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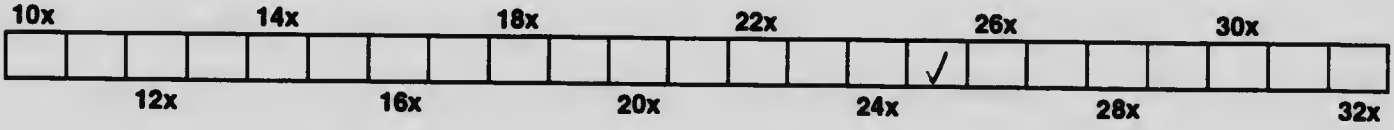

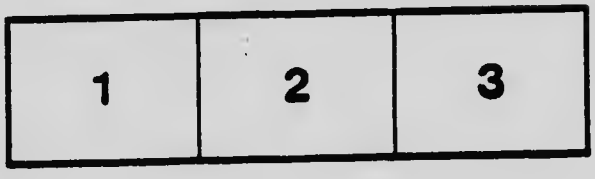

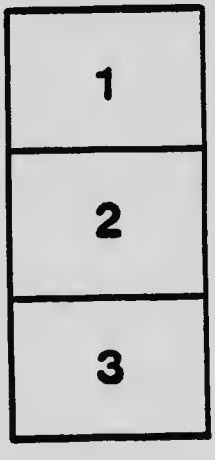

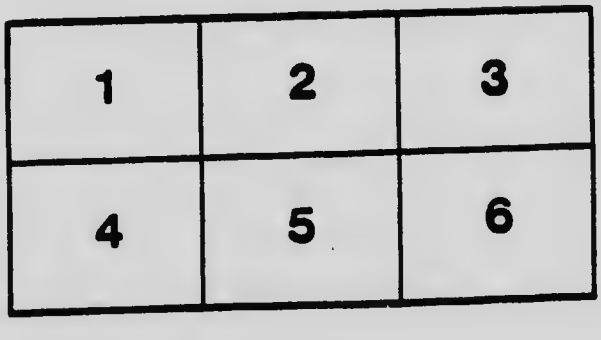

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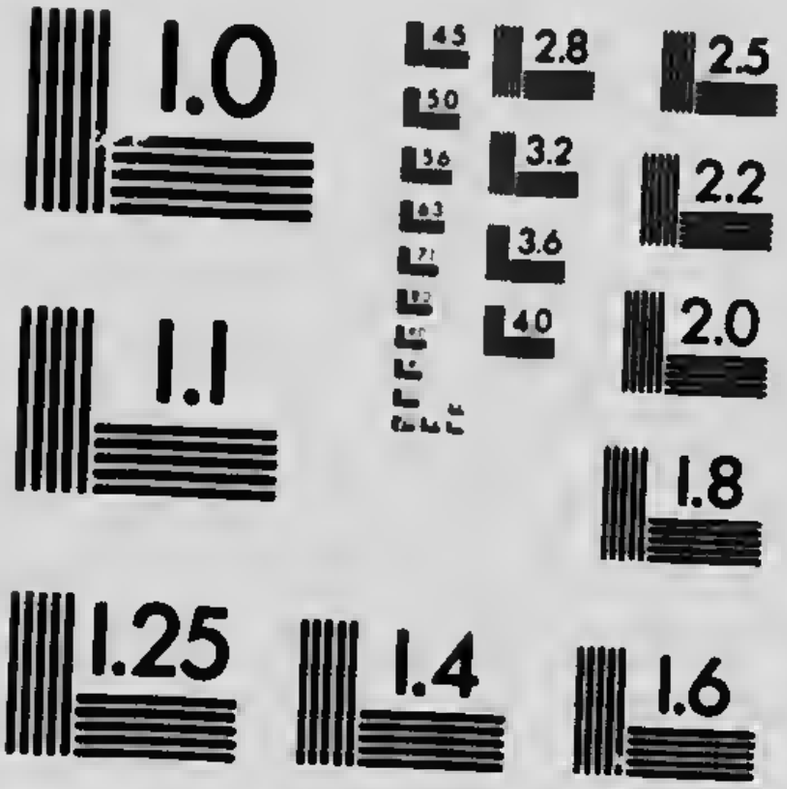

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ENTOMOLOGICAL BRANCH
C. GORDON HEWITT, DOMINION ENTOMOLOGIST

CUTWORMS AND THEIR CONTROL

BY

ARTHUR GIBSON
Chief Assistant Entomologist

BULLETIN No. 10

Published by direction of Hon. MARTIN BURRELL, Minister of Agriculture, Ottawa.

OTTAWA
GOVERNMENT PRINTING BUREAU
1915

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NOTE.

Farmers and others are invited to send specimens of cutworms, or of other insects, which are found causing injuries to their crops. Such specimens should be enclosed with a supply of food plant or grass in a tin or wooden box (not a paper box). Small packages up to 12 ounces in weight may be mailed "Free" as third class matter if addressed to the Dominion Entomologist, Department of Agriculture, Ottawa In all cases the specimens should bear the address of the sender, and should be accompanied by a letter giving the crops which are being attacked and the extent of the damage.

OTTAWA, March 11, 1915.

To the Honourable
The Minister of Agriculture,
Ottawa.

SIR,—I have the honour to submit herewith for your approval Bulletin No. 10 of the Entomological Series on "Cutworms and their Control," which has been written by Mr. Arthur Gibson, Chief Assistant Entomologist.

This bulletin is an enlarged and revised edition of our former Bulletin No. 3 (Bull. No. 70 of the Experimental Farm Series) which is now out of print. It contains descriptions of several Cutworms not mentioned in the previous bulletin, the most important of these being the Pale Western Cutworm, *Porosagrotis orthogonia*, which hitherto had not been recorded as an injurious species, but which has been the cause of extensive damage and loss in southern Alberta. In addition, improved methods of control are described, and further notes on life-histories are given. An entirely new set of illustrations has been prepared with a view to providing greater facilities for the identification of the different species. The Army-worm is described in a separate bulletin (No. 9).

Every grower of field and garden crops or plants, whether he cultivates a few square yards of ground or several hundred acres, experiences more or less serious losses owing to the presence of these common insects; losses which in many cases might have been prevented or materially reduced had he been in possession of the information contained in this bulletin. Consequently, the bulletin will be of value to a very large number of people. At the same time it should be pointed out that the information which we possess concerning the life-histories and habits of several of our common species of noctuid caterpillars is still very meagre, but by constant investigation we are endeavouring gradually to fill in these gaps in our knowledge and to improve the methods of control.

I have the honour to be, sir,

Your obedient servant,

C. GORDON HEWITT,
Dominion Entomologist.

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CONTENTS.

CUTWORMS AND THEIR CONTROL.

By Arthur Gibson, *Chief Assistant Entomologist.*

SUMMARY.

Cutworms are noctuid caterpillars which are more or less abundant every year and which, as a class, rank in importance with our worst insect pests. These caterpillars are smooth and in shape cylindrical and have sixteen feet; in colour, most of them resemble the soil in which they hide during the day.

The life-histories of even our commoner cutworms are by no means complete. Some hibernate in the pupal state, or as half-grown caterpillars, and others in the egg or adult state. A single female moth lays several hundreds of eggs. These are deposited in clusters on the leaves of weeds, grasses, shrubs, etc. When full grown, the cutworms are about an inch and a half in length, and enter the ground to the depth of an inch or two to transform to the pupal condition, the adult moths emerging, as a rule, in June, July, and August.

Under normal conditions, cutworms feed at night. As the name "cutworm" indicates, these caterpillars cut off plants near the surface of the ground, or a little below it. Some kinds climb fruit and other trees and destroy the buds or young fruit, etc. Others feed entirely below the surface of the ground, attacking the roots of grasses and other plants. Cutworms when they become excessively abundant march ahead in true army-worm habit.

The destruction wrought every year throughout Canada by these insects amounts to a large sum of money. In some seasons when they occur in extraordinary abundance, this loss totals hundreds of thousands of dollars.

Clean cultivation is an important factor in the control of cutworms. This includes the collection and burning of all refuse remaining after the removal of crops, and the destruction of weeds. Infested land should be ploughed deeply in the fall. These methods destroy many hibernating caterpillars and pupæ in the soil.

For the protection of plants which are set out annually, cylinders made of tin or paper may be placed around the stems of the plants. As the surface-feeding cutworms cannot climb such bands, their attacks in this way will be prevented.

Birds, beneficial insects, and parasitic diseases, help materially to control cutworms. Farmers, horticulturists, and others should aid in the work of protecting our insectivorous birds. They are among the best friends the farmer has, and this fact should be more fully realized.

Bran, poisoned with Paris green, is the best remedy for the destruction of most kinds of cutworms, and should be applied immediately their presence is detected. Fresh bundles of clover, etc., which have been sprayed with a strong Paris green or arsenate of lead mixture, are also very useful, and should be placed at short intervals apart throughout an infested field.

When cutworms assume the marching habit, deep furrows should be ploughed across the fields ahead of the caterpillars. In these furrows, at intervals of about fifteen feet apart, post holes should be dug. The caterpillars, when they reach the furrows, wander along in them and fall into the holes, where they may be crushed by means of a post or a piece of fence rail, or a small quantity of coal oil may be poured over them.

INTRODUCTION.

Cutworms cause more widespread injuries and are responsible for more inquiries on the part of farmers, market gardeners and others who cultivate the soil, than most classes of injurious insects. Taking them as a class, they rank in importance with such well-known pests as the San Jose Scale, the Codling Moth, and the Hessian-fly—all of which are among our most destructive insect enemies. There are certainly few insects which, year after year, do such widespread damage to garden and field crops as the various caterpillars known commonly as cutworms. The annual loss occasioned by these insects in Canada amounts to hundreds of thousands of dollars. In one year (1900), the Variegated Cutworm alone destroyed in British Columbia crops to the value of $168,000, and, if we add the losses in the same season in Manitoba and Ontario, the figures would easily reach $200,000. Chittenden has estimated that the total damage caused by this cutworm in the above year in the United States and Canada amounted to the enormous sum of $2,500,000.

FIG. 1.—*a*, Moth of Yellow-headed Cutworm, *Hadena arctica; b*, moth of Clover Cutworm, *Mamestra trifolii; c*, moth of Pale Western Cutworm, *Porosagrotis orthogonia*; *d*, moth of Dingy Cutworm, *Feltia ducens*—all natural size. (Original).

The moths of these cutworms belong to the family Noctuidæ, of which in North America there are over two thousand different kinds. In Canada, fortunately, not more than about twenty-five of these have ever appeared in numbers, as cutworms, to do serious damage to growing plants. The moths in general are similar in appearance, being of a grayish or dull-brownish colour, the front pair of wings being usually crossed with four or five irregular lines. On each of these wings, also, are two characteristic marks, the one nearest the body, about halfway down the wing, being round or orbicular in shape and the other, nearer the tip of the wing, larger and reniform or kidney-shaped. In size, they expand from about an inch to two inches in width, when the wings are spread. When at rest, the wings lie folded over the body. Being nocturnal in habit, they are seldom seen during the day time, but in the early evening they appear in search of the nectar of flowers. They are readily attracted to lights and, for this reason, the bright lights, such as are used along the city and town streets, are often visited by entomologists for the purpose of securing the moths for study. At night the eyes of these moths shine brightly, and owing to this and their nocturnal habit, they were given the popular name of "owlet-moths."

In England cutworms are known as "Surface Grubs" or "Surface Caterpillars." In Germany they receive the popular names of "Erdraupen," "Wurzelraupen" and "Grasraupen" which may be translated respectively as "Ground Caterpillars," "Turnip Caterpillars" and "Grass Caterpillars." The French popular name "Ver Gris" (Grey Grubs) is very descriptive; the moths are generally known as "Les Noctuelles."

The eggs (see figure 13, *e* and *f*) of these moths are, in general, similar in appearance, being pale in colour, dome-shaped and less than one millimeter in diameter. If examined under a lens, they are seen to be beautifully ribbed, the ribs being joined by indistinct cross-ridges.

The caterpillars, or cutworms, of these moths, are also, usually, nocturnal in habit. When conditions are not normal, however, as for instance where there is a lack of food, their feeding habits become changed and they feed by day as well as by night. In general, cutworms are similar in appearance, being smooth, cylindrical caterpillars about an inch or more in length, and in colour of some dull shade, similar to the ground. When disturbed, they coil themselves up. During the day they hide just beneath the surface of the soil.

FIG. 2.—Young plant showing characteristic cutting habit of cutworms. (Original).

NATURE OF INJURIES.

Injury by cutworms is mostly effected in spring, when plants are young and succulent, but there are a few species which occur in destructive numbers as late as the middle of summer. As a rule, however, cutworm injury ceases before the end of June. As their popular name indicates, these caterpillars have the habit of cutting off the plants, during the night, near the surface of the ground or a little below it. When they are present in numbers in a garden or field, the plants will soon be seen to have been cut, or eaten off, and if an examination is made, the cutworm will most likely be discovered in the soil, coiled up and just below the surface. In many instances, the young plant will be found to have been drawn partly into the ground. Not all cutworms, however, feed in this manner; some climb up into fruit trees or such plants as currants, gooseberries, tomatoes, etc., and feed upon the foliage or the fruit. In fact, when they are excessively abundant, they will attack anything green and juicy. In such years some kinds assume the marching habit, so characteristic of the Army-worm. In seasons of severe infestations it is often necessary, unless the proper precautions are taken, to resow, or replant a second, or even a third, time before a crop can be secured.

LIFE-HISTORY.

As cutworms vary considerably in the time of their appearance in the different stages—egg, larva, pupa, and adult—and as such appearance, too, is often irregular from year to year, it is not possible to state their life-history in general. Some pass the winter in the pupal state, or as half-grown caterpillars, and others in the egg or adult state. The moths of the chief injurious species appear in June, July and August.

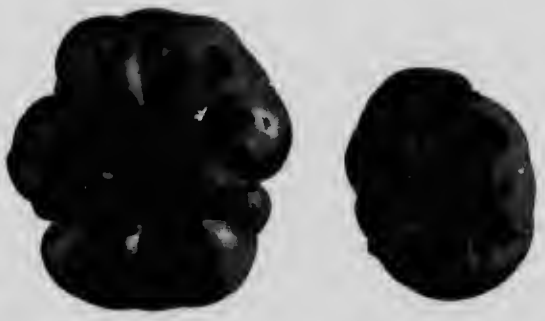

FIG. 3.—Green tomatoes eaten into by the Variegated Cutworm. (Original).

The eggs of cutworm moths, as a rule, are laid in clusters or masses on the leaves of trees, shrubs, weeds, grasses, etc. They have even been found on window panes and on the putty, as well as on clothes which had been hung out to dry. In the case of the Variable Cutworm, *Mamestra atlantica* Grt., we have found the eggs on the upper surface of a honeysuckle leaf, in a compact heap of three layers. Another species (in confinement) laid eggs singly or in clusters of from three to twenty. The number of eggs laid by a female varies considerably. In some clusters there will be less than 100 eggs, in others, over 700; in fact, a female of one species is known to have laid over 1,000 eggs. The eggs of most of these moths are laid in early or midsummer. Those of some species, however, may be deposited as early as the end of April.

FIG. 4.—Earthen cocoon made by cutworm, in which it pupates. (Original).

a *b*

FIG. 5.—Pupæ of cutworms: *a*, ventral aspect; *b*, lateral aspect. (Original).

When a cutworm becomes full-grown, it enters the earth and makes an earthen cell in which it changes to a brownish or dull reddish pupa, and when this happens in June or July the moth usually emerges in about two weeks' time. Some cutworms, however, do not change to pupæ immediately they complete their earthen cell, but remain as larvæ for some days, the actual period often varying, and the moths in such cases do not emerge for three or four, or even more, weeks, from the time the caterpillar became full-grown and entered the earth.

NATURAL ENEMIES OF CUTWORMS.

There are many different kinds of beneficial insects which prey upon cutworms and help very materially to keep these pests in check. Among the parasitic insects, the two-winged dipterous flies belonging to the family Tachinidæ and the four-winged hymenopterous flies of the families Braconidæ and Ichneumonidæ are extremely important. One of the best known of the dipterous parasites is the Red-tailed Tachina fly, *Winthemia quadripustulata* Fab., which

FIG. 6.—Red-tailed Tachina fly, enlarged one-third. (Original).

FIG. 7.—Spotted Cutworm bearing on front segments, the eggs of the Red-tailed Tachina fly—natural size. (Original).

was so abundantly present in Eastern Canada during the 1914 outbreak of the Army-worm. This fly deposits its eggs freely on smooth noctuid caterpillars, and when these hatch the young fly maggots enter the body of the cutworm, feeding entirely within and eventually killing the host. The braconid parasites also feed in the larval stage within the bodies of the cutworms and when mature they leave the caterpillars and spin loose white, or yellowish, egg-shaped cocoons, from which the small, four-winged flies emerge. The ichneumonid parasites, with their long ovipositors, puncture the skin of the cutworms and lay their eggs within the bodies of the caterpillars. The maggots live in the caterpillar, not killing it, however, but allowing it to complete its growth and change to the pupal state, the parasites emerging ultimately from the pupæ. Figure 8 illustrates the Glassy Cutworm destroyed by a very small hymenopterous parasite which Mr. A. A. Girault, of the United States Bureau of Entomology, has determined as a new variety of *Berecyntus bakeri* Howard. In 1914 this

FIG. 8.—Glassy Cutworm parasitized by *Berecyntus bakeri*, var. (Original).

species was abundant in the Ottawa district. The number of individual specimens of this parasite which emerge from the body of a single cutworm is very remarkable. From three cutworms we reared, respectively, 702, 607, and 541 specimens of this parasite, the dates of emergence being July 15, July 12, and August 12, 1914.

Several important predaceous insects are constantly hunting for cutworms to devour. The Fiery Ground Beetle, *Calosoma calidum* Fab., and its grub, known as the Cutworm Lion, devour large numbers of cutworms. The beetle is brownish-black in colour, with three rows of coppery-red pits on each wing cover. In length it is about seven-eighths of an inch. Another common carabid beetle which destroys cutworms is the Large Harpalus, *Harpalus caliginosus* Fab. Among the hymenoptera the sphecid wasps dig out the cutworms and store them in their cells, or nests, as food for their young grubs. A well-known example of these four-winged flies is the Black Ground wasp, *Sphex luctuosa* Smith. This is an abundant species in Eastern Canada.

In addition to the parasitic and predaceous insects which destroy cutworms, some of our native birds are very fond of these fat, juicy caterpillars. The value of many of our wild birds as insect destroyers should be more and more recognized, and farmers, gardeners, etc., should do all they possibly can to protect them from being shot and their nests from being robbed. The meadow lark, blue jay, catbird, house wren, robin, etc., destroy every year large numbers of cutworms. Even the much-abused crow is extremely valuable, as insects constitute its principal food during spring and early summer, and of the insects eaten, cutworms form a most important part.

FIG. 9.—Predaceous enemies of cutworms: *a*, Fiery Ground Beetle; *b*, Large Harpalus. (Original).

Parasitic fungous diseases, such as species of *Empusa*, help to reduce outbreaks of cutworms. On several occasions when the Black Army Cutworm was abundant in eastern Ontario, it was largely destroyed by *Empusa virescens* Thaxter. In fields, as has been recorded by Fletcher, the larvæ were seen in large numbers on stones, fences, stems of grasses and other plants upon which they had crawled and to which they had become attached by the fungus. During 1914 a fungous disease was noticed to have destroyed many cutworms in the Ottawa district. Dr. Roland Thaxter, to whom diseased specimens were submitted, reported that the fungus corresponded in all respects to *Sorosporella agrotidis*, and that he was so naming it. Cutworms are also subject to bacterial diseases.

METHODS OF CONTROLLING CUTWORMS.

PREVENTIVE MEASURES.

Clean Cultivation.—The eggs of most of our cutworm moths are deposited soon after the adult insects appear in early or midsummer. As they are laid chiefly on weeds, or other nearby succulent vegetation or upon the remnants of crops, it is most advisable to plough deeply, in the early fall, all fields where cutworms have been troublesome. Such clean cultivation not only destroys many of the eggs and the young hibernating cutworms, but also numbers of other insects which winter beneath fallen plants, refuse, etc. Fall ploughing should always be practised where circumstances will permit, not only for the destruction of hibernating insects, but also because the land will be put into better condition for early spring sowing. In gardens and orchards, all remnants of crops, or other refuse, should be carefully gathered together and destroyed by burning. When such cleaning up is done as soon as possible after the crop is removed, useless plants, which would be suitable for the moths to lay their eggs upon are removed.

Protective Bands.—In fields or gardens where such plants as cabbages, cauliflowers, tomatoes, etc., are set out, protection against cutworm attack can be had by placing a band of tin, or wrapping a piece of paper, around the stem of each plant at the time of setting out. Tin, of course, lasts longer than paper,

and is, therefore, to be preferred. Pieces of tin about 6 inches long and 2½ inches wide are sufficiently large for this purpose and can easily be made into a cylindrical shape by bending them around a broom handle. Old tomato or other tins, in which canned vegetables have been preserved, are useful for this purpose, and if thrown into a bonfire the tops and bottoms fall off, leaving the central piece of tin which, if cut down the middle, will be sufficient for protecting two plants. When paper is used, cut this into pieces about 3 inches square. The pieces may be threaded on to a loop of string, which may be tied to the box in which plants, such as cabbage and cauliflower, are taken to the field. About 2 inches of the paper should be left above ground.

FIG. 10.—Method of protecting young seedlings from cutworms by means of small tin cylinders. (Original).

To protect fruit and other trees from climbing cutworms, a band of cotton batting 4 inches in width may be fastened tightly around the tree near the bottom. The wire or strong string holding the cotton batting should be placed near the lower edge, so that the upper part of the band can be hung down thus forming a sort of funnel, or cone-shaped mass of batting. Bands of tree tanglefoot are also useful in preventing the caterpillars from gaining access to the foliage, etc., of trees.

REMEDIAL MEASURES.

Poisoned Baits.—The poisoned bran remedy is the one which is now used most extensively for the destruction of cutworms generally. This is made by moistening the bran with sweetened water and then dusting in Paris green in the proportion of half a pound of Paris green to fifty pounds of bran. It is important that the bran be noticeably moistened (but not made into a mash or moistened too much to prevent its being crumbled through the fingers) so that when the poison is added, it will adhere to practically every particle. Two gallons of water, in which half a pound of sugar has been dissolved, is sufficient to moisten 50 pounds of bran. If more convenient, the same quantity of salt may be used instead of sugar, or even molasses may be employed. The mixture should be applied thinly as soon as cutworm injury is noticed. It is important, too, that the mixture be scattered after sundown, so that it will be in the very best condition when the cutworms come out to feed at night. This material is very attractive to them, and when they crawl about in search of food they will eat it in preference to the growing vegetation. If the mixture is put out during a warm day, it soon becomes dry, and is not, of course, as attractive to the cutworms. In treating fields of hoed crops, such as beets, turnips, etc., a simple method is to have a sack filled with the bran, hung around the neck and by walking between two rows, and using both hands, the mixture may be scattered along the row on either side. When cutworms are so numerous as to assume the walking habit, the poisoned bran may be spread just ahead of their line of march. In gardens, where vegetables or flowering plants are to be protected, a small quantity of the material may be put around, but not touching each

plant. Fruit trees may be protected from climbing cutworms in the same way, but the mixture should, of course, not be thrown in quantity against the base of the tree, otherwise injury may result from the possible burning effect of the Paris green. As an instance of the remarkable effectiveness of the poisoned bran, I would mention that on one occasion when we used it to protect young tobacco plants on the Central Experimental Farm, Ottawa, we soon afterwards made careful counts of the dead cutworms near a number of the plants. Around one plant we found seventeen dead cutworms, around another eight, around still another nine, and so on. Only one-half of the tobacco plantation was treated. In the other half, where no poisoned bran had been distributed, the cutworms were extremely destructive, very many plants being destroyed.

The Kansas Grasshopper formula has been found of equal value in the destruction of the Variegated Cutworm, and it will undoubtedly prove a most useful remedy for other cutworms, particularly the surface-feeding kinds. This formula is as follows:—

Bran	20 pounds.
Paris green	1 pound.
Molasses	2 quarts.
Oranges or lemons	3
Water	3½ gallons.

In preparing the bran mash, mix the bran and Paris green thoroughly in a wash-tub while dry. Squeeze the juice of the oranges or lemons into the water and chop the remaining pulp and the peel into fine bits and add them to the water. Dissolve the molasses in the water and wet the bran and poison with the mixture, stirring at the same time so as to dampen the mash thoroughly. In our experiments near Ottawa on the control of locusts, the farmers prepared the mixture on the cement floor of a stable or other outhouse, stirring it thoroughly by means of an ordinary field hoe. The mixture should be broadcasted early in the evening. In the control of the Variegated Cutworm in alfalfa fields in Kansas, the above quantity of bran was spread in such a manner as to treat about 3 acres. Scattering the mixture thinly places it where it will reach the greatest number of cutworms, and when thus spread there is no danger of birds, poultry or live stock being poisoned.

Fresh bundles of any succulent weed, grass, clover, or other tender vegetation, which have been dipped into a strong solution of Paris green (one ounce of Paris green to a pail of water), may be placed at short distances apart in an infested field, or between rows of vegetables, or roots, and will attract many cutworms and protect the crops from further injury. These bundles, also, should be put out after sundown, so that the plants will not be too withered before the cutworms find them. As in the case of the poisoned bran, they should be applied just as soon as the presence of cutworms is detected.

The above poisoned baits have given excellent results for surface-feeding cutworms. For those kinds, however, as the Glassy Cutworm, which feed almost entirely underground, these baits are, of course, of little value. For such cutworms it is important to keep the land to be used for grain crops the following year as free as possible from long grass and weeds. If this is done, there will be no tall vegetation to attract the female moths for the purpose of egg-laying.

Furrows or Ditches.—As a rule, when cutworms assume the marching habit, they are nearly full-grown and, of course, are very ravenous. In such instances, as has already been mentioned, applications of poisoned bran have been extremely useful in stopping the attack. Severe outbreaks may also be largely controlled by ploughing deep furrows in advance of the line of march of the cutworms.

The progress of the caterpillars is thus stopped and when a furrow is entered by them, a log drawn by a horse may be dragged through it and the cutworms in this way will be crushed and killed. If a series of post holes about a foot deep and about 15 feet apart are dug in the furrow, hundreds of the cutworms will fall into them and they can then be easily killed by crushing them with the blunt end of a post, or a piece of fence rail.

Handpicking.—In small gardens, as soon as cutworm injury is noticed, the culprits can, as a rule, be easily located in the soil, about an inch or so beneath the surface, and within a radius of a few inches of the plant, and destroyed by hand. Such handpicking should, of course, be always practised whenever a plant is seen to have been cut off. Where such a species as the Variegated Cutworm is occasionally troublesome in greenhouses, the simple method of digging them out by hand has given relief.

Poultry.—Flocks of chickens, turkeys, or other poultry, are useful in outbreaks of cutworms and, if turned into infested fields or gardens, will soon find and devour not only many of the caterpillars but also the pupæ.

THE COMMONER SPECIES OF CUTWORMS.

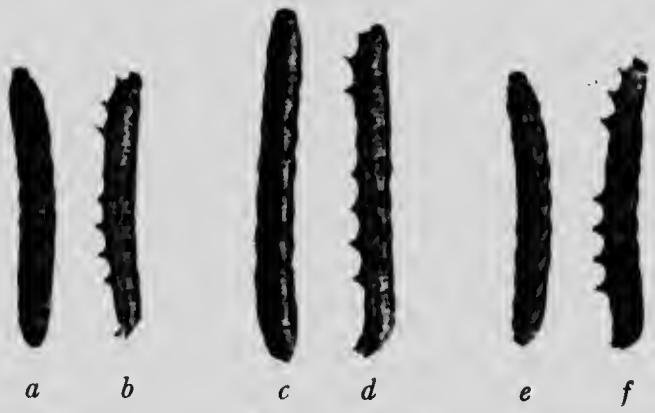

FIG. 11.—*a*, Red-backed Cutworm, dorsal aspect, *b*, Red-backed Cutworm, lateral aspect; *c*, Greasy Cutworm, dorsal aspect; *d*, Greasy Cutworm, lateral aspect; *e*, W-marked Cutworm, dorsal aspect; *f*, W-marked Cutworm, lateral aspect. (Original).

THE RED-BACKED CUTWORM, *Euxoa ochrogaster* Gn.

Appearance.—As its popular name indicates, this cutworm is red along the upper side, or back. When full-grown, it is about $1\frac{1}{2}$ inches long. The head and the shield behind are yellowish-brown, the former having two distinct black marks towards the centre. In the middle of the back there is a pale stripe, and at each side a dark stripe borders the red of the back. As in other cutworms, the body bears the usual series of rather small, dark tubercles, or wart-like excrescences, each of which bears a single hair. The three pairs of true legs from the three segments next to the head are similar in colour to the under surface of the body, which varies from greyish to brownish, as are also the heavier five pairs of pro-legs from the more central and anal segments. The reddish colour of the upper surface of this cutworm usually distinguishes it from our other common species. (See figure 11, *a* and *b*.)

The moth of this cutworm is extremely variable in colour and markings. In size, it ranges from about $1\frac{3}{8}$ inches to $1\frac{5}{8}$ inches. The ground colour of the

wings varies from a pale clay yellow to a beautiful dark red. The front wings are each crossed by four or five irregular lines, some of which in some specimens are hardly traceable. These wings, in most examples, bear heavy conspicuous black markings, particularly near the base of the wing and on either side of the round and kidney-shaped marks in the centre of the upper half of each wing. The hind wings are usually dark, paler in the centre and at base. The body is of the same colour as the front wings.

FIG. 12.—Moths of Red-backed Cutworm, *Euxoa ochrogaster*: *a*, at rest; *b*, with wings spread—natural size. (Original).

Habits and Life-history.—The Red-backed Cutworm is the most regularly occurring and, on the whole, the most destructive cutworm which we have in Canada. It is present in every province of the Dominion, and attacks not only all kinds of garden and field crops, but practically every succulent plant which happens to be nearby, especially if the same is of any value. In flower beds, annuals are often entirely destroyed by the ravages of this cutworm. In Eastern Canada, vegetables, such as cabbages, cauliflowers, beets, radishes, etc., are destroyed every year, and in the western provinces much injury is done to oats, oftentimes whole fields being entirely ruined. Wheat, barley, etc., are also attacked.

The moths of this cutworm appear at the end of June and during July and August, some years even later, the actual time depending upon seasonal conditions. In ordinary years the moths occur in the largest numbers during the latter half of July and during early August. At Ottawa, the species has been found to pass the winter in the egg state, but whether this is always the case, is not known. Eggs deposited in October di' not hatch until April 20. Caterpillars from these eggs became full-grown and pupated on June 10, the first moths appearing on July 20. On another occasion, eggs which were laid late in August passed through warm weather in September and October and did not hatch until the following May, but at that time much larger larvæ were found out-of-doors in the ground. In 1914 larvæ received from Manitoba pupated on June 24 to 27, and the moths emerged on July 15 to 20. A specimen from Saskatchewan pupated on July 6, the moth emerging on July 31.

This cutworm does most damage in the latter half of May and during the first half of June. In most seasons the caterpillar becomes full-grown in the latter half of June, and enters the ground to a short depth of about from 1 to 2 inches, where it makes an earthen cell in which it changes to a reddish-brown pupa, about three-quarters of an inch in length. In this inactive state it remains for about three or more weeks. In some years the moths will emerge in less than three weeks; other seasons it has been five weeks from the time the caterpillars entered the earth, before the adults appeared.

In one year (1909) these cutworms were very abundant in eastern Ontario in the first half of July, and did not become fully fed until the middle of that month. Such late occurrences, however, are unusual.

THE GREASY OR BLACK CUTWORM, *Agrotis ypsilon* Rott.

Appearance.—Full-grown specimens of this cutworm measure from an inch and a half to an inch and three-quarters in length. The general colour is a

uniform dark greasy-grey, although some individuals are decidedly blackish. Down the centre of the back is a pale yellow line, and, along the sides are three other lines of the same colour, the upper of which on each side is the most distinct. Some larvæ have also yellowish patches down the back. The small tubercles, or piliferous spots on the segments, are black, shiny, and conspicuous. The head varies in colour from almost wholly dark brown, or black, to a pale brown marked with two black dashes on the front near the middle, and two smaller black dashes on the lower part of either side. The shield on the first body segment is mostly dark brown or blackish. The legs in front are pale brown, those behind being similar in colour to that of the ventral surface of the body, which is paler than the back and inclined to greenish. (See figure 11, *c* and *d*).

The moth of this caterpillar is rather large, expanding with the wings spread, from about an inch and three quarters to two inches in width. The forewings are dark purplish-brown suffused with pale brown, particularly in the outer third and near the base. In some specimens the pale brown extends along the lower half of the wings. The transverse lines are fairly distinct as are also the round and kidney-shaped marks. From the middle of this latter spot, outwardly, there is a conspicuous, blackish, lance-shaped mark. The hind wings are whitish or dusky, with a pearly lustre. The thorax is of a greyish-brown colour, the abdomen being still paler.

Habits and Life-history.—This common and very injurious species is widely distributed and occurs throughout the breadth of the Dominion. It is especially destructive to garden crops, cabbages, cauliflowers, cucumbers, etc., the cutting habit being developed to a high degree. It often cuts off large potato tomato, and tobacco plants, usually about an inch above ground, and one cutworm, in a single night, is capable of destroying three or four plants. In Ontario, it has, in some years, done serious injury in fields of corn. Flowering garden plants are also often attacked, and in many instances the roots are eaten as well as the leaves. In eastern Ontario we have found the caterpillars very numerous in the latter half of May and during the first week of June, destroying young beets and radishes and newly set-out cabbages and cauliflowers. In 1913, the Greasy Cutworm was very prevalent in Sunbury county, New Brunswick, the potato crop being particularly attacked. In some fields nearly every third plant was destroyed. The larvæ on this occasion were mature in the second week of July.

It is not known definitely how many broods of this insect there are in Canada, but it would appear from present knowledge that there are two annual generations. In Ontario, we have collected the adult moths as early as May 16 and as late as October 25. Some years the moths are extremely abundant in late summer and autumn. Larvæ collected in the field in July entered the earth on the 17th of that month to pupate and the moths appeared on August 7. On July 23, 1911, the writer found at Ottawa a batch of the eggs of this moth, which had been deposited on the upper side of a birch leaf. They were cream-coloured when found, but turned dark before the young larvæ hatched on July 27. At first, the young cutworms were pale green, the black tubercles on the segments being very conspicuous. Later, the pale central stripe down the back appeared as well as the lateral stripes. On August 20 they were full-grown, and within a few days later all had entered the earth and changed to pupæ, the moths emerging from September 14 to 18.

The Variegated Cutworm, *Peridroma saucia* Hbn.

Appearance.—This cutworm, when mature, is a large, plump caterpillar measuring about two inches in length by one-fourth of an inch in width. It is variable in colour, ranging from pale-gray to almost a dull-brown, some specimens with a greenish tinge. The body is mottled and streaked with dark

brown, or black, and marked along the side with a conspicuous yellowish band. Between this band and the middle of the back is an interrupted stripe of velvety black blotches bordered, more or less, with orange. Below this and above the yellowish band just mentioned are a series of blackish curved dashes on either side, one on each segment. On the top of the last segment but one, there is a conspicuous velvety black mark shaped somewhat like the letter W, with the lower part filled in. Down the centre of the back is a rather thin yellowish stripe which is expanded into a spot in the middle of some of the central segments. These spots are nearly always present on segments four to seven, and in some examples the stripe is widened into spots on one or two other segments. That part of the body beneath the wide band on the sides is much paler than the back. The head is reddish-yellow and conspicuously marked with black bands which form a rather imperfect letter H.

FIG. 13.—The Variegated Cutworm: *a*, moth; *b*, *c*, *d*, caterpillars; *e*, egg—enlarged; *f*, egg mass on twig. (After Howard).

The moth of the Variegated Cutworm is also extremely variable. The front wings are of some shade of brown, or reddish-brown, usually darker along the outer margin. Some specimens are more or less blotched with pale brownish-yellow, while in others the whole lower and central area of the wings is pale brownish yellow; in such examples, the colour along the upper margin is decidedly dark, almost blackish. The wings are crossed with four more or less distinct double wavy lines. The round and kidney-shaped spots are usually distinct, the latter being the darker. The centre of the hind wings is pearly-white, with a purplish reflection, the edges being bordered with brown. The head and the thorax are of the same colour as the front wings, while the abdomen is much paler and in some examples is covered partly with a whitish down or pubescence. These moths, when the wings are expanded are from about an inch and a half to nearly two inches in width.

Habits and Life-history.—While this cutworm does not occur every year in destructive numbers, probably no other species has done as much damage in a single season. As has already been mentioned, this cutworm has destroyed in one season alone, in Canada and the United States, crops having a market value of over two millions of dollars. The species is cosmopolitan in distribution, and, in Canada, occurs almost everywhere. It has no limited feeding habits, and attacks freely all garden and field crops, and even often does much damage

by climbing fruit trees, currant bushes, etc., and eating the leaves. In 1900, a phenomenal outbreak of this cutworm appeared in British Columbia, the loss in garden crops alone being enormous. Millions of the caterpillars occurred, and they fed at all times of the day and night. They were also present in exceptional numbers in Manitoba and Ontario. The attack in that year was first app. ent in early July, and the ravages were continued throughout that month, and during early August, almost every kind of crop being attacked—vegetables, fruit trees and fruit, flowers, etc. In 1914, near Port Hope, Ont., the larvæ destroyed green tomatoes by eating into them as shown in figure 3, and in Nova Scotia, in the same year, I saw a large pea pod which had been entered by the cutworm and all the seeds eaten. This larva was two-thirds grown on August 12.

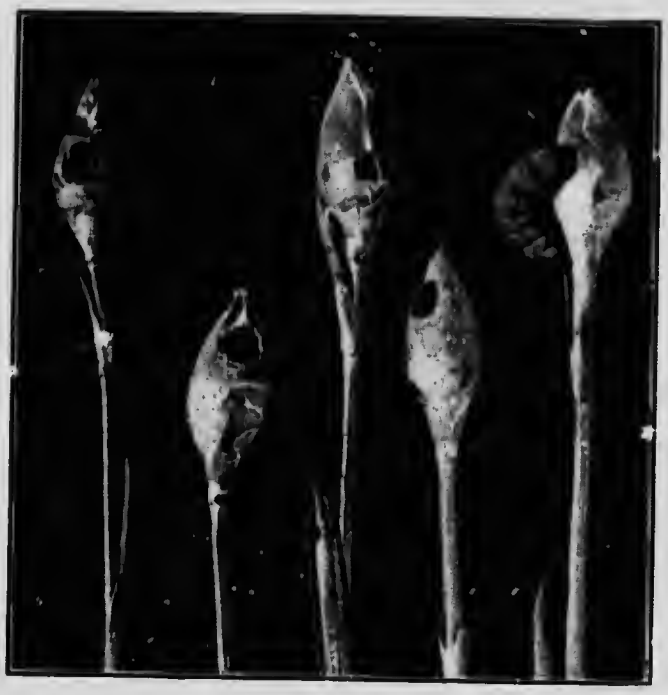

FIG. 14.—Carnation buds eaten by the Variegated Cutworm. (Author's illustration).

The Variegated Cutworm is occasionally found attacking carnations, chrysanthemums, etc., in greenhouses. The buds of carnations are eaten into as shown in figure 14. Recently one florist in Ontario reported serious injury to chrysanthemums, the cutworms attacking the heads and cutting off the florets. Such outbreaks in greenhouses may be controlled either by hand picking, as mentioned on page 15, or by using poisoned bran, made as described on page 13.

In British Columbia, as many as fifty clusters of eggs undoubtedly of this species were found on June 28, 1900, on clothes which had been hung out to dry. On the same day they were also found on windows, verandas, and on the leaves of hop, etc. They were even found inside houses on curtains and other objects. These eggs are of a creamy-yellow colour, and are usually laid in patches, some of which contain as many as 500 eggs. They are very often deposited in rows

along twigs of fruit trees. Eggs which we received from British Columbia and which were laid on June 27 (1902), hatched on July 3. The cutworms at first are pale in colour with a black head and indistinct lines. In their younger stages they loop when walking, as do our other species, on account of some of the pro-legs being abortive.

In 1900, large numbers of this cutworm became full-grown and entered the earth the latter week of July and during the first half of August, although other individuals did not pupate until later in August or in the beginning of September. Specimens which buried themselves on July 27, produced the moths on August 13 to 16, in others the pupal period was longer. In 1907, one moth from larvæ collected at Ottawa emerged on September 6. In 1914, I reared at Ottawa, one moth on August 21, the date of pupation being July 23. The pupa of this cutworm is of a mahogany-brown colour, and in size is about five-eighths of an inch long and about five-sixteenths of an inch in width at widest part; at the end are two short spines.

From present knowledge it would seem as if there were two broods of this insect in normal seasons in Canada, the moths appearing in June and again after the middle of August. It is not definitely known how the insect usually passes the winter in Canada. At Ottawa, moths have been captured as late as October 14, and about the middle of November pupæ, which later produced the moths, were dug up out-of-doors. The species, in some years, therefore, evidently hibernates in the pupal state. It seems probable, however, that the eggs would be laid in August or September by the moths emerging during those months, and larvæ would emerge from these soon afterwards and pass the winter in a partly grown condition. Hibernation may also possibly take place in the adult moth state.

The Dark-sided Cutworm, *Euxoa messoria* Harr.

Appearance.—The chief characteristic of this cutworm is that the colour of the sides is noticeably darker than the skin of the rest of the body. The general colour of full-grown specimens is dull greyish, some having a pale-greenish or other light-coloured tinge. The head and shield behind are shiny and of much the same colour as the body. The back is marked down the middle with a dark line, and on each segment of the body are the usual number of blackish, single-haired, tubercles. The underside of the body is paler than the back, as are also the feet. In its younger stages, the sides are much darker.

Fig. 15.—Moths of Dark-sided Cutworm, *Euxoa messoria*: *a*, at rest; *b*, with wings spread—natural size. (Original).

The moths of this cutworm are very similar in appearance, there being no conspicuous variation in colour in a series of specimens. The upper wings are dark grey and are marked with dark brown, or blackish, transverse lines and shadings. The two spots near the centre are conspicuous, and in most specimens there is a pale patch at the apex of each of these wings. The hind wings are mostly pale, almost whitish, bordered with a brownish band.

Habits and Life-history.—The Dark-sided Cutworm is a very common species, and occurs widespread. Its injuries, however, in the past have been

confined largely to the eastern provinces, especially Ontario and Quebec, where it often occurs in large numbers in May and June. This cutworm has very wide feeding habits; it is not only particularly destructive to onions and other vegetables, as well as to almost all kinds of plants in flower gardens, but it also very frequently climbs small trees and shrubs, doing serious injury to the buds. Owing to this latter habit, many young trees in newly set out orchards are entirely ruined. When prevalent in onion fields this cutworm has the habit of climbing to the top of the stalks and eating downwards. In 1914, the species was very prevalent in the provinces of Ontario and Quebec, and destroyed many vegetables, including tomatoes, as well as annual flowering plants.

Unfortunately, the life-history of this insect is not as yet completely known. The moths occur commonly in many widely separated districts. In Ontario and Quebec they are on the wing in August and September. At Toronto the moth has been collected as late as September 26 (1904), and at Ottawa on October 5 (1903). In Manitoba, the moths have been taken in the middle of August, and in British Columbia about the same time. In eastern Ontario, we have reared the moths from larvæ collected in the field on August 30 (1903), and August 17 (1904). In 1914, the moths appeared earlier. From larvæ found at Ottawa, moths emerged on July 21, August 5, 10, and 11. One cutworm received from York county, Ontario, pupated on July 19, the moth issuing on August 12. Larvæ received from Labelle county, Quebec, on June 21, pupated on July 6 to 8, and moths emerged on July 26, August 12, 14, and 22. One moth from this sending did not emerge until September 9.

The White Cutworm, *Euxoa scandens* Riley.

Appearance.—When full-grown, the White Cutworm is about one and three-quarter inches long. It is of a light yellowish-grey colour with whitish patches on the back and sides. A distinct line is present down the middle of the back and on each side of the back and along the centre of the side there are other longitudinal lines which are not so distinct. The piliferous tubercles on this cutworm are dark, but not very apparent. The black spiracles along the sides are conspicuous. The head and the shield on the first body segment are pale brown, sparsely dotted with black. All the feet are of a similar colour to that of the underside of the body. The general whitish colour and, on the whole, the inconspicuous markings of this cutworm, usually distinguish it from any of our other common forms. (See figure 16, *c*.)

The moth varies considerably in the colour of the front wings, which may be either ash-grey, or grey suffused with a yellowish, brownish or reddish colour. Near the outside margin of each of these wings is a conspicuous wavy, whitish line. The other cross lines on the forewings are indistinct, but the round and kidney-shaped spots are readily apparent in most specimens. The hind wings are whitish with a dark spot in the centre and a double brownish shade along the outer edge. The thorax is of the same colour as the front wings, while the abdomen is whitish. With the wings spread, this moth expands about one and three-eighths inches.

Habits and Life-history.—Although this cutworm is often responsible for serious losses from its well-known habit of climbing fruit trees and destroying the buds, etc., it does not by any means always confine itself to such habit in eastern Ontario, as we have found it, on several occasions, working in vegetable gardens, particularly where the soil is sandy. In years of prevalence, however, the chief damage it does is in climbing fruit trees after dark and eating the buds, the young fruit and the tender leaves. Such injury is done in May and early June, and when young trees—apple, pear, peach, etc.—are attacked, the injury is often fatal.

This insect occurs more or less abundantly almost every year from Manitoba to the Maritime Provinces. A single specimen of the moth was taken at Calgary, Alta. (August 1, 1904). The moths appear usually in June and during July. One caterpillar, which we found injuring radishes at Ottawa on May 17, was full fed and entered the earth on June 1, and the moth appeared on July 1. In another year, the cutworms were mature earlier, and the moths emerged on June 5. In 1908, when they were very destructive in gardens at Ottawa, they had mostly pupated by the middle of June. The pupa is similar to that of other cutworms, and measures about five-eighths of an inch in length.

In eastern Ontario, the insect hibernates as a half-grown caterpillar. On April 16, 1907, the writer found at Ottawa several of these cutworms about an inch below the surface of the ground; they were 20 mm. long (thirteen-sixteenths of an inch), and were hibernating in soil where cabbages had been grown the previous year.

The W-marked Cutworm, *Noctua clandestina* Harris.

Appearance.—This cutworm is readily recognized by the series of conspicuous marks resembling the letter W which are present on its back, with the exception of the first three segments. The general colour is pale brown, streaked and spotted with dark brown. The sides of the W marks are bordered with bright pale yellow. A pale line is present down the centre of the back; the yellow markings referred to rest on a pale line, and below this along the side, about the middle, is a wide, more or less distinct, band, bordered above with yellow and dark brown. The head is pale brown, marked down the middle of each side with a wide very distinct black dash, the rest of the head is conspicuously marked in a fine network, or reticulated with dark brown. The shield on the first segment behind the head is also dark brown. The three front pairs of feet are pale brown, the others being similar in colour to the under surface of the body which is not so dark as the back and upper portion of the sides. When mature this larva is about $1\frac{3}{8}$ inches long. (See figure 11, *e* and *j*)

The moth of the W-marked Cutworm expands about $1\frac{5}{8}$ inches when the wings are spread. The front wings are of a dark, smoky-brown colour, the transverse lines paler and not very distinct. The round or orbicular spot is margined with black, as is also the inner side of the reniform or kidney-shaped spot. In many specimens these spots are joined together by a short black line. The hind wings are whitish, tinged with brown, darkest at the outer edges.

Habits and Life-history.—This cutworm, although common and widespread in Canada, has not been reported to the same extent as some of our other species. In years of abundance, however, it does do much damage, not only to all kinds of vegetables—cabbage, cauliflower, corn, beans, etc.—but also to the roots of grasses, and most probably does a good deal of injury in wheat fields. It also has the habit of climbing trees and shrubs and feeding upon the buds and leaves. Apple, currant, gooseberry, etc., are attacked. It will be seen, therefore, that it is a very general feeder, and that almost any succulent plant is liable, any year, to be injured or destroyed.

The moths fly in June, July, August and September, and occur from Nova Scotia to British Columbia. Some years they are very numerous and fly into houses during the evening, becoming quite a pest.

The full life-history of this cutworm is not as yet known. The caterpillars hibernate in a partly grown state in the earth, a short distance below the surface, and on the first growth of vegetation in spring they become active and at once attack plants. They reach maturity in eastern Ontario towards the end of May and in June, and change to the usual reddish-brown pupæ, the moths emerging from their earthen cells in June and early July, the dates varying with

the seasons. The moths have been collected in the open as late as the middle of October, but whether there are two broods in the year, or even a partial second brood, it is impossible to say from our present knowledge. We have on several occasions succeeded in getting female moths to oviposit in confinement. Eggs secured in August did not hatch until the end of October. On another occasion, the eggs were deposited on September 13. They were laid in patches on the side of a wooden pill box.

FIG. 16.—*a*, Spotted Cutworm, dorsal aspect; *b*, Spotted Cutworm, lateral aspect; *c*, White Cutworm; *d*, Dingy Cutworm; *e*, Black Army Cutworm, dorsal aspect; *f*, Black Army Cutworm, lateral aspect. (Original).

THE SPOTTED CUTWORM, *Noctua c-nigrum* Linn.

Appearance.—The general colour of this cutworm is pale brownish, or ashy-grey, some examples having a distinct ruddy or greenish appearance. The conspicuous character by which it may be recognized is the row of triangular-shaped,blackish marks (more conspicuous on the rear segments) on either side of the back. These marks are similar to those on the W-marked Cutworm, but are not so heavy and lack the conspicuous yellow bordering of those of the latter caterpillar. Down the middle of the back, there is a pale line, and between this and the conspicuous whitish, or yellowish, stigmatal band, which connects the spiracles or breathing pores on the sides, there is also a pale line. On each of the abdominal segments there is an oblique blackish dash, very distinct in some specimens, just above each breathing pore. In some caterpillars the stigmatal band is flushed with a reddish tinge, and the whole body is more or less blotched and streaked with brown. The head and shield on the first segments are yellowish-brown. Two brown bands are present on the front of the head, and the sides and top are reticulated with the same colour. The front feet are pale brown and shiny, the back pairs being dull and similarly coloured to the ventral surface of the body. (See figure 16, *a* and *b*).

The adult moth is about 1½ inches in expanse of wings. The general colour of the front wings is of a purplish-brown, or reddish-brown, some being much darker than others. Towards the centre of each of these wings is a conspicuous C-like spot, the open part towards the front margin of the wing being filled in with a pale blotch which extends in many specimens to the upper edge of the kidney-shaped mark. The transverse lines are easily traced and the outside margin of the wings is usually darker. The hind wings are pale yellowish-brown, becoming darker near the edges. The thorax is of the same general colour of the front wings but it is crossed in front by a distinct whitish collar; the abdomen is paler.

Habits and Life-history.—This cutworm is also a very general feeder. In 1900, it appeared in destructive numbers in Ontario, and attacked almost all kinds of vegetation—tomatoes, carrots, mangels, turnips, peas, etc. In one

pla.e (Whitby) where tomatoes were attacked, the cutworms had climbed the vines and as many as a dozen or so were found eating into a single tomato. In another place (Pefferlaw) they devoured the leaves of Canada thistle, gooseberries, chokecherries, etc. This injury in the above year was done by the second brood which appeared in July. In 1914, the caterpillars were present in large numbers in a hay field near Cathcart, Ont. Here they were working with the true Army-worm, and were feeding on timothy and marching from plant to plant in army-worm habit. Near Ancaster, Ont., the Spotted Cutworm destroyed, the same year, fully three-quarters of an acre of mangels. In 1900 a cluster of eggs found at Niagara, Ont., upon an apple leaf, was sent to the department. These were reared to maturity on apple, the cutworms becoming full-grown and entering the earth from July 24 to 27, and the moths appearing from August 18 to 25. In another year (1902) we received eggs from Nova Scotia, which hatched on June 26. The caterpillars passed through six stages, and some entered the earth on July 25, turning to pupæ two days later. Ten moths were secured, five emerging on August 22, and the others on August 23. In the same year at Ottawa the writer found a larva which produced a moth on June 17, and another which became mature on August 1, the moth emerging on September 3. In 1903, from larvæ collected in the field we reared the adults on June 8. The overwintering larvæ come out of hibernation early in spring and as soon as food is available, plants are at once attacked and the cutworms become mature and produce moths in the end of May or early June. It will thus be seen that the moths occur at almost any time from late in May till autumn. We have collected them at Ottawa as late as October 10.

The Glassy Cutworm. *Hadena devastatrix* Brace.

Appearance.—The caterpillar is of a dirty whitish colour, with a g..nish tinge. The head is reddish or reddish-brown, the shield on the first segment being conspicuous and brownish. The only markings on the body are the dull brown tubercles, each of which bears a single hair. The front fee. are pale brownish, the hind ones being of the same colour as the body. Full-grown specimens are about an inch and a half in length. This cutworm is similar in appearance to the Yellow-headed Cutworm, but from the colour of the heads, it is usually an easy matter to distinguish them.

Fig. 17.—*a*, Moth of Glassy Cutworm, *Hadena devastatrix*; *b*, Glassy Cutworm—both natural size. (Original).

The fore wings of the moth vary in colour from pale ashy-grey to dark brownish-gray. The transverse lines are usually distinct, the subterminal one near the outer margin being the most conspicuous and in some specimens almost whitish. On the inner side of this line are a series of short arrow-like dashes. The usual round and kidney-shaped spots are large, the former being the paler. The hind wings are brownish, the inner half being paler.

Habits and Life-history.—Unlike most of our other cutworms, this species seldom comes above the surface of the ground, even during the night. It f..ds chiefly upon the roots and lower stems of various kinds of grasses, such as

wheat, oats, corn, and grass in meadows, and, as a rule, is only troublesome in grain fields sown on grass lands which have recently been ploughed up. In addition, however, to grasses, this cutworm also attacks garden plants such as cabbages, beans, lettuce, etc. In Ontario it has injured seriously fields of oats 15 to 20 acres in size, between May 10 and 25, and also has been troublesome in fields of corn. Fields of fall wheat have also been damaged in May and early June to such an extent that it was necessary to plough them up. At the Central Experimental Farm, Ottawa, Ont., the larvæ were found, in June, 1914, destroying young tobacco plants. In Manitoba much injury has been done in wheat fields. In this province, in 1914, Mr Norman Criddle, Field Officer of the Entomological Branch, found the larvæ apparently feeding by preference on the roots of Barley Grass, *Hordeum jubatum*, which is a weed.

The insect is widely distributed in North America, and in Canada the moths have been found commonly in all provinces from Nova Scotia to British Columbia. It flies from late June until the middle of September. Eggs are laid in the latter part of the season; the young larvæ emerge soon afterwards and hibernate in a partly grown condition. Larvæ found in Ontario in May (1906) became full-grown and pupated on May 19, the moths emerging on July 19—two months later. From larvæ found in June (1914) we reared moths on July 11 to 13. The pupa is rather large, nearly an inch in length by about a quarter of an inch in width, and of a reddish-brown colour. In 1914, one larva pupated in a breeding jar at a depth of 3½ inches. It was full grown and entered the earth on June 26. The earthen cell was one and three-eighths inches long by three-quarters of an inch in width.

The Yellow-headed Cutworm, *Hadena arctica* Bdv.

Appearance.—This cutworm is very similar in appearance to the Glassy Cutworm; but, as its popular name indicates, it has a yellowish head. The shield behind the head is of a tawny-yellow and the body is of a smoky-grey colour, without markings. When mature it is about an inch and a half long.

The moth (see figure 1, *a*) is a fairly large species, expanding when the wings are spread from an inch and three-quarters to slightly more than two inches. The front wings are reddish-brown, shaded towards the base and the outer space with bluish-grey. In some specimens the cross lines are distinct being a pale yellowish colour; in others they are darker and not so conspicuous. The same applies to the round and kidney-shaped marks. The latter one is large and more or less filled with a whitish or pale yellowish colour. At the apex of each of these wings is a pale blotch. The hind wings are brownish, the outer third being darkest; in the centre there is a dark brown spot. The thorax is the same colour as the front wings, the abdomen being paler and of a rust-red shade particularly along the back.

Habits and Life-history.—The habits of this cutworm are similar to those of the Glassy Cutworm. It usually lives about 1 or 2 inches below the surface of the ground, feeding on the roots and cutting off the lower portion of the stems of oats, wheat, corn, etc. Fields of spring grain in western Ontario have been frequently injured, and in some instances the crops were so badly attacked that it was necessary to replough the fields and sow to peas, or use the land for other purposes. Besides grasses, the species is also known to attack cabbage, turnip, spinach, lettuce, and other garden vegetables, as well as the young shoots of roses, currants, etc. These cutworms are mostly prevalent in May and June. We have reared the moths in eastern Ontario in the latter end of June. In 1914, one larva found at Ottawa, pupated on June 2, and the moth emerged on July 2—exactly one month later The pupa is of the same size and colour as that of the Glassy Cutworm. years the moths are extremely numerous

and are on the wing in June, July, and August. When they are abundant they have the annoying habit of flying into houses, getting into lamps, etc., and soiling curtains and clothes. In Canada, the species is widespread, being found from the Atlantic to the Pacific coast.

The Clover Cutworm, *Mamestra trifolii* Esp.

Appearance.—This caterpillar varies considerably in colour, some specimens being distinctly green, or greenish-yellow, others quite dark above, owing to brownish or blackish mottlings. Down the back is a pale yellowish central line. Between this and a broad pinkish band along the middle of the side is a broken stripe of yellow, more or less edged above with black. The pinkish coloured band is bordered above and below with white or pale yellow. The spiracles, or breathing pores, are each surrounded by a blackish patch. The under surface of the body is greenish-grey with pale yellowish spots and streaks. The head is pale-yellowish, or pale-greenish, with white mottlings. When mature, this cutworm is about 2 inches in length.

The fore wings of the moth are of a yellowish-brown colour marked with gray and dark brown. The cross lines are distinct, the outer one being whitish and, in the centre, forming the letter W. Outside of this line the wings are dark. The round and kidney-shaped marks are distinct, the latt · being mostly dark. The hind wings are pale to a little beyond the middle, then dusky. The thorax and abdomen are of the same general colour as the fore wings. With the wings spread the moth measures about 1½ inches in width. (See figure 1, *b*.)

Habits and Life-history.—This insect is a common species, and the larvæ have on several occasions inflicted serious damage in Canada. In some years in Ontario, this cutworm has attracted considerable attention during August, from its ravages particularly in pea fields. Specimens of the remains of vines sent to the department showed that much of the outside fleshy covering of the pea pods had been gnawed away by the caterpillars, as well as all the leaves and green portion of the stems. Clover is also attacked, as well as mangels, turnips, cabbages, lettuce, spinach, and other vegetables. In years of abundance, when food becomes scarce, this cutworm assumes the marching habit characteristic of the true Army-worm.

The insect occurs across the breadth of the Dominion. In Ontario and the eastern provinces we have collected the moths from late in May until autumn; so, most probably, the species is at least double-brooded. In one breeding experiment the larva became full-grown and buried itself in the earth on August 26, and the moth did not emerge until June 8 of the following year. In Manitoba the moths have been taken commonly in August, and in Alberta in June, July, and August.

The Dingy Cutworm, *Feltia ducens* Walk.

Appearance.—Of a dull greyish-brown colour, marked down the middle of the back with a series of paler blotches, which almost give the appearance of a very wide dorsal band, down the centre of which is an indistinct line. Looking at the caterpillar from the side the skin between the blotches mentioned and the spiracles, or breathing pores, is dark, the wide substigmatal band just below the spiracles is of a pale yellowish colour, and the side of the body below this to the feet is pale brown. The spiracles are wholly black and appear as spots along the side. The shields on the back of the first and last segments are noticeably darker than the skin of the rest of the body. The head is pale brown, with two conspicuous, curved, blackish bands down the front; in addition it is distinctly marked with a network of dark brown. When mature it is about an inch to one and a quarter inches in length. (See figure 16, *d*.)

The moth (see figure 1, *d*) in general, is brown in colour with a purplish tinge, the shadings being greyish. The cross lines are not well defined, but the round and kidney-shaped spots are distinct, the former being open above and of the same colour as the grey shading near the upper edge of the front wings. The kidney-shaped spot is marked with reddish-brown. The claviform mark near the centre of each front wing is wholly brown defined by a black margin. Between the kidney-shaped spot and the outside margin there is a conspicuous wide, irregular, greyish band. The veins near the centre are lined with white. The hind wings are whitish, shaded with brown particularly at margins. The thorax is brownish, greyish or purplish-grey at centre and on sides. The abdomen is of a pale yellowish or cream colour. With the wings expanded the moth measures from about 1¼ to 1½ inches in width.

Habits and Life-history.—In the early reports of the Division of Entomology and Botany of the Dominion Experimental Farms, in which mention is made of this cutworm, the scientific name of the insect is given as *Agrotis* (*Feltia*) *subgothica* Haw. This name, in fact, has been used by economic entomologists generally in treating of the Dingy Cutworm. *Feltia ducens* Walk., however, is the common and widespread species which occurs in Canada. In Eastern Canada this cutworm has attacked all kinds of garden crops—turnips, cabbages, etc. Of late years, however, no reports indicating serious injury have been received In the United States it is an important pest of corn, wheat, early vegetables, and has even been found climbing fruit trees and shrubs to devour the buds and leaves. In the Ottawa district we have found the young larvæ of *Feltia ducens* in September, and the caterpillars have been found in the spring up to the end of June. About this latter time they enter the ground for pupation, and the moths emerge in July and August. In Eastern Canada the moths are some years very abundant in August, and specimens have been collected up till the middle of September. In Western Canada the moths are on the wing from about the middle of July, being common in some seasons, especially in August.

The Black Army Cutworm. *Noctua fennica* Tausch.

Appearance.—Full-grown specimens of this caterpillar are from an inch and a half to about an inch and three-quarters in length. The general colour when mature is brown with white lines and dark brown and blackish markings. Down the centre of the back is a series of velvety black, somewhat diamond-shaped marks, one on each body segment excepting the first. On each side of the back is a white line bordered above with black, and just along the lower edge of the spiracles is a wide white band, reddish-brown in the centre. Between this band and the stripe on the side of the back, the colour of the skin is blackish. Before the caterpillars become full-grown they are more of a general velvety black colour, the white stripes being very conspicuous, but as they become mature they are brownish in colour the back being more or less shaded with reddish. The whole body is spotted and streaked with white. The head is yellowish-red, black in front, the shield behind the head being black. All the feet are of a pale brownish colour. (See figure 16, *e* and *f*.)

The moth, like the caterpillar, is of rather handsome appearance, and with the wings spread it measures about an inch and a half across. The front wings are blackish-brown shaded with black and with a more or less purplish sheen; the round or orbicular spot is whitish with a few yellowish or dark brownish scales. The reniform or kidney-shaped spot is large and either distinctly yellow, reddish, or yellow and red. The double cross lines are black, excepting the subterminal, near the outer margin, which is whitish. In the males the lower third of the front wings is conspicuously yellowish-brown. The hind wings are pale becoming brown at edge.

Habits and Life-history.—The habits of this cutworm are very similar to those of our common species; some years, in fact, it is found working in company with the White Cutworm and the Red-backed Cutworm. In years of ordinary occurrence it feeds as do these latter species, but when present in large numbers it marches ahead in swarms in true army-worm habit. In eastern Ontario, its favourite food are plants belonging to the Leguminosæ; cultivated peas and clover are specially attractive to the caterpillars, although asparagus and other garden vegetables are often attacked. It has also been found climbing young oak, black walnut, horse chestnut, elm, negundo, and maple, which were being grown from seed on the Central Experimental Farm, Ottawa. In one instance at Ottawa the larvæ in the third week of May spread from a clover field to a 3-acre field of peas, which they soon devoured almost bare. They are, in their later stages, exceedingly voracious, and in a single night do great damage. Although this insect is widely distributed in Canada, most of the complaints of injury by the caterpillars have been received from the provinces of Ontario and Quebec. From larvæ collected in the field near Ottawa we have reared the adult moths, the dates of emergence being from June 15 to June 30. Outside, we have collected the moths from about the middle of June until the middle of September. The larva hibernates when about half-grown, and matures rapidly in spring, the injury being done before the end of May or early in June. The full life-history of the insect is not as yet known.

As the Black Army Cutworm becomes full-grown and disappears in most years about the end of May, it is often unnecessary, if the farmer knows the species, to apply any remedy. It has been found where we have advised correspondents not to resow the land to another crop, that the peas, or clover, recovered from the attack and, later, heavy crops were harvested.

The Bronzed Cutworm, *Nephelodes emmedonia* Cram. (*minians* Gn.).

Appearance.—In general colour this cutworm is greyish-brown or bronze, with conspicuous straight longitudinal pale-coloured stripes. These are as follows: a dorsal stripe down the middle of the back, two others on each side above the spiracles, the upper of which is wide and the lower narrow, and a very wide band below, but touching, the spiracles. The shield, behind the head, is black, divided by the dorsal and upper stripes. The head is yellowish-brown, and unmarked. The feet are paler than the body, but black at base. At the posterior end of the body there is also a black shield, which is divided by the upper stripes. When mature it is about an inch and three-quarters in length.

Fig. 18.—*a*, Moth of the Bronzed Cutworm, *Nephelodes emmedonia*; *b*, Bronzed Cutworm—both natural size. (Original).

The forewings of the moth vary from a glossy-brown mouse colour to a reddish-brown colour, the transverse lines being paler. The brighter contrasting colour occupies the middle portion of each of the upper wings. The round and kidney-shaped spots appear as small, pale areas, the same colour as the outer portions of the wings. The hind wings are glossy-brown, the fringes being reddish. The moth with expanded wings is about $1\frac{1}{2}$ inches in width.

Habits and Life-history.—While this cutworm is common and widely distributed in Eastern Canada, it has, fortunately, in the past been found to injure chiefly grass lands in the Maritime Provinces. In one year (1891) large areas of marsh hay in Westmoreland county, New Brunswick, were entirely destroyed. In some sections the injury was very general; on one farm where the sward land had been sown to barley and wheat, such crops were practically ruined. In the United States the Bronzed Cutworm is injurious to corn, and has been known to climb fruit trees and attack the buds and leaves. It is, however, a grass-feeding species, and almost every year may be found in varying numbers in meadows or pasture fields. At Ottawa we have found the larvæ commonly from April to early June. Mature specimens have been frequently met with about the end of May and during the first week of June.

In Eastern Canada we have collected the moths in numbers in August and September. The eggs are laid in late summer or autumn, and the winter is passed in the larval stage. On one occasion, I secured eggs from a captive female moth on September 9.

The Striped Cutworm, *Euxoa tessellata* Harr.

Appearance.—Pale brownish in colour, with a slight yellowish tinge on the back, or dorsum. The sides are dull grey, and the underneath portion of the body, or venter, is greenish. Down the centre of the back there is a pale stripe margined on either side with dark brown. The markings on the sides are as follows: a wide sub-dorsal brownish stripe (enclosing tubercle ii); a narrow, whitish, upper lateral stripe, touching lower edge of sub-dorsal stripe; a wider, more conspicuous, white lateral stripe, and a wide, white, stigmatal band. The head and shield on back of first segment are shiny brown, the former mottled with darker brown and the latter divided by three pale stripes. The tubercles on the body are dark brown, and the spiracles are black. The front feet are pale brownish and the pro-legs, or posterior feet, are similar in colour to that of the under side of the body. When full grown this cutworm is about 1½ inches long.

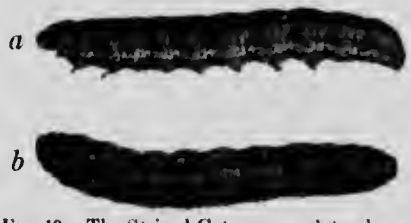

Fig. 19.—The Striped Cutworm: *a*, lateral aspect; *b*, dorsal aspect—one-quarter enlarged. (Original).

Fig. 20.—Moth of Striped Cutworm, *Euxoa tessellata*—natural size. (Original).

The moth which is known as the Checkered Rustic is from about 1¼ to nearly 1½ inches wide when the wings are expanded. The front wings are brownish-grey, with a pale pinkish tinge. The cross lines are readily apparent, the one nearest the body being yellowish, the others paler. The round and kidney-shaped spots are quite distinct, the former being greyish and the latter yellowish, filled partly with brown. Between these spots and to the second cross line from the body, the colour is blackish, and very contrasting. The outer margin of these wings is darker. The hind wings are brown, becoming whitish towards centre and base.

Habits and Life-history.—In June, 1914, this cutworm was the cause of serious losses, particularly in vegetable gardens, in the provinces of Manitoba, Ontario, Quebec, and Prince Edward Island, and doubtless occurred destructively in New Brunswick and Nova Scotia, although no specimens were received

from these latter provinces. In the Ottawa district it was specially troublesome on the Central Experimental Farm, where many annual flowering plants and young vegetable and tobacco plants were destroyed. Its feeding habits were similar to the Dark-sided Cutworm, in fact both these caterpillars were found working together in the same fields. Cabbage, lettuce, beans, beets, spinach, and other vegetables are freely attacked, and although chiefly a garden cutworm it has been known also to injure plum, apple, pear, and cherry.

This species occurs chiefly in the eastern provinces of the Dominion, but fortunately it is not a regularly occurring cutworm and, as yet, in Canada has only appeared intermittently as a destructive caterpillar. In Ontario and Quebec we have collected the moths commonly in July and, to a less extent, in August. There is apparently only one brood in a year. In 1912, one larva from Prince Edward Island buried in the earth to pupate on June 29, and the moth emerged on July 22. In Ontario, in 1914, the caterpillars were full grown, and pupation was entered on June 23 to 27, the moths emerging on July 11 to 16. The length of the pupal state varied from sixteen to twenty-two days. One larva from Manitoba pupated on July 12, and the moth emerged on July 29. In this latter province the moths have been collected in early August.

The Pale Western Cutworm, *Porosagrotis orthogonia* Morr.

Appearance.—Of a sordid whitish or greyish colour; no markings on the body. The shield behind the head is brown with a whitish stripe in the middle. The spiracles are black, and the tubercles are dark brown. Dorsal vessel conspicuous in some specimens. The thoracic feet are pale brown, the prolegs being concolorous with the body. The head is pale brownish with a conspicuous band of dark brown, or black, on either side near the centre, somewhat after the sides of the letter H; the ocelli are black, the mouth parts blackish. When mature, this cutworm is from about 1¼ to nearly 1½ inches long.

The forewings of the moth are of a light, greyish-green colour. The cross lines are rather indefinite; pale, margined with dark brown or black. The round, or orbicular spot, and the kidney-shaped, or reniform spot, are also inclined to be inconspicuous, and more or less filled with brown. The claviform mark close beneath the round spot is brown and the spaces on the side, inwardly, of the obicular and reniform spots are also brownish. The hind wings are brown in some specimens, becoming whitish towards base. The wings when expanded are about 1¼ inches in width. (See figure 1, *c*).

Habits and Life-history.—This cutworm is an excellent example of a rare and little-known species becoming decidedly destructive. Until 1911 it was not known as an injurious insect. In June of that year reports of extensive injury to grain crops in southern Alberta by a species of cutworm were received by us. One correspondent claimed to have lost 320 acres of wheat before June 21. During May and June, 1912, a very large acreage was destroyed in that part of Alberta known as the Lethbridge Land District. It was carefully estimated that fully 33 per cent of the grain sown was destroyed. From personal visits to infested districts made by Mr. W. H. Fairfield, Superintendent of the Dominion Experimental Station, Lethbridge, it was calculated that between 30,000 and 35,000 acres of grain had actually been destroyed. The crops chiefly attacked were fall and spring wheat, oats, barley, flax, alfalfa, and beets. The young cutworms apparently only feed above ground for the first few days after hatching from the eggs. In 1912, larvæ collected at Lethbridge on May 6 were received at Ottawa on May 10. They differed in size from about half an inch to 1 inch in length. Some became full-grown and entered the earth for pupation on May 28. The larvæ remained in the earth, no change taking place until June 18, when the first pupa was observed. The moth from this emerged on July 19; others emerged later, the last issuing on August 21. In 1913, Mr. E. H. Strick-

land, in charge of the Entomological Laboratory at Lethbridge, Alta., who is studying this insect and its control, found the first pupa on July 11. By the middle of August all the specimens had pupated in the field, the pupal period varying from twenty-eight to thirty-four days. In late August and during the first half of September the moths were on the wing. In the same year, I visited southern Alberta and found the cutworms fairly numerous in fields of spring wheat, fall wheat, and oats. On May 6, larvæ in some fields were in numbers from 3 to 11 per square foot, and on this date were mostly from one-quarter to one-half inch long. In the field, on two occasions, Mr. Strickland found the eggs in the soil the first time on September 17, when seventy-seven eggs were found. These were mostly attached to each other in groups of from two to eighteen. The second finding was on December 3, when a group of three only was taken from frozen ground. The eggs hatched in a heated laboratory, and adult moths were reared. The eggs undoubtedly, under normal conditions, would not have hatched until the following spring.

LITTLE KNOWN CUTWORMS.

In addition to the cutworms already mentioned, there are several which occur in the western provinces, and which some years have done considerable damage to various kinds of crops.

In the provinces of Saskatchewan and Alberta the caterpillars of *Chorizagrotis auxiliaris* Grt., *C. introferens* Grt., and *C. agrestis* Grt. have attacked many kinds of succulent plants. In British Columbia, the caterpillars of *Euxoa excellens* Grt. have, on several occasions, appeared in very large numbers in market gardens, and those of *Dargida procinctus* Grt. have also injured crops in the same province. In Manitoba, the larvæ of *Euxoa personata* Morr. and *Feltia venerabilis* Wlk. have destroyed plants in vegetable gardens, and, in 1914, the latter species was also found injuring oats. In the same province the cutworm of *Euxoa declarata* Wlk. has occasionally appeared in destructive numbers; in one year (1893) a field of 30 acres of wheat was completely ruined; vegetables oats and barley have also been attacked.