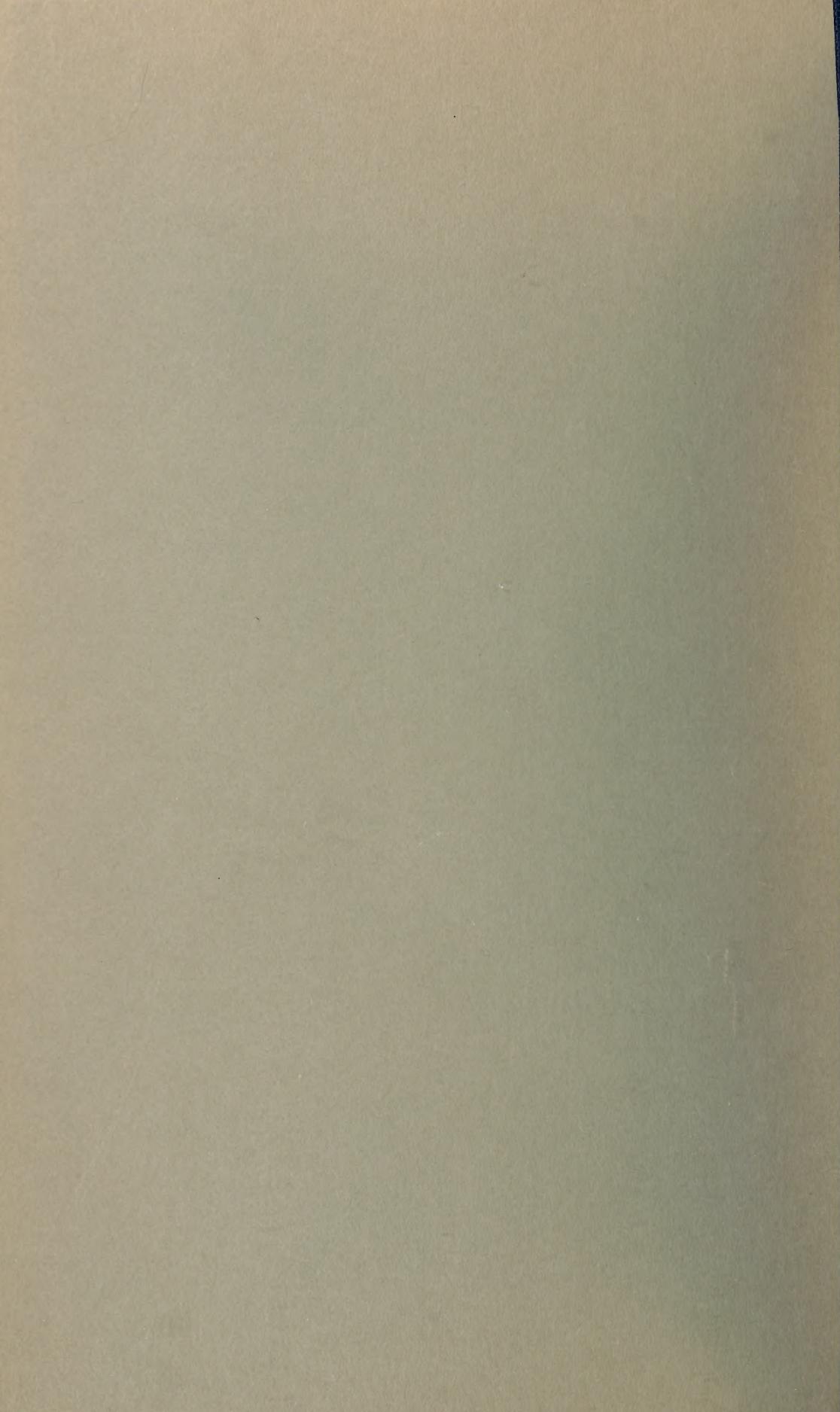


**Biological
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Serials**

Canada. Dept. of Agriculture. Entomology Research Institute
Report of the Dominion Entomologist

1885



DEPARTMENT OF AGRICULTURE.

REPORT

OF

THE ENTOMOLOGIST

(JAMES FLETCHER, F.R.S.C.)

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*Printed by order of the Minister of Agriculture, in compliance with a request
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REPORT OF THE ENTOMOLOGIST.

(JAMES FLETCHER, F.R.S.C.)

SIR,—Herewith I have the honour to hand you a report of Observations on Injurious Insects during the year 1885, with the methods of prevention and remedy which I have suggested when they have been brought under my notice. I regret that many investigations, the completion of which I had anticipated during the past season, are still unfinished. This is owing to a sudden temporary impairment of my eyesight, on account of which my physicians forbade me for some months to read or write, to use the microscope, or to draw. The practical effect of this has been the unavoidable postponement until another season, of many interesting scientific studies which I had hoped to work out during the past summer, as well as the critical examination and delineation of insects collected. This trouble, I am thankful to say, is now passing away, and I look forward confidently to the coming summer, for further opportunities of showing that the office of the Entomologist of your Department is one of general utility to the country at large. My efforts, during the past year, have been necessarily confined to the answering of correspondence, which has now assumed very large proportions, of visiting and consulting farmers concerning the condition of their crops, and addressing agricultural and educational institutions, whenever opportunities occurred, with a view to showing the direct bearing of Economic Entomology upon Agriculture, and the comparative ease with which many of the most formidable of our crop pests can be withstood, by those who will take the trouble to familiarize themselves with the mere elements of the study. A visit to British Columbia in the spring of the year, and to the Maritime Provinces, during the present winter, to attend the Annual Meeting of the Fruit Growers' Association of Nova Scotia, gave me opportunities for becoming personally acquainted with many of the farmers of those Provinces, from whom I have received much useful information. These visits were particularly useful to me as allowing me to acquaint myself by actual observation with the different climatic conditions, and methods of culture practised, in these far distant and fertile regions. In all cases I was received with the utmost kindness and attention upon making my mission known. The present report contains the results of my own observations and those of some of my correspondents, extracts from whose letters I have inserted when I thought that they illustrated the subjects referred to, or would be of interest to others engaged in the same pursuits. It is prepared not so much with the idea of giving it a scientific value, as with the hope that it may be found useful by those, for whose benefit it is specially prepared—the farmers, agriculturists, fruit-growers and horticulturists of the Dominion. Judging by the large number and the tenor of the letters I receive from this class of the community, asking for information concerning injurious insects, I am much pleased to note a growing appreciation amongst them, which is often expressed in their correspondence, of the value of the studies in which I am engaged. This recognition of the importance of Economic Entomology as a necessary branch of agriculture, is becoming more wide-spread every day, as is evidenced by the amount of work which is being vigorously prosecuted in this direction, by Governments, societies and private individuals in all parts of the world; and so manifest is the direct bearing of the results arrived at upon the success of all agricultural operations that even

scientific Entomologists find it necessary to devote some of their time to assisting in the great cause of combating our too numerous insect enemies. On this continent large sums of money, and the energies of some of the most eminent scientific men in the country, are devoted to these studies. In Canada there are several workers in the field, notably amongst the members of the Entomological Society of Ontario, the Ottawa Field-Naturalists' Club, the Toronto Natural History Society, and the Natural History Society of New Brunswick. In addition to these, valuable work is being done by individual students and specialists. Foremost amongst these is the Abbé Provancher, the accomplished editor of "*Le Naturaliste Canadien*," a useful magazine published in the French language, through the columns of which I have been courteously allowed to address a letter to the French Canadian farmers of the Province of Quebec, asking them to co-operate with me, by reporting insect injuries promptly upon the appearance of the attack, and by testing remedies suggested. I am under a further obligation to the learned Abbé for referring to, and himself pointing out, the value of this work in later issues of his magazine.

From the geographical position of Canada and the United States, many of our interests and theirs are naturally identical. In nothing is this more patent than in the investigations which I have the honour to carry on under your instructions. Year after year fresh States of the great Republic, whose boundaries touch our own for more than 3,000 miles, are added to those who acknowledge the necessity of having a Government official who shall devote all his time to studying the habits of Insects Injurious to Agriculture, and the methods for controlling and preventing their depredations. The results of their studies are published regularly, and are easily accessible to all. The last addition to the list of States which employ Entomologists is Tennessee, which has lately appointed Prof. E. W. Doran, of Loudon (Tenn.) Academy, to this position.

The courtesy of Prof. Riley, and his able staff of Assistant Entomologists, at Washington, as well as of the gentlemen entrusted with this work in the several States which are advanced enough to employ Entomologists, cannot be exceeded. Any applications from Canadians for information have always received as prompt attention, as if they had come from residents within the Union. I am repeatedly apprised of this fact by my correspondents, and gladly take this opportunity of publicly acknowledging my indebtedness to these gentlemen for assistance frequently and cordially rendered, and would particularly refer to Prof. C. V. Riley, who has presented me with a collection containing typical specimens of 34 different species of western locusts, as well as many of his valuable reports. To Mr. J. B. Smith, of the United States National Museum, for identifying difficult species of lepidoptera and coleoptera; to Prof. J. A. Lintner, State Entomologist of New York, for advice in many matters relating to the investigation of injurious insects, and to Mr. J. J. Rivers, of the University of California, for reports and descriptions of the important experiments which are being carried on with regard to the Phylloxera in California.

To Prof. Saunders, of London, Ontario, I am deeply indebted for timely advice in some difficult questions, concerning which his long experience as an Entomologist, and extensive knowledge of chemistry, have rendered him an authoritative source of reference. Also to Mr. W. H. Harrington, of Ottawa, who kindly undertook to attend to my correspondence while I was absent in British Columbia. During my investigation in British Columbia, I received unlimited kindness and attention from the Rev. G. W. Taylor, Incumbent of Cedar Hill Parish, who, being an accomplished Naturalist, rendered me the greatest assistance in my entomological enquiries, and since my return to Ottawa has kept me well informed concerning the insects of Vancouver Island.

An important step in the right direction has been taken in England during the past twelve months, by the commencement of publication of a series of reports on Insects Injurious to Hop, Corn and Fruit crops. This work, two parts of which have already appeared, has been placed in the hands of Mr. C. Whitehead, F.L.S., F.G.S., and certainly provides the farmers and horticulturists, for whose benefit it is

intended, with short, intelligible accounts of the chief crop pests, and the most practical remedies. The reports are got up on the same plan as Miss Ormerod's most excellent annual reports, upon which it would be difficult to improve, and are illustrated by figures which have already appeared in Miss Ormerod's reports, and are well known from their accuracy and life-like expressiveness. The author of these reports has received a high compliment as to their worth in the request of the Belgian Minister to republish them in Belgium—a permission most properly granted by the Imperial Privy Council. In other colonies of the British Empire the Legislatures have found it necessary to take cognizance of the injuries annually committed by insects, and I have received, through Mr. D. W. Beadle, editor of the *Canadian Horticulturist*, a report of the Joint Codling-Moth Committee of New Zealand for 1885. This report is replete with useful information concerning the most injurious pests of fruit trees in the colony. By it we find that the two most destructive enemies of their apple crops are the same Codling Moth and Oyster-shell Bark-louse which work such havoc in our orchards.

I am frequently reminded of, and have endeavoured to meet, the necessity for expressing my reports in simple language, avoiding the use of scientific terms, except when actually necessary for the sake of accuracy. Mr. Edwin Chase, of Port Williams, N. S., writes: "Remedies must be short, to the point, and plainly expressed. We shall then understand, remember and attend to them better."

And Mr. Robert Wilkie, now Master of the Dominion Grange, says: "Endless vigilance is required, on the part of the agriculturist and horticulturist, to meet the attack of insects. Most of the farmers know almost nothing of Entomology, and the scientific names, which are generally used in such writings, carry no meaning with them to the farmer. He knows the Wheat-midge, the Wire-worm, &c., when he meets their names in the language he is used to; but when he meets them under other names he neither recognizes them nor does he know what he is reading about. He consequently takes no interest in the subject, and eventually drops it altogether."

Appended to this report are some papers of general interest, which I have concluded would add to its utility. The address to the Fruit Growers' Association of Nova Scotia is upon the general principles of Economic Entomology, and will, I trust, be considered to attain the end I had in view in preparing it.

From reasons to which I have already referred, the preparation of my own illustrations was impossible; but as figures add so materially to the intelligibility of any report, I have gladly availed myself of the generous permission granted by the Entomological Society of Ontario to make use of any of the figures in the possession of that Society.

Finally, I beg to thank my many correspondents for their assistance in the past, and to request a continuance of the favour for the future. I am convinced, that if my work is to be of use to the country, much of the information made use of and distributed through this means, must be derived from practical men, actually engaged in the cultivation of the soil. If suggested remedies are successful, the very best must be discovered and made known as widely as possible; if they fail, the reason must be discovered, and if they are useless, farmers must be warned against them, so that no time may be lost which might be better employed.

NOTES ON THE PRINCIPAL INJURIOUS INSECTS OF THE YEAR 1885.

The season of 1885 has not been, I am happy to say, characterized by the appearance of any new species of injurious insects in undue numbers, nor have some of those mentioned in my last report as injuriously abundant, appeared again during the present year. The Army-worm, last year recorded as being so abundant, in New Brunswick, was less so in 1885. The "Black Army-worm," injurious in the Ottawa district, was this year almost unrepresented, a few moths only, the perfect insects of this caterpillar, being collected at light on the evenings of 7th

and 8th August. The Clover-seed Midge, possibly the most injurious insect of the year, has again committed serious depredations; but it is evident that farmers can, in a large measure, obviate this loss by pasturing their clover until the beginning or middle of June, instead of leaving it standing in the field till the end of the month. The Wheat-midge seems to have slightly attacked the wheat over a large area of country, but nowhere with sufficient virulence to leave a marked effect upon the whole crop. Other cereals have not suffered to any large extent. Manitoba and the North-West Territories have been remarkably free from insect depredations; but from certain parts of the Territories have come rumours of the return of the "Hateful Locust." None of the specimens forwarded to me, however, for identification proved to be this species. When in British Columbia, reports were received that the Hessian fly and Wheat Isosoma were severely attacking the wheat crop in California and Oregon. I therefore kept a close watch for these insects, but could not succeed in discovering a single instance of their operations.

The destructive Root maggots which injure so many garden vegetables have been very abundant in certain localities, as the Cabbage Maggot, on Vancouver Island and in Ontario, the Onion Maggot in the Ottawa District, where, however, I found it to be vigorously assailed by several enemies, and succeeded in breeding from larvæ collected, two true parasites, a small hymenopterous fly, and a beetle of the genus *Aleochara*. The perfect insects, of this last beetle, were very numerous amongst the infected onions, but at that time, I did not suspect its beneficial mission. The Radish Maggot was abundant in almost every locality whence I have received reports. A most interesting exception to this, however, was observed on the occasion of a visit I paid Mr. John Murray, at Spence's Bridge, in the interior of British Columbia. The climate at that place is very dry and all cultivation has to be effected by means of irrigation. The natural vegetation of the valley consists chiefly of Cactus, Sage-brush and other desert plants; naturally the insects which feed upon these, are not likely to relish the succulent vegetables which man cultivates for his own use—consequently, Mr. Murray, is able to cultivate in his garden, without taking any steps for the prevention of insect attacks, the most delicious vegetables. Although under present circumstances the valley of the Thompson, at Spence's Bridge, is dry to the extreme; as soon as water is applied, all vegetation springs up with the most profuse luxuriance. Mr. Murray has brought down water from the mountains at a heavy expense to water his garden, and has transformed a piece of dry sun-parched alkaline river-bank into a garden of the greatest beauty, where radishes are produced over 12 inches in length by an inch and a half in diameter at the top, without a sign of a maggot. Lettuces are equal to those grown with all the care of a Parisian market gardener. Cabbage, spinach, and all other vegetables are grown to perfection, as well as small fruits of all kinds. The only injurious insect I could find was a small lepidopterous larva, which was attacking the Gooseberries, and the habits and appearance of which seem to be identical with the common Gooseberry Fruit-worm of the east (*Dakruma convolutella*.) In addition to these useful products, Mr. Murray's garden was at the time of my visit a blaze of beautiful flowers, and his greenhouse contained many rarities.

Cutworms of two or three species, not yet fully worked out, occurred in the most remarkable numbers I have ever witnessed in the garden of Mr. G. A. Knight, near Victoria, V.I., during the months of April, May and June last. Nearly all the specimens I brought back with me to Ottawa, in the larval and pupal states (as well as the larvæ of a large rapacious Carabideous Beetle, which was found actively destroying them) were unfortunately killed by the excessive heat, from which they could not be protected, during the journey from Vancouver Island. However, as I secured several specimens in alcohol, I hope, with the aid of Mr. Knight, who is a most diligent worker and keen observer, to be able to complete the life-histories of some of these species during the coming summer.

Apple trees, from one end of Canada to the other, have, to a certain extent, suffered from the Codling Moth and Oyster-shell Bark-louse. In the Maritime

Provinces the Canker Worms have for the last few years been the worst enemies of this staple product.

In Prince Edward Island the Fall Web-worm is the only insect, in addition to the three last named species, concerning which serious complaints have been made.

In many parts of the Dominion the Plum Curculio is increasing in numbers, doubtless owing to negligence on the part of the fruit-growers to jar their trees. Nevertheless I feel confident that trouble with this insect is virtually at an end. Nearly all experimenters concur in testifying that its ravages may be prevented by spraying Paris Green over the trees at the time the females are laying their eggs. This material has also been extensively and successfully used against the Codling Moth.

The attacks on forest trees during the season have not been of a remarkable character. The Larch Saw-fly has not spread to the extent I anticipated it would, and no new enemy of our forests has appeared in large numbers. I will now give a more detailed statement, under the headings of the chief classes of crops, of the observations of the year.

C E R E A L S .

WHEAT.

The Wheat Midge (*Diplosis tritici*, Kirby).

The only grain crop which has suffered at all severely from insect causes, during the past season, is wheat, and this, although assailed by rain, fungous diseases and insects, has, upon the whole, produced a good average crop.

The Wheat Midge is of course, at the present time, the greatest enemy. Throughout the Maritime Provinces, Quebec, and many parts of Ontario, a certain proportion of the wheat is attacked.

The following extracts, from different sources, illustrate this. In the Ontario Agricultural Returns for November, 1885, we find:—

“The Wire-worm has been at work on the wheat roots in a good many localities in Western Ontario, and a few yellow patches in the field indicate the presence of the Hessian-fly; but the injury done by these pests is, on the whole, insignificant. Some fields, too, which were sown very early, were attacked about the edges by Grasshoppers, and one correspondent expresses some alarm that the pest will return in force next summer.”

“The Hessian-fly has made its appearance for the first time in this section of country.”—P. CLARK, Culross, Bruce, Ont.

“Wheat sown alongside of grass fields, is considerably eaten up by Grasshoppers but only the outside ridge.”—JAMES ALEXANDER, Ekfrid, Middlesex, Ont.

“Wheat suffered severely from rust, and to a certain extent, from Weevil.”—G. HENRY, Bomanville, Ont.

“Wheat suffers more or less every year from the Midge. On an average about $\frac{1}{2}$ an inch of each head is destroyed.”—WM. MILNE, Maxwell, Ont.

“The only crops which suffered to any appreciable degree, were wheat, from the Wheat fly, turnips, from the Flea, and clover, from the Clover-seed Midge.”—H. DOUPE, Kirkton, Ont.

“The Wheat Midge, during the year 1834, destroyed the Egyptian and other varieties of fall wheat. It was noticed, however, that a variety of fall wheat called ‘Democrat,’ was not much injured, owing, it is thought, to the chaff, or covering, being thicker, consequently the insect could not penetrate it. The ‘Democrat’ variety was not injured again this year, and gave an excellent yield, while other varieties were badly infested by the Midge.”—JABEL ROBINSON, Middlemarch, Ont.

Mr. T. B. ELLIS, of Pembroke, Ont., writes:—“The Weevil has been bad in past years, but was not hurtful this year. Farmers here sow earlier or later than the usual time, so as to avoid it. I prefer to sow early, so that the kernel may mature, to a certain extent, before the egg is developed.”

Messrs. THOS. MCKAY & Co., of Ottawa, large buyers of Canadian grain from all quarters, have kindly furnished me with the following statement:—

"We find that the Fyfe or Scotch wheat has been injured by the fly or weevil, to some extent, in all cases. The White Russian and other soft varieties have been so injured in some cases, but not generally. The liability to be attacked by the 'fly' or 'weevil' does not appear to be so much a question of variety, as it is of the time of sowing and ripening, for if the grain is far enough advanced before the fly appears, it is apparently able to withstand its ravages. The wheat crop this year, all over Ontario, has suffered from rust; in the section east of Kingston the damage was not so heavy as it was further west, and the quality is not much below the average."

In the Province of Quebec, although a slightly larger area was under wheat this year than last, the aggregate amount of this crop was not large. That grown, however, seems to have suffered less from the Midge than usual. The most favourable accounts come from Montreal:—

"After extended enquiries from farmers and seedsmen here, I find that the Midge has not done any damage to the wheat in this locality; in fact I have been told by several competent parties that we have had no Midge here 'this year at all.'—W. D. SHAW, Montreal, Que.

"Owing to improved methods of cultivation, the farmers in my county have reaped a much better harvest of wheat this year than for some years past. The Midge is still with us; but did not injure the crop much last season."—G. A. GIGAULT (M.P.), St. Césaire, Que.

"We consider wheat an uncertain crop, and do not care to run the risk of putting in large quantities, as other crops generally pay us better. This year the Midge did not injure us much."—Hon. W. H. CHAFFERS, St. Césaire, Que.

In the Maritime Provinces the Wheat Midge seems to be gradually becoming less troublesome. Mr. T. W. Morrison writes from Folly Village, N.S.: "The Midge, or as we call it down here, the Weevil, has been very bad for a few years, in fact so bad that the farmers gave up sowing wheat. Last year (1884) a few sowed small quantities, and it did very well, being very little attacked by the Midge."

Mr. A. B. Black writes me from Amherst, N.S.: "In 1885 the 'Weevil' was not nearly as destructive as in former years."

From Manitoba the reports all show a most remarkable freedom from insect pests. Mr. Acton Burrows, Deputy Minister of Agriculture, writes:—"We have little to complain of in the way of insects, as far as I can ascertain this season. They committed few depredations in this Province. Cut-worms have not done as much damage as last year. Potato-bugs have shown up in one or two places; but not to an alarming extent."

"During the past year we have been singularly free from the attacks of insects, even Cut-worms were scarcer than usual."—COPLAND COWLARD, Ossowo, Man.

"I am happy to say in this district we have had no injuries to crops by insects since 1881, when this part became settled."—A. G. McDUGALL, Virden, Man.

"Last year we were troubled a good deal in our gardens by Cut-worms among our cabbages, and by the Turnip-fly."—DONALD FRASER, Lake Louise, Emerson, Man.

The wheat crop in British Columbia, wherever that cereal has been cultivated, has been quite satisfactory, and there are no complaints of insect attacks. The fields about Victoria, V. I., looked well, and samples examined showed no sign of insect ravages. At Kamloops, I was informed by Mr. James McIntosh, of Messrs. McIntosh & Mara, that he had never seen any "fly-struck" wheat in the country. Samples of grain which he gave me from that and the Spallumcheen district—which are the wheat districts of British Columbia—were perfectly free from any traces of attack.

Midge Remedies.

Under this head there is hardly anything that can be said of practical value. From the habits of the insect and the time of attack it is clear that applications to

the wheat plant are impossible. However, as the greater proportion of the larvæ leave the ears and burrow into the soil a few inches to complete their transformations, something may be done in the way of surface dressing immediately after the crop is carried. Mr. C. Whitehead in his second report to the British Agricultural Department, says: "The sole practical means of prevention is to cultivate the wheat stubble, directly the wheat is carried, so as to bury the larvæ deep in the ground. A dressing of hot lime might be applied with good results, but in this case the land should be very lightly scarified with one of Coleman's lightest scarifiers, in order to bring the lime into close contact with the larvæ. After some days the land should be deeply ploughed to bury them and effectually prevent further transformation, at least to the imago form. Couch grass must be eradicated (this grass is, botanically, closely allied with the wheat plant and the Midge is known to go through its transformations in it as well as in wheat). Hedge sides and outsides of fields should be carefully brushed. It should be remarked here that brushing hedge-sides and all outsides, grassy roads, waste corners, and headlands should be done systematically, twice if possible, once early before grasses go to seed and the insects hatch out, and again in the autumn when insects are hibernating upon grasses and hedge-side rubbish, either as perfect insects or in the egg state. And it is not of much use merely to brush, the rubbish should be burnt or carried away to be mixed."

It is further suggested that in years of bad attack all chaff or rubbish, after threshing, should be burnt, put in a mixen, or under cattle in yards.

Sometimes a large proportion of the larvæ remain in the ears until after the grain is carried, and when threshed fall down with the chaff, dust, and rubbish, in sufficient numbers to make the ground quite red. Mr. Meech, of Meech's Lake, Chelsea, Que., informs me that, a few years ago, this was the case in the Ottawa district. These larvæ should, of course, have been most carefully swept up and destroyed.

In many parts of Canada it has been found necessary to give up putting in fall wheat altogether, and then by changing the time of planting in the spring, endeavour to get the wheat into ear at a time when the Midge is not abundant. The great number of different varieties of wheat, some early and some late, largely assist the farmer in this direction, but he must constantly watch for the time of appearance of the Midge in his own locality, and then sow or choose varieties of wheat which are not coming into ear just at this time. It is claimed by some farmers that when they get a so-called Midge-proof wheat that after a time the Midge changes its habits and appears earlier or later, as the case may be, to correspond with the season of the wheat coming into ear. With regard to this question I think it is more probable that the change takes place gradually in the wheat plant; and if, upon observation, this be found to be the case, the difficulty might be obviated by frequently procuring seed-wheat from a distance. From time to time we hear of certain varieties being proof against the attacks of the Midge, and there is no doubt here a field for investigation, the results of which are of enormous importance to the country at large. Wherever Democrat wheat has been grown, it is, in every case reported upon, stated to be free from attack. Mr. Casey, M.P., informs me that, even when grown in the same field with other varieties, it is exempt from attack when they are destroyed. There are also other varieties which have almost the same reputation. It is probable, however, that the same variety which will answer in one district will not be successful in another, and the most suitable for each must be decided by experience.

The Rocky Mountain Locust (*Melanoplus spretus*, Uhler.)

In parts of the North-West there are rumours of injuries by the Rocky Mountain Locust (*Melanoplus spretus*, Uhler), and doubtless considerable injury has been wrought in certain restricted localities; but none of the specimens which have been submitted to me have been the true Rocky Mountain Locust; nevertheless, of course, part of the North-West lies within the region where that species breeds, and it is advisable for

every farmer to be on his guard, and at once report any unusual number of "Grasshoppers," and send specimens for identification. The insect most often confused with the destructive Rocky Mountain species is *M. femur-rubrum*, the most apparent difference between which and *M. spretus* is shown in the accompanying figures, *a* and *b*.



Fig. 1.—*Melanoplus spretus*, Uhler.

Fig. 2.—*Melanoplus femur-rubrum*, Burm.

It will be observed that *M. spretus*, the Rocky Mountain or Hateful Locust, has much longer wings and by this means it is able to fly long distances, while the common Red-legged Locust is usually confined to the locality where it is born. For this latter species large broods of poultry are particularly useful in keeping down the numbers—and should form a part of the equipment of every prairie farm. In addition to these assistants, all insectivorous birds, as "Blackbirds," Meadow-larks and particularly the different species of Grouse should be jealously protected by the farmer. I have dissected Prairie-hens, the crops of which were almost filled with the remains of Locusts.

OATS.

The oat crop is universally reported as having been of the first quality and complaints of insects attacking it are few. The most serious attack was brought under my notice by Mr. J. Sriver, M.P., Huntingdon, with regard to

The Red-Legged Locust (*Melanoplus femur-rubrum*, Burm) Fig. 2.

Mr. Sriver says: "Grasshoppers were numerous and very destructive in certain localities. In the month of August our pastures were swarming with them and they afterwards attacked the oats also. They did much injury by biting off the separate flowers just as they came out of the sheath, sometimes destroying the whole panicle. Their ravages were most severe in the Townships of Hemmingford and Havelock and particularly in the Parish of Lacolle, where one farmer had to cut down his oats and use them for fodder."

The curious habit of *M. femur-rubrum* attacking oats in the manner described has also been noticed by the Hon. W. H. Chaffers, at St. Césaire, Que; in Iowa, by Prof. Osborne, and, in Michigan, by Prof. Cook.

"Grasshoppers" are complained of in some sections of Ontario and Quebec, as injurious to hay and oats, and were very numerous on Vancouver Island, in July, whence I received one or two notices of their attacking turnips as well as other crops generally.

BARLEY.

No attacks upon growing barley were brought under my notice, the only injury reported from insects was upon imported grain.

The Grain Weevil (*Calandra oryzae*, L.).

In August, 1885, Mr. F. R. Latchford brought me a sample of imported pot-barley badly infested with the above-named beetle. This insect belongs to the *Curculionidae*, or Snout-beetles, and does considerable damage to stored grain, both in Europe and in this country. It has committed great havoc in California, New York, and Liverpool, England. It is not, luckily, a common insect in Canada, but might very easily become so from its great vitality. In August, 1884, I obtained from Mr. W. Scott, of Ottawa, a glass jar containing a sample of Egyptian wheat which he had imported from Liverpool. This grain was badly infested by these weevils, and I took twelve from the bottle and shut them up in

a box for examination with some empty shells of wheat. The insects remained alive and active in the box all the winter until March, when I left the city for some time. In view of the fact that they are so tenacious of life, great care should be taken not to allow them to escape if discovered. If the grain is not too badly destroyed, the insects may be killed by drying it with hot hair, at a temperature of 130°. This will kill the insects; but will not injure the quality nor the germinating power of the grain.

The eggs of these beetles are laid upon the loose grains in the granary; when they hatch the small grubs bore into the grain and consume the interior, only emerging in the shape of the perfect beetle in the autumn, after the whole of the contents have been consumed.

PEAS.

The pea crop still remains as free from the attacks of the weevil (*Bruchus pisi* L.) as last year. The Black Army-Worm (*Agrotis fennica*), noticed last year as having been so destructive to this crop in the Ottawa district, did not, as was then anticipated, appear again this year in large numbers. Mildew seems to have materially affected the quality of the pea crop. The Hon. W. H. Chaffers says: "The weather which was very unfavourable for hay in the County of Rouville, appears also to have affected the peas, which crop was a general failure."

HAY AND CLOVER.

HAY.

The hay crop seems to have suffered considerably from various causes during the past year. A "Joint-worm" is complained of in the Timothy from several localities in Ontario, Quebec, New Brunswick and Nova Scotia. So far, I have been unable to obtain specimens, and shall feel obliged to any one who, next year, will send me some for examination. It has been suggested that the injury is not from an insect at all; but from frosts in the beginning of June. On the other hand, Mr. W. Brodie, of Toronto, tells me that he has actually found the larva of a species of fly (*Chlorops*) doing much harm in the four townships of Pickering, Whitby, Uxbridge and Reach of the County of Ontario. The description of the attack he noticed seems to agree with that of the so-called "Joint-worm." Mr. Brodie writes: "The timothy was just ready for mowing, and, of course, quite green in colour; but in many fields the dead heads were so numerous as to give a ripened appearance to the crop. The heads were pale straw color, dead and dry, and on a slight pull the culm parted at the upper joint, where the larvæ had fed. I was, unluckily, unable to work the matter up; but, from the few larvæ I succeeded in finding, I feel sure that the state of the crop was due to the attacks of a species of the genus named."

Mr. T. B. Ellis, writing from Pembroke, Ontario, says: "The timothy hay crop was a comparative failure, not the result of being winter-killed, nor owing to any lack of rain; but, though it grew well and promised well on the 1st June, it did not mature, but withered or faded when it should have ripened. I do not know the cause, which is unusual to farmers here." And again: "The 'Joint-worm' has been bad here, at times destroying the timothy largely."

Mr. Peter White, M.P., of Pembroke, Ontario, also tells me that the "Joint-worm" (locally known as "Cut-worm") has attacked the wheat in that district in the same manner. From the fact that the withered stems, to the extent of perhaps $\frac{1}{2}$ of 1 per cent., are scattered all through the fields, he feels confident that the injury is done by an insect. It is only during the last six or seven years that he has noticed the attack at Pembroke.

It is well known that in Europe a fly of the genus mentioned (*Chlorops tenuipus*, Curtis) commits great ravages in fields of oats and barley in a similar manner.

The attack, which has been attributed to the "Joint-worm," was several times referred to in correspondence from Quebec, and was also observed in the vicinity of Dalhousie, N.B., on the farm of Mr. Charles Stewart, where both timothy and Kentucky blue-grass were affected. The hay in New Brunswick, in addition to the

above, has also suffered again this year from the "Army-worm." News of the most severe attack comes from the County of Westmoreland. Mr. Josiah Wood, M.P., reports that the hay crop in the large tract known as the Sackville Marshes, was greatly diminished by this insect. In many fields the timothy was entirely destroyed.

Most of the reports from the Province of Quebec show that the hay crop was below the average, and in many places a failure. Along the north shore of the St. Lawrence, as at Berthier, Que., where Mr. E. O. Cuthbert, M.P., informs me that the hay was remarkably heavy and good, there were, here and there, good crops secured; but on the south shore, very few. As a rule, this deficiency seems to have been due more to meteorological causes than to insects. Grasshoppers have been complained of as injuring pastures in the Counties of Huntingdon and Rouville.

Mr. S. A. Fisher, M.P. for Brome, Que., says: "Although the hay crop promised well early in the season, with good stocky bottom, it did not make any growth. This I attribute to the cool weather which prevailed during the greater part of the summer. The pastures were short all the season, and did not seem to recover after the first cropping. In some parts of the County of Brome the White Grub did much injury in meadows. This, however, is no new thing, and if a remedy can be discovered, it will be a great boon to many farmers in the Eastern Townships."

The reports on the hay crop which come from the Pacific Coast are not more favourable than those from the Eastern Provinces. Upon Vancouver Island, the hay, in most parts, was thin; but Mr. J. A. R. Homer, M.P. for New Westminster, tells me, that on the alluvial flats and marsh land, about the mouth of the Fraser River, the crop was good and very heavy.

CLOVER.

The Clover-seed Midge (*Cecidomyia leguminicola*, Lintner).

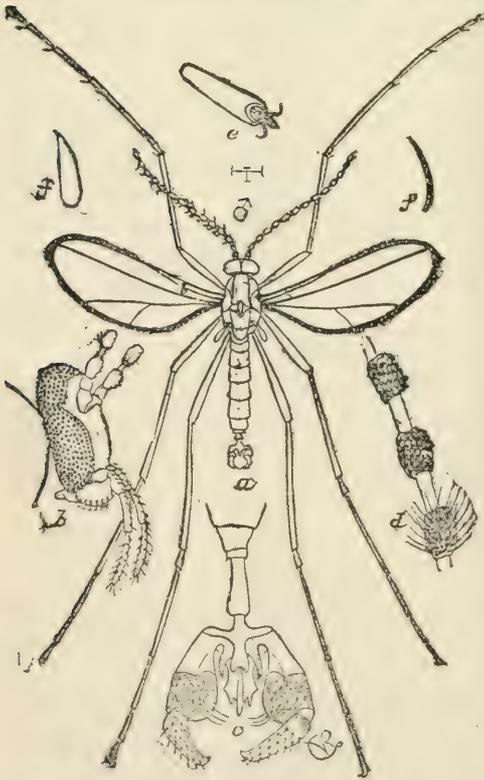


Fig. 3.—Clover-seed Midge (male.)

(Figures very much magnified.)

Fig. 4.—Clover-seed Midge (female.)

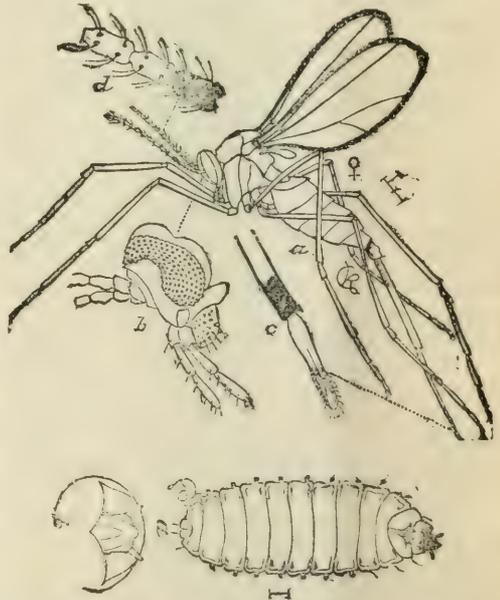
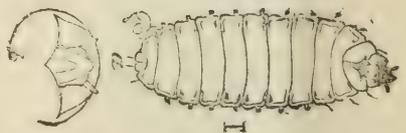


Fig. 5.—Clover-seed Midge (larva.)



The Midge has again proved itself a most serious tax on the farmers throughout Central and South-western Ontario, where clover was once grown for seed. The only instances where any seed has been reaped are where, instead of allowing the clover to stand in the field till the end of June, it has been fed off by cattle and sheep till the beginning or middle of June, and then left to go to seed for the autumn crop. There are apparently two broods of the Midge in Western Canada; part of the second brood goes over the winter in the pupa state and hatches in the beginning of May. The eggs of this brood are laid in the forming heads of the clover plant, and complete their larval growth about the end of June. These then leave the heads of clover and go into the ground to complete their transformations, the perfect flies emerging about the middle of July. These again produce the second brood, which destroys the fall crop of clover seed, and part of which emerges in September and part not until the next spring. The verdict of all the growers who have tried the experiment now seems to be that two crops cannot be secured, and to get any seed at all, the first crop must be pastured until the beginning, and not later than the middle, of June. In this way the minute larvæ of the flies which are to lay the eggs for the second brood, are eaten by the cattle at the same time as the clover, and destroyed. It is quite apparent, that if all growers will adopt this plan, that much good will be done, and if some fall dressing for the land can be devised to destroy the hibernating brood, we may hope, before long, to get rid of this injurious insect. Fresh gas-lime, if obtainable in sufficient quantities, would undoubtedly destroy the midge; but the supply of this is limited. Experiments will have to be tried until something is discovered. Late fall ploughing would probably have a good effect. In the Ontario Agricultural Returns we find: "There is a remarkable concurrence of testimony from experienced farmers, that a yield of clover seed can no longer be depended upon with any degree of certainty where two crops are cut in the season."

"In this section of the country the clover seed is an entire failure again this year, except where it was pastured until the middle of June, when it yielded from 3 to 4 bushels to the acre."—JABEL ROBINSON, Middlemarch, Ont.

"Clover seed has been generally injured by the Clover-seed Midge here, the only crops being when the first growth has been allowed to seed after pasturing late in spring."—R. J. DOYLE, Owen Sound.

"Respecting the raising of clover seed, the system of pasturing and turning off early in June is the only chance we have for seed now; but even under this system a late cold season like last fall may so delay the blossoming of the plant as to bring it within the season when the midge strikes it."—ROBERT WILKIE, Master of the Dominion Grange, Blenheim, Ontario.

ROOT CROPS AND VEGETABLES.

TURNIPS.

Reports come in from all quarters speaking of the injury committed by the Turnip Flea-beetles. In the vicinity of Victoria, V. I., the attack was very severe. White turnips had in some instances to be sown as many as three times before sufficient plants could be saved to make a crop. There appear to be two or three different species of *Haltica* which attack the turnips on Vancouver Island; a black one (much like *H. pubescens*, which is troublesome in this part of Canada) occurs in large numbers and is very destructive in some localities. Mr. John W. Tolmie, of Cloverdale, near Victoria, informs me, however, that he has never found it to be very injurious to turnips on his farm, "owing to the fact that it seems equally fond of two very common weeds which grow abundantly in rich cultivated land, *Chenopodium album* and *Polygonum Convolvulus*; these partially divert the attack until the turnips are far enough advanced to withstand it." There is also a striped Flea-beetle much resembling, if not identical with, *Phyllotreta striolata*, Fab. It was remarkably abundant and destructive in the vicinity of Cedar Hill, V. I.

On Vancouver Island this year, the spring was a very dry one, and I have no doubt that to this the severity of the attack of the Turnip Flea was due. The

seed germinated and appeared above the ground slowly, when it was at once pounced upon by the beetles and devoured. The treatment most successful in England with these insects appears to be to manure and plough the land in autumn, leaving the frosts of winter to reduce the surface to a fine tilth which forms a suitable seed-bed. The surface of course needs cultivation in the spring to destroy the weeds; but ploughing should not be done at this time for turnips as it only opens up the soil, allowing the necessary moisture to evaporate and leaving harbours for the insects. The farmers who have been most successful say "manure well, disturb the surface as little as possible in spring and put in plenty of seed."

Changing the time of sowing from that usually practised is claimed to be successful in some localities; but evidence is rather contradictory on this point, as the following extracts will show, and would seem to indicate that each one must be guided by experience according to the conditions which hold good in his own district. I shall be glad to receive notes upon this matter. Some correspondents say "we must sow early," others exactly the reverse. Mr. F. W. Morrison writes from Folly Village, N.S.: "To avoid the Turnip Fly we have either to sow early, or about the last of June." Mr. Thomas Henderson, of Nepean, Ont., who has a farm on a clay soil, tells me that he ploughs two or three times in spring, unless the soil is too wet, and that if he sows too early he loses more turnips than if he waits until about 20th June. Immediately the seed leaves appear he puts on a liberal supply of gypsum which creates a rapid growth, and his crop seldom suffers from the flea.

"Turnips planted from the 1st to the 7th of June are very good, those planted after that time are very thin in consequence of the fly."—JOHN SCOTT, Howick, Ont.

When turnips are badly attacked by the flea, I have in one or two extreme cases advised the sprinkling of a weak Paris Green wash over them, so as to keep the beetles in check while the rough leaves were forming. This has been effective in garden cultivation of early turnips. A useful dry application may be made by mixing 1 part of Paris Green with 40 of common flour or Plaster of Paris. Dusting with lime and ashes in the early morning while the dew was on the leaves is reported from different quarters as having been successful. This is the same treatment as that mentioned by Miss Ormerod in England, where one of her correspondents drove a large flock of sheep over his field in the early morning when the dew was on the leaf, thus covering the young plants thickly with dust. The treatment was repeated until the rough leaves of the plant appeared. The effect of destroying the rough leaves is not so injurious to the plants, because they do not perform so important a function as the first pair of smooth seed-leaves. The rough leaves are supported by the root, whereas the seed-lobes are actually the reservoirs of prepared food upon which the young plant has to feed until it has formed roots, by which it can derive nourishment from the soil. Any treatment, therefore, such as the application of gypsum, superphosphates, &c., which pushes on an active growth at the time the seedlings appear above the ground is useful, so as to get them past the stage when they can be destroyed by the beetles. As soon as the rough or true leaves are formed, they, together with the roots, perform the same function by manufacturing the plant-food from which the young plant is to be built up, as was performed, at first, by the seed-leaves which provided it ready-made for the same purpose. In garden culture this rapid growth at the critical time has been produced by watering the turnips in times of drought; but this would seldom be practicable in fields. Occasionally mustard is grown with the turnips for the reason that it germinates more quickly, and, by the time the turnips appear, is a more conspicuous object, and as it also appears to have greater attractions for the beetles, the attack is diverted from the turnips to the mustard.

A Turnip Aphis—(*A. brassicae*, L.?).

A pest which has occasionally been very destructive on Vancouver Island is described as a "Gray Aphis" (possibly *A. brassicae*) which sometimes increases so much as to materially diminish the whole crop of cabbages and turnips in the district. Mr. J. W. Tolmie writes: "Soon after being attacked the leaves rot away, and in

the case of turnips the root follows. With this fly the smooth-leaved turnips (*Rutabaga*) are most infested, and, in 1876, when it was worst, we tried many experiments, but were unable to rid ourselves of our unwelcome visitors. Now, whenever they appear, we remove the plant bodily and destroy it, considering this the most inexpensive way of getting rid of the pest."

Remedies.

This insect is generally more abundant on the Cabbage; but also occurs upon several cruciferous weeds, as Charlock, Shepherd's purse, &c., for which reason these latter should always be kept down. From its habit of congregating beneath the leaves it is rather a difficult insect to treat. In garden culture much good may be done by gathering such of the lower leaves as contain clusters of the lice and destroying them so that they may not spread. Syringing the plants with Pyrethrum or Carbolic washes, made by adding Pyrethrum powder or Carbolic acid to strong soapsuds, or a Kerosene Emulsion would probably be the most effective remedy.

When cabbages have been attacked, drenching them with strong salt and water has had a good effect. The cabbage in its native state, is a seaside plant, so consequently would not be injured by this treatment.

Western Ten-lined June Bug—(*Polyphylla decemlineata*, Say).

A specimen of a large scarabaeidous larva was brought to me when in Vancouver Island by Mr. Saunders, of Cadboro Bay, who had found several of them while hoeing the turnip fields of Mr. Benjamin Evans of the same place. This grub, from its size, is probably that of *P. decemlineata*, specimens of which I have received from Victoria.

Turnip Maggot—(*Anthomyia*).

In the garden of Mr. G. A. Knight, of Mount Tolmie Road, near Victoria, V. I., I found some young Turnips much injured by a species of *Anthomyia*, much resembling in appearance, but not in its work, the Radish fly. The large galleries formed by the maggot were in the upper part of the root, starting close beneath the crown and running in all directions through the upper half of the substance of the roots, utterly spoiling them for the market. The fly has not been yet identified. For remedies, *vide* Radish Maggot.

Carrot Fly—(*Psila rosea*, Fab.)

Carrots and Parsnips were little troubled with insects; but during the present winter I received, from Prof. Guignard, of Ottawa, some specimens of Carrots purchased in the market which were much mined by small white maggots. These have produced in the breeding jars the carrot-fly (*P. rosea*), so injurious in England. I have never heard of this insect being sufficiently numerous in Canada to be considered injurious; but should it become so, as, unluckily, is too possible, easy methods of lessening the attacks are sowing sand and petroleum amongst the young plants at the time of thinning out, and watering the beds frequently with salt and water.

RADISHES.

The Radish Maggot—(*Anthomyia raphani*, Har.)

Radishes, in almost every part of Canada, are injured by this insect. "I did not get a sound radish" is a common complaint, and frequently whole beds have to be dug up without even producing enough to pay for the seed. This maggot is the product of a small active fly which may be seen flying about close to the ground as soon as the young plants begin to appear. In general appearance it resembles a slender House-fly, but has longer wings and is of a lighter shade of brown.

Remedies.

Remedies to prevent the parent flies from depositing their eggs are decidedly the best for these troublesome insects. Fresh manure, too, should never be used for plants liable to the attacks of these root maggots, as there is now no doubt that it attracts them.

In Professor Lintner's First Report as Entomologist for the State of New York, he refers to some experiments made by Professor Cook, with Carbolic Acid, at the State Agricultural College of Michigan. "Carbolic acid is very repellant to insects, and is remarkable for the permanency of its disagreeable odour. A preparation was made by adding two quarts of soft soap to two gallons of water, to which, when heated to the boiling point, a pint of crude Carbolic Acid was turned in. For use, one part of this mixture was taken with fifty of water, and applied by sprinkling directly upon the plants. It was found that a single application kept the insects at bay for about two weeks. When applied weekly the radishes were almost entirely free from attack." This easy method of fighting the injurious Anthomyian flies should be remembered and tried thoroughly.

It must, however, be remembered that it is a "preventive" of attack, not a "remedy" for application after the attack has once begun. It is for keeping the flies from coming to lay their eggs on the radishes. When used as a remedy to destroy them it would have to be of such a strength as would destroy the radishes also. The reason for this is given by Prof. E. W. Hilgard, in Supplement 1 to Report of College of Agriculture of the University of California. He says: "The soil is a powerful absorbent of almost all substances soluble in water, thereby rendering them inactive toward animal life, for the time being. The same disinfecting property of soil that enables it to purify the foulest water filtered through it, without itself becoming offensive, also serves to render ineffectual a large proportion of any poison, that may be introduced in watery solution. It is only after the soil has become saturated with it to a certain (very variable) extent that a remaining portion can become effective. Hence the amount needed of any insecticide, when used in the soil, is very much greater than that which would be required if water were to be applied to the insect directly. A solution of Carbolic Acid or a tea of Persian insect powder, that would be instant death to an insect sprinkled with it, becomes inodorous and harmless when filtered through a few inches of soil; and the same is more or less true of all kinds of poisons." I draw especial attention to this because several of my correspondents to whom I had recommended Prof. Cook's preventive remedy have reported against its efficacy. Upon enquiring into the matter, however, I have found, invariably, that it had been tried as a remedy after the radishes were found to be infested. The first application must be made directly the seed leaves appear; the day should be noted and a fresh sprinkling given regularly every week afterwards.

Experiments were made during the past season by growing Radishes in rows and sprinkling sand saturated with Petroleum along the rows, once a week, until they were large enough to thin out and have the ground well hoed over the roots. Hardly any wormy roots were found.

POTATOES.



Fig. 6.—The Colorado Potato Beetle.—(*D. decemlineata*, Say.)

This insect still makes its presence appreciably manifest in many localities, which is much to be regretted, because with care and prompt application of Paris Green in water, at the time the first brood appears, and with every farmer and gardener acting in unison, this pest could, I believe, be practically exterminated. Many of our injurious insects when driven from their appropriate food-plant or when the cultivation of that food-plant is discontinued with a view of starving them out, are able to exist in small numbers upon some of the wild native plants, allied to the cultivated crop they had attacked. With the Colorado Potato Beetle, however, this is less the case than with any other injurious insect, for the wild species of *Solanum*, which never occur abundantly, would be entirely inadequate to keep up a food supply. Moreover it is found that although other members of the *Solanaceæ* are grown, they are seldom attacked. The tomato, for instance, is hardly ever touched until all the potato tops have died down, and then it is only the fruit that is eaten very sparingly. So that if all would only agree for one or two years to use conscientiously the remedies which have been so long tested and have proved so efficient, we should seldom hear of material damage to the Potato crop by the Colorado Beetle. The proper proportion is, if the poison be pure, one teaspoonful to a pailful of water. Throughout Ontario and Quebec, where Paris Green is regularly used, there is very little complaint this year concerning the Potato Beetle, yet a few localities seem to have suffered.

Mr. J. J. McLaughlin, of Williamsburg, Ont., writes: "The annual ravages of the potato bug have been so great that an incessant war has to be waged against this hitherto indomitable enemy by every farmer in this part of the country, not with the hope of exterminating the pest, but of checking its ravages."

Mr. J. B. Hobbs, Warwick, Ont., says: "Early potatoes were a good crop, nor were they eaten by bugs, but the late ones were swarming."

In the vicinity of Cheslea, Que., several fields were found to be badly infested, but were easily cleared by prompt use of Paris Green.

The Colorado Potato Beetle has not yet reached British Columbia, but has extended eastward through Quebec, New Brunswick and Nova Scotia to the Atlantic. Active measures are being taken in all these Provinces to stamp it out. I have notes of its appearance at Kentville in the Annapolis Valley, at Sydney, C. B., and many other spots, but never as being very injurious.

Mr. A. B. Black writes from Amherst, N. S.: Paris Green is found to be the most effective remedy for the Potato Beetle. Last year, however, its inroads were so slight as hardly to require notice, some farmers having raised as high as 400 bushels per acre."

Wire-worms—(*Elateridæ*).

Reports come in from all parts of the Dominion, complaining of the attacks of Wire-worms (sometimes called Yellow-worms). By far the largest proportion of these complaints is with regard to their attacks on Potatoes. In many localities on Vancouver Island they were particularly obnoxious, and seemed chiefly to cut into the long stem of the plant close above the tuber. This mode of attack was noticed at Saanich and at Sooke on the farm of Mr. Godel, who probably owns the most western farm in North America. Mr. Robert Craig showed me many roots in his garden which had been injured as above, early in the season; but had thrown out supplementary tuber-bearing roots above the point of attack. Mr. Thomas Marshall, of Cowichan, V. I., writes me that "the wire-worm is not very bad here this year; but last year we had about one-sixth of our potatoes ruined with them, and a few oats killed as well. I know of one farmer who had to plough his oats up entirely." In Ontario and Quebec very few complaints have been made about wire-worms.

Remedies.

Most of my correspondents agree that the attack from Wire-worms is much less severe upon well manured, highly cultivated, and well cleaned ground.

Mr. William Miller, of Bridgetown, N.S., a gentleman of large experience and a successful farmer, tells me that he can clear any ground from wire-worms by high culture and careful cleaning by the third crop. Where potatoes are grown he says they should be picked up immediately, they are dug, and most of the wire-worms will be taken with them and can be destroyed. He mentioned an instance of a piece of land he had just cleared which, when he first took it, was so full of wire-worms that he had been able to gather them up by the handful from the bottom of the cart in which the potatoes were drawn from the field. In confirmation of this, I give the following quotation from the report which has just been issued by Mr. C. Whitehead for the Agricultural Department of the Imperial Privy Council Office in England: "First and foremost among means of prevention (of wire-worm attacks on crops) is the abolition of weeds from the land and from the outsides of fields. This has been recognized and adopted long ago by some agriculturists, for we find the following passage in Vol. XV of the Journal of the Royal Agricultural Society of England, in an essay upon the farming of light land, which is always more liable to attacks of wire-worms. 'There is a farm in the neighborhood of Guildford which presents an instance of a perfectly clean farm, and kept so by deep ploughing and unsparing use of horse and hand hoes. It has often been remarked that root crops and corn are unmolested by wire-worms upon this farm. The owner asserts that he starved them long ago by growing no weeds to sustain them in the absence of a crop.'"

Black Worms, Thousand-legged Worms—(*Julidæ*).

In some localities in the Maritime Provinces, growing potatoes have been injured by "Black worms." Prof. H. Youle Hind informs me that they begin the attack by cutting narrow winding grooves in the surface of the tuber. Mr. W. Miller has found that they almost invariably follow the application of chip or sawdust manure to fields, and suggests that many substances might be more advantageously used as litter for stables or as a vehicle for liquid manure than sawdust. The species referred to is probably the *Julus cæruleocinctus*, Wood, described by Prof. Lintner in the "Country Gentleman" of 24 May, 1883. Specimens of Tomatoes containing hundreds of these Millepedes were purchased by me in the Ottawa market. These fruits had probably been on low branches and rested upon the ground. Prof. Saunders, of London, tells me that on one occasion he had trouble with these creatures in his greenhouse, where they attacked tender seedlings.

CABBAGES.

Cabbage Maggot (*Anthomyia brassicæ*, Bouché).

This troublesome pest has been, as usual, very injurious in every Province of the Dominion. All the varieties of the Cauliflower seem to suffer most severely. The estimates of loss from this cause vary between 25 and 75 per cent. of the crop. Mr. G. A. Knight, of Mount Tolmie Road, Victoria, V.I., lost every plant in a large bed of Cauliflower. Mr. J. C. Black, of Truro, N.S., when speaking of the Anthomyian flies, says: "Sometimes I lose half my crop of Cauliflowers, Cabbages, Radishes and Onions through the attacks of the maggots."

Remedies.

The discovery of a sure and safe remedy for this insect appears to be difficult, sometimes success will attend certain methods, which will fail in the hands of another experimenter. In my own experience the most satisfactory preventive treatment has been to dip each plant bodily into a pail of Pyrethrum wash at the time of planting out and then put a small quantity of fresh Gas-lime round each plant at once so as to prevent eggs being laid, or, when Gas-lime was not obtainable, sand saturated with Petroleum has had a like good effect of keeping away the flies. In all solutions

of Pyrethrum and Hellebore I always put a small quantity of soap; this makes it more effective against such insects as *Aphides*, and those which throw off watery applications.

From Miss Ormerod's experiments it would appear that the attack of all these Anthomyian flies is much more severe after fresh unrotted manure has been used. Prof. Riley suggests late fall ploughing as possibly useful, where these insects have occurred, so as to disturb their winter quarters and expose them to the effects of the frosts; he also quotes, with approval, as a remedy the scattering of coal dust, slaked lime or ashes around the stems of young plants, after setting out, with here and there a few plants not so protected. The flies, in laying their eggs, would avoid the spots where the application was made and seek out the unprotected plants. So as to leave the bed intact these traps might be planted in between the rows, and might be removed carefully, with the earth surrounding them, when they had effected their end.

Injurious Caterpillars (———?)

In the vicinity of Victoria, particularly in the garden of Mr. G. A. Knight, considerable injury was committed by the larva of a small moth, which perforated the leaves very badly. This injury might have been prevented, had it been observed in time, by applying Pyrethrum, either dry in the proportion of one part of the powder to 20 of flour, applied by means of an insect-gun or bellows; or by watering the plants with a solution formed by pouring a little hot water over a spoonful of Pyrethrum powder, in a large watering pot, and then filling it up with cold water. The perfect moth was bred from cocoons found on the leaves of the plants, but has not yet been identified. In some instances, either from want of material at the time of attack, or from the circumstances of the case, special remedies cannot be applied and we have to resort to hand-picking in its various forms, that is seeking out each individual insect and destroying it. Many instances have come under my notice of great success attending such methods. In the following extract this is exemplified. It will be seen that from the data given, it is impossible to decide to what species the attack described should be referred.

"The only things on the farm which have suffered in the slightest, have been cabbage and cauliflower. A small Moth or Butterfly deposits its eggs on the underside of the leaf, as soon as they are put out; little worms from the eggs appear in a few days, and commence at once to eat the plants, and if left alone, will soon destroy them. I have seen an acre of cabbage destroyed in ten or twelve days. I have tried the following experiments, with complete success, in each case saving every plant of both cabbage and cauliflower:—1. Wash the underside of the leaves of the plants with strong soap-suds, which cannot be too strong; but each leaf of the young plant must be taken in the hand and rubbed with a cloth. 2. Water the plants in the heat of the day with ice-water; it must be done two or three times, and unless the water is ice cold, it is of no use. 3. Sift ashes on the plants two or three times, while the dew is on, well covering them with ashes.—JOHN W. SIFTON, Brandon.

These methods of treatment, however, while they show great perseverance on the part of Mr. Sifton, would, I think, require too large an expenditure of labour and time to be applied on an extensive scale, and I believe that as soon as farmers and gardeners are familiar with the Kerosene Emulsions for application while the plants are young, and a solution or dry application of Pyrethrum, which may be applied at any time without affecting the taste of the vegetables, these will be the standard remedies for all such vegetables as are used for pot-herbs.

In Prof. Lintner's second Annual Report (1885) he quotes the following from the "Country Gentleman":

"As cheaper than Pyrethrum, and more quickly applied, the following application may be made: One tablespoonful of the cheapest black Carbolic Acid, diluted in one gallon of water, applied sparingly, after heavy rains, at intervals of three or four weeks, if the Caterpillars are observed. Persons who have tested the above claim that it has given them uninjured crops of cabbage."

The Cabbage Worm. The Imported White Cabbage Butterfly—(*Pieris Rapæ*, L.).

Complaints of this insect are frequent, especially from the Province of Quebec and parts of Ontario. Mr. W. D. Shaw, Sec. Treas. of the Montreal Agassiz Association, who has kindly made enquiries for me, concerning insect injuries on the Island of Montreal, writes that "the Cabbage Worm (*P. Rapæ*) has been very abundant, but as there are such large quantities of cabbages grown on the Island, its injuries have not been felt to any great extent. Where small crops have been grown the depredations have been really serious."

So far *P. Rapæ* has not reached British Columbia; the two species occurring there (*Pieris Napi*, Esp., winter form *Venosa*, Sc., and summer form *Pallida* Sc.) are not sufficiently abundant to be injurious to crops; they correspond with our eastern forms (*Pieris Napi*, Esp., winter form *Oleracea-Hiemalis*, Harr., and summer form *Oleracea-Æstiva*, Harr.). The caterpillars of the Vancouver Island species probably feed more on wild species of *Arabis* than on garden vegetables. Many specimens of the larvæ were seen by me upon the upright stems of *A. perfoliata*. The eggs were laid among the flower stems and on the leaves, and when the young larvæ hatched out, they fed first on the scanty foliage of the stem; and when this was consumed, devoured the seed-pods. There were seldom more than two larvæ on each plant; when mature, they invariably left the food plant to pupate.

The Imported White Cabbage Butterfly (*P. Rapæ*) has now spread over a great part of North America, and commits considerable depredations, notwithstanding the fact that it is severely attacked in all quarters by a fungous disease. In Europe this insect is not nearly the scourge to the market gardener that it is on this continent, which is probably due to the large number of its enemies there, which were not imported with it when introduced. In 1884, however, Prof. Riley added yet another to the many obligations, under which he has placed the whole community, by giving the farmers and agriculturists another means of keeping down the numbers of this injurious insect. In his report for 1884, he makes the announcement of the successful introduction of *Apanteles glomeratus*, L., a small parasitic fly, which is very abundant in Europe, and which we may sanguinely anticipate will soon spread here and perform the same good offices which it does there, by infesting this injurious pest.

ONIONS.

The Onion Crop has not been a good one in most localities. In Ontario and Quebec there have been severe attacks of the Onion Maggots (see Fig. 16) and Cut-worms have done their share of injury. (See page 35.)

Cut-worms (*Agrotis*, etc.)

At Ottawa *Hadena devastatrix*, *Agrotis Ypsilon* and *A. subgothica* were the commonest species of Cut-worms attacking all kinds of garden crops.

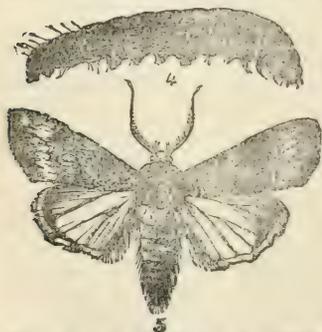


Fig. 7—*A. Ypsilon*; 4, grub; 5, moth.

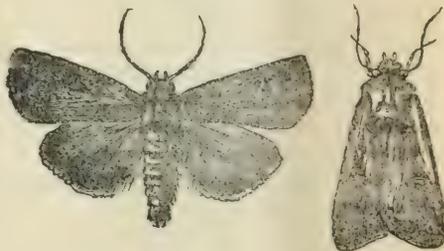


Fig. 8—*A. subgothica*, showing wings expanded and folded.

Owing to want of complete information with regard to some of the species studied during the season, as well as of figures, a detailed account of the Cut-worms will be held over until next report.

The Striped Cucumber Beetle (*Diabrotica vittata*, Fab.).

A few enquiries have been made as to remedies for the Striped Cucumber Beetle. As the beetles appear early in the year and attack the leaders of the vines long before there is any fruit formed, Paris Green, London Purple and other poisons may be safely used, and should be sprinkled over the young plants as soon as they appear above the ground. Melons and all kinds of squashes are attacked by this beetle, the perfect insects feeding on the seed-leaves and leading shoots, while the larvæ bore in the roots. Mr. W. Tyndall, of Cumming's Bridge, Ontario, writes: "There is a small yellow and black striped beetle which does much damage amongst our young Melon and Cucumber plants—the only plan we have adopted is to sow a few squash seeds in the same hills, which, as they come up sooner, and are more attractive to the beetles, serve to draw them off from the melons and cucumbers until they become too vigorous to be injured by their attacks."

FRUITS.

The fruit crop of the year, taking it as a whole, has been less affected by insects than usual. Wild fruits and berries of all kinds were very abundant. The late spring in Ontario and Quebec, added to the cool summer, appear to have affected the output to a certain extent.

APPLES.

The apple crop, on the whole, has not suffered severely from insects. Of course there are complaints of the Codling Worm from all quarters, in some places worse than in others, and we likewise learn of the work of the Round and Flat-headed Borers. In Prince Edward Island, the Tent Caterpillar, so abundant last year, has been supplanted by the Fall Web-worm.

The Oyster-shell Bark-louse (*Mytilaspis pomorum*, Bouché)

This insect elicits enquiries for remedies from Prince Edward Island to British Columbia. Soap washes and kerosene emulsions have been the remedies advised. Mr. W. Miller, of Bridgetown, N.S., considers that clean culture and the maintenance of a vigorous condition of the tree is the best preventive against the injuries of these pernicious insects, Rev. J. R. Hart, President of the Fruit Growers' Association of Nova Scotia, also writes: "The Oyster-shell Bark-louse is very prevalent; but few orchards being entirely exempt from its ravages; though it does not appear to injuriously affect the fruit to a great extent where the trees are well fertilized." The Hon. R. P. Haythorne tells me that this is by far the most injurious insect to the apple on Prince Edward Island, and reports having treated his trees successfully by painting them lightly, in the winter, with petroleum or oil paint. For the scale insects of all kinds, the safest remedies are alkaline washes, and the most effective kerosene emulsions. For the first, the time of hatching of the young insects must be discovered, so as to apply the wash at the time they are most susceptible of injury. With the kerosene emulsion great care must be taken not to have the mixture too strong. Although in the experiments mentioned above no injury resulted to the trees treated, it was almost more than could have been expected and the remedies are too hazardous for general application. With reference to the use of linseed oil mixtures upon apple trees to kill scale insects, it must be remembered that they should be put on very lightly, or by stopping up the pores of the bark the tree will be injured. The Oyster-shell Bark-louse affects apple trees from the Atlantic to the Pacific. "The Bark-lice have nearly killed out several orchards

and prevail in almost every locality where the apple is grown. I have tried a solution of concentrated lye and found that it completely cleared the only tree we had affected by them. A syringe is necessary for the small limbs."—T. Marshall, Cowichan, V.I. Mr. D. W. Gordon, M.P. for Vancouver Island district, says: "The Oyster-shell Bark-louse is the worst enemy of our fruit orchards, and is more partial to some varieties than others. The Red Astrachan, standing in an orchard among other kinds, will be covered with the scale whilst the rest are comparatively free. Aphides are very destructive, attacking several kinds of fruit trees, particularly apple, plum and cherry."

Mr. E. Daubney informs me that a young orchard of twelve-year-old apple trees was entirely destroyed at Plantaganet, on the Ottawa River by the Oyster shell Bark-louse.

The Codling Moth (*Carpocapsa pomonella*, L.)

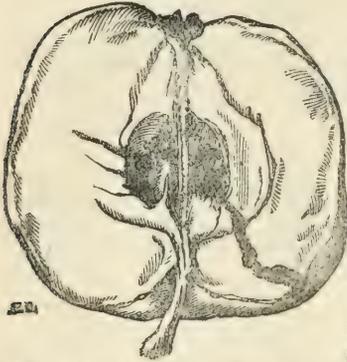


Fig. 9.—Apple injured by larva of Codling Moth.

This troublesome insect is so well known to fruit growers that any description of the insect or its mode of working is unnecessary. Throughout the Maritime Provinces, Quebec and Ontario, it appears not to have been quite as destructive as usual; but in British Columbia it has given much trouble. Mr. Thomas Marshall, of Cowichan, V.I., writes: "The Codling Moth is very bad with us, as many as one quarter of all our apples are affected by it. I have seen it in other places as well, but not so bad as with us. In fact this and other pests are so bad that unless some remedy can be found it is no longer profitable to grow apple trees; in fact, some have given up entirely, and take no notice of their apple trees." Similar reports to the above come in from all quarters. There is, however, no need for

giving up the culture of apples even in the worst affected districts, for with the old and long-tried remedies of trapping the larvæ and letting pigs and sheep have the range of the orchard, they can always be kept down sufficiently to allow a good crop to be secured.

Remedies.—Up to the present time the most successful method of destroying these insects has been by trapping the larvæ at the time they leave the apples and turn to chrysalids. After leaving the apple, at maturity, they spin a cocoon in a crevice of the bark of the nearest tree, and there remain for the winter. By placing convenient harbours for them to go through their transformations, large numbers can be captured and destroyed. The usual plan is to attach a band of carpet, cloth, old sack or paper round the trunks of trees between 1st June and the end of August. The larvæ collect beneath these objects in great numbers, and may, of course, be easily destroyed. Whatever material is used for a trap it should be folded loosely and twisted round the tree two or three times. The traps should be visited every week from a month after the blossoms fall, and the caterpillars and chrysalids must be destroyed either by dipping the bands in boiling water or by crushing them. Attracting the perfect insects to a lantern, hanging over a pan of water with a little oil on the top, has been frequently recommended, but with varying success. The only time I tried this remedy there certainly were several of the perfect insects upon the top of the oil. Neither of these remedies however will, I believe, require before long to be practised, for the experiments of the last year or two seem to show that this and another of the worst pests of our fruit trees in Canada have been brought within control. For years the Codling Moth and Plum Curculio have committed great havoc in almost every part of the Dominion; but now, unexpected as I confess it was to me, and in the case of the Curculio inexplicable as it still is, there seems to be little doubt, but that most decided results have been obtained by spraying the apple and plum trees with Paris green for these insects. Mr. D. W. Beadle, of St. Catharines, writes with regard to fruit insects for the year: "We were remarkably

exempt from all insect pests last season. Those who have experimented with Paris Green, spraying it on the apple for the Codling Moth, and on the plum for the Curculio, report very favourable results." This remedy should certainly be tried by every one. The proportion of Paris Green in this mixture should be much weaker than in other applications. Mr. Woodward, of Lockport, N. Y., gives one tablespoonful to a barrel of water as the proper quantity. After spraying an orchard with Paris Green, animals should be kept out until after a rain. It is probable that Paris Green acts as a protection against the Codling Moth in a two-fold capacity; not only is the small amount of the material eaten by the caterpillar a poison to it directly, but also it appears that the parent moths avoid the trees bearing this arsenical compound on their leaves. The trees should not be sprayed until the blossoms have well passed maturity, and may be done at any time before the young fruit has turned down from its increasing weight.

Canker Worms (*Anisopteryx vernata*, Peck, and *A. pometaria*, Harris).



Fig. 10—*A. pometaria*, (Harris.)
a, male moth; b, female; c, joints of antennæ of female; d, an abdominal segment of female.

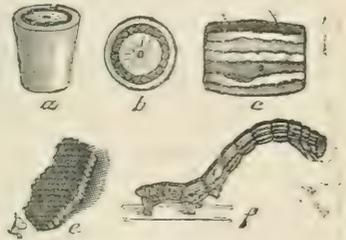


Fig. 11—*A. pometaria*, (Harris.)
a, egg; b, do. end view; c, mass of eggs; f, caterpillar; e, enlarged segment of caterpillar.



Fig. 12—*A. vernata*, (Peck.)
a, male moth; b, female; c, joints of female antennæ; d, an abdominal segment of female; e, ovipositor of female.

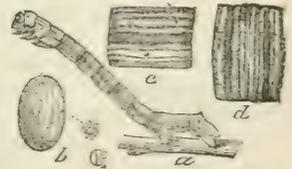


Fig. 13—*A. vernata*, (Peck.)
a, caterpillar; b, egg; c, d, enlarged segment of caterpillar.

There are two distinct kinds of moths in Canada, the caterpillars, of which are known by the name of Canker Worms. These two species resemble each other closely, both in habits and appearance. The moths of one kind, the Fall Canker-worm (*A. pometaria*) appear in October and November, and the eggs are laid then, and remain on the trees all the winter. Of the Spring Canker Worm moths a small proportion emerge in the autumn; but the greater number do not appear until the spring. The eggs of both kinds hatch at the same time.

Canker-worms are complained of in Nova Scotia. Mr. C. R. H. Starr, of Port Williams, N.S., writes: "The most formidable enemy the apple grower has to contend with just now, in this section of the country, is the 'Canker-worm,' which has in many instances during the last five years left orchards in June leafless, and looking as though run over by fire." Mr. Starr also writes:

"The remedy most successful in combating the Canker-worm has been printers' ink, applied to bands of tarred paper around the trunk during the autumn, which in some cases would require to be renewed daily to prevent the moths bridging them over with their dead bodies. Paris Green and London Purple have both

been used largely with good effect during the spring, by mixing a spoonful in a bucket of water and applying with a force pump."

Mr. R. W. Starr, of Starr's Point, Port Williams, N.S., also writes me concerning these insects, and as he is an experienced fruit grower, and gives the remedies which I also consider the best, I give them in his own words.

"The Canker-worm is really the most serious insect pest we have had to deal with, and in certain localities has caused a great deal of loss, large orchards being stripped of fruit and foliage in a very few days. Various methods are used for prevention and remedy. Among the various preventatives, a band of tarred paper, 6 to 10 inches wide, around the trunk of the tree, and well smeared with printers' ink, put on in November and well looked after, and the ink renewed until the ground freezes, and then again renewed in the spring, has proved the best. To destroy the worms a solution of Paris Green or London Purple, applied with a force pump to the foliage, is most generally used, care being taken to make the solution weak enough not to injure the leaves but yet strong enough to kill the worms. Some have used with good effect a mixture of finely slaked dry lime and Paris Green dusted on the trees by means of a bellows and tube forming an asperser. This is used when the dew is on the leaves, and it is claimed to be better than the solution, as it adheres to the damp foliage, and, being white, shows where it strikes, so that there need be no part of the tree untouched. It is also claimed that it is not so dangerous to the foliage and less labor to apply.

"I am happy to be able to state that they have a great many natural enemies. In my own case I seldom have to resort to any further means than encouraging the birds about my orchard and keeping a large flock of Brown Leghorn hens. I call the chicks and thrash the trees with a long pole, then sweep the pole around under the branches to break the webs which they spin to lower themselves with, and leave the chickens to do the rest. During the winter months, when pruning, I am always on the lookout for eggs of both caterpillar and Canker-worm, and frequently find the latter perforated and dry, the work of some minute enemy."

The Eye-spotted Bud Moth (*Tmetocera ocellana*, Schiff).

These annoying little creatures are complained of from many localities and are difficult to treat. The small brown caterpillar commences operations early in the spring and attacks the young buds, and is particularly partial to the young flower-bearing shoots. It commits its worst depredations in the month of May, while the apples are in blossom, and not only eats the flowers and young fruit, but bores down the centre of the shoot and kills the twig. I do not know for certain the life history of this little moth, but believe that it passes the winter as a larva on the branches of the apple trees, protected by a covering of silk. I have found small brown larvae hibernating in this manner at Kentville, N.S. The size of the caterpillar in spring, when it attacks the buds, also points to the probability of this view. "The larvae are usually full grown by the middle of June, when they change to dark brown chrysalids within their nests, from which the perfect insects escape in July."



Fig. 14.

measures, when its wings are expanded, about half an inch across. It is of an ash-grey colour. The fore wings have a whitish-gray band across the middle, and there are two small eye-like spots on each of them, one near the tip, composed of four little black marks on a light-brown ground, the other, near the hind angle, formed by three minute black spots arranged in a triangle, with sometimes a black dot in the centre. The hind wings are dusky-brown."—Saunders "*Insects Injurious to Fruits.*"

An interesting account of an attack, which I refer to this species, being put a stop to by birds, is noted by Rev. J. R. Hart, of Bridgetown, N.S. :—

"Two years ago our apple trees were attacked by a large number of brown grubs which ate the young leaves and fruit buds just as they were opening. The grub was about half an inch in length when full grown, and about the size of

a large darning needle. I tried to watch them developing, but the birds so industriously gathered them up that I could find none coming to maturity. Last spring a few appeared but their ravages were insignificant."

Mr. J. N. Coleman, of Lakeville, N.S., reports the insect as particularly obnoxious to freshly-set scions, where it does great harm, by destroying the buds. Scions should always be closely examined for eggs or small larvæ of insects, especially when received from a distance. An alkaline wash would always be useful in cleansing them from any eggs of insects or young larvæ.

Specimens of this insect will be most acceptable during the ensuing season, and may be sent long distances by mail, if packed in tight tin boxes, *without* any holes punched in the lid, "so that the insect may breathe." This is entirely unnecessary with most insects, and is frequently the cause of their death, on account of their food drying up. Baking-powder tins and mustard tins are very useful for this purpose.

PLUMS.

The Curculio (*Conotrachelus nenuphar*, Herbst).

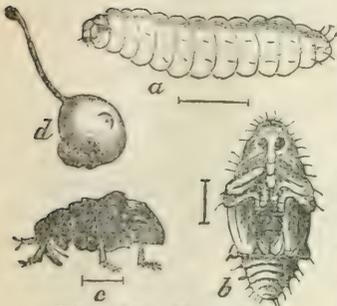


Fig. 15—Curculio.

The Curculio is still the most injurious insect which attacks the plum tree—and this, I believe, in all parts of Canada. There is no doubt that this insect could have been kept down in numbers, so as to allow of a good crop being secured every year, by the well established, simple method of jarring the trees; but this appears to have been neglected by fruit-growers of late years, and, consequently, complaints come in from all quarters of the depredations of the Curculio. Fig. 15 shows the beetle and grub, and plum attacked by the former. The unwelcome intelligence recorded below shows that new districts are suffering from its work.

"This insect, which has been so destructive in older sections of the Province has made its way here. Our district, once so famous for plums, runs the risk of losing its reputation, unless some remedy is found. One trouble is, many of our farmers, who are not careful observers, do not know what is the matter when they see the ground under their plum trees covered with newly-formed fruit, from the size of a pea upwards, and consequently do not take any steps to prevent the depredations of the Curculio."—R. J. DOYLE, Owen Sound.

Mr. George Henry, Bowmanville, reports: "A bountiful crop of plums ripened, but so large a quantity of fruit set on the trees that the ravages of the Curculio may still have been considerable. Cherries are almost extinct in these parts, so great is the prevalence of Black Knot, and the few Cherries that are produced are wormy." From further correspondence with Mr. Henry's son, Mr. Thomas Henry, on the latter point, he is confident it is the Curculio which attacks them, having frequently shaken the beetle from the cherry trees. He has also noticed that those trees which stand nearest the plum trees are the most severely attacked.

"The curculio is very destructive to our Plum crop, and not only the Plums, but the Cherries have to suffer from his insatiate appetite. He has been a long time among us and is pretty well known. The only method of destruction used in his case is to jar him down on to a sheet and make him prisoner, when he gets a short shrift. I find that the services of the Leghorn chicks come into play well here. I do not have to provide a sheet. I simply do the jarring, and they make the prisoners and execute justice without delay."—R. W. STARR, Port Williams, N.S.

It is manifest that some plums are not so much attacked by the Curculio as others. At the late meeting of the Fruit Growers' Association of Nova Scotia, there was considerable discussion concerning the "Masters Plum," a variety produced at Kentville, N.S. This plum, it was stated, was almost exempt from the attacks both of the Black Knot and the Curculio. The Rev. G. F. Day, in answer to the sugges-

tion that possibly it was a heavy bearer, and therefore the attack was not noticed, responded, that on the other hand, it was not a very heavy bearer, and he had examined trees all through the season, but never could detect the work of the Curculio, either by fallen fruit beneath the trees or injured fruit upon them. As already mentioned under the heading of "Codling Moth," during the past year or two experiments have been tried, which have resulted in a most remarkable and unexpected success in the treatment of the Curculio, by spraying Paris Green or London Purple over plum trees as soon as the blossoms fall. It has even been found that where alternate trees in the same row or orchard have been sprayed, those treated with Paris green were not attacked, whilst those not so protected, were badly infested. This discovery is of the greatest importance, and if used regularly, and varieties of Plums, exempt from attack, are grown, no doubt before long the Plum Curculio will be as completely brought under control as the Colorado Potato Beetle.

GRAPES.

The injuries to grapes by insects during the past year have not been so severe as usual. *Haltica chalybea*, Illig, was complained of this year in the Ottawa district as injuring the buds of the Concord, Salem, Martha and Brighton vines.

The Grape Phylloxera (*Phylloxera vastatrix* Planch.).

A great many enquiries have been made as to whether we have in Canada the true grape Phylloxera. There is no doubt that we have, and Prof. Saunders, of London, tells me that several instances have come under his notice in Western Canada, where this insect has seriously injured grape vines in gardens and small vineyards. However, from the long time that the Phylloxera has been known to exist in Canada, and from the comparatively small amount of injury it has committed, I do not think that we shall ever be troubled in Canada in the severe manner in which some other countries have been. Before long, too, we may hope that the study which this insect is receiving will be productive of some practical remedy.

When returning from the Pacific Coast during the past summer I had the pleasure of meeting and travelling with Prof. Dwinelle, Lecturer on Practical Agriculture, at the University of California, who informed me concerning some important experiments which are now being prosecuted on the grounds of the University, in the direction of grafting the best wine grapes upon the native *Vitis Californica*, which is said to be exempt from the attacks of the Phylloxera. I have also heard later from Mr. J. J. Rivers, of the same University, that "if 'resistent stock' with vines proves a success, then grafted vines alone will be used. This plan is now being tried by our gardeners at the University."

I have received from Mr. F. B. Caulfield, of Montreal, a pretty little beetle, *Phymatodes amoenus*, which had been sent to him by Mr. G. J. Jack, of Chateauguay Basin, P. Q., with the information that it bored in grape vines.

In 1864 the Rose-beetle (*Macrodactylus subspinosus*, Fabr.) was very injurious to grape vines in the County of Simcoe, particularly in the Townships of Walsingham, Charlotteville and Middleton. The following successful remedy has been sent to me by Mr. J. B. Carpenter, of Simcoe, Ont.: "In 1883 I had a very large crop of grapes, and in going among the vines one afternoon, in June, I found countless thousands of the Rose-beetle destroying the flowers and young grapes—the leaves were literally covered with them, and they threatened total destruction, so I concluded to experiment on them. There came a very heavy shower of rain, just before evening, and after it ceased I took a swab and dipped it into coal-tar, having a boy with me to light the torch. I moved along and gave every vine a good smoking, moving the blaze quickly so as not to injure the vines, and we went through the whole vineyard in a very short time, using less than half a gallon of tar. The next morning there was not a beetle to be seen. I have not had a chance to use the remedy since, but I am satisfied that it was the black fumes of the coal-tar that did the work."

GOOSEBERRIES.

The Imported Currant Saw-fly (*Nematus ventricosus*, Klug.), when not promptly treated with hellebore, did a considerable amount of damage in some sections. The Gooseberry Fruit-worm (*Dakruma convolutella*, Hub.) although appearing in most districts heard from, does not seem to have done much harm. This, or an allied species, I found in small numbers in the garden of Mr. John Murray, at Spence's Bridge, B.C., and also heard of its depredations at Cowichan, V.I.

Remedies.—It has been suggested to dust air-slaked lime freely over the bushes in spring, to prevent the moths from laying their eggs on the young fruit. Hand picking is also a successful remedy. When the berries are attacked they turn prematurely red and should at once be gathered and destroyed.

The Currant Plant-louse (*Myzus ribis*, L.).

Two reports of severe attacks by this insect have come in, one from Nova Scotia, where great injury has been done to the gooseberry bushes, the other from Vancouver Island.

Mr. Isaac Shaw, of Berwick, N.S., writes: "For the last five years a small insect has attacked the Gooseberry bushes in this place; they blight the entire foliage, and stand proof against lime, ashes, brine, or drugs of any description yet tried. Dr. Middlemas, of this place, after having applied without success everything he could think of, dug up and cleared his garden of a fine lot of bushes which, previous to the attack of these insects, had yielded very large crops of fine fruit. Large numbers of Gooseberry bushes have been planted in this valley during the past two years and, if no remedy can be found to stay the ravages of this foe, much loss will come to small-fruit growers on this account."

Remedies.—As a general thing these insects do not appear in sufficient numbers to work the destruction mentioned by Mr. Shaw; when, however, they do, there are some standard remedies which can always be tried, and will be found successful. Syringing the bushes with a solution of pyrethrum with a little soap in it, with a kerosene emulsion, or with a carbolic wash, would undoubtedly have destroyed these insects.

CURRANTS.

The Currant Weevil (*Anthonomus rubidus*, Say). Just before the White Currants change colour and ripen, it is frequently noticed, at Ottawa, that many of them turn brown and shrivel. These either fall to the ground or hang on the bunch. Upon opening these shrivelled berries a small white grub will be found, which later in the season hollows out a cell for pupation and ultimately produces a little reddish-brown weevil. This insect in some gardens has destroyed as much as 5 per cent. of the crop. It is also recorded as attacking the Raspberry; but I have not noticed this at Ottawa, even in the gardens where its attacks upon the White Currants have been worst.

Mr. S. Greenfield, of Archville, near Ottawa, reports that a species of bark-louse was very injurious to his currant bushes. The wood produced was very small and the fruit was bitter and unpleasant.

The Imported Currant-borer (*Aegeria tipuliformis*, L.) commits considerable depredations every year, and has a very wide distribution over the Dominion. The caterpillar burrows for a distance of two or three inches down the centre of the stems of Red, White and Black Currants and Gooseberries, destroying the pith and some of the wood. The moth appears in the month of June, and is a pretty little creature, resembling in general appearance a small wasp.

Mr. R. W. Starr, writing from Port Williams, N.S., says: "This insect is widely spread, and very destructive to the Currant bushes in this locality. There is scarcely a garden in the country but can furnish evidence of its work."

The only remedy which can as yet be suggested is to prune closely and cut out the infested wood and burn it, to prevent the contained caterpillars from completing their transformations.

These, above mentioned, comprise all the attacks on fruits which have been seriously complained of during the past year; but in addition to what is quoted there is a vast amount of information contained in notes and letters from correspondents, which will be of great use in the future.

FOREST AND SHADE TREES.

CONIFERÆ.

Of all the insect foes against which the Economic Entomologist has to contend none are so difficult to treat as those which attack the giants of the forest. When we consider that in British Columbia we have magnificent Cedars more than 300 feet in height and with a diameter, in rare instances, of 17 feet, man's inability to protect them against their insect foes is made manifest. With the shade-trees, however, with which we beautify and render healthy our streets and gardens, we are able to attain a certain amount of success, and now, by means of the various ingenious contrivances which have been produced at Washington under the able supervision of Prof. Riley, there are few of our shade trees which may not be easily protected by spraying poisonous compounds over the foliage. For those insects which attack forest trees, such wholesale application of remedies as would be necessary, is out of the question, and the only steps we can take are such as will foster and protect their natural enemies.

AMERICAN LARCH OR TAMARAC.

The Larch Saw-fly (*Nematus Erichsonii*, Hartig.)

In my last report I referred to the ravages of the Larch Saw-fly upon the Tamaracs in New Brunswick, Quebec, and part of Ontario. This attack, at that time so serious, does not appear to have increased, during the summer of 1885, to the same degree as it did the two previous seasons, nor to the extent to which, judging from the past, I had feared that it might. It made its appearance at Ottawa, and all the colonies observed were promptly destroyed by Mr. W. H. Harrington in July. In the infested districts the attack does not appear to have attracted so much notice as before, and I believe we may, with reason, hope that this plague is passing away.

Mr. S. A. Fisher (M. P.), writing from Brome, Que., where he had taken me to visit some trees in July, 1884, which were, in many instances, entirely defoliated, says as follows:—"I have seen the Tamarac trees several times since I came home in July, but have noticed no destruction comparable with what we saw last year."

Dr. A. S. Packard, jun., special agent of the Department of Agriculture, Washington, in his second report to the Entomologist on the Cause of the Destruction of Forest trees in Northern New England and New York, gives the following favourable report:—"On the whole, while a small proportion of Larches have been killed by this worm, this vigorous tree, though defoliated for two successive summers, seems, in the majority of cases, to survive the loss of its leaves, though it threw out much shorter ones the present summer. Possibly 10 per cent. of our Northern Larches died from the attacks of this worm. Very probably the numbers of this insect will diminish during the next year (1885), and the species may ultimately become as rare as it always has been in Europe, until a decrease in its natural insect parasites and favourable climatic causes, induce its undue multiplication."

With reference to the effects of the defoliation of the Larches by this insect, many instances have been brought to my notice where, after the attack had finished, the leaves in each fascicle, which had been eaten right down to the base, were further developed about one-quarter of an inch in length. This amount of foliage I have no

doubt materially assisted the tree in sustaining its vitality. Probably every year more of our native predaceous insects attack the Larch Saw-fly, and important information comes from Quebec where Rev. T. W. Fyles, of South Quebec, has found the pupæ much attacked by some unknown predaceous insect. He writes under date 12th November, 1885 :—

“ I send you herewith some cocoons of *N. Erichsonii*, which I secured early in the season. On my return from London I went to the spots in which they had been so abundant; and, strange to say, every cocoon I met with had been opened at one end and its tenant extracted. I send you some of the empty shells. What kind of creatures have been the aggressors—ground-beetles, predaceous larvæ, or what? Evidently they had done their work thoroughly. I could not find one sound cocoon. I think this discovery an important one.”

Upon enquiry as to the possibility of the cocoons being old ones from the year before, Mr. Fyles gives the following answer :—

“ After the meeting of the Entomological Society of Ontario, remembering your request, I went to the spot to obtain cocoons for you; but whereas on the former occasion I had found numbers of the sound cocoons but no empty ones, on the latter I met with abundance of empty cocoons but not a single sound one. At first I considered whether the insects finding themselves in an unsuitable position had bitten their own way out, and sought other quarters, and I dug deeper and examined the surroundings; but I soon abandoned the idea, remembering that I had had others of the same batch of cocoons exposed in a recessed window of my study, and yet others which I had carried about the country, all of which remained intact. I could only come to the conclusion that the exposed cocoons had been assailed by predaceous insects.”

“ You will have observed that the empty cocoons are of the same texture and colour as the sound ones. Supposing that vacated cocoons of last year’s insects could have remained till the date of my discovery, they surely would have been more broken, blackened and decayed than those which I sent you.”

The cocoons when received were much begrimed with damp earth; but upon washing and comparing them I believe Mr. Fyles is correct in his assumption.

From the nature of the attack of the Larch Saw-fly and the habitat of the Larch tree being in deep peat bogs, nothing can be suggested as a remedy. When the native Tamarac or the European Larch are grown as ornamental trees upon lawns, attacks of this Saw-fly have been arrested by spraying hellebore over the trees. This has been done at Ste. Anne’s, P. Q., on the grounds of the Hon. J. J. C. Abbott.

SPRUCE.

Enquiries have been received from Quebec and New Brunswick with regard to injuries to Spruce forests, and a few specimens have been received from New Brunswick of the work of the Spruce Bud-Moth (*Tortrix fumiferana*); but I do not think that this is the cause of the injury complained of, and taking advantage of Dr. Packard’s investigations in Northern New York, Maine and New Brunswick, I believe that the injury results from the attacks of small beetles, *Scolytida*, which attack the trunks of vigorous, growing, trees. I have not yet succeeded in getting specimens; but have been promised a good supply next summer; the species can then be identified.

I have been informed by Mr. Edward Jack, a gentleman who has spent many years of his life in the forests of New Brunswick and has been a close observer, that he first noticed the diseased state of the Black Spruce, about 10 years ago, when his attention was called to it by the large amount of débris lying on the snow in winter. This he attributed to the operations of woodpeckers in hunting out the grubs. He afterwards noticed that the tops of the trees were red. This attack was particularly noticeable on the ridges, where the trees grew thickest and had never been cut amongst.

Mr. Jack was of the opinion that “ the only remedy is prompt cutting, when the disease is first observed, at once cut out the injured trees. When they die before they

are cut they are not used for lumber. Spruce forests are different from Tamarac. I have noticed for 25 years that as soon as Tamarac is cut amongst it becomes diseased; but as soon as Spruce is thinned out, the other trees improve and disease will stop. When Spruce grows amongst Cedars, on low lands, it is not nearly so much attacked as when growing in dense bodies, in fact the more valuable the Spruce land the heavier the attack."

Mr. C. E. Towle, D. L. S., of Lachine, Quebec, informs me that this "Spruce disease" was very bad a year or two ago in the Township of Windsor, along the St. Francis River and in the Township of Dudswell and adjoining townships.

From Dr. Packard's report, above referred to, we are again able to receive comfort; he says, after recounting the results of his investigations: "From various persons we learned that the evil is now abating, and without doubt if the tracts of dead Spruce, at least those near settlements or villages, could be cut down and removed, leaving, however, the Spruce undergrowth, a new growth of Spruce would spring up which in 40 or 50 years could be profitably lumbered."

The Spruce Saw-fly (*Lophyrus abietis*, Har.)

This insect has been bred and collected by Mr. W. H. Harrington, on Spruce, at Ottawa. Larvæ, which, according to Dr. Packard's Bulletin on Insects injurious to Forest and Shade trees, apparently belong to this species, although differing somewhat in appearance from those found on the Spruce, were also found by him very abundant on White Cedar.

Mr. Brodie, of Toronto, also announces that he has found the Spruce Saw-fly in that locality. He collected a large number of the larvæ and reared them to maturity and found them very irregular as to their time of appearance. No parasites were found by him.

PINES.

Mr. J. Goldie, of Guelph, has set a good example, for which he deserves great credit. Some time ago he imported from England a stock of ornamental pines. Upon planting them in his grounds, he observed that they were injured by some Weevil which attacked them just above the ground, and not only mined under the bark, but bored into the substance of the wood. Directly he detected this, he at once grubbed up the trees and burnt them, thus arresting the injury before the insect had become established in the neighbourhood.

On the Pacific Coast the magnificent Coniferæ seemed comparatively free from insects which attack living, vigorous trees.

At Spence's Bridge, British Columbia, I had an opportunity of examining the *Pinus ponderosa* groves. This handsome pine is sparsely scattered all through the interior of British Columbia, and formed almost the only reliable source of firewood previous to the completion of the Canadian Pacific Railway. The living trees seemed very free from injurious insects, although several species of *Buprestidæ* were collected from the piles of cordwood lying at the foot of the mountain.

Mr. Murray kindly obtained horses and we both rode up into the mountains to examine the trees. Although a large collection of insects was made, none were of economic interest, except a *Lepidopterous* larva, which was found to be burrowing in the cones of *Pinus ponderosa* and destroying the seeds. But few of these were found, and I was unable to rear them to maturity. I had previously heard of this insect from Mr. Albert J. Hill, C.E., in 1881, when it was much more abundant. At that time Mr. Hill wrote: "The cones are everywhere attacked by a small white grub, which works from the centre, and following the spirals of the cone destroys all the seeds, so that it is difficult to procure any sound ones."

In travelling up the Fraser River, the Douglas Fir was found to be attacked by many species of wood-boring beetles, and the exceedingly active little *Buprestis Melanophila Drummondii*, Kirby, was always to be seen in great abundance on the bark. At Kamloops, a single specimen of *Monohammus confusor*, Kirby, was taken in Messrs. McIntosh & Mara's Mill.

HARDWOODS—THE MAPLES, OAKS, &c.

The Sugar-Maple Borer (*Glycobius speciosus*, Say.)

Several specimens of the above-named handsome wasp-like beetle have been sent in for identification, and considerable damage is reported to city shade-trees from its ravages. The perfect beetle is nearly an inch in length, and is beautifully marked with bright yellow bands. It is easily recognized by a W-shaped mark on the shoulders, with a semi-circular band close above, and another rather farther off below it, which almost form a circle round the W; there is then a broad band of black, and the ends of the wing cases, about $\frac{1}{3}$, are yellow, bearing two round black spots, with a curved black stripe above them.

Remedies.

The perfect beetles appear about the first week of July, and may be found well on into August. When they occur in large numbers they may be prevented from laying their eggs upon ornamental or shade-trees by washing the trunks with a soap or carbolic wash. The borers might also be destroyed in infested trees by cutting out or by inserting a stiff wire into the hole as soon as their presence is detected in spring by the dust they cast out of the burrows.

The Maple-Leaf Cutter (*Incurvaria acerifoliella*, Fitch.)

The Hard Maples (*A. saccharinum* and *A. saccharinum v. nigrum*), in many localities about Ottawa, have been found to be attacked, to a moderate extent, by the curious case-bearing larvæ of this pretty little moth; but on the 12th September last, enormous numbers were found to be destroying the foliage in the woods adjoining the Government House grounds. The Maple trees, for a space of perhaps 4 acres, had the foliage almost all consumed, and the flat disc-like cases, which had fallen from the leaves, were carpeting the ground, and were also seen in great numbers on the sides of trees; these larvæ probably had been blown down before mature, and were returning to the foliage to feed. Growing amongst the Maples were some Beech trees, and these were also eaten after the leaves of the Maple had all been devoured. The attack was very severe. The leaves were so perforated and skeltonized, that instead of the woods being green, they were cream-colored in hue. The larvæ, when full grown, are about a quarter of an inch in length, with a brown flattened head, and are of a dirty white color. They cut from the leaves small oblong wads, from which they form cases, which they carry about with them as they feed. The case seems to be fastened at one side to the leaf, and the larva then eats the green part of the upper surface, in circles or parts of circles, leaving the fibres and lower surface untouched. When it has consumed all within reach, it moves on to another spot. The cases of the mature larvæ are formed of four wads, two of which are about $\frac{1}{3}$ of an inch in diameter, and the larger pair about $\frac{2}{3}$. When full fed, which at Ottawa is in September, the larvæ fall to the ground inside their cases, where they change to pupæ in a few days, and do not emerge as moths until late in the following spring. The moth is described in Packard's "Insects Injurious to Forest and Shade Trees," as follows:—"The moth, with long narrow pointed wings; the fore pair brilliant steel-blue; the hind wings smoky brown, with purplish reflections. Between the antennæ, a dense tuft of erect bright orange-yellow hairs. (Fitch.)"

The Rev. T. W. Fyles, of South Quebec, sends me the following account of a visitation similar to the one experienced at Ottawa last year:—"This insect was exceedingly abundant in Missisquoi County in the year 1881. I noticed it particularly in the Maple groves belonging to Hon. G. B. Baker, M.P., and Mr. G. F. Shufelt, near the village of Sweetsburgh, Que. The leaves throughout extensive Maple woods were so skeltonized that they presented a brown and scorched appearance that was

very remarkable. It seemed as if a hot blast had passed over large tracts of the woodland. Myriads of the larvæ in their disc-like coatings were to be seen on the leaves and stems of the trees and on the undergrowth. Next season clouds of the perfect insects would rise from the foliage shaken by the passers-by."

OAKS.

The Oak trees, which occasionally suffer very severely from insects, have not been troubled so much as usual. In 1884 the following insects were very abundant, but did not appear this year in sufficient numbers to be called destructive:

Edema albifrons, Sm.-Abb., appeared in great numbers and was most injurious to both Oaks and Maples at Ottawa.

Clisiocampa disstria, Hub. (*C. sylvatica*, Har.), the Forest Tent-Caterpillar, was very injurious in parts of Nova Scotia and New Brunswick, I have been informed, entirely defoliating large tracts of hardwood bush. In British Columbia I heard complaints of the oaks being frequently stripped bare by the larvæ of a geometer. None of the above, however, were complained of during the past year.

The Oaks supply food for a vast number of insects. The following interesting note is from Mr. W. Brodie, of Toronto, an ardent naturalist and a prominent member of the Toronto Natural History Society, who writes with reference to the number of Hymenopterous insects alone which are found on the Oak:—

"We have, around Toronto, 4 species of Oak in great abundance. On these we have 13 different kinds of galls produced by 11 species of *Cynipidæ*, containing at least 9 species of *Inquilines*, or insects which live in and on the galls, without, however, causing their formation. The *Cynipidæ* are infested by 13 species of Hymenopterous parasites, the *Inquilines* by at least 5; that is, our oak galls contain about 38 different kinds of insects."

No reports on observations of serious attacks on other hard-wood trees have been received during the past season.

GARDEN PLANTS.

The insects which have been brought under my notice as injuring flowering plants in gardens are very few.

Cutworms were very destructive amongst bedding plants when first put out in the spring. The following preventive remedy, which I have found quite satisfactory, is given in Prof. Lintner's pamphlet on Cutworms. "*Tin Bands*—a simple, cheap and permanent device, is this:—A strip of tin two inches wide, ten inches long, bent into the form of a cylinder, with a narrow lap at each end so as to hook together." The following is given in its favor:—

"It works to a charm; no cutworm ever goes over it; it can be hooked together and put over a plant, and remain there until the plant is out of the way of the worm, then it can be unhooked and put away for another season. The inside should be painted, as the bright tin when new will concentrate the rays of the sun and burn the plant. They cost about \$1.50 per hundred, and will last a long time if painted." (*Country Gentleman*, May 31, 1877, p. 348.) I have found tomato tins, with the tops and bottoms cut out, a perfect protection against these annoying insects, and in the case of choice plants, to well repay the trouble.

When Cutworms occur in large numbers, as is frequently the case in newly-made gardens, poisoning them by means of attractive baits must be resorted to. Prof. Riley, in his Annual Report for 1884, gives as the most effectual remedy for ridding land from cutworms the use of poisoned balls of some succulent plant, and quotes the experience of Dr. A. Ormler, of Wilmington Island, Ga., who says:—"My method of dealing with Cutworms of late years has been to remove them from the field before the crop to be jeopardized is up or the plants are put out. By placing cabbage leaves and bundles of grass along the rows of watermelon hills, I caught, by hunting them daily, 1,538 worms on about one-quarter of an acre before the seed came up, and lost

but a single melon plant. On one occasion I captured, one morning, 58 of all sizes under a single turnip leaf." Prof. Riley suggested, as an improvement on the above plan, poisoning the leaves placed as traps, so as to save the labour of collecting and destroying the Cutworms.

This suggestion proved quite successful, and the cut worms soon destroyed themselves without any further labour than renewing the traps two or three times. He says:—"We used chiefly Clover, sprinkled with Paris Green water and laid at intervals between the rows, in loosely-tied masses or balls, which served the double purpose of prolonging the freshness of the bait and affording a lure for shelter."

A most remarkable attack of Cutworms occurred during the spring months in the vicinity of Victoria, V. I., British Columbia; nearly all crops were attacked, but Onions suffered most severely.

Rose trees when not closely watched were in many instances rendered unsightly by the Rose Slug (*Selandria rosea*, Har.), which eats all the green portion of the leaves, leaving nothing but the whitened skeleton. If noticed, when the attack begins, and attended to promptly, the bushes can be easily cleared by syringing with hellebore or pyrethrum. The equable climate of Vancouver Island permits the cultivation of the best varieties of French and English Roses, consequently these lovely flowers are largely grown. During the months of May, and June they were found in some gardens to be badly infested with *Aphides*, or Green Fly. The following treatment was found successful:—An open pan was half-filled with strong Soap-suds, into which, while hot, about $\frac{1}{2}$ oz. of Tobacco had been placed; when cool enough the young shoots upon which the green flies were congregated were bent down and washed backwards and forwards two or three times in the pan and were easily cleaned. A similar treatment was successfully practised by Mr. P. T. Johnson, of Cadboro Bay Road, Victoria, V.I., on young cherry trees in his nursery. Instead of Tobacco, a tablespoonful of Pyrethrum in the water would have possibly answered the purpose better. Another insect which injured the rose trees about Victoria was observed abundantly in the garden of the Hon. Joseph W. Trutch. This was a small white *Erythroneura*, usually called "Rose Thrip," which attacks the Rose by sucking the sap from beneath the leaves, giving them a white parched appearance and causing them to fall prematurely. These insects pass through their transformations upon the leaves of the plants they affect, and during the larval and pupal stages are not nearly so active as when mature. They should be treated before the perfect condition is arrived at, by syringing the trees with Soap-suds and Tobacco or Pyrethrum wash. As they keep beneath the leaves a syringe is necessary to reach them. A dry mixture of 1 part of Pyrethrum to 20 of Flour may also be used, if puffed up from beneath; but is less satisfactory than the syringing.

An interesting attack was brought to my notice by Mr. J. J. Cowley, of Victoria, V. I., who had a great many young plants of Chinese Pinks destroyed by the larvæ of a small Anthomyian Fly. The injury was first noticed about the middle of May. The egg appears to be laid at or near the base of the topmost leaves. The young maggot burrows beneath the epidermis of the base of the leaves for some time, and then bores down the centre of the stem. Mr. Cowley writes that "they did not attack the large plants of Sweet-William; but they did the small ones, also Carnations and other kinds of Pinks when small, any time before they got five or six leaves. They destroyed many of my young seedling plants entirely. When I noticed the Chinese Pinks dying, I used fine Ashes and I thought they were a preventive. I think if Ashes or Lime were sprinkled on them, so that it would go well down into the centre of the leaves as soon as, or before, the fly appears it would probably keep the female from laying her eggs there." The maggots left the plants about 1st June and went into the ground to pupate. The flies appeared about 10 days latter. An interesting point about this insect is that I found a specimen at Ottawa which was destroying Indian Pinks in exactly the same manner as those in Mr. Cowley's garden, and which produced a fly apparently identical with those he bred for me at Victoria.

Mr. Cowley also complained that—"the *Phlox Drummondii*, Candytuft, and some other plants were much attacked by a very small bug not half the size of the common turnip fly, just as soon as they appeared above the ground. They were so small that I thought for some time the plants were covered with dust until I saw they were dying and then discovered the cause. I used ashes for a few days and thought it was effective." This small insect is probably the small Podura known as the Garden Flea *Smynturus hortensis* (Fitch), which occurs in gardens in May and June and is sometimes injurious to seedlings of cruciferous vegetables, as cabbages, cress and radishes.

Amongst the regular pests of the flower garden the Imported White Cabbage Butterfly (*P. Rapæ*) has now to be considered as quite injurious. In every part of Canada where the insect has reached, it seems actually to prefer the scented Mignonette (*Reseda odcrata*) to cruciferous plants—its proper food.

The stems of the common Sun-flower (*Helianthus annuus*) have for some years been periodically brought to me, by persons desiring to know the name of the maggot which bores in the pith. This is the larva of the beautiful fly *Straussia longipennis* and is so prevalent at Ottawa that it is impossible to find a plant of the Sun-flower of which the pith is not much devoured; but strange to say, it does not appear to injure the plant to any practical extent—a giant plant, over 12 feet in height and with many branches was found to have the pith bored and tunnelled from the base to the very flowers; but yet grew with the above remarkable luxuriance and kept green and vigorous up to the first frosts.

I have the honor to be, Sir,

Your obedient servant,

JAMES FLETCHER,

Honorary Entomologist to Department of Agriculture.

The Honorable

The Minister of Agriculture,

Ottawa.

APPENDIX 1.

THE ONION MAGGOT (*Phorbia ceparum*, Meigen).

A LETTER TO THE "OTTAWA CITIZEN," 30TH JULY, 1885.

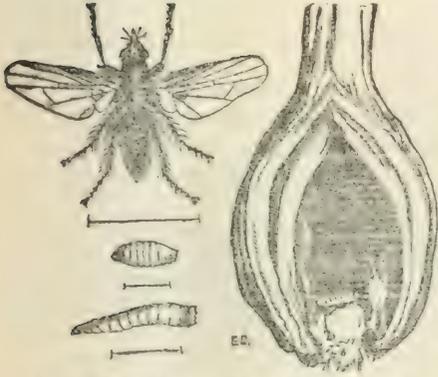


Fig. 16.—Onion-fly and maggot.

SIR,—I beg to inform you, in answer to the letter of a "Nepean Farmer," which you have referred to me for advice, that upon receipt of it I at once visited the district mentioned and investigated the cause of complaint. It proves to be a very severe attack of what is known amongst gardeners as the "Onion Maggot." This maggot is the larval stage of a small fly belonging to the *Anthomyiidae* to which order also belong the injurious flies that produce the maggots which commit such havoc amongst both radishes and turnips, and cabbages when first transplanted. Other species also mine between the upper and lower skins of the leaves of spinach and beet root. The attack in question has already made great headway, probably three-quarters of the whole crop being destroyed, but I believe with care and a little labour a large proportion of the remainder may yet be saved. For an intelligent application of remedies it is necessary to know something of the life-history of the insect we wish to subdue, and it not infrequently happens that it would be a great advantage to know exactly to what species of any genus the marauder might belong. There are, I believe, two or three of the *Anthomyiidae* flies, almost identical in size and appearance, the grubs of which destroy onions in all their varieties and at all stages of growth, from the seedling to the mature bulb. But although the perfect insects are so similar, the habits of the grubs are different, the eggs of one species are laid at the base of the leaves, and those of another on the bulb itself, the grubs attacking it from beneath.¹ It is impossible to say for certain, after the attack has progressed so far, to which species the insects under consideration belong, but they will most probably prove to be the true "Onion fly," *Phorbia ceparum*. There are several broods during the season, so that constant vigilance is necessary. The parent fly, which lays the eggs of the first spring brood, passes the winter in the earth as a pupa or chrysalis, and emerges as a perfect fly just about the time that the young onions are coming up; the eggs, five or six² in number, are then laid at the bases of the lowest leaves, and about a week later hatch out as white grubs, which eat their way down to the bulb, between the stem and sheath of the leaf; they soon destroy the young bulb entirely, which, of course, is very small at this time, and then pass on from one root to another, their presence being made manifest by the leaves turning yellow and fading. As soon as this is noticed every affected onion should be removed³ by means of a broad-bladed knife and burnt, so as to destroy the grub

1. A single instance has since come under my notice of the attack being made in the stem of the onion, quite half an inch above the bulb.

2. Major C. J. Anderson, of Ottawa, showed me in August an instance where more than 100 eggs had been laid high up on the leaves of an attacked onion, after the rows had been well hoed up. These eggs did not hatch.

3. With reference to this point, Miss Ormerod has since written to me: "Do you not think that we might improve on the old plan of digging up the infested onions, by dropping a very little dilute carbolic acid on each infested bulb? The fluid would run down and solidify into the parts where the maggots lie and kill them, and this without disturbance to the bed or injury to growing plants. Of course, in after cultivation, the carbolic acid would be so dispersed that it would not cause injury."

inside it. The importance of raising the whole bulb and a portion of the ground round it, by means of some broad instrument, is very great, because if the plants are simply pulled up it is most likely the grubs will be left in the ground, for they are not always inside the bulb, but lie just outside, in the earth. It is also most necessary to destroy the injured onions, as the following will clearly show: Miss Ormerod, the Entomologist to the Royal Agricultural Society of England, cites an instance of one of her correspondents who noticed that some of his onions showed signs of flagging while still only about the diameter of a knitting needle. Every onion so affected was at once taken up and carefully burnt. The beds were treated this way every two or three days for three weeks, and the result was, there was no further damage during the summer, and the crop of onions was the only good one in the neighbourhood. One of the gardeners employed on this work had an onion bed in his own garden, and followed the plan so far as to pull up all the faulty onions, but threw them down a short distance from the bed, and the consequence was, he lost his entire crop. Unluckily "Nepean Farmer's" crop is too large, and the insects have now done so much injury that this remedy is not practicable at this busy time of the year; but it is imperative that something should be done to preserve the remainder of the crop and also to destroy the grubs so as to prevent their ravages next season. After many experiments with these insects I have come to the conclusion that the best remedy is hot water. This can be easily applied by means of an ordinary pot with a spout, and should be heated almost to the boiling point and poured along the rows with the nozzle close to the roots, so that the hot water may go directly on the bulbs but not on the leaves. It has been found that this does not injure the onions, but kills the grubs; and does not require any large expenditure of labour or time. After this treatment the onions should be hoed, and the earth well drawn up over the bulbs, so as to prevent further attacks.⁴ With reference to the earthing up of onions, most satisfactory results have followed in England, where Miss Ormerod has advised for some years that the onion bulbs should be covered with earth up to the neck, or even higher, so that the fly could not get at the bulb to lay its eggs upon it. When mature, the eggs *must* be laid, and if the bulbs are well covered up they are laid too high up on the foliage to do any injury, or are dropped on the earth and perish.

This plan has actually been carried so far as to grow onions in a trench, and as the bulbs grew the earth was worked down upon them so as to keep them buried throughout the season. The crop was found to be very fine, the onions large and sound, with scarcely any attack of the fly.⁵

Where there has been a severe attack of any insect which passes the winter in the ground a useful remedy in Gas-lime. This is a waste product from gas works, and should be easily obtained. It is of a most poisonous nature when fresh, both to plants and insects, but becomes, after some months exposure to the air, a valuable fertilizer, and is harmless to vegetation. A dressing of this substance, after the crop of the year has been removed, would undoubtedly be of great service in killing all the pupae or hibernating larvae, and would at the same time enrich the soil.

I may, in conclusion, mention that good results have been obtained this season in Stewarton, near Ottawa, by sowing along the rows, in onion beds, sand saturated with coal oil every two or three weeks, whilst the onions were small, and until they were hoed up; the odour of the mineral oil evidently keeping off the flies when they came to deposit their eggs. Gas-lime sown in between the rows would also answer the same purpose. This preventive remedy is of course the best means of securing a crop, and care should be taken at the time the rows are thinned out to draw the soil well over the plants so as to prevent the deposit of eggs on the bulbs. Any plant with a strong odour, as an onion, is doubtless more susceptible of an attack when

4. This treatment was tried and proved quite successful.

5. Miss Ormerod writes me on September 19, 1885: "My trench onions have been doing well this year, and whilst the rest of my garden crop grown on the flat suffered greatly from the long drought, those in the trenches were a very good size. The ground between the trenches is not wasted, for we had very nice lettuce off it."

being hoed or thinned out, for two reasons—not only does the odour of the broken plants attract insect enemies, but the vigour of the plant being temporarily impaired by the root fibres being disturbed and broken, it is less able to withstand such injury.

Hoping that this information may be acceptable and useful to your correspondent, and begging any others who may find their crops attacked to apprise me of the fact as soon as possible,

I am, Sir,

Your obedient servant,

J. FLETCHER,

Honorary Entomologist to Department of Agriculture.

OTTAWA, 29th July, 1885.

N. B.—There are still some points affecting this question with regard to the cultivation of onions which I have not yet fully worked out. My thanks are due to Mr. E. Bell, of Archville, for trying experiments and assisting me in other ways in the study of these different root maggots.

J. F.

APPENDIX 2.

INSECTS INJURIOUS TO FRUIT TREES.

An Address delivered before the Fruit-Growers' Association of Nova Scotia at their Annual Meeting held at Kentville, N.S., by James Fletcher.

MR. PRESIDENT AND GENTLEMEN,—Some time ago there came into my hands, by accident, a copy of the transactions of your society, and in the perusal of this report I was so much struck by the amount of practical common sense by which the discussions at your meetings were characterized, that I was induced to write for a complete set of the transactions. By this means, and through the courtesy of Mr. C. R. H. Starr, your energetic secretary, I was put into communication with several of the leading fruit-growers of the Annapolis valley, members of this association, from whom I have received most valuable assistance in carrying out the work with which I have been entrusted by the Government, the importance of which none can appreciate better than you, who are daily brought face to face with the large amount of injury wrought by our small but powerful enemies of the insect world. When I received an invitation to be present at your annual meeting and deliver an address before you, I accepted gladly the permission to attend, given by my Minister, the Hon. J. Carling, a gentleman whose name is well known as a promoter and patron of scientific agriculture in Canada, and to whom really belongs the honour of having conceived, and organized, the institution which was afterwards re-located and has developed into the Ontario School of Agriculture and Experimental Farm at Guelph. It may not be amiss, here, to explain exactly what my position is as Dominion Entomologist. The appointment was made by the Hon. J. H. Pope when Minister of Agriculture, in 1884, in response to recommendations from several persons interested in agriculture in various parts of the Dominion, and particularly by the Select Committee on Agriculture which met at Ottawa during the Session of 1884. It was decided that the appointment should be purely an honorary one; in fact it was an experiment to test the value of such investigations, to the country at large. This decision was, I believe, a very wise one, for I have found by experience that farmers, agriculturists and orchardists throughout the country, among them many of you here present this evening, upon learning this fact, have gone to considerable trouble to assist me in my studies, which might not have been the case, to such a large extent, had this been a remunerative political appointment. The importance of the work itself would, of course, have demanded their attention before long; but I cannot help thinking that at the beginning, at any rate, this kind of work should be carried on by a specialist—one who takes it up and labours at it for its own sake, without thought of any reward, further than that the results arrived at may be of benefit to the world. For my own part I feel highly privileged in having been allowed to labour in this great cause, knowing well the enormous importance, to all engaged in agriculture and horticulture, of a knowledge of Economic Entomology—that is, the life histories of Injurious and Beneficial Insects, and the best methods of keeping the former in check.

I am safe in saying that an average of at least 20 per cent. of all crops produced, is annually destroyed by insect agencies. Of this proportion 15 per cent. can undoubtedly be saved by simple methods. It has been calculated that there are upwards of 200 different insects which attack the apple alone. Of this large number probably most can, with care, be prevented from seriously injuring the crop.

The fame of Nova Scotian apples is world-wide. I have seen them in England, exhibited and advertised as such, on account of their well-known good qualities; and again, I have had apples shown me in the far west of this continent, in Oregon and Washington Territory, with the boast that they were as good as any which could be

produced in Nova Scotia. This plainly showed that yours were recognized as a standard of excellence.

The apple trade between your Province and England, which has been so largely built up by the efforts of this Association, is now of great importance, and therefore any subject which materially affects it, is of the deepest interest to every member of the community. Such a subject, I maintain, is practical Entomology.

I am aware that many of you here already know the value of this study; but there may be some amongst you who have not yet fully appreciated to what extent and with what comparative ease you may be helped in your constant struggle against injurious insects. It is the conviction that I can give you advice which will enable you, by simple and practical methods, to keep down a large proportion of your insect enemies, which has induced me to come here and presume to take up a part of the time, all too short, which you set apart for the discussion of the important subjects you have to consider at your annual meetings. Fully recognizing the value of every minute, I shall endeavor to make my remarks as short and as much to the point as possible. With this object in view, as soon as I knew for certain that I was to have the honour of addressing you, I wrote to several of your members to enquire what insects had made themselves most obnoxious, so that I might treat especially of those kinds concerning which information was most required and would be most acceptable. I found that the insects which trouble you are mainly the same kinds which, although in a varying degree, harass the fruit-grower in other parts of Canada, and, as published accounts of these, with the best remedies, are easily accessible, I shall, during the time at my disposal this evening, direct your attention to a few general principles, a knowledge of which will be found useful for the proper understanding and intelligent application of remedial measures; and I shall rely on further opportunities of giving information concerning special pests, by answering questions put to me during the meeting, or by private conversation afterwards with individual members. I beg you to remember that the more questions you ask me the better I shall be pleased, and should you not agree with what I say, I shall take it as a special favour if you will tell me so, and by this means we shall come to an understanding which will be mutually beneficial. The accusation has occasionally been made that entomologists couch their language in scientific terms and mar their writings by using unnecessary technicalities, which render them unintelligible to many, for whose benefit they profess to have specially prepared them. This is possibly, to a certain extent, true; but it must be borne in mind that these scientific terms are merely exact names, applied for the special purpose of avoiding error, and as in every trade, those who traffic in it, find it necessary to become familiar with the terms used therein, so in like manner is it the case with the different branches of science; but, whereas a trade may be confined to any country, the special terms belonging to it may be in the language of that country, without causing confusion; on the other hand, the results of science—which is merely another name for the highest knowledge—cannot be confined to one country alone, and therefore, in order that they may be comprehended by all nations, scientific students use for their special terms a language which may be learnt by all. For this purpose the classic languages, Latin and Greek, are, by common consent, made use of, from the fact that being dead languages, and not spoken by any living people to-day, they cannot change, but remain now, and will remain for all time, in exactly the same form as when spoken in classic times by the ancient Romans and Greeks.

These terms, however, are for the use of scientific entomologists, who require to speak or correspond with each other, in exact language, about a large number of different insects. Now, I am under the impression that for the purposes of Economic Entomology these technical scientific terms may be almost, if not entirely, dispensed with; for although the actual number of known insects is enormous, those species which bring themselves conspicuously under our notice, by means of the ravages which they commit on our cultivated crops, are comparatively small, and I think distinctive English names can be found for them all. The chief thing necessary when a farmer finds his crops attacked by insects is to discover the cause, so that he may

apply the proper remedy, and it matters little to him what the name of the culprit may be, or by what minute differences it is separated from its nearest relatives. What concerns him most is to recognize the nature of his enemy by the state of his crops, and thus to discover the best means of putting a stop to its ravages.

To enable him to do this, some knowledge of the life-histories of our common insect pests is indispensable. By this I mean he should strive to get sufficient information to recognize them in their different stages of grub, chrysalis, and perfect insect; for it frequently happens that they are open to our attacks in one of their stages, while they can defy our efforts in the other stages of their existence. The life of an insect is divided up into four well marked periods, during each of which their habits are entirely different. These are: 1. The egg; 2. The caterpillar or larval stage, during which, as a rule, they are most injurious; 3. The chrysalis or quiescent stage, in which, except in a few orders, the insects lie quiet, and are without the power of motion; and 4. The perfect insect. Some insects are injurious in three of their stages, but the larger number in one only, so that unless we know them in all their forms we may lose opportunities of destroying them, from not recognizing them as enemies. It is clear that the farmer who possesses this information has a great advantage over the one who does not.

I would not, of course, advise men who are actively engaged in fighting the battle of life to stop and study the, to them, unnecessary details of a difficult science; but I firmly believe from the fact that insects play such an important part in the economy of nature, that a knowledge of the general principles of Economic Entomology is an absolute necessity for all who wish to become successful fruit-growers.

There seems, however, to be a prevalent opinion that much time and study is necessary for the acquisition of sufficient knowledge to bear practical results, and many of my correspondents, who give me most useful information concerning the lives of insects, begin their letters by saying that because they know little of entomology, therefore, their information will probably be of little value.

Now, I hope this evening to be able to convince you that both these views are very erroneous. With regard to the former, I shall endeavour to show you that the actual amount of this information, necessary for a farmer to secure good results, is small and easily acquired; for it will be found upon examination, that all injuries committed by insects conform to certain general plans in accordance with the form of their mouth-parts, and also that all remedies are applied upon broad general principles, dependent upon the same structural characters.

If you examine a large number of different insects you will find that, they all may be roughly divided into two large groups, by the form of their mouth-parts. These two groups are: 1. Those which possess jaws, by means of which they consume the substance of their food, and 2. Those which have instead a hollow tube, by means of which they suck up their food in the shape of liquid juices. Now, it is apparent that for insects of the first group, as the Colorado Potato-beetle, which consumes the whole substance of its food-plant, all that is necessary is to apply to the foliage some poisonous material, which will not injure the plant, but which, being consumed with the leaves, will destroy the insects devouring them. Such poisonous materials we have in the various arsenical compounds which I shall mention later.

For the second group, however, which do not masticate their food, these remedies are useless, for the insects having their mouth-parts in the shape of a hollow tube, as we find in the *Aphides*, or plant-lice, can pierce through these poisonous applications on the surface of their food, and extract the juices upon which they live, from the interior of the leaf. Fig. 17 represents *Aphis mali*, the plant-louse of the apple, which belongs to this group, much enlarged. With such insects it is necessary to make use of remedies which act by mere contact with their



Fig. 17.—*Aphis mali*, Fab.

bodies, and do not require to be eaten at all. For this purpose Coal Oil (Petroleum) and Carbolic Acid, as well as the vegetable insecticides known as Hellebore and the Persian and Dalmatian insect powders, are most useful. These remedies, too, as they will destroy all insects, are of much wider application than the poisons mentioned above.

And now with reference to information received from those who are not scientific entomologists. Do you know, gentlemen, strange as it may sound, I believe, there are sometimes advantages to be derived from this very want of scientific knowledge. Farmers are practical men, and only want practical information, and while all must, of course, acknowledge the necessity for some one to do the accurate scientific work, and carry out the tedious experiments which are necessary, they are not the ones to do it, for with very few exceptions, they have not the leisure. No! this is the work of the scientific entomologist, and the more extensive knowledge he can acquire the better he will succeed. Economic Entomology is a practical branch of Agriculture, and deals with the successful results arrived at by the scientific entomologist. All that the farmer requires is to know the common Injurious and Beneficial Insects when they appear, so as to apply the proper remedies, and be able to refer to them by some name when recording his observations or when seeking for information concerning them. The chances of mistake, as to the identity of the insects referred to, are slight, especially when specimens can so easily be sent by mail; and every single fact in the life history of any insect, when accurately recorded, has its scientific value. Moreover, scientific observers might possibly be led astray by preconceived notions or theories as to what any given insect ought to do; but the practical farmer would have no such danger, but would carefully record, only, exactly what he had seen. This is one reason why I am here to-night. I want to show you the value of Economic Entomology. If I satisfy you, and you think what I tell you is of value to you in increasing the yield of your orchards, I, in my turn, expect to reap much benefit from your experience in fruit-growing, which will assist me in carrying on my studies. In all sciences there is a great deal too much theory; but what we require is practical results. Ever since I have concerned myself with the study of Injurious Insects I have always kept before my eyes a short motto, which is also a warning, and according as I can follow out its admonitions, by so much, I believe, will the work I have undertaken be successful. That motto is, *Be Practical*.

To attain this end, I have endeavoured, as much as possible, to enlist the sympathies and secure the co-operation of practical farmers and horticulturists all over the country, for none are so competent, or so likely to take notice of the results of any treatment suggested as those actually engaged in making their living in these pursuits. Many valuable discoveries have resulted from the observations of such men, the most remarkable, perhaps, of all, being the remedy lately found for that dread scourge, the Clover-seed Midge. Ontario, five years ago, produced a crop of clover seed worth \$648,600.* Since that time this pest has made its appearance in great numbers and its injuries have been so considerable that, instead of Canada exporting large quantities of this valuable seed, our farmers have now to import seed to sow their fields. I believe the honour is due to Mr. Jabel Robinson, ex-Master of the Dominion Grange, for discovering a means of checking its ravages. This consisted of the following treatment: Instead of cutting the first crop of clover at the end of June, and leaving the second crop for seed in the fall, he pastured the first crop until the beginning or middle of the month, and then left it to grow for the fall crop of seed. By this means not only were the grubs of the first brood (the eggs of which were deposited on the growing clover as soon as the heads formed) destroyed by the cattle eating them; but many of the perfect insects must have been destroyed by the trampling of the cattle at the time they were emerging from the ground. By leaving the clover standing in the fields till the end of June, a sufficient time elapsed for the insects to pass through the preparatory stages, and leaving the heads of clover, go into the

*By the Census of 1881 we find that Canada produced in that year 324,316 bushels of Hay and Clover seed; of this quantity at least half was clover seed, this would give 162,158 bushels. Clover seed ranges between \$3 and \$9 per bushel, but taking the value at only \$4 per bushel we have \$648,632.

ground and complete their transformations, to emerge again just as the second crop was coming into blossom. The female flies would then lay their eggs in the opening flowers, and thus the seed of the second crop would be destroyed.

Another remedy, of great interest to all of you, was discovered almost by accident, and was certainly contrary to what might have been expected. I refer to the use of Paris Green as a remedy against the Codling Moth. The perfect moth emerges from the chrysalis or dormant state in which it has passed the winter, just about the time the apple trees are in flower, and the female lays her eggs inside the opening blossoms. Here they remain for some days. After hatching, the small caterpillar eats its way into the young apple and destroys it. It has been discovered that if a very weak mixture of Paris Green and water be syringed over the trees just after the flowers have fallen, sufficient of the poison will lodge inside the upturned calyces to destroy the young caterpillars when they hatch from the egg, and start to eat their way into the apple. Great care, however, must be taken not to apply the poison until after the flowers have passed their prime. No time is saved, because the eggs do not hatch until several days after they are laid, and serious injuries may result. Instances have been brought under my notice where an apple-grower, by applying Paris green when the flowers were in perfection and filled with honey, killed all his own and his neighbours' bees. Besides this, the stigma of all flowers being without epidermis is very sensitive, and these arsenical compounds falling upon this delicate part, might possibly injure the crop of apples as much as the Codling Moth which it was desired to keep in check.

This remedy has also, just as unexpectedly, been found to be efficacious against the Plum Curculio.

Before I pass on to a description of the most useful insecticides, it may be well to say a few words as to the relations existing between insects and man, and as to those insects which we stigmatise as injurious.

The naturalist finds his studies upon the assumption that nothing in nature is useless, and everything that is, has some special function to perform or it would not exist. Vegetable and animal life are the two re-agents employed by nature to keep up the balance of creation, the one feeding upon or deriving its nutriment from the other. These two agents again are, to a certain extent, acted upon and kept in check by their own component parts. Whenever too many seeds of any one kind 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; consequently, it is provided that the weaker shall 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 injurious insect 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. These beneficial insects may be grouped under two heads, those which do actual good, and those which prevent others from doing harm. As an example of the first group, mention may be made of those which act as scavengers. All substances which are deprived of the principle of animation must be regarded as nuisances, when considered with relation to the whole. In this relation stands a dead animal or a dead tree, which are clearly encumbrances which it is desirable to have removed. The office of effecting this removal is chiefly assigned to insects. Were it not for these small creatures the world would soon become uninhabitable. Effete animal matter, in the slow process of decomposition, without their accelerating agency, would soon taint the whole atmosphere with noisome gases. And again, were it not for the many borers and wood-destroying 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 consider for a few moments what would be the consequence did none of these insects exist. A giant of the forest, injured by some storm or other cause, would die, and in course of time fall to the ground. Where it fell there it would remain, and nothing could grow from the space it covered. Time would roll on; tree after tree would fall beside the first, until the whole surface of the ground would be covered with the trunks and limbs of fallen trees,

and what was once a stately forest, with all its wealth of life, would be a vast wilderness, where nothing could grow. Now let us mark how different is the beneficent operation of nature under the present conditions. Scarcely has a tree shown signs of declining vigour before the insect hosts are at work. First come certain species, which detect any weak spot, there they lay their eggs, which, in time, hatch and eating their way into the tree, hurry on its decay. When it dies and falls to the ground it is at once 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 exposing it to the influences of air and moisture. Fungi soon develop, and smaller beetles and other insects follow in the wake of the larger, and boring into the softened, decaying wood, use it as food or as materials for their nests. The work of destruction goes on with astounding rapidity, and in an incredibly short time the giant which had taken hundreds of years to mature is reduced to powder, which serves to fertilise the soil and enables it to produce fresh trees to fill up the gap left by the one which has gone.

Among the insects which prevent other species from doing harm, particular mention must be made of those parasitic species, which are known by the names of Ichneumon Flies, Fig. 19, and Tachina Flies, Fig. 18. In these man finds his greatest protection from the countless hordes which deprive him of so much of his produce. The former of these belong to the same order as the bee and wasp, and may always be recognised, from being very active, and having two pairs of wings, which are caught together at their margins by microscopical hooks, and in many species possessing a slender ovipositor at the end of the body, as shown at Fig. 19. Their mode of life is as follows. The female

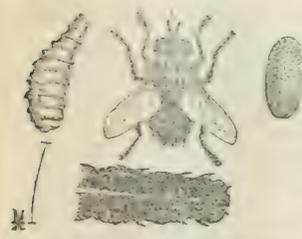


Fig. 18.—*Nemora leucanise*; parasite on Army-worms, of one of which is shown forepart upon which the eggs are placed.

inserts an egg, by means of a long slender ovipositor, beneath the skin of a caterpillar or other soft-bodied insect. This hatches inside its victim and lives upon the juices of its body, and it is remarkable that it never injures any of the vital organs. When full grown it eats its way out, and spins a cocoon, either on the body of its victim, as shown at Fig. 20, which represents a caterpillar of the Grape-vine Sphinx Moth with the cocoons of a small parasite which attacks it, or attaches it to some object near at hand, or even sometimes it finishes its transformation inside the body of its host.

The Tachina Flies, Fig. 18, have only two wings, and belong to the same order as the House Fly, which they much resemble. The chief difference in their habits, from those of the Ichneumon Flies is that the egg is deposited on the outside of the skin of its victim and the young maggot eats its way into its host.

It is of course of paramount importance that every farmer should know the appearance of these beneficial insects, so that he may not indiscriminately destroy his friends with his enemies. This is not a very difficult matter, for the families of the different classes into which insects are divided, may generally be recognised as such with ease, and, as a rule, the different genera of any family have the same habits. As a general statement, not however for close application, the following will be found to be a useful guide when the habits of an insect are unknown. If it be slow and heavy in its movements it is probably injurious; if active and with well-developed running powers, consider it beneficial until you have proved the contrary. The reason



Fig. 20.

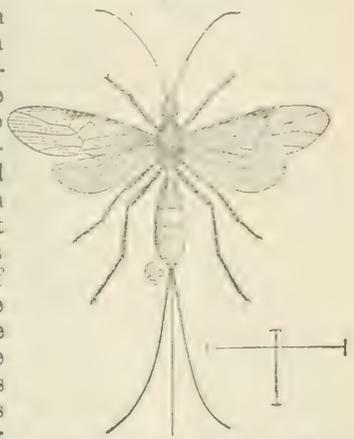


Fig. 19.—*Bracon charus*, a parasite of Flat-headed Apple-tree Borer.

for this is easy to understand: Those insects which feed on vegetable matter are most likely to be injurious—that is, they destroy what we require for our own use. As vegetation is stationary they have no need for great activity. The predaceous species, on the other hand, require well-developed means for moving quickly, because they have to catch their prey before they can devour it.



Fig. 22.

Calosoma scrutator.

These two types are well exemplified by the accompanying illustrations. Fig. 21 is the Colorado Potato-beetle, an inactive but very injurious insect. Fig. 22 is the Green Caterpillar-hunter, an active beneficial insect. Insects in a state of nature seldom appear Fig. 21. to be injurious, from the fact that their food is distributed thinly amongst other vegetation. A large food supply is the main cause which regulates the amount of insect presence. When we cultivate large areas under any one crop we naturally attract those insects which feed upon it, and in this way insects which had previously been scarce, may suddenly increase in numbers so enormously as to become a serious hindrance to agriculture. In illustration of this, let us glance at the history of the Colorado Potato-beetle. This beetle was discovered about seventy years ago by Thomas Say in the mountains of Colorado, where it fed upon *Solanum rostratum*, a plant belonging to the Nightshade family, to which also the Potato plant belongs. A peculiarity of the species was its extreme rarity, probably owing to the fact that its food-plant was not abundant and the individual plants widely separated. Many years after, as man civilized North America, in his march westward, he carried with him the Potato, which, being cultivated from the east, until the home of the beetle was reached, a bridge was thus formed over which it has swept eastward like a whirlwind, carrying devastation in its wake. I do not think, however, it will ever be again the scourge which it has been in the past, for a remedy has been discovered by which it can be effectively kept in check. As soon as it reached this Province, Principal McKay, of Pictou, with most commendable zeal, at once caused to be printed hand-bills, giving a figure of the insect in all its stages, and the proper means of destroying it. These bills were distributed in every direction, and thus the farmers being prepared, its ravages were successfully checked. I imagine that the climate of this Province will not allow of its numbers increasing to the alarming extent to which they do in Western Canada; but should they do so, the sovereign remedy, "Paris Green," will always check them. The application of this substance to the Potato fields is now almost as much a part of the culture of this necessary tuber as manuring the soil.

This naturally brings us to a consideration of some of the most important insecticides. As I have already said, these are of two kinds, those which act internally and those which act by contact. Of the former, the most important are:—

Arsenical Compounds.

No. 1. *Arseniate of Soda* must be mentioned first under this head. Prof. Charles V. Riley, the very eminent State Entomologist of the United States, asserts that 50 grains of this substance and 200 grains of dextrine, dissolved in a gallon of water, will make a mixture which may be diluted at the rate of 1 ounce to 10 gallons of water, and furnishes one of the cheapest insecticides at command. For the manufacture of this poisonous salt the formula is: 1 lb. of arsenic and 1 lb. of sal soda boiled in 1 gallon of water, till the arsenic is dissolved, this mixture to be diluted at the rate of 1 quart to 40 gallons of water. The chief merits of arsenic are its cheapness and solubility. Its demerits are its tendency to burn the foliage of plants and its white color, from which accidents might occur, by its being mistaken for some of the many harmless substances of a like appearance.

No. 2. *Paris Green* has certainly been more extensively used than any other compound. It is a combination of arsenic and copper, and when pure contains about 60 per cent. of arsenious acid. It has been extensively used as an insecticide since 1869, when its usefulness was discovered by Mr. George Liddle, jun., of Fairplay, Wis., and has since been brought into use through the experiments and writings of Prof. Riley. It is used dry, with various substances as diluents. Flour and Plaster of Paris seem the most satisfactory, and may be used in the proportion of 1 part of the poison to 50 of the diluent for a dry application, and $\frac{1}{2}$ lb. to a barrel (40 gallons) of water; or in smaller quantity, $\frac{1}{2}$ oz. to 1 bucket of water for a wash or spraying solution. If the Paris Green is quite pure this may be found too strong for some foliage, so should be tried cautiously and at first over a small area. The liquid must be constantly stirred or the poison sinks to the bottom. If a little dextrine be added it will adhere better to foliage. Lately, as I have mentioned, it has been discovered that Paris Green and London Purple may be used with good effect against the Codling Moth and the Plum Curculio. In these applications the amount of poison must be very small—not more than 1 tablespoonful to a barrel of water.

No. 3. *London Purple*.—This substance is mainly an arseniate of lime. Prof. Riley speaks so highly of it as an insecticide that I shall refer to it at some length. In bulletin 6 of his department, 1885, a copy of which I place before you, he describes and illustrates an apparatus for distributing such poisonous mixtures as this over trees. It consists of a barrel on wheels, in which the poison is mixed and contained, and has a force pump attached, with an ingenious device for keeping the mixture stirred while the trees are being sprayed. Here are his instructions for preparing the poison :

Take of London Purple.....	$\frac{1}{2}$ lb.
Cheap Flour.....	3 quarts.
Water.....	40 gallons.

For mixing, use a large galvanized iron funnel of 13 quarts capacity having vertical sides, and with a fine sieve at the bottom. Place the flour in the funnel and wash it through the gauze into the barrel by pouring water upon it. It will then be diffused in the water without appearing in lumps. The London Purple must then be washed through the sieve in the same manner until the barrel is filled. Three-quarters of a pound is the maximum strength allowable, and should only be applied as an extremely fine mist, without drenching the foliage. For smaller quantities $\frac{1}{2}$ an oz. of London Purple may be used to 1 bucketful of water.

London Purple is used with diluents either wet or dry, in the same manner as Paris Green, and for most insects is equally effective, and has the advantage of being cheaper, of covering twice the ground weight for weight, of being more soluble, less poisonous, more adhesive and permanent in its effects, and, being of decided colour, is much more visible on the foliage, so that the mistake of applying it twice on the same part of the tree, and thus injuring the foliage, is not likely to occur. Prof. Riley therefore thinks that when intelligently used it is in all ways preferable, and that its efficiency once established it will be preferred to all other arsenical remedies (Ann. Rep. 1884, p. 327).

Prof. Saunders, of London, Ontario, has not, however, the same confidence in this preparation. London Purple is a waste product, which is produced in the manufacture of aniline dyes, and for this reason he says the amount of contained poison must be uncertain, and, therefore, its effects in experimenting cannot be relied on. He suggests that an artificial coloured mixture of arsenic and lime of known strength could be produced just as cheaply, and would be much more reliable than London Purple. Prof. Saunders is undoubtedly the first Economic Entomologist in Canada, and is the author of the valuable work entitled "Insects Injurious to Fruits." As I believe this work should be in the possession of every fruit-grower in the country, I have brought a copy with me to show you; this I also place on the table for examination by any of those present who may wish to see it.

The most advantageous diluent for all these arsenious poisons is flour, which not

only acts as an adhesive medium, but also prevents to some extent the corrosive injury of the poison on the leaves.

Of the remedies which act by contact, the first place has been claimed for the following:—

Kerosene Emulsions.

Certain insects, as the numberless species of scale insects, are protected from the effects of ordinary remedies by the nature of their bodies, and it became necessary to discover some substance which would destroy insects without injury to the plant.

Milk Emulsion.—Petroleum, which is a hydro-carbon, and more of the nature of a spirit than an oil, was known to be most injurious to insects, but was also known to be, in all its forms, very injurious to plants; the great difficulty in the way of making use of it was to discover some diluent harmless to plants with which it would assimilate. This difficulty, after much thought, was overcome by the discovery, made in 1880 by Dr. W. S. Barnard, that it would mix with sour milk, and that this mixture could again be reduced with water. An emulsion resembling butter can be produced in a few minutes by churning, with a force pump, 2 parts of kerosene and 1 part of sour milk in a pail. The liquids should be about blood heat. This emulsion may then be mixed with 12 times its amount of water. It must be thoroughly mixed and then may be applied with a force-pump, spray-nozzle, or even with a strong garden syringe.

Soap Emulsion.—An emulsion may also be made with soap. The most satisfactory formula, as given by Prof. Riley, is as follows:—

Kerosene.....	2 gallons,
Water.....	1 do
Common soap, or whale-oil soap.....	$\frac{1}{2}$ pound.

“Heat the solution of soap and add it boiling hot to the kerosene. Churn the mixture by means of a force-pump and spray-nozzle for five or ten minutes. The emulsion, if perfect, forms a cream, which thickens on cooling, and should adhere, without oiliness, to the surface of glass. Dilute before using 1 part of the emulsion with 9 parts of cold water. The above formula gives three gallons of emulsion, and makes, when diluted, 30 gallons of wash. The kerosene and soap mixture, especially when the latter is warmed, forms, upon very moderate agitation, an apparent union; but the mixture is not stable, and separates on standing or when cooled or diluted by the addition of water. A proper emulsion of kerosene is obtained only upon violent agitation. It is formed not gradually, but suddenly. The temperature should not be much above blood heat.” Prof. Riley lays great stress upon the fact that all who use kerosene as an insecticide, must bear in mind that it is only a safe remedy when properly emulsified, and he maintains that all failures have resulted from carelessness in making the emulsions.

Pyrethrum.

This insecticide owes its virtue to a volatile principle. Its effect upon some insects, particularly caterpillars, is most remarkable, a very small quantity paralysing and, in time, killing them when brought into contact with their bodies. It has been used with good results against the caterpillar of the imported White Cabbage Butterfly, and for keeping down the numbers of House Flies and Mosquitoes in dwelling houses, and for destroying Green-fly on house plants it is of the greatest value. For house pests, as the last named, it is generally used as a dry powder, and may be diluted with 10 times its weight of flour; it should be puffed into the air by means of bellows or insect-guns; but it may also be used for many insects as a liquid solution, either made from an alcoholic extract, a tea, made by pouring boiling water over it and keeping it covered until cool, or by simply stirring the powder in water. The last of these methods will be found quite as efficient and much less trouble than the others.

The active principle is readily imparted to water and half an ounce of it will be sufficient for a pailful of water. As this poison is perfectly harmless to vegetation, and comparatively so to the higher animals, it is available as a protection to many garden crops, as cabbages and other greens, upon which arsenical compounds cannot be used. It is manufactured by pulverizing the flowers of two or three species of *Pyrethrum*, beautiful plants, growing wild in the east of Europe and in Persia. The poison itself has long been known in commerce as Persian and Dalmatian Insect Powder.

Hellebore.

This is the powdered root of *Veratrum album*, and may be used much in the same way as *Pyrethrum*, except that it does not exert the same remarkable influence over house pests. For insects which attack small fruits, however, as the Imported Currant Saw-fly, it is a most valuable remedy. Not only does it kill by contact, but is also poisonous if eaten, in this particular differing from *Pyrethrum*. Both of these poisons owing their virulence to volatile principles, care should be taken to procure fresh samples, because if left exposed for any length of time they will lose their virtue. They should always be kept in tin canisters.

I have now drawn your attention to the most important insecticides used to keep down our insect enemies. These, I hope, will serve as a basis upon which you can work yourselves, and find out the most convenient methods for applying them, according to circumstances. I shall always be much pleased to correspond with any of you upon these subjects, and give you the benefit of any knowledge I may possess. I am much pleased to notice here this evening Prof. Hind, who, as you all know, has paid much attention to all matters connected with agriculture, and some years ago published a useful work upon the insects and diseases which attack the wheat plant.

Mr. Robert Starr is also here, I am glad to see. He probably knows as much about the insects which attack your orchards as any man can, who does not make a special study of them.

Had I known that these gentlemen, and a few more I see before me present this evening, would have been here, I might have doubted the necessity of my coming down from Ottawa to address you. Gentlemen, I thank you for the attentive hearing you have given me.

A further Address delivered at the Fruit-Growers' Association dinner on the following evening.

MR. PRESIDENT AND GENTLEMEN,—I have been requested, instead of responding to a toast, to give you some further remarks concerning the best methods of combating injurious insects. I thank you for the consideration you have shown me during my visit, and particularly for this further opportunity of carrying out the object with which I attended your meeting. I do not think I can occupy the time more profitably than by speaking on some of the other remedies which occasionally have to be resorted to instead of, or as well as, the insecticides concerning which I addressed you yesterday. You will remember I told you that insects pass through four stages of development before they reach maturity, and also that the stage in which they are most troublesome is generally the active larval stage succeeding the egg state. Insects, in all stages, are sometimes spoken of as worms; but there are exact names which should be applied, and which can easily be learnt. For instance, the eggs of flies hatch into long cylindrical bodies without any legs; these are *maggots*. The eggs of beetles produce long cylindrical bodies, with three pairs of legs near the head, these are *grubs*; a too well known example of these is the white grub, which attacks the roots of strawberry plants. The eggs of moths and butterflies hatch into *caterpillars*, which have, in addition to the three pairs of legs near the head, from two to five pairs of legs of a different form, which are called pro-legs. Examples of these are the Canker worm and the Tent-caterpillar of the apple. It is not always

possible to find a remedy for a certain insect when it is in its most injurious stage; but by studying its life-history we are frequently able to check it from devastating our crops, by making use of what are known as Preventive Remedies. We thus have for the protection of our crops against insects, Remedies and Preventives. These, again, are each divided under two heads. Remedies consist either of the application of poisonous substances to the food plant, which may be styled Automatic Remedies, or the different methods which may be termed, in a general way, "hand-picking" or Active Remedies, these methods all consist of seeking them out in their different states, and destroying them. We will glance briefly at some of these various methods, with reference to the different stages of the lives of insects.

The egg.—Much useful work may be done by turning up the leaves of plants and destroying the eggs. This may at first sight seem a very tedious operation, but it has been found useful in many instances.



Fig. 23.

During the early spring, when the farmer has more leisure than at any other time of the year, if he will walk through his orchard on a dull day the gummy egg clusters of the Tent-caterpillars (Fig. 23) will be easily seen against the leaden sky, and by collecting these he may with ease rid his orchard of this pest. In like manner, the cocoons of the White-spot Tussock-moth may be collected and destroyed. The female moth of this species is almost wingless (Fig. 24), and when she emerges from the chrysalis, she merely crawls outside her cocoon and lays her eggs all over it, and then dies. Here the eggs remain until the following spring, and therefore are at our mercy all through the winter.



Fig. 24.

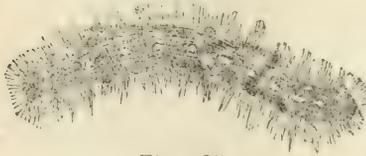


Fig. 25.

hang in mid-air. A few sweeps with a stick will break all the threads, and they will fall to the ground, where chickens will be the most useful allies in destroying them, or some of the devices for preventing insects from ascending the trunks of trees may be made use of. Besides chickens, pigs and sheep will be found most able assistants, by eating fallen apples, in destroying the caterpillars of the Codling Moth. In fact, up to this time this has been found to be one of the most effective remedies. It must be remembered, however, that if the trees are young and the bark smooth the trunks must be protected from sheep rubbing against them, because the oil from their fleeces would injure the trees, or they might be injured by the sheep nibbling the bark.

The removal of the nests of the Fall Web-worm, by cutting off the boughs upon which they are situated, and cutting off the twigs bearing the clusters of such social caterpillars as the Red-humped and Yellow-necked caterpillars of the apple, are, perhaps, the best known remedies for these insects. For the small clear-winged moth, the caterpillar of which bores in the stems of currant bushes, and the Two-spotted Raspberry-cane Borer, cutting out the injured branch is the only remedy.

The American Tent-caterpillar (Fig. 25) occasionally appears in vast numbers, and when the eggs have not been collected during the winter, the orchards must be carefully watched during May and June, and the caterpillars destroyed. This is easiest done by taking advantage of their peculiar habit of feeding at certain times in the day, and then returning to their "tent", or nest on the trunk of the tree to rest for several hours. These caterpillars are closely allied with the European processionary caterpillar, which has exactly the same habits as ours.

The Chrysalis.—This is the stage in which many insects pass the winter, and as they cannot move during this stage, they are very much more at our mercy, provided we know their life-histories and habits. Insects in a state of nature are very little affected by cold. Some chrysalids, although only protected by a few threads of silk, will pass the winter safely; but if this slight covering be in any way interfered with they will perish if exposed to the elements. Owing to this, many species which pass the winter beneath the surface of the ground can be destroyed by late fall ploughing. This treatment has been very successfully practised with regard to the Canker-worm. Not only are the chrysalids thrown up to the surface, where they are eaten by birds and animals, but the cells which they have prepared as winter quarters being disturbed and broken, they are killed by the frost. Fig. 26 shows the chrysalis of the male White-spot Tussock-moth.

The Perfect Insect.—Many insects, when they have reached maturity, do not commit any harm, and unless we know their life histories we do not recognize them as the enemies which, under another form, in their preparatory stages, had decimated our crops. At the same time it frequently happens that in this harmless state they may be destroyed much more easily than when in their hurtful form. Most moths and many beetles are greatly attracted by light, and this has been taken advantage of to destroy large numbers of our enemies.

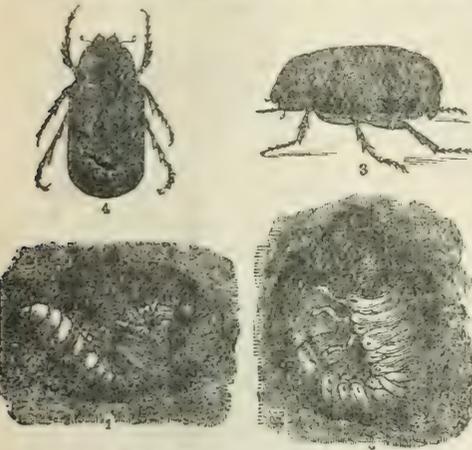


Fig. 27—June Bug.

Lachnosterna fusca, Fröhl.

Showing grub, pupa and beetle.

insects within bounds, is beating or jarring trees while they are at rest. This remedy is the most reliable means of fighting the Plum Curculio. A stout iron spike should be driven into the tree where the branches start out from the trunk. A blow upon this with a metal hammer produces the sharp concussion necessary to make the Curculio loosen its hold of the tree and fall to the ground, where it can be destroyed. Beating foliage has a like effect for some insects, and many species will be found to have favourite kinds of trees upon which to rest. For instance, the June-bug will rest on the cherry and plum in preference to all other trees.

This brings us to the end of Active Remedies. But there is another large class which I have referred to as Preventive Remedies. These may be divided under two heads: 1st. Agricultural or Scientific Preventives; 2nd. Active Preventives.

It is an old and time-honoured saying that "prevention is better than cure," and this is perfectly true with regard to our present subject. Whatever success we may obtain by the use of insecticides and hand-picking, undoubtedly the remedies of the greatest use are those which prevent the attack from beginning at all.

First amongst agricultural preventives, of course, is high culture, by which a

vigorous, healthy growth is promoted. Frequently, even after a severe attack has begun, by putting on some quick-acting manure, the crop is picked up and forced on past the period when it is likely to be injured by insect pests. Mr. William Miller tells me he has been most successful with high culture, and thinks that by its means he can clear his orchards of the Oyster-shell Bark-louse, and his fields from the Wire-worm, in about three seasons.

A most necessary part of good agriculture which affects this subject, is a comprehension of the principles regulating the rotation of crops, by means of which any insect attracted to a locality by a certain crop being grown there, will not have the same plant to feed upon the next year.

It sometimes becomes necessary to change the time of planting a crop, so as to present it to its insect enemies at their regular time of appearing in a condition in which it cannot be injured, or even to give up the cultivation of a certain crop for a length of time altogether, so as to starve the insects out. For this latter remedy to be successful, great care must be taken to have all hedges, rubbish-heaps and fences kept clear from weeds and litter.

Occasionally the planting of a small strip of a more attractive food-plant, round the outside of a field, has had the effect of drawing off insects from the main crop.

Amongst the active preventives are embraced all such methods as placing mechanical contrivances on trees to prevent the ascent of the female insects, as the Canker-worm moths which leaving the ground in autumn and spring ascend the trunks of trees and lay their eggs on the bark.

Traps in the shape of bands of straw may be used for catching the caterpillars of the Codling Moth when they are seeking a place to complete their transformations.

Peach trees may be protected against the borer by mounding the earth up round the roots; and the Flat-headed and Round-headed borers of the apple may be prevented from laying their eggs on apple trees by washing the trunks during June with an alkaline wash, made as follows: Make a cold saturated solution of washing soda with soft soap, until the soap is reduced to the consistency of paint. Apply during dry weather, and it will form a coating over the trunks of the tree not easily washed off by rain.

There is one more principle we work upon, namely, the fact that insects are either attracted or repelled by certain odours. You will have observed that the small maggot, which works such destruction by boring in the stems of young cabbages when they are first set out, seldom attacks them in the seed-bed; but immediately after they are set out they suffer severely. This is due to the fact that in the operation of transplanting, many of the root-fibres are broken, and the plants to some extent bruised. On this account more of the characteristic odour of the plant is emitted than when left undisturbed. This, added to the fact that the plant is checked in its growth by its removal, leaves it in a less vigorous state to withstand insect attacks. The most successful treatment, in my experience, has been to place some strongly odorous substance round the young plants immediately they are planted out. For this purpose gas-lime is the best; but as the supply of this is limited, sand saturated with petroleum may be used. Take a pailful of dry sand and pour into it a teacupful of petroleum. Mix all well together, until the sand is thoroughly permeated with the odour of the petroleum, then put a good spoonful round each young plant, not quite touching the stem. Where fresh gas-lime can be obtained it is a far better protection, but must not be allowed to touch the plant, because until it has been exposed to the air for some months it is very caustic, and will kill all plants or insects with which it comes in contact. A ring, about 2 inches from the young plants, I have found a perfect protection. The advantage of this substance, too, is that after exposure to the air for some time its caustic principle, sulphite of lime, is converted into the harmless sulphate of lime or plaster, a well-known and useful manure.

I have now, gentlemen, given you what may be called some of the first elements of Economic Entomology. I trust that some of you who had not, previous to this time, paid much attention to the matter, may be induced to do so in the future, and I

beg to assure you that if I can be of any assistance, by giving advice or informing you what have been the results of experiments in any particular direction, I shall always have much pleasure in doing so. My address is "The Entomologist. Department of Agriculture, Ottawa." All letters can be sent to me *free*, and will be answered promptly and to the best of my ability.

Before I sit down, there are two points upon which I should like to say a word or two. With reference to the Experimental Farm, spoken of by Prof. Hind, there can be no doubt in the world that such an institution would be of the utmost value to the Province. There are certain experiments which have to be tried—as, for instance, whether particular modes of culture, classes of manure, and varieties of fruits or plants can be successfully adopted in any given locality. The expense and risk of failure of such experiments I consider should be borne by the Province at large, instead of coming upon the individual farmers, who have not the means nor time, as a rule, to run the risk of failure. In addition to these experiments, there are others of a more general nature, but of paramount importance to the whole Dominion. These, I cannot help thinking, should be carried on by the Federal Government. As examples of such general questions, I would mention two which have taken up much of our time during the present meetings, viz., the "Black Knot" and the peculiar disease which is so prevalent amongst your Gravenstein apple trees. The investigation of these diseases will require much study and many experiments before we can hope to remedy them, but from the fact that these fungous and bacterian diseases affect so largely the fruit crop in all parts of Canada, it is necessary that steps should at once be taken to try and find some means of putting a stop to their ravages. As most of you here to-night are much interested in these matters, you are probably aware that during the last Session of the Dominion Parliament a sum of \$20,000 was voted for this purpose. I feel confident that if such an institution is started, it will be both successful and popular.

The statement has been made this evening that you have difficulty in getting members to join your association. I cannot help expressing surprise at this, for, from the active part the association has taken in developing the apple trade between Nova Scotia and Europe, and from the value of that trade to the whole Province, it becomes the duty of every man, whether a fruit-grower, a resident in this fruitful valley, or not, to join and support with his subscription and sympathy such a useful organization; and besides this he would get good value for his money. Why, Mr. President, the privilege of attending your meetings and listening to such discussions as we have heard to-day, on the "Black Knot," the packing of apples, and the best varieties to cultivate, is worth more than ten times the amount of the subscription. At your periodical meetings one meets the leading apple-growers and merchants in the Province, and has opportunities of hearing them express their views and exchange experiences, upon all the burning questions of the day.

I speak strongly, Sir, about these meetings, for I tell you I have enjoyed this meeting as I have seldom enjoyed a similar meeting before, and I trust I have begun friendships with some of your members which will last for many years.

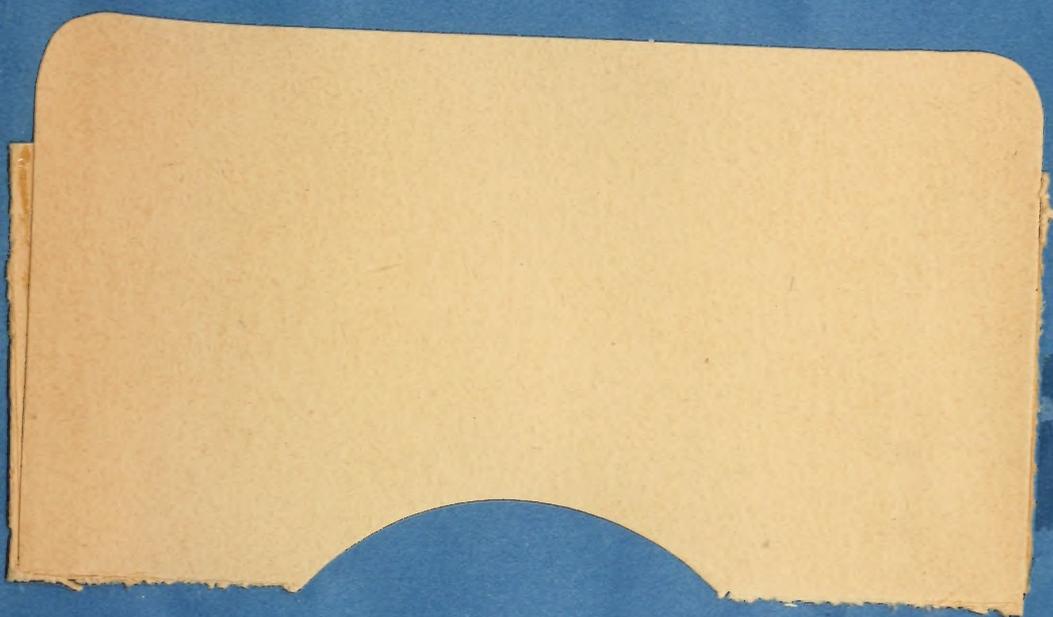
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