SB
818
.C397
ENT

1900

SMITHS
3 90

AUTHOR'S EDITION

FROM ANNUAL REPORT ON EXPERIMENTAL FARMS FOR THE YEAR 1900

CANADA

DEPARTMENT OF AGRICULTURE

CENTRAL EXPERIMENTAL FARM

REPORT OF THE ENTOMOLOGIST AND BOTANIST

(JAMES FLETCHER, LL.D., F.R.S.C., F.L.S)

1900

OTTAWA
GOVERNMENT PRINTING BUREAU
1901

APR 10 1907
183488

SB
818
C397
ENT

AUTHOR'S EDITION
FROM ANNUAL REPORT ON EXPERIMENTAL FARMS FOR THE YEAR 1900

CANADA

DEPARTMENT OF AGRICULTURE

CENTRAL EXPERIMENTAL FARM (Ottawa, Ont.)

REPORT OF THE ENTOMOLOGIST AND BOTANIST

(JAMES FLETCHER, LL.D., F.R.S.C., F.L.S)

1900

OTTAWA
GOVERNMENT PRINTING BUREAU
1901

REPORT

OF THE

ENTOMOLOGIST AND BOTANIST.

(JAMES FLETCHER, LL.D., F.L.S., F.R.S.C.)

1900.

OTTAWA, December 29, 1900.

Dr. WM. SAUNDERS,
Director of Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to hand you herewith a report on some of the more important subjects which have been brought officially before the Division of Entomology and Botany during the past season. Owing to the large increase in correspondence and the numerous species of insects and plants inquired about, it has been somewhat difficult to decide what subjects could be most usefully treated of in the present report. I have prepared articles upon those subjects concerning which I thought information would be of most service to the farmers, fruit-growers and gardeners of Canada.

Since the fitting up of a new room for the exhibition of specimens, many visitors to the Central Experimental Farm have availed themselves of the opportunity of consulting the collections which are now being gradually arranged and put into shape for reference. Many valuable additions have been made during the year to both the entomological and botanical collections.

Considerable progress has been made in the studies of the life-histories of our native insects, both noxious and beneficial, and a fine collection illustrating all stages of their development is being gradually accumulated. During the past year many specimens of inflated caterpillars have been prepared by Mr. Arthur Gibson, assistant in the Division, and are much admired by visitors.

The experiments in growing grasses and other fodder plants have been continued and are of great interest.

The Apiary, as heretofore, has been looked after by Mr. John Fixter, the farm foreman, and his report on that branch of the division work is printed at page 243.

Correspondence.—From November 30, 1899, to November 30, 1900, the number of letters, exclusive of circulars, received by the Division, was 3,017, and the number of letters despatched was 2,847.

Meetings Attended.—Meetings of farmers, dairymen, fruit-growers, &c., have been attended whenever official duties would allow of my absence from Ottawa. Addresses were delivered at the following places : Granby, Que., February 20 and 21 ; Cowansville, Que., March 14 and 15 ; St. Catharines, Ont., March 20 ; Danville, Que.,

September 5 ; Niagara Falls, Ont., December 5 and 7 ; London, Ont., November 13, 14 and 15, attending the annual meeting of the Entomological Society of Ontario. Meetings have also been attended and addresses delivered before the Toronto and Montreal branches of the Entomological Society, and also before the Toronto and Ottawa Normal School students on nature study. In June last on account of reports received from Manitoba of serious depredations on crops by locusts, and at the request of the Provincial Minister of Agriculture, I was instructed by the Honourable the Minister of Agriculture to proceed to Manitoba and investigate the matter. Accordingly, on June 21 I left Ottawa, and, having joined the Chief Clerk of the provincial department at Winnipeg, visited some of the worst affected districts. This matter is reported upon later on.

In response to a request to the Minister from the government of the North-west Territories, I then went on to Regina and joined the Hon. G. H. V. Bulyea and, in company with him and Mr. Angus Mackay, the Superintendent of the Experimental Farm for the North-west Territories, went to the Prince Albert district and held a series of farmers' meetings. Addresses were delivered upon agricultural subjects with special reference to the control and eradication of noxious weeds. These meetings were very successful, and the country traversed—a circuit of about 200 miles through a country of great fertility—was of extreme interest. Leaving Prince Albert on July 7, where the first meeting was held the previous day, we drove east and south and held meetings at Colleston, July 7, Melfort, July 9, Kinistino and Harperview, July 10, St. Louis, July 11, Lindsay and Willoughby, July 12, Rosthern, July 13, and back to Duck Lake on the railway on July 13. A supplementary and very largely attended meeting was held at the request of Mr. Wm. Trant, at Lumsden, twenty miles from Regina. Several excellent farms were examined en route and much valuable information as to the nature of the country and its suitability for various crops was acquired, which will be of much use to me in the future.

Acknowledgments.—My special thanks are gratefully tendered to the following for frequent and valuable assistance : to Prof. John Macoun, of Ottawa ; Prof. J. B. Smith, of New Brunswick, New Jersey ; Dr. L. O. Howard and Messrs. B. T. Galloway and A. F. Woods, of Washington ; Prof. F. M. Webster, of Ohio, and Mr. G. B. King, of Lawrence, Mass., for identification of specimens, and also to Prof. C. C. James, Deputy Minister of Agriculture for Ontario ; Mr. J. R. Anderson, Deputy Minister of Agriculture for British Columbia, and Mr. Hugh McKellar, Chief Clerk of the Department of Agriculture for Manitoba, for prompt notification of outbreaks of injurious insects. To Mr. R. M. Palmer, Inspector of Fruit Pests for British Columbia, and the Rev. Father Burke, of Alberton, P.E.I., I am indebted for reliable reports on insect injuries and the condition of the crops in their respective provinces, all of which have been of great service to me in making the work of the division under my charge useful to the farmers of Canada.

In conclusion I have much pleasure in testifying to the assiduity and excellence of the work performed by my assistants, Mr. J. A. Guignard, B.A., and Mr. Arthur Gibson, in office hours or afterwards whenever required.

I have the honour to be, sir,

Your obedient servant,

JAMES FLETCHER,

Entomologist and Botanist.

INSECT PESTS.

THE HESSIAN FLY

(Cecidomyia destructor, Say*).*

A serious outbreak of the Hessian Fly in the fall wheat fields of western Ontario during the past season has to be recorded. There was some appearance of the summer brood in the same districts, but only a few references were made to the insect, until it was found that the new crop of fall wheat was infested to a degree which has seldom been seen in Canada for many years. The district where the greatest harm was done, was in the area lying to the west of Lake Ontario, and north of Lake Erie.

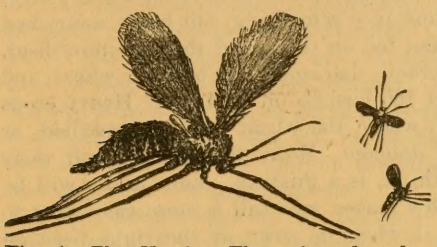

Fig. 1.—The Hessian Fly—enlarged and natural size.

Prof. Lochhead, of the Guelph, Ontario, Agricultural College, writes as follows :—

'Guelph, December 22.—The Hessian Fly is very general in Essex, Kent, Elgin, Norfolk, Haldimand, Lincoln and Middlesex ; it is reported from various parts of Welland, Lambton, Huron, Oxford and Brant. Occasional mention is made of it in Perth and Simcoe. Practically none is reported from Bruce, Grey, Wellington, Waterloo and Dufferin. The eastern half of the province is practically free from the Hessian Fly. (The above information was obtained chiefly through the reports of the Bureau of Industries.) Professor Pettit, of the Michigan Agricultural College, writes me, December 1, that this year all early sown wheat, and, in fact, all wheat sown before October 1, is infested, some of it badly. This is the case over a great part of the state. In ordinary years the third week in September is late enough to sow wheat to escape the fly, and we should not, I think, make our deductions from two such unusual years as the last were.'

'Brantford (Brant Co.), Ont., August 3.—The Hessian Fly has been bad in this neighbourhood this season. How late should I sow my wheat in order to escape the fly altogether ? Would there be any use in sowing as small a plot as half an acre on a fifty-acre farm, to act as a trap, if no neighbour sowed any wheat extra early ? What would be the best date to sow ?'—T. F. Howell.

'Waterford (Norfolk Co.), Ont., Nov. 7.—The Hessian Fly seemed to injure the sample of wheat this year by preventing some of the grain from maturing. Late sown fall wheat seems rather free this autumn, but that sown early seems to be in some cases so badly infested that farmers are talking of ploughing it under.'

'Waterford (Norfolk Co.), Ont., November 29.—I have found two fields quite close together which are affected by the Hessian Fly. The grower, Mr. James Clark, states that both fields were sown from 15th to 23rd September. In one, a field of Clawson wheat, I believe that 80 per cent of the plants contain Hessian Fly puparia, and in the other field, of Democrat wheat, about 30 per cent. You will notice from the specimens sent that the Clawson plants affected show the upper and earlier sprout generally killed, but there is an uninjured sprout growing up from the original seed. The Democrat variety, on the other hand, shows that the insect has not injured the original sprout to so great an extent, and, consequently, this second sprout from the seed has not made its appearance in so many cases as in the Clawson. With respect

to the appearance of the two fields, the Democrat looks quite green, healthy, and apparently uninjured, but the Clawson appears wilted and not nearly so green. The difference in favour of the less injured field was very noticeable. About November 8, I found no larvæ in the fields; all had changed to flax-seeds. This fall has been very remarkably free from early frost.'—N. H. COWDRY.

'Belmont (Middlesex Co.), Ont., December 4.—Fall wheat has been considerably injured in this section by Hessian Fly. Feeble wheat on poorly-prepared ground is very badly injured, portions of it being entirely killed out. Most of the wheat turned yellow, more or less, during October, owing, I think, partly to the unseasonably warm weather, causing rust to develope. Since receiving your letter, I have carefully examined many fields of wheat, and am convinced that all the damage was not done by Hessian Fly. Wheat that has a bulky vigorous growth promises to give a fair crop next year, as the stools have many comparatively sound and healthy shoots left ; after feeding the fly, they had a lot of vitality and substance remaining, but badly nourished wheat had little or nothing left after the flies had fed on them, and they are now dead, or nearly so. The summer brood did considerable damage here, both to wheat and barley. I am satisfied that the fly cut me short 100 bushels on 27 acres. Heavy crops of wheat were hardly touched by the fly ; but, where the wheat was winter-killed, or otherwise weakened and thin, it did a lot of damage Many farmers held off their sowing this year to escape the fly, but this, I think, is a mistake. Late wheat will be weak and more liable to winter-kill, and for this reason will fall a more easy prey to the summer brood next year. I believe that if wheat is sown at the right time on rich and well-prepared land, it will get a vigorous, bulky growth in the fall, and will thus be able to withstand the attacks of both broods of the fly.'—H. PETTIT.

'Ferguson (Middlesex Co.), Ont., October 30.—Since reading Dr. Saunders's article in the Entomological Society of Ontario report for 1882, I have found that the suggestions there made concerning treatment for the Hessian Fly work very well. However, I have followed them again to the letter this year, working the land with the twin plough immediately after the crop was taken off, then ploughing after, and sowing from 17th to 24th September, and have now under wheat, ground that was previously sown to clover, barley, oats, and a small piece of wheat. The result in all cases is the same, the plants are full of Hessian Fly in all stages, from the tiniest mite to the flax seed state. I have also found another insect, a sort of buff colour, with legs and a proboscis, with which it probes the plants, and any plants that I have seen attacked are doomed. The Hessian Fly is so numerous this year that I have counted as high as fifteen clustered in one stalk. Yesterday, my interest in this subject being aroused, I inspected many fields which had been sown on or about August 31 up to September 29, and I find them all thoroughly infested, and to such an extent that I think the most advisable course will be to plough them under and sow a spring crop. You could do agriculturists a signal service by collecting evidence of the extent or area covered by this pest, and by giving the results publicly in the press, describing the habits of the fly, and particularly how often reproduction takes place. By doing this, farmers would be in a position to judge of the advisability of leaving their fields, or of ploughing up and resowing with oats or some other spring crop. It would also give them an opportunity to provide seed, which is at a late date, like spring ploughing, for instance, both difficult to get and often dear.'—JOHN C. WALLIS.

'Binbrook (Wentworth Co.), Ont., December 4.—I mail you to-day two samples of fall wheat, one sown on September 10, and the other September 13. They are both of the same variety, Long Amber. This is a fair sample of the wheat in Wentworth county.'—E. J. DUFFY.

The samples sent were found to be pretty badly infested with puparia of Hessian Fly. In the first parcel of 22 plants, 3 of them were crowded with flax seeds, but 19 were uninjured. In the second parcel, 12 were infested and 14 uninjured.

'Waterford (Norfolk Co.), Ont., December 3.—In the townships of Townsend and of Windham, the Hessian Fly will nearly ruin the whole wheat crop. My wheat is half dead now, but some of it has started up from the root again. I have counted as many as nine flax seeds on one stem. I sowed my wheat on September 19 and 20. I do not think there will be half a crop of wheat. Some farmers sowed earlier and some later, but their wheat is as bad as mine.'—WILLIAM SCHRAM.

Every plant sent with the above letter was heavily infested, and the roots were apparently quite dead, with no appearance of new shoots being thrown out, as in the case of the plants sent from the same place by Mr. Cowdry.

'Glencoe (Middlesex Co.), Ont., December 4.—The fall wheat is so badly killed that there is very little left. There will be hardly a field left by spring. I sowed my first wheat on September 14, and on the 18th I sowed another field. The field I sowed last is the worst I have, but it is a weak growing variety called Kansas Turkey Red. All the rest of my wheat is Dawson's. One of my neighbours sowed September 1; all is gone. Another sowed on October 1, and this is not affected so far as I can see, but it did not make much top. I was about 40 miles west from here, and I saw a great amount of the wheat affected. Some was not up which was sowed very late. I sowed a field for one of my neighbours on September 19 on a gravelly loam. There is not a single green leaf left in the field. I notice that there is a little more greenness on the heavy clay than on the loam, gravel or sand. We had no frost until very late this year.'—JAMES GLASGOW.

The samples sent by Mr. Glasgow were all badly attacked, and about equally, by the Hessian Fly (every specimen of which was in the flax-seed state) and by the Wheat-stem Maggot (*Meromyza americana*, Fitch), all in the larval state.

It will be seen from the above letters, which cover all the points brought forward in other letters, that there are two features about this year's attack by the Hessian Fly which are unusual. In the first place, the severity of the outbreak, accompanied by a remarkable number of puparia in each stem, and the late date at which the flies were active and laying their eggs this autumn, thus necessitating at least a delay of one week more beyond the usual date recommended for safety, viz., the third week in September, before it will be safe to sow fall wheat and have it free from the attack of this enemy. From correspondence and a personal investigation of the fields in the Niagara Peninsula made early in December, this year, it was apparent that late sowing was attended with very beneficial results. Owing to the open and mild autumn this year, it was possible to sow later than usual, and several fields sown in the beginning of October were much freer from attack than those which were sown at what was considered to be the proper time, namely, the end of August or the beginning of September.

For many years previous to 1899 the Hessian Fly has done very little harm in Canada to fall wheat, and as a result of a great many experiments which are being carried out every year by the members of the Ontario Experimental Union, and other progressive farmers, it had become well known that the best crops were reaped from fall wheat sown at or before September 1. This, therefore, had given rise to the opinion that the proper time to sow fall wheat was at or about the date mentioned. This, however, is only true in such seasons and localities as the Hessian Fly and Wheat-stem Maggot are not abundant; but in periods when these two serious enemies increase, as has been the case during the present season and last year, it will be found that the proper season to sow fall wheat and rye is subsequent to the time when the egg-laying females of the autumn broods of both of these insects have disappeared. For a year or two, at any rate, it will certainly pay farmers to acquaint themselves better with the life histories of these insects and the remedies which have been found successful in preventing the losses due to their attacks.

The life history and the remedies for the Hessian Fly have been frequently given in the reports of this Division, and were fully treated in last year's report, but it may be well here to again give a short synopsis of these.

Attack.—In autumn a few small whitish maggots, oval in shape, generally showing a green stripe in the centre, may be found in the root shoots of fall wheat. Later these harden and turn brown, when they resemble small flax seeds. During May and June of the following spring, the so-called Hessian Flies, small blackish midges, with smoky wings and about ⅛ inch long, appear and fly to the fields of growing wheat, where they lay minute reddish eggs, singly or in small clusters, on the upper sides of the leaves. The young maggots, after hatching, work their way down inside the sheaths of the leaves and feed at the bases of the joints. The presence of the puparia, or flax seeds, can usually be detected by the breaking down of the stem at the point where these occur, owing to the weakening of the stem by the attacks of the maggots. The flies from this summer brood appear in September and lay their eggs upon the leaves of the young fall wheat. This is called the autumn brood, and is the one which has done so much harm this year.

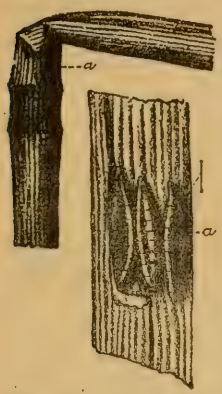

Fig. 2.—Hessian Fly; injured wheat-stem; three puparia enlarged.

Fig. 3.—Hessian Fly: puparia—natural size and enlarged.

Remedies.—1. Late Sowing.—The most important preventive remedy against injury by the Hessian Fly is the postponement of seeding until the end of September. By this means the appearance of the young plants above the ground is delayed until after the egg-laying flies of the second brood are dead. Where fall wheat has been sown in August, as is frequently done, the plants are well up and ready to receive the eggs of the flies when they emerge from the flax seeds of the summer brood. It is sometimes advised to feed off the green tops to a certain extent with sheep during the months of September and October, in which way it is claimed that many of the eggs are destroyed. I have never been able to prove that there is any advantage in this method other than giving a supply of good fodder at a time of the year when this is sometimes short. The chief objection to sowing so late as the end of September is that, as a rule, the plants have not time to make vigorous roots and tops so as to withstand the cold of severe winters. This, however, is seldom true, and in a great number of experiments, even at Ottawa, I have frequently found that good crops can be obtained from wheat sown much after the first of October, and while the Hessian Fly is abundant I believe that it is the very best policy for farmers to sow their fall wheat rather by the first of October than by the first of September, for although they may get a slightly smaller yield, it is better for them to be content with this and to be sure of it, than, in the effort to get a bigger crop, perhaps run the risk of losing half or even more from the attacks of the Hessian Fly. On this question of the proper time to sow fall wheat, the following from Prof. F. M. Webster, the State Entomologist of Ohio, who for a great many years has made a special study of the Hessian Fly, is of interest :—'I think the proper time for sowing fall wheat is late September. Early sown wheat will surely invite the attacks of the fly, and, while in years when this is not abundant the wheat may go into winter in better condition than that sown later, I believe that ordinarily this will not be the case. Your idea of choosing vigorous growing varieties and sowing late, on land prepared in the best possible manner is, to my mind, the right one. I think that in fall wheat the spring brood of Hessian Fly generally selects the younger tillers. I have observed in many cases that at harvest, what from appearances seemed to be tillers that had made the least growth in the fall, were attacked by the fly in the spring and another stem had been formed. Still, I do not think that any fixed rule can be laid down with regard to this. I believe that the Hessian Fly in spring will lay its eggs upon any stem or tiller that promises a good food supply for the young.'

2. Burning Refuse.—Many of the flax seeds of the summer brood are carried with the straw, and at threshing time are dislodged and fall down with the rubbish beneath the machine or are left in the straw. All dust and screenings should, therefore, be carefully destroyed, and all straw and small seeds should be either used during the winter or burnt before spring.

3. Treatment of Stubbles.—Most of the puparia of the summer brood are placed so low on the stems that they are left in the stubble when the wheat is cut. A large proportion of these give forth their flies in September, but some pass the winter in the stubble. An effective way to destroy these puparia is to plough down the stubbles deeply as soon as possible after the crop is cut, so as to place the insects so deep beneath the earth that the delicate flies, when they emerge, cannot reach the surface.

4. Trap Crops.—A method of reducing the numbers of the Hessian Fly, which is little practised, but which is spoken highly of by those who have adopted it, is the sowing of narrow strips of wheat in August, which will attract the females to lay their eggs, and which can afterwards be ploughed down. What is practically the same plan, is to run a harrow over fields as soon as the crop is cut, so as to start the volunteer crop from grain which has dropped in harvesting and induce a growth of wheat on the field sooner than otherwise would be the case.

5. Fertilizers.—When it is found that a young crop of fall wheat is only lightly infested, it is sometimes possible to stimulate the growth of the plants in spring by making a light application (so as not to cost too much) of some quick-acting special fertilizer such as nitrate of soda.

In cases such as we have many of in our fall wheat fields this autumn, where the attack is irregular in its occurrence, it will frequently be rather a difficult problem for a farmer to decide what his wisest course is. When, as is generally the case, there are patches in a field which have been destroyed, it is desirable to save such parts of the field as are uninjured. These patches can be sown in spring to some crop which will not require cultivation during growth, e.g., an early ripening barley, which can be cut at the same time as the fall wheat and the whole threshed as mixed feed. If, however, it is necessary to save the wheat separately, peas may be sown on these patches, and either the peas can be cut after the wheat, or the grain can be separated after threshing. In cases of bad infestation it would sometimes pay better to use the land at once for some other crop. It will, however, be necessary to replough the land deeply so as to bury the flax seeds too deep for the flies to get out, and then lay their eggs for the summer brood on spring wheat or the remnants of the crop of fall wheat. Unfortunately, the usual practice is merely to cultivate deeply, so as to produce a good seed bed. After reploughing, any crop may be sown except spring wheat. Barley and rye are also sometimes liable to attack, consequently other crops are preferable to barley or spring rye, such as oats, peas, corn or roots. There will also sometimes be cases when the farmer is uncertain what it is best to do, owing to the occurrence of uninjured patches in an otherwise badly infested field. In these cases, it will be best to wait and see how the wheat will turn out. If at last something else has to be substituted as a crop, probably the best returns will be obtained by sowing early-ripening corn, where a cultivator can be used, or early peas, where the patches are surrounded by wheat. Both of these crops may be sown as late even as the middle of June, and will usually give good results.

In the summer of 1899, as recorded in my last report, there was a remarkable outbreak of the Hessian Fly in the spring wheat crop throughout Manitoba, amounting to from 5 to 25 per cent of the crop. It is satisfactory to be able to record that there has been no recurrence of this outbreak during the past season. Mr. Hugh McKellar, Chief Clerk of the Department of Agriculture, writes under date December 18: 'I have much pleasure in advising you that this department did not receive any information this season, of the presence of the Hessian Fly in any part of the province.'

WHEAT-STEM MAGGOT

(*Meromyza americana*, Fitch).

Although the injury by this insect is not known to have been very serious during the past season, specimens have been sent in from a good many different places. It has been found attacking fall wheat in western Ontario in company with the Hessian Fly. The larger number of complaints and inquiries have come from Manitoba, and the North-west Territories, where the 'dead heads' caused by the summer brood had attracted attention and were thought by many to be the work of the Hessian Fly. The remedies for the Wheat-stem Maggot are practically the same as those for the Hessian Fly.

THE WHEAT-STEM SAW-FLY

(*Cephus pygmaeus*, L.).

This insect was reported from a few places in the North-west Territories during the summer of 1900, but no widespread injury was attributable to its attacks. Specimens were sent in from three places, and I have to thank my correspondents for taking a great deal of trouble in securing specimens and information concerning this interesting insect, which in any year may develop into a serious pest. A pretty full account of the insect and its life history was given in my report for 1896, when the most serious attack which has yet been recorded in Canada, was reported upon. This was at Souris, Man., on the farm of Mr. William Wenman. Mr. G. S. Tuxford, of Buffalo Lake, near Moose Jaw, Assa., has reported every year since then on the occurrence of the insect, and this year reports a serious outbreak, as follows :—

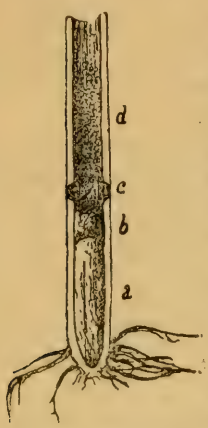

Fig. 4.—Wheat-stem Saw-fly ; *a*, cocoon; *b*, borings.

'Buffalo Lake, Moose Jaw, August 9.—Last summer I wrote you that there was not much sign of the Wheat-stem Saw-fly. Later I had to write again saying that some fields were rather badly attacked. This year, in our immediate neighbourhood of Buffalo Lake, the pest is assuming very serious proportions. We have just started wheat-cutting, and some fields especially all along the outside have from 20 to 40 per cent cut off and lying down. Our grain is ripening very rapidly this year ; a great deal is dead ripe now. We had four heavy rains on the 5th, 6th, 7th and 8th instant. Crops are from good to very good, though some fields sown on stubble will not give more than ten bushels to the acre.'

'September 18.—I have been trying to find some more stubbles in which the grubs of the Wheat-stem Saw-fly were hibernating ; but, owing to the early harvest, the late date of your request, and the many heavy rains, I find after many searches that it is impossible now to find any. At the end of July and early in August, it was very easy to trace and unearth the grub. I am sending you, however, a number of samples of the cut-off stems and heads. This is the same pest I complained of in the fall of 1897, and of which I then sent you samples. I remember you then advocated as one remedy, burning the stubbles in the fall. As the grub retires below the surface, would not this still leave it untouched ? It would be very difficult to get over a large area of ground by fall ploughing out here where the fall is so short.'—Geo. S. Tuxford.

It will be remembered that all wheat in the North-west is spring wheat.

The early date at which this wheat was ripe, August 9, was doubtless due to the dry hot season. This also accounts for the small yield mentioned by Mr. Tuxford, of fields sown on stubble. The advantage of sowing on land summer fallowed, as a means of retaining moisture, was very marked in the West last season. The injury by insects to an infested field being most severe on the outside, is not an unusual

circumstance and merely shows the readiness with which flying insects settle down and deposit their eggs when suitable food for their young is found.

The work of the larvæ inside the stems sent from Buffalo Lake was plainly noticeable, and the Wheat-stem Saw-fly was undoubtedly the cause of the stems being cut off.

As pointed out by Mr. Tuxford, the larva does burrow down very deeply into the base of attacked stems ; but I think that the burning over of stubbles will be found a very useful remedy against this insect. Fall ploughing in most seasons in the West is difficult, owing to the lack of moisture: but where the Wheat-stem Saw-fly has been abundant, it is important that wheat should not be sown on stubble land unless a good burn has been secured, and if possible the land should be ploughed deeply either in fall or spring. Summer fallowing every other year as is done by many farmers at Moose Jaw, and doing the work early, before the middle of June, will do much to control this insect.

'Cottonwood, Assa., August 13.—Can you tell me the cause of my wheat being cut down in this way? As you notice, it is fully ripe. It was grown on summer fallow. We have had heavy rains lately, which probably accounts for so much being broken down. I shall be grateful for any information which will help me to destroy this grub.'

'August 31.—I undertook the search for the specimens you asked for, this afternoon, and although there were any number of cut-off wheat stems scattered on the field it was difficult to locate the lower end, as nearly all seemed to be gnawed off at a level with and sometimes below the ground.'—Harold D. Buchanan.

The wheat here referred to was injured by the larvæ, and was merely broken off by the wind and rain. The stems were cut off mostly at the surface of the ground, and the larvæ would have been destroyed in these instances by burning over the stubble.

'Osler, Sask., August 7.—In searching for more specimens of the swollen stems which we have been communicating about, I found to-day one fallen straw in which there was a small worm about $\frac{3}{8}$th of an inch in length; it was at the broken point, but immediately below the joint, with no appearance of a swelling on the stem. I think this is a different trouble from that which causes the swollen stems.'

'September 15.—I was much interested to hear that you had found a specimen of the Wheat-stem Saw-fly larva in the wheat straw I sent. However, I do not think it can be at all prevalent here; for, while searching around so much for the swollen stems which I sent you at the same time, this was the only specimen I found which showed any trace of the work of an insect.'—Percy B. Grant.

Remedies.—The means which are to be recommended for checking the increase of the Wheat-stem Saw-fly are : The burning over or ploughing deeply of all stubbles, also burning of such straw as is not used by the following spring, and summer-fallowing in June every other year.

Undoubted specimens of Wheat-stem Saw-fly were sent with the above letters, but some other correspondents who wrote of this insect were mistaken as to the identity of the insect they complained of.

Injuries to Wheat due to Weather.

There were several curious conditions of wheat in the West last season, which can only be accounted for by unusual climatic conditions, chiefly the excessive drought, accompanied with great heat and bright sunshine in the last days of June. The ears of wheat were scalded just as they emerged from the sheath or just inside it. Shade trees which had been planted for several years were also severely injured by this unusual heat. The thermometer along the Canadian Pacific Railway through Manitoba and westward as far at any rate as Regina, registered 98 to 106 and 107 degrees Fahr. in the shade on the three successive days June 28, 29 and 30. Spruce trees

planted at various places were turned chocolate brown on the sunny side in one day, and many kinds of plants suffered severely. The injury to wheat was curiously local, but I cannot discover any other possible reason for the aborted and scalded heads in some places. Very interesting specimens were sent in by Mr. Geo. Wise and Mr. W. S. Wallace, of Shellmouth, Man., with a complete account of the injury and its occurrence on various soils and under different exposures. The affected area was eight miles long, north and south, and one mile wide. The injury to the ears was such that no theory could satisfactorily account for it, the ears being blighted and shrivelled up, sometimes at the tip, most frequently at the base, five or six florets being whitened and empty, and sometimes in the middle, with good grain forming at the base and at the tip. Frost and heat would either of them account for some of the characteristics, but not all. The injury lasted a very short time, and the chief peculiarity was that in adjoining fields grain at the same stage and apparently under exactly the same conditions was uninjured. Another curious distortion of stems of wheat plants was shown to me at Osler by Mr. Percy B. Grant, in which the stem was swollen, hardened and thickened, and as a rule bent rather abruptly so as to burst the sheath just above the top node of the stem. This attack resembled closely the work of the Joint-worm *(Isosoma)*. Mr. Grant wrote after considering the matter carefully and examining many specimens: 'My opinion of the matter is that the trouble is an excessive growth induced by the moist weather which came after a prolonged period of exceedingly dry weather.' I quite agree with Mr. Grant in this opinion, and so also do other botanists to whom I have shown the specimens.

'Osler, Sask., September 5.—I am sending you to-day a bundle of about 20 more or less injured stems ; all of these I cut off as near to the ground as possible, and all were standing except those which had broken at the injured points and fallen over. They show the swelling of the stem in various stages. I never saw this injury to wheat until this summer. Beginning with the middle of the month of June we had a spell of exceedingly hot and dry weather; the heat and drought gradually increasing till the end of the month, when nearly all the grain was out in head, although the straw was only from 6 inches to a foot high. Large patches of stubble land were materially injured by the want of moisture and, had the drought continued much longer, the bulk of the crop would have been ruined. However, about July 1, heavy rains set in, and there was an excess of moisture for nearly all the month. There was plenty of warmth in the ground, which, together with the moisture, pushed forward the growth at a rapid rate. The injured fields recovered rapidly, and those which had held their own during the dry spell sent up a rank growth. About a week after the rains began, numbers of the wheat stems were noticed to be lodged. The lodging continued for about a week and then stopped. The amount was variously estimated from one-twentieth to one-tenth, according to the field, being worst on new land (breaking) and least on summer fallow. The lodging was worst in the rankest spots of any particular field. It was always the largest stems with the largest heads which lodged. On closer examination, I found large numbers of stems still standing with the stems much swollen above the joints, and I noticed that the lodged stems were also swollen and had broken at the most distorted point. The swelling sometimes spread several inches up the stem, but in most cases was confined to one point until the stem bulged out so much that the sheath was burst and the inner stem protruded so much as to bend almost at a right angle, when it broke and was blown over by the wind. I found no lodged stems which did not show the swelling. The swollen stems which did not lodge were perhaps a little later in maturing than the rest of the crop.'—PERCY B. GRANT.

CUTWORMS IN WHEAT.

There was rather a serious outbreak of some kind of cutworm which attacked wheat fields in Manitoba. I was informed by the Department of Agriculture for that province, at the end of May last, that a great deal of harm had been done in the

Stonewall district. From Stonewall to Teulon it was reported that very few farms had escaped entirely, and in many cases the loss was serious. Mr. Arch. Woods, who lives about 2½ miles south of Teulon, had one field of 23 acres of wheat on summer-fallow three-quarters destroyed. The worms were said to clear the crop out completely, leaving the field as black as before it was sown. Mr. C. C. Castle lost 15 acres in the same way, and Mr. Mudd and other farmers in the same locality suffered to a similar extent. The caterpillars were almost full grown on May 19. Unfortunately no specimens of these cutworms were sent to the Division, so the species could not be identified with certainty. The Red-backed Cutworm *(Carneades ochrogaster*, Gn.) was abundant in Manitoba last summer, the caterpillars attacking turnips and many other low plants. The Rev. W. A. Burman reports injuries by this species at Deloraine, and Mr. A. W. Hanham informs me that this was the commonest moth at Winnipeg in the season of 1900. I have never actually detected this species attacking wheat ; but it is a well known pest of Indian corn, and it is quite possible that it may have been the culprit on this occasion.

GRASSHOPPERS IN MANITOBA.

About May 20 reports began to come in on the abundance of various kinds of grasshoppers in Manitoba, and by the end of the month the injuries had assumed serious proportions. An urgent invitation was received from the Provincial Minister of Agriculture for me to visit the districts and advise farmers. Unfortunately previous official engagements rendered this impossible until the end of June, when I proceeded to Winnipeg, and in company with Mr. Hugh McKellar, the Chief Clerk of the Department of Agriculture, visited a portion of the infested district. Through the courtesy of the Canadian Pacific Railway free transportation was provided to any part we wished to visit. Accordingly, leaving Winnipeg on July 2, we proceeded to Stockton on the Glenboro' Branch of the Canadian Pacific Railway, and then drove through the country worst infested round towards Wawanesa, Treesbank and Aweme, where we spent the night, and were hospitably entertained by Mr. Criddle, and where we received much valuable information and saw most interesting specimens of natural history objects. Leaving there the next morning, all too soon, we passed on to Douglas, another point where much harm had been done by locusts. In the afternoon a circuit was made round this place for several miles north-east and south-east. The next day I went on towards Brandon. The places in Manitoba where considerable injury was reported to have been done by locusts were along the line of the Canadian Pacific Railway from McGregor past Melbourne, Carberry, Douglas, Brandon and Oak Lake to Routledge, and south by Pipestone, Lauder, Hartney, and following the Souris river to Glenboro' and thence north-easterly to McGregor. At the time of my visit the grasshoppers were enormously abundant, but all farmers agreed that there was not at that time one where there had been one hundred a few weeks previously. I found every one well acquainted with the habits of the insects and the chief methods of fighting them. The article in my report for 1898, where all the best remedies are given, had been read carefully, but the greatest credit is certainly due to the Provincial Minister of Agriculture and his energetic Chief Clerk, Mr. McKellar, who had spared no effort in distributing information through the press, by holding meetings and circulating leaflets of use to farmers in meeting this outbreak. The farmers had responded promptly and had followed instructions well, by destroying the young insects both by burning them at night when they had collected on rows of straw spread across fields for the purpose, ploughing down stubble fields, the use of hopper-dosers, large numbers of which could be seen in all parts of the country, and by poisoning the insects with a mixture of bran and Paris green. There

Fig. 5.—The Rocky Mountain Locust.

is no doubt that the efforts put forth at this time had a very appreciable effect upon the numbers of the locusts, and much good was done in reducing the numbers during the hot dry period which prevailed throughout the month of June. The importance of ploughing down all stubble this autumn or next spring was impressed upon farmers by the Provincial Department of Agriculture, so as to complete the work of fighting the grasshoppers which was so well begun last spring. It will be noticed that the area infested this year was not the same as that which was invaded by locusts north of the Turtle Mountains during the two previous summers. A comparative freedom of those localities in southern Manitoba must be attributed, I believe, to the good work done by farmers last year. This serious outbreak was, no doubt, very much aggravated, if not entirely caused, by the dry hot season, which not only checked cultivated crops, but almost entirely prevented the growth of vegetation on the prairies. The only green thing for the grasshoppers to feed upon was the young and half-starved crops on cultivated land. Seeing the hundreds of acres in some places swept bare, I expected to find large swarms of the Rocky Mountain Locust *(Melanoplus spretus,* Uhler*)*, but at only one place was this insect detected, and this was at Douglas. The species which were almost entirely answerable for the destruction of crops in Manitoba in 1900, were the native species *Melanopolus packardii* (Scudd.), *M atlanis* (Riley), and *Camnula pellucida* (Scudd.). These were almost in equal numbers throughout the districts mentioned, and probably the first named was responsible for the larger proportion of the injury, being a large species somewhat like the well known Two-striped Locust, but more active. It is easy to distinguish the species by the broader margin to the thorax and its bright blue tibiæ or shanks. There were many other parts of the West where grasshoppers were more than usually abundant, as is generally the case in dry seasons, but complaints were not made of their attacks on crops.

The following report from Mr. Norman Criddle, of Aweme, Man., gives a concise account of the outbreak at that place, which was one of the centres of worst attack.

'Aweme, Man., December 22.—With regard to the locusts, I forward some extracts from my note-book which may be of use to you. There is no doubt that the poisoned bran was far superior to anything else we tried. It was first used here with success by Mr. Harry Vane of this place.

April 24.—Locusts began hatching.

May 8.—Bulk of locusts are hatched.

May 14.—Several fields cleared off. Still hatching. H. Vane has tried Paris green with some success. Large numbers were ploughed under on edge of fields during night.

May 19.—Found a locust killed by Tachina flies; seven grubs found in ground beneath it.

May 24.—Locusts rapidly eating wheat.

May 25.—Locusts beginning to fly.

May 29.—Seem to have done hatching; are not doing as much damage as formerly. H. Vane has invented a machine somewhat similar to the 'hopper-doser,' only longer. It is made of sheet-iron and burns wood. With this and a mixture of Paris green and bran, the locusts are being kept under control.

May 30.—Hopper-dosers are being used at most places with some success, though not much.

May 31.—We are using Paris green bait with great success; we are spreading it round all the fields.

June 6.—Half the locusts can fly.

June 7.—Still a few locusts hatching. Large increase of Tachina flies in some places.

June 12.—Several people report locusts killed by Tachina flies. H. Vane reports large numbers dead and dying from Tachina flies, two miles west. There are very few here killed by them.

June 20.—Locusts have been flying south-east (with the wind) in large numbers. These were : *M. spretus* and the Lesser Migratory ; quite a lot crossed the river.

June 23.—Lots of locusts leaving. They go with every puff of wind.

June 27.—Locusts have nearly all disappeared. A tremendous lot are dead round the field, killed by poisoned bran. They can be picked up by handfuls.

June 28.—Locusts have ceased to do damage. Most of them have disappeared.

August 24.—There has been a slight migration of locusts into this part the last few days. They were of the two migratory kinds, and came from the south-east.

August 30.—There is hardly a locust to be seen.

'The mixture of Paris green mentioned above is made as follows : One part Paris green, one part salt (the locusts will not eat it without), and eleven parts of bran. Mix into a mash, adding as much water as the stuff will hold. Spread in as small lumps as possible. We generally use a trowel or thin piece of iron. Get a little of the mixture on the edge and then fling so that it will spread some 15 yards. A pound of Paris green should make enough mixture to spread a strip two miles long by 15 yards wide. Fresh stuff should be spread every two days. The poison takes from two to five days to kill the locusts, so that they are able to fly long distances before they die. They eat it much more ravenously when they are full-sized than they do when young. Everybody who tried this remedy now swears by it ; several of them were heard to say that they will never fear locusts again. I only saw one locust attacked by a hair worm ; this was about 11 inches long, and was seen in July.

'No locusts were seen to lay eggs, nor have I been able to find any eggs in the ground. Those that did most damage were Nos. 7, 11 and 13 of those I send ; the damage done by them was about even. (They are probably the same, M. *atlanis*, Riley).

'There was also a small percentage of *M. spretus*, which you identified when you were here. I saw several cases of *M. spretus* mating with *M. atlanis* (No. 11). This was noted during the migration south-east on June 20, 21, 22 and 23. During this time they got vastly thicker where before there had been very few.

'The damage done here was greatly over-rated. We lost some 50 acres out of 260, and our fields were the first attacked. Other people lost perhaps a little more which was because they did nothing to stop the advance. The locusts had been increasing here for about three years, in fact, considerable damage was done in the latter part of 1899.'

The grasshoppers certainly were answerable for much loss ; but, as compared to the rest of the province, the area where their depredations were of a serious nature was not very large. Many causes added to the loss, which at the time was generally all attributed to grasshoppers. Drought, frost, wind and gophers all did their share of the injury, and as the species most concerned were native species which occur on the prairies in some numbers every year, it is to be hoped that this was merely an exceptional outbreak of local species, which will not recur next season. The probability of this recurrence is certainly rendered less probable by the work which has been done this autumn in following out the wise suggestions as to ploughing, which have been made by the provincial Department of Agriculture.

The two most abundant species throughout the province of Manitoba were *M. atlanis*, the Lesser Migratory Locust, and *Camnula pellucida*, the Pellucid Locust.

These two latter species occurred also in considerable numbers in the Okanagan valley, in British Columbia, where bunch grass pasture lands and grain crops were reported to be seriously affected.

WHITE GRUBS ATTACKING WHEAT.

The White Grub, the larva of the June beetle *(Lachnosterna)*, is a frequent enemy of pastures, and also occurs, as is too well known, in gardens as an enemy of the strawberry, and occasionally in farm lands is a destructive pest in corn fields. This year an attack of some importance on fall wheat was brought to my notice.

'Tancred (Lambton Co.), Ont., October 10.—The White Grub is eating out the fall wheat in this locality, especially on land that is inclined to be sandy. A year ago last spring the June Bugs or Beetles were so bad that my small plum and cherry trees were nearly destroyed by them. I was in a great quandary to know how the young foliage was being destroyed; not a leaf was allowed to grow until long after other trees were in full leaf. I examined them carefully every day, but not a sign of insect life could I find, until one night I was going to the stable with a lantern, and the thought occurred to me, I'll look at the trees and see if I can find any insect working by night, for I knew the trees, which were two years old, should be exceedingly healthy and thrifty. To say I was surprised at what I found is putting it very mildly. Every twig and limb was one mass of crawling June Beetles. I prophesied a full crop of White Grubs last spring, and sure enough we got them.'—T. H. Myers.

Unfortunately, very little can be done when White Grubs are found attacking a crop. When the beetles attack fruit trees, spraying the foliage with arsenical poisons will destroy large numbers, and when the White Grubs are found destroying the grass on lawns some good may be done by spraying the grass freely with kerosene emulsion and then washing it in with water. The eggs of the June Beetles are laid in spring, and the young grubs hatch soon after, but do not attain their full growth till the middle of the next summer. They then change to pupæ, and soon afterwards into the perfect beetles, which, however, do not emerge until the following spring.

THE PEA WEEVIL OR 'PEA BUG'

(Bruchus pisorum, L.).

Attack.—A small, brownish-gray, very active beetle, one-fifth of an inch long, with two conspicuous black spots on the end of the body, which emerges from seed pease in autumn or in spring, leaving a small round hole. The insect is generally spoken of under the incorrect name of 'pea bug,' and infested pease, as 'buggy' pease. The egg is laid on the outside of the young pod, and the grub on hatching eats its way in and penetrates the nearest pea. Here it remains until full grown, consuming the interior of the pea and passing through all its stages, from a white fleshy grub to the chrysalis, and then to the perfect beetle. Some of the beetles, the percentage varying with the season, escape from the pease in the autumn and pass the winter hidden away under rubbish or about barns and other buildings. The greater number, however, do not leave the pease until the following spring, so that they are frequently sown with the seed.

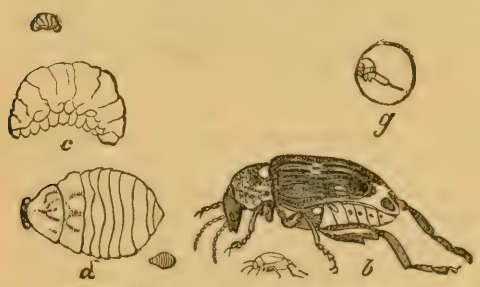

Fig. 6.—Pea Weevil.

The perfect insects fly easily and resort to the pea fields about the time the blossoms appear. They have been observed feeding upon the leaves and flowers of the pea vines before the pods were formed, but the injury so done is inappreciable compared with the greater loss from the injury to the seeds by the grubs.

The injury by the Pea Weevil during the past season has been very serious indeed, and I wish to impress upon all pea growers in the districts where this insect prevails, the importance, or even necessity, of making a united effort to decrease this great annual loss by adopting some of the well known methods for the destruction of this pest.

The following are extracts from one or two of a great many letters on this subject:—

'Ottawa, November 26.—During the month of August I made a bicycle tour through the counties of Peterborough, Ontario, York and Brant, Waterloo, Wellington, Oxford, Perth, Middlesex, Lambton, Huron, Bruce, Grey and Dufferin. During this trip I paid considerable attention to the insect enemies of farm crops, and discussed the matter with many farmers. From my observations, I do not hesitate in saying that the Pea Weevil is the most important pest with which the farmers in the counties mentioned have to cope. I believe that the losses sustained in the province of Ontario from this enemy are such as should direct more attention to the methods of reducing or even exterminating this insect. In talking with farmers, even where the weevil has been present for a number of years, I found that neither the habits of the insect nor the proper methods of fumigating were very well understood. Farmers who a few years ago grew every year 20 to 30 acres of peas have become so discouraged that 5 or 10 is about the acreage they now grow, and many have dropped peas altogether out of their rotation.'—G. H. Clark.

'Vellore (York Co.), Ont., August 15.—The Pea Weevil is unusually bad this year. A large percentage of the pods have every kernel punctured, and some kernels have two insects in them. Last year, in early-sown field-peas, the bugs matured very early, and at threshing time, shortly after the harvest, they were in swarms in the barn, and the men were covered with them. It was an unusually hot season, with continued drought, which, I presume, hastened the development. Late sowing may result in fewer weevils, but this method is invariably disappointing in the yield and quality of pease. Many people sow one field from year to year, but they always depend upon the early ones for the best quality of pease and straw. A heavy crop of peas has the same beneficial effect upon land as clover, but to a less degree. This result is very apparent on heavy clay lands. The much easier preparation of pea stubble for wheat-growing is of great importance to those who make a specialty of wheat, and as wheat usually does better on pea land than on other stubble, farmers cling to pea growing for the above reason, which, in my opinion, is a very good one. I have told many farmers of the plan of fumigating with bisulphide of carbon; but, when extra trouble and cost as well as some danger are entailed, it seems next to impossible to get farmers to take hold of this; if, however, you could devise some method by which public exhibitions could be given, for instance in properly fitted-up railway cars to be moved from place to place, in which farmers could have their pease treated at a small cost, I think they would soon learn the value of this method, and if it were done for one season, there would be a general clamouring for more of it the second year. A couple of years in any district would so thoroughly demonstrate the benefits as to make it become a recognized duty of every pea-grower to treat his pease, and with this united action much good would result.'—John Lahmer.

'Waterford (Norfolk Co.), Ont., November 7.—There seem to be few Pea Moths here, but the Pea Weevils are very nearly equal in number to the pease.'—N. H. Cowdry.

'Belmont (Middlesex Co.), Ont., December 4.—Pea Weevils have done much harm. If a farmer treats his own seed pease with carbon bisulphide, unfortunately that does not prevent the weevils from his neighbours' fields from injuring his crop. There cannot be much good done unless we can in some way get united action. I am preparing to sow 12 acres of sod with peas next spring, for there is nothing like the pea-vine to thoroughly kill out the grass of a sod field. Before receiving your

letter I had already planned to treat my pease next year. Pease should be threshed as soon as ripe and immediately treated, before the weevil has attained full size or done much damage. If stored away in a barn and threshed in October, the bug has made its full growth and the damage is done.'—H. PETTIT.

There are many valuable suggestions in the above letters, and I am convinced that if pea-growers on a large scale, as well as those who only grow a small quantity for their own use, would regularly fumigate with carbon bisulphide, in a very few years this united effort would have an appreciable effect on the unnecessary loss which occurs every year in this important crop. I believe that most farmers in the districts where the Pea Weevil occurs are pretty well acquainted with the life habits of the insect, and also know that the fumigation treatment is effective. By following the instructions which have been frequently given, and which are repeated here, there is really very little danger ; but of course the work must be done with care. Most of our large seed-growers and seed-dealers do regularly treat their seed, but I think a change for the better might be made by doing this work earlier. Not only is the carbon bisulphide more easily vaporized in hot weather, but its effect on the insects is much more fatal than in cold weather or later in the season, when the weevils are in the torpid state in which they pass the winter. The sooner the fumigation is done after the pease are ripe, naturally, the less the seeds will have been eaten away by the grubs and injured. Moreover, by postponing the fumigation until late in the autumn, in some seasons a large proportion of the weevils will have left the pease and escaped before the operation.

Any farmer can treat his own seed easily and with perfect safety in the following way : Place the quantity of pease to be treated in an ordinary 45 gallon coal-oil barrel, which will hold about five bushels of pease. The quantity of carbon bisulphide which has been found necessary to destroy the weevil is one ounce to every hundred pounds of seed—the treatment to last for 48 hours. Therefore, for the above quantity, as pease weigh from 60 to 65 pounds to the bushel, 3 ounces would be required if the barrel were filled. The chemical may be poured right on to the pease, and the barrel must then be covered quickly and closely, first with a thick cloth or canvas which has been damped in water, and then with boards. The carbon bisulphide will not injure the seed in any way, either as to vitality or as to its wholesomeness as food. Carbon bisulphide is a colourless liquid which readily turns into vapour when exposed to the air, except in very cold weather. This vapour is quite invisible, but has a very strong unpleasant odour. It is heavier than air and therefore sinks quickly to the bottom of and permeates the contents of any closed receptacle in which it is used to free grain of infesting insects. It is, however, extremely inflammable both in the liquid and vapour form ; consequently great care must be taken not to bring any flame, not even a lighted pipe or cigar, near the liquid or barrel during the treatment. The pease or other grain must be left in the tightly closed barrel for 48 hours to destroy the weevils ; it will therefore be best to place the barrel in an outside shed at some distance from the living-house.

The late sowing of pease is certainly useful in preventing attack by Pea Weevil, but the method is not in much favour with farmers, because late sown peas in most seasons are liable to be so badly attacked by mildew as to reduce very much the value of the crop.

Holding over seed.—An easy remedy and an excellent one when only a small quantity of seed is required, is to hold over until the second year after harvesting. This must be done in close bags so as to prevent the escape of the beetle which naturally emerge before the end of the second season, and as they cannot perforate bags even when these are made only of paper, they must die ; for, unlike the Bean Weevil, they cannot propagate in dry grain. The vitality of pease is not injured to any appreciable degree by this delay of one year before sowing. At the time of sowing the seed should be examined and if necessary hand picked ; every grain which has been perforated should be discarded. as it has been proved that it is impossible to grow strong plants from weevilled pease.

The great need in Ontario to-day in this matter is concerted action among all concerned. If a few only treat their pease carefully, little good can be done in controlling this serious enemy, but on the other hand, it cannot be too often stated that, as is often averred by farmers, it certainly is not true that there is no use in one man doing what is right when others close at hand, do nothing. This is a big undertaking ; the Pea Weevil has now for many years been practically increasing year by year, and has now obtained such a foothold that it can only be controlled by stirring up public opinion to the extent of inducing everybody concerned to do something. As a means to this end, Prof. Lochhead, of the Ontario Agricultural College, makes the practical suggestion of bringing the subject prominently forward at the winter meetings of every farmers' institute in the province. This could be very easily done, the life history of the Pea Weevil is perfectly well known and has been published over and over again in official reports, both federal and provincial, as well as in agricultural journals. There is a competent staff of speakers for the farmers' institutes, and it would be almost impossible to hold a meeting in any of the pea-growing counties where there would not be several who could speak on this insect and its work, to the great advantage of many present.

There is, however, every necessity that those who discuss the matter, should prepare themselves beforehand and make it very plain which insect is being discussed. On frequent occasions when reports have been received from correspondents, I have to write to them before I can be sure which insect they mean. The Pea Weevil is the short, roundish, hard beetle which occurs, at the time when it is most often noticed, among seed pease from which it has emerged, leaving a perfectly round hole in the hollowed-out pea, in which it passed its preparatory stages. This insect is shown enlarged, and of the natural size at figure 6. The Pea Moth, as it is generally seen by farmers, is in the form of the caterpillar, usually called the 'worm,' in the pea pods, where the white caterpillars devour the green pease from the outside, leaving a ragged cavity and a mass of excrement. The perfect insect, the moth, Fig. 8, is very rarely seen. It resembles very much the Codling Moth, of the apple, but is of a general slaty gray colour instead of bronzy brown. The Destructive Pea Aphis is a soft-bodied green plant-louse, shown below, very much enlarged. These plant-lice cluster in enormous numbers at the ends of the shoots of peas, of all kinds, clovers and vetches.

THE DESTRUCTIVE PEA APHIS

(Nectarophora destructor, Jnsn.).

Fig. 7.—The Destructive Pea Aphis; winged viviparous female—enlarged.
(After Johnson, Md. Agr. Exp. Sta. Bul. 63.)

In my last report considerable space was devoted to the Destructive Pea Aphis, a new pest of the pea, of which no previous attack had been recorded in Canada. The injury extended from all parts of the Maritime Provinces, through Quebec to the western boundaries of Ontario, and the loss in many places was serious. Not only did it occur in Canada, but much greater injury was caused by it in certain of the United States, as Maryland, Delaware, New Jersey, New York, Connecticut, &c. Excellent work has been done upon this insect in Maryland by its describer, Prof. W. G. Johnson, and in Delaware, by Prof. E. Dwight Sanderson, both of whom have published bulletins on the subject.

In Canada during the past season, although the Destructive Pea Aphis has occurred throughout most of the districts visited by it last year, the numbers and injuries have been decidedly less. It has been discovered in the United States that this insect should perhaps be considered more particularly an enemy of clover than of peas. In Canada the species has been found only in small numbers on clover, and no perceptible harm has either been observed or reported to this crop. Wherever the Destructive Pea Aphis was observed, it was attacked to a very noticeable degree by parasitic enemies. All of the species mentioned in my last report were found during the past season in even greater abundance, and in addition to these with every outbreak the fungous disease due to *Empusa aphidis* was more or less prevalent. At Ottawa by far the most inveterate enemy of the plant-lice was the small orange larva of a species of *Diplosis* ; these minute maggots, about one-tenth of an inch in length, crawled about on the surface of the pea vines and worked very much in the same way as the larvæ of the *Syrphidae*, or Hover Flies ; creeping up to an aphis they transfixed it and held it up, raised from the surface, while they sucked out the juices of its body. The growth of these little creatures was very rapid and there were several broods in the season. When full grown these *Diplosis* larvæ spun a minute cocoon on the stem of the pea plant, or, falling to the ground, spun it there close to the surface, attaching several grains of sand to the outside. This cocoon closely resembles that of the Wheat Midge, or the tiny Cecidomyid *Lasioptera vitis*, of Osten Sacken, which emerges from the Grape Vine Tomato Gall. The winter is passed by the larva inside the cocoon. The plants most seriously attacked in Canada this year were late field peas, sweet peas in gardens and the new crop plant known as the Grass Pea, which is being grown in some districts on account of its exemption from the attacks of the Pea Weevil. Several occurrences of the Destructive Pea Aphis were watched from the time they first appeared this year at Ottawa, on July 27, until the time when permanent snow fell, and a few specimens were found on clover by digging up the plants from under the snow. Parasites of several kinds were abundant throughout the season, and a constant warfare was waged. No sooner did the aphis increase, and appear in large numbers than the parasites appeared in greater numbers and brought them down again suddenly almost to a point of total annihilation. However, at the end of the season a few specimens of the aphis could be found wherever there were chance seedlings of peas and upon late sweet peas, as well as the few mentioned above as found on clover. The attacks of this insect upon the plants where it occurs are of a very pernicious nature, the plants soon becoming stunted, and the flowers, if produced, quickly withering up. Sweet peas which were sown early and had made good growth stopped flowering as soon as the insects appeared, and late sown plants were dwarfed and made no further growth after the attack began.

Last year the worst complaints of injury came from the Maritime Provinces. This year Mr. Robertson, the Superintendent of the Experimental Farm for the Maritime Provinces, writes : 'The Pea Aphis began its work this season in Nova Scotia just about the same time as last year and it looked as if it was going to be just as destructive ; but for some unaccountable reason it disappeared all at once, though not until it had completely destroyed peas which were sown late or on poor ground, where they had a sickly growth to begin with. Such as had a strong and vigorous growth were not much hurt. I did not notice any on clover.'

The injury in Ontario is summarised in the following letter from Messrs. the John H. Allan Seed Company :—

'Picton (Prince Edward Co.), Ontario, November 19.—The Pea Aphis appeared in some portions of Ontario last year and more largely in the United States, and has done material damage to the pea crop. This season it has done considerable damage in New York State, Michigan and Wisconsin. Last season, as well as this, it caused injury in Prince Edward county, as well as in Lennox and Addington. We are also told that it did much damage in Renfrew county.'

The losses due to the Destructive Pea Aphis in the Atlantic Coast States have been shown by Prof. Johnson to be enormous, and he quotes from *The Trade*, a canned goods journal, published in Baltimore, the information that the crop of peas of the Atlantic coast this year will not exceed on the outside one-third of what it was even last year, and continues : 'This is about as serious as it can be, when it is taken into account that it is mostly due to this one pest.' . . . 'With this year's experience, however, we have shown conclusively in our experiments and practical work in the field that this insect can be kept in control to a very great extent if taken in hand in time. In the first place, the peas must be planted in rows 24 or 30 inches apart, and not broadcast or in drills, as is frequently the case.' Many remedies were experimented with by Prof. Johnson, and it was found that what he has called the 'brush and cultivator method' was the most effective remedy. For this it is necessary that the peas should be planted in rows as stated above, and when the insects are noticed the vines are brushed backward and forward with a good pine switch, in front of an Iron Age cultivator, drawn by a single horse. In this manner the plant-lice, which leave the vines quickly when these are shaken, were covered up as soon as they fell to the ground, and a large proportion of them destroyed. The operation was not repeated until the third day, as it usually required over 48 hours to destroy the insects when covered with earth. The particulars are given of an extensive experiment, where a 600-acre pea plantation was practically saved by the persistent and energetic efforts of Mr. C. H. Pearson, of Baltimore. All the methods from a practical standpoint were tried on this place, and it was found that the brush and cultivator method was the most effective. Forty men were engaged, and the 600 acres of peas were brushed and cultivated every third day for two weeks, and in this manner the entire field was saved, netting the owner from 25,000 to 30,000 cases of pease, of two dozen tins each. The year before the pease over the same area were broadcasted, so there was no opportunity of fighting the pest, and, as a consequence, 480 acres were entirely ruined. Another method which was tried with considerable success, consisted of a brush which dislodged the insects so that they fell into a pan containing coal oil and water, drawn between the rows of peas. In this way a bushel of plant-lice were caught to each row of peas 125 rods long. Spraying was tested after a thorough trial, upon 100 acres, and all sorts of insecticides for sucking insects were used, but this method of fighting the insect was abandoned, because no spray could be found which would destroy a large enough percentage of the insects to warrant the expense of the operation

THE PEA MOTH
(*Semasia nigricana*, Steph.).

This insect was unusually abundant in the provinces of Ontario and Quebec during the season of 1900. Prof. Lochhead reports it as troublesome this season in the northern counties of Ontario : Grey, Bruce, Huron, Perth, Dufferin and Wellington, but it does not appear to have been quite so destructive as usual in the Maritime Provinces, although inquiries have been received from all three provinces. Some experiments as yet incomplete may be reported upon provisionally, as they appear to be promising. Mr. J. E. Wetmore, of Clifton, King's county, N.B., was good enough, at my request, to try spraying the peas at the time the pods were forming, with the same spray of Paris green and water as is used for the Codling Moth. This experiment was suggested by the similarity of the habits of the Pea Moth and those of the Codling Moth, and although only two sprayings were given, the results were so promising as to show the importance of careful experiments being carried out in spraying peas to prevent loss from the Pea Moth. There should be at least three sprayings, the first applied when the blossoms begin to fall, the second one a week later, and the third ten days later again. As liquids will not adhere easily to such plants as the pea, owing to their waxy covering, it is necessary, after mixing the Paris green and water, 1 pound to 100 gallons, to add whale-oil soap, or some other soap, in the proportion of 1 pound to every 25 gallons of the mixture. Mr. Wetmore's report on the result of two sprayings, is as follows :—

Fig. 8.—Pea Moth : caterpillar and moth. 2 and 4, enlarged.

'Clifton, N.B., October 4.—I think that the injury to pease in this section was less this year than for a long time previously, and, therefore, it was not a very favourable year for the experiment. Early peas never suffer much from the Pea Moth, therefore I did not spray them, and they were not injured by the moth, except a few at the latter end of the pick. I mixed the spray as you directed and applied it with an Electric Sprayer, which only worked tolerably well. The first application was made on July 21, when the blossoms were beginning to fall from the pease, the second one on July 28. I did not spray again, as the pease were about ready for use, and I did not care to have the mixture on them. I gave the vines about the blossoms a good soaking. I picked the first pease for the table on August 1, half sprayed and half unsprayed, and found one caterpillar in each. August 11, tested pease again, but I could not detect any difference in sprayed and unsprayed pease. Very few pods were affected in either, not more than one in fifty. I examined them for moth several times after this, and found the number of affected pods increasing steadily in both sprayed and unsprayed towards the end of the season. There was, however, a noticeable difference between the sprayed and unsprayed at the end of the season, about 9 or 10 per cent of the sprayed pods were affected, while 20 to 25 per cent of the unsprayed were attacked. I also examined pease on my neighbours' plots and found about 25 per cent infested. This result was not entirely satisfactory to me, because the mixture failed to keep the moth off entirely, though the vines were well drenched.

'I do not think, however, that the moth always lays its eggs in the very early stages. I have found a number of very young grubs on pease ready for the table, though the majority were much older. In fact, I found all stages of growth at that period, from very young to big fat grubs.'—J. E. Wetmore.

THE VARIEGATED CUTWORM.

(*Peridroma saucia*, Hbn.)

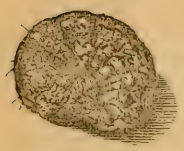

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 9, The Variegated Cutworm ; Fig. 10, moth ; Fig. 11, pupa.
(All natural size.)

One of the most remarkable outbreaks of an injurious insect which has ever been recorded in Canada, occurred last summer on the Pacific Coast, extending from Oregon through Washington, and in every part of British Columbia from which reports have been received. The loss in all garden crops was enormous, and was due to the attacks of the caterpillar of one of the noctuid or 'owlet moths (*Peridroma saucia*, Hbn.), which has been named somewhat inappropriately the Variegated Cutworm. The parent moth is known in England under the name of the 'Pearly Underwing.' Not only did this insect occur in disastrous numbers in British Columbia, but it was rather more than usually abundant in Manitoba and Ontario. The first intimation of the outbreak was received from Kelowna in the Okanagan Valley, British Columbia, in a letter dated July 9; but every day after this for more than a month letters were received, accompanied by specimens, all of which proved to be of the same species. The following extracts from correspondence have been selected to show the extent of the injury, and are given at some length on account of the importance of the outbreak :—

'Kelowna, B.C., July 9.—I send you under separate cover in a tin box a half dozen specimens of a worm that is eating our tobacco crop quite seriously. Please tell me what they are and what I must do to destroy them.'—H. G. Watson.

Mr. Watson was written at once that the caterpillars were the so-called Variegated Cutworm, and the remedies of most use for this class of injurious insects were recommended. Immediately after this began an extensive correspondence with Mr. J. R. Anderson, the Deputy Minister of Agriculture for the Province of British Columbia, who was most untiring in his efforts to distribute information as to the habits of this insect and the best means of meeting its attacks. As soon as any new feature was discovered, which it was thought would be of use to the farmers and gardeners of British Columbia, circulars and emergency bulletins were issued and distributed broadcast. I have no hesitation in saying that the prompt and energetic measures which were carried out by Mr. Anderson in this phenomenal outbreak of such a large and injurious caterpillar, with the habits of which farmers and gardeners were wholly unacquainted, was the means of saving thousands, if not hundreds of thousands, of dollars worth of crops. That the outbreak was of an unusual nature was shown by the receipt on July 20 of the following telegram from Mr. Anderson :—

Victoria, B.C.—Wire advice on receipt my letter seventeenth. Case very urgent.'

The following is the letter referrd to :—

'Victoria, B.C., July 17.—By the present opportunity I am sending you specimens of cutworm, an invasion of which has suddenly set in. They are devastating everything they came across. The first report I received from Lulu Island, where Mr. Tom Wilson found them feeding at night. This was quickly followed by reports from

Cowitchan, Chilliwack, and lastly from Saanich, the outbreak therefore is widespread, and is naturally causing great consternation. You will see that they are of various sizes, but I take it they are all the same species, although quite different in appearance. I have sent a letter to *The Colonist*, giving extracts from your reports as to the remedies for cutworms. Let me have further advice as soon as possible.'—J. R. ANDERSON.

'July 21.—I wired you yesterday asking you to advise me by telegraph as to the subject of my letter of the 17th. Since the 17th I have been deluged with reports of the ravages of these cutworms, and I have published further articles relating to their life history, the remedies, &c., taken chiefly from your reports and from Prof. Slingerland's bulletin. I went out yesterday to Mr. Wrigley's place at South Saanich and witnessed the depredations of these pests. It is truly astonishing to see the manner in which whole fields of carrots and other things are cleared off. Mr. Wrigley was spraying vigorously.'—J. R. A.

'July 30.—Your letter of 23rd inst. received this morning. I am printing part of it in an additional leaflet, giving also extracts from a letter from Mr. Brodie, of the Washington Agricultural Experiment Station. These are going to all the newspapers for publication. The infestation by this insect in Washington amounts to a plague, and I fear most root crops will be lost, as well as other green crops. In consequence of the exhaustion of Paris green in the province and adjoining states, the government was appealed to. I therefore wired you this morning to send 500 pounds.'

'July 31.—I inclose you a copy of an additional leaflet I have published. A meeting of the Victoria Farmer's Institute was held last night at the Royal Oak, for the purpose of considering the cutworm question. I attended it, and read your letter. We all wished you could have been there. The experience of those present went to show that those who used the poisoned bran as you directed were very successful in killing off the cutworm, but the numbers of these are so great that it seems almost hopeless. There was, however, after the meeting, a more hopeful spirit among those present, and I think, if we only had Paris green, every one would use it. The lawns in front of the government buildings here are swarming with cutworms. I have induced the caretaker to have them rolled. This is killing them by thousands.'

'August 2.—I was told by a gentleman from Salt Spring Island that he had noticed five cases of the cutworms devouring those which had been poisoned I am also told that some of the worms are being attacked by parasites, but I have not seen anything of this myself as yet.'

'August 6.—Paris green came safely to hand yesterday. I am now distributing it to the different Secretaries of Farmers' Institutes.'

'August 15.—I am much obliged for the specimen of *Peridroma saucia* which you have sent. This moth will be very useful to identify our British Columbian specimens by, when they emerge. None of the chrysalids have given the moths yet here, but Mr. Tom Wilson gave me one a day or two ago when I was in Vancouver, which he had hatched out. It is undoubtedly the same insect. Do you think it at all likely that another brood of caterpillars may hatch out before winter ?'

'August 16.—I inclose you a copy of a part of a letter from Mrs. J. S. Place, of Dog Creek, B.C., This is a part of the province which I do not think you are acquainted with. I think you will find the letter of great interest, as it gives the date when the eggs were laid. Mrs. Scott, the wife of the mayor of New Westminster, told me that a short time ago she noticed a number of small loopers where the light happened to fall on a light coloured patch on the carpet in her drawing room. She found that they were dropping from a curtain cord where she found the remains of a cluster of eggs. She had previously destroyed several of these egg-clusters which she had found deposited on the curtains and other places in the room.'

The following is the letter Mr. Anderson refers to:—

'Dog Creek, B.C., August 10.—We had an acre and a half of potatoes, and the cutworms ate all the leaves off in two weeks, leaving only the stalks. When they had

finished eating the leaves of the potatoes, they began to cross the fence into the vegetable garden. The fence was just covered with them. However, we cut a ditch through the garden and turned on water. They then tried to cross and were drowned by thousands. Some managed to get over on straws and bits of twigs. We have killed large numbers with Paris green and lime, but we happened to be without any Paris green, and they got a week's start of us. Now I want to ask a few questions. The 28th June was a very hot day, and we had clothes out on the line. When I gathered them in, the clothes had about 50 or 60 separate lots of eggs. I had to get a knife and scrape them off. They were a pale yellow, nearly white. I then went to look at the hops, and found there quite a lot of these egg clusters underneath the leaves. Then we began to look round and found that the same eggs were laid on the windows and all over the verandah. We set to work and got steps and crushed all we could see, which was a very large amount. I thought of sending you some of these leaves, and I am sorry I did not do so. The caterpillars have eaten the potatoes, and now they are thick on the peas and beans. They will eat the end off a pod and then eat the inside. Of onions they eat the top and then go down the stalks. Do you think that the eggs mentioned above are what the cutworms now so troublesome hatch from ?'—Mrs. J. S. Place.

In reply to this letter, Mr. Anderson answered that he had no doubt that the eggs mentioned were those of the parent of the Variegated Cutworm, and there is no doubt he was accurate in this opinion. Dog Creek is in one of the arid districts of British Columbia, where irrigation is resorted to, and the plan adopted by Mrs. Place in preventing the cutworms from travelling by turning on water is an excellent one which has been resorted to very satisfactorily at Kelowna and Vernon, B.C., during this outbreak.

'Victoria, B.C., September 20.—I have a number of the chrysalids from caterpillars sent to me by Mr. E. A. Carew-Gibson, under date of September 2, from the 150 Mile House, now inclosed in a gauze cage. I will put them out of doors as you suggest, and place some twigs, leaves, &c., for the moths to lay their eggs on when they emerge. Mr. Gibson says in his letter accompanying the caterpillars : "I am sending you by this mail a box containing about 20 pupæ and a handful of larvæ of the year's pest—cutworms. I take it these are the same which are so bad all over the province this year. The amount of damage done and the extent of country covered seems extraordinary. At the mining camp at Horse Fly, an isolated settlement 32 miles from here, cutworms have this year completely destroyed the gardens, and have denuded potato fields of their foliage. They have been equally harmful at Soda Creek and Quesnelle Mouth. We were not able to get hold of the Paris green as quickly as it was needed, and the damage was nearly accomplished before the larvæ were much noticed. These cutworms do not seem at all particular about their diet. The handful I send were picked from under hop vines, nasturtiums and sweet peas, growing against this house." I thought that you would like to get this note of the occurrence at 150 Mile House, because it is so far out of the way.'—J. R. Anderson.

'September 21.—Several of the moths from Mr. Gibson's caterpillars have already emerged this morning. This surprised me, as I thought they would be much later.'

To the above quotations from a few of the letters received from Mr. J. R. Anderson, the following extracts from other correspondents, may be added :—

'New Westminster, B.C., July 21.—Cutworms are doing immense damage to all crops on the lower mainland. I have been afraid of this for some time, as I noticed the extraordinary number of common cutworm moths at "sugar". Kindly let me know at once what you advise as the best means of keeping them down. I have found that tobacco sprayed over plants makes them distasteful to the caterpillars. They are everywhere, in fields, in gardens and in greenhouses.'—W. A. Dashwood-Jones.

'Vernon, B.C., July 23.—We forward to-day a tin box containing sugar beet and grubs. We first noticed this grub around an old potato pit where we had potatoes

for the pigs last fall. They have destroyed about an acre of sugar beet adjoining this pit. We have them also around the house on the clover, and they have stripped the hops from the verandah. We have a few on our hop-yards, but very few. We trust that they will not increase on the hops, as they are too far advanced to spray with Paris green. We are poisoning with Paris green on our sugar beet, and also surrounding the patch with a ditch and water to try and stop them travelling. Are they likely to be worse next year.'—D. C. RICARDO.

'Comox, B.C., July 23.—I send a number of caterpillars. Please let me know all about them, as they are in such numbers here at present as to be a perfect scourge, and threaten to destroy all vegetation. They attack everything green, field crops, garden crops and house plants. They are here in millions, and are as destructive to the potato as the Colorado Beetle, but are equally so to turnips and other crops. They eat every portion of the leaf except the ribs, which they leave bare and dead. I have been all over the district, and find the pest universal. We are spraying with Paris green.'—JOHN J. R. MILLAR.

'Agassiz, B.C., July 24.—I send five cutworms. These are so plentiful that I picked five on the walk without moving a foot. They are eating the leaves of many of the shrubs, vines, &c., besides garden plants. In the orchard they have attacked the pears. In the field they are eating the fleshy outside covering of the pea pods. The only remedy I can suggest is to sweeten a bran mash and doctor it with Paris green. They are here in swarms. What can we do to protect our crops ?'—THOS. A. SHARPE.

'Froek, B.C., July 25.—I wish you could tell me how to get rid of these worms out of my garden and potato fields. The ground is just covered with them. They eat leaves, stems and everything of vegetables, and then take the root very often. They have destroyed everything for me this year, so that I shall have nothing for winter use. Is there anything I can do to prevent these things next year ? I never saw anything like them before. In the parcel I send, the small ones are picked from the stems and the big ones from the ground.'—NILS FRALANDER.

'Victoria, B.C., July 25.—The enormous numbers of cutworms have naturally reduced the food supply and made it necessary for them to change their usual feeding habits. This necessitates a corresponding change in methods of fighting them. I find them distributed all over all kinds of plants, vegetables, flowers, &c., and feeding at all times of the day and night ; in roots such as carrots and mangels, they eat holes and live inside these ; also in tomatoes ; in fact, they are everywhere. Many complaints are coming in now of their injuring fruit trees and fruit, and the loss to the farming community on their account is going to be very large. In many cases people are slow to use Paris green, being afraid of it, or use it too late. I have had excellent results where the pests are distributed promiscuously over the plants by using a Paris green mixture, dusted or blown through the entire leaf surface, one pound of Paris green to twenty pounds of flour, while the bran and arsenic mixture is effective only in certain instances. A Paris green spray is not so generally effective as the powder form, but I think this is due to the fact that many persons spray too heavily and most of the poison is washed off the plants. Reports are coming in now from Saanich that grain crops are suffering and the work of the cutworms seems almost identical with that of the true Army Worm. It is certainly the most serious occurrence of this nature since I have been in office. I shall be glad to know the proper names of the species as soon as you have reared them. I suppose there will be several different kinds.'—R. M. PALMER.

'Victoria, B.C., August 17.—It is quite a relief to know that you consider it unlikely that we shall have another plague of cutworms next year. Such an event would be indeed disastrous. My own investigations have led me to come to the same conclusions as were stated in your recent letter to Mr. Anderson, namely, that so many of the cutworms are parasitized, at any rate in some localities, that there is no reason to anticipate such a plague in 1901, as we have had this season.'—R. M. PALMER.

'Agassiz, B.C., July 27.—There is what is to me a strange feature in this attack, the cutworms are eating a number of my Thuyas. *Thuya vervaeneana* is one that they appear to be particularly fond of. There appears to be a slacking off in the numbers of these cutworms now, but this may be only temporary. However, many are going into chrysalis just under the suface of the ground. Would it be well to plough clover fields with a shallow furrow and plough or disc with a spading harrow all other fields? Would this have any effect in lessening the caterpillars or killing the chrysalids? I dislike the idea of ploughing up my clover, but would not hesitate if it would be useful. I am told that some hop yards will not pick a hop. Mr. Breed, in Saanich, is one who has no crop this year, on account of the cutworms, and they have begun on the yards here. I saw a field of four acres of potatoes this morning, and I think there is not a hatful of foliage left in the field. Ours, so far, are saved, but how long this will continue I do not know. I sprayed roots, potatoes and trees, until all my poison was gone, and now I would use poisoned bait if I could get the poison, but cannot before Monday or Tuesday.'—Thos. A. Sharpe.

'Maywood, Victoria, B.C., July 28.—I send specimens of a cutworm which is devastating the gardens and fields round Victoria. Whole crops of roots are entirely eaten up, and the corn is now being attacked. It is the most serious disaster I have seen in the eleven years I have lived here. Round five turnips in my garden I found 236 cutworms. Many farmers have lost their entire crops of carrots, potatoes and other roots. A row of sweet peas, sprayed with double-strength Paris green, was again covered 12 hours later. Nothing escapes. Carnations have every flower bud eaten out. Dahlias are eaten to the stems. We shall soon have nothing left. They have attacked the flowers in the conservatories and the tomato houses, where I have poisoned them with bran and Paris green.'—J. W. Webb.

'Victoria, B.C., July 30.—Yesterday I drove out about five miles and saw several gardens. I assure you it was a sorry sight. In some places even rhubarb was entirely stripped, only the stalks and leaf ribs being left. Potatoes were stripped to bare stalks, and the worms were eating the tubers. Some tubers had four or five cutworms in them. These latter are so abundant that they are crawling about in search of food by day.'—Geo. A. Knight.

'Langley Prairie, B.C., July 30.—The worms are destroying potatoes and root crops. Yesterday was the first day I noticed them. They have been very bad at Chilliwack.'—D. H. Nelson.

'Kaslo, B.C., July 31.—We have been suffering all through the Kootenays for several weeks past with a plague of grubs, not the ordinary cutworm, but a dark grub which has attacked all vegetables and almost all flowers. I am now trying whale-oil soap and quassia. The latter I have found the best thing for roses, but from all I can see these remedies will have no effect against this grub.'—Geo. Alexander.

'Armstrong, B.C., August 1.—The cutworms are much larger than our ordinary cutworm, and have been much later in appearing. They are doing an immense amount of damage nearly all over the province, some potato fields being about destroyed. Some people assert that it is the Army Worm.'—Donald Graham.

'Victoria, B.C., August 3.—I have one moth hatched out and many chrysalids, so I hope the worst is over for this season. Still there are many small larvæ yet.'—R. M. Palmer.

'Agassiz, B.C., August 6.—I am sending cutworms of very different sizes. I found them and the chrysalids in the same bed of garden peas. There were so many chrysalids that I was in hopes the trouble was nearly over, but, if the smaller ones have to grow as large as the big ones, it must be some time yet before they pass away.' —Wm. S. Jemmett.

'Agassiz, B.C., August 11.—The cutworm nuisance seems to be abating at last.'—Thos. A. Sharpe.

'Nanaimo, B.C., August 13.—I send you a few notes on *Peridroma saucia*. The moth was very common round my house in June, and I captured several. I do not remember to have taken it in British Columbia before. The first caterpillars I saw were in a field of potatoes at Boat Harbour, on July 15. I did not recognize the caterpillar. It is not one of our common British Columbian cutworms. Since July 15, of course, everybody has heard of it, and the damage done has been very considerable. Mangels, potatoes, turnips, &c., have been bored into, wherever near the surface of the ground. The caterpillars have travelled a little when food was scarce, and they have stripped nettles, thistles and bracken just outside fences. They have also attacked the second growth of clover, and have climbed fruit trees when planted near garden stuff. The larvæ are now pupating, and some moths have already appeared. This, I think, establishes the fact of a double brood. I collected at willows, and presume I should have taken some of the moths, had they hibernated as such.'—Rev. G. W. Taylor.

'Nanaimo, B.C., August 25.—*P. saucia* is now coming out of pupa state in considerable numbers. I have no doubt about two broods now, and I fear an attack of caterpillars must be expected in spring.'—G. W. T.

'Kaslo, B.C., August 16.—I made a tour through some ground which I knew had been infested with cutworms, but found that they had all pupated, so I mailed you last night a box of pupæ. These were so thick in the ground that every spade would turn up from three to nine pupæ. These caterpillars when young were blackish-gray on the back and lightish stone colour on the legs and belly, with a row of four yellowish spots on the back. After the last moult the general colour is greenish stone, and the four spots fade considerably, in some specimens they are almost imperceptible. They vary much in colour and size. If I am correct in my supposition of the moth of these pests, it has not appeared here before in any numbers. I had none of the moths prior to last spring. The last visitation of cutworms was in 1892.'—J. W. Cockle.

'Armstrong, B.C., August 18.—I notice the chrysalids from the cutworms in constantly increasing numbers among my potatoes.'—Donald Graham.

'Agassiz, B.C., August 18.—The cutworms are gone, but the potatoes, mangels and peas have been seriously injured. In some cases, as the mangels, our crop is destroyed. The peas were lessened 50 per cent, and potatoes are defoliated to a considerable degree, but the absolute injury will not be known until they are harvested.'—Thos. A. Sharpe.

'Chilliwack, B.C., September 3.—Cutworms have been devastating our pea crop and roots. However, I have only lost about 15 acres of peas, so I consider myself lucky; but some of those I have got harvested are shrivelled and very small.'—G. Maxwell Stuart.

'Okanagan Mission, B.C., August 20.—Caterpillars did a great deal of damage here this year, but copious irrigation proved a pretty good method of controlling them.'—J. T. Davies.

In summing up the insect injuries of the year in British Columbia, Mr. R. M. Palmer writes, as follows :—

'Amongst insect pests occurring during the year the Variegated Cutworm has made a record of damage far exceeding anything known in the province. You have so much data from Mr. Anderson on this that it is unnecessary for me to deal with the matter at length. The crops which suffered most severely were potatoes, tomatoes, cabbage and allied plants, peas and clover. The cutworm seriously injured the apple crop in some districts, and also defoliated or cut off many young shoots of fruit trees. To prevent the cutworms from climbing the stems of fruit trees, banding them with a strip of the common sticky fly paper proved very effective, and when the Paris green and bran mixture was deposited near the base of the trees, immense numbers of the pests were destroyed. A capital plan in using the poisoned bran for this purpose, is to cover the mixture with pieces of sacking or other material, under which the cut-

worms collect, and feed—while poultry and other birds are prevented from getting the poisoned bran—a very important matter.

'There is no doubt that much of the loss caused by the cutworms could have been prevented by timely use of Paris green, but the plague was so unexpected, much valuable time was lost before farmers generally woke up to what was going on, and when the fight was fairly started, unfortunately the supply of Paris green was not equal to the demand.

'The wide circulation given by Mr. Anderson to your letters containing information as to ways and means of fighting the cutworms was much appreciated, and the methods advised were adopted generally.'

The following epitome of this remarkable occurrence of a common native species was written by Mr. Anderson at the end of the season, and will be read with interest :

'Victoria, December 3.—Regarding the cutworm outbreak which occurred in this province last summer it might appropriately be characterized, on account of its suddenness, extent and the myriads of individuals, as a veritable plague. I have not been able to ascertain how far south and east the plague extended, but it may safely be said that the States of Oregon, Washington and Idaho, and the whole of the province of British Columbia, as far north as any reports were obtainable from, were infested. The first report to this department was made by Mr. Tom Wilson, in the middle of July, he stated that the potato tops on Lulu Island were being devoured by some insect, but which, in spite of diligent search, could not be detected. Suspecting the cause, I advised looking for the culprit at night with lanterns, this was done with the expected result. Not suspecting the infestation to be widespread, I merely recommended the treatment usually followed. However, a few days later reports began pouring in from all parts of the province and bulletins were issued from time to time recommending the remedies you prescribed in your reports. The sweetened bran poisoned with Paris green, when it was used in accordance with directions, was found to be most effectual.

'Unfortunately, the supply of Paris green, not only in this province but in the adjoining states and California, was not equal to the demands, in consequence of which great havoc was wrought before a supply could be received from the East. When at length a supply was obtained, many of the caterpillars had passed into the chrysalis stage. The numbers of the caterpillars were simply incredible ; in places the surface of the ground was described as a moving mass, and where they were poisoned in any numbers the stench was unendurable. On account of their numbers and the consequent scarcity of food, they soon relinquished their natural nocturnal and non-climbing habits, and myriads could be seen crossing the dusty roads in the heat of the day in search of food ; fruit trees, if not protected, were ascended, and the fruit as well as the leaves consumed. Naturally, green succulent food was first consumed, but, as that got scarce, anything and everything was attacked ; after consuming the tops of potatoes, turnips, onions, carrots and such things, the tubers were attacked. Potatoes which were well matured and those which were quite late, escaped with the least loss : carrots and onions suffered very severely. The potato crop was probably reduced one-third, and other root-crops in proportion. The second crop of clover was almost entirely destroyed. Grain was attacked, but no material loss resulted.

'In August the caterpillars began to enter the chrysalis stage, and their ravages began then to be, of course, much lessened. Altogether, the period of activity lasted about from six weeks to two months. A number of caterpillars which I had in captivity were all in chrysalis by the end of August or the beginning of September. A number of these emerged as moths in October, but I have not been able to discover any eggs. A large number of the moths were also caught in the grass-cutters used on the lawns surrounding the government buildings here. My observations have led me to the following conclusions, viz.: That the cutworms appeared in such abnormal numbers owing to the scarcity or absence of their natural enemies, parasites, birds, &c.; that where fowls were allowed to roam the plague was reduced to a minimum ;

that poisoned bran when used as directed is most efficacious; that parasites are increasing and will probably reduce the numbers of cutworms next season; that from good services rendered in devouring great numbers of these cutworms the crow frequently so destructive to potatoes and other crops in this province, has this year done the farmers good service.'—J. R. ANDERSON.

*Fig. 12.—Variegated Cutworm: moth—twice natural size.

DESCRIPTION OF THE INSECT.

The moth, which is the parent of the Variegated Cutworm, is a large species expanding from an inch and a half to nearly two inches when the wings are spread. It varies very much in colour; the forewings are, as a rule, rather dark brown, but varying to ochreous or russet-brown, shaded on the disk and toward the end of the wing with darker brown; occasionally specimens are quite light along the costal region and at the base of the wing. The wings are crossed by the usual four more or less distinct double wavy bands, but in many specimens these merely show as double spots on the costa. The reniform or kidney-shaped spot is usually darker than the orbicular or round spot, and the reniform bears a few white scales on the outer margin. In two specimens no trace of the reniform or of the orbicular can be seen. The underwings are pearly-white in the centre, with a purplish sheen, bordered broadly and veined with dusky brown, and fringed with white (hence the English name of this moth, The Pearly Underwing). The thorax is of the same colour as the forewings, and bears in the centre a tuft of raised light-tipped scales.

The eggs are laid in elongated flat patches, and were first found by Dr. Riley and figured in his First Missouri Report for 1868. In years of great abundance it is probable that these eggs are laid in various places other than on the food plant. Eggs which were most probably of this species were found upon curtains, on clothes hanging on lines, and on the woodwork of houses, by Mrs. Walton, of Armstrong, B.C., and Mrs. Place, of Dog Creek, B.C. On hatching, the young caterpillars, as is the case with some other cutworms, are loopers, and resemble the larvæ of the Geometrid moths, lacking some of the prolegs which appear in later stages. A full account of the appearance of the larva in the different stages is given by Dr. Lintner in his Fifth Report as State Entomologist of New York.

---

*Figures Nos. 9 and 11 have been kindly lent by Prof. Otto Lugger, and Nos. 10, 12, 13 and 14 by Prof. M. V. Slingerland.

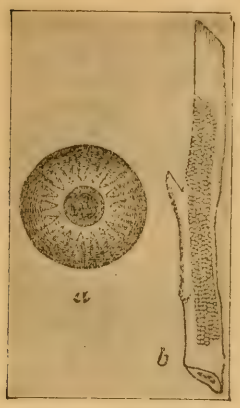

Fig. 13.—Variegated Cutworm : eggs.

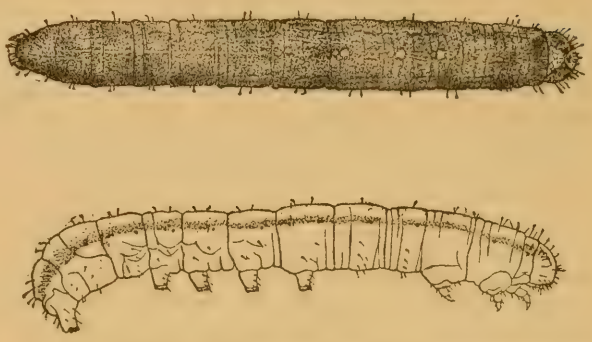

Fig. 14.—Variegated Cutworm—enlarged one-half.

The following is a description of the full-grown larva, the form in which it appeared as such a destructive enemy among the crops of British Columbian farmers and gardeners last season :—

Heavy-bodied cutworms, about two inches in length by over a quarter of an inch in width, of varying shades of gray or stone colour, the whole body finely mottled and variegated with black, gray, brown, or pinkish markings, any one of which may predominate more or less in different specimens ; many have a ruddy appearance from the ground colour of the skin being of a pinkish colour. The markings of these caterpillars consist of a conspicuous yellow band, mottled with orange, beneath the spiracles; a sub-dorsal interrupted stripe of velvety black blotches washed with orange, sometimes very conspicuous, but at others almost obliterated ; a medio-dorsal line of yellow, almost continuous from the head to the apex of the anal flap. This line expands into four or sometimes five conspicuous yellow spots, situated in the centre of the middle segments. These spots are always present on segments 4 to 7, those on 5 and 6 being the largest. There is also occasionally a spot on segment 3. The supra-stigmatal area bears on each segment, except the head, a diagonal blackish, curved, almost S-shaped mark, the lower end of each of which incloses the black spiracle. These marks form a wide, but on some specimens distinct, sinuous band between the sub-dorsal stripe and sub-stigmatal band. On segment 12, the sub-dorsal stripes meet and form a black velvety patch, somewhat like the letter W, with the lower part filled in. Behind this, on segment 13, and the posterior third of segment 12, is an orange or pale patch, sharply defined anteriorly against the straight edge of the velvety patch on segment 12. The ventral surface is paler than the dorsal and glaucescent. Head round, deeply cleft at summit, testaceous, coarsely mottled with brown or reddish markings. In the centre of the face are two curved black stripes which, starting from the summit of each lobe of the head and converging, meet above the frontal triangle, and then run down to the base of the antennæ. Thoracic feet testaceous ; prolegs concolorous, bearing testaceous chitinous plates at the base exteriorly ; claws blackish.

When full-grown, these caterpillars burrow a short distance into the ground and form a smooth oval cell, in which they change into the chrysalis or pupal stage, when they are of a bright chestnut brown, about three-quarters of an inch in length. The anterior segments following the rounded head parts and to the tips of the wing covers, are cylindrical, but the six remaining segments, as has been noticed by several correspondents, are capable of movement. These segments diminish in size to the tip, which is armed with two slender black spines, which lie so close together as to appear as one, unless closely examined with a magnifying glass. This stage for the second brood, of which the moths emerged in August and September, was from 20 to 23 days.

There is no doubt that there are two broods of this moth in Canada, as was stated to be the case by Dr. Riley, in Missouri, many years ago. The moths of these two broods appear normally about the end of June and after the middle of August ; but it seems as if some individuals of this latter brood may be delayed in emergence till late autumn, or even till the following spring. Prof. Otto Lugger writes that he has taken this moth so frequently at St. Anthony Park, Minn., very early in the spring, from March 2 to 27, that he feels almost certain that at least some of the moths may hibernate as such. He has also found them very late in autumn, after all foliage had disappeared from plants. In fact, he finds such irregularity in the appearance of this species, that they can be obtained almost throughout the season. On November 9 last, I dug up at Ottawa two pupæ which produced the moth ten days afterwards indoors. This was nine days later than the date when the ground was covered with a fall of snow, which has remained ever since, and will in all probability be here until next spring. Therefore, had these pupæ not been found, the moths could not have emerged from them until next year, showing that the species sometimes hibernates as a pupa ; but a large number of the moths, by far the largest of those reared this year, appeared by the third week in August, and it seems probable that with this species, as with a great many other cutworms, egg-laying would take place by the end of August and the beginning of September, that the young larvæ would hatch and make part of their growth before winter, or even, as in the case of *Carneades ochrogaster*, Gn., that the eggs might remain unhatched until the following spring ; it would thus appear, from the very diverse dates at which the perfect moths and caterpillars have been found, that this species may pass the winter in almost any stage, and this is doubtless the case with a great many other species, the life histories of which have not been perfectly worked out. An excellent article on the Variegated Cutworm has been published by Prof. Slingerland (Bull. 104, Cornell Agric. Exp. Stn., 1895.)

The most important facts with regard to the insect are the class of crops which are likely to be injured by it, and the best remedies with which to prevent its injuries. As to the range of its food plants, the extracts given above indicate pretty well that almost any vegetation is acceptable.

Professor French, in the Seventh Report of the State Entomologist of Illinois, says: 'The Variegated Cutworm is widely distributed, and it is probable that we have no other species that is more voracious or is a more general feeder. While some kinds of cutworms are not found much out of certain situations, this may be sought in any place during its season with a good prospect of finding it. There seems to be no cultivated crop that is free from its attacks, and when these are not at hand, it readily preys upon weeds that are found in fields and by the roadsides.'

Remedies.—The remedies for cutworms have been given so frequently in former reports that it is hardly necessary to repeat them in full here. Briefly, they consist of:

(1). The banding of freshly set-out annual plants with rings of paper or tin.

(2). The poisoning of the caterpillars either with traps of fresh vegetation tied in bundles and, after being dipped is a mixture of Paris green and water, or other poison, distributed at short intervals over infested land, when the cutworms appear. A modification of this remedy which has given the greatest satisfaction in British Columbia during the past season, is known as the poisoned bran remedy. This was first used successfully on a large scale some years ago in California as a remedy against grasshoppers in vineyards, since which time it has come more and more into use, owing to its efficacy and the ease with which it can be prepared and applied. This mixture consists merely of bran, moistened with sweetened water, and Paris green, mixed in the proportion of 1 pound to 50 pounds of bran. In making this mixture, the most convenient method is to dampen a small quantity with the sweetened water, a few ounces of sugar in a pail of water, and then add more dry bran until the whole is almost dry again. If the Paris green is added to the bran without

dampening it, it sinks with remarkable rapidity to the bottom, even in this dry mixture, when it is stirred. If it is desired to use the poison as a wet application, more water can be added until it is of about the same consistency as porridge ; but if to be used dry, dry bran must be stirred in until the mixture will run through the fingers easily. This poison may then be applied to the land, either around or between plants to be protected, or a row of it may be run close to the drills of crops planted in that manner.

PARASITES.

The valuable aid rendered by parasites, whenever any injurious insect appears in unusual numbers, is so well known that the practical entomologist is always on the alert to detect if these are present during an outbreak of an injurious species, such as occurred in the case of the Variegated Cutworm in British Columbia during the summer of 1900. That these were present in some numbers was proved, but they seem to have been local in their distribution. They are, however, difficult to detect, and it is to be hoped that they may have been overlooked in many instances. At Nanaimo they were looked for carefully but unsuccessfully by the Rev. G. W. Taylor, an experienced entomologist, and he is of the opinion that there may be trouble again in that locality next year. The experience of the past with regard to similar outbreaks would, however, seem to justify a more hopeful view of the case. Cutworms of all kinds have many enemies, both parasitic and predaceous, and these increase with remarkable rapidity, so that two successive years marked by such an outbreak as was experienced this year would be almost without precedent. Not only will parasitic and predaceous insect enemies, and fungous and bacterial diseases have increased, owing to the large food supply, but many insectivorous birds and domestic animals, having learned how to find them, will be ready to assail them next year on their first appearance. The phenomenal abundance of the Cutworms and the widespread injury they wrought has forced farmers and gardeners to learn their habits and acquaint themselves with the most practical remedies. The following are a few extracts from correspondence bearing on the subject of the natural enemies of the Variegated Cutworm in British Columbia.

'Nanaimo, August 13.—I have boxed up a couple of hundred caterpillars of *saucia* for the sake of breeding parasites ; but they seem remarkably healthy, and I have not seen a single one attacked by Tachina Flies.'—Rev. G. W. Taylor.

'Victoria, August 17.—I send larvæ of what I take to be a parasite. The man who brought them to me said he put cutworms only into a jar, and on looking at them a few days ago, he found one dead one, killed, I think, by parasites, two chrysalids and these larvæ in an earthen hollow which had, I think, been inhabited by the host.' —J. R. Anderson.

'Victoria, August 3.—You will be pleased to learn that some of the caterpillars are parasitized by ichneumon flies, and it is reported to me from Salt Spring Island that "white eggs" (Tachina eggs ?) are on many of the cutworms near their heads.'—R. M. Palmer.

'Victoria, August 17.—Three lots of larvæ which I had under observation, were almost all destroyed by the maggots of a parasitic fly, no doubt the same species as you found in your Victoria consignment of larvæ. Field investigations show the parasites to be well distributed.'—R. M. Palmer.

'Vancouver, August 20.—I saw in a recent letter in the papers (with reference to cutworms) that you state that cutworms turn to moths. In going over a farm near here, I picked up a number of chrysalids, among others one that was just bursting, in fact the insect was partly out ; it was not, however, a moth, but a large black fly, and seemed to pretty well fill the chrysalis. The fly was not unlike a black flying ant, but with very long legs, in fact a sort of cross between a flying ant and a hornet. It had a small sting apparently. Is this a parasite of the cutworm ? I have frequently

seen these flies in the gardens and on the farms. There are a great many about just now.'—C. E. Hope.

This last important observation evidently refers to an Ichneumonid parasite. The larvæ sent by Mr. Anderson produced *Meteorus vulgaris*, Cress., a well-known parasite of all kinds of cutworms, and the flies mentioned by Mr. Palmer, as reared at Ottawa, from caterpillars sent from British Columbia, were the large muscid the Cattle Fly (*Muscina stabulans*, Fallen), of which no less than 17 were reared from one sending of caterpillars from Victoria.

'Nanaimo, August 27.—*P. saucia* is now coming out of the pupa state in considerable numbers. So far as I can see in this district, the parasites have not done very much for us. I have only seen one caterpillar attacked by hymenopterous parasites, and only a very few by diptera. Many caterpillars, however, have shrivelled up in the pupal cell without changing.'—Rev. G. W. Taylor.

Several correspondents mentioned finding the caterpillars dead on the ground, or in the cavity made in the ground by the cutworms, before turning to pupæ (or chrysalids). Some of these were sent by Rev. G. W. Taylor, who had found them in considerable numbers at Nanaimo. These were forwarded to Dr. Roland Thaxter, at Harvard University, in the hope that a parasitic fungous disease might have been discovered, but unfortunately no fungus could be detected. Dr. Thaxter writes: "I looked at the *saucia* larvæ soon after receipt, but found no sign of fungus. It is possible that it may have been bacteriosis, but it would be impossible to determine this from the material. Such cutworms are subject to *Empusa aulicae*, and I have no doubt that if careful investigation were made during one of these invasions, this or some other *Empusa* would be found destroying them.'

PREDACEOUS ENEMIES.

Wild birds were occasionally spoken of as destroying these caterpillars, but as a rule the kinds were not specified. Robins are mentioned by Mr. Dashwood-Jones, and the following letter is from Mr. J. R. Anderson :—

'Victoria, August 15.—'I am sure you will be pleased to hear a good word spoken in favour of the execrated old Crow. For some time before it was discovered that the cutworm plague was upon us, I noticed first one, then several, and then a large number of crows busily engaged among the grass on the lawns in front of the Government buildings. On investigation I discovered that they were after the cutworms, and good work they must have done judging from the assiduity with which they pursued their labours. I have since had similar reports from several parts of the province, and even the still more execrated Blue Jay has come in for a good word from some quarters. The old adage is borne out that a certain gentleman is not always as black as he is painted.'

Chickens and ducks are mentioned by several observers as having done good work. The following are among the most interesting records :—

'Victoria, July 30.—I saw a remarkable thing yesterday. There were two gardens close together with the same kind of soil, &c. One was beautiful, the other was eaten bare by cutworms. Chickens had the free run of the first, in the other there had been no chickens. In small gardens there would have been very little trouble in keeping them clean.'—G. A. Knight.

'Victoria, July 28.—I turned the chickens into the garden, giving them water, but no wheat, and they are working at the caterpillars all day, but cannot get rid of them all ; they are in thousands, every handful of soil is full of them. Ducks seem to eat even more than the chickens, but want some one with a rake to bring the worms to the surface.'—J. W. Webb.

Pigs were very useful at Agassiz.

'August 6.—I intended to put down some poisoned bran, but I found nine of my young pigs in the potato field, travelling regularly up the furrows, just moving

the earth sufficiently to get at the worms. In no case did I find the potatoes uncovered or touched ; from the look of it, the pigs must have been at this work for some days. They are about 5 or 6 weeks' old, and seem to have lived mostly on these worms. They have eaten nothing in the sty, except from the mother, until the last 2 or 3 days, and they are perfectly fat. I knew they ate a lot of raspberries, but could not see how they got so fat on them. The potato field joins the pig field, and it is my intention to turn the pigs in as soon as I have lifted the potatoes.'—WILLIAM S. JEMMETT.

As there is a possibility that the Variegated Cutworm may again appear in British Columbia next season, it will be wise for every one to be keenly on the lookout for its first appearance in any form, and to write and send specimens promptly to the provincial Department of Agriculture in Victoria, or to this Division, so that advice may be given as to the best steps to take under the circumstances to prevent loss. Observations on the occurrence of parasites, and predaceous insects, and of work done by wild birds, poultry, pigs, &c., will be of special interest, and I shall be greatly indebted to any observers who will report to me any instances which may come under their notice.

THE SPOTTED CUTWORM

(*Noctua c-nigrum*, Linn.).

Among the outbreaks of cutworms reported to this Division during the season of 1900, mention may be made of one which occurred in Ontario just at the same time that the Variegated Cutworm was doing so much damage on the Pacific coast. Injury was reported from Niagara and several places north of Lake Ontario. The moth was also extremely abundant at Ottawa from July to the end of the summer. Almost all kinds of vegetation, with the exception of the various grasses, were attacked, and the larval habits of this species seem to resemble very closely those of the Variegated Cutworm. Young larvæ in the looper stage were received from Niagara, from Mr. Joseph Healey, on June 13, who had found the cluster of eggs upon an apple tree and the larvæ were reared to maturity upon the leaves of that tree. Pupation continued from July 24 to 27, and the moths all appeared from August 18 to August 25. The following extracts refer to two of the worst occurrences reported :

'Whitby, July 25.—Upon examining some tomatoes to-day, the fruit of which is not more than half grown, I discovered that, with scarcely an exception, the tomatoes were more or less eaten by greenish coloured grubs, the largest of which were a little over an inch long, some being quite small. They ate through the skin and then consumed the inside. There were a number, a dozen or so, in each tomato. The plants are healthy and vigorous, the foliage not being affected. There are thirty or forty plants in the patch. Every one I examined was in the same condition. The grubs are not very active. As the matter may be of economical importance, I thought it would be well to let you know about it at once. It may, of course, be only a casual invasion ; but, should it spread and become general to the extent that this patch of mine is affected, it will prove a serious matter for tomato growers.

'Since writing the above I have learned from my man that there were a large number of these same grubs in a patch of oats and peas growing alongside of the tomatoes, and that on a nearby farm there were immense numbers in a field of peas. Some cauliflowers growing near my tomato plants are also being visited.'—W. O. EASTWOOD.

'July 30.—As requested I send you some of the grubs from my tomatoes. My man tells me that, upon pulling up some of the affected plants, he found bunches of the grubs an inch or more below the surface, also that they are thick in a field of peas about half a mile from here.'—W. O. E.

'Pefferlaw (York Co.), Ont., July 30.—I send you by mail a box of worms which are abundant on the farm of Mr. James Cornwall, of Georgina township. They have

stripped a field of carrots and mangels. They devour the leaves of Canada Thistle, gooseberries, choke-cherries, &c. A field of oats beside the carrots is untouched. About eighty rods away, on the farm of Mr. W. Jackson, they have devoured a field of peas. After eating the leaves of the mangels they attacked the roots and ate large holes in them. They can be dug out of the ground around the carrots and mangels in large numbers. Kindly tell me what they are and advise a remedy.'—THOMAS CORNER.

Like the Variegated Cutworm this is a double-brooded species and is never a rare insect; but this year it was exceptionally abundant. It was the second brood, the larvæ of which are found in July, which was so destructive this year.

The following is a description of the full-grown larva of *Noctua c-nigrum*, the Spotted Cutworm.

Length, about one and three-quarters inches, by slightly less than a quarter of an inch in width. The markings of this caterpillar are in a general way very similar to those of *Peridroma saucia*, except that the mottlings are finer and less distinct, thus by contrast making the bands and stripes more prominent. The medio-dorsal line is continuous and not expanded into the yellow spots so characteristic of the Variegated Cutworm. The black velvety blotches of the sub-dorsal stripe are more clearly defined, and the posterior extremities do not meet on segment 12 in the black W-shaped blotch of *P. saucia*. The black blotches of this line are all separate and decrease in size anteriorly, and each one bears in front of it, lying towards the centre of the dorsum, a pale blotch, behind which in the centre of each segment is a smoky shield-shaped blotch. These markings give a much more checkered appearance to this caterpillar than is the case with the Variegated Cutworm. The sinuous band between the infra-stigmatal band and sub-dorsal stripe is also shadowed above with pale blotches. The ventral surface is conspicuously paler than the dorsal. This caterpillar as compared with the Variegated Cutworm is more slender, shorter, and the colour is, as a rule, ruddier, the mottlings much finer and the black marking more contrasted with the ground colour.

These caterpillars when full-grown burrow into the ground and form a cell in the same way as the Variegated Cutworm. The length of time from the hatching of the eggs until the caterpillar is full-grown is about six weeks in summer. The hibernating larvæ begin feeding in April and produce moths by the end of May or early in June. It has been noticed, however, by Dr. Forbes, in Illinois (Ill. Agr. Exp. Stn. Bull. 60) that a few are said to continue much longer in the pupal stage, even as late as August. This retardation of development is a common feature with many insects, of all orders, and is doubtless a provision of nature as a means towards the preservation of species.

The moth of the Spotted Cutworm, which, from the markings on the forewings, has been called the Black C Rustic, is a rather showy moth of about an inch and a half in expanse of wings. The forewings are, as a rule, purplish brown, sometimes almost black, in the females, and much paler in the males. There is a black C-like spot in the middle of the forewing, the open part towards the front edge of the wing, and filled with a much paler blotch, which extends beyond the C-like spot and merges with the general colour of the wing. There is great variation, however, in the shade and intensity of the colouring, specimens of both sexes being lighter or darker than the average. The hindwings are dusky, paler towards the base, and of a satiny lustre. The thorax is of the same colour as the forewings, with a distinct pale collar.

The remedies which are recommended for the Variegated Cutworm on a previous page will be found applicable to this species also.

There were but few parasites noticed among the caterpillars sent with the above letters, but upon one larva three curious egg-like bodies were observed, which proved to be the larvæ of a small hymenopterous parasite, which has been identified by Mr. W. H. Ashmead, of Washington, as *Euplectrus frontalis*, How. These parasitic larvæ were oval, like minute white eggs, at first, but later were attenuated posteriorly and about one-twelfth of an inch in length. They were attached to the back of the cater-

pillar, close to the head, and only relaxed their hold when full-grown, to spin their light silky cocoons among the leaves close to the dead body of the caterpillar, which they had destroyed.

THE CABBAGE PLUSIA

(Plusia brassicae, Riley).

Fig. 15.—The Cabbage Plusia: *a*, caterpillar; *b*, cocoon; *c*, moth.
(Cut kindly lent by Dr. S. H. Forbes.)

This insect is frequently a serious enemy to the market gardener in the United States; but I have never received a complaint concerning its work in Canada until the present year. This has been a matter of some surprise to me, because it has been the cause of much loss in States of the Union close to our boundaries, both in the East and in Minnesota. In July last, specimens of the caterpillars were sent in from the North-west, and moths were taken at Ottawa and St. John, N.B., for the first time.

'Regina, Assa., July 18.—The caterpillars I send have been doing some damage in gardens here. I observed them first on potatoes about three weeks ago; they ate small round holes in the leaves. They have since turned their attention to lettuce. In my own garden they ate a row of green lettuce right to the ground before I found out what was the matter. They have since got into the bronze variety; but do not appear to devour it so voraciously as the other. I have found them in a neighbour's garden eating the leaves of celery much in the way they attack potatoes. The colour of the caterpillar is a bright, rather blue, shade of pea-green, somewhat whitish along the back. It is very lively, especially when small, and when disturbed rolls itself into a ball. Some of the caterpillars are now spinning their cocoons in the lettuce leaves. Please let me know what species it is, and what remedy to apply.'—J. R. C. Honeyman.

The Cabbage Plusia, also known as the Cabbage Moth, and, in the caterpillar form, as the Cabbage Looper, is said to be, where it occurs, the worst pest known on lettuces grown in forcing houses. It would appear as though this insect were becoming year by year a worse pest, and that the area where it occurs as an injurious insect is enlarging. It may be that before long we may, in Canada, have to reckon with this insect as a regularly recurring enemy.

The most practical means of preventing the work of the caterpillars on lettuces in forcing houses is stated to be the keeping of the ventilators closed with mosquito netting. It is thought that the eggs are sometimes laid on plants before they are taken into the houses, but probably the moths gain access to forcing houses more generally through the ventilators. There are many other plants in greenhouses which are attacked by this caterpillar. In the autumn they have been found troublesome among chrysanthemums, cutting off the flower buds. Smilax and other plants have also been injured. In the open ground the caterpillars are most destructive to cabbages and related plants, such as have smooth leaf surface. They feed on the surface of the

leaves, and are said by Mr. Sirrine to be much more particular about what they eat than is the case with the imported Cabbage Worm. They walk rapidly, and, if they find any foreign substance on the leaves, they move off to other parts of the plant.

The caterpillars are pale green, striped with longitudinal whitish lines. The body of these caterpillars is shaped differently from most of the common noctuid caterpillars found in gardens, in that it increases gradually from the head to the last segment, where it is largest and slopes off abruptly. Another noticeable difference between the caterpillars of the Plusias and other noctuid caterpillars, is the fact that they have only two pairs of prolegs instead of four. There are several species of these insects, but none have ever proved very troublesome in Canada. In 1884, the Cabbage Plusia was very destructive in the State of Minnesota, almost equalling the injuries of the common Cabbage Worm *(Pieris rapae*, L.). Dr. Forbes states (Ill. Agr. Exp. Stn. Bull. 60) that the larva feeds on celery, kale, turnip, tomato, lettuce, mignonette, dandelion, dock, clover, lamb's quarters, and some less common cultivated crops. It ranges through the United States and occurs also in Canada. The eggs are laid upon the food plants, singly or in small clusters The larva spins a gauzy cocoon among the leaves. The pupa is light yellowish brown in colour. The moths are very dark, the upper wings being almost black or very dark gray, marked with small white points and indistinct bands, and having a silvery U-shaped spot on the middle of the forewing, and a smaller round silvery dot close to it on the outside. There seem to be two broods of this insect in Canada.

It has proved to be a difficult matter to destroy the caterpillars of the Cabbage Plusia upon cabbage and lettuce crops. Mr. F. A. Stirrine (N.Y. Agr. Exp. Stn., Bull. 144) tried many experiments with remedies, and found that a soap wash containing arsenical poisons proved the most useful. He speaks of this as a resin-lime mixture and gives the best formula for its preparation. The estimated cost for preparing and applying this remedy is $2 an acre.

THE SAN JOSE SCALE

(*Aspidiotus perniciosus*, Comsk.).

This insect continues to receive the keenest attention from practical entomologists in all parts of North America, and most careful experiments have been carried out in the endeavour to find any treatment which will control the scale without injuring the tree. At the present time crude petroleum and whale-oil soaps (caustic potash fish-oil soaps) seem to give the greatest promise in this direction. With regard to crude petroleum, more experience seems to be necessary before a definite recommendation can be made as to the strength and manner in which it can be safely applied. Mr. George E. Fisher, the chief Inspector for San José Scale for the province of Ontario, has experimented extensively during the past summer with both of the above-mentioned materials, and the results of this work, which he presented in an important address before the Entomological Society of Ontario, at the annual meeting in November last, may be summarized as follows :—

Fig. 16.—San José Scale; apple branch with scales ; large scales above at left.

Whale-oil soap, at a strength of two pounds to one gallon of warm water, killed many scales; but in no case was complete success obtained, however carefully the work might have been done. The trees, nevertheless, were in most cases benefited by the application. The scale was reduced to the

greatest degree on cherry trees, and aphids were quite destroyed. Even when trees were in blossom, no injury from the soap was noticed. The treating of trees with the whale-oil soap did not prevent the young scales from settling soon afterwards on the parts treated.

Crude petroleum gave better results as far as the scale was concerned. A mechanical mixture of water with 30 per cent crude petroleum could be used quite safely on apple trees, and also with care upon plum and peach trees ; even this, however, was not a perfect remedy, as all the trees treated had some scale upon them at the end of the season. Mr. Fisher considered that a combination of whale-oil soap and crude petroleum would probably be found the best remedy. He did not think it safe to recommend crude petroleum for general use. The ordinary fruit grower would not use even the whale-oil soap in accordance with instructions, and he felt sure they would use crude petroleum in the same careless way, and trees would be killed. He believes that a frequent cause of injury from crude petroleum when applied with water is that operators when spraying, go over trunks and other parts of trees twice ; beginning on the trunk, they go over the tree and finish up again on the trunk, thus depositing two applications or twice the necessary quantity of oil, because the water evaporates quickly but leaves the oil on the tree. Imperfect work is frequently done from the difficulty of reaching the upper side of the high branches on the opposite side of a tree which is being sprayed. The best time to apply the spray, whether of soap or of crude oil, is in April.

A word of warning may be here inserted for the benefit of those who may wish to use crude petroleum with regard to the variation in the specific gravity of crude petroleum from different wells. Dr. J. B. Smith, who has certainly done more to test the value of this remedy than anyone else, says (New Jersey Bulletin, 146), after giving the specific gravity of several samples :—

'Thus thirteen samples register 50° or over, leaving 70 that run between 40° and 49°, the majority running nearer to 46° than to 44°, both in green and in amber oils. It is a fair requirement, then, for a straight crude petroleum that it should have a specific gravity of 43° or over, at a temperature of 60° Fahr.; anything less might be harmful; anything more than 45° is unnecessary.

The importance is thus shown of knowing what the specific gravity by the Baumé oil scale is before any sample is used by a fruit-grower upon his trees.

The San José Scale exists in Canada only over a small area of the province of Ontario, extending from Niagara around the western end of Lake Ontario as far as Burlington and westward through the counties bordering on Lake Erie, and, even in that area, although it is true that the scale has increased considerably during 1900, the outside limits of this area have not been extended, and it is only in certain orchards where the insect occurs. In addition to this the majority of the owners of these orchards understand now the danger of neglecting to treat their trees, and are adopting vigorous measures to control the pest. The area may be described in general terms as that part of Ontario where the peach can be grown commercially. All reports of the occurrence of the San José Scale in other provinces are erroneous. The only other province where it has ever been found living on trees, is British Columbia ; this was some years ago, and Mr. R. M. Palmer, the official Inspector of Fruit Pests, expressly writes on this subject :—

'Victoria, B.C., November 21.—You will be glad to know that there is no San José Scale in the province. Reports of the presence of this dreaded pest from Salt Spring Island and Cowichan district, upon investigation, proved to be unfounded. The "scare" arose from the fact that many apples affected with the "leaf-spot-fungi" developed a red-spotted appearance somewhat like the discoloration of the fruit caused by San José Scale.'—R. M. Palmer.

An important step with regard to this insect was taken by the Hon. Minister of Agriculture last spring in putting through an amendment to the San José Scale Act, by which under certain restrictions nursery stock was allowed to be imported

into Canada from countries where the San José Scale was known to occur. When it was discovered that this insect could be killed on nursery stock by fumigating with hydrocyanic acid gas, at the urgent request of many fruit-growers, horticultural societies, nurserymen and others, by instruction of the Minister of Agriculture, proper fumigating houses were erected last spring at such points on the boundary as it was thought would be most convenient to importers, and qualified superintendents were appointed to treat any nursery stock, trees, shrubs or other plants as might be imported through these ports, and then repack and send them on to their destination as promptly as possible. For this fumigation with hydrocyanic acid gas the formula recommended by the United States Entomologist for dormant stock was adopted, it being the simplest effective formula, viz. : one fluid ounce of commercial sulphuric acid, one ounce of refined cyanide of potassium (98 per cent), and three fluid ounces of water to every 100 feet of cubic space—exposure 45 minutes. These fumigating houses were located at the customs ports of St. John, New Brunswick; St. John's, Quebec; Niagara Falls and Windsor, Ontario; Winnipeg, Manitoba; and Vancouver, British Columbia. The whole expense of these stations was assumed by the Dominion Government, but all shipments were made entirely at the risk of the shippers or consignees, the government assuming no risk whatever. The packages had to be addressed so as to enter Canada at one of the above named ports of entry, and the route by which they were to be shipped, clearly stated upon each package.

Many horticulturists and nurserymen availed themselves largely of this concession, and at every port much stock was imported from the United States and Japan. Nursery stock of all kinds can be imported from Europe without fumigation, as the San José Scale has never gained a foothold in European countries. Certain other plants which are not liable to the attack of the San José Scale are also exempted from treatment under the San José Scale Act. These are: (1.) green-house plants, including roses in leaf which have been propagated under glass; (2.) herbaceous perennials, including strawberry plants ; (3.) herbaceous bedding plants ; (4.) all conifers ; (5.) bulbs and tubers.

The fumigating houses were kept open with a superintendent constantly in attendance throughout the seasons of spring and autumn shipments of stock. Owing to the lateness of the season at which it was decided to do this work, the fumigating station for British Columbia was not operated until the autumn season of 1900, and, as all vegetation is much earlier in Oregon and Washington States, from which most shipments are made into British Columbia, it has been arranged that for that province the fumigating house shall be kept open for the winter months from October 15 till March 15. For Manitoba and the Eastern Provinces the spring season is from March 15 till May 15, and the autumn season from October 7 till December 7.

The San José Scale, although only occurring as stated above in a comparatively restricted area in the province of Ontario, has increased considerably in orchards which were infested last spring and other orchards adjacent to them. Nevertheless, the condition of orchards even in the area where trees are liable to become infested, is by no means hopeless. The Ontario Government has expert, capable and wise officials devoting their best energies to the discovery of a practical remedy ; and, although, from the lack of knowledge on the part of some fruit-growers, the work of controlling the San José Scale has been much hindered by the suspension of remedial measures in 1899, at the same time, the results of experiments show that much good can be done by treating orchards if this is done systematically. This treatment, however, in the present state of our knowledge, is both dangerous and rather expensive; but the former of these drawbacks will most probably be lessened or done away with by future experimenting, and the question of expense is merely a business matter of comparing outlay with returns, the same as has to be met in every branch of a fruit-grower's or any other business man's work. It is merely a question of whether the treatment pays or whether it does not. If it can be shown that a certain expenditure of money and labour will bring a profitable return, that is all the business man has to consider.

As an illustration of this, it will be worth the while of all fruit-growers living in that part of Ontario where the San José Scale occurs, to acquaint themselves with the actual facts of the present condition of Catawba Island, Ohio, in Lake Erie. A year or two ago this island was practically one large and very prosperous peach orchard. Later the San José Scale was imported and increased to the extent that the fruit prospects of the whole island were thought to be ruined. The natural excitement caused by this state of affairs stirred up the whole fruit-growing community to the adoption of energetic measures. By the advice of Prof. F. M. Webster, whale-oil soap was adopted as the universal remedy. Arrangements were made with Mr. W. H. Owen, of Catawba Island, to make a uniform grade of whale-oil soap, and this was applied to the trees throughout the island. As a consequence of this work, a large crop of fruit has been reaped from Catawba Island, where but for this concerted action only devastation and ruin could have existed. It must not be forgotten, however, that this action by the fruit-growers was almost universal, and nearly every orchard was sprayed regulary and at the time advised. Now, Prof. Webster expressly states that the San José Scale on Catawba Island is by no means exterminated, but that the fruit-growers have got it under control by a persistent use of whale-oil soap. They have simply reduced the pest to a point where it can be controlled ; but, just as sure as they give over their efforts for a single year, the insect will come to the front again, and, if two or three years were allowed to pass without treatment, a great many trees would be lost.

In one particular district in Ontario the fruit-growers protested strongly against the measures adopted by the Provincial Government to control the scale, but at the same time it was found afterwards that they had done nothing to treat their trees to prevent the scale from spreading. As a consequence, during the past season this district has become one of the very worst infested. There was at one time in the United States the same difficulty in persuading fruit-growers to treat their trees. Prof. Webster in his bulletin (No. 103, Ohio Agr. Exp. Station), 'The San José Scale Problem in Ohio, in 1898,' says: 'Heretofore it has sometimes been difficult to get the owners of some slightly infested orchards to apply whale-oil soap, but this season has taught them a lesson that they will not soon forget, for, while they stubbornly refused to treat their orchards last spring, they now have the rather humiliating spectacle of trees on their own premises almost if not quite totally devoid of fruit, while their more progressive neighbours, who invested their money in whale-oil soap and applied it faithfully, have plenty of fruit and no longer fear the San José Scale. Many orchards whose owners could hardly have been induced to treat their trees last season on suspicion of the San José Scale being present, will hereafter be treated on the slightest possible suspicion of the scale being present, and the owners will do it willingly.'

Prof. Lochhead, of Guelph, who has devoted much time and attention to the question of the San José Scale in Ontario, says, under date December 22, 1900 :

'This is the cloud which is hovering over the fruit-growers of south-western Ontario at the present moment. They recognize now that the scale has spread very widely during the past season, and has also increased in intensity. They know also now that no remedy need be applied in a slipshod fashion. To my knowledge the scale is spreading from new centres not previously known. The remedies are known, but it remains for the owners of orchards to follow the prescription closely which has been given by entomologists. The nurseries will be more closely watched than ever this coming year, so that no infested stock can possibly leave the grounds.'

It will be seen from the above precautionary measures, which are being strictly enforced by both the federal and the provincial governments, that every possible effort is being made in Canada to-day to control, if possible, this terrible pest, and to prevent by every means fresh introductions. Not only is every woody-stemmed plant imported into Canada from infested countries fumigated with hydrocyanic acid gas, but every nurseryman in Ontario is forced to submit to the same treatment every shrub and tree supplied to customers.

THE PALMER WORM

(*Ypsolophus pometellus*, Harr.).

Attack.—Slender greenish white caterpillars, reddish brown on back, with a central stripe down the middle, bordered on each side with white irregular bands; when full-grown, a little over half an inch in length; feeding on the leaves, and sometimes on the surface of the fruit.

Complaints of the work of this insect have been received from several localities during the past season, particularly from sections along the northern shore of Lake Ontario. It has also been found as far north as Ottawa. Judging from reports received, the Palmer Worm has confined its attacks chiefly to the apple. From a letter received from Mr. A. W. Peart, of Freeman, Ont., dated June 19, the following is extracted :—

'I enclose in small box some worms which are very plentiful here at present, working particularly on the apple. They vary in size from a ¼ of an inch to ⅝ of an inch in length. They are a light yellow with two stripes running lengthwise on either side of the back. Their most marked characteristic is their rapid motion. Take one in the palm of the hand, and touch it, it wriggles and jumps an inch or two with rapid lightning-like contortions. When you catch one, it is hard to hold. Like the cankerworm, it spins a thread when you disturb a branch, and lets itself down, and you can see it swinging; but unlike the cankerworm, it does not loop in travelling. I find it in holes eaten in the young apples, and I think it is responsible for at least a portion of the cavity, if not all. On some trees, with their leaves badly riddled, you can find them by hundreds.'

Letters of a similar nature to the above have been received from Oakville, Adolphustown, and other points.

The life-history of the Palmer Worm is fairly well known. When the caterpillars are young they eat only the soft tissues of the leaves, but, as they mature, they devour the whole of the foliage, with the exception of the coarser veins. This is especially so when the larvæ are numerous. When the infestation is not of a serious nature, the caterpillars may be found feeding in a folded portion of a leaf. These larvæ are extremely active, and, as has been observed above, if a tree on which the caterpillars are at work is suddenly jarred, the larvæ will drop from their feeding places, and suspend themselves in the air by means of silken threads. If one is placed on any flat surface, it wriggles, and when touched moves with remarkable rapidity.

When full-grown, the caterpillar is a little over half an inch in length, and in general appearance is a greenish-white larva, with the dorsal area reddish brown, having a central dorsal stripe widely bordered on each side with white irregular bands, a little wider than the medio-dorsal stripe. The head is honey-yellow. The thoracic shield is transparent and inconspicuous, having the hind margin borderded with black for half its length, the black edge terminating with a hook forward on each side of the shield, leaving a wide central opening. The stigmatal fold is prominent. Along the dorsal area are two series of black piliferous spots, those on the anterior portion of each segment closer together than the others. Spiracles whitish, difficult to detect. The body bears a few slender bristles, one from each spot.

When mature the caterpillar changes to a chrysalis, usually in a fold of a leaf, and produces the moth in about fourteen or fifteen days. Those received on June 28 spun up on July 2, and the moths appeared on July 16 and 17. The moth is a delicate little creature of about five-eighths of an inch in expanse of wings. It is of a grayish-brown colour, with a purplish or golden reflexion; some specimens are of a tawny yellow. The forewings are dotted with small dark chocolate-coloured spots. The margins of the dusky lower wings are deeply fringed.

Remedy.—The remedy for this insect is spraying with the arsenites. A hymenopterous parasite was bred from this species by Mr. C. H. Young, of Ottawa.

SESSIONAL PAPER No. 16

THE GREENHOUSE LEAF-TYER

(Phlyctaenia ferrugalis, Hbn.=*Botis harveyana*, Grt.).

Attack.—Slender semi-translucent green caterpillars, when full-grown, nearly an inch in length, with two distinct black spots (one on each side) close behind the head, the green dorsal vessel showing distinctly down the middle of the back, bordered on each side with a double white band ; feeding on the cellular tissue on the lower sides of the leaves. In many cases the leaves are drawn together by threads of fine silk.

In my last report the above insect was treated of at some length, and, as it is now still prevalent in the same locality (Toronto) and has appeared in other houses in Hamilton, I again draw special attention to it, for unless checked it is liable to spread and possibly become a serious greenhouse pest in Canada. In Toronto last year the larvæ did much harm, causing considerable loss to roses, but this year the species is also attacking violets and chrysanthemums. On November 12, Mr. Arthur Gibson, of this Division, paid a visit to the houses of Mr. J. H. Dunlop, Toronto, and specimens of the larvæ in all stages, pupæ and moths were found in some abundance. In one of the chrysanthemum houses especially, the insect was very prevalent and numbers of the moths were flying at the date mentioned. In this house some eggs were found, and these have since hatched in the office and proved to be the same species.* The eggs were laid on the under side of the leaves. They are flattened and remarkably like those of the Codling Moth, dirty-whitish, about one-half mm. in width, round, strikingly iridescent, the surface coarsely reticulated (which gives them a slightly roughened appearance), and are laid sometimes singly, in pairs, or in clusters of 3 to 7, the eggs of which overlap at the edges. The work of the caterpillars was only noticed on the underside of the leaves, and in the case of the mature larvæ large pieces of the soft tissue were eaten away. The caterpillars were generally found to be within a slight silken web, and in many cases two leaves were brought together and fastened by threads of silk, the larva feeding on the soft tissues on the underside of the upper leaf. The young caterpillar, as soon as it hatches from the egg, is about one-twelfth of an inch in length, and of a semi-translucent creamy-white colour, with a large black head. The body bears slender whitish hairs, and the skin is smooth and shining. After they have been feeding, the colour of the green food contents gives the caterpillars a slight greenish appearance. In the second larval stage, pale whitish stripes are present on the body, and these, as the larva passes through its other stages, become more distinct. When mature the caterpillars are about three-quarters of an inch in length, slender, semi-translucent, with the dark-green dorsal vessel showing distinctly through the skin, but rather faint on segments 2, 3 and 13. On each side is a double white sub-dorsal band which is also rather faint on segments 2, 3 and 13. On segment 2 are two distinct black spots, one on each side of the dorsal area. Head about one twenty-fifth of an inch in width, bilobed, smooth, shining, whitish, splashed with brownish blotches on cheeks and bearing a few pale hairs. Mouth parts brownish; ocelli black. Spiracles white and very small, joined by a faint whitish line. On segments 2, 3 and 4 this line is represented by a few faint white dots and is obsolete on segment 13. Thoracic feet and prolegs of the same colour as the body ; the thoracic feet each bear exteriorly two black dots, one above the other. The whole body is sparsely covered with slender pale hairs, the ventral surface being lighter in colour than the dorsal. When at rest these caterpillars have a habit of curling round to the side of the body their heads and the first three or four segments. The duration of the pupal stage is from seventeen to twenty days. The moth is of a rusty-brown colour, and when the wings are spread measures a little over five-eighths of an inch in width. When at rest it measures three-eighths of an inch at widest part. The wings are crossed with darker lines and also bear darker markings.

As to remedial treatment, the picking of the leaves on which the caterpillars are at work is recommended, and in the Toronto houses good work in this direction has

* Many eggs have since been secured from moths kept in confinement.

been done; large numbers of the moths have also been dislodged from their resting places and killed. The proper carrying out of such work, however, takes up too much time, especially if many large houses have to be gone over, and, as this insect is almost continuously at work when once established, no doubt fumigation with hydrocyanic acid gas is the quickest and most effective remedy.

A GREENHOUSE LEAF-ROLLER
(*Cacoecia parallela*, Rob.).

Attack.—Dull green caterpillars about an inch in length when full-grown, with yellowish-brown head and thoracic shield ; each segment but the first two bearing conspicuous white piliferous tubercles ; feeding on the foliage of rose bushes in greenhouses, drawing the leaflets together by threads of silk, or rolling a leaf up and spinning a web inside.

In my last report I recorded the occurrence of two new greenhouse pests in Canada, viz., the Greenhouse Leaf-tyer *(Phlyctaenia ferrugalis*, Hbn.), and the Black Violet Aphis *(Rhopalosiphum violae*, Perg.), both of which occurred at Toronto. During the past year there was brought under my notice for the first time in Canada the work of another insect, attacking the foliage of rose bushes in greenhouses of Messrs. Webster Bros., at Hamilton, Ont. Specimens of the caterpillar were sent to the Division, and these have since been bred to maturity, and proved to be those of a small tortricid moth, *Cacoecia parallela*, Rob., somewhat resembling the Oblique-banded Leaf-roller, which has long been known to injure roses, particularly out of doors.

The caterpillars of *Cacoecia parallela*, Rob., were first noticed doing injury at Hamilton in June, 1899, and since then they have appeared in hundreds, causing great annoyance and damage. The larvæ were particularly prevalent during the present year, from the end of March until about the middle of October. The work of the caterpillar is much after the style of both the Greenhouse Leaf-tyer and the Oblique-banded Leaf-roller. It feeds on the green foliage and has the habit of drawing the leaflets together by means of threads of silk, or rolling a leaf over, spinning a web and feeding inside.

The caterpillar when full-grown is about one inch long ; it tapers slightly to each end and has the segments distinctly marked. The colour is dull green, overlaid lightly with velvety black, of a slightly darker shade on the dorsum. The piliferous tubercles are white and conspicuous, bristles long and slightly wavy. The head is round, slightly depressed in front, of a yellowish-brown colour, and bears some slender light hairs ; mouth parts and antennæ darkened; ocelli black. Behind each cheek, at the back of the head, is a black elongated blotch in line with the ocelli. Thoracic shield honey coloured, with two small back spots on the front margin, divided by the pale median line. The posterior margin of the shield is bordered heavily with black, which gradually enlarges into a wide blotch towards the apex. Like the double blotch on the front margin, these blotches are separated by the median line. Below the thoracic shield are two short tubercle-like chitinous dashes, the upper of which is immediately in front of the spiracle. Each of these dashes bears a pair of bristles. The anal shield is darkened towards the apex and bears several slender bristles. The conspicuous white piliferous tubercles are arranged as follows :—The sub-dorsal tubercles are widely separated, so as to bring them and those of the lateral series almost into line. The supra-stigmatal tubercles are immediately above and close to the small black-ringed spiracles, in some cases partially inclosing them. The infra-stigmatal tubercles are directly below the spiracles, and separated from them by twice their width. The supra-ventral tubercles lie in a line directly below those of the lateral series. There is a ventral series of large double tubercles which lie at the base of the prolegs and thoracic feet, and each of which bears two or three bristles. On segments

5, 6, 11, 12 and 13, there is beneath each segment a series of small ventral tubercles on each side of the medio-ventral line. The thoracic feet are shiny, black, white at joints, and almost ringed at the base with a narrow shiny black band, which is open on the outer side. The prolegs are concolorous with the ventral surface. All the feet bear short hairs.

When full-grown the caterpillars spin light cocoons among the leaves, two or three of which they gather together. The pupal period of specimens bred during the past season was about nine or ten days.

The moth, which, in a superficial way, closely resembles the well known Oblique-banded Leaf-roller, measures from three-quarters of an inch to very nearly an inch in expanse of wings, and in greenhouses there are several broods in the season. The colour of the upper wings is a pale brown, crossed obliquely by three bands of a much darker shade, the central one of which is clearly defined at its margins. The other two bands fill up the apical and basal areas of the wings. In many specimens the basal band is almost obliterated. The whole wing surface is loosely reticulated with indistinct basal lines. Under wings paler than the upper.

Fig. 17.—*Cacœcia parallela.* (After Prof. O. Lugger.)

Although rather smaller, this moth resembles the Oblique-banded Leaf-roller very much in general appearance, but it will be seen by the above description of the larva that these two insects are very different indeed in the caterpillar stage of their existence. The larva of the Oblique-banded Leaf-roller may in general terms be described as a green larva with a very dark brown, almost black, head, while that of the above is a blackish green caterpillar, with a yellowish head, and having the body conspicuously dotted with white tubercles.

Owing to their habits, the caterpillars are rather difficult to reach with remedies. Spraying with Paris green and water was tried to a limited extent, but it was not thought to have a sufficiently beneficial effect to continue the applications. This failure, it was claimed, was due to the way in which the caterpillars protect themselves. There is no doubt, however, that many of the larvæ were destroyed, and doubtless more would have been killed if the spraying had been continued longer at short intervals. In the above houses only two applications of Paris green were made, and as this did not appear to have good results, the caterpillars were left to themselves, and no further treatment was applied to the foliage. Late in the season (September) the moths were very numerous, and hand-picking of the larvæ was resorted to, a good sharp boy being sent through the houses early every morning to pick the caterpillars from the bushes. All the larvæ obtained in this way were burned.

Remedies.—As regards remedial treatment, of course, hand-picking of the caterpillars has certainly some beneficial result ; but, as I have pointed out in the case of the Greenhouse Leaf-tyer, the carrying out of such work carefully and properly, takes up too much time, especially if large houses have to be gone over. If the infestation is light, hand-picking will probably be all that is necessary, but when the insect is at all abundant in large houses, spraying or dusting with poisonous mixtures or fumigation with hydrocyanic acid gas are the most effective remedies. Fumigation with this gas, however, must be done carefully and strictly according to instructions, and if such treatment is adopted by any one to destroy greenhouse insects, unless they are fully posted on the matter, communication should previously be entered into with this Division, when full information will be cheerfully given. Hydrocyanic acid gas is now largely used to destroy greenhouse insect pests, but its very dangerous nature must not be overlooked.

SOME INSECTS OF SPECIAL INTEREST REPORTED TO THE DIVISION OF ENTOMOLOGY DURING 1900.

(Detailed Treatment of which in the Present Report is Precluded by Want of Space.)

FODDER CROPS.

The Clover Root-borer (*Hylastinus obscurus*, Marsh,=*Hylesinus trifolii*, Mueller).—Reported at a few places in Ontario. The worst occurrences in old clover fields at London, Picton and in a small patch at Ottawa. Remedies : A short rotation and the ploughing down of infested fields as soon as there is a pretty good growth after the hay has been cut.

The Large Clover Weevil (*Phytonomus punctatus*, Fab.).—Larvæ found at Picton, Ont., on May 24, in large numbers, but so severely attacked by the parasitic fungus *Entomophthora phytonomi*, Arthur, that little injury was done.

The Green Clover Weevil (*Phytonomus nigrirostris*, Fab.).—Occurring with the last named at Picton and also abundant in clover fields at Ottawa. Remedy : Early cutting. The larvæ feed chiefly in the sheathing bases of the leaves and in the flower heads.

ROOTS AND VEGETABLES.

Cabbage Worms (*Pieris rapae*, L.).—This common enemy of the market gardener was particularly abundant in all parts of Canada this year. Reported as abundant and destructive at Kaslo, B.C., by Mr. J. W. Cockle, who observed it first in British Columbia last year. For the first time this year it appeared on Vancouver Island, and did much harm to cabbages and mignonette in gardens (J. R. Anderson, R. M. Palmer and G. A. Knight). In Ontario it was destructively numerous in the counties north of Lake Ontario, injuring the turnip crop seriously ; also reported as one of the worst pests in Nova Scotia (Harvie Gray) and parts of Quebec.

Remedy : Dusting with Pyrethrum and lime (or some other dry diluent), and spraying with arsenical poisons in turnip fields.

Root Maggots (*Anthomyia*) of Cabbages, Cauliflowers, Radishes and Onions.—Many experiments were tried with more or less success. On cauliflowers and cabbages the best results were secured by using the Gough tar-paper discs which have been reported upon previously. For the other crops, carbolized mixtures seem to be of greatest promise.

These insects are reported to have been unusually scarce at Nappan, in Nova Scotia, this season, and as a consequence good cabbages and cauliflowers were grown (W. S. Blair). At other points in Nova Scotia (K. McIntosh), New Brunswick and Prince Edward Island (Father Burke), they were as destructive as usual.

Cabbage Pionea (*Pionea rimosalis*, Gn.).—Destructive in turnip fields in Prince Edward Island (S. A. Stewart and G. F. McKinnon).

Turnip Aphis (*Aphis brassicae*, L.).—A considerable amount of harm has been done by the Turnip Aphis in a few localities, but the complaints this season have been far less numerous than has usually been the case. The worst attacks have been in the counties of Huron and Bruce, where in some sections as much as half the crop of turnips was destroyed (H. Deacon).

Remedies : Spraying with kerosene emulsion or whale-oil soap solution, 1 pound in 6 gallons of water, at the time colonies first appear in August ; also ploughing down deeply the tops as soon as cut from the roots, as the eggs were found to be laid upon these in large quantities at Belgrave, Ont.

Diamond-back Moth (*Plutella cruciferarum*, Zell.)—Very destructive in parts of Vancouver Island (G. A. Knight) and Saskatchewan (Percy B. Gregson).

FRUITS.

Codling Moth (*Carpocapsa pomonella*, L.).—This is still a cause of enormous loss to fruit-growers. Where systematic spraying is practised, supplemented by the banding of trees with strips of burlap or whisps of straw, the numbers have been reduced to a marked degree. Many practical fruit-growers might be cited from every province of the Dominion to prove this.

Plum Curculio in Apples (*Conotrachelus nenuphar*, Herbst).—For several years this insect has been a troublesome pest in the orchard of Mr. Jack, at Chateauguay Basin, Que. In the fall of 1899 the orchard was ploughed and the land has been cultivated most of the past summer, and, as a result, no injury has been done by the curculio, except where some raspberries were left growing among the trees.

Oyster-shell Bark-louse (*Mytilaspis pomorum*, Bouché).—There is probably no orchard pest in Canada which is wider spread than this and which has destroyed more trees. A practical remedy has long been a desideratum. The standard remedy, up to the present time, has been the kerosene emulsion ; but this has never been popular, owing chiefly, I think, to the trouble of making it and its destructive effects on rubber hoses. About five years ago it was noticed that trees sprayed with Bordeaux mixture were freer from this insect than those which had not been sprayed. This was due, it was thought, to the deposit of lime from that mixture which was left on the trees.

In the course of some experiments made on apple trees which happened to be badly infested with Oyster-shell Bark-louse on the Experimental Farm by Mr. W. T. Macoun, by spraying with a lime whitewash to retard the opening of flower-buds as a protection against late frosts, it was discovered that these whitewashed trees were very much cleared of the Oyster-shell Bark-louse, and subsequent experiment shows that this is probably an easy, cheap and effective remedy against this pernicious insect. The best time to apply the whitewash is late in the autumn, so that the scales loosened by the wash may be scaled off with the lime during the winter. Spraying trees during the winter is a very unpleasant operation, so this work should be done during the warm days of November, and the strength of the whitewash which has been found effective is from one to two pounds of lime in each gallon of water. A better coating of lime is deposited on the trees if two applications are made, the second being applied as soon as the first one is thoroughly dry.

Applications of concentrated lye, as supplied in tins for household uses, were also experimented with in varying strengths from 1 pound in 3 gallons of water, up to 1 pound in 6 gallons ; but they were not sufficiently fatal to the scale insects to justify their recommendation. Even at the strength of 1 pound in 3 gallons, although the leaves of some plants were spotted, no permanent injury was done. All the samples of concentrated lye which were obtainable were found to be caustic soda.

The Pear-tree Flea-louse (*Psylla piricola*, Foerster).—This insect is widely spread through the pear orchards of western Ontario, but seldom occurs in large enough numbers to attract attention. It is, however, a pest which pear-growers should watch carefully, and treat promptly if the numbers increase. Mr. George E. Fisher, a most accurate observer, with exceptional opportunities of examining orchards, writes : 'On several occasions I have noticed Pear Psylla doing very serious damage to pear orchards. When once established it multiplies very rapidly. Here at home a number of years ago I had 300 Dwarf Duchess trees badly infested, and even now, after spraying regularly, they do not seem to have fully recovered. My neighbour, Mr. J. S. Freeman, had a block of 400 Dwarf Duchesses so badly attacked that nearly all died. In 1899, Mr. E. J. Henry, of Winona, had an orchard badly affected. I am fully persuaded that this is not an insect to trifle with, but I do not dread it as much as I did, for I now know that by the use of an emulsion of crude petroleum and whale-oil soap I can destroy such insects as winter exposed on the trees. For Psylla one must

operate early, because the eggs are laid early. In May, 1899, I visited a large Dwarf Duchess orchard belonging to Mr. Henry Lutz, of Youngstown, New York State. In 1896 this block of trees had been almost ruined by Psylla. In February, 1897, the whole block was sprayed heavily with lime, which destroyed the insect so completely that when I saw the trees two years after they appeared very healthy indeed.'

The Red-humped Apple-tree Caterpillar (*Oedemasia coneinna*, S. & A.).—Specimens of these caterpillars were sent from Kaslo, B.C., by Mr. J. W. Cockle. They were very prevalent at the time in apple orchards.

The Pear-leaf Blister Mite (*Phytoptus pyri*, Sheuten).—Several inquiries about this have been received from British Columbia. Mr. Palmer reports : 'This insect continues to be a very persistent pest, and is quite generally distributed through the province. It is easily kept down by the use of the lime, salt and sulphur spray used in winter, but is difficult to exterminate and will reappear if spraying is neglected.'

The Black Vine Weevil (*Otiorhynchus sulcatus*, Fab.).—Occasional references to injuries by this beetle have been made, chiefly to garden plants and in greenhouses in British Columbia. The beetle is not uncommon on the sea shore in Nova Scotia, but no injury to crops of any kind has ever been reported from that province until the past season, when specimens and an account of serious injury were received from Mr. J. H. Churchill, of Westport, N.S. Strawberry beds have been injured for many years, and among the samples received were several plants which were attacked, not only by the Black Vine Weevil, but also badly by the Strawberry Root-borer (*Anarsia lineatella*, Zeller), fortunately an uncommon enemy in Canada. This injury has been going on for about six years, during which time Mr. Churchill estimates his loss in strawberries at $1,500. In British Columbia, Mr. Tom Wilson, of Vancouver, observed another occurrence of the Black Vine Weevil, where considerable injury was done to strawberry plants and primroses. In Europe this beetle is known to be a troublesome pest of grapes, strawberries, raspberries, mangels and primroses, but up to the present time nothing of importance has been recorded against it on this continent. The strawberry plants sent by Mr. Churchill from Nova Scotia on July 8, contained grubs and pupæ of the beetles, and in another parcel received on September 19, there were grubs, pupæ, and beetles, some of the latter being immature, but a few perfectly coloured. The only remedy which can be suggested for this beetle as yet is the planting of strawberries in new ground, and frequent renewal of the beds, the worst injuries being done to old plants.

In this connection I may add that Mr. W. T. Macoun, the Horticulturist of the Central Experimental Farm, tells me that he considers the single crop method of growing strawberries the one which pays best, the fruit being finer and the land being kept clean much more easily. Some varieties which do not make runners freely should be left for two years.

Nepticula (*Micropteryx*) *pomivorella*, Pack.—This interesting little insect has been more than usually abundant in western Ontario during the last two years, and a large series of specimens have been reared. The larva is a leaf miner, but when full grown, leaves the mines and spins small cocoons on the twigs of apple trees, in which it passes the winter. It has been lately discovered by Mr. A. Busck, of Washington, that this insect, which was described as a *Micropteryx*, is a true *Nepticula*.

The Lesser Apple Worm (*Semasia prunivora*, Walsh).—Mr. R. M. Palmer reports that this insect occurred in nearly all the fruit-growing districts of British Columbia excepting the Okanagan valley, but in smaller numbers than in 1898-9. He draws attention to the fact that this pest is still often mistaken for the true Codling Moth, by fruit-growers, but he is pleased to report that the latter has not occurred in any part of the province, although watched for carefully. A most rigorous inspec-

tion is maintained of all fruit coming into the province, so as to prevent its introduction by that means.

The Apple Fruit Miner (*Argyresthia conjugella*, Zell.) appeared in small numbers on Vancouver Island during July, but no instance of its presence in large numbers was reported.

The Mealy Plum Aphis (*Hyalopterus pruni*, Fab.) was very prevalent in many parts of British Columbia. Spraying with whale-oil soap and quassia proved an efficient remedy.

The Mediterranean Flour Moth (*Ephestia kuehniella*, Zell.).—A mill badly infested with this insect, near Ottawa, was fumigated with sulphur with satisfactory results. An interesting observation was that the larvæ were largely parasitized by a small hymenopterous insect, which has been found by Mr. W. H. Ashmead to be a new species, and has been named by him *Idechthis ephestiae*.

The Red Turnip Beetle (*Entomoscelis adonidis*, Fab.).—This native beetle, which is bright red with three black stripes down its back and a spot on the collar, and is ⅜-inch long by ¼-inch wide, was very abundant in the North-west Territories and parts of Manitoba last year. Several inquiries were received concerning its habits, and it was observed almost everywhere during July, chiefly upon cruciferous weeds, but also on turnips, radishes, &c. Upon a piece of neglected summer-fallow at Kinistino, Sask., it was seen in thousands upon the steeple-like plants of the Gray Tansy Mustard (*Sisymbrium incisum*, Engl., var. *Hartwegianum*, Watson) and upon *Erysimum parviflorum*, Nutt., and *Erysimum asperum*, DC., a near relative of the garden wallflower. This insect has been treated of at length in my report for 1892.

'Strathcona, Alta., June 1.—I send you some beetles which are abundant, climbing up the stems of some weeds on about half an acre of timothy: they come out of the ground, which I dug up and found the holes about ½ to ¾-inch deep. Are they likely to hurt the timothy? I have seen them before, but not so plentiful as now.'—Thomas Daly.

'Strathcona, June 12.—I send a sample of a beetle which has been doing great damage in my garden, attacking wallflowers and stocks, all young plants; they are now on my turnips, radishes and cabbage. I have killed probably 1,000. What are they called, and what is the best remedy?'—John H. Wilson.

'Souris, Man., September 13.—I am sending an insect which is doing much damage in gardens in the Souris district, especially at this time.'—Robt. I. Crisp.

This beetle, both as a grub and in the perfect state, attacks all cruciferous plants. The best remedy is to spray or dust the plants attacked with arsenical poisons in the same way as for the Colorado Potato Beetle. The grubs are nocturnal in their habits, and are seldom seen.

This is also a European insect, but there is hardly a doubt that it is a native species in the North-west. In certain seasons it is very abundant, and may at any time develop into a serious enemy of the agriculturist. It belongs to the Chrysomelidæ, the family to which also the Colorado Potato Beetle belongs.

The Asparagus Beetle (*Crioceris asparagi*, L.).—The Asparagus Beetles, treated at some length in my last report, have occurred again in the Niagara district during the past season, but do not seem to have been the cause of much injury. However, their attacks have been supplemented by another enemy, the Asparagus Rust (*Puccinia asparagi*, DC.), and one of the Hemiptera (*Cosmopepla carnifex*, Fab.) was found upon asparagus by Mr. Frank Arnold, at Queenston, Ont. These clustered on the plants in very large numbers during the last week of July. No special injury was noticed at that late date, and it was not thought worth while to advise any remedial treatment. Spraying with either kerosene emulsion or whale-oil soap would doubtless destroy them, should they at any time prove troublesome.

The Squash Bug (*Anasa tristis*, DeG.).—This troublesome enemy of the gourd family is a regular pest in western Ontario, but is seldom heard of in the eastern counties. In the last week of June specimens were sent from Inverary (Frontenac Co.), Ont., by Mr. Alex. Ritchie, with the complaint that they were destroying his squash, pumpkin and cucumber vines. The remedies recommended for this insect are :—

Fig. 18.—Squash Bug.

1. Hand-picking, which is claimed to be the most practical remedy. This is done early in the morning, during the cooler hours of the day, while the bugs are sluggish.

2. Traps. If shingles or short pieces of board are placed among the plants, the bugs will hide beneath them at night, and can be destroyed before they become active and leave these retreats the next morning.

3. The young bugs can be destroyed by spraying with kerosene emulsion or whale-oil soap.

Army Worms in Winter.—A rather curious occurrence of the Army Worm in winter took place at Alberton, in Prince Edward Island, last February. This was reported to me by my esteemed correspondent, the Rev. Father Burke, of Alberton, who also sent specimens for identification from the farm of Mr. John T. Weeks, of the same place. The occurrence is described by Mr. Weeks, as follows :—

'Alberton, P.E.I., February 17.—I am in receipt of your letter of 8th instant, and am surprised to know that we have such a pest in our midst. The specimens I sent were supplied by my brother. He is going to try and get you some more specimens, and if he is successful he will forward them in the way you suggest. He says he saw them as he drove across several farms, and they were quite a long distance from bare ground.'—J. T. W.

'February 19.—This morning my brother came in with some more of the army worms. I am sending them in a tin box with some moist earth and some grass. These are much larger than the first I sent, but among the lot are several very small ones, which are apparently dead ; but I send them so that you may see the different stages of development. My brother tells me he saw them on at least half a dozen farms, and would have had no difficulty in picking up a hundred. We had an easterly snow-storm all day yesterday, which will probably cover them up again. I fear they seem to be pretty well distributed. To what extent are they known in Canada ? What is the remedy ?'—John T. Weeks.

In reply to these letters it was explained that the Army Worm passed the winter partially grown, in a torpid condition, near the surface of the ground, and that there were previous instances where they had appeared suddenly on the surface of snow during winter. It was suggested that this appearance in winter might prove beneficial, because many thus disturbed in winter perished. The distribution of the species in Canada was given and reports of this Division were sent, in which the usual remedies are stated.

In a report on the insect injuries of the year, Father Burke informs me that no injury whatever by the Army Worm was noticed during the past season.

The Black Blister Beetle (*Epicauta Pennsylvanica*, DeG.).—Injuries to potatoes by the Black Blister Beetle are reported from Dugald, Man., by Mr. Kenneth McLeod, from different parts of Ontario by Mr. C. W. Nash, of Toronto, and from Inverary, Ont., by Mr. W. T. McClement, who had also found them on the farm of Mr. John Guthrie, of Perth Road (Frontenac Co.) Ont., where, he says, they ate the tops of potatoes very cleanly, and were very active. If plentiful in a district, they would be worse than the Colorado beetle, for they are much more active. They flew ahead of the poison-can and ate the tops which were not poisoned, avoiding those dusted or sprinkled, and clustered thickly on the clean tops. They were plentiful about July 25. They were not widespread, but troubled only a few fields, and these near together.

The habits of Blister Beetles were explained to these correspondents, and also the connection of these insects with various species of locusts, upon the eggs of which the larvæ are predaceous parasites.

Specimens of an allied western species, *Cantharis cyanipennis*, Say, were also sent from Ducks, B.C., by Mr. Hewitt Bostock, who had found them injuring pea-vines in his orchard.

THE APIARY.

As in previous years, the sole management of the Apiary has been in the hands of Mr. John Fixter, the Farm Foreman. The season of 1900 has been a particularly poor one in the greater part of Ontario, but by the exercise of care and attention the colonies were housed in good condition, and as far as can be judged at this date are wintering well. Several meetings of bee-keepers were attended by Mr. Fixter, and addresses were delivered by him on practical apiculture, which were highly appreciated by his hearers. I myself had the pleasure of attending the annual meeting of the Ontario Bee-keepers' Association, at Niagara Falls, Ont., on December 5 and 6, and by request gave an address upon the Fertilization of Flowers by Bees. There was an interesting discussion upon the question whether bees could injure ripe fruit before the skin was broken ; careful experiments were cited showing that this was not the case, though bees will sometimes take advantage of a crack in the fruit or of an opening made by wasps or other insects, and will suck the juice.

REPORT OF MR. JOHN FIXTER.

Experiment in Feeding Sugar Syrup for Winter Stores.

During the winter of 1899, and the spring of 1900, great trouble was experienced with dysentery among bees in many parts of the country. The disease was thought to be due to food or honeydew gathered in the autumn. An experiment was started last autumn with four colonies. All the natural stores were extracted on September 17. A Miller feeder was placed in an empty section super, close to the top of the brood frames, any part of the brood frames not covered by the feeder being covered with a propolis quilt cut so as to allow the bees a passage through it or on its side. By keeping the feeder well packed, except where the bees enter, the heat is kept in and at the same time the bees cannot daub themselves with the liquid. In this experiment the bees had a constant supply of syrup. This syrup was made of the best granulated sugar, two parts to one part of water by weight. The water was first brought to a boil, then the boiler was set back on the stove and, the sugar having been poured in, the mixture was stirred until the sugar was all dissolved. This syrup was supplied to the bees at about blood heat.

At the beginning of the feeding the average weight of the hives and colonies was 33½ pounds, and at the close 52½ pounds. It required 80 pounds of sugar to make up the weight of the four colonies to carry them through the winter and spring successfully. The weight of water used to make the syrup should not be taken into account, as it is afterwards all evaporated during the winter.

Experiments in Wintering, 1899-1900.

Experiments in wintering bees were continued in the cellar, in a root-house, in the house apiary and in a pit dug in a hill side. The results were very much the same as those described in the report for 1898 (at page 213).

THE SEASON OF 1900.

March 10.—The temperature being 41° Fahr., and the day bright and calm, eighteen colonies were removed from their winter quarters ; of these six were again placed in the exposed apiary, when there was about 18 inches of snow on the ground; six were placed in the sheltered apiary, where there was also considerable snow ; and six were placed in the house apiary. As soon as they were settled on their stands, the bees all began to fly at once, the weather being fair and calm. They were thus enabled to cleanse themselves and return ; the snow was discoloured for a considerable distance around the hives. Very few bees were noticed which were unable to return.

March 31 and April 1 being fine and warm, the colonies of all three apiaries had good cleansing flights. From April 2 to 6 there was very little flying, the weather being cool and windy. On April 7 the bees in the house apiary and in the sheltered apiary were flying well, while those in the exposed apiary could scarcely be seen to move out.

The balance of the colonies were taken from their winter quarters on April 8, the temperature being 44°. The weather was too cold for the bees to come out to have a cleansing flight until April 11, when the temperature rose to 54°, and all began to fly. The colonies first set out were flying as well as is usual in the month of May.

From April 11 to 18, there was very little flying, on account of cool winds and wet weather.

On April 18 an examination was made of the colonies set out early in the different apiaries, and of those set out later, that is, at the usual time; the purpose being to find out whether any difference could be seen as to the strength of the colonies. In every instance, we found that those set out first, more especially those in the house and sheltered apiaries, had more brood and eggs, and appeared to be very much more active than those set out later. When once they get a good cleansing flight, whether through activity or from getting water, whatever may be the cause, more brood and eggs are found in the hives. I would advise setting the bees out just as soon as they can fly out safely. The colonies which are set out a few days earlier will be by so many days further advanced at the beginning of the honey flow, that is, those set out later will require so many days more to become as strong after the beginning of the honey flow.

On April 18 the temperature went up to 69°. The snowdrops and squills blossomed, and the bees were seen to work on them at once. On April 20 and 21, the swamp willow, soft maple and Manitoba maple came into bloom. This time would have been too late for the removal of the bees from their winter quarters, for they would before this have become restless ; many would have left their hives and been lost on the cellar floor.

From April 19 to 25 the bees were seen gathering pollen or sap running from the trunks of hard maple trees that had been injured.

April 26.—Very high wind, increasing to a hurricane in the afternoon—the day of the big Hull and Ottawa fire.

April 27 to May 7.—Weather very fine ; all colonies working well, gathering pollen and honey. Every colony was building up rapidly.

At this time, and also from the blossoming of fruit trees to that of clover, the greatest care is necessary, so that there may be no check in brood rearing. When the queen stops laying, or when starved brood or dead larvæ are observed in the hives, many beginners, and even many experienced men, imagine that the cause is some disease, and at once send for the Inspector of Foul Brood. An instance of this is given on a later page (Appendix A), with the answer of the Inspector of Foul Brood (*see* page 247).

May 8-10.—Very cold winds ; scarcely any flying.

May 11-16.—Very fine weather ; bees working well.

May 17 and 18.—Very dull and cold ; scarcely any flying.

May 19 to June 7.—The bees gathered a great amount of pollen, but very little new honey ; nearly every hive was full of brood and young bees.

The first drones were noticed on May 28. A considerable amount of honey and syrup was fed from May 1 to June 8 in order to keep up brood-rearing and to prevent starving.

On June 7 and 8, White Dutch Clover and Alsike came into bloom, and there were many flowering trees and shrubs in bloom, but there was very little increase in honey.

June 8 to July 15, the bees gathered a small amount of honey from clovers and basswood.

On July 15 the first honey was taken off ; bees were very thick on flowers ; but there was very slight increase in weight of hives during the latter half of July.

After August 3, the bees gathered very little honey, and there was no increase in weight of the hives. The autumn flowers gave no surplus, and, there being no buckwheat sown in this district in 1900, no honey was gathered from that source.

September 1 to 10.—All colonies and hives were weighed in order to ascertain how much they had lost or gained. They were weighed again on October 1 and on November 12, just before they were put into their winter quarters. Any colony and hive found to weigh less than 50 pounds on September 1 was either given full frames of sealed honey or fed syrup to make up the difference in weight. While our experiments show that each colony consumes only from 9 to 14 pounds during the winter, it is a very wise policy to have 10 or 15 pounds extra in each hive to be used in spring before the honey flow.

Average weight of forty colonies and hives :

On October 1, 51¾ pounds.
On November 12, 49 pounds.

The forty colonies had therefore lost altogether 110 pounds. The greatest loss of any colony was 4½ pounds, the smallest ½ pound.

All were put into winter quarters on November 12.

List of Plants, Trees and Shrubs on which the bees were seen working well during the summer, and dates at which the visits were first noticed.

April 18—Snowdrops and squills.
" 20—Manitoba maple and soft maple.
" 21—Willows in swamps and on lawns.
May 10—Tulips.
" 11—Plum and apple trees.
" 12—Dandelions.
" 19—Wild black cherry tree.
" 22—Grape hyacinth.
" 22—Garland Flower *(Daphne Cneorum).*
" 23—Vinca, several varieties.
" 23—Anemones and alpine poppies.
" 23—*Adonis vernalis.*
" 23—*Doronicum Caucasicum.*
" 24—Sand cherry.
" 24—Currant bushes.
" 24—Siberian Pea-tree *(Caragana).*
" 25—Pear and cherry trees.
" 25—Lilacs, several sorts.
" 25—June berry.
" 25—Polemoniums.
" 27—Pæonies and Irises.
" 29—Honeysuckles and barberries.
" 31—*Pyrus baccata.*
" 31—Mountain Ash.
June 1—Strawberries.
" 2—Buckthorn bushes and hedges.
" 4—Forget-me-not.
" 4—Ginnalian maple.
June 4—Rhubarb.
" 4—Mountain Centaury.
" 4—*Ajuga Genevensis.*
" 4—*Anemone narcissiflora.*
" 7—White Dutch clover.
" 8—Alsike and sainfoin.
" 8—Raspberries and blackberries.
" 8—Sharp-leaved common Cotoneaster.
" 8—Alliums.
" 8—*Rosa rugosa.*
" 8—*Spiræa VanHouttei.*
" 12—Golden-leaved Spiræa.
" 12—Highbush Cranberry *(Viburnum Opulus).*
" 14—Geraniums.
" 14—Wild vetch.
" 19—Large red poppy.
" 19—Strawberry-flowered Cinquefoil.
" 19—*Lupinus.*
" 21—Golden Groundsel.
" 21—Wild Mustard.
" 21—*Dictamnus.*
" 23—Locust.
" 23—*Rosa multiflora Japonica.*
" 24—English horse beans.
" 28—Broad-leaved Bellflower.
" 28—*Anchusa altissima.*

July 1—Sweet clover *(Melilotus albus).*
" 8—Asparagus.
" 8—Grass Peas.
" 8—*Lathyrus sylvestris Wagneri.*
" 8—*Eremurus altaicus.*
" 8—*Sedum Kamtschaticum.*
" 8—*Thalictrum aquilegifolium.*
" 11—Basswood.
" 14—Lilies, different varieties.
" 14—*Veronica*, different varieties.
" 14—Mulleins.
" 15—Double Queen of the Meadow.
" 15—*Linaria.*
" 15—*Asclepias tuberosa.*
" 15—*Agrimonia.*
July 18—Mignonette.
" 23—*Hypericum Kalmianum.*
" 27—*Echinops Ruthenica.*
" 28—*Lychnis.*
" 30—*Solidago.*
Aug. 9—Button Bush *(Cephalanthus occidentalis).*
" 9—Pumpkin.
" 9—Late-sown English horse beans.
" 11—Campanulas and Rudbeckias.
" 21—Sunflowers.
Sept. 1—Wild Asters.
Oct. 4—African Marigold.
" 4—Gaillardias.

Experiments with Comb Foundations in Sections.

As there has been in connection with the production of comb-honey a difference of opinion as to the proper size of foundation to use, a thorough test was made with comb foundation of different sizes in the sections.

The results show that it is of great importance that the sections should be filled up to the sides and bottom with comb foundation. On examining the different sections in this experiment, it was found that the smaller the piece of foundation was, the more holes or gaps there were around the comb in the sections, and the comb was thus less firmly fastened around the sides and bottom to the wood.

The following sizes of comb foundations were tested :—

1. Full sheets fastened at the top and fitting closely to the sides and down close to the bottom.

4. Two inches square in centre of top section.

3. Quarter sheets across upper end.

4. Two inches square in centre of top of section.

5. One inch square in centre of top of section, besides a narrow strip of about half an inch across top and bottom.

6. No foundation at all.

From past experience, I would recommend that full sheets be always used. The bees worked on the full sheets first, and these were filled more evenly and very much better.

Many inquiries are made why bees will not work in supers, when the other colonies in the same apiary are working on drawn combs in extracting frames. The explanation is that the pieces of foundation in the sections were too small. Many bee-keepers, even experienced bee-keepers, do not put much foundation in the brood chamber when hiving new swarms, though they put full sheets in the supers ; consequently, the bees fill the sections in the supers first.

The experiment with different makes and sizes of hives was not completed owing to the very poor season.

House Apiary.

The House Apiary has again been tested and has worked very satisfactorily, as far as summer management is concerned ; but, for wintering, every one of the past six winters it has proved to be a failure.

Returns.

The experience of the past season has been a repetition of that of 1899. Reports from most parts of Ontario and Quebec show that there has been a very poor honey

flow, poorer even than 1899. In many places no surplus was secured, and bees have had to be fed more or less during the autumn.

Swarming was also poor on account of the shortage of honey. All the swarms that came out at the Experimental Farm Apiary were made to go back to the mother hives or were put with weak colonies ; 18 of the old colonies were doubled up, leaving now on hand 42 colonies.

The returns from the experimental apiary show an average of only 13 sections per colony. The colonies which were run for extracted honey gave 19 pounds per colony.

JOHN FIXTER.

APPENDIX A.

An Ontario bee-keeper wrote as follows to Mr. Wm. McEvoy, Inspector of Foul Brood for Ontario :—

'Dead brood appeared in half of my colonies. There would be from one to five or ten dead larvæ in a colony, and some of these I often found in capped cells, when I opened them with a penknife.

'I tried the starvation plan. Several of the colonies I starved twice, as the larvæ continued dying. I even destroyed two sets of foundation. Just think of the time and patience required to look into every cell in 80 colonies ; this I did several times. I had made up my mind to clean them up. I have melted many a score of white combs and super combs. I wish to be first on your list for inspection next summer. I may buy a lot of colonies which will be subject to your inspection.'

Mr. McEvoy's answer is full of valuable information :—

'Your colonies ran out of unsealed honey while they had a large quantity of brood on hand to feed, and then your bees did not uncap the sealed stores fast enough to keep pace with the amount of brood that required feeding, and the result was that considerable brood died of starvation. And some time after that the brood would suffer in proportion to the length of time that the brood nest was short of unsealed stores, and it would end in an increase of starved brood, which the bees would allow to remain in the combs for some time after the honey flow commenced. You never would have found one cell of dead brood in any of your colonies if you had kept them well supplied with unsealed stores. You may say that I am very much mistaken as to the cause in your case, but I am not ; I have travelled over every inch of this line for fully twenty years and from close observing, feeding and watching results, I have found that such is the cause why the bees fail to feed all the brood at certain times.

'On the night of May 28, 1889, we had a killing frost all over the province of Ontario, which was followed by several days of wet weather. That frost coming at the end of one of the warmest and most favourable springs ever known for bees, was a serious thing, because it caught all hives full of brood and suddenly stopped all the honey flow at the time when every colony had an immense quantity of larvæ to feed. I warned every bee-keeper at that time that he could look out for a wholesale starvation of brood and a very small crop of honey if he did not go to work and feed his bees so as to give them a chance to feed the larvæ. I kept my brood chambers well supplied with unsealed stores (through uncapping and feeding) until the honey flow began again. By thus doing, I secured one of the largest yields of honey I ever took, and I did not see one cell of dead brood. Late in the summer of 1889, many a bee-keeper became very much alarmed when he found his brood chamber in a rotten state with dead brood. Spraying of combs, starving the bees, and other methods were resorted to, to stamp out the dead brood. If these men had gone to work right after that great frost of May 28, and kept the brood chambers well supplied with unsealed honey through uncapping a part of the old sealed stores at one time, then another afterwards, and so on until the honey flow began again, they would have had

the most of the old honey used up and more space filled with brood : at the same time they would have had an increase in the number of the bees and would have secured a much larger yield of honey ; there would have been also no dead brood. The very wet weather that set in all over the province in the last half of May and first week in June, was very hard on the constitution of thousands of colonies, because it prevented any honey gathering during that long rainy time, and after the bees used up the unsealed honey (a thing they always use first) they did not uncap the old sealed stores fast enough to keep pace with the large quantity of larvæ that required feeding ; the result was a lot of starved brood, weak colonies and a small honey crop in many places. During the three weeks of wet weather I kept my colonies well supplied with unsealed honey by uncapping the sealed stores from time to time until all was used up, and after that I fed the bees until they commenced to gather honey. When the honey season opened, the combs in every brood-chamber were full of brood, and a large number of bees were hanging out on the front of every hive. I then put supers on, and from ninety colonies in that off season I took over 10,000 pounds of clover honey and left abundance for the bees to winter on. Last season I kept my colonies supplied with unsealed honey between fruit bloom and clover bloom, and when I finished extracting the balance of my crop in the fall I found I had taken over 11,000 pounds of clover honey from 100 colonies, and left plenty to winter the bees. You say that you tried the starvation plan and the dead brood showed up again ; also that you starved several of them twice. I am certain that dead brood (starved brood) would not have shown up again after you put the bees on foundation, if you had fed the bees freely until they began to gather honey. You also say that many a score of white comb you melted. What a loss ! These beautiful combs should not have been melted. With different management you could have made $250 or more, and saved all the combs and yourself from a world of worry.' —J. McEvoy.

WEEDS.

SPRAYING FOR DESTRUCTION OF MUSTARD.

In my last report an account was given by Mr. Frank T. Shutt, M.A., F.R.S.C., Chemist to the Dominion Experimental Farms, of some experiments carried out by him, with the assistance of the Horticulturist of the Central Experimental Farm, to test the efficacy of the French method of eradicating Wild Mustard by spraying infested growing crops with solutions of copper sulphate. The conclusion arrived at from these experiments was, that a 2 per cent solution of copper sulphate, applied at the rate of 50 gallons to the acre, when the mustard plants were young, was the most effective, safest (as regards the grain crops) and most economical to use. The average cost of this application would be $1 per acre.

During the past summer, the Horticulturist, having men and horse-power at his disposal, again tested this remedy, and the results were again successful, although the experiment was carried out rather late in the season, and under certain other disadvantages as to the nature of the crop infested and the weather which prevailed at the time.

Mr. Shutt has drawn my attention to an important article on the subject, entitled 'The destruction of Charlock,' by Dr. J. Augustus Voelcker, in the Journal of the Royal Agricultural Society of England, vol. X, pt. 4, pp. 767-775, which, on the whole, confirms Mr. Shutt's conclusions and gives much valuable information on the subject. One quotation from a report made by Mr. Wm. Carruthers, the Consulting Botanist of

the Royal Agricultural Society, on some of the experiments referred to, is of particular interest to Canadian experimenters, who have been disappointed at the results sometimes obtained when spraying has been tried for the destruction of mustard in districts where the Bird Rape (also called Kale, or Smooth-leaved Charlock) is abundant. This is particularly the case in Manitoba, where by far the greater proportion of the plants called Wild Mustard are really Bird Rape *(Brassica campestris,* L.) 'I have not been able to detect anything in the structure of the Charlock that should make it so readily a prey to the copper sulphate. This is still more remarkable when we find that it does not in the least injure another species in the same genus, which in Cumberland is known as the "Smooth-leaved Charlock." This plant, the *Brassica campestris* of Linnæus, is very common in some districts. A correspondent in Cornwall writes that it is very common in his county. He has observed that while the common Charlock is easily destroyed by copper sulphate, the smooth-leaved plant is quite uninjured by it. This is probably the explanation of the difference in the testimonies as to the influence of copper sulphate on Charlock. The two plants so closely resemble each other that only a careful observer can distinguish that they differ. The true Charlock *(Brassica Sinapistrum,* Boiss.) is destroyed by treatment, while the smooth-leaved Charlock (*Brassica campestris,* L.) is not affected.

'As the general outcome of Mr. Hornsby's experiments, it would seem that for Charlock when still young, 40 gallons per acre of 2 per cent solution of sulphate of copper would be found effectual, but that, if the Charlock were already in flower, as much as 60 gallons of a 4 per cent solution would be required.'

INDEX

PAGE

ENTOMOLOGIST AND BOTANIST—Report of the 195-204
Acknowledgments 196
Anarsia lineatella 240
Anasa tristis 242
Anderson, J. R., on variegated cutworm 215, 217, 221, 226
Anthomyia maggots in roots 238
Aphis brassicæ 238
Apiary, The 243
experiment in feeding syrup for winter stores 243
season of 1900 244
experiments with comb foundations 246
The House Apiary 247
returns 247
dead brood mistaken for foul brood. 247
Apple Fruit Miner 241
Apple Worm, Lesser 240
Argyresthia conjugella 241
Army Worms in winter 242
Asparagus Beetle 241
Asparagus Rust 241
Aspidiotus perniciosus 230
Black C Rustic 228
Black Vine Weevil 240
Blister Beetle, Black 242
Botis harveyana 235
Brassica campestris 249
Sinapistrum 249
Bruchus pisorum 208
Cabbage Pionea 238
Cabbage Plusia 239
Cabbage Worm 238
Cacœcia parallela 236
Camnula pellucida 206, 207
Cantharis cyanipennis 243
Carneades ochrogaster 205
Carpocapsa pomonella 239
Cecidomyia destructor 197
Cephus pygmœus 202
Charlock, spraying for destruction of .. 248
Clover Root-borer 238
Clover Weevil, Green 238
Clover Weevil, Large 238
Codling Moth 239
Collections, additions to 195
Conotrachelus nenuphar 239
Correspondence 195
Cosmopepla carnifex 241
Criddle, Norman, on Locusts 206
Crioceris asparagi 241
Cutworm, Red-backed 205
Cutworm, Spotted 227
Cutworm, Variegated 215
description of moth 222
description of larva 223
remedies for 224
parasites of 225
predaceous enemies of 226
Cutworms in wheat 204
Diamond-back Moth 238
Diplosis preying on Aphis 212
Empusa aphidis 212
aulicæ 226
Entomoscelis adonidis 241
Entomophthora phytonomi 238
Ephestia kuehniella 241
Epicauta pennsylvanica 242

PAGE

Euplectrus frontalis 228
Fisher, Geo. E., work by 281
Fixter, John, report by 243
Flour Moth, Mediterranean 241
Fumigation of nursery stock 232
Grasshoppers in Manitoba 205
Greenhouse leaf-roller, a 236
remedies for 237
Greenhouse Leaf-tyer 235
Hessian Fly 197
remedies for 200
Honey plants visited by bees 243
Hover Flies 212
Hyalopterus pruni 241
Hylastinus obscurus 238
Hylesinus trifolii 238
Idechthis ephestiæ 241
Insect pests 197
Johnson, Prof. W. G., on Destructive Pea Aphis 213
Lachnosterna 208
Lecturing tour in the West 196
Lochhead, Prof. W., on Hessian Fly .. 197
on San José Scale 233
Locust investigation 205
Locust, Lesser Migratory 207
Locust, Rocky Mountain 206
Locust, Pellucid 207
McKellar, Hugh, work by 205
Mediterranean Flour Moth 241
Meetings attended 195
Melanoplus atlanis 206, 207
packardii 206
spretus 206, 207
Meromyza americana 202
Meteorus vulgaris 227
Micropteryx pomivorella 240
Muscina stabulans 226
Mustard, Wild, spraying for destruction of 248
Mytilaspis pomorum 239
Nectarophora destructor 211
Nepticula pomivorella 240
Noctua c-nigrum 227
Œdemasia concinna 240
Otiorhynchus sulcatus 240
Oyster-shell Bark-louse 239
Palmer, R. M., on Variegated Cutworm. 220
Palmer Worm 234
Pea Aphis, Destructive 211
remedies for 213
Pea Bug 208
Pea Moth 214
Pea Weevil 208
remedies for 210
Pear-leaf Blister Mite 240
Pear-tree Flea-louse 239
Pearly Underwing 215
Peridroma saucia 215
Phlyctænia ferrugalis 235
Phytonomus nigrirostris 238
punctatus 238
Phytoptus pyri 240
Pieris rapæ 238
Pionea rimosalis 238
Plum Aphis, Mealy 241
Plum Curculio on apples 239
Plusia brassicæ 229
Plutella cruciferarum 238

	Page
Entomologist and Botanist—Report of the—*Con.*	
Psylla pyricola	239
Puccinia asparagi	241
Rape, Bird	249
Root Maggots	238
San José Scale	230
Semasia nigricana	214
prunivora	240
Squash Bug	242
Strawberry Root-borer	240
Syrphidæ	212
Turnip Aphis	238
Turnip Beetle, Red	241
Vine Weevil, Black	240
Weather, injuries to wheat due to	203
Webster, Prof. F. M., on Hessian Fly.	200
on San José Scale	233
Weeds	244
Wheat, cutworms in	264
injuries to, due to weather	203
White Grubs attacking	208
Wheat-stem Maggot	202
Wheat-stem Saw-fly	202
remedies for	203
White Grubs attacking wheat	208
Ypsolophus pometellus	234

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01491 7413

1900