two or three inches long, and of which the interior was rendered perfectly concave without assistance.

"The societies of *F. fuliginosa* make their habitations in the trunks of old oaks or willow trees, gnawing the wood into numberless storeys more or less horizontal, the ceilings and floors of which are about five or six lines asunder, black, and as thin as card, sometimes supported by vertical partitions, forming an infinity of apartments which communicate by small apertures; at others by small light cylindrical pillars furnished with a base and capital which are arranged in colonnades, leaving a communication perfectly free throughout the whole extent of the storey.

"Two other tribes of carpenter ants (*F. æthiops* and *F. flava*) use sawdust in forming their buildings. The former applies this material only to the building of walls and stopping up chinks; the latter composes whole stages or storeys of it made into a sort of papier mâché with earth and spider's web."

A species of ant (*Atta barbara*) has been found by Moggridge actually to make its nest in solid sandstone rock at Mentone in the south of Europe. He states that he traced some workers to a part of the sandstone rock where steps had recently been hacked out leading to some terraces and thus by accident discovered the nest, which he thus describes:—"I soon saw that the ants entered and came out from three or four small passages in the cleft surfaces of the rock, and that their nest actually lay in the sandstone itself. Having contrived to wedge off several large flakes of the rock, which was soft in most places and might be scooped out with a strong knife, I discovered that though some of the passages of the ants followed the lines of cleavage and the cracks made by the fine wiry fibres of the bushes growing on the surface, others were frequently made in the form of tubular tunnels through the living rock. Without the aid of hammer and chisel it was not possible to follow the galleries and to secure specimens of the mined rock; but on the next day I returned armed with tools, and with the assistance of a friend quarried out a portion of the nest, tracing it down eventually to twenty-three inches below the surface

of the rock in a vertical, and to about sixteen inches away from the surface in a horizontal direction. At one point where the rock was almost entirely solid and without flaw or crevice, and where it was clear that the passages were entirely the work of the ants, we measured a tunnel by worming a straw down it, and found it to be ten inches in length. We subsequently traced this tunnel or rock-gallery down until it communicated with a chamber filled with winged ants and seeds of several kinds." He afterwards discovered a second nest of the same kind.

Though almost all ants construct their nests under ground or in decayed timber, a species has been found in India, called *Myrmica Kirbii*, that builds its nests on the branches of trees and shrubs out of a most extraordinary material, namely, cow-dung! The nests are round in shape and about the size of an ordinary foot-ball. Flakes of dry cow-dung are placed upon each other like the tiles of a roof, so that although the insects can creep beneath them into the nest, no water can penetrate them; on the top of the nest there is placed one very large flake that crowns the structure and protects the rest.

4. Slave-making Ants.

Among the many very curious and extraordinary proceedings of ants is the practice, prevalent amongst some species, of making slaves of their weaker brethren. Regular expeditions are made by the slave-makers, commonly called Amazon ants, for the purpose of obtaining fresh supplies from the nests of the inferior species; these captives they compel to do all the hard labour required in their own community. This might seem incredible were it not attested by numbers of independent observers in different countries, some of whose accounts we may now transcribe. There are two species which are known to reduce others to slavery, viz., the russet ant *(Formica rufescens)*, and the red ant *(F. sanguinea)*; of the latter species there is an American variety. The best known descriptions are those made by Huber, a European observer, who devoted the greater part of his life to the minute observation of the lives and actions of insects. The following account translated from his works, is taken from Kirby & Spence:—

"Their time of sallying forth is from two in the afternoon till five, but more generally a little before five; the weather, however, must be fine and warm. Previously to marching there is reason to think that they send out scouts to explore the vicinity; upon whose return they emerge from their subterranean city, directing their course to the quarter from which the scouts came. They have various preparatory signals, such as pushing each other with the mandibles or forehead, or playing with the antennæ, the object of which is probably to excite their martial ardour, to give the word for marching, or to indicate the route they are to take. The advanced guard usually consists of eight or ten ants, but no sooner do these get beyond the rest than they move back, wheeling round in a semicircle, and mixing with the main body, while others succeed to their station. They have "*no captain, overseer, or ruler*," as Solomon observes, their army being composed entirely of neuters, without a single female; thus all in their turns take their place at the head, and then, retreating towards the rear, make room for others. This is the usual order of their march, and the object of it may be to communicate intelligence more readily from one part of the column to another.

"When winding through the grass of a meadow they have proceeded to thirty feet or more from their own habitation, they disperse: and, like dogs with their noses, explore the ground with their antennæ to detect the traces of the game they are pursuing. The negro formicary, the object of their search, is soon discovered; some of the inhabitants are usually keeping guard at the avenues, which dart upon the foremost of their assailants with inconceivable fury. The alarm increasing, crowds of its swarthy inhabitants rush forth from every apartment; but their valour is exerted in vain, for the besiegers, precipitating themselves upon them, by the ardour of their attack compel them to retreat within, and seek shelter in the lowest storey; great numbers entering with them at the gates, while others with their mandibles make a breach in the walls, through which the victorious army marches into the besieged city. In a few minutes, by the same passages, they as hastily evacuate it, each carrying off in its mouth a larva or pupa which it has seized in spite of its unhappy guardians. On their return home with their spoil, they

pursue exactly the route by which they went to the attack. Their success on these expeditions is rather the result of their impetuosity, by which they damp the courage of the negroes, than of their superior strength, though they are a larger animal; for sometimes a very small body of them, not more than 150, has been known to succeed in their attack and carry off their booty."

Mr. Kirby corroborates the foregoing account by the following description of his own observations several years later, when he had an opportunity of visiting Paris, and calling upon the celebrated French entomologist, M. Latreille: "He assured me," to quote Mr. Kirby's words, "that he had verified all the principal facts advanced by Huber; at the same time he informed me that there was a nest of the rufescent ants in the Bois de Boulogne, to which place he afterwards was so good as to accompany me. We went on the 25th of June. The day was excessively hot and sultry. A little before five in the afternoon we began our search. At first we could not discern a single ant in motion. In a minute or two, however, my friend directed my attention to one individual—two or three more next appeared—and soon a numerous army was to be seen winding through the long grass of a low ridge in which was their formicary. Just at the entrance of the wood from Paris, on the right hand and near the road, is a bare place, paled in for the Sunday amusement of the lower orders—to this the ants directed their march, and upon entering it divided into two columns, which traversed it rapidly and with great apparent eagerness; all the while exploring the ground with their antennæ, as beagles with their noses, evidently as if in pursuit of game. Those in the van, as Huber also observed, kept perpetually falling back into the main body. When they had passed this inclosure, they appeared for some time to be at a loss, making no progress, but only coursing about; but after a few minutes' delay, as if they had received some intelligence, they resumed their march, and soon arrived at a negro nest, which they entered by one or two apertures. We could not observe that any negroes were expecting their attack outside the nest, but in a short time a few came out at another opening, and seemed to be making their escape. Perhaps some conflict might have taken place within the nest in the interval between the appearance of these negroes and the entry of their assailants. However this might be, in a few minutes one of the latter made its appearance with a pupa in its mouth; it was followed by three or four more; and soon the whole army began to emerge as fast as it could, almost every individual carrying its burthen. Most that I observed seemed to have pupæ. I then traced the expedition back to the spot from which I first saw them set out, which according to my steps was about 156 feet from the negro formicary. The whole business was transacted in little more than an hour. Though I could trace the ants back to a cert ain spot in the ridge before mentioned, where they first appeared in the long grass, I did not succeed in finding the entrance to their nest, so that I was deprived of the pleasure of seeing the mixed society.

"M. Latreille very justly observes that it is physically impossible for the rufescent ants (*F. rufescens*), on account of the form of their jaws, and the accessory parts of their mouth, either to prepare habitations for their family, to procure food, or to feed them.

"*Formica sanguinea* (the red ant mentioned above) is another of the slave-making ants; and its proceedings merit separate notice, since they differ considerably from those of the rufescents. They construct their nests under hedges of a southern aspect, and likewise attack the hills both of the negroes and miners. On the 15th of July, at ten in the morning, Huber observed a small band of these ants sallying forth from their formicary, and marching rapidly to a neighbouring nest of negroes, around which it dispersed. The inhabitants, rushing out in crowds, attacked them and took several prisoners: those that escaped advanced no farther, but appeared to wait for succours; small brigades kept frequently arriving to reinforce them, which emboldened them to approach nearer to the city they had blockaded; upon this their anxiety to send couriers to their own nest seemed to increase; these spreading a general alarm, a large reinforcement immediately set out to join the besieging army; yet even then they did not begin the battle. Almost all the negroes, coming out of their fortress, formed themselves in a body about two feet square in front of it, and there expected the enemy. Frequent skirmishes were the prelude to the main conflict, which was begun by the negroes. Long before success appeared dubious they carried off their pupæ, and heaped them up at the entrance to their nest, on the side

opposite to that on which the enemy approached. The young females also fled to the same quarter. The sanguine ants at length rush upon the negroes, and attacking them on all sides, after a stout resistance the latter, renouncing all defence, endeavour to make off to a distance with the pupæ they have heaped up. The host of assailants pursues, and strives to force from them these objects of their care. Many also enter the formicary, and begin to carry off the young brood that are left in it. A continued chain of ants engaged in this employment extends from nest to nest, and the day and part of the night pass before all is finished. A garrison being left in the captured city, on the following morning the business of transporting the brood is renewed. It often happens (for this species of ant loves to change its habitation) that the conquerors emigrate with all their family to the acquisition which their valour has gained. All the incursions of *F. sanguinea* take place in the space of a month, and they only make five or six in the year. They will sometimes travel one hundred and fifty paces to attack a negro colony."

Let us now turn to an account of the proceedings of slave-makers nearer home. Miss Mary Treat has given a most interesting narrative of her observations of the doings of the American red ant *(F. sanguinea)* at her home in New Jersey; the account was published in *Harper's New Monthly Magazine*, from which we extract the following description. It is the result, she says, of several weeks' close observation, to the exclusion of all other work, commencing the 1st of July and extending into August.

The nest of the red slave-makers was in a grove, and must have contained several thousand working inhabitants. About fifty feet from it was a nest of black ants (*F. fusca*), apparently fully as large and strong as that of the red ants. Externally the two nests did not differ very much. The red ants raised a slight mound, while the blacks had simple excavations about the roots of an oak tree.

"On a sultry afternoon, the 1st day of July"—to quote Miss Treat's words—"I was lazily sauntering in the grove, when, on looking down, I found to my surprise, that I was in the midst of a battle-field. A powerful army of red ants had invaded the dominions of the black colony which for three years past I had had a kind of supervision over. I had often brought plants covered with aphides–the immortal Linnæus called these aphides the ants' cows—and stuck the plants into the earth around their dwelling, and had given them sugar, and had driven and carried toads from their nest which were devouring them. In short, I had become very much interested in and quite attached to this colony, but I was powerless to aid them now. I could only look on in wonder and astonishment.

"A yard or more around the foot of the tree the battle was raging, and no place for the sole of my foot without crushing the combatants. I found in every instance a red ant pitted against a black; sometimes two red ones against one black, in which case the black was soon despatched. For three hours I watched the conflict; all around me the combatants locked in a close embrace, rolling and tumbling about, never separating until one was killed, and often the dead victim had fastened with so firm a hold on his adversary that it was with the utmost difficulty that he could free himself from his death-grip. The sun went down, and the gathering darkness compelled me to leave my post of observation; but as long as I could see, the conflict was as fierce as ever. I now picked up several of the warriors, but so intent were they in their terrible struggle that my handling did not divert them in the least. I carried several pairs into the house, placed them under a large oval glass on a marble-topped table, and watched the conflict.

"I found I had ten black and ten red warriors, not engaged in a general melee, but each intent upon killing his own adversary. It was fully an hour before the first warrior was killed—a red had at last despatched his black antagonist, and not satisfied with killing him, he tears his legs from his body and severs his antennæ. After convincing himself that he is really dead, he looks around at the other warriors which are still closely locked in their dreadful embrace, and now he hurries from one couple to another, as if to see where his services are most needed. He finds a couple whose struggles are nearly over—a black is fastened with a death grip to his adversary's foreleg. The red hero soon severs the head from the black soldier, and leaves it hanging to the leg of his dying comrade. He now goes to another couple who are still fiercely contending; he seizes the black, and now all three roll and tumble about together; but the black is soon killed, and, as in the other case, his mandibles are locked on his adversary's leg. But this time

our hero does not sever the head from the black soldier, but leaves his comrade to free himself as best he can, while he goes to the assistance of a third less fortunate brother, where the black seems to have the better of his antagonist. Here a long struggle ensues, and now another red soldier has despatched his opponent, and he comes to the struggling three, moves about them in an excited manner, with his mandibles stretched wide apart, waiting his opportunity to fasten them on the black; he finds his chance, seizes him between the thorax and abdomen, and severs the body in two; but the dying black does not relax his hold of the first antagonist. and they die together.

"I now leave the fierce combatants for the night. In the morning I find that every black is killed, and four red soldiers are dead, and two others cannot long survive. The legs and antennæ and mutilated bodies of the dead warriors are strewn about, every fragment showing conspicuously on the white marble. Out of the twenty, fourteen are dead and two nearly lifeless—only four have survived. I put some drops of water and moistened sugar under the glass for the surviving heroes; two find the water and drink. I now repair to the battle-field. The struggle is over, not a black to be seen, but a column of the red invaders is emerging from a large cavity that leads to the numerous galleries and underground chambers of these industrious blacks, and each invader is carrying a larva or pupa. I follow the column, which is from four to five inches in width, to the nest of red ants before mentioned. There is a wide opening in the side of this nest, down which they all disappear and leave their burdens, and again start for more plunder. All day long these powerful marauders are engaged in this work. They carry a larva or pupa carefully, and drop it on being disturbed. But what does this mean? Every little while a red warrior comes out with a black bundle, which he carries as carefully as he does the pupa or larva. I stop him to inquire into the matter; he drops his bundle, which immediately unrolls, and lo! it is a lively black ant, apparently unhurt, and to my eye, no way different from the warrior with whom he was so fiercely fighting."

It has been generally supposed that the red ants only took captive the young of the blacks, in order that, growing up in the home of their captors, they might have no desire to escape. "But these ants certainly carried a great number of adult blacks to their nest, and I am quite sure that they did not run away, but stayed and helped to nurse and feed the larvæ. I capture several of the red marauders with their victims, and place them under the glass. The reds now pay no attention to the blacks, but simply try to make their escape. I take larvæ and lay them on a leaf, and put them under the glass also, and place moistened sugar in their reach. Very soon the blacks are feeding the helpless larvæ. I remove the glass cover; the reds immediately run away, but the blacks stay, and continue to sip the moistened sugar and feed the young. I hold a magnifying-glass over them, and find the little larvæ raise up their heads and open their mouths to be fed, very much like young birds. I now take the larvæ, together with their nurses, and place them near the nest of red ants. I soon lose sight of the nurses, but the larvæ are quickly taken into the nest by the red soldiers."

After a few days another raid is made by the red ants. "The blacks open the large entrance of the nest, dragging the material with which it is closed to one side; and now the soldiers come out in full force, and march in a straight line to a spot about thirty feet distant; here they diverge, and seem to be hunting over the ground; soon they find a small colony of blacks. The greatest excitement now prevails among the invaders; some are passing down the main entrance, while others are rushing about with extended mandibles prepared for conflict; but the blacks are escaping from another opening a few inches distant, not trying to defend their young in the least. Very soon the marauders emerge, each with a larva or pupa. Those outside, seeming satisfied that there will be no battle, quiet down and join the ranks in ravaging the nest. In less than an hour the spoils are all taken; and the marauders, not satisfied in sacking so small a settlement, again form in line and march directly to another colony a few feet beyond the one they have so recently plundered. They go so directly to this spot that it looks as if it must have been a preconcerted plan. This colony also proves to be a small one, and the inhabitants all flee, leaving the young to be captured In less than two hours the spoilers have transferred the young to their own nest; and now, apparently satisfied with their day's work, they make preparation to close the entrance—the blacks are clearing the passages which their

masters have littered while carrying in their booty. As soon as the passages are cleared, a large force is engaged in closing the entrance." Many more accounts of raids upon both black and yellow ants are given by Miss Treat, but the above will suffice to prove that slave making is a recognized "institution" among the red ants. The relative position of the masters and slaves seems to vary a good deal in the case of the species already referred to. The red ants (*F. sanguinea*) appear to bear a considerable share of the work of the community, and not to be entirely dependent upon the offices of their slaves; but the russet ants *(F. rufescens)* seem to be altogether above doing any kind of work for themselves, except when they are engaged in the military operations of attacking a nest of blacks—consequently, the entire work of the colony in their case devolves upon their slaves. Huber found by experiment that the russet ants would starve, if left to themselves, sooner than take the trouble to make use of food left conveniently within their reach. He relates that he "shut up thirty of these ants in a glazed box, supplying them with larvæ and pupæ of their own kind, with the addition of several negro pupæ, excluding very carefully all their slaves, and placing some honey in a corner of their prison. Incredible as it may seem, they made no attempt to feed themselves: and though at first they paid some attention to their larvæ, carrying them here and there, as if too great a charge they soon laid them down again; most of them died of hunger in less than two days, and the few that remained alive appeared extremely weak and languid. At length, commiserating their condition, he admitted a single negro; and this little active creature by itself re-established order, made a cell in the earth, collected the larvæ and placed them in it, assisted the pupæ that were ready to be developed, and preserved the life of the neuter rufescents that still survived."

It might be supposed that the lot of the enslaved ants was a very hard and cruel one, and that their bondage would be as distasteful to them as it usually is to human slaves. But it has been clearly shown by Westwood and others that it is quite unnecessary to bestow our compassion upon them, as the work they perform is exactly that for which they were made. The labours which the slaves undertake are not arbitrarily forced upon them by the fear of punishment, but are urged upon them by the instincts implanted within them. They would have worked precisely in the same manner and with the same industry and perseverance in their own nests as in that of their captors, and the labours are undertaken as willingly in the one case as in the other. They find themselves perfectly at home in the nest of their captors, and are in every respect on terms of equality with their masters. They have no other home but that to which they have been brought, and are no more to be pitied than our domestic animals that never have freedom.

As the slaves are always neuters, it is necessary that fresh supplies should be obtained as often as the demand for workers exceeds the available material; consequently raids have to be made for the purpose at frequent intervals during the season.

5.—Harvesting Ants.

From the middle of the last century until a few years ago, naturalists had agreed to doubt the ancient belief, dating from the days of Solomon, that ants show forethought and husbandry in the collection and storage of seeds and grains, because they had been unable to observe that anything of the kind was done. It is now, however, satisfactorily proved by the minute observations of competent persons, especially of Dr. Lincecum, in Texas, and Mr. Moggridge, in the south of France, that certain species of ants do exhibit the foresight and providence necessary for the storing of supplies of food to carry them through the wintry or rainy seasons.

Ancient authors abound in references to the harvesting operations of ants, which no doubt were quite familiar to them. There are, for instance, the well-known passages in the Book of Proverbs, where Solomon says (vi. 6-8):—"Go to the ant, thou sluggard; consider her ways, and be wise: which having no guide, overseer, or ruler, provideth her meat in the summer, and gathereth her food in the harvest;" and again (xxx, 25):—"The ants are a people not strong, yet they prepare their meat in the summer." Horace, Virgil, Plautus, Hesiod and other classical authors, also have allusions to the foresight of the ant. Claudius Ælianus, who lived in the time of the Emperor Hadrian, gives a detailed

account of the habits which he attributes to ants: "In summer time, after harvest, while the ears are being threshed the ants pry about in troops around the threshing floors, laeving their homes, and going singly, in pairs, or sometimes three together. They then select grains of wheat or barley, and go straight home by the way they came. Some go to collect, others to carry away the burden, and they avoid the way for one another with great politeness and consideration, especially the unburdened for the weight carriers. Now these excellent creatures, when they have returned home, and stored their granaries with wheat and barley, bore through each grain of seed in the middle; that which falls off in the process becomes a meal for the ants, and the remainder is unfertile. This these worthy housekeepers do, lest when the rains come the seeds should sprout, as they would do if left entire, and thus the ants should come to want. So we see that the ants have good share in the gifts of nature, in this respect as well as others. . . . . So the ants though they need no threshing time, nor men to winnow for them, nor an artificial draught of wind to separate corn and chaff, yet have the food of men who both plough and sow for it" (Moggridge).

The following account of modern harvesting ants is taken from Moggridge's valuable and interesting work. He found four species of genuine harvesters, and carried on observations from October to May at Mentone in the south of France. In a warm and sheltered valley, a few minutes' walk from the house in which he lived, he discovered thirty nests of the most active seed-storing ants. The spot was a rough slope of soft sandstone rock, with accumulations of sandy soil in the hollows, covered with a sparse and scrubby vegetation. Cultivated lemon terraces lay on the edge of the wild ground lower down in the valley, and at that season were overgrown with a rank crop of weeds, most of which were in seed. "I had scarcely set foot on the wild ground," he relates, "before I was met by a long train of ants *(Atta barbara)*, forming two continuous lines, hurrying in opposite directions, the one with their mouths full, the others empty. About ten yards distant, partly shaded by some small bushes, lay the nest, to and from the entrance of which the incessant stream of incomers and outgoers kept flowing." The workers usually sought their harvest at some distance from the nest, going in search of it as far as the cultivated ground where the crops of weeds were more abundant and more varied. "In one case I was able to follow the thread-like column of workers from the nest to the weedy terrace, and found that the nearly continuous double line measured twenty-four yards. Even this gives but an inadequate idea of the number of ants actively employed in the service of the colony, for hundreds of them were dispersed among the weeds on the terrace, and many were also employed in sorting the materials, and in attending to the internal economy of the nest. Still this affords some evidence of the systematic and extensive scale on which foraging is carried on by this ant, and of the high importance which these creatures attach to their provision of grain."

The ants brought in not only seeds of large size and fallen grain, but also green capusles of shepherd's purse, chickweed, etc. They did not employ any materials in the construction of their nest, but simply excavated it out of the earth itself or the sandy rock; the large mounds, in great part composed of vegetable matter, frequently found at the entrances of their nests, were nothing more than the rubbish heaps of each establishment. They consisted in part of earth and grains of gravel brought from the nest during the excavation of the subterranean chambers, but principally of plant refuse, such as the chaff of grasses, empty capsules, gnawed seed-coats, and the like, which would occupy much space if left inside the nest. While an army of workers is employed in seeking and bringing in supplies, others are busy sorting the materials thus obtained, stripping off all useless envelopes of seed or grain and carrying them out to throw away.

"I selected a nest," Moggridge relates, "where the coarse and hard rock lay near the surface, compelling the ants to extend their nest in a horizontal direction. Here, almost at the first stroke, I came upon large masses of seeds carefully stored in chambers prepared in soil. Some of these lay in long sub-cylindrical galleries, and owing to the presence in large quantities of black shining seeds of amaranth, looked like trains of gunpowder laid ready for blasting. There were in this nest seeds, etc., which had been taken from more than twelve distinct species of plants, belonging to at least seven separate families. The granaries lay from an inch and a half to six inches below the surface, and were all

horizontal. They were of various sizes and shapes, the average granary being about as large as a gentleman's gold watch."

"I was greatly surprised to find that the seeds, though quite moist, showed no trace of germination, and this was the more astonishing, as the self-sown seeds of the same kinds were then coming up abundantly in gardens and on terraces." In order to investigate this matter thoroughly he collected and carefully examined large quantities of the grain and seeds taken at different times from the stores of twenty-one distinct nests, the first of which was opened on October 29th, and the last on May 5th. In these twenty-one nests, out of the thousands of seeds taken, he only found twenty-seven in seven nests which showed trace of germination, and of these eleven had been mutilated in such a way as to arrest their growth. Yet the vitality of the seeds was not destroyed, as he proved by raising crops of various weeds from seeds taken out of these granaries.

"When the seeds do germinate in the nests," he relates, "and it is my belief that they are usually softened and made to sprout before they are consumed by the ants, it is very curious to see how the growth is checked in its earliest stage, and how, after the radicle or fibril—the first growing root of dicotyledonous and monocotyledonous seeds—has been gnawed off, they are brought out from the nest and placed in the sun to dry, and then after a sufficient exposure, carried below into the nest. The seeds are thus in effect malted, the starch being changed into sugar, and I have myself witnessed the avidity with which the contents of seeds thus treated are devoured by the ants."

In an appendix, Mr. Moggridge gives corroborative testimony from other observers, from which the following extracts are taken. Lieut. Colonel Sykes, in his descriptions, of new Indian ants, relates: "In my morning walk at Poonah, June 19th, I observed more than a score of little heaps of grass-seeds in several places, on uncultivated land near the parade ground; each heap contained about a handful. On examination, I found they were raised by a species of ant *(Atta providens)*, hundreds of which were employed in bringing up the seeds to the surface from a store below; the grain had probably got wet at the setting in of the monsoon, and the ants had taken advantage of the first sunny day to bring it up to dry. The store must have been laid up from the time of the ripening of the grass-seeds in January and February. As I was aware this fact militated against the observations of entomologists in Europe, I was careful not to deceive myself by confounding the seeds of a *Panicum* with the pupæ of the insect. Each ant was charged with a single seed, but as it was too weighty for many of them, and as the strongest had some difficulty in scaling the perpendicular sides of the cylindrical hole leading to the nest below, many were the falls of the weaker ants with their burdens from near the summit to the bottom. I observed they never relaxed their hold, and with a perseverance affording a useful lesson to humanity, steadily recommenced the ascent after each successive tumble, nor halted in their labour until they had crowned the summit, and lodged their burden on the common heap."

"On the 13th of October of the same year, after the closing thunderstorms of the monsoon, I found this species in various places similarly employed as they had been in June preceding; one heap contained a double handful of grass-seeds. It is probable that the *Atta providens* is a field species of ant, as I have not observed it in the houses."

Dr. Jerdon, in a Madras journal, gives a somewhat similar account of the same ant, stating that it digs up small garden seeds immediately after they are sown, and carries them off to its nest, to the great annoyance of the gardener. Mr. Home gives an account of similar observations in another part of the East, and Mr. Buchanan White records the harvesting performances of a colony of ants at Capri. With all this testimony we cannot but believe that the ancients were right and modern European entomologists wrong as regards this interesting characteristic of these species of ants.

Miss Mary Treat, whom we have already quoted, gives, in a paper communicated to *Lippincott's Magazine*, a very graphic and interesting account of her observations on harvesting ants in Florida. Their nests are abundant in the low pine barrens of that State, and consist externally of a little mound, surrounded by a circle of small chips and bits of charcoal, often brought from some distance; the mounds are regular in outline, with a crater-like depression on the summit, in the centre of which is the entrance. Their colour is reddish brown, and they are furnished with stings, which inflict about the same

amount of pain as that caused by honey bees. There are three sets of neuters in each colony—major and minor workers and soldiers, and one wingless queen.

"Early in December, 1877," Miss Treat relates, "I brought a large colony of these ants from one of the hills, including the workers, major and minor, and soldiers, and established them in a glass jar which I placed in my study. They very soon commenced work, tunnelling the earth and erecting a formicary, as nearly as they could after the pattern of their home on the barrens. The mining was done entirely by the small workers. At first they refused all animal food, but ate greedily fruit and sugar; and all kinds of seeds which I gave them were immediately taken below, out of sight. I now visited the mounds on the barrens, and found abundant indications of their food supplies. At the base of each mound was a heap of chaff and shells of various kinds of seeds. The chaff was of *Aristida speciformis*, which grew plentifully all about. I also found many seeds of *Euphorbia* and *Croton*, and several species of leguminous seeds. But the ants were not bringing seeds in at this time of the year; they were only carrying out the discarded seeds and chaff; and only on the warmest days were they very active. But they do not wholly hibernate. Even after a frosty night, by ten o'clock in the morning many of the hills would be quite active.

"On excavating a nest, I found chambers, or store-rooms, filled with various kinds of seeds. But, so far as I have observed, the seeds are not eaten until they are swollen or sprouted, when the outer covering bursts of itself. At this stage the starch is being converted into sugar, and this seems to be what the ants are after. They also seemed to be very fond of the yellow pollen-dust of the pine. The catkins of the long-leaved pine commenced falling in February, and I noticed ants congregated on them; so I took those just ready to discharge the pollen, and shook the dust on the mound in little heaps, which were soon surrounded by ants, crowding and jostling each other in their eagerness to obtain a share.

"The colony in the glass jar seemed perfectly contented, not trying to make their escape at all. The earth was originally a little more than two inches in depth, but by the first of February these wonderful architects had reared their domicile to the height of six inches. They raised tier upon tier of chambers in so substantial a manner that they never fell in. One of the store-rooms in which they deposited the seeds I gave them was at the bottom of the jar, and the seeds were stored against the glass with no intervening earth between; it contained about a teaspoonful of millet. I gave this chamber the right degree of heat and moisture to sprout the seed by pouring a little water down the side of the jar until it penetrated the chamber, and then setting it near the fire. The ants soon appreciated the condition of this store-room, and many congregated there and seemed to be enjoying a feast. The next day the seeds were all brought to the surface and deposited in a little heap on one side of the jar, where many of them grew, making a pretty little green forest, which the ants soon cut down and destroyed. This chamber remained empty for three or four days, and was then again filled with fresh millet and apple and croton seeds."

On excavating some nests of the same species *(Atta crudelis)* in their native haunts on the barrens, she found granaries of seeds scattered irregularly throughout to the depth of twenty-two inches below the surface of the ground; some were near the surface, and a few scattered about in the mound had sprouted. The mound is usually not more than four to six inches above the level of the ground.

"The great majority of nests," she adds, "that I have found are in the low pine barrens—so low that on reaching the depth of two feet the water runs into the cavity like a spring, and stands above some of the granaries. Notwithstanding this wet locality, I found no sprouted seeds in the deeper store-rooms, but only in the warmer mound. On sunny days the larvæ are brought up into the mound and deposited in chambers near the surface, where they receive the benefit of the sun's rays. On cool, cloudy days and in the early morning I found no larvæ near the surface. If the ants are intelligent enough to treat the larvæ in this way, why should they not store seeds where they will not sprout? And when they need to sprout them in order to obtain the sugar they contain, it would take no more wisdom to treat the seed as they do the larvæ—bringing them near the surface to obtain the right degree of heat for the required result."

6.—How to Get Rid of Ants.

As we have now almost exhausted the space allotted to us for this subject, we shall close with the mention of a few modes of getting rid of ants, as no doubt they are more familiar to our readers as domestic pests than in the interesting character described above. We find that we must leave over to another year any account of many other varieties of ants, such, for instance, as the dreaded driver ants of Africa, the agricultural ants of Texas, the leaf-cutting and foraging ants of Central and South America, (see figs. 71, 72 and 73), the honey ants of Mexico (see fig. 74) and other remarkable species. We must

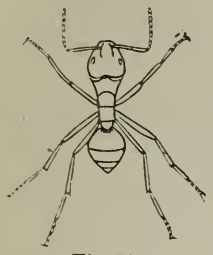

Fig. 71.

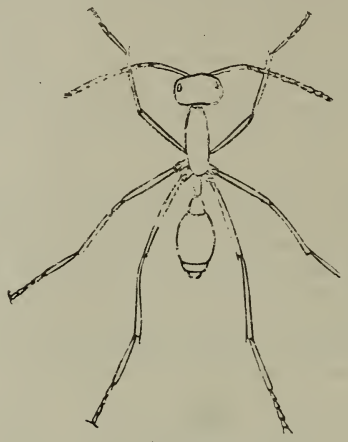

Fig. 72.

Fig. 73.

Fig. 74.

Fig. 71, Worker Major (*Polyrhachis arboricola*). Fig. 72, Worker Minor (*Eciton Mexicana*). Fig. 73, Worker Minor (*E. Sumichrasti*). Fig. 74, the Honey Ant of Mexico (*Myrmecocystus mexicanus*).

also postpone any description of the wonderful works of ants, in road-building, tunnelling, well-digging, etc., their care of aphides, domestic life, intelligence, language and other particulars, which, we have no doubt, are of great interest to all lovers of natural history.

Numerous, and not uncalled for, are the complaints that house-keepers make in this country respecting the inroads upon their sugar and preserves and other goodly stores, by the swarms of little ants that infest our houses in the summer time; but the annoyance caused by these tiny creatures in this country cannot for a moment be compared with the fearful ravages they often commit in hot climates. The following are some modes recommended for their destruction when they come into the house:—(1) Take a coarse sponge, damp it slightly, and then dust over and into it some finely pulverzed sugar; lay the sponge in the place that they most frequent, removing for the time any sweets that they usually attack. In a very short time the sponge will be found full of ants; dip it in boiling water, squeeze out the dead bodies, and repeat the operation. A little perseverance will exterminate the pests. (2) A somewhat similar plan is to lay fresh bones around their haunts; they will leave everything else to attack them. When thus accumulated, destroy as before by dipping in hot water. (3) Another plan that has been found effective, but we do not recommend it owing to the danger arising from any carelessness in its use, it is to put arsenic or Paris green in highly sweetened water, and set the vessel in their way. It is said that in two or three days no more will be seen. (4) When ants are troublesome in flower-beds or lawn they may be de-

stroyed by pouring very hot water copiously into their nests, or by using coal-oil in the same way ; a few tablespoonfuls is said to suffice for the destruction of a nest. (5) The burying of a few sliced onions in the nest is said to cause them to abandon their quarters; but if so, they may remove to an equally unsatisfactory position. (6) Carbolic acid and corrosive sublimate are said to be especially poisonous to ants, the latter substance rendering them actually insane, if such an expression may be used of these creatures. Among natural checks may be mentioned the ant-lions *(Myrmeleo)*, which dig pits for the capture of the ants, at the bottom of which they lie in wait for their victims, toads, and some species of birds.