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AUTHOR'S EDITION
THE ANNUAL REPORT ON THE EXPERIMENTAL FARMS FOR THE YEAR 1896

CANADA

DEPARTMENT OF AGRICULTURE

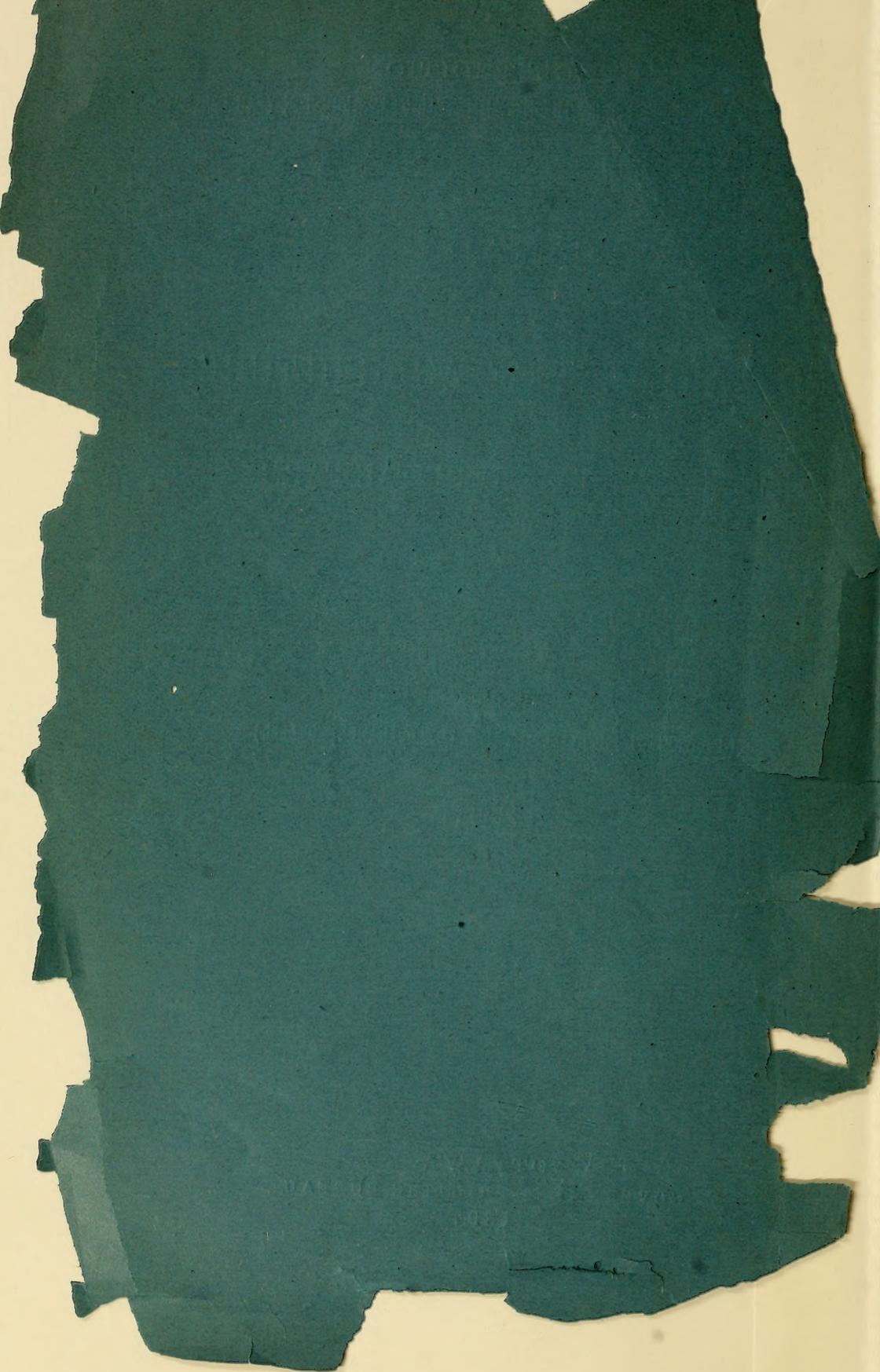
CENTRAL EXPERIMENTAL FARM

REPORT OF THE ENTOMOLOGIST AND BOTANIST

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

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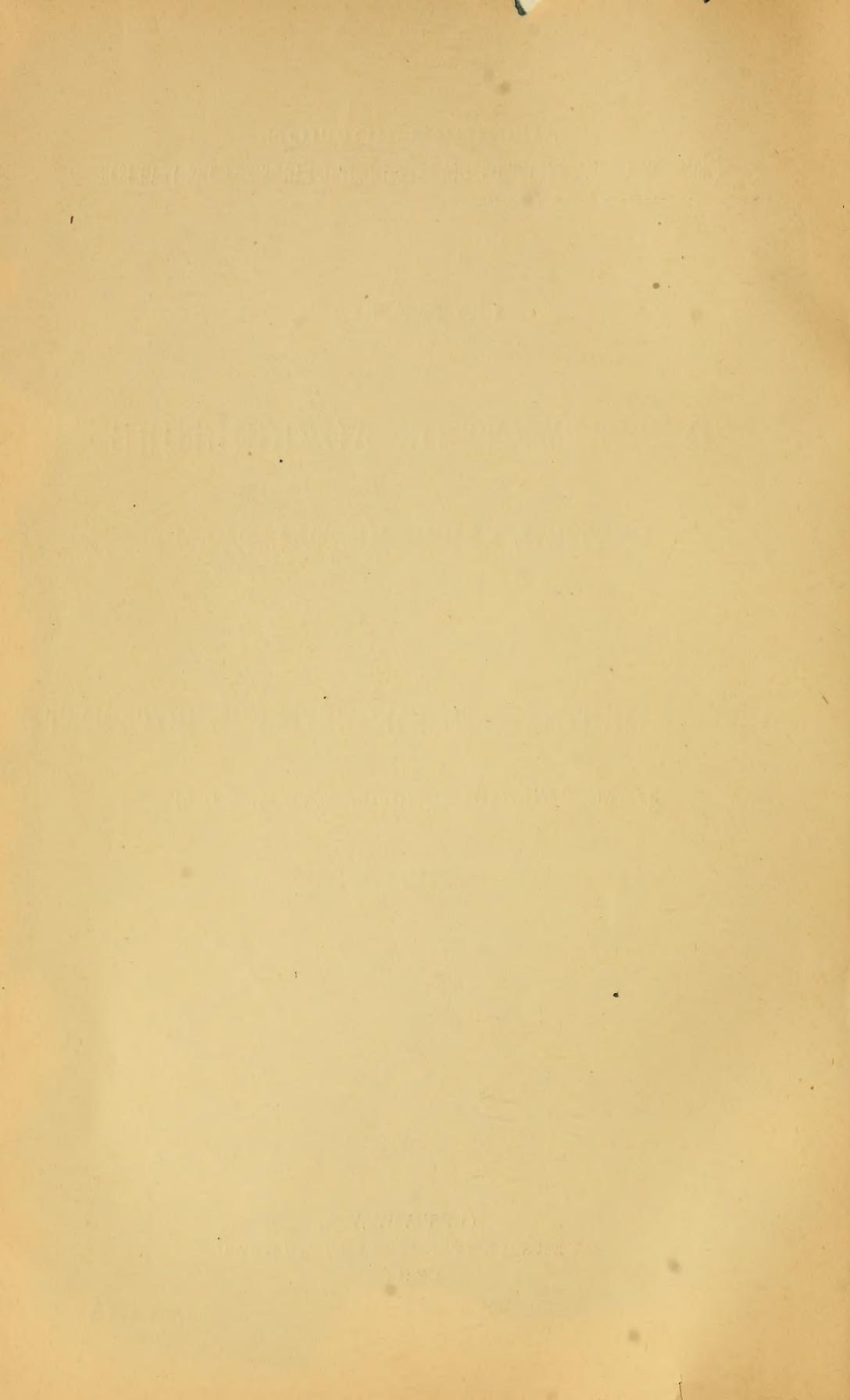
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REPORT

OF THE

ENTOMOLOGIST AND BOTANIST.

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

DR. W. SAUNDERS,
Director, Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to hand you herewith a report on some of the most important subjects which have been brought officially under my notice during the past season. The correspondence of this division is now very large, which I trust may be taken as an indication of the growing appreciation of the utility of the investigations prosecuted. As heretofore, I have endeavoured to come into direct communication with my many correspondents in all parts of Canada, so as to benefit as much as possible from the observations of practical workers and actual eye-witnesses of the different matters studied. It is of course impossible to treat in the annual report of all the subjects which engage the attention of the Entomologist and Botanist during the year; but the many valuable data and records of observations in letters from correspondents are all carefully preserved and classified for future use when the subjects to which they refer are treated of in full. Included among these are references to various attacks upon crops, of more or less importance by insects, the study of the life histories of which is as yet incomplete. As in previous years, much time has been taken up in distributing information concerning well known injurious insects and plants. Among the insects which cause much loss every year and which are now being studied with the view of arriving at better remedies, the following may be mentioned:—Wireworms, cutworms in grain, the pea moth, the strawberry leaf-roller, the carrot rust-fly, the “fish-bug” (*Silpha Lapponica*, Hbst.), which attacks codfish on the “flakes” during the process of being cured, root-maggots of the onion and cabbage and white grubs.

The experiments with grasses and fodder plants of all kinds have been continued upon the Experimental Farm, and a large number of small samples of seeds have been distributed to farmers living in all parts of the Dominion for testing. The reports from these correspondents are of great interest as proving the suitability of some of the valuable varieties for cultivation over a far wider area in the Dominion than might have been anticipated. The experimental grass plots on the farm continue to be of great interest to visitors. In these plots may be seen growing nearly all the grasses, clovers and other fodder plants suitable for cultivation at Ottawa, of which the seeds are to be obtained from seedsmen as well as a large number of our native Canadian grasses. Seeds have also been procured from botanists in Australia and in the United States. Among these mention may be made of an erect variety of barn-yard grass (*Panicum Crus-galli*) and two early varieties of Soja beans from Japan received from Prof. W. P. Brooks, of the Massachusetts Experiment Station.

During the past year many entomologists and botanists in various parts of the Dominion have availed themselves of the services of the officers of this division in identifying specimens of insects and plants. A large number of collections have been received for this purpose. From these collections several valuable additions have been made to the farm museum. The collections sent in for naming are always returned to the senders with the names of the specimens, but many species which were found to be desirable for our herbarium have been kindly presented to us by their owners upon that fact being made known to them. Through these collections valuable additional information is acquired as to the known distribution of our native insects and plants, lists of the names, localities and dates of all specimens received being carefully kept.

The practical work of the Arboretum and Botanic garden, which was done to a large measure under my direction until last spring, was then, at my request, handed over to Mr. W. T. Macoun, the foreman of forestry, who, having men under his control, was in a better position to look after the necessary labour, such as cultivation, planting, tidying up, &c., than I was, with only one man, whose time is very fully occupied with the grass and fodder experiments. In addition to the above reason, Mr. Macoun is specially well qualified for this work from his natural tastes and knowledge of plants. I had, therefore, very much pleasure in recommending to you that this work should be entrusted to him.

Whenever my official duties would allow of my absence, every opportunity has been taken of attending farmers' meetings to deliver addresses on the work of the division and to meet the farmers. In this way information concerning the work of this division has been spread to many who might not otherwise have known of its utility. Meetings were attended at the following places:—

January 7-10—Campbellford, Ont.
do 14-16—Cornwall, Ont.
February 7- 8—Toledo and Newboro', Ont.
do 10-15—St. Johns and Ormstown, Que.

By instruction of the Hon. Minister of Agriculture, and at the request of the Manitoba government, I proceeded to Manitoba on 23rd June last, and, in company with Mr. Hugh McKellar, Chief Clerk of the Provincial Department of Agriculture and Immigration, or Dr. S. J. Thompson, Veterinarian of the same department, I held a series of twenty meetings in many of the most important wheat growing centres of Manitoba. The subject treated of at all these meetings was "Noxious Weeds, their Nature and Habits, and the best Means to adopt for their Eradication." These meetings were in every case well attended and very great interest was manifested in the subject, large numbers of weeds being brought in at every meeting for naming and information. All arrangements and expenses of these meetings were undertaken by the Provincial Minister of Agriculture, the Hon. Thomas Greenway, who, by associating with me in this work the two above named officers of his department, materially increased the value of the meetings on account of the practical knowledge and long experience of both of these gentlemen in the methods of culture practised in Manitoba, as well as their thorough acquaintance with the capabilities and physical features of the country.

Acknowledgements.—As in previous years, I am under great obligations to my friends, Prof. John Macoun and Mr. W. H. Harrington, for frequent assistance in the identification of difficult plants, insects and other objects of natural history. To Mr. J. B. Tyrrell, of the Geological Survey Department, I am indebted for the identification of specimens of *Arachnida*. I also take pleasure in again gratefully acknowledging the valuable assistance I have received from my many correspondents in all parts of the Dominion, who have much aided the work of this division by making observations and by sending me prompt notice of the occurrence of injurious insects and weeds. My thanks are particularly due to Dr. L. O. Howard, the United States Entomologist, and his staff for many favours in the identification of insects, for the use of illustrations and for valuable publications. The following donations have been received, all of which are most acceptable:—

- J. R. Anderson, Esq., Victoria, B.C.—Botanical specimens and living roots of five species of British Columbian *Ribes*.
- André Bôdy, Esq., Quebec.—Botanical specimens and seeds.
- Rev. W. A. Burman, Winnipeg.—Seeds and specimens of Manitoba weeds.
- F. C. Clare, Esq., Edmonton, Alta.—Specimens of rare plants and insects from the North-west.
- M. G. DeWolfe, Esq., Kentville, N.S.—Living root of *Amorphophallus Rivieri*.
- A. Grant Ferrier, Esq., Sorrento, Florida.—Insects from Florida, including a living specimen of the whip-tailed scorpion (*Thelyphonus giganteus*).
- T. W. Ramm, Esq., Ross Mount, Ont.—Specimens of insects, including a beautiful pair of the Imperial Moth (*Eacles imperialis*, Drury) taken in Ontario.

W. Scott, Esq., Toronto.—Botanical specimens.

Rev. G. W. Taylor, Nanaimo, B.C.—British Columbian plants and insects.

T. N. Willing, Esq., Olds, Alta.—Rare plants and insects from Alberta.

The Director, Bangalore Botanic Garden, India.—Several packets of seeds.

In addition to the above special mention should be made of a consignment of specimens of the Apricot scale, *Lecanium Armeniacum*, infested by its parasite, *Comys fusca*, Howard. These were sent by Mr. E. M. Ehrhorn, of Mountain View, California, with the hope that they might prove useful in controlling the New York Plum-scale, a species similar to the Apricot scale. Part of these specimens were allowed to escape in an elm tree at Ottawa badly infested by another *Lecanium* very similar to the two above mentioned, and part were sent to Mr. L. A. Woolverton, Secretary of the Fruit Growers' Association of Ontario, to be liberated at Grimsby where the New York Plum-scale was known to exist.

The most important addition to the museum was in the shape of an exchange from the Government of New South Wales, through the Curator of the Technological Museum at Sydney, and consists of a large collection of named botanical and entomological specimens from that colony.

In conclusion, I beg again to acknowledge the great help I have received in all branches of my work from my assistant, Mr. J. A. Guignard, B.A., who has done a great deal to render this division what I trust and confidently hope that it is—a useful branch of the public service.

I have the honour to be, sir,
Your obedient servant,

JAMES FLETCHER,
Entomologist and Botanist.

OTTAWA, 31st December, 1896.

CEREALS.

There was not during the past summer any widespread or very serious injury to grain crops by insect enemies. Notwithstanding that in the province of Ontario large areas of fall wheat were ploughed down as being "winter-killed," the crop proved of good quality and an average yield. It is highly probable, from the reports that have since come in from the districts where this winter killing prevailed, that some of the loss,

at any rate, was due to the attacks of the HESSIAN FLY (*Cecidomyia destructor*, Say), Fig. 1. Actual reports mention this insect only in Prince Edward Island and the western part of Ontario. In this latter section, however, there is decided evidence that the Hessian fly is increasing, and it is well for farmers to recognize this and adopt the well known methods for preventing its injury. In October last Prof. J. H. Panton, of the Ontario Agricultural College and Director of the Committee on Economic Botany and Entomology of the Ontario Agricultural and Experimental Union, sent out a list of questions to some of the most prominent farmers in Ontario. One of these questions was: "What are the six worst insects in your locality?" And another: "What new insects are likely to be injurious?" In an interesting summary of the replies to these questions, written by Mr. T. F. Paterson for the *Montreal Family Herald* of December 15, 1896, it appears that "forty-three different insects were enumerated. The following list will give a fair estimate as to which are most injurious to the farmer at the present time. The eight worst

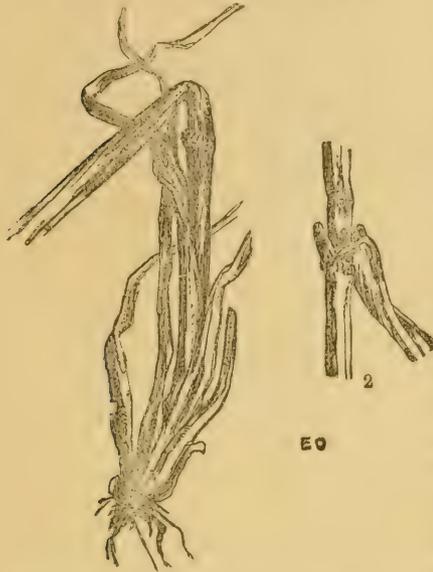


Fig. 1.—Barley stem attacked by Hessian fly.
2, Showing flax-seed-like puparia.

ones have been selected, as, from the reports, they seem to greatly exceed the others in numbers and injurious effects:—1. Colorado potato beetle, 39. 2. Grasshoppers, 32. 3. Horn-fly, 25. 4. Cutworms, 18. 5. Tent caterpillars, 15. 6. Army-worm, 13. 7. Cabbage worm, 11. 8. Hessian fly, 10." From the above, it is also clear that the Hessian fly is recognized as the cause of considerable loss in the year 1896, and in the answers to the question as to what insects are likely to prove troublesome in the future it is the fifth of twenty-three kinds mentioned, and the Wheat Midge is the sixth. The following letters are from Ontario:—

"Pinehurst, Kent Co., Ont., 29th June.—In this county the Hessian fly is doing a great deal of damage to the wheat crop; in fact, many fields are ruined, and, unless something can be done to protect the wheat, we think it a great risk to sow any this fall."—J. T. O'KEEFE.

"Delaware, Middlesex Co., Ont., 2nd Nov.—I am told that the prospects for fall wheat are not good in this neighbourhood, owing to the attack of the larvæ of Hessian fly."—J. DEARNESS.

"Verdun, Huron Co., Ont., 1st Dec.—Referring to previous correspondence, I am beginning to think that the Hessian fly may be blamable for the injury to my fall wheat this autumn; and, if so, there is every year here much loss from it. Much complaint was made last spring of fall wheat being killed off after it had apparently come through the winter all right, and I am now inclined to think, since communicating with you, that the Hessian fly was the cause of this loss also. The condition referred to extended over

all this township, and this fall much of the very early sowing (in August) is noticeably yellow in places. I have, however, examined a few fields, but did not find sufficient pupæ of the Hessian fly as would, I think, account for the whole of it. As to the extent of the damage to the wheat crop, six weeks ago as much as one-third apparently was injured, but this is not so noticeable now, owing to the killed plants having withered and the healthy ones covering the ground."—WM. WELSH.

The life history of the Hessian fly is well known, but fortunately this insect has not for some years required particular attention except in restricted localities. Its work is generally recognized in the spring of the year by dead plants in wheat fields. Upon examining these, the characteristic pupæ, resembling small flax seeds, may be found in the crowns of the young plants; sometimes three or four specimens will occur beneath the leaf sheaths of a single plant. In summer time the same flax-seed-like puparia (Fig. 1) may be found above the first or second joint of the stems of barley, rye and wheat, where they lie beneath the sheath of the leaf, but outside the stem; the larvæ suck the sap of the stems and so weaken them that they frequently fall down. The perfect insect is a tiny blackish midge with smoky wings, expanding only a quarter of an inch from tip to tip, which appears in April and May and again in August, lasting until about the middle of September. The females lay their minute scarlet eggs upon the inside crease of the leaves, and the young maggots, upon hatching, work their way down to the axils of the leaves where the injury to the plant is done.

Remedies.—The remedies for the Hessian fly are as follows: 1. Late sowing. The postponement of seeding until after the third week in September has the effect of delaying the appearance of the young wheat plants above the ground until all the Hessian flies of the second brood are dead.

2. Burning refuse. As a large proportion of the "flax seeds" are carried with the grain and at threshing are thrown down beneath the machine among the rubbish and broken straw, it is of great importance to destroy all rubbish, tailings or fine screenings wherever grain is known to be infested.

3. Treatment of stubbles. As soon as the crop is cut, it is an excellent plan to run a harrow over the fields so as to start a volunteer crop from the grains which have dropped in harvesting. By the time the fields are ploughed, many flies of the August brood will have emerged and laid their eggs on these plants; these will thus be destroyed at the same time as many seedlings of noxious weeds. If fields are conveniently situated away from barns, houses and stacks, much good may be done by burning over the stubbles before ploughing, as the pupæ occur, as a rule, at the first or second joint of the stem. To facilitate the operation of burning, a little dry straw may be scattered lightly over the stubble. It is, perhaps, hardly necessary to say that neither wheat, barley nor rye should be sown again in fields where a crop has been infested the year previous.

The JOINT-WORM (*Isosoma hordei*, Harris).—In my last report I made mention of the occurrence in injurious numbers of a joint-worm in wheat fields at Meaford, Grey Co., Ont. My correspondent, Mr. Thomas Harris, who reported his observations last year, writes that there has been no recurrence of this attack during the past summer on his own fields, nor has he heard of any upon the crops of his neighbours.

The GRAIN PLANT-LOUSE (*Siphonophora avenæ*, Fab.)—As usual, this plant-louse has occurred to some extent in all parts of the Dominion, but only two reports state that actual injury has been done to grain. That the insects were exceptionally abundant is shown by the following:

"Princeton, Brant Co., Ont., July 24.—In this part of the province we have begun to cut our oats, and these insects abound to an enormous extent. They literally cover the table of the binder. One farmer told me to-day that they piled up four or five inches deep under the knoter of his machine. I am sure I do not exaggerate when I say it would not be hard to sweep a good shovelful off a binder after cutting a field of oats."—J. E. RICHARDSON.

"Shakespeare, Oxford Co., Ont., July 27.—I send you some small insects. There are millions of them on my oats. I do not recollect having seen anything like it before."—J. W. DONALDSON.

"Doe Lake, Muskoka, Ont., August 18.—The wheat is very much shrunk here. This was not from rust, as the straw was bright, but the heads while green were covered with lice."—F. C. JUDD.

No special treatment can be recommended for the grain plant-louse, nor, as a rule, is any remedy necessary, for the natural parasites suffice to keep it in check.

The AMPUTATING BROCADE MOTH (*Hadena arctica*, Boisd.).—In the summer of 1895, the moths of this species were so abundant in some parts of Western Ontario as to attract the attention of many people, and complaints were received of their swarming into houses where they gave annoyance by soiling clothes and curtains and also by dying in large numbers in shop windows. As might have been expected, the caterpillars were last summer destructive in the same districts to wheat, oats, corn, &c., complaints coming in from the counties of Middlesex, Grey and Carleton. Writing from Granton, Middlesex Co., Ont., Mr. J. Dearness, President of the Entomological Society of Ontario, on 15th of May, says:—"I am sending you herewith samples of a cutworm that in innumerable force is ravaging spring crops sown on sod. The drill rows are followed, and every blade of grass is cut off, leaving large areas of the field perfectly bare. In this neighbourhood last year,—and from reports, I judge it was pretty general through this part of Ontario,—the Amputating Brocade moth was very troublesome, filling lamps, soiling clothes and pestiferous in other ways. I inclose one of these moths. Is it the same species as the cutworm sent?"

Reply:—"The cutworm and moth sent are both the same species. I am sorry to say that the only measure I can suggest by which infested fields can be turned to good use this year, is to plough up the portions worst affected and plant some crop which can be put in as late as possible, so as to give the caterpillars time to mature before the crop appears. It would be better to use some other crop than a plant belonging to the grass family. As far as my own observation goes, *H. arctica* feeds on grasses, although there are many records of the caterpillars feeding on other plants, such as root crops and even orchard trees; but I have never seen this. They are large whitish cutworms nearly two inches long, with bright chestnut red heads, which exist a long time in the larval form, continuing their ravages almost to the middle of June. They have every appearance of caterpillars which feed normally beneath the surface of the soil."

Serious injury to corn fields, which was probably by the same species, was reported by Dr. T. Sproule, M.P., as occurring in the county of Grey.

The PEA MOTH (*Semasia* sp.) has again this year attracted a good deal of attention by the extent of its injuries. Many of the accounts differ somewhat on important particulars, and it is much to be regretted that, so far, all efforts to breed the perfect insect have failed, so that the exact identity of the moth cannot as yet be given. The following interesting letter adds to our knowledge of its life history:—

"Clifton, King's Co., N.B., February 24.—I have been greatly interested in your report on the Pea Moth. This insect is very destructive here, especially late in the season. Late pease are so damaged by it that they are quite unfit for use as seed unless hand picked. Indeed I have had about all my late seed repeatedly destroyed. Last season, the late garden pease when picked and being prepared for the table were found to be so affected as to be unfit for market, fully three-quarters of them being destroyed by the worm. Late varieties of pease such as Stratagem were so injured that it was almost impossible to get any that were fit for seed.

"The pea pod is always attacked at the upper end first, and, when the pease are badly eaten up a quantity of granular excrement and silken threads unites the whole. The pods on the under side of vines lying on the ground seem to be most badly affected, and the damage is greater on ground planted in pease the year before, in garden plots, in damp positions and when the weather has been damp.

"I notice in your report that Mr. Cowdry says he found caterpillars only in pods quite matured. I have repeatedly found them in very young pods, too young for table use.

"This pest has existed here at least forty years, and I can see no appreciable increase or decrease. It causes considerable loss in this vicinity, but so far no remedy seems to be generally applicable. Possibly deep ploughing might do much, or burning the stems in garden plots."—J. E. WETMORE.

THE WHEAT-STEM SAW-FLY.

(*Cephus pygmaeus*, L.)

Attack.—Slender, white grubs. Head rounded, yellowish, with the mandibles darkened. Body swollen at the first two joints after the head and tapering very slightly to the end, which is terminated by a short, blunt tubercle with a darkened and hardened tip. This Monsieur Herpin describes as a tubular appendage, which is capable of being protruded like a telescope, and assists the insect in its progress within the tube of the straw. Beneath the first three segments of the body are three pairs of rudimentary thoracic feet. These larvæ are found inside stems of wheat. When full-grown they are nearly half an inch in length and have by that time bored through all or most of the knots in the stem, leaving a discoloured tunnel extending from the top joint down to the root, where, when mature, they spin thin transparent cocoons in which they pass the winter and change to pupæ the following summer.

In November, 1889, Prof. Comstock published a bulletin (*Cornell Univ. Coll. of Agr., Bull. 11.*) "On a Saw-fly Borer in Wheat," in which he gives a full account of a remarkable outbreak of *Cephus pygmaeus* on the Cornell University farm, when nearly five per cent of the wheat in a field was infested. In the *Canadian Entomologist* for 1890, page 40, Mr. W. Hague Harrington records that in 1887 he took a specimen of this insect at Ottawa, and that he had received specimens taken at Buffalo, N.Y., in the middle of June, 1888, and again at the same place and season the following year. With the exception of these records, I have been unable to find any mention of specimens being taken in America. On the 5th July, 1895, at Indian Head, N.W.T., I collected specimens of the perfect insect by sweeping the flowers of the Tumbling Mustard which grew in the greatest abundance just outside the Experimental Farm. At that time no injury by the larvæ was noticeable on the wheat growing in the district, nor has any report of injury attributable to it been received since from that district; but on the 6th of August last Mr. John Wenman, of Souris, Man., sent a packet of wheat stems containing nearly full grown larvæ which answered in every particular to those of *Cephus pygmaeus*. Mr. Wenman was written to for full particulars of the occurrence, and the following letter was received:—

"Souris, Man., Sept. 2.—In reply to your favour of the 12th ultimo, I beg to inform you that I have looked several times for more specimens of the injured stems of wheat, but the field which was most visibly affected had been cut the day before your letter came, and I could not secure good specimens. You ask how it was that I noticed the injury. I observed that some straws were lying down or lodged here and there, and, upon examining these stems, I found in nearly every instance that the straw was discoloured and broken between the first and second joints. We had had hail a day or two before. On following up inside the affected stems, I found in most cases the grub which you saw in the sample sent, about half an inch long, head brownish and body cream-coloured. In one case I found the grub had worked through all the joints up to the head of grain. I looked for this pest in several of my neighbours' fields. I saw a little in one field. The damage resulting from this attack, however, is so far, I am sure, not appreciable, but precautions must, of course, be taken, and I shall be on the *qui vive* for any further visitation."

The specimens of straw sent by Mr. Wenman contained larvæ which were nearly or quite full-grown on the 12th of August, but only a small proportion of these stems had been tunneled up to the top joint. The larvæ were some distance above the root, but judging from the state of maturity of the straw, they would have descended very soon to the root to form the cocoons in which they pass the winter.

There is, however, a marked difference in the season of the Manitoban specimens and that of those studied by Prof. Comstock at Ithaca, N.Y., which were in general terms just about one month earlier. By the 19th of July, 1889, all the larvæ examined at Ithaca had descended to the lowest joint, while in Manitoba this year, nearly a month later in the season, some of the larvæ were not full-grown until about the 13th of August. Specimens of the mature insect were flying at Indian Head on the 5th of July, 1895, and it would take from a month to six weeks before the larvæ from eggs laid by these reached full growth, which would occur about the same time as the ripening of the wheat, when naturally the straws would dry up and become unfit for food.

Several European writers have treated of this insect and its habits. Probably the best known account is that of John Curtis in his celebrated work *Farm Insects* (1860). This account includes the observations of Herpin and other French authors. The most complete study of the insect is that by Prof. Comstock presented in the bulletin above referred to.

A summary of the life history of the Wheat-stem Saw-fly is as follows:—

The eggs are laid inside the wheat stem just before the ears appear above the sheath, being inserted into the hollow of the stem through a minute hole cut by the female with its saw-like ovipositor. The egg hatches in a few days, and the young larva grows rapidly and attains full growth before the straw ripens and hardens, by which time it will have eaten its way from the topmost joint of the stem to the lowest, feeding chiefly on the substance of the knots, but also on the inside tissues of the straw. About the time the grain ripens, it descends to the bottom joint, and, just above the surface of the ground, gnaws away the inside substance of the straw so as to cut a ring almost, but not quite, through to the outside. (Fig. 2.) This is to enable the perfect fly to emerge easily in spring. It then spins a thin, delicate cocoon; and, like the larvæ of most saw-flies, remains torpid until the following spring, when it turns to a pupa only a few days before transforming into the perfect fly. The date of appearance of the perfect insect evidently varies with the season and locality. The adult is a shining black four-winged fly, banded and spotted with yellow, with the abdomen slightly compressed. The head is large, with prominent eyes, and there are also three ocelli or minute simple eyes near the summit of the head. The antennæ are slightly club-shaped and composed of about twenty segments. The female is rather larger than the male and less ornamented with yellow. The average length is about one-third of an inch (male, 8 mm.; female, 10 mm.). This insect is interesting scientifically, as it must be classified between the true Saw-flies (*Tenthredinidæ*) and the Horn-tails (*Uroceridæ*), so-called from the fact that the larvæ bear a sharp horn-like appendage at the end of the body.

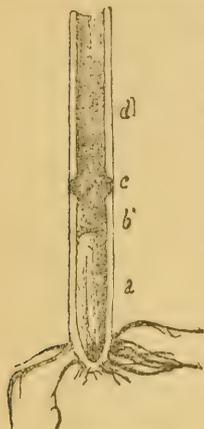


Fig. 2.—Base of straw infested by Wheat Saw-fly: a, cocoon; b, plug of borings; c, circular cut; d, scattered borings. (Figure kindly lent by Prof. J. H. Comstock.)

It is evident from an examination of the different stages, that it is more nearly related to the Horn-tails. The Wheat-stem Saw-fly is a native of most of the countries of Europe, and in some years, particularly in France, it has been the cause of much loss. Miss Eleanor A. Ormerod speaks of it in many of her invaluable reports, and shows that while it occurs in noticeable numbers every year, it is only occasionally a serious enemy to the wheat grower.

The question of the introduction of this European insect into America is one of some interest to entomologists, and it seems difficult to understand how it could have taken place. It has been suggested, however, by Prof. Comstock, who found a few cocoons in the straw above the point where it would have been cut by a reaper, that "a small proportion of the insects are probably removed from the wheat fields in the straw and, consequently, there is danger of the spreading of the species in this way. It is probable that the insect was introduced into this country in straw used in packing, and it may be further distributed here in the same way." (*Bull. No. 11*, p. 141).

It is, of course, possible that the insect may have been introduced in this way and although recorded only from the above mentioned widely separated localities, from the inconspicuous nature of the injury, it is extremely likely that it has been overlooked in many places where it occurs. It has not yet been found feeding in any other member of the grass family than wheat and rye. With regard to its occurrence at Ithaca, N. Y., Mr. Slingerland writes under date 28th December, 1896:—"Cephus pygmaeus has not attracted noticeable attention here in our locality, nor in our State, as far as I know, since Prof. Comstock discussed it in *Bulletin 11*. I do not know that it occurs in any other State, although it is suspected that it occurs in Ohio and West Virginia."

Remedies.—As nearly all the larvæ pass the winter in the base of the straw, it is quite evident that the most practical remedy will be found in treating the stubble, so as to destroy them or the pupæ before the flies emerge. This may be done either by ploughing deeply after harvest, or by burning over, which for another reason also will certainly be a most useful practice in Manitoba, for in that province, on account of the usual plan of growing wheat for several successive seasons on the same land, some bad weeds have increased enormously. The burning over of stubbles in autumn will certainly destroy vast numbers of these and their seeds, as well as at the same time the larvæ of the Wheat-stem Saw-fly. In Manitoba a great deal more straw is produced every year by farmers than they can possibly feed or use otherwise, and as a consequence, as soon as the farmer knows how much he will require, the residue, a large amount, is burnt every spring, simply to get it out of the way. Should the Wheat-stem Saw-fly ever increase sufficiently to affect the yield appreciably, the burning in autumn of the straw not needed would undoubtedly be a wise practice, as it is known that a few of the cocoons, at any rate, are formed in the straw.

THE ARMY-WORM.

(*Leucania unipuncta*, Haw.)

Attack.—Brown, or sometimes blackish, striped caterpillars (Fig. 3), eating the leaves and stripping the stems of grasses and many other low plants. When attacking cereals, frequently cutting off the heads. When full-grown, over an inch and a half in length, and when occurring in large numbers, migrating in bodies from one food patch to another. On reaching full growth, the caterpillars burrow into the ground and turn to light brown chrysalids, from which in about two or three weeks the moths emerge.

These (Fig. 4) are of a warm satiny-brown colour sprinkled with minute black specks, and with a small but distinct white spot in the middle of each upper wing. They are very active. When the wings are closed, the moth measures about an inch in length.



Fig. 3.—The Army-worm.

The life history of the Army-worm in Canada is as follows: There are two broods in the year. Eggs are laid in autumn and hatch in ten or twelve days. After feeding for a short time, the small caterpillars, like many of the cutworms, become torpid and pass the winter beneath tufts of grass and other low herbage. In the following spring they complete their growth,

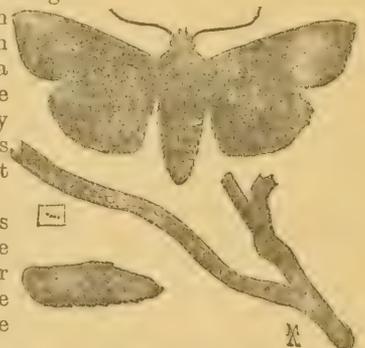


Fig. 4.—Chrysalis, moth and eggs of the Army-worm.

feeding on the young grass and grain crops, and produce the moths in June. These lay eggs for the second brood, which is usually much the more numerous and destructive. By the latter part of July, in this part of Canada, the young caterpillars are large enough, when abundant, to attract attention by their depredations. They are full-grown by about the first week in August, when, burrowing an inch or two into the

ground, they change to chrysalids and emerge as perfect moths towards the end of the month.

It has been noticed by many observers that Army-worms are frequently destructive in seasons following years of unusual drought and that they are seldom abundant in the same place for two successive years. In 1895 collectors of insects were struck by the number of Army-worm moths which flew into houses or were seen in several parts of Ontario. From this it was feared that there might be trouble from Army-worms during the present year. This turned out to be the case, for in July and August reports of serious injury were received from almost every part of the province, from Russell county in the extreme east to Essex in the extreme west, and from Welland to Algoma district. The loss was greatest, according to the *Ontario Crop Report* for August 13, 1896, in Essex, Kent, Haldimand, Welland, Lambton, Huron and Wellington. Nor was loss from the Army-worm confined to Canada, but considerable harm was done in some of the Northern United States. In the *Massachusetts Crop Report* for July, 1896, a good article on this subject appears by Mr. A. H. Kirkland, and at the last meeting of the Association of Economic Entomologists held at Buffalo in August, 1896, injuries by Army-worms were mentioned by other entomologists.

The Army-worm feeds, under ordinary conditions, upon various members of the grass family, having apparently a special preference for oats and timothy, but it also occasionally injures seriously rye, barley, wheat and many grasses, as well as, when such food is scarce, pease, beans, lettuce and other vegetables. Mr. Kirkland records that the loss in the Massachusetts cranberry swamps from Army-worms was very considerable this year. He also made some interesting observations on the periods of occurrence of the different broods and found that this year there were three broods in Massachusetts. As stated above, we have only two broods in Canada, but according to Dr. L. O. Howard, there may be as many as five or six broods in the south. In the *Ontario Crop Report* referred to above, is given a long list of extracts from correspondents in all parts of Ontario. The following from some of my correspondents give interesting information on the subject. Those extracts which bear upon the unusual abundance of the moths again this year are of exceptional interest, and in Mr. Metcalfe's experience at Port Hope in catching a large number of the mature moths, we may have the suggestion of a remedy which it would pay to practise on a larger scale when the moths are noticed to be unusually abundant. Of course, when this is the case, not only should the moths be captured as much as possible, but infested lands, whenever possible, should be burnt over in the autumn or early spring and a keen lookout should be kept the following year for the first appearance of the Army-worms, so that the well-known remedies may be applied.

"Marshville, Monk Co., Ont., July 3.—You will find inclosed some most voracious insects which are in my rye in innumerable numbers; they have nearly destroyed it and are now moving on to my corn. What are they? How long will they live? What can be done for them? They seem to have been bred in my fall grain. Are they confined to it? They have eaten the timothy (small) out of my rye, and have left the clover as yet, but I am sure they will eat it when hungry. Please give me as early an answer as possible."—J. E. REAMLY.

"Humberstone, Welland Co., Ont., July 9.—I write in relation to a pest which appeared suddenly in this district one week ago, about the 2nd inst., the Army-worm. This place is a village on the Welland Canal, one mile north of Port Colborne and Lake Erie. About a mile below this place, and extending two or three miles, is a tract of low land, the soil being a black loam. It was in this tract of land, on the farm of James Phillips, two miles north of this place, that the Army-worms were first noticed in countless numbers destroying principally oats and corn. In the oats, these worms first take the leaves, then the head, afterwards the stalk. Some farmers are applying Paris green to their corn crop. Is that safe or desirable? What is it advisable to do, in order to prevent their destroying the oat crop? Can anything be done to prevent their entering any field? The worms are of various sizes, from half an inch to one inch and a half in length, and are of a dark colour. All the information the farmers can give in relation to their origin is that on the night of the 1st of July there had been a slight

frost and when they examined their crops the next morning they found countless numbers of these worms in their oats and corn. They come in such numbers that they make a clean sweep of all before them, and unless some way can be found to check their ravages the damage they will do will be exceedingly great. The most of the destruction, so far, has been in the tract of low land referred to. We are anxious to hear from you as soon as possible."—C. E. THOMPSON.

"Diamond, Carleton Co., Ont., December 8.—I received your letter and report *re* the Army-worm, and thank you most sincerely for the promptness with which you answered my inquiries. I followed your directions, rolling and ploughing, and found that it destroyed them greatly. I used a three section roller, and where the ground was level it did good work. Where the surface was rough I ploughed three trenches and in the third I sank holes, as you described, and there did not half a dozen succeed in crossing. It was pasture land, and they were heading for the grain, but never reached it, so that I am unable to say anything with regard to fighting them in the grain. They did considerable damage in some parts of this township, Fitzroy, in the grain."—JOHN GREENE.

"Jermyn, Peterboro' Co., Ont., August 10.—I send some moths which came into our house last night in thousands."—SAMUEL ARMSTRONG.

"Toronto, August 18.—The Army-worm moth (*L. unipuncta*) has been very numerous this fall, literally swarming everywhere during the first three weeks in August."—JAS. H. McDUNNOUGH.

"Port Hope, Durham Co., Ont., August 11.—Several large honeysuckles are growing in my garden covered with berries which attract hundreds of Army-worm moths at night."—REV. C. J. S. BETHUNE.

"Port Hope, Durham Co., Ont., Nov. 11.—I have been doing some collecting this fall that may be of economic value, viz., the collecting of over six hundred Army-worm moths, mostly females, at sugar. Would not killing the moths thus attracted be a very effective way of fighting them ?

"While collecting larvæ last spring, the Army-worm did not appear as common as usual, and so I was surprised at the large numbers of the moths that were flying about the first week in June. They swarmed on the under side of pine branches and hovered about the bloom of the barberry in small clouds. No armies appeared in my immediate vicinity, the larvæ not being in such numbers as to get ahead of the supply of their natural food. They fed on Quack Grass (*Agropyrum*), Fox-tail (*Setaria*) and Wild Buckwheat. After the pease were pulled, the caterpillars sheltered under the bundles and I had a good opportunity to examine them. The bulk were plentifully dotted with the eggs of a *Tachina* fly. Those very useful beetles, *Calosoma calidum* and *Harpalus caliginosus*, were busily feasting on them. These beetles were innumerable, and, when the wind changed after a land breeze, would be washed up on the lake shore in bucketfuls.

"About August 10, I commenced sugaring ; the bait was smeared on the supports of an open shed facing the north, this, of course, being an unfavourable position, but, notwithstanding, the moths came readily to the sugar. The largest catch was made on the evening of August 17, when I took over a hundred before nine o'clock. Over six hundred were taken before August 25. The mixture used was made by dissolving sugar in hot water and adding enough rum to give an attractive odour."

"Port Hope, Ont., Dec. 1.—Many of our common beetles are washed up in great numbers on the shores of the lake here, at Toronto and at Grimsby, as well as members of the other orders. After a north wind of one or two days' duration the wind usually shifts till it blows from a southerly direction, and then is the time for a harvest of beetles on the lake shore here. While at Grimsby (on the other side of the lake) in the summer of 1894, on only two or three occasions did the wind blow on shore, the balance of the time it blew almost continuously from the south. I found many good things on the rare occasions of a north wind."—W. METCALFE.

Remedies.—Under this head I have nothing to add to what appeared in my annual report for 1894 as follows :—

"Although only occurring occasionally in excessive numbers, and then in but few localities, this moth is very widely distributed in Canada, and may generally be found

in most parts in low lands where the caterpillars have suitable conditions for growth and an abundance of food. It has also been observed that the Army-worm is most abundant in wet seasons: following a dry autumn, the damp weather giving them the same conditions over a large area as they would find in their own special habitat, viz., low, swampy, and grassy places.

“When the caterpillars appear only in moderate numbers, they have an abundant food supply, and do not then acquire the habit of ‘marching,’ which is merely moving from one place where all the food has been devoured, to a fresh pasture. When, however, their occurrence is excessive, they must of necessity move on to some other place or starve. They may be prevented from marching from one field to another by ploughing a deep furrow across their path. This should be cleared out so as to leave the edge nearest to the field to be protected, perpendicular or slightly overhanging. Along the trench so formed, pits must be dug about 12 feet apart. When the caterpillars come to the trench, they are unable to climb up the opposite side, and after a few trials, walk along until they fall into the pits, when they may be destroyed by covering them with earth and tramping it down, or, as Prof. Luggier, of Minnesota, suggests, ‘with a liberal dose of kerosene oil and water. Even a shallow ditch will answer this purpose if the earth is made friable enough to keep the worms from ascending. If a log is dragged continually through such a ditch, nearly all the worms collected there are either killed or maimed.’

“If pits are not dug, when the caterpillars occur in large numbers, the trench will soon be filled, and they will walk over on the bodies of their fellows. In case any of the worms succeed in crossing the ditch, a narrow strip of the plants on the opposite side of the trench should be dusted or sprinkled with a strong mixture of Paris green diluted either with 25 times its weight of flour, ashes or land plaster, or mixed with water as strong as one ounce to a pailful of water.

“When an attack has been very severe in any locality, much good may be done by burning the old grass and stubble in autumn or spring; in this way, many of the young larvæ are destroyed, as well as the old stems, which it seems are the favourite place for the spring brood of moths to lay their eggs upon.

“An encouraging feature in connection with an invasion by the Army-worm, is the fact that it is extremely rare for the insects to appear in large numbers two years running in the same place. This is due to the fact that they are almost invariably attended by parasitic foes, which destroy them so effectually that the occurrence of two consecutive ‘Army-worm years’ in the same locality is almost unknown.”

FODDER CROPS.

The injuries to fodder crops during the summer of 1896 were chiefly by the Army-worm and Grasshoppers. Occasional mention was made of the work of the Clover Seed Midge, which, however, is found to be far wider-spread over the Dominion than is indicated by reports, because this insect is mentioned only by correspondents in the seed-growing districts. Undoubtedly much clover was killed out by the droughts of 1895 and 1896 and by the severe cold of December, 1895, and January, 1896, which came when there was no snow on the ground. The work of the Clover-root Borer (*Hylesinus trifolii*, Miller) was reported by Mr. R. A. Harvey, of Laskay, York Co., Ont.

WHITE GRUBS, the larvæ of the different species of June beetles (*Lachnosterna*), have been reported as injuring meadow lands and lawns. The good work of robins and high-holders (golden-winged woodpeckers) in destroying the grubs on an infested lawn is mentioned by Mr. J. F. McDonald, barrister, of Dunnville, Ont. Another instance involving considerable injury was on the land of Mr. Caius M. C. Hubble, of Sand Hill, Ont., who writes:—“I dug up these grubs all the season among potatoes, carrots, corn and turnips; but they are most numerous in the carrots. The last I found was on November

6. They were in the same condition as those I dug up in the summer. There are a number of tall poplars bordering my garden which, no doubt, were the cause of my having such a number of these grubs. For a piece of ground adjoining mine, where there are only three or four apple trees near it, had very few. About one-tenth of my ground where I had white carrots was badly infested, but I found them scattered among other crops. It is a very unusual occurrence for them to be so abundant here."

COTTONY GRASS-SCALE (*Eriopeltis festucae*, Fonsc.).—There has been little reference during the past summer to this insect, treated of in my last report. Mr. D. G. Crawford, of Sydney Mines, C. B., N.S., says:—"I noted that the egg-sacs began to be formed about 21st July, and they were not nearly so numerous as last year, but appeared in other localities to a limited extent. I believe they will disappear in a year or two."

GRASSHOPPERS.—The three species of grasshoppers which have this year committed depredations on fodder and grain crops throughout the Dominion, are the same as were injurious last year, namely, the Common Red-legged Locust (*Melanoplus femur-rubrum*, DeG.), the Lesser Migratory Locust (*M. atlantis*, Riley) and the Two-striped Locust (*M. bivittatus*, Say). These were reported as very abundant in some parts of Ontario and Quebec early in the season. In the *Ontario Crop Report* for August 13th, there is frequent mention of their attacks upon spring and fall wheat, barley, corn, pastures, and even on hops.



Fig. 5.—A Locust.

Locusts are generally spoken of by correspondents as Grasshoppers, and I cannot see the least objection to using the words "Grasshopper" and "Locust" indiscriminately, for although entomologists claim that the word "Locust" is the more accurate name for those species with short antennae (the Acridiidae), the name "Grasshopper" is so universally used and understood for these insects by the public in general that it is certainly wise to recognize this word, at any rate, in these reports prepared especially for farmers or those who, with very few exceptions, are not entomologists. Particularly is this the case as it seems difficult to understand why the word "Grasshopper" should be restricted to the Locustidae, or long-horned grasshoppers, while the word "Locust," which we might naturally suppose would most aptly apply to the Locustidae, should be considered the accurate popular name for the Acridiidae, or short-horned species. Possibly, it may have been because the plague of locusts mentioned in the Bible was known to have consisted of a short-horned species, and the application of the word for that reason has become so well known as applied to those forms with short antennae that, to some, it has seemed unwise to change it.

The correspondence during the past season, concerning grasshoppers, their injuries and their enemies, is too extensive for us to give more than a few extracts.

"St. Lin, L'Assomption Co., Que., June 7.—Please tell me the best and most economical plan for destroying grasshoppers. They threaten to destroy the whole crop."—J. P. ARCHAMBAULT, *Secretary of Agricultural Circle*.

"Mastai, Quebec Co., Que., August 19.—Grasshoppers eating up cabbages."—H. F. HUNT.

"Port Elgin, Bruce Co., Ont., June 16.—During the past few weeks there has been a plague of grasshoppers in this vicinity. They follow the roadsides, eating the grass so closely that it has the appearance of being singed by fire. At intervals they enter the fields, starting at one point and sweep everything clean before them, such as oats, hay and pasture,—pease, so far, being the only exception. In the evening they gather in countless numbers on the fences of the field they intend to devour, and actually eat into the rail-posts and boards, staying there until the warmth of the day comes, when they again begin their work of destruction. Is there a remedy to stop this fearful plague and save the crops? Could they be scattered when they commence their inroads on a field, or destroyed on the fences at night?"

"June 26.—Fields have been destroyed by grasshoppers. Pastures are singed as if by fire, and the cutting of oats and fall wheat in the green state has begun in some places. A small red insect is to be found under their wings, which is destroying some

of them, but there are many young hoppers coming in their place. If the present state of things continues much longer, there will be very little of anything left. I fear it is now almost too late to try the hopper-dozer, as the grasshoppers can fly well. Of all the pests this is the worst we have ever seen."—A. BEATON.

"Ashgrove, Halton Co., Ont., Sept. 14.—Grasshoppers this year were very numerous in some sections, but were not so general over the country as I have seen them. In some parts that were stony they appeared at one time as if they would take everything. They were particularly destructive on grass, spring wheat, oats and turnips."—GEORGE HARDY.

"Osnabruck Centre, Stormont Co., Ont., Nov. 23.—The worst pests we had to contend with in this section were grasshoppers and Colorado Potato-beetles. With regard to the grasshoppers, they were very bad for a while, but disappeared from this part, as far as I can remember, about August 1st. They were particularly destructive to grain fields adjoining pastures or grass lands."—A. S. HODGINS.

Remedy.—When locusts appear in enormous numbers, they frequently become a serious scourge to the agriculturist. The most efficient remedial measure which can be adopted is the use of the hopper-dozer, which has been described in previous reports. In the case of restricted swarms, much good may be done by the use of poisonous mixtures. As an instance, I cite the following experience:—

"Princeton, Brant Co., Ont., June 23.—I am trying to get rid of the locusts by mixing bran, Paris green and molasses together and putting it in heaps in different parts of a field. Can you recommend any better way of exterminating them? They are doing considerable damage to my crops already.

"July 7.—As to the result of the mixture I used, viz., bran, Paris green and molasses, I applied it in a similar way to that in which the mixture you mentioned in your letter was applied. I put it around six acres of beans which the locusts were destroying as fast as they could. In the next field I had another six acres of beans which were sown a week later. After putting the mixture on the first field the locusts did no further damage to that piece, but started at the beans in the next field. Noticing this, I put the mixture round the second field and they did no further damage to either piece afterwards. I noticed several dead around the heaps and suppose several hopped away to the fences and died there. Whether the poison stopped them eating the beans or whether the beans got too tough for them, I cannot say. Only, I am quite sure they did not bother either lot after it was applied. Alongside of the first lot of beans I had nearly five acres of potatoes just coming out in flower. There we put Paris green on for the potato bug, a few days after putting the poison on the second lot of beans. We then noticed that the locusts were cutting the potato stems off. Some of the stems cut I noticed were a foot in length. When walking through the patch lately I saw hundreds of locusts lying dead. The Paris green was applied to the potatoes mixed with land plaster. At the present time there are millions of grasshoppers or locusts on my farm, and they are doing an enormous amount of damage to my oats. I am afraid it is too late to stop them, although I intend to scatter the poisonous mixture about the fields. My opinion, so far, is that the mixture should be put on, especially on grass land, early in the season before the locusts get their wings and before there is much for them to eat, and continue to apply it at certain intervals."—J. E. RICHARDSON.

From the answers received to the questions sent out by Prof. Panton, grasshoppers were rated as second in the amount of injury caused by insects in Ontario during the past year. There is no doubt but that early in the season there was a considerable amount of damage done by locusts; nevertheless, one of the remarkable occurrences of the year was certainly the widespread and sudden diminution in the numbers of these insects, beginning about the 1st of August.

A curious fact affecting the sudden disappearance of locusts in August last was brought to my notice by Mrs. J. Cunningham Stewart, of Ottawa, who, when travelling on Lake Huron, saw large numbers of grasshoppers floating in the lake. Mrs. Stewart also kindly referred me to Mr. Wm. Lockerbie, engineer of the Canadian Pacific Railway Co.'s steamship "Athabasca," who had observed them on a previous trip. Mr. Lockerbie writes: "As to how numerous these insects were, I can only say they were

collected in patches that would probably cover half an acre or perhaps more, and there seemed to be a very great number of these patches, so much so that when the wind blew off the bay (Georgian Bay), they would float up the Owen Sound River and collect in any shelter that was open." Mr. Lockerbie suggests that they may have been blown off the shore by a high wind.

Judging from a great many letters of correspondents, as well as my own observations, I feel sure that the sudden disappearance of locusts over large districts in Canada was due almost entirely to four kinds of well known parasites—a fungus, intestinal worms, the maggots of two or more species of flies and the locust mite. All of these active friends are well known to entomologists and have been frequently observed before, but, as there has been so much interest evinced in the subject, I give herewith a short account of each, which I feel sure will be acceptable to many.

GRASSHOPPER PARASITES.

Fungous Disease of Grasshoppers.—A most potent ally in the destruction of locusts when they exceed their normal numbers is a parasitic fungus known by the name of *Empusa grylli* (Fresenius) Nowakowski. This produces a very infectious disease, the effects of which are frequently observed, but the cause of which is seldom recognized. Diseased locusts were received from Princeton and several other places in Ontario. The disease seems, too, to have been very virulent near Montreal. Mr. T. A. Crane writes from that place, under date of 1st August: "A few days ago the grasshoppers were vigorously attacking my oats. Last evening, when I examined them again, I noticed that they were clinging fast to the tops of the stalks, but they were all dead. Some were minus their heads and some minus their entrails." This describes well the appearance of locusts which have succumbed to this disease.

During the month of August, and later, it was a common thing to see around Ottawa and in almost all other places visited, numbers of different species of locusts, but particularly the Two-striped Locust, hanging motionless, generally near the tips of stems of grasses and other plants. (Fig. 6.) Upon examining these, they were found to be dead and the bodies frequently dried up, brittle and containing a powdery material. This powder is in reality the spores of a parasitic fungus very nearly allied to the well-known and frequently observed *Empusa musca*, which every year destroys so many house flies, leaving them dead on windows, curtains, plants, &c., with a cloud-like deposit of the spores of the fungus around them. Under certain conditions, probably much affected by weather—warm, foggy weather being considered favourable—the disease of grasshoppers above mentioned frequently becomes a most fatal epidemic. Each of the mummified bodies is a centre of infection containing myriads of spores, each one of which, blown away by wind or washed down by rain, if it fall upon a locust in a suitable condition, is capable of causing death. This useful parasite, which does such efficient service, had attention first drawn to it by Prof. Herbert Osborn in Iowa, who published his observations, with Prof. Bessey's original description, in *Bulletin No. 2, Iowa Agr. Coll., 1884*, under the name of *Entomophthora calopteni*. The accompanying original illustration, kindly loaned by Prof. Otto Lugger, of the University of Minnesota, shows admirably the attitude of a Two-striped Locust killed by the fungus.



Fig. 6.—Two-striped Locust killed by fungus. (O. Lugger.)

The Tachina Flies.—Mr. J. E. Richardson, of Princeton, Ont., who, I find from several letters received on this subject, is a close and accurate observer, writes:—

"July 7.—I have of late noticed, more especially the other day after a rain, flies attacking the locusts. About half a dozen would fly after one, and as soon as it settled down they would alight upon it."

Prof. Riley graphically describes what this meant, in the *First Report of the United States Entomological Commission on the Rocky Mountain Locust*, page 319: "The most common of the parasites which prey on the locusts internally are the larvae of certain flies belonging to the genus *Tachina*, gray-coloured, two-winged flies having very much the general appearance of house-flies.

"These *Tachina*-flies firmly fasten their eggs—which are oval, white, and opaque, and quite tough—to those parts of the body not easily reached by the jaws and legs of their victims, and thus prevent the eggs from being detached. The slow-flying locusts are attacked while flying, and it is quite amusing to watch the frantic efforts which one of them, haunted by a *Tachina*-fly, will make to evade its enemy. The fly buzzes around, waiting her opportunity, and, when the locust jumps or flies, darts at it and attempts to attach her egg under the wing or on the neck. The attempt frequently fails, but she perseveres until she usually accomplishes her object. With those locusts which fly readily, she has even greater difficulty; but though the locust tacks suddenly in all directions in its efforts to avoid her, she circles close around it and generally succeeds in accomplishing her purpose, either while the locust is yet on the wing, or, more often, just as it alights from a flight or a hop. The young maggots hatching from the eggs eat into the body of the locust, and after rioting on the fatty parts of the body—leaving the more vital parts untouched—they issue and burrow in the ground, where they contract to brown, egg-like puparia, from which the fly issues either the same season or not till the following spring. A locust infested with this parasite is more languid than it otherwise would be; yet it seldom dies till the maggots have left. Often, in pulling off the wings of such as were hopping about, the bodies have presented the appearance of a mere shell filled with maggots; and so efficient is this parasite that the ground in parts of the Western States is often covered with the Rocky Mountain Locusts dead and dying from this cause."

There are several species of these *Tachina*-flies, and we have bred two kinds during the past summer, one from specimens sent by Mr. Richardson, and another much larger species,

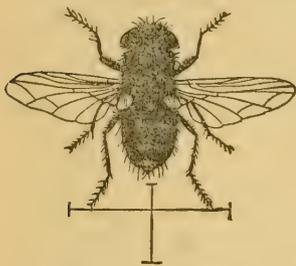


Fig. 7.—*Tachina*-fly.

Exorista flavicauda, Riley (Fig. 7.), from several localities. This last named species is of great interest from the fact that it is the enemy of the Army-worm, which, above all others, brings down the numbers of that plague when it increases unduly. There are also, in addition, parasitic species of flesh-flies (*Sarcophaga*) which resemble the above very closely, but may be distinguished by their antennæ being hairy instead of smooth.

Hair-worms.—Hair-worms, or Hair-snakes, as they are sometimes called, are objects of great curiosity, not only to those who know nothing of their habits, but also to all who have studied their remarkable life history. Their great abundance in some places during the past summer has been remarked by many correspondents, and the good work they have done as parasitic enemies of many kinds of grasshoppers, crickets and other injurious insects, renders it advisable to give a short outline of what is known about them. There are many misapprehensions as to the true nature of these creatures, notably the erroneous ideas that they are related to the true snakes or that they are horse-hairs which by some mysterious process have become capable of living and moving. Snakes, however, belong to the much more highly organized Vertebrates, or animals with backbones, while the Hair-worms are members of the Entozoa, or intestinal worms, a section of the Articulates which have their bodies merely divided into joints.

The supposition that a horse-hair or any other dead organic matter can ever become a living creature, is too absurd to need more than mention.



Fig. 8.—Egg of *Gordius* containing a fully developed embryo.—highly magnified. (After Leidy.)

It must be acknowledged that there are some gaps in our knowledge of the life history of Hair-worms concerning which it seems impossible to make any suggestion. It is known positively that the eggs (Fig. 8.) are laid in water and that the young worms begin their lives as free-moving animals, which have been actually seen to

penetrate through the delicate skin at the joints of the legs of aquatic insects and live for some time inclosed within a cell inside the bodies of these. The next stage is as parasites in fish, the food of which consists largely of aquatic insects. When the latter containing young Hair-worms are eaten, the cells are broken or dissolved by the process of digestion and the young worms at once work their way, by means of special hooks around the head (Fig. 9.), into the stomach of the fish, where they again become encysted in the mucous layer. After a time they bore through their cells and are passed out from the fish's stomach into the water. Subsequent to this, nothing is known, until they are found as parasites inside insects of various orders, and it is difficult to conceive how it is possible for these worms to enter the bodies of such active insects as locusts and crickets, which also, besides, live mostly in dry places. It is true, though, as has been pointed out, that ground beetles, spiders and locusts which live in low, moist places are most infested. Certain it is, how-

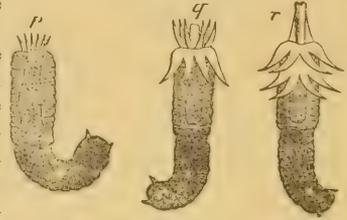


Fig. 9.—Young Hair-worms after escaping from the egg, highly magnified, showing the circles of hooklets (*p*) drawn in, and (*q*) partially and (*r*) wholly protruded.

ever, that Hair-worms are parasites inside the bodies of many insects, and that specimens have been seen to lay eggs from which young emerged which passed through the stages described above. These worms are of two kinds, which, when only examined superficially, differ chiefly in colour: dark ones, from 6 inches to a foot in length and with a diameter not reaching at the thickest part one twenty-fifth of an inch, belonging to the genus *Gordius*, with the above life history; and others, white in colour, much longer and slenderer, belonging to the genus *Mermis*, which, although similar in their parasitic habits to the *Gordius* worms, have a quite different mode of development, as well as a different internal structure. Both kinds of these parasitic worms are frequently found associated within the body of the same host. The eggs of *Mermis* are laid in the ground and the young on hatching resemble their parents in form. On emerging from the egg they make their way to the surface of the ground and enter at once on their parasitic life in some insect. They acquire full growth inside their host and then bore out through the skin and bury themselves in the ground. It is not until this period in their lives that the genital organs develop. They pass the winter in the ground at varying depths, and eggs are laid in the spring. I received from Mr. T. Pearson, of Knowlton, Que., gardener to the Hon. Sydney Fisher, a large specimen 17 inches in length, which he had found in December under a stone six inches beneath the surface of the ground.

As stated above, these parasitic worms infest insects of various orders. Mr. W. Hague Harrington, of Ottawa, writes to me:—"I have frequently obtained *Gordius* from locusts, and on one occasion I obtained two small specimens of *Mermis* from a lady-bird (*Hippodamia 13-punctata*).

In the *First Report* of the United States Entomological Commission is a full account by Prof. Riley of almost all that has been found out concerning these strange creatures. I quote the following:—

"These Hair-worms are not only very frequently found in different locusts, but Prof. Leidy even has one from a cockroach. They likewise occur in many other insects and small animals, as beetles, moths and butterflies, bees, two-winged flies, spiders and snails. As a rule, the worms forsake Lepidoptera while these are in the larva state or more rarely in the pupa state, whereas they generally issue from Coleoptera and Orthoptera only after these have acquired the perfect state."

While they are inside the bodies of their hosts, Hair-worms are folded and coiled up so as to occupy a surprisingly small space. When seen, as is frequently the case, on the ground, they move in a snake-like manner, sometimes with a part of the body raised up and swaying from side to side. When in the water, they are either knotted together and tangled like a piece of black cotton or swimming with an undulated motion close to the surface of the water.

When referred to in correspondence, it is seldom that species of *Gordius* and *Mermis* are separated, though they are frequently mentioned. In no year do I remember so many inquiries to have been made as during the past summer, which, of course, was due

to their unusual numbers. Mr. J. H. Vivian, of Toronto, reports a remarkable occurrence of Hair-worms in Toronto, as follows:—"October 14.—On the occasion when I first saw them there were millions of them both white and dark-coloured. I have a large garden, and it was almost impossible to find a space of two inches between the spots occupied by these worms. A very heavy rain fell on the night preceding. The special peculiarity about them to me was their snake-like movements; standing almost on their tails, they swayed the upper two inches of the body in the air."

During the past autumn they were very abundant, as could frequently be seen on sidewalks where crickets and grasshoppers had been crushed. Sometimes as many as five specimens were found inside a single host. There is no doubt that these parasites materially affect the increase of the insects which they infest, but the statement that grasshoppers so infested never lay eggs is not always at any rate correct. In October last I found a female of the Two-striped Locust which had been trodden upon while laying her eggs between two boards of the sidewalk; upon pulling her abdomen from between the boards, I found she had laid five or six eggs and the abdomen contained several more ready to be laid, and also one specimen of *Gordius* and two of *Mermis*.

The Locust Mite.—The parasite of grasshoppers which has probably been most frequently noticed and which has been very widespread during the past summer, is the small red mite, *Trombidium locustarum*, Riley, which, in its larval form, is often a conspicuous object on the bodies of grasshoppers. The larvæ are small, bright red, bag-like, six-legged mites (Fig. 10*a*), most frequently found attached,

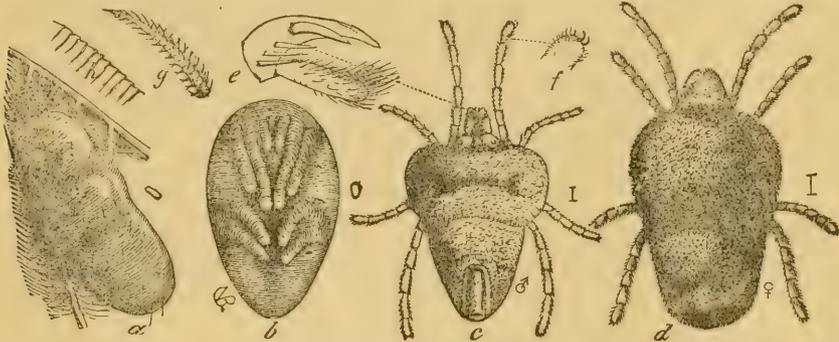


Fig. 10.—Locust Mite: *a*, mature larva when about to leave the wing of a locust; *b*, pupa; *c*, male adult when just from the pupa; *d*, female—the natural size indicated to the right; *e*, palpal claw and thumb; *f*, pedal claws; *g*, one of the barbed hairs; *h*, the striations on the larval skin. (After Riley.)

in varying numbers, on or near the base of the wings of the perfect grasshoppers, but also sometimes abundant on the pupæ. When full-grown, these are about one-twentieth of an inch in length and about half as wide. The life history of these useful allies,

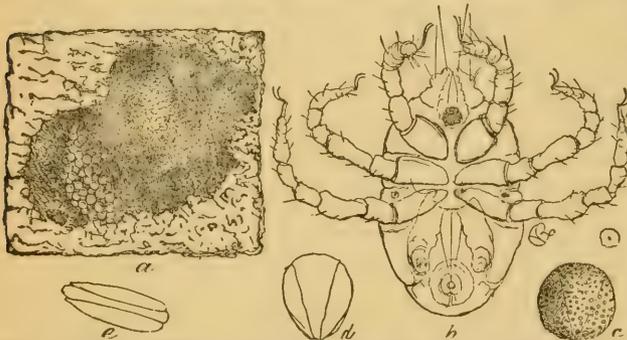


Fig. 11.—Locust Mite: *a*, female with her batch of eggs (after Emerson); *b*, newly hatched larva—natural size indicated by the dot within the circle; *c*, egg; *d*, *e*, vacated egg-shells. (After Riley.)

which, although so small, destroy many injurious locusts, has been worked out fully by Dr. Riley. The eggs are laid in spring in clusters of between 300 and 400, an inch or two beneath the surface of the ground. From these eggs hatch little orange red mites (Fig. 11*b*), which, being very small, crawl out easily between the particles of the soil and fasten themselves to their future hosts, generally selecting a spot near the base of the wings from which they

cannot be dislodged. Sinking their minute jaws into the tissues of the body of their victim, they remain firmly attached, sucking its blood and living entirely at its expense, until the full larval growth is reached. Dr. Riley thinks that the full period of development of the larvæ, after attachment, seldom exceeds a fortnight. When distended with food, these mites are so swollen that their short legs are almost invisible, and many people who notice them mistake them for the eggs of some parasite. When examined closely, however, their legs can be seen and are found to be six in number, which is now known to be one of the characters of the larvæ of the genus of mites called *Trombidium*. As soon as the larvæ are full-fed, they let go their hold of their hosts and fall to the ground, where, under some temporary shelter, they gradually change to pupæ inside the larval skin. Finally, both the old larval skin and the new one inside it, which incased the pupa, burst, and the perfect form, an eight-legged mite, emerges. These are common objects in the country, drawing the attention even of people who do not study insects, by the intensity of their velvety scarlet colour. They pass the winter in the perfect state, and are frequently conspicuous on the ground in early spring before vegetation has made much growth. Not only is this insect useful in the larval form, when it preys upon locusts, but also in the perfect state it does good service by seeking out and devouring their eggs.

I give below a few extracts from letters of correspondents who have noticed these mites:—

“Craighurst, Simcoe Co., Ont., Dec. 19.—We had this year the same experience with grasshoppers as you mention. They hatched out in immense numbers, and at one time we were afraid they would do great damage, but they seemed to disappear early in August or the latter part of July. The parasite that lays its eggs on their backs under the wings was abundant. Most specimens examined showed their presence.”—G. C. CASTON.

“Princeton, Brant Co., Ont., June 23.—On examining some locusts or grasshoppers, I find on the underside of the wings some minute insects—I suppose, parasites. They are now on nearly all the locusts I have looked at. The majority are about $\frac{1}{10}$ of an inch in length, but many much smaller, of a bright red colour.”—J. E. RICHARDSON.

“Doe Lake, Muskoka, Ont., August 18.—Grasshoppers damaged both grass and grain. They have done much harm on light sandy soil; there are many of the red eggs under the wings. Are they parasites?”—F. C. JUDD.

“Omamee, Victoria Co., Ont., Aug. 3.—I send you a common grasshopper, with red insects on it. They appear to be very numerous this year, but I fear came too late to prevent the grasshoppers doing harm.”—E. S. MORGAN.

“Louise, Grey Co., Ont., September 26.—Grasshoppers came along about the 1st of June in massive flocks and destroyed nearly all the hay. They were by far worst on spring wheat and barley; in fact, there was hardly any of either grain in this part. Oats turned out about 10 to 12 bushels per acre. Pease were a fair crop. The hoppers all disappeared about the 1st of August.”—GEORGE LAST.

“London, Middlesex Co., Ont., December 7.—I never saw grasshoppers worse than in a part of McGillivray about the middle of June, but within two or three miles on each side they were scarce. Where they were very numerous, I found none of the locust mites; where scarce, almost every one was infested.”—J. DEARNESS.

THE GRAY BLISTER BEETLE.

No account of the common parasitic enemies of grasshoppers would be complete without some mention of the Blister Beetles, which in their larval stage prey upon the eggs. During the past summer, as is usually the case in years following excessive locust presence, Blister Beetles have done considerable damage to potato and bean crops and several kinds of garden plants.

“Grenville, Argenteuil Co., Que., June 11.—I send by mail specimens of a new (to me) potato pest. On a potato patch 20 feet by 40 feet there were many thousands of them. I was through the patch two days ago, and there was no appearance of anything unusual. Now the plants on which they are feeding are almost leafless.”—ROBERT HAMILTON.

"Staynerville, Argenteuil Co., Que., June 18. I have a field of horse beans which came up and are growing nicely, but during the last two or three days a kind of bluish fly is stripping off every leaf."—WM. NICHOLS.

"Chêneville, Labelle Co., Que., June 16.—I send you some insects which are in very large numbers on my potatoes, eating the leaves rapidly. I have sprayed the plants with a mixture of 1 pound of Paris green in 200 gallons and the insects are already disappearing."—H. LEFEBVRE.

Specimens were also sent from Mr. L. Lepage, from Minerve in the same county.

"Port Arthur, Ont., June 23.—I mail you herewith insects captured on a potato patch near Port Arthur, wherein they were stripping the vines of their leaves. These are apparently a far worse destroyer than the Colorado Potato-beetle. This is the first time an enemy of the leaf of the potato has appeared in this district."—JOSEPH G. KING.

"Montreal, Que., June 25.—I send you beetles which did a little harm on my farm last year, and this year they have done a good deal. Their preference seems to be for tender, delicate foliage, but when this is not handy they take what they can get. They began with *Caragana gracilis*, *Aralia spinosa* and *Clematis flammula*, and ended with potatoes and tomatoes. They come in hundreds and make a clean sweep of any branch they attack."—THOS. A. CRANE.

"Montreal, Que., June 24.—I send specimens of a beetle which attacks the Windsor Broad Beans. We have grown these beans for three years at Lachine. The first year they produced well, the next year this beetle pest appeared in swarms and ravaged them severely. Tired of picking them off, we tried a weak mixture of Paris green, with flour or water, I forget which, but it killed the crop and we did not have a dressing. This year we have more beans growing than usual, but they have been attacked incessantly by the pest which is a voracious eater. A neighbour not knowing our experience tried Paris green and killed his plants. We have been picking and knocking the pests off into a mixture of coal oil and water in a broad, shallow vessel, which seems to kill them. Last year a small cloud of them settled down on the potato vines and ate to some extent, but did no damage. This year they have left the potatoes alone for the beans. They do not breed in our place, but settle down in small swarms, full-sized, and it seems to us that nothing but a strong mixture, dangerous to the plant, would kill them, but perhaps you can tell us a remedy. It is necessary to pick them off at least once a day (earlier in the season, perhaps oftener), but they are not diminishing much. The labour is so tiresome that we shall be little disposed to grow our favourite bean another year, and others no doubt feel the same."—A. H. CHAMBERS.

"Previok Hill, Port Arthur, Algoma, Ont., Sept. 5.—In July my horse beans were infested with black beetles which I have sometimes seen on potatoes. I do not think they have podded quite so well. I did not dare to use poison for the beetles, as it would have spoiled the fodder. I killed as many as possible by hand, but they stripped many stalks of the leaves."—WILLIAM WILSON.

"Petitcodiac, Westmoreland Co., N.B., Dec. 9.—The black blister beetles were on my horse beans in about the same numbers as last year."—D. SINCLAIR SMITH.

All the specimens sent in this year were the gray blister beetle (*Macrobasis unicolor*, Kirby). Here on the Experimental Farm the same species was abundant and troublesome on *Caragana* hedges, some other leguminous shrubs in the botanic garden and *Aralia chinensis*, L. Although the attack is severe while it lasts, the period during which blister beetles injure vegetation is not of long duration. Moreover, these insects do not appear in injurious numbers every year. They are seldom noticed except in seasons following those when locusts of different kinds have been unusually abundant, a fact which is easily understood when we remember that the larvæ feed upon the eggs of locusts. For the same reason we may confidently hope that next year we shall have little complaint of the ravages of blister beetles on beans and other crops, owing to the marked diminution in the numbers of grasshoppers after the 1st of August last. In localities liable to be visited by blister beetles a sharp watch should be kept for their appearance during July, and as soon as they are seen efforts should be made to fight them, either by sweeping the crops with a net mounted on a handle or by beating them into a pan containing some

water, with a little coal oil on the top. When the area attacked is too large for this, spraying promptly with Paris green, one pound to 100 gallons of water, or dusting with one pound of Paris green to 50 of flour, would destroy them.

Referring to Mr. A. H. Chambers's experience above mentioned, I think there must have been some other cause than the Paris green which destroyed his crop, for a very much stronger mixture than he mentions has been used by some of my correspondents and by myself without injury on the same crop.

LOCUSTS ON SABLE ISLAND.

In my reports for 1894 and 1895 I have referred to serious injury by locusts on Sable Island, off the coast of Nova Scotia. This was so severe last year that it was necessary to purchase 50 tons of hay to keep the horses and stock through the winter. During the past summer the loss has been far less. The Superintendent of the island writes: "September 7.—In a few days we shall have finished harvesting the hay crop, which this season is large, owing to the unusual continuous fogs and heavy rains from June till the middle of August. The locusts have done but little damage, although plentiful. Vegetation nearly everywhere kept ahead of them." In an earlier letter dated the 12th of June, the Superintendent expressed the opinion that hopper-dozers could not be used satisfactorily on Sable Island, owing to the uneven surface and loose sand in places. He invested in turkeys and raised a large number of chickens, which doubtless were useful in destroying many locusts. The young locusts first appeared at No. 4 Station about the 24th of May, but none appeared at Main Station until the 12th of June.

ROOT CROPS AND VEGETABLES.

Few complaints of injuries by insects to root crops during the past season have been received. There were, of course, the usual applications for remedies against the TURNIP FLEA-BEETLE (*Phyllotreta vittata*, Fab.) from all parts of the Dominion, but the loss was not extensive. The best remedy—dusting the young plants as soon as they appear with land plaster and Paris green (50 to 1)—is now well known. During June this insect, both in the mature and larval forms, was troublesome in gardens at Ottawa upon cress, particularly the curled varieties. When the plants were young, a mixture of Paris green and flour was used successfully; but later, when the crop was ready for the table, dusting with powdered tobacco waste was substituted, and the cress was kept closely picked. The larvæ, which are slender, dark brown grubs, dotted with black, are from one-eighth to three-sixteenths of an inch long, and for the most part mine inside the tissues of the leaves, but frequently, when nearly full grown, burrow out through the thin epidermis and feed for a time on the surface. I have been unable to find these feeding, either on or in the roots. When full-fed they enter the ground, sometimes to a depth of three inches, and emerge nearly three weeks later as the well known perfect flea beetle, which are about one-eighth of an inch long, with two wide waved yellow stripes down the back. As a rule, the larvæ are not often noticed, because by the middle of June the demand for garden cress as a salad or table relish has ceased, owing to the abundance of radishes and similar vegetables. Injury to the leaves at this time is, therefore, of small importance, as the larvæ are never abundant enough to affect the formation of seeds on such plants as are left for that purpose. When green leaves are required, the best method is to encourage a quick growth by watering frequently and cutting as soon as the leaves are fit for use. A weak solution of nitrate of soda (one ounce in three gallons of water) applied carefully to the roots twice a week was found to be a quick-acting stimulant. In this way succulent leaves are produced abundantly before the larvæ have time to develop. When, however, a bed is badly infested, the only plan is to cut the whole bed and water freely; the new growth will also start more quickly if the beds are shaded.

In the North-west Territories and Western Manitoba the RED TURNIP BETTLE (*Entomoscelis adonidis*, Fab.) did some harm to cabbages and turnips, but the beetles were easily disposed of where Paris green was applied.

The STRIPED CUCUMBER BEETLE (*Diabrotica vittata*, Fab.) was the cause of much loss on melons, squashes and cucumbers in several parts of Ontario. The injury is done by the perfect beetles to the flowers and leaves, and by the grubs to the roots in which they burrow. The remedies which have given the greatest satisfaction are dusting the plant with Paris green and dry ashes (1 to 50) or covering them, until the runners are produced and the plants become too large, with a piece of gauze or cheese cloth, supported by two or three sticks stuck into the ground, and with the edges held down by a handful of earth on each side. This means of protection was first suggested by Dr. Clarence Weed in a bulletin of the Ohio Experiment Station for September, 1889, and has been used with much success by some of my correspondents, particularly in garden culture. For preventing egg-laying and also for killing the young larvæ, putting a small quantity of tobacco dust or sand, impregnated with coal oil, close round the base of the stems, is useful if the gauze covers above mentioned are not used.

THE CLOVER CUT-WORM (*Mamestra trifolii*, Esp.).—During the month of August I received from a few localities in Peterborough county, Ont., specimens of caterpillars of the Clover Cut-worm, with the information that they were damaging pease and turnips severely, and some other crops. They were so numerous that they had assumed the Army-worm habit of marching from field to field in search of food. The Clover Cut-worm is a thick, green, smooth caterpillar with black or gray markings extremely variable both in the depth of the ground colour and the shape and extent of the markings, some specimens appearing to be all green, while others have the dark markings so extensive as to cover the whole of the upper surface. Length, about one and a half inches. A more exact description of the full-grown caterpillar is as follows :—

“A dark-green noctuid caterpillar with a very narrow dorsal stripe, a broken sub-dorsal stripe of yellow, edged above by velvety black blotches (the black line not quite as continuous as the yellow); below the breathing pores, a broad pink band, narrowly edged with white above and below. Above the upper white line is a black one which spreads out into a black blotch around each spiracle. The whole body mottled with white on a smooth green surface, giving a somewhat glaucous shade to the green. The narrow dorsal stripe consists of an aggregation of these mottlings, and the dorsal space has them shadowed with black, giving that area a darker appearance than the rest of the body. Legs and pro-legs green, like the body. Head green, bearing on the upper part of the face and on the cheeks clouds of white mottlings. Some of these caterpillars were simply pale green with fuscous markings, others were green, with clear brownish or black markings, some had the mottling all over the body so shaded with brown as to suggest the appearance of the Army-worm. Specimens intermediately tinted between all these colours occurred.”

“Birdsall, Peterborough Co., Ont., August 10.—By this day's mail I send you a box with half a dozen worms that have nearly destroyed a field of pease for me. Kindly tell me the name of them, and if it would be safe to sow the field with fall wheat next month, or would they be apt to come and destroy it next year or this fall? The ground is nearly covered with them. They first appeared about two weeks ago. They have destroyed several patches of turnips in the neighbourhood. I also send you a sample of the pea vine as partially eaten by them.

“August 17.—Thanks for your prompt answer to my letter in regard to the caterpillar. It may be as you state, that the damage to the pease will not be as great as I at first expected, as they hardened up so quickly that the worms had to leave. They all started off in a south-eastern direction and will by this time have all fallen into the river or lake. They have not attacked my turnips, as they are to the west of the field, but many of my neighbours to the north and west are having their turnips destroyed by them.”—F. BIRDSALL.

“Birdsall, Peterborough Co., Ont., November 25.—The turnips injured grew right besides a field of pease, and for a time we thought some new insect pest had made its appearance, but when we came to cut the pease the mystery was explained, as they were

evidently the same kind of caterpillars as are always found on pease ; only, this year they were very much more numerous than usual and crossed over from the pease to the turnips. The green leaves near the ends of the pea vines and the ends of the vines themselves were eaten, but the pease were too nearly ripe when they were attacked to be injured much. I never before saw anything like it. The ground was literally alive with the crawling insects. We put Paris green on the turnips, and this doubtless helped, but the insects were so numerous that one set after another took the place of those killed. The turnips near the pease were injured most and as you receded from the edge of the pease the injury lessened. The turnips put forth a new set of leaves, but the growth of the roots were stunted and they were only about half a crop. There seemed to be about half a dozen different kinds of caterpillars. I could see no difference between some of them and the ordinary cabbage worms. Then there were all shades of green and brown with various markings, some with two rows of yellow stripes, others with two rows of yellow dots along the back, others with black dots, and some simply a shade of green, brown or black. I did hear of caterpillars being plentiful in some parts of adjacent townships, but in this immediate neighbourhood I do not think the injury caused by them was very great. They were on no crops near here, only pease and turnips, and the turnips alone were greatly injured.”—ROBERT TUDHOPE.

“Villiers, Peterborough Co., Ont.—The green caterpillar which destroyed our turnips did not touch our pease, but there were thousands of them on turnips and carrots, doing much injury. One of my neighbours, Mr. James Fife, says there were millions on his turnips and carrots, injuring the crop about half. Mr. George Webber used Paris green on his turnips, but with little effect, as the numbers were so great.”—PHILIP W. ELM-HIRST.

Remedies.—When these caterpillars assume the habit of the Army-worm of marching from field to field, ploughing a deep furrow across their path is a useful check. If sufficiently abundant, as will rarely be the case, to fill up the furrow, they may be easily destroyed by dragging a heavy log over them. When they occur on roots and other crops, the only practical method of destroying them is dusting or sprinkling the plants with a Paris green mixture. Ploughing late in the autumn is also recommended. As the Clover Cut-worm passes the winter in the chrysalis stage inside a slight cell a short distance beneath the surface of the soil, late ploughing will disturb many and expose them to the frost and to predaceous enemies.

THE ZEBRA CATERPILLAR (*Mamestra picta*, Harris).—A good many letters of complaint have been received concerning the work of the well known Zebra Caterpillar, which was abundant in the eastern parts of Ontario. There are two broods of this insect every year. The moths of the first brood issue from the chrysalis during May and lay their eggs in large clusters on the under sides of leaves of many different plants. These hatch in a little more than a week, and the young caterpillars for a time feed gregariously, devouring all the green cellular portion and making large conspicuously white patches on the leaves. As they grow larger, they separate and feed singly. The caterpillars of the first brood are full grown about mid-summer, when they are large caterpillars, two inches in length, beautifully ornamented, velvety black on the back, with two golden yellow stripes connected by narrow white lines along the sides. The head, thoracic feet and pro-legs are bright reddish brown. When full-grown these caterpillars spin slight cocoons just beneath the surface of the ground and the moths emerge about the first week in August; they are rather dull-coloured, purplish-brown moths, with white under-wings, expanding about one and a half inches across the opened wings.

The eggs for the second brood are laid throughout August and into September, and the caterpillars are to be found, as a rule, later than those of any other of our moths. Being conspicuously coloured, they are often noticed crawling about looking for food late in the autumn when most kinds of plants have been frozen and killed. The winter season is passed in the chrysalis state beneath the ground.

The crops most attacked by the Zebra Caterpillar last season were pease, and particularly sweet pease in gardens, turnips, clover, potatoes and cabbages. In addition to these, however, these insects levied heavy toll in the flower garden attacking indiscriminately almost all annuals. The eggs and clusters of young caterpillars of the second

brood were found in remarkable numbers at Ottawa during August on lucerne, and on lily and gladiolus leaves.

The eggs were much infested by two minute parasites, *Trichogramma pretiosa*, Riley, and *Telonomus* sp., noticed in the same connection in 1892, and the young caterpillars were also destroyed by an *Apanteles* which occurred both at Ottawa and at Birdsall, Ont.

"Birdsall, Peterborough Co., Ont., August 18.—There are two kinds of caterpillars which are doing a good deal of harm on my turnips, a green one and a yellow and black striped one. I suppose a little of the Paris green and plaster mixture would be the best thing for them. Kindly let me know if you think there would be any danger in feeding roots so treated to stock."—F. BIRDSALL.

"Omeme, Victoria Co., Ont., August 18.—I send you some striped caterpillars which I find in numbers on the turnips, a great many together on a single leaf; they seem to eat the upper surface principally. There are with them, also abundant but occurring singly, some green ones which eat the edges of the leaves, No. 2, and besides a few of the smooth green ones with dark marks, No. 3, which feed like No. 2."—E. S. MORGAN.

The green caterpillars mentioned by Mr. Birdsall and the No. 2 of Mr. Morgan's sending were those of the small White Cabbage Butterfly (*Pieris Rapæ*, L.). Mr. Morgan's No. 3 were specimens of the Clover Cut-worm (*Mamestra trifolii*, Esp.).

"Peterborough, Ont., September 3.—The inclosed worm is very abundant in this neighbourhood this season; it feeds on the leaves of turnips."—J. A. FIFE.

Remedies.—The best remedy for these caterpillars is spraying or dusting with arsenical mixtures, but they seem to be rather resistant to the action of those poisons generally used, such as Paris green. Mr. T. W. Ramm, of Ross Mount, Northumberland Co., Ont., writes: "You know the yellow-striped caterpillars of *Mamestra picta* which are sometimes plentiful on pease. It took almost two days to kill some of these which were on pease, although I almost buried them in dry Paris green of full strength tested with ammonia and then it destroyed the pease as well." A weaker mixture distributed evenly over the food plant would probably have been more fatal to the caterpillars without injuring the pea plants—1 lb. of Paris green to 200 gallons of water or to 50 lbs. of dry land plaster was quite satisfactory at Ottawa.

No danger need be apprehended from feeding roots to stock which have been dusted or sprayed with Paris green mixtures. There are always several weeks—and this at a rainy season of the year, too—between the time that this is likely to be necessary and when the roots are fed to stock. If there is any doubt, however, about all the poison being washed off the roots, the tops can easily be cut off closer to the root than usual, which will remove all possibility of danger. The poison could only lodge in the axils of the leaves, of which a clean sweep will be made when the leaves are cut off.

Owing to the gregarious nature of the caterpillars when young, good work can be done in August and September by picking off the leaves bearing the young broods and destroying them.

SMALL WHITE CABBAGE BUTTERFLY (*Pieris Rapæ*, L.).—It will be noticed in the above extracts that this insect was twice mentioned as injurious to turnips. There were other reports of the same nature, but the chief injury mentioned by correspondents was to cabbages. There are few insects more easily controlled than this, if prompt action be taken at the proper time.

The best remedy for this insect, as far as my experience goes, is undoubtedly pyrethrum powder diluted with four times its weight of common flour and then kept in a tightly closed vessel for twenty-four hours until the poisonous principle has permeated the whole mixture. If a small quantity of this mixture be dusted over infested plants, the caterpillars are all destroyed, and in a surprisingly short time. Pyrethrum or insect powder kills by contact, both in a dry condition and as a decoction, so that such caterpillars as are not actually reached by the powder are destroyed by the poisonous principle of the pyrethrum carried farther among the leaves by rain or condensed dew. This remedy is so effective and so cheap that I do not think it well to recommend any other.

It has also the very great advantage of being perfectly safe, because, although so fatal to all insects, it has no poisonous effect on man and the higher animals.

The COLORADO POTATO-BEETLE (*Doryphora 10-lineata*, Say) seems to be, on the whole, the most troublesome farm insect in the country. Prof. Panton, of Guelph, Ont., expresses the same opinion in his report on answers received to the questions he had sent out to the farmers of Ontario as to which were, in their experience, the insect pests most injurious to farm crops. In most places, however, growers have generally adopted the easy and cheap means of keeping it in check by spraying or sprinkling the potato plants with Paris green mixed with water or some dry powder as a diluent. This remedy, when applied with ordinary care, answers its purpose most effectively.

"The potato-beetle was reported as numerous by some correspondents, while others stated that it was not nearly so bad as usual."—*Ontario Crop Report, Aug. 13.*

"Point de Bute, Westmoreland Co., N.B.—The potato-beetle did less damage this season than last."—HOWARD TRUEMAN.

"Alberton, P.E.I.—The Colorado beetle came out of winter quarters later than usual this spring and many were congratulating themselves that it would not show itself, but it soon got to work, and if the potatoes were late in coming up, it stood right by, waiting their arrival, utilizing the blades of grass for egg laying in the meantime. Good Paris green saved the crop. Farmers have improved ways of 'greening' now. As a general thing, a cask on a cart or truck, provided with a sprinkler at each side, thus covering quite a number of drills at a time, made the work light. The acreage under potatoes is restricted now. A farmer seldom plants more than a couple of acres. They are low-priced, and the bug has raised the cost of production. I really think, though, that this bug is running its course."—REV. A. E. BURKE.

"That great potato pest, the Colorado potato beetle, seems to be much less dreaded than formerly. It seems to have been well kept in check by the use of Paris green, either sprayed on the vines or dusted on after being mixed with gypsum or land plaster."—*Nova Scotia Crop Report, November.*

According to the notes from the different districts of Nova Scotia, contained in the above crop report, the potato-beetle was particularly troublesome in the north-western counties, but much less in the others.

"Yarmouth, Yarmouth Co., N.S.—I have not yet seen a potato-beetle in my county. A few have appeared in widely separated localities since 1893, when the first were noticed, but this is the fourth year since, and there has not been at any time a marked increase in serious injuries from them in this county."—CHARLES E. BROWN.

"Glace Bay, Cape Breton, N.S.—Insects this season did much less damage to vegetation. Chief among them is the Colorado Potato-beetle, which made things pretty lively for the farmers round my home. Some used Paris green, others hand-picked them. The beetles do not seem, however, to be so numerous as at first."—JAMES W. EDWARDS.

"Upper Baddeck, Victoria Co., N.S.—The potato bugs were very plentiful. I did not learn that any in this district used Paris green, as they are somewhat afraid of its poisonous effects. We, however, find that if we commence early, when the beetles first show themselves, to spray the fields carefully three or four times in as many weeks, it leaves them powerless to do much injury when the vines get strong."—ALLAN McMILLAN.

"Berwick, King's Co., N.S.—The potato bug has become so general that it is taken quite as a matter of course, and the farmer expects to use Paris green quite as much as he expects to plant his seed."—S. C. PARKER.

CUT-WORM injuries in garden and field crops have this year been frequently reported. The most severe depredations were committed in New Brunswick, Nova Scotia and in Alberta District; strange to say too, it was by the same species the Red-backed Cut-worm (*Cameades ochrogaster*, Gn.). It is seldom that correspondents trouble to send in cut-worms, but when this was done, in almost every instance, the species was found to be the above which gave trouble during the spring of 1896. Although there are so many different species of cut-worms, their general habits are now so well known that a wide-awake gardener or farmer can by prompt attention and a little trouble, as a rule,

do a great deal to prevent serious loss. Cut-worms are the caterpillars of dull-coloured active moths belonging to the *Noctuidæ* or Owllet Moths (Fig. 12), of which there are upwards of 400 different kinds in North America. The caterpillars of these different kinds vary somewhat in their habits, but, on the whole, they are very similar, being smooth, almost naked, gray-looking caterpillars (Fig. 13) of some dull shade of colour similar to the ground in which they hide during the day. The head is smooth and shining as well as a small horny plate on the segment next to the head. Their habits are almost always



Fig. 12.—A Cut-worm Moth (*Agrotis clandestina*).



Fig. 13.—A Cut-worm (*A. clandestina*).

nocturnal; lying hid by day just beneath the surface of the soil, they come out at night to feed. When they occur in large numbers, they change their habits somewhat and feed by day as well, owing to the reduced food supply consequent upon their ravages. The eggs from which cut-worms hatch are laid by some species in the autumn and by others in the spring or summer and, as a consequence, cut-worms of all sizes can be found in the spring; for these insects, according to the species, may pass the winter in the state of either a perfect moth, a chrysalis, a partially grown caterpillar, or an egg. This last habit is that usually, if not always, followed by the Red-backed Cut-worm. Eggs laid in Ottawa in October did not hatch until the end of the following April, and the caterpillar took 6 weeks to reach full growth; they were then large cut-worms over $1\frac{1}{2}$ inches in length, gray, with a broad sienna-red stripe down the middle of the back. The moths did not emerge until 5 weeks after the caterpillars buried themselves to turn to chrysalids. This cut-worm is particularly injurious. It is a large voracious species with an exceptionally wide territorial distribution and feeds upon almost all kinds of succulent vegetation. Nearly all the references in the following extracts were to the Red-backed Cut-worm.

"Edmonton, Alta.—Cut-worms as busy as ever in the Peace River District."—C. BURTON.

"Edmonton, Alta., June 16.—Everybody about here is troubled with cut-worms, which have done great damage, necessitating the sowing of gardens over again."—FRANCIS C. CLARE.

"South Edmonton, Alta., July 13.—I send you a box containing cut-worms. They are most destructive, cutting off cabbage and all root crops just under the ground. If you remove the earth from a bitten off plant, you find the grub buried just beneath. They are general throughout this district."—I. L. ANDREWS.

"Lacombe, Alta.—I tried alsike clover here; it came up splendidly; but the ground was so full of cut-worms that they took almost the whole of it, although I sowed about six acres."—HARRY SARGENT.

"Cochrane, Alta.—This summer for the first time cut-worms were very bad on my cabbage crop; they cut the plants off close to the ground."—JOHN DARTIGUE.

"Calgary, Alta.—I have a fair-sized vegetable and flower garden here. This spring my garden swarmed with cut-worms, as did gardens of others in the neighbourhood. The worm is just the colour of the soil; it burrows into the ground by day and comes up at night to feed. These insects gave no trouble after the first or second week of June. I had to plant three crops of every thing before I could get the start of them. The vegetables the worms went for were onions, beets, parsnips, carrots, peas, beans, turnips, radishes, lettuce. Can you advise me what to do to rid my garden of this pest?"—E. D. H. WILKINS.

"Victoria, B.C., June 12.—Cut-worms have been hard at work about Victoria. One grower lost all his onions, and I have heard complaints from many others."—J. W. TOLMIE.

At the same time specimens were also received from Mr. Mont. McDonald, of the same place.

"St. John, N.B., May 27.—Please send me some information about cut-worms. Last year in the garden at my summer house out of town we were very much troubled

with them. It seems impossible to destroy them. Can you give us a remedy?"—W. WATSON-ALLEN.

"Sussex, N.B.—Cut-worms in the spring were a terrible pest, and several men who make a habit of growing some hundreds of barrels of onions in this section were unable to grow any at all."—W. W. HUBBARD.

"Fredericton, N.B.—We had a regular plague of cut-worms last spring. Our root crops, and to some extent the corn and grain, were much damaged by them. I knew a field that was re-seeded four times."—PERCY C. POWYS.

"Petitcodiac, N.B.—The cut-worm is our worst enemy and is worst on sod, even if ploughed fall and spring."—B. SINCLAIR SMITH.

"Halifax, N.S., June 27.—How can I destroy cut-worms? It is impossible to grow anything in some lands in this neighbourhood, even in newly turned up soil. They are destroying my ensilage corn."—R. HUNT.

"Berwick, King's Co., N.S.—Cut-worms were very destructive in Nova Scotia this summer; many fields of beans, turnips, cabbages and tomatoes were much injured. Our cabbage and tomato crop was only saved by wrapping the stems with paper as the plants were set."—S. E. PARKER, *Secretary, Fruit Growers' Ass., N.S.*

"Nappan, Cumberland Co., N.S.—Cut-worms bothered us a good deal, but were extremely destructive in Yarmouth Co."—W. S. BLAIR.

"Yarmouth, Yarmouth Co., N.S.—Cut-worms abounded throughout the county, destroying successive sowings of vegetable crops. They are estimated to have reduced mangels by 15 per cent."—C. E. BROWN.

"Bear River, Digby Co., N.S.—Cut-worms did a great deal of harm in the spring to all kinds of vegetables."—R. G. TURNBULL.

"Chester, Lunenburg Co., N.S.—Cut-worms destroyed gardens."—E. D. LORDLY.

In the *Nova Scotia Crop Bulletin* for November, 1896, cut-worm injuries are recorded in the counties of Digby, Lunenburg, Pictou and Yarmouth.

"Alberton, P.E.I.—We were much troubled with cut-worms in our gardens in late May and June. Some people lost all their young vegetable plants, having been, I think, too careful to pull out all the weeds early. The dry weather suited the worms. At night in June and July you could hardly see out of the windows from the numbers of the clumsy brownish gray moths of this pest."—REV. A. E. BURKE.

Remedies.—The remedies for cut-worms are active or preventive. The chief active remedies are, poisoning the caterpillars, which may be done effectively in two ways, or hand-picking:

1. Traps.—Large numbers may be destroyed by placing between the rows of an infested crop, or at short distances apart on infested land, bundles of any succulent weed or other vegetation which have been previously poisoned by dipping them into a strong mixture of Paris green (2 ounces to a pailful of water). The cut-worms eat the poisoned plants then they bury themselves and die. In hot dry weather these bundles should be placed out after sun-down, and a shingle may be laid on each to prevent fading.

2. Poisoned Bran.—Striking results have been obtained during the last two years by putting along rows, or at the base of such plants as tomatoes and cabbages, a small quantity of the following mixture which is mentioned in Prof. J. B. Smith's excellent new *Manual of Economic Entomology*:—

Thoroughly mix together in a dry state 50 pounds of bran and 1 pound of Paris green; then add water a little sweetened with sugar until the whole is thoroughly wet but not sloppy. Prof. Smith says: "This mixture is extremely attractive to cut-worms, being preferred to plants in all the instances which have come under my notice. It takes about ten pounds of this mixture to an acre of potatoes as ordinarily planted."

The same mixture has been used dry by Mr. F. A. Serrine of Geneva, N. Y., with, he claims, even better results than the wet mixture, which is apt to get mouldy.

3. Hand-picking, or digging up the cut-worms whenever a plant is seen to be cut off, should, of course, always be practised.

Preventive remedies consist of:

4. Clean culture, by which all vegetation is removed, upon which the young caterpillars could feed in the autumn or which would attract the moths to lay their eggs.

5. Banding.—Cut-worms are heavy-bodied insects unable to climb over smooth surfaces; therefore, surrounding a plant or tree with a band of tin or even of paper in the case of such plants as cabbages and tomatoes is an effective means of protection. Tin bands may easily be made by taking pieces of tin six inches long by two and a half wide and bending them around a spade or broom handle so as to form short tubes. In placing them around a plant, the two ends can be sprung apart to admit the stem and then the tube should be pressed a short distance into the ground. I have found this a useful means of disposing of tomato and other cans. To prepare these easily the cans need only be thrown into a bon-fire, when the tops and bottoms fall off and the side becomes unsoldered. The large piece of tin can then be used whole or may be cut down the centre with a pair of shears so as to form two bands. It may be well to mention here that the two remedies so often recommended in newspapers, salt and lime, have proved quite worthless in our experiments for preventing cut-worm injuries.

FRUITS.

The fruit crop of Canada, particularly of apples, has this year been enormous, and compared with other years, there has been little complaint of insect injuries. Wherever spraying with Paris green, either alone or mixed with fungicides, has been practised, marked results have been obtained. These would, of course, have been much more noticeable in a year of less abundant fruitage. It is to be regretted that this most useful means of saving money is not more universally adopted by the fruit growers of the Dominion.

Two new pests of the apple, the Apple Fruit-miner in British Columbia, and the Apple Maggot in Ontario, have demanded attention on account of their injuries during the past season. These are treated of at some length later.

The CODLING MOTH (*Carpocapsa pomonella*, L.) has, as usual, been mentioned frequently in correspondence, but, on the whole, owing to the enormous apple crop and also to the more general adoption of spraying, has not done much harm.

“Berwick, King’s Co., N.S.—Codling Moth did but little injury. Fruit seldom was so free from worms.”—S. C. PARKER.

The only mention of this insect in the Nova Scotia *Crop Report* for November, 1896, is the following:

“Lawrencetown, Annapolis Co.—Very few wormy apples.”—J. W. WHITMAN.

In the Ontario *Crop Returns* for August, 1896, there are only two correspondents who mention this insect as follows:—

“Plympton, Lambton Co.—There are no worms in the apples so far this year, even where spraying has not been done.”

“Ashfield, Huron Co.—Spraying was little practised and yet the fruit is almost free from fungi and worms. This is unusual, and spraying with proper mixtures should not be disregarded, for this exemption may not occur again.”

“Grimsby, Wentworth Co., Ont.—The second brood of Codling Moth has been very troublesome this year in some orchards, particularly where spraying has been neglected. One of my orchards on the hill-side was very difficult to reach with the spraying waggon, and, therefore, it was neglected. As a result, a very large proportion of the apples were affected and had to be thrown out as seconds. Although spraying for fungi has not been so necessary this year, yet spraying for Codling Moth has been as necessary as ever.”—L. WOOLVERTON.

“St. Catharines, Lincoln Co., Ont.—The Codling Moth has not been quite so bad as usual, though the enormous crop of apples pointed to by the sceptical as evidence of the futility of spraying is rather misleading. The number of Codling Moths active this year would have made a very different showing if the crop of apples had been a small instead of an abnormally large one.”—MARTIN BURRELL.

"Freeman, Halton Co., Ont.—In the younger apple orchards the Codling Moth did a great deal of damage, a large proportion of otherwise very fine apples being injured. The thinner the crop on a tree, the greater was the proportion of wormy apples. Some varieties seem more liable to attack than others. With me the Greening seems always to be the worst infested. The Baldwin, too, suffers a great deal, as well as the Roxbury Russet. The Ribston Pippin, Blenheim, King and Cranberry appear to get off better."—A. W. PEART.

"Craighurst, Simcoe Co., Ont.—Little damage from Codling Moth this year."—G. C. CASTON.

"Hamilton, P.E.I., Sept. 14.—Where spraying is attended to, the Codling Moth is a thing of the past."—H. A. STEWART.

TENT CATERPILLARS (*Clisiocampa*).—These easily destroyed caterpillars have caused much loss in several parts of Canada this year.

"Freeman, Halton Co., Ont.—The Tent Caterpillars have not been troublesome in the Burlington district this year, but some ten or twelve miles north of here they almost amounted to a plague, whole orchards, in some cases, being stripped of their leaves before the owners realized the fact. There was then a general attack made on them, chiefly by crushing their nests in the evenings and mornings. Spraying effectually disposes of them with me."—A. W. PEART.

"Berwick, King's Co., N.S.—The Tent Caterpillar seems to thrive best in the villages. It seldom becomes numerous in isolated orchards. I think the ornamental trees in towns and villages prove a good breeding ground for this insect. The usual formula—4 ounces of Paris green to 40 gallons of water—applied twice will exterminate this enemy."—S. C. PARKER.

"Alberton, P.E.I., Aug. 3.—The Tent Caterpillars seemed to be more numerous than ever. They were the chief leaf-eaters this season."—REV. A. E. BURKE.

"Hamilton, P.E.I.—The most troublesome insect this season has been the Tent Caterpillar."—H. A. STEWART.

"Victoria, B.C.—Tent caterpillars have been very destructive to the foliage of fruit trees in many places, especially Chilliwack, and I notice that the eggs are numerous everywhere in the orchards."—R. M. PALMER.

Effective remedies for Tent Caterpillars are hand-picking of the eggs in winter and the destruction of the colonies of young caterpillars when the young leaves are unfolding, at which time they are conspicuous by reason of the copious white silky web upon which they rest. If not attended to at this time, spraying with Paris green disposes of them easily.

THE EYE-SPOTTED BUD-MOTH (*Imetocera ocellana*, Schiff.) has been troublesome in certain districts.

"St. Catharines, Lincoln Co., Ont.—I inclose a peach pest which I consider the most dangerous insect I have met with."—A. GLASS.

"Olinda, Essex Co., Ont.—I send you a number of peach twigs injured by a pest which I have not noticed before. This spring a great many trees are badly infested, the young shoots even being attacked, the insect boring down through them."—J. O. DUKE.

"St-Henri de Montréal, Que., June 8.—I notice the bud-moth and leaf-roller have been very bad in some orchards in this neighbourhood. I have kept them subdued by the use of Paris green and the Bordeaux mixture."—R. BRODIE.

"Victoria, B.C.—I have found the Bud-moth is increasing in numbers in our orchards. I hope that the use of Paris green in combination with the Bordeaux mixture will soon become general in lower British Columbia, as the numerous leaf-eating pests are becoming much more destructive."—R. M. PALMER.

This insect is certainly a difficult one to cope with and also, from its habits of attacking the flower buds and boring down into the fruit spurs, its injuries are frequently very serious. The remedy which has given the best results is to spray very early, just when the buds are bursting. The partially grown caterpillars pass the winter snugly ensconced in silken shelters on the twigs of trees which they infested the previous autumn. About the time the buds open, they leave these shelters and crawl out to the tips of the twigs where they do much harm to the unfolding buds.

CANKER-WORMS have been complained of as usual in many localities, and the importance of early spraying while the caterpillars are very small has been again shown. Two or three correspondents mention that they have been unable to control this insect, even when spraying with a mixture strong enough to burn the foliage. A very serious out-break occurred in Pelham township, Monck County, Ont., and another near Fredericton, N.B.

THE CIGAR CASE-BEARER (*Coleophora Fletcherella*, Fernald) has been mentioned by correspondents in all provinces in Eastern Canada, but no complaints of serious attack have been received. Mr. Harold Jones, of Maitland, Grenville Co., Ont., noticed the young Case-bearers moving from their winter resting places out to the buds on 2nd May last. He sprayed at once with the kerosene emulsion (Riley-Hubbard formula), 1 to 12, with the result of practically clearing his orchard of this insect.

THE OYSTER-SHELL BARK-LOUSE (*Mytilaspis pomorum*, Bouché) continues to trouble the apple grower in many districts. It occurs in every province of the Dominion and spreads rapidly, particularly in neglected orchards.

"Baddeck Forks, Victoria Co., N.S.—The scale insect is the greatest pest. All our apple trees will be killed in a few years more if we cannot stop its ravages."—A. B. WATSON.

"Nappan, Cumberland Co., N.S.—The apple tree bark-lice give me the most trouble I used kerosene emulsion twice in June, but there are still many on the trees. Do you think the application now of a mixture made up as follows would not be advisable: concentrated lye, 3½ lbs.; fish oil, 1 gallon; water, 8 gallons? It seems impossible to get kerosene emulsion to all parts of the tree when in foliage. I do not think they are troubled much with this pest in the Annapolis valley; at least, I never noticed many there. But, all through the country where I have been, trees are being killed or at least stunted by the bark-louse."—W. S. BLAIR.

"Berwick, King's Co., N.S.—As usual the bark-louse gains ground on trees that are not in good cultivation. Alkaline washes which are recommended will clean the trees up completely, and I think that the thorough applications annually will also prevent the work of the shot-borer (*Xyleborus dispar*, Fab.)."—S. C. PARKER.

"Alberton, P.E.I.—If we cannot soon get means to destroy the Oyster-shell Bark-louse, we shall have to give up raising apple trees."—JOHN T. WEEKS.

"Lakeville, P.E.I.—Please send me receipt for wash to destroy bark-lice on apple trees. They are fast destroying our trees."—JOHN J. McINNIS.

"Freeman, Halton Co., Ont.—The Oyster-shell Bark-louse has had its day in this district. There are but few left, and these only on neglected trees. Ten years ago they threatened to sap the life out of the orchards."—A. W. PEART.

The recognized remedies for the Oyster-shell Bark-louse are spraying the trees, before the buds burst and again in June when the young are moving, with the Riley-Hubbard kerosene emulsion (1 to 9). At the same time a healthy, vigorous growth should be induced by judicious pruning of the trees, manuring the roots and cultivating the soil.

Several instances have been brought to my notice, which would indicate that trees badly infested with the Oyster-shell Bark-lice, after having been sprayed with Bordeaux mixture, were much freer from these insects. This was possibly due to the fact that twigs bearing a coating of Bordeaux mixture were thereby rendered distasteful or unsuitable for the young bark-lice when seeking a spot to settle.

THE PEAR-TREE SLUG (*Ericcampa cerasi*, Peck), has been very abundant in Ontario, Quebec and British Columbia. I cannot help thinking that the reason this pest of the pear, plum and cherry is so prevalent every year, is that the late broods are neglected. Spraying with the standard mixture of Paris green (1 pound in 200 gallons of water with 1 pound of fresh lime) is always fatal to the larvæ.

"Grimsby, Ont.—The Pear-tree Slug has been more destructive than usual. It has skeletonized the leaves of the pear, plum and common cherry trees, and, where it has been left unchecked, has done a great deal of damage in stunting the growth of the

trees. The second brood is more troublesome to us than the first, because at that season fruit-growers are so busy that it is almost impossible to find time to spray with Paris green."—L. WOOLVERTON.

"St. Catharines, Lincoln Co., Ont.—The Pear-tree Slug has done more damage than most pests in this district, familiar as it is and easy to fight as it is. I think I am well within the mark in saying that it has been far more destructive than in any season for the past decade. The second brood worked very freely on the plum as well as on the quince, cherry and pear, and thousands of young trees—particularly cherry—had their leaves skeletonized."—MARTIN BURRELL.

The PLUM WEB-WORM (*Lyda rufipes*, Marlatt).—When travelling through the Mennonite country in Southern Manitoba in the first week of July last I noticed a great deal of damage done to plum trees by the gregarious false-caterpillars of a saw-fly which webbed together the leaves of small branches and soon stripped them of all green cellular portions in a very similar manner to the larvæ of the Cherry-tree Tortrix (*Cacaccia cerasivorana*, Fitch). Upon examining the webs I found them to be filled with enormous numbers of a false-caterpillar of a species of saw-fly belonging to the genus *Lyda*, which was quite unknown to me. The larvæ were nearly $\frac{3}{4}$ of an inch in length, grayish above, yellowish or pinkish below; head yellow, thoracic shield and feet as well as the tip of anal segment, black; pro-legs wanting. They have two seven-jointed antenna-like appendages, protruding from the front of the head, and also two others three-jointed, from each side of the last segment. I was unable to rear the perfect insects, but I find a description of what is evidently the same species by Prof. T. A. Williams in *Bulletin 28*, April, 1896, of the South Dakota Experiment Station, in which the insect is described and figures are given of the perfect insect, the cluster of eggs and a bunch of sand cherry infested by the larvæ. It is described as one of the most destructive insects attacking plums and cherries. It feeds upon all the common forms both wild and cultivated. It is found most often on the common wild plum (*Prunus Americana*, Marsh) and the sand cherry (*Prunus pumila*, L.). Prof. Williams describes the mature insect as much flattened, with body, head, antennæ and feet shining black, legs reddish. He gives as the date of appearance of the flies the second week of June. The larvæ which I found in Manitoba were full-grown in the first week of July, and at that time most of the plum trees in the gardens of the Mennonites over an area of many miles were almost entirely defoliated.

The eggs are deposited in close masses along the under side of the mid-rib of the leaf, the long axis of the eggs lying parallel with the mid-rib. The younger leaves are invariably selected, and the eggs laid before the leaf has expanded. Immediately on hatching, the young larvæ begin to spin a web and feed through or crawl over to the upper surface of the leaf. As they continue to grow, they travel to other leaves and envelop all in a tough web not unlike that of the tent caterpillar. A large colony will spread over the whole side of a tree before the insects become full-grown. When ready to pupate, the larvæ go to the ground and gradually envelop themselves in cocoons, turn to pupæ and emerge again [the next year] in the late spring or early summer as mature insects."—(*South Dakota Experimental Station, Bulletin 48*).

As a remedy, plum trees should be sprayed with Paris green or dusted with white hellebore as soon as the webs appear.

It is just possible that this insect may be the *Lyda fasciata* of Norton, described and figured by Prof. A. S. Packard on page 524 of his *Forest Insects* under "Cherry Insects." But, until specimens are secured of the Manitoba insect, it will be impossible to identify the species with certainty. From the manner of occurrence of the colonies seen in the Mennonite villages, the idea of an imported species is suggested, such as *Lyda pyri*, Schrank, mentioned in Miss Ormerod's last report, as having caused a similar injury in English orchards. Synonyms of the latter are also *L. clypeata*, Klug; *L. fasciata*, Curtis and Westwood, and *Pamphilius flaviventris*, Cameron.

The SAN JOSÉ SCALE (*Aspidiotus perniciosus*, Comstock).—An important discovery has been made by Mr. R. M. Palmer of undoubted specimens of the San José scale in Vancouver Island. From the appearance of infested wood forwarded, the pest must have

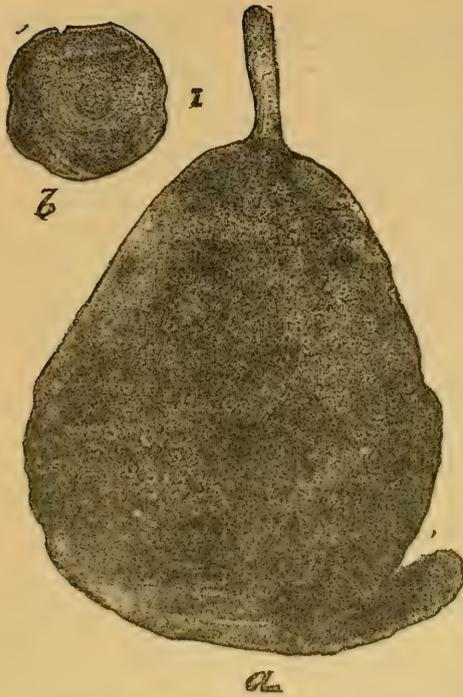


Fig. 14.—Pear attacked by San José Scale;
b, scale much enlarged.

but when fresh the characteristic marking of the twigs, leaves and fruit, due to the work of the insect, was very evident, and there was no doubt as to the identity. It was the bright discoloration of the fruit which first drew my attention to the presence of the insects in both the cases found. A microscopic examination was also made on my return to Victoria, which confirms this opinion.”—R. M. PALMER.

The limits of distribution of the San José Scale, like those of all other insects, are undoubtedly controlled to a large extent by climate. It has been found from long-continued observation that both animals and plants are restricted in their distribution to what have been called “life zones,” which are determined, according to Dr. C. H. Merriam, the eminent zoologist, “by the total quantity of heat during the season of growth and reproduction.” The San José Scale occurs more or less in all the States lying to the south of the great lakes, and although the data upon which life zones could be laid down accurately in Canada are too meagre to be of use in consideration of the question whether this insect would be likely to spread and become a serious enemy of the fruit grower in Canada, there is no doubt that it must be regarded as a very possible danger, at any rate in those parts of Ontario which lie along the north shore of Lake Erie, extending perhaps from the County of Essex to the County of Wentworth. It was supposed at one time that the San José Scale would not thrive east of the Rocky Mountains, but we now know that this supposition was erroneous; therefore, all fruit growers, particularly in that part of Ontario mentioned above, are urged to be keenly on the alert to watch for and report promptly any occurrence of this or any other scale insect which resembles it, either in their orchards or upon young nursery stock imported from the United States. In cases of doubt, specimens should be forwarded for examination, as soon as detected.

* Since the above was written two other instances have come to my knowledge of trees in Canada being infested with San José Scale, and samples have been received and examined. One infestation is at Chatham, Ont., the other at Niagara, Ont. Every care is being taken in both places, to eradicate this serious enemy of the fruit grower.—J. F.

existed for some years on the trees where it was found. So that there might be no mistake as to the identity of the species, specimens were sent to Dr. Howard, United States Entomologist, who confirmed Mr. Palmer’s opinion.* In a most interesting report sent to me by Mr. Palmer on the insect injuries of the year, he writes of the matter as follows:—

“Victoria, B.C., Dec. 10.—I am sorry to report that I have found San José Scale in two orchards on Vancouver Island. The infested trees have been destroyed, and, of course, trees and bushes in their vicinity will be closely looked after the coming season. I may say that the popular opinion that San José Scale will kill the trees in three years, is not borne out by observations made here on these infested trees. One of them, at any rate, had apparently been infested for a much longer period, and it was still growing. I find it difficult to detect the presence of the scales on the trees, or, rather, very close observation is required. In both of the above cases my attention was drawn to them by the characteristic marking of the fruit growing on the trees, caused by the insect.”

“Victoria, B.C., Dec. 29.—*Re* San José Scale: I send you part of the infested wood and twigs I have. It is rather dried up now,

Remedy.—A very complete series of experiments was conducted, not only at Washington, but also in many other parts of the Eastern United States, in which every material known as an insecticide for scale insects was tried, and Dr. Howard's final conclusions are now of value to us. He says: "With the San José Scale the most satisfactory work can be done only with a winter wash; for this species may be found in various stages of development at any time through the summer months, and an emulsion spray at any given time will kill only a small proportion. Moreover, the young larva of the San José Scale settles almost at once and immediately begins secreting a dense scale which after 48 hours is practically impervious to the ordinary emulsion diluted so as not to injure the foliage."

As stated above, the only satisfactory treatment for this insect is a winter wash, and the question naturally arises. Which is the best? Dr. Howard answers this for us: "But one absolutely satisfactory winter wash has been found. This is whale-oil soap (not containing more than 20 per cent of water) a pound and a half or two pounds to a gallon of water. This mixture killed every insect upon the trees to which it was applied, as was proved by a very thorough examination. Good whale-oil soap can hardly be bought for less than four cents a pound by the barrel, and this makes a thorough winter treatment an expensive matter. The best recommendation that can be made from the present outlook, however, is to use this mixture soon after the leaves fall in the autumn, and then, if examination reveals any survivors, to repeat it shortly before the buds open in spring."

The San José Scale is one of the most injurious insects which have been found on fruit trees, and, should it be allowed to establish itself in our Canadian orchards, it will be the cause of great loss to our fruit growers. It is, therefore, imperative that all should exercise the utmost care in examining their trees if they have been lately imported, and in buying trees only from nurserymen whose stock is known to be free of infestation. The home-grown trees of all of our Canadian nurseries are certainly much safer in this respect than those of any in the United States.

The San José Scale is a small flat scale insect, only about $\frac{1}{16}$ of an inch in diameter and so hard to detect on the bark of trees that it can hardly be recognized without a magnifying glass. The best indication of its presence is the dirty grayish appearance of the bark as if ashes had been dusted over the trees.

The PLUM CURCULIO (*Conotrachelus nenuphar*, Hbst.).—Many reports from all parts of Eastern Canada referred to the Plum Curculio as abundant, but the injury was not appreciable this year, owing to the enormous crop. Mr. L. Wolverton says: "The Plum Curculio has not been quite as troublesome this season, perhaps because of the abundant crop in this section, which made its attacks less noticeable." Mr. S. C. Parker, of Berwick, N.S., also says: "The Plum Curculios were plentiful, but could not destroy enough to lessen materially the enormous crop of plums. Some of our plum growers pick up carefully all the dropped plums, and claim that they can thereby keep their plum orchards free from the Curculio."

The GRAPE PHYLLOXERA (*Phylloxera vastatrix*, Planch.).—This insect, so well known by name from its enormous injuries to the vineyards in Europe, is seldom the cause of serious injury in Canada. It, however, attracted much attention in the Grimsby district last summer. Mr. Wolverton reported it as "unusually abundant on the leaves of grape vines throughout this district. In many cases hundreds of vines on one plantation had their foliage covered with the galls of this louse. I examined some sections of these galls under the microscope and could see great numbers of the eggs and several fully developed insects. I have not recommended any special remedy, because I note what you say that the Phylloxera is not to be looked upon as an important enemy in our Canadian vineyards, as, although a native, it has not in the past caused serious loss. I have never observed any of the variety which affects the roots, nor have I had any one report it to me."

The PEACH-BARK BORER (*Phloeotribus liminaris*, Harris).—I have referred in previous reports to the extensive injuries due to this minute insect in the peach orchards of the Niagara district, and also to some successful experiments carried out by Mr. Carl E. Fisher, of Queenston, Ont., with an alkaline wash, to which Paris green, lime and

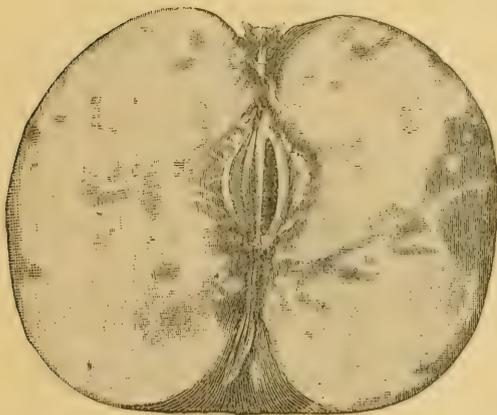
carbolic acid were added. This wash has been again used successfully during the past season by Mr. Fisher, who writes: "The last wash I used for the Peach Bark beetle was the dead shot remedy. Every tree it was tried on is free from the little beetles." This remedy is applicable for many other bark-boring beetles, such as the Shot-borer of the apple and plum. The formula, as last used by Mr. Fisher, is as follows:—

Washing soda, 5 pounds; soft soap, 3 quarts (or hard soap, 3 pounds); water to make 6 gallons; air-slaked lime sufficient to give the mixture the consistency of thick paint; finally, add 4 ounces of Paris green and 1 ounce of carbolic acid. To be applied with a whitewash brush, thoroughly covering the trunk of the tree and a few inches up the limbs. The first application should be made as soon as the beetles appear in the spring, sometimes as early as the middle of March. Two or perhaps three applications, a month apart, may be necessary.

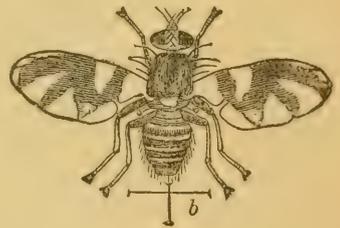
The BLACK PEACH APHIS (*Aphis persicæ-niger*, E. F. Smith).—Letters from Essex County and a single one from St. Catharines show that a good deal of injury is being caused in young peach orchards by the Black Peach Aphis. Up to the present no satisfactory remedy has been applied, but experiments have been arranged to be carried out next season. The application of kainit, as advised by Prof. J. B. Smith and mentioned in my last report, is specially commended to the attention of peach growers. Prof. Smith says: "In our State, on light soil I advise about 10 pounds of kainit per tree, covering the probable extent of the root system—this for a tree 4 to 6 inches in diameter and in bearing—the application to be made in spring, when the trees are leafing out. In our orchards the kainit has proved successful wherever used. Dr. Erwin F. Smith recommends ground tobacco, and so does Prof. Alwood, of Virginia."

THE APPLE MAGGOT.

(*Trypeta pomonella*, Walsh.)



Infested Apple.



Perfect fly.

FIG. 15.—APPLE MAGGOT.

Attack.—Slender, white or greenish white footless maggots; when full-grown, about $\frac{1}{4}$ of an inch in length by $\frac{1}{2}$ of an inch in width, tapering gradually to the head and cut off abruptly behind; burrowing in all directions through the flesh of apples, feeding upon the pulp and leaving brown channels. There are sometimes as many as a dozen maggots in a single apple, but one is enough to render it worthless. The eggs are inserted beneath the skin of the fruit by a two-winged fly with a sharp ovipositor. The young maggots which hatch from these become full-grown in about six weeks, causing the fruit to ripen prematurely and drop to the ground, when the maggots work their way out and entering the soil a short distance, change to pale coloured puparia, inside which the maggots remain unchanged until the following spring. The pupa state is assumed only a few days before the perfect insects appear.

The fly of the Apple Maggot (Fig. 15, *b*) is a pretty little insect described as follows by Prof. Harvey, of Maine, who published a most complete study of this pest in the "Annual Report of the Maine State College for 1889": "The perfect insect is a two-winged fly somewhat smaller than the house-fly, readily recognized by its general black colour; yellowish head and legs; dark feet; greenish prominent eyes; white spot on the back and upper part of the thorax; three white bands across the abdomen of the male and four across the abdomen of the female, and four black bands across the wings, resembling the outline of a turkey."

The injury done to the apple crop by the Apple Maggot in the states of New York, Massachusetts, Connecticut and Vermont are well known, but, outside of these States, although the insect is common and feeds in the larval form upon the fruit of the hawthorn (*Crataegus*) over a large area of country, there is no record of its having attacked cultivated apples to any appreciable extent. During the past summer, however, infested apples were received from Dr. D. Young, of Adolphustown, Lennox Co., Ont., north of Lake Ontario, with the following letter, which is the first record of its injurious occurrence in Canada:—

"Adolphustown, 31st October.—I send you apples injured by worms of some kind from a tree that heretofore always produced very clean and smooth fruit. Kindly tell me what the worm is and what remedy to apply. I spread round the trees which bore the infested fruit ten or twelve wagon loads of barn-yard manure in the spring of 1895 and again in 1896. I fear this may have enticed the insect. What gives me this idea is that I have two trees, a Golden Russet and a Winesap, that always produced clean fruit till we put a pig pen and yard right between them, the roots running under the pen and yard where the soil is immensely rich. Since the pigs were kept there, the fruit on these two trees has been very poor, and this year was entirely worthless on the Golden Russet. Although heavily loaded, there was not on the tree one good apple, and the Winesap was nearly as bad. It was heavily loaded too, but I think not one in fifty was good for anything. Yet the apples on the other Golden Russet and Winesap trees near by were very fine."—Dr. D. YOUNG.

A little later Dr. Young sent me a good supply of infested apples, with the statement that the maggots were working in other varieties than those mentioned. No living maggots were found in these, but two dead specimens served to identify the species in confirmation of the opinion formed from the very characteristic work of the larvæ in the fruit.

There is only one brood of this insect, but the eggs are laid by the females during a very long period, namely, from the beginning of July till frost sets in. The flies, which are produced from early ripening varieties of apples, appearing at a correspondingly early season the following year, and those from late varieties lay the eggs which produce the maggots found in the stored apples during the winter. Prof. Harvey says: "We have never seen the exit holes in hanging fruit, and believe the maggots do not drop, but go into the ground from the fallen fruit. Their presence causes the fruit to mature earlier. Fruit picked from the tree may contain larvæ, and often stored or marketed fruit is alive with maggots. Apples apparently sound when gathered may, by the presence of eggs or young larvæ, afterwards become hopelessly involved. The development of the maggot is slower in late and hard fruits."

When infested fruit is stored, the maggots emerge as they become full-grown and turn to puparia inside the barrels or bins.

Remedies.—As the egg of this insect is laid beneath the skin of the apple, it is evident that spraying with poisonous applications would be useless. The remedy which is most relied on by those who have had experience with the insect, is the prompt destruction of windfalls, so as to prevent the maggots going into the ground. This can be done by keeping a sufficient number of pigs, sheep or other stock in the orchard. If this is inconvenient, the more expensive operation of collecting by hand and destroying or feeding to stock must be rigorously practised if this pest is to be controlled. The refuse from bins or barrels should, of course, also be dealt with in some way to prevent the insects coming to maturity. Prof. Harvey says emphatically: "The gathering of windfalls for the express purpose of checking *Trypeta* has been tried and found effectual. We firmly believe we have in the careful destruction of the windfalls, the means of

destroying the pest. If windfalls are left lying in an orchard, the maggots will leave them and enter the ground; but they always remain near the surface, so that deep spading or ploughing would bury most of them so deeply that the flies would be unable to emerge. A most useful practice also is the penning up of poultry beneath infested trees; these will scratch out and devour large numbers of the insects."

It is hardly likely that the flies were attracted by the odour of the manure applied by Dr. Young to some of his trees or by the pig-pen beneath others, but the observation is well worthy of being remembered in case the Apple Maggot spreads and becomes more destructive in Canada. A characteristic of the occurrence of this insect is its slowness in spreading from one locality to another, from orchard to orchard, or even from variety to variety and from tree to tree in an orchard. It is said to be largely confined to sheltered locations and sandy soils.

THE APPLE FRUIT-MINER.

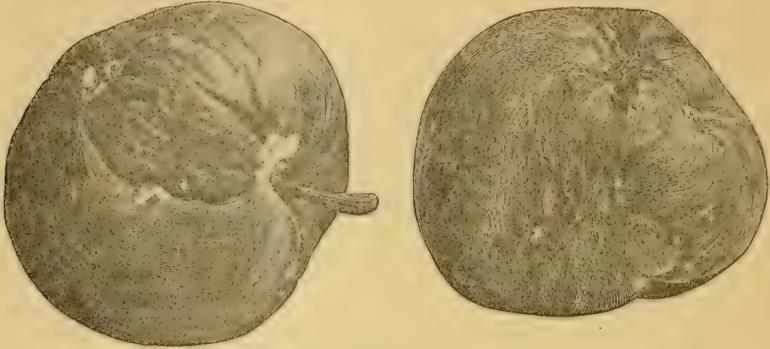


Fig. 16.—Apples injured by Apple Fruit-miner.

Attack.—Small caterpillars tunnelling in all directions through the flesh of apples, discolouring them and rendering the fruit unfit for use; when full-grown, they are a little over a quarter of an inch in length, dirty white in colour, tinged with pink just before spinning their cocoons. Head and a small shield at the end of the body, dark brown, somewhat resembling the caterpillar of the Codling Moth, but only about half its size when full-grown, and with the body much more tapering to each end. When ready to spin up, these caterpillars leave the fruit and make cocoons which in nature are probably placed in crevices of the bark in the same way as those of the Codling Moth.

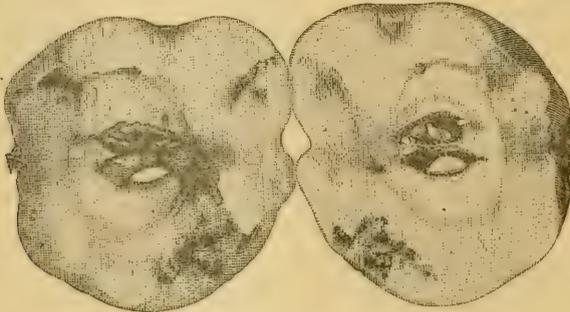


Fig. 17.—Apple injured by Apple Fruit-miner (inside).

Nothing is known of the egg-laying habits of the moth from which the caterpillars spring, but, from the appearance of the infested fruit at the entrance of the tunnels, it would appear possible that the young caterpillar may live at first for a short time on the foliage or beneath a leaf attached by it to the fruit. A point of entry is frequently marked by several very small tunnels opening over the surface of a comparatively large area one-eighth of an inch to one-quarter of an inch in diameter, as if the insect had fed

there for some time. With the growth of the fruit, this point becomes the centre of one of several—sometimes 3 or 4 on a single apple—conspicuous depressions, by which the apples are much distorted; the blackened skin at the bottom of these depressions is also frequently further discoloured by a white deposit, probably consisting of dried-up juice from the apple, which has oozed from the wound.

This is a most serious enemy of the apple grower on the Pacific coast, and it is to be hoped that every effort will be made next June to discover the method of egg-laying and the early habits of the young caterpillar. As the injury is done chiefly inside the fruit where the insect cannot be reached, it is probable that any practical active remedy will require to be applied at or soon after the time the eggs are laid.

It is strange that this insect, which injures the fruit of the apple in such a very similar way to that of the Apple Maggot (*Trypeta pomonella*, Walsh), should have broken out in British Columbia just at the same time as the latter insect was discovered in Ontario as a pest of cultivated apples.

It is probable that both of these insects are native species which are abundant in their wild food plants, the Apple Maggot in the fruit of hawthorn, and the Apple Fruit-miner in the wild crab (*Pirus rivularis*, Dougl.), and that the habit of attacking cultivated apples is exceptional with both; but, as *Trypeta* has shown that when once this bad habit is acquired it is very persistent although local, no effort should be spared to find out as soon as possible with regard to this new enemy, all that can be known of its life habits, so as to arrive at a remedy.

As far as reports have been received, the injuries of this insect have not been noticed in the interior of British Columbia. Mr. Thomas G. Earl, the owner of a beautiful orchard at Lytton, on the Fraser River, just within the limits of the arid climate which characterizes the Interior Plateau of the province, says:—"I am happy to say I am not troubled with the worm you mention. I have seen it at Chilliwack and Agassiz."

The following interesting letters will show the serious nature of this new pest, and also give all that is actually known of the life history:—

"Victoria, B.C., July 17.—I send two specimens of infested apples forwarded to me from Chilliwack. Can you let me know what has caused the injury?"—R. M. PALMER.

"Victoria, B.C., Aug. 20.—Mr. Gibson has been looking after a number of specimens of the apple caterpillars from Chilliwack, and has succeeded in getting some cocoons. I hardly think the moths will emerge till spring."—R. M. PALMER.

"Agassiz, B.C., Aug. 12.—I send you, under another cover, some apples infested with a worm. This appears to be very prevalent in some districts in British Columbia this year. I noticed a few cases in previous years, but these were so few that I did not trouble about them, but this year it is a pest."—THOS. A. SHARPE.

"Spence's Bridge, B.C., Sept. 15.—I collected another box of apples infested with that new pest and have mailed them to you from Agassiz. I spent last Friday in Victoria, most of the time in the Department of Agriculture and with Mr. Anderson at his house. Mr. Anderson's assistant showed me several of the cocoons of this new pest in the apple, which seems to me to be much more injurious than the Codling Moth. It is a lepidopterous insect which, judging from the larva and cocoons I have seen, is about half the size of the Codling Worm. The cocoons are closely spun inside, with an outer covering of whitish silk of a neat and open pattern. The larva, as you will see, eats channels all through the flesh of the fruit, completely spoiling the apple for use. At the Department of Agriculture here the cocoons had been obtained by putting the apples uncut into a large glass jar and tying it over with gauze. As the larvæ matures, it finds its way out and spins its cocoons at the sides of the bottom of the jar."—DR. WM. SAUNDERS.

"Agassiz, B.C.—I sprayed when the blossoms had fallen and once when the fruit was as large as a small crab. I dealt effectually with the caterpillar, and if Paris green were a remedy for this pest, I should have expected it to be killed at the same time, but it was not, or at least there were a great many left. I gathered a number of apples that I knew were infested and put them in a glass jar, covering it with thin muslin. I also mounted specimens, but have found out nothing definite. Of some varieties of apples, such as St. Lawrence, Wellington, American Pippin, Stark, Maiden's Blush and Fall Pippin, more than half the crop was injured. Other varieties suffered less, though to a considerable extent; and some varieties, like Winter St. Lawrence, Salome, Mann,

Yellow Bellflower, Scott's Winter and Sutton Beauty, were practically uninjured. I hear from some purchasers that many apples sold are injured by the maggot, which goes to show that in some cases at least they are taking no care for next year, as in late picked specimens I found very few worms, but evidence of their having been in the fruit."—THOS. A. SHARPE.

"Victoria, B.C., Dec. 10.—Your valued favour of the 30th ult. to hand and contents noted. In reply *re* Apple Fruit-miner, Mr. E. A. C. Gibson has been making a special study of this pest, and any information or specimens which I have obtained have been turned over to him. As I know he intends sending you a full account of his work, I do not wish to anticipate him, so will only say that the insect has been specially destructive in the Chilliwack valley, and in the Mission City and Agassiz districts, but to a lesser extent is widely distributed in the lower part of the province, as I have received or observed specimens and their injuries at Ladner's Landing, Victoria, Cowichan and the Islands, as well as the lower Fraser valley. I am of opinion that it is a native insect. Its proper food is the fruit of the native crab apple. This Mr. Gibson's observations will determine."—R. M. PALMER.

"Victoria, B.C., Dec. 11.—I remember having seen these insects in the native crabs for a long time, but apparently they did not attack cultivated apples until recently, or if they did it was not noticeable. At Chilliwack, however, last summer I saw the effects of their ravages on the orchards of that place."—J. R. ANDERSON.

"Victoria, B.C., Dec. 16.—This insect has certainly occurred and been noted before this year, but I do not think it has till now caused any material damage. I secured most of my infested fruit from Mr. Kipp, of Chilliwack, who says: 'It is general throughout the upper end of my district,* and I noticed it at Agassiz as well on August 8th.' Mr. Kipp also says, in answer to some questions I addressed to him: 'I noticed it first about June 20th, found the worm, which was very small at that time, with blackish head, the other extremity the same, the body the same colour as the flesh of the apple (Gravenstein). Later in August the worm was about one-eighth of an inch long; body, brown. I found worms from time to time through September. In October I could find no more worms, but late in October or about the first of November hundreds of small moths (white) were flying about mostly all day. Gravenstein, Ben Davis, Russets, Baldwin (slightly), Lady's Sweet, and various other varieties I cannot name, were attacked. * * * Seventy-five per cent of my fruit was affected.' I myself have received specimens of fruit attacked by this insect from Hornby Island as well as Chilliwack. I am sending you by the present opportunity under separate cover specimens of wild crab apples which have been altogether spoilt, as I think, by this same insect, and a piece of an apple, inside which I found the cocoon, which you say you would like to have. I found cocoons in several others as well."—E. A. CAREW-GIBSON.

Mr. Carew-Gibson has also kindly prepared the following interesting note on the subject:—

"NOTE ON A NEW APPLE FRUIT PEST IN BRITISH COLUMBIA.

"The new apple pest which has this summer more strongly forced itself upon our notice than previously, owing to the loss it has occasioned to the fruit crop in some parts of this province, is, I believe, an indigenous insect, as I have traced it back to what I believe is its original home, *i.e.*, the wild crab apple swamps. In the larval stage this insect is very small, when full-grown only measuring a quarter of an inch in length. The larvæ are of a dullish white colour tinged with brownish green, excepting the head, a broken line on the top of the first segment, thoracic feet and last segment with hind pro-legs, all brown. These larvæ diminish in size towards their extremities and can in this way be easily distinguished from the larvæ of the Codling Moth, which, besides, are very much larger when full-grown. A nearly full-grown larva on being caged on the flesh of a freshly cut apple soon disappeared from view; it started by chewing the apple pulp till it had a large mouthful, when it drew back its head from the hole thus made and disgorged the pulp, thereby giving the body room to get farther into the apple, this

* A rich district on the Fraser River extending from Sumas Lake to Popcum, a distance of about 20 miles, with the town of Chilliwack on the Fraser River situated almost centrally.

operation was repeated continuously and the insect was buried out of sight when looked for eighteen hours later. The larvæ apparently enter the fruit from the side, and eat their way into the interior by tunnelling the fruit in all directions. They sometimes reach the core and feed on the apple pips, but more often keep to the more fleshy part of the fruit, which is thus entirely spoilt, as the passages made by these insects soon turn brown and start decay throughout the fruit. When fully grown the larva emerges at the side of the fruit, and probably lowers itself to the ground before spinning up. I judge this to be the case, as by holding the spinning thread of a fully grown larva which had just emerged from the fruit I induced it to lower itself by its thread over six feet. It then spins a very beautiful white cocoon of an open-work pattern, and inside and separate from this, it spins another close-fitting white covering. These cocoons measure about three-eighths of an inch long. I have found cocoons of this insect spun up inside the core of several apples. It will be easily seen, however, that this is only possible in the more open cored varieties of fruit, and the chances of survival are very slight for those following this plan. I have specimens of this insect which spun up as early as August 6th, and also had samples of fruit containing larvæ apparently not full-grown on November 9th. The only sign that the fruit is infested at an early stage of its attack is by the exudation of juice from the fruit at the point where the insect entered, which generally dries up in the form of a little bubble; later, when the larva has left, the small hole in the side of the fruit through which it escapes can be readily seen on a close examination. The rotting of the fruit along the passages made by this insect may be caused by spores of fungi lodging where the apple skin is pierced, and thereby decay working its way along the open passages. My reason for thinking that this insect is indigenous is because I have several cocoons from infested fruit of wild crab apple trees. I have often in previous years noticed that a great deal of the fruit of the wild crab apples is completely spoilt, and have arrived at the conclusion that it is our new enemy which is responsible for the damage. I took some infested wild crab apple fruit and placed it in a jar on September 13th, and on September 25th I had three nicely spun cocoons in the bottom of the jar. The wild crab apple fruit which is affected, when ripe, turns quite black, instead of being of the ordinary brown colour, and one sometimes sees a whole tree with scarcely a sound berry on it."—E. A. CAREW-GIBSON.

The fruit of *Pirus rivularis* is borne in bunches of about a dozen together on slender stalks over an inch in length; each individual fruit is a small, berry like, ovate, oblong pome, about half an inch in length by three-eighths in width.

Besides the above insects, there are some other caterpillars which injure apples, the life histories of which require working out, owing to the possibility of their becoming of economic importance. At Victoria in 1895 I found specimens of a small caterpillar feeding on the surface of the fruit, particularly at the calyx end eating the skin and mining a short distance beneath it; very similar larvæ were also received during the past summer from Mr. C. P. Newman, of Lachine Locks, Que., but some of these worked entirely beneath the skin, making large blotch mines, but not running nearly so deeply into the flesh as the British Columbian Apple Fruit-miner.

Mr. Palmer says as follows on the subject of the insect enemies of fruit in British Columbia: "The Codling Moth has been reported from several places, but after careful examination of infested or damaged specimens of fruit, I have failed up to the present to find the true Codling Moth. Still considerable damage was caused by worms in apples (distinct from the Apple Fruit-miner) of two or more different species and I hope with Mr. Gibson's aid and your special knowledge that we shall be able next season to determine what the pests actually are (as by that time we ought to have specimens of the perfect insects) and the proper methods of dealing with them."—R. M. PALMER.

As up to the present, owing to the energy of the provincial Department of Agriculture of British Columbia, the Codling Moth has been prevented from being introduced, as far as can be learnt, into that province, and, as larvæ of the Apple Fruit-miner have been mistaken for those of the Codling Moth and its work for that of the Apple Maggot, it may be well to point out some of the important characters in which these three insects differ. There should be no trouble in distinguishing them in all their stages

The Apple Fruit-miner and the Apple Maggot injure apples in a very similar manner, tunnelling the pulp of the fruit in every direction, leaving brown coloured channels with here and there rather large chambers. The injury of the former is generally rather less extensive than that of the latter.

The two insects, however, are quite different in appearance: the Apple Maggot is as its name implies a footless maggot which changes beneath the surface of the ground to a smooth whitish puparium, inside which it remains unchanged until the following spring; while on the other hand, the Apple Fruit-miner is a caterpillar with a distinct head, three pairs of thoracic feet on the segments next to the head, four pairs of short fleshy pro-legs under the middle segments and a similar pair of pro-legs at the end of the body. This turns to a chrysalis in autumn inside a close white cocoon which further is surrounded by an outer web or loose net work of white silk.

The Codling Moth, again, differs as to its work from both of the above. Instead of tunnelling in all directions through the flesh and destroying the whole apple, the caterpillar always works to the core and feeds upon the seeds, in most cases entering the fruit from the calyx end, and emerges through a hole straight from the core to one side. The larvæ of the Apple Fruit-miner and of the Codling Moth are both caterpillars, but that of the Codling Moth when full-grown is nearly three times the size of the Apple Fruit-miner, and is spotted with black, bristle-bearing points. The cocoons, too, are very unlike; while that of the Apple Fruit-miner is one-quarter of an inch long and surrounded by a white, lace-like outer netting, that of the Codling Moth is half an inch long and brown and close, with many particles of the bark upon which it is spun worked into it.

Specimens of the Apple Fruit-miner confined in a jar upon moist earth and with pieces of bark, invariably chose the latter to spin upon, the cocoons being generally placed deep in a crevice or under a flake of bark.

Remedy.—Until more is known of the habits of this insect, it would not be wise to make more than general suggestions as to a remedy. Mr. Sharpe mentions that he sprayed his trees for caterpillars, and that the fruit was badly infested on trees so treated, but no comparison is drawn with trees that were not sprayed. From so much of the life history as is known, spraying with Paris green, lime and water, in the same manner as for the Codling Moth, soon after the flowers fall, with two or three applications a week apart later, would seem to be the most reasonable method, and certainly would, at any rate, have the great advantage of destroying several other kinds of biting insects.

Description of caterpillar of the Apple Fruit-miner from Chilliwack, B.C., made August 3, 1896, after it had emerged from apple:—

Nearly cylindrical, slender, almost three-eighths of an inch long when extended, by $\frac{1}{8}$ in diameter. Head small, fuscous. Thoracic shield fuscous, with a white stripe in centre. Anal plate conspicuous, and on the anterior half of segment 13 is a long, narrow chitinous blotch, similar to the anal shield and probably representing the expanded bases of tubercles. Body whitish, washed all over with pink; bristles white and slender; spiracles inconspicuous; surface of the body uneven; intrasegmental folds deep, as also a median transversal fold on each segment. There is a row of deep depressions above and below the stigmatal fold.

When received on July 24, 1896, the above larva was white in general colour, with black head and thoracic feet. Two larvæ spun on 4th and 5th of August.

A cocoon crushed by accident on October 31 showed that the pupal stage had been assumed. The cocoon is double, consisting of a close, dense, white, spindle-shaped inside cocoon, one-quarter of an inch in length, inclosed in a loose bag of open network of large meshes; this is three-eighths of an inch by one-eighth. The inside cocoon is apparently open at one end, for, although no opening can be seen, in nearly every instance the larval skin and head are pushed out into the outer cocoon.

THE HORN-FLY.

(Hematobia serrata, Rob.-Desv.)

The invasion of Canada by this pernicious insect was first noticed in 1892, and every year since that date losses from the irritating bites of the Horn-fly have been complained of by cattle owners in some new parts of the country. The hope expressed in my annual report for 1893 that the numbers of the flies would after two or three years become less and less in any invaded district, has, to a large measure, been realized. In the province of Ontario, where the first Canadian specimens of the Horn-fly were noticed, there is a decided diminution of the numbers of this pest. Among answers to the questions sent out by Prof. Panton of Guelph, to farmers in different parts of the province, 25 reports were received of its increase and 46 of its decrease, and 25 correspondents noticed no change in the numbers. The following extracts are also of interest:—

“London, Ont., Dec. 7.—The Horn-fly was very conspicuous in its season, but the alarm concerning it seems to have abated.”—J. DEARNESS.

“Sackville, Westmoreland Co., N.B., July 13.—I mail to your address under separate cover several specimens of a very troublesome fly known here as the Horn-fly. They gather in large clusters about the base of the horns and around the root of the tail, also under the flanks. They are evidently the cause of a very decided decrease in the flow of milk among the cows of this place. If you have a remedy for them, please let me know as soon as possible.”—JOHN L. FAWCETT.

“Pointe de Bute, Westmoreland Co., N.B.—The Horn-fly was not quite so troublesome to the cattle this year in New Brunswick as last, but for several weeks was very active. Very little was done to protect the cows. The impression is growing that the fly will disappear in a short time.”—HOWARD TRUEMAN.

“Yarmouth, N.S.—The prescription I used for the Horn-fly was taken from the *Country Gentleman*:—‘Take equal parts of lard and coal oil with a few drops of carbolic acid, and apply every few days as needed.’ Any soft grease may be used instead of lard. I observed drinking at a public fountain near my place two yokes of oxen, the bodies of one yoke covered with thousands of these flies, while the others were entirely free from them. ‘What do you use for the Horn-fly?’ I asked from the driver of the former yoke. ‘Fish oil,’ was the reply. Whale oil soap would, no doubt, be effective. Along the sea coast fish oil is cheap and easily procured, and it is probably more durable than coal oil and grease.”—CHARLES E. BROWN.

“Berwick, King’s Co., N.S.—The Horn-fly was very abundant. I found an English sheep dip (E. Liddle & Co.’s., I think,) applied to the cows with a brush about once in three days the cheapest and best preventive I have yet tried.”—S. C. PARKER.

“Sydney Mines, Cape Breton Co., N.S.—The Horn-fly was not nearly so numerous nor blood-thirsty as last year, and I hope will disappear in a year or two.”—DAVID G. CRAWFORD.

“Glace Bay, Cape Breton, N.S.—The Horn-fly continues to give us some trouble, but not quite as much as at first. Various methods are adopted to defeat them, all fairly successful.”—JAS. W. EDWARDS.

“Charlottetown, P.E.I.—The Horn-fly did a great deal of damage here during the summer of 1895. I think a reasonable estimate for milch cows would be about one-sixth shrinkage in the milk flow, and fattening cattle did not do well. Last season (1896) they were not nearly so bad. I hope they have had their day and will not show up in the spring.”—THOS. J. DILLON.

“Alberton, P.E.I.—The Horn-fly was, many say, as bad as last year. My own personal observation points to a decrease, but others say to the contrary. Our farmers are at a loss for a cheap effective remedy. Kerosene emulsion, fish oil, vegetable oils are all ineffectual to completely keep off the pest.”—REV. A. E. BURKE.

Remedies.—There is nothing new to record in the way of remedies. As previously stated (*Experimental Farm Report*, 1893, page 186), almost any greasy substance rubbed on the animals will keep the flies away for several days. A number of experiments were tried in the field with the result that train oil alone and train oil or lard

with a little sulphur, oil of tar or carbolic acid added, will keep the flies away for from three to six days, while with a small proportion of carbolic acid it will have a healing effect upon any sores which may have formed. Train oil or fish oil seem to be more lasting in their effects than any others experimented with.

The safest and most convenient way of using carbolic acid is in the shape of carbolized oil, which can be prepared by dissolving one ounce of crystallized or liquefied carbolic acid in 1 quart of oil. Train oil, fish oil, tanner's oil, olive oil or any other fixed oil will answer; but not coal oil, as carbolic acid is not soluble in this liquid. The crude carbolic acid does not dissolve easily in fixed oils, and, therefore, must not be used. Instances have been reported to me of injury to animals and the hands of operators, when the crude has been substituted for the purer form of carbolic acid.

Mr. Robert Elliott, the herdsman at the Central Experimental Farm, finds that the most convenient mixture which is effectual is 10 pounds of lard mixed with one pound of pine tar.

THE APIARY.

The practical management of the Apiary during the past season, as heretofore, has been satisfactorily carried on by Mr. John Fixter, the farm foreman. Mr. Fixter has been of great service in showing visitors over the bee-yard and explaining all matters connected with bee-keeping when consulted. All details with regard to this branch are given in Mr. Fixter's report appended hereto. Mr. Shutt has also kindly prepared a report in continuation of that of last year upon further experiments with different brands of "foundation," which I feel sure will be read with much interest by all bee-keepers.

In May last four colonies of thoroughbred Italian bees were purchased from Mr. M. B. Holmes, of Athens, Ont. Two of these were sent to the Experimental Farm at Brandon, Man., and one each to the farms for the North-west Territories and British Columbia. These bees were very beautifully marked, and the queens were all young imported stock, with the exception of one of those sent to Brandon, which was two years old, but also imported. The colonies all arrived at their destinations in good order, and will be found mentioned in the reports of the various branch farms.

I was much pleased to be able to arrange for a joint mid-summer meeting of the Bee-keepers' Associations of the counties of Russell, Prescott and Glengary. This meeting was held at the Central Experimental Farm on the 12th of June last, and was attended by many of the leading members of the various associations, who expressed themselves as much pleased with what we were able to show them of the work being done in the Apiary.

REPORT OF MR. JOHN FIXTER.

EXPERIMENTS IN WINTERING (1895-96).

The experiments begun last year as explained in the report for 1895 were repeated this season and some others were undertaken. Following is a report on these:—

Experiment No. 1.—Seventeen colonies put into winter quarters in the cellar on the 20th of November, 1895. Empty hives were placed on the floor, with 3-inch blocks of wood on the top of them, at the back, and the hives piled up three tiers in height. In addition to the 3-inch blocks, by which the back was raised higher than the front, so as to give free ventilation, each hive was raised from its own bottom board with small blocks $\frac{3}{8}$ inch in height. All front entrances left wide open. The wooden covers of all these hives were removed and replaced by chaff cushions, four inches thick. Above the cushions strips of wood, one along each side, prevented them touching the bottom of the hive immediately above them, and also allowed air to circulate freely under each hive.

This mode of wintering was, on the whole, very successful. One swarm, however, died from an unknown cause. When put into the cellar it had plenty of honey and weighed 58 pounds. In spring its weight was found to be $47\frac{1}{2}$ pounds.

The average weight of the 16 other colonies was before winter $50\frac{1}{4}$ pounds, and in the spring $40\frac{1}{4}$ pounds, each colony having consumed an average of only 10 lbs. of their stores against 12 pounds 9 ounces the preceding winter, and 20 lbs. in 1894-95. During the winter scarcely any humming could be heard in the hives, and there was no sign of dampness nor of dysentery.

The product from the 16 hives during the season was, on an average, 47 sections of honey from each, besides 17 pounds in "extracting-frames" reserved for winter and spring feeding. The 16 hives gave 5 new swarms.

Experiment No. 2.—Two colonies put into the cellar, with tops and bottoms of the hives left on, just as they were brought in out of the bee-yard. These were to be watched for dampness.

By the 30th December, some mould was noticed at the entrance of one hive, and a fortnight later both were very damp, one even had water on the bottom board. In this hive, however, the bees kept very quiet and scarcely any hum could be heard, while those of the other hive were very restless, some coming out at the entrance from 30th January; consequently, on 10th February, a little ventilation was provided by displacing somewhat the wooden cover; nevertheless, on 1st March, there were signs of dysentery, and about half a pint of dead bees was removed. By 16th March signs of dysentery appeared also on the other hive, and on the 1st April both seemed to be in a very bad condition, a considerable number of dead bees having to be removed from them.

On 15th April the two hives were taken out and placed on their summer stands; there were many dead bees and mould on the bottom board; but the colonies were still fairly strong. The bottom boards were removed and clean ones put in place of them.

On 27th April the hive that had been the quieter one during winter, was found deserted; its frames were very mouldy and soiled with feces. The other hive, on the same date, had two frames partly filled with brood and with new honey. The product of this hive and of one swarm which it gave, was 92 sections of honey.

Experiment No. 3.—One colony was placed in a packing case in the cellar, on the 22nd November, 1895, and packed with four inches of dry sawdust all round the hive; brood chamber raised from bottom board by four small 1-inch blocks; wooden cover of hive replaced by a 4-inch chaff cushion, and the packing case filled up with four inches of dry sawdust above the cushion. For ventilation a small shaft of the same size as the opening to the Langstroth hive, led from the opening of the hive to the outside of the packing case. Case placed on the top of another case, three feet high, in the stone cellar beneath dwelling house.

About the 21st of January, this colony began to be uneasy; some bees were coming out. On 30th January, the top was somewhat displaced to give ventilation; nevertheless bees kept coming out, though the cellar was perfectly dark, and on 14th February a piece of thin netting was placed over the entrance to stop them. On 1st March, there were many bees dead about the entrance which was much soiled with feces. The number of dead bees then became less and less, and on 1st April the colony was perfectly quiet. On 15th April it was taken out of the cellar and found to be in a very weak condition with no more than one frame of bees; the other frames were much soiled with feces. The weight of the hive, 55 pounds on 22nd November, was now reduced to 39 pounds, the bees having consequently consumed 16 pounds of honey.

On 1st May the bees though weak were gathering pollen actively; on 15th May the hive contained two frames with brood and much new honey, but no eggs and no queen. One queen cell only was capped. On 25th May, all the brood had emerged and flown away leaving scarcely a dozen bees in the hive. On 30th May, the hive was deserted, the queen cell not being uncapped; 7 pounds of fresh honey had been gathered into the brood chamber.

I am of the opinion that this colony perished from being kept too warm and for want of sufficient ventilation.

Experiment No. 4.—This experiment is very similar to the last, but no ventilation was provided, it having been claimed by one of our correspondents that he had always wintered bees satisfactorily in this way.

The bottom board of the hive was removed and the hive was stood on four blocks $1\frac{1}{2}$ inches high, one under each corner, placed right on the bottom of the packing case, which was then filled in with dry saw-dust, four inches all round and above, as in Experiment 3, except that no shaft for ventilation was cut through to the outside of the packing case; but immediately beneath the hive there was a narrow crack between the boards of the packing case, not $\frac{1}{16}$ of an inch wide. The packing case itself was raised about an inch off the earthen floor in the stone cellar by means of small blocks.

On 22nd November the hive weighed 49 pounds. No sound could be heard in it all winter. On 15th April the bees were found all dead on the bottom board and appeared to have died early in the winter, as scarcely any honey was consumed and the combs were dry and clean. Weight on 15th April, $47\frac{1}{2}$ pounds. It is plain that this plan cannot be recommended.

Experiment No. 5.—One colony was placed in a packing case large enough to allow of 4 inches of cut straw and chaff being packed all round the hive, and the box was left out of doors in a sheltered place on the ground in the yard. Bottom board loosened and 1-inch blocks put at each corner between bottom board and brood chamber. Wooden cover also replaced by 4-inch chaff cushion, and box filled up with 4 inches of chaff and cut straw. No ventilation.

The case was, besides, buried under a foot of snow shovelled upon it. No sound could be heard from this hive during the winter till it was taken out on 15th April; the weight had been reduced from 57 pounds in November to $49\frac{1}{2}$ pounds, the bees having consumed $7\frac{3}{4}$ pounds. On being taken out, the hive was found very wet and mouldy with a thickness of about two inches of dead bees on the bottom; two frames only were partly filled with bees. Water had evidently come in from the outside, which would have been avoided if the hive had been raised about one foot from the ground, and the results might then have been much better.

On 1st May the bees from this hive were gathering pollen, but were few in number. May 14:—Colony very weak, but queen apparently in good condition; two frames with brood and eggs and new honey. June 1:—Hive deserted, though plenty of stores remaining; $11\frac{1}{2}$ pounds of new honey in the brood chamber.

Experiment No. 6.—One colony packed exactly as No. 5, but with ventilating shaft from entrance to the outside of the case which was placed three feet from the ground on the top of an empty case out of doors.

No sound could be heard from this hive all winter up to the 1st April, when a slight hum was perceptible. On 8th April the first bees made their appearance, some flying in the evening; there were many dead bees at the entrance; outside temperature, 44° F. From the 8th to 14th April, on warm days, a few bees were noticed flying. On 15th April the hive was taken out of the packing case and found to be deserted; many dead bees lay at the back end of the hive; the frames above were all dry and clean.

The hive when put into the case on 22nd November, weighed 51 pounds; when taken out on 15th April, $39\frac{1}{4}$ pounds, $11\frac{3}{4}$ pounds of honey having been consumed.

Conclusions:—The mode of wintering that has given most satisfaction is No. 1.

Hives put in the cellar as they came from the bee-yard with the tops and bottoms on (No. 2), had not sufficient ventilation. Dampness caused dysentery.

In the hive packed in saw-dust with no ventilation (No. 4,) the bees were smothered; in the hive similarly treated but with ventilation (No. 3,) the colony was much weakened by heat, dampness and insufficient ventilation.

The hives packed in chaff and left out of doors, one on the ground without ventilation (No 5) and the other with a ventilating shaft (No. 6), seem to have both been

insufficiently protected with packing, but the former one probably suffered most from the water that found its way into the hive.

The temperature of the cellar during the winter 1895-96 was:—

November.....	38° to 40° F.
December.....	40° to 44° F.
January.....	38° to 44° F.
February.....	38° to 43° F.
March.....	40° to 41° F.
April.....	40° to 47° F.

SEASON OF 1896.

- April 13, 1896.—The weather being very fine, bright and calm (temperature in the cellar 42° F., out of doors, 55° to 59° F.), three hives were taken out of the cellar at noon and placed on their summer stands, which were set on about one foot of snow. The bees began to fly at once, but at night there was a considerable number of dead bees about the entrances.
- “ 14.—Weather very cool; very little flying.
- “ 15, 16.—Very warm, bees actively gathering pollen on willows in the swamps.
- “ 16.—Remaining colonies taken out. Temperature in cellar 47° F.; out of doors, 75° to 78° F.
- “ 16–30.—Bees working well, gathering pollen on willows and soft maples. Some bees seen attempting to rob; entrances of threatened hives were contracted so that only one bee could pass at a time.
- May 1–7.—Bees gathering pollen. Two days were cold and windy; some dead brood was carried out before the entrance of the hive.
- “ 8–13.—Bees began to work on cherry and plum blossoms.
- “ 13.—Apple blossoms provide abundance of pollen and honey.
- “ 14.—Dandelions in full bloom and very attractive to bees.
- “ 15–20.—Very fine; bees working well.
- “ 20.—White flowers of *Viburnum Lantana* covered with bees gathering honey.
- “ 20–31.—Bees working well; buckthorn hedges (*Rhamnus frangula*) thronged with them. This, like the *Viburnum*, appears to be a very valuable shrub for bees, as it comes in bloom so early in the season, before the clovers. Both these shrubs, especially the buckthorn, make also good and useful hedges and can be grown from seed.
- June 4.—Bees clustering for the first time. Removed all cushions and propolis quilts. Placed supers on all hives requiring them.
- “ 5.—Clover and Mock Orange (*Philadelphus*) beginning to bloom.
- “ 13.—First swarm of the season.
- “ 19.—Bee-moth grubs found in some of the hives, of which the colonies had died or deserted in the spring. These hives were taken into a closed room, and fumigated with sulphur. For this purpose the brood chambers, after removal of the top and bottom, were piled on the top of each other, and raised sufficiently from the floor to allow of an iron vessel standing on legs, containing half a pound of sulphur to be placed under the lowest; the sulphur was ignited, and the fumes rose through all the frames and killed every grub.
- “ 22.—Inspected every hive; a considerable number of sections were capped.
- July 1.—First honey taken off from the hives this season.
- “ 3.—Noticed bees very thick on mustard and basswood, of which the blossoms are just opening. Marked all supers, and removed those that were full.
- “ 21.—Bees working still on clover and basswood, and beginning on the English horse-beans.
- “ 23.—Basswood blossoms just finished.
- “ 24.—Noticed bees abundantly attracted by the following flowering plants:—*Asclepias tuberosa*, *Aster sibiricus*, *Centaurea macrocephala*, *Linaria spectabilis*, *Veronica spicata*.

- July 26.—Bees very thick on St. John's wort.
 " 27.—Buckwheat plot No. 1 in bloom ; bees working well.
 Aug. 4.—Workers first noticed killing drones.
 " 6-18.—Very hot and dry ; this weather lessened the flow of buckwheat nectar considerably, so that the bees worked on this plant only early in the morning.
 " 18-Sept. 1.—Weather very fine, with occasional showers ; bees flying well, but no increase in weight of honey.
 Sept. 1.—Removed all supers, and weighed brood chambers ; all the hives of a weight less than 55 pounds were given extracting frames with good sealed stores, so that they might go into winter quarters weighing about 50 pounds. For this, the frames that were empty, or nearly empty, were taken out and replaced by full frames with well-capped honey. When it was not found advisable to replace the frames, but feeding was necessary, a super containing partly-filled sections, or extracting frames, was placed on the top on the propolis quilt, a corner only—about one inch—of the quilt being turned back to provide a passage for the bees, so as to make the bees believe they were taking the honey from another hive. It is important to uncap the whole of the sections or frames in the super, or the bees will not take the honey down to their own combs so readily. If this mode of feeding is followed, there is little danger of the bees robbing.

The above excellent plan of placing a quilt under the super, as explained above, was suggested to me by Mr. William McEvoy, of Woodburn, Ont., Foul Brood Inspector, and proved perfectly successful. This plan prevents robbing, and uses up any sections which may be only partially filled.

Those who have no extra sections or frames of honey should feed granulated sugar of the best quality, two parts, by measure, in water, one part. The water should first be boiled and then, while still on the stove, kept thoroughly stirred while the sugar is put in and until all is dissolved. This syrup is to be fed lukewarm, great care being taken not to allow any to leak or be spilt around in the hive. We generally use a Miller feeder.

BUCKWHEAT.

Two plots of Silver-hulled buckwheat were sown last season on the Experimental Farm, primarily as pasturage for the bees, but also for the grain.

Plot No. 1.—The ground was partly sandy, partly clay loam. A dressing of wood ashes—about 150 bushels to the acre—was applied during the early part of the winter and ploughed under in spring. The buckwheat was sown on 20th June, three pecks to the acre. It came up 27th June, was in bloom 26th July, when the bees began at once to work on it ; its growth was strong and even, and the seed was ripe on 25th September. A heavy frost on 22nd September injured this plot so that it was of no further use for the bees. Yield of threshed grain per acre, 29 bushels 26 lbs.

Plot No. 2.—Soil similar. Sown, 29th June ; came up, 5th July ; in bloom, 30th July and 1st August, when the bees began at once to work on it ; it made a strong and even growth. It was injured by frost on 22nd September, and cut on 25th September. Yield of grain per acre, 23 bushels 32 lbs.

FIVE-BANDED ITALIAN BEES.

There is in the apiary but one colony of pure Five-banded Italian bees. It has again this year given very good returns. It was one of the colonies of the wintering experiment No. 1, and came out of winter quarters fairly strong, having consumed only $7\frac{1}{2}$ pounds of honey. During the summer it made 20 sections of honey and 53 pounds of extracted honey, and swarmed once in July. A swarm from another hive, which came out at the same time, was very much mixed with this one, but the Italian queen came through safely. These two swarms together made 22 sections and $37\frac{1}{2}$ pounds of extracted honey.

HIVE IN A WOOD SHED.

Many inquiries having been received from the city, where space is scarce, about the possibility of keeping bees in sheds, we tried last season by placing one in a wood shed. A small hole, 6 inches by 6, was cut in the side wall of the shed, on a level with the floor, facing the south. The entrance of the hive was close to this. From 15th April to 1st May bees from other hives tried very hard to rob this hive; so the entrance was contracted so as to allow only one bee to pass in and out at a time. This hive and the swarm which it gave produced 93 sections of honey. This hive has been left in the shed for the winter. (See Experiments in wintering, 1896-97, No. 5.)

HIVE KEPT ON SCALES TO SHOW DAILY GAIN.

Records of the daily weighing of one colony were kept during the summer. This was a first swarm secured on 13th June, and weighed at that date $6\frac{3}{4}$ pounds. It was put into a hive with four frames of drawn comb and four frames of foundation, placed alternately.

1st week from	17th June,	gain.....	$22\frac{3}{4}$ lbs.	
2nd	" 24th	" "	$20\frac{1}{2}$ "	
3rd	" 1st July	" "	$12\frac{1}{4}$ "	
4th	" 8th	" "	$15\frac{3}{4}$ "	
5th	" 15th	" "	$15\frac{1}{4}$ "	
6th	" 22nd	" loss		$4\frac{1}{4}$ lbs.
7th	" 29th	" gain.....		
8th	" 5th August	" "	$11\frac{3}{4}$ "	
9th	" 12th	" loss		$\frac{1}{4}$ lb.
10th	" 19th	" "		2 lbs.
11th	" 26th	" "		1 lb.
			<hr/>	
			$98\frac{1}{4}$ lbs.	$7\frac{1}{2}$ lbs.

Making a total gain in weight of $90\frac{3}{4}$ pounds. Ninety-four sections of honey were taken from this hive. Some of the difference represents the weight of brood, &c.

The largest gain on any one day was $6\frac{1}{4}$ pounds, on two occasions, one during the clover flow and the other during the basswood flow.

RETURNS.

The total returns of the Central Farm Apiary for the season of 1896 show an average of 50 sections, and 16 pounds and $\frac{1}{2}$ ounce of extracted honey for each colony.

THE BEE CELLAR.

The winter quarters are a chamber boarded off from the cellar of a private house. In former winters, it was found to be too cold and damp and the ventilation was not satisfactory. There was only an upright ventilator, 3 inches by 3 inches, passing through the ceiling up to a stove pipe, and provided with a damper with which to regulate the draught; but no air could be let in from the outside.

Several important improvements have been made in this cellar during the last summer: a cement floor, shelves and an entrance from the outside. It is also larger than before, being 11 feet 6 inches by 15 feet, which allows 3 tiers of shelves above each other, and two passages. It is boarded off from the remainder of the cellar by a partition of tongued and grooved lumber. The floor is concrete over 8 inches of small stones. The lowest shelf is 18 inches from the floor, the second 20 inches clear above, and the third again 20 inches clear above that; neither the hives on the third shelf nor the uprights supporting the shelves reach the ceiling, so that no vibrations can reach the hives from the ceiling above.

Outside air can be let in at any time by slides into both the bee-chamber and the large cellar. Adjoining the bee-chamber is a smaller one provided with ventilators and having a coal stove, so that, whenever necessary, fire can be made to raise the temperature or purify the air of the whole cellar by increasing the ventilation.

EXPERIMENTS IN WINTERING (1896-97).

Colonies put into winter quarters, 16th November, 1896.

No. 1.—A repetition of experiment No. 1 of the former winter, with 15 colonies of an average weight of 50 pounds and 15 $\frac{3}{4}$ ounces each.

No. 2.—A repetition of experiment No. 2 of former winter, with two colonies weighing respectively 49 pounds and 56 pounds.

No. 3.—Two colonies weighing 60 $\frac{1}{2}$ pounds and 63 pounds were placed in the root house of the Central Experimental Farm, which is 100 feet long, 25 feet wide and 10 feet deep. They are on a shelf nailed up against the side wall about 3 feet from the ceiling and projecting about 2 feet. A curtain is hung from the wall over the top and front of the hives, so as to keep out all the light. The propolis quilt of one of these hives had been removed on 2nd November and a cushion put in in its place. That of the other hive has been left and a cushion placed above it, but the front of the hives has been raised half an inch more by means of an inch block in the middle of the entrance.

No. 4.—Two colonies weighing 50 pounds and 52 pounds, have been put into a pit dug in the side of a hill 3 feet deep by 3 feet in width and 10 feet long, so that the ventilators at both ends should not be immediately above the hives which are in the middle of the pit. The hives rest on two cedar poles laid along the full length of the pit. A third cedar pole of the same length is laid in front of the entrance of the hives and insures the necessary circulation of the air from the ventilators. These ventilators which are 3 inches by 4, are made of boards, three of which reach down to the bottom of the pit, the fourth only to the top of the pit, and they rise 3 feet above the ground.

In each hive half-inch strips of wood have been laid under both sides and under the back end, between the brood chambers and the bottom boards, so as to provide more space at the bottom of the hive in case a quantity of dead bees should accumulate there.

The pit is filled up with loose straw up to four inches from the top, which is made of cedar poles along the length of the pit, the middle ones higher than the others, covered with a layer of straw and one foot of soil.

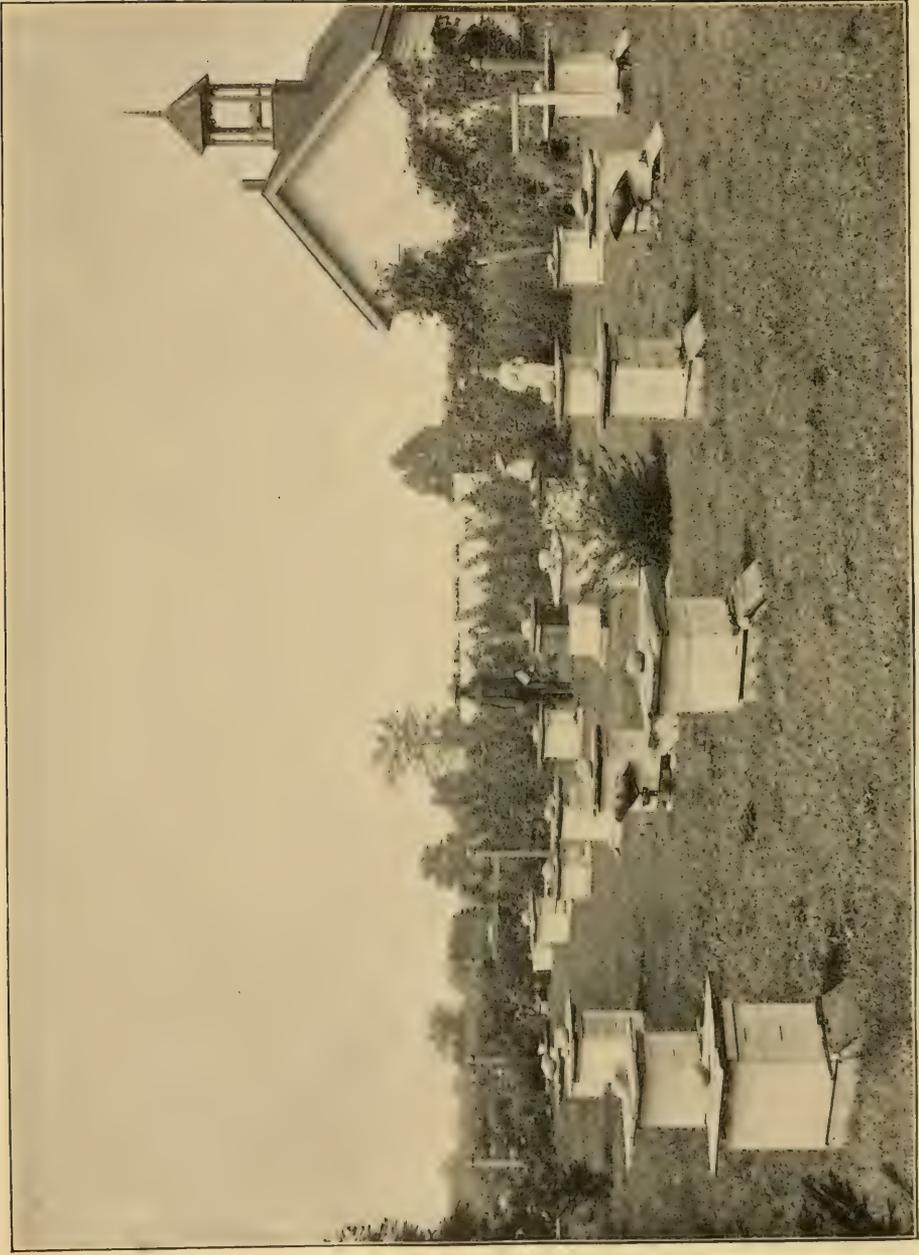
A small shaft has also been arranged between the hives, down which a thermometer can be let by means of a string, so that the temperature of the pit may be ascertained. The thermometer is examined once every week. If the temperature rises too much, some of the covering may be removed; and if the contrary, some may be added.

No. 5.—Two colonies, weighing 54 pounds, and 63 pounds, were put in a wood shed, the walls of which are double-boarded, with an air space of four inches. The floor, which is about one foot from the ground, is also double-boarded, and there is no draught under it. The hives are about one foot from the wall, resting on a double thickness of sacks laid on the floor, and are covered above and all round with a double thickness of the same sacking. No ventilation is provided for one hive. For the other, which is the one that was kept in the shed during the summer, a small shaft, $\frac{1}{2}$ -inch square, extends from the opening of the hive to the outside of the shed, and $\frac{1}{2}$ -inch strips of wood are put under both sides and under the back end, between the bottom boards and the brood chambers, so as to give more space at the bottom of the hive in case a quantity of dead bees should accumulate there.

A FEW SUGGESTIONS TO BEGINNERS IN APICULTURE.

Locate your bee-yard in a well sheltered place, where no cold wind can chill the brood. It will pay to build a high board fence if you cannot provide shelter in any other way.

Have no high trees near the apiary, for it is very difficult to get the swarms down from them.



View of the Apiary at the Central Experimental Farm, Ottawa.

Shade may be obtained by the use of a second cover to the hives, made of boards one foot wider and one and a half feet longer than the cover of the hive.

Do not use propolis quilts during the honey season

Do not allow your sections to be travel-stained by leaving them in the hives too long ; remove them to a warm room.

If the outside sections are not well filled, put them back in the next super.

Use 4-piece sections in preference to 1-piece sections.

Use full sheets of foundation in your sections ; the bees will go up sooner and work better on full sheets.

In the same way, in the brood chamber use full sheets of foundation ; this will be found a saving of time and do away with much drone comb.

Wire all brood frames and extracting frames.

Always sort your sections and clean them thoroughly before sending them to customers. Send them always in a clean super or in a neat crate.

Let the bees always have a supply of water as near as possible to the apiary, for in cool weather they require a great deal of water, especially when they are rearing a brood or if the honey flow is light.

Always handle your bees with the greatest care and gentleness.

JOHN FIXTER.

REPORT UPON FURTHER EXPERIMENTS WITH CERTAIN BRANDS OF COMB FOUNDATION, BY FRANK T. SHUTT, M.A., F.I.C., CHEMIST, DOMINION EXPERIMENTAL FARMS.

This investigation, commenced in 1894, and continued from year to year since that date, has for its chief object the determination of the relative usefulness in comb building of certain brands of "foundation." It was supposed that those brands of wax of which the bees used the most, or, in other words, to which they added the least amount of wax, in the building of the cell walls, would prove to have the greater value to the bee-keeper. It is argued by most practical bee-keepers that, in supplying the bees with wax that they can readily draw out and utilize in cell formation, a greater store of honey may be expected. This, indeed, seems to be the main reason for furnishing bees with artificial comb, though there are others of perhaps somewhat less importance. On the other hand, however, there are some bee-keepers who think that there is but little advantage in this respect, the chief benefit being a more regular structure of the cells in the section. At my suggestion, Mr. R. F. Holtermann, editor of the Canadian Bee Journal, has kindly furnished the following statement respecting the objects to be attained in supplying the bees with comb foundation :—

"As to the object of using comb foundation, brood foundation is used to save the bees time and material, to get all worker cells, and to secure straight comb. The foundation in the sections is first of all to aid in enticing bees into the supers, to save them material by the giving of wax, to save time, as they can begin storing more quickly in the supers ; also to get an evenly-filled section, and to have it attached to the sides and bottom of section. Bees are much less likely to do this well when they build the comb themselves. Again, it is desirable to have the cells of a uniform size ; by giving them the foundation, this is secured."

In connection with the question of wax utilization and deposition, Mr. Holtermann is also of the opinion that bees utilize the wax in the foundation to a greater extent when the honey flow is light ; in other words, that, when gathering large quantities of honey, bees manufacture or produce more wax than when the honey supply is light. It might be urged that this argument, carried to its logical conclusion, would in a large measure go to show that, in seasons of a heavy honey flow, there is little economy in supplying foundation. In these considerations, the fact must not be lost sight of that wax is not a material gathered by the bees, but a true secretion, the result of the physiological functions of certain glands in the bee, and is produced to a large

extent at the cost of the honey consumed by the insect. Wax, is, therefore, in a sense, a physiological concomitant of honey, and consequently it is improbable that all the wax necessary for the construction of the comb can be furnished the bees; indeed, our past results all point in this direction. It is, however, at the same time true that a portion of this wax can be economically supplied in the foundation, and within certain limits it would appear that the wax added by the bees is inversely proportionate to that furnished as foundation. I am further inclined to the belief that the weight of the comb varies somewhat with the season; the reason for this may be accounted for by Mr. Holtermann's theory already referred to.

For the details of the method of procedure, the reader is referred to page 171, Report of the Experimental Farms for 1895. An additional experiment has, however, been made this year, namely, that of ascertaining directly the weight of foundation after it had been drawn out by the bees. This was done by carefully shaving away the empty cells on both sides till the foundation was left. The great difficulty experienced in doing this with any degree of accuracy, owing to inequalities and to the fact that the foundation is not always in one plane, renders the results but approximate. Indeed, it will only be from oft-repeated experiments in this matter that safe conclusions can be drawn.

In Table I, we present in detail the data showing the weight and percentage of wax added by the bees in building the comb:—

TABLE I.
EXPERIMENTS with various Brands of "Foundation," 1896.

Designating Letters.	Name of Wax and Mill.	Section.	Milling	Weight in grammes of "Foundation," 2 inches square.	Weight in grammes of empty honey-combs, 2 in. square.	Weight in grammes of wax added by bees per 2 in. square.	Percentage of wax added by bees.	Gathered from
			Temperature.					
			F.					
A 1	Choice wax, Root mill.	Outer	89°	1.401	2.655	1.254	89.5	Clover.
A 2	" "	Inner	89°	1.401	2.735	1.334	95.2	"
B 1	" "	Outer	120°	1.204	2.691	1.487	123.5	"
B 2	" "	Inner	120°	1.204	2.647	1.443	119.9	"
C 1	Foundation in general use, 1896	Outer		1.215	2.946	1.731	142.4	"
C 2	" "	Inner		1.215	3.003	1.788	147.1	"
D 1	" " 1895	Outer		1.215	2.761	1.546	127.3	"
D 2	" "	Inner		1.215	2.700	1.485	122.2	"
D 3	" "	Outer		1.215	3.082	1.867	153.6	Buckwheat.
D 4	" "	Inner		1.215	3.182	1.967	161.9	"
E 1	Heavy sheet, Root mill.	Outer	120°	1.315	3.062	1.747	132.8	Clover.
E 2	" "	Inner	120°	1.315	3.069	1.754	133.3	"
F 1	Inferior wax, Root mill	Outer	89°	1.224	2.823	1.599	130.6	"
F 2	" "	Inner	89°	1.224	2.771	1.547	126.3	"
G 1	" "	Outer	120°	1.167	2.664	1.497	128.2	"
G 2	" "	Inner	120°	1.167	2.666	1.499	128.4	"
H 1	Choice wax, Given process	Outer		1.801	3.538	1.737	96.3	"
H 2	" "	Inner		1.801	3.567	1.766	98.0	"
I 1	Poor wax, Given process.	Outer		1.582	3.739	2.157	136.3	"
I 2	" "	Inner		1.582	3.771	2.189	138.3	"
J 1	Patent process, 12 sq. ft. per lb.	Outer		1.004	3.193	2.189	218.0	"
J 2	" "	Inner		1.004	3.311	2.307	229.7	"
K 1	" " 15 sq. ft. per lb.	Outer		1.093	3.555	2.422	221.6	"
K 2	" "	Inner		1.093	3.329	2.236	204.6	"
L 1	Heavy sidewall, R. F. H.	Outer		1.257	2.792	1.535	122.1	"
L 2	" "	Inner		1.257	2.875	1.618	128.7	"

Although in some instances there would appear, comparing the above results with those of last year, to have been less wax added than in 1895, there are so many exceptions that no conclusions can be safely drawn, either as regards variation in weight of

wax deposited or its possible causes. The foundation supplied was from the same stock as that in previous years and consequently the same weight for the 2 inches square of foundation were used. The "percentage of wax added" by the bees, therefore, varies with the "weight of wax added".

The differences between the weights of wax added in the outer and inner sections is so small that the argument that the cell walls of the outer sections are stouter and heavier than those of the inner sections, receives no support from these data. This conclusion is practically identical with that reached in last year's experiments.

It is to be noted that in the case where very light foundations were used, as in *J* and *K*, the weight of wax added was much greater than when heavier brands were supplied.

As reported last year, the weight of wax added when the honey was collected from buckwheat is greater than in that deposited for clover honey.

With respect to the appearance of the comb from different brands of foundation, it was noticed as heretofore that the dark or deep yellow varieties produced unsightly "fishbones," which would materially affect the sale of the honey in the comb.

Since the chief object in this investigation was to ascertain the relative ease with which the wax of the various brands of foundation could be drawn out or utilized by the bees, and the above method of procedure not proving altogether satisfactory, it was thought that, at all events, approximate results could be obtained by weighing the foundation after the empty cells had been shaved away on both sides of the foundation, and subtracting the weight thus found from that of the same area of foundation as put into the section. The figure thus obtained would represent the weight of wax drawn out from the foundation supplied and utilized by the bees in building the cell walls.

The data in Table II, resulting from this method of experiment are:—

TABLE II.
EXPERIMENTS with various Brands of "Foundation," 1896.

Designating Letter.	Name of Wax and Mill.	Section.	Milling Temperature.	Weight in grammes of "Foundation," 2 inches square.	Weight in grammes of "Foundation" after removal of cells.	Weight in grammes of "Foundation" wax utilized by bees.	Percentage of "Foundation" wax utilized by bees.	Gathered from
			F.					
A 1	Choice wax, Root mill.....	Outer.....	89°	1'401	'702	'699	49.9	Clover.
A 2	" " ".....	Inner.....	89°	1'401	'641	'760	54.2	"
B 1	" " ".....	Outer.....	120°	1'204	'835	'369	30.6	"
B 2	" " ".....	Inner.....	120°	1'204	'77	'434	36.0	"
C 1	Foundation in general use, 1896.....	Outer.....		1'215	'842	'373	31.0	"
C 2	" " ".....	Inner.....		1'215	'741	'474	39.0	"
D 1	" " " 1895.....	Outer.....		1'215	'81	'405	33.3	"
D 2	" " ".....	Inner.....		1'215	'821	'394	32.4	"
D 3	" " ".....	Outer.....		1'215	'765	'450	37.0	Buckwheat.
D 4	" " ".....	Inner.....		1'215	'747	'468	38.5	"
E 1	Heavy sheet, Root mill.....	Outer.....	120°	1'315	'856	'459	34.8	Clover.
E 2	" " ".....	Inner.....	120°	1'315	'900	'415	31.6	"
F 1	Inferior wax, Root mill.....	Outer.....	89°	1'224	'803	'421	34.4	"
F 2	" " ".....	Inner.....	89°	1'224	'774	'450	36.8	"
G 1	" " ".....	Outer.....	120°	1'167	'726	'441	37.8	"
G 2	" " ".....	Inner.....	120°	1'167	'712	'455	38.9	"
H 1	Choice wax, Given process.....	Outer.....		1'801	'187	'614	34.0	"
H 2	" " ".....	Inner.....		1'801	'988	'813	45.1	"
I 1	Poor wax, Given process.....	Outer.....		1'582	1'107	'475	30.0	"
I 2	" " ".....	Inner.....		1'582	1'135	'447	28.3	"
J 1	Patent process, 12 sq. ft. per lb.....	Outer.....		1'004	'875	'129	12.8	"
J 2	" " ".....	Inner.....		1'004	'891	'113	11.2	"
K 1	" " 15 sq. ft. per lb.....	Outer.....		1'093	1'014	'079	7.2	"
K 2	" " ".....	Inner.....		1'093	'853	'240	21.9	"
L 1	Heavy sidewall, R. F. H.....	Outer.....		1'257	'793	'464	36.9	"
L 2	" " ".....	Inner.....		1'257	'761	'496	39.4	"

The weight of wax utilized by the bees from 2 inches square of foundation varies from .079 grams to .813 grams. The latter amount of wax was taken by the bees from the heaviest brand of foundation supplied, while the former was from the lightest brand. If we exclude the heaviest and lightest foundations, however, it will be seen that the amounts of wax utilized in cell formation are not subject to much variation, though it should be remembered that the method employed did not allow of any great degree of accuracy in the determination. It will, therefore, be wisest to consider average results before making deductions.

A study of the data of *A 1*, *A 2*, *B 1*, *B 2*, might appear to favour the view that the milling temperature exercised an influence upon the relative ductility of the wax and go to show that wax made at 89 degrees F. is more easily drawn out than that milled at 120 degrees F. This view, however, receives no corroboration from *F 1*, *F 2* and *G 1*, *G 2*,—a parallel case; and I am inclined to the belief that the larger amounts utilized in *A 1*, *A 2*, are due to the foundation supplied being heavier than *B 1*, *B 2*, (see table.)

On calculating the "per cent of wax added," it becomes apparent that in 18 cases (or 70 per cent of the trials made) this percentage was between 30 and 40; in three trials, more than 40 per cent, and in 5 instances, less than 30 per cent. As remarked in considering the "weight of wax added," the higher numbers were obtained from the heavier foundations.

Table III, which presents the averages of the foregoing data, was prepared for the purpose of making clearer the features already alluded to and to assist in the more ready comparison of the data from the various brands.

TABLE III.

TABLE of Averages, 1896.

Designating Letter.	Name of Wax and Mill.	Milling Temperature.	Average weight in grammes of 2-in. sq. of empty comb.	Average weight in grammes of wax added by bees.	Average percentage of wax added by bees.	Average weight in grammes of "foundation" after removal of cells.	Average weight in grammes of "foundation" wax utilized by bees.	Average percentage of foundation wax utilized by bees.
		F.						
<i>A 1</i>	Choice wax, Root mill.	89°	2·695	1·294	92·3	·671	·729	52·0
<i>A 2</i>								
<i>B 1</i>	" "	120	2·669	1·465	121·7	·802	·401	33·3
<i>B 2</i>								
<i>C 1</i>	Foundation in general use, 1896. ....	.....	2·974	1·759	144·7	·791	·423	35·0
<i>C 2</i>								
<i>D 1</i>	" " 1895. ....	.....	2·730	1·515	124·7	·815	·399	32·8
<i>D 2</i>								
<i>D 3</i>	" " 1895. ....	.....	3·132	1·917	157·7	·756	·459	37·7
<i>D 4</i>								
<i>E 1</i>	Heavy sheet, Root mill.	120°	3·065	1·750	133·0	·878	·437	33·2
<i>E 2</i>								
<i>F 1</i>	Inferior wax, "	89°	2·797	1·573	128·4	·788	·435	35·6
<i>F 2</i>								
<i>G 1</i>	" "	120°	2·665	1·498	128·3	·719	·448	38·3
<i>G 2</i>								
<i>H 1</i>	Choice wax, Given process .....	.....	3·552	1·751	97·1	1·087	·713	39·5
<i>H 2</i>								
<i>I 1</i>	Poor wax, " .....	.....	3·755	2·173	137·3	1·121	·461	29·1
<i>I 2</i>								
<i>J 1</i>	Patent process, 12 sq. ft. per lb. ....	.....	3·252	2·248	223·8	·883	·121	12·0
<i>J 2</i>								
<i>K 1</i>	" 15 " .....	.....	3·442	2·329	213·1	·933	·159	14·5
<i>K 2</i>								
<i>L 1</i>	Heavy sidewall, R. F. H .....	.....	2·833	1·576	125·4	·777	·480	38·1
<i>L 2</i>								

There would not appear to be any definite relation between the weight of wax added and that of the wax utilized, though the data of *I 1*, *I 2*, and *K 1*, *K 2*, make it evident that in very light foundations the amount of wax utilized is very small and the amount added correspondingly large. This would point to economy in supplying heavier foundations than the brands just referred to, if the question resolves itself into one of furnishing wax that can be utilized by the bees.

The average weight of "foundation" after the removal of the cells, is, all things considered, seen to be fairly constant. The greatest weight was from "Choice Wax, Given Process"—the heaviest foundation experimented with—, the least weight was obtained from "Choice Wax, Root Mill, temperature 89 degrees F." by no means the lightest brand used, but the brand from which the bees utilized the most wax.

In considering the average weight of foundation wax utilized, the largest amounts were from *A 1*, *A 2*, and *H 1*, *H 2*, the Choice Wax of the Root Mill and Given Process, respectively. The least amounts so utilized were from "Patent Process" 12 square feet and 15 square feet per pound.

In summing up the results of this year's work, we may conclude that, considering the values of the comb foundations to be dependent upon the extent to which they are utilized by bees in cell formation, the Choice Wax, Root Mill, temperature 89 degrees F., gave the best, and the "Patent Process," 12 square feet and 15 square feet per pounds, the poorest results. Both the Choice and Poor Wax of the "Given Process" give very heavy "fishbones." Concerning the other brands on these points, the differences are not sufficiently well marked to allow of any emphatic statement being made respecting them.

F. T. SHURT.

NOXIOUS WEEDS.

The subject of weeds is one of burning interest all over Canada, and is too large to treat exhaustively in this place. Farmers, as a rule, are not well informed even with regard to the common species of aggressive weeds occurring on their land. Figures have already been given in former reports of some of the plants, the appearance, name and nature of which it was important, from their injuries, should be known so as to be eradicated whenever noticed. I submit herewith a figure of one of the new pests of Manitoba, namely the Cow Cockle (*Saponaria Vaccaria*, L.), also known locally under the different names of Cow Herb, China Cockle and Soapwort. This plant has been noticed as an aggressive enemy in field crops only during the last two years, and so far only in the province of Manitoba, where it has spread very rapidly, particularly in the Mennonite settlements and other parts of Manitoba, the pretty porcelain pink flowers sometimes occurring in such numbers as to give a reddish tinge to many acres of crop. The Cow Cockle belongs to the Pink or Carnation family. It is an annual herb with pale green, fleshy, sessile leaves, borne in pairs at each joint of the stem. The flowers first appear in Manitoba in July; they are about $\frac{3}{4}$ inch in diameter and are borne in large numbers, but each singly at the end of the thread-like branchlets of the many times divided flowering stems, as shown in the excellent figure herewith, which is engraved from a photograph taken by Mr. R. G. Mackay at Indian Head. Strong plants will frequently grow over two feet in height, with a diameter almost equal. The smooth

pod is inclosed in a five-angled calyx which enlarges with it. When the seeds are ripe the apex of the pod opens, forming a four-toothed orifice. Each of the pods with its enveloping five-winged calyx, measures about $\frac{1}{2}$ inch in diameter, and contains an average of 16 round, black, slightly roughened seeds. This plant, together with the Tumbling Mustard (*Sisymbrium altissimum*, L.; = the *S. sinapistrum*, Crantz, of former reports), Ball Mustard (*Neslia paniculata*, Desv.), Hare's-ear Mustard (*Erysimum orientale*, R. Br.*), and False Flax (*Camelina sativa*, Fries.), has spread with almost incredible

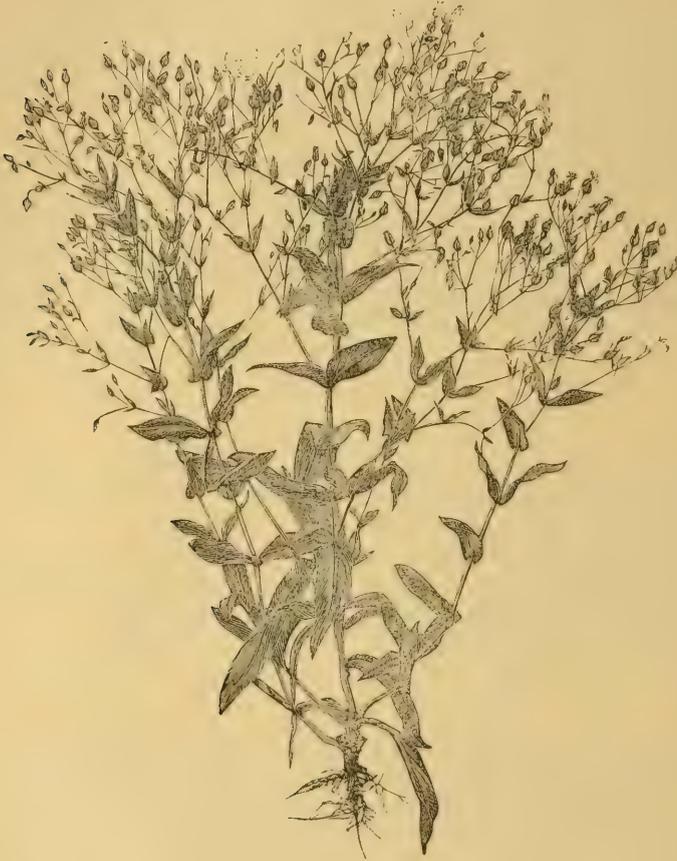
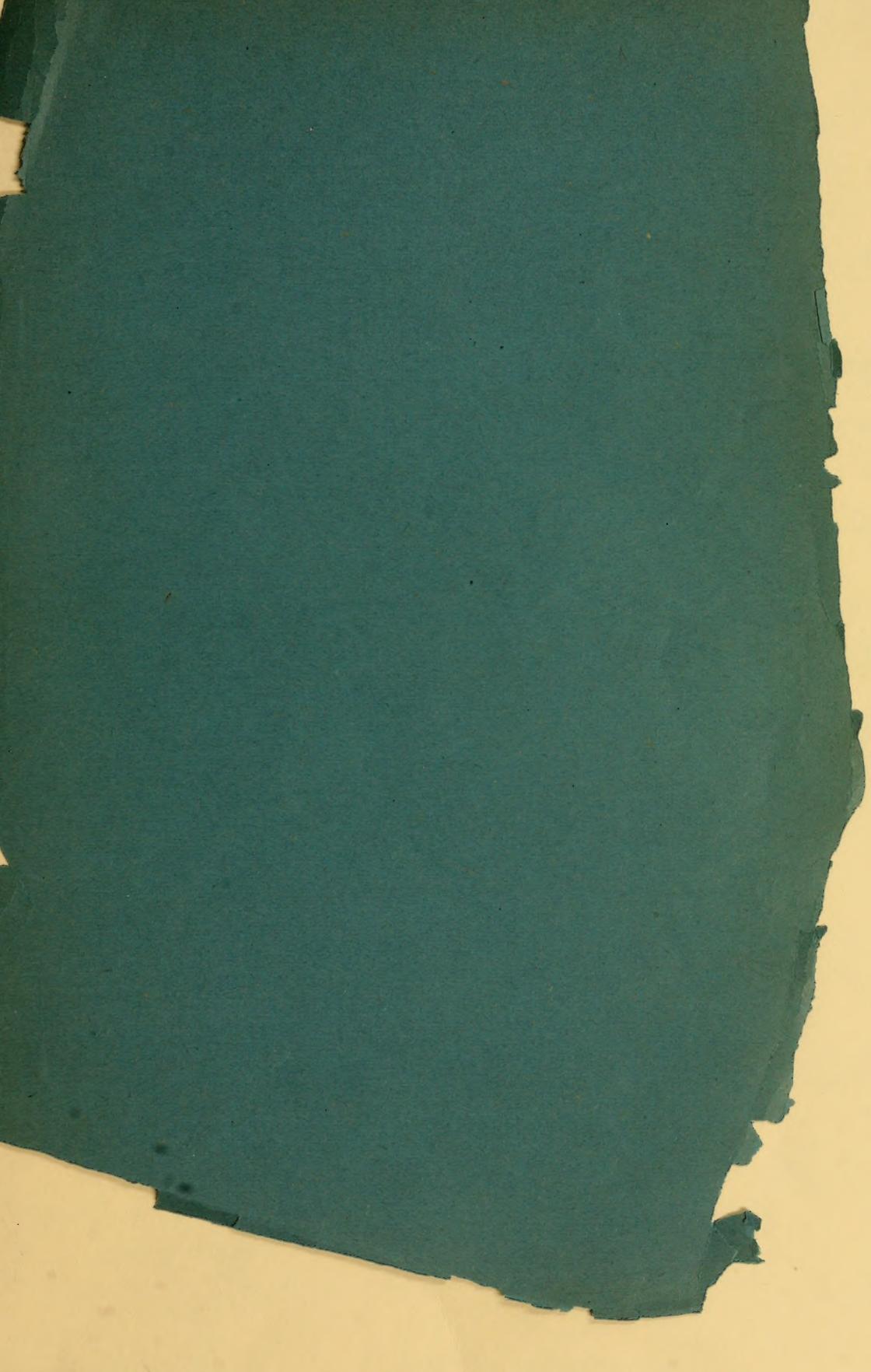


Fig. 18.—Cow Cackle.

rapidity through the wheat-growing districts of Manitoba and the North-west Territories. The indications are that all of these were introduced from Europe in flax seed, and, although in the case of the Cow Cackle and Ball Mustard, there was little in their appearance from which it might be anticipated that they would become troublesome, the rapidity with which they have spread shows how important it is that every one of these plants should be destroyed by hand pulling or summer fallowing as soon as detected on land in a new locality.

*This plant is now known under the name of *Conringia orientalis* (L.), Andr. *Conringia* is quite a different genus from *Erysimum* and certainly should be separated from it.—J. F.





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