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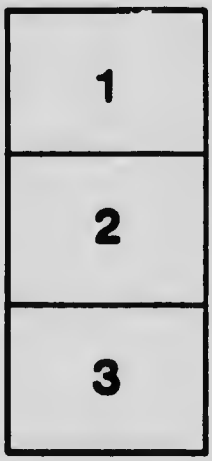

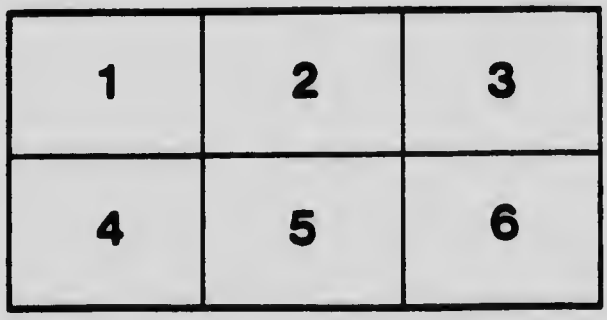

DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS

DIVISION OF ENTOMOLOGY

Bulletin No. 3

CUTWORMS AND ARMY-WORMS

BY

ARTHUR GIBSON

Chief Assistant Entomologist

BULLETIN No. 70

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

OTTAWA
GOVERNMENT PRINTING BUREAU
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To the Honourable,

The Minister of Agriculture,

SIR,—I have the honour to submit for your approval Bulletin No. 70 of the Experimental Farm Series (and No. 3 of the Division of Entomology) entitled "Cutworms and Army-worms" prepared by Mr. Arthur Gibson, Chief Assistant Entomologist.

Practically every man having to do with the cultivation of the soil in Canada has suffered in some degree from Cutworms. In very many cases the losses sustained might have been materially reduced, if not altogether prevented, had information such as contained in this bulletin been at his disposal. The issuing of this publication should, therefore, prove of great value to Canadian Agriculture.

I have the honour to be,

Sir

Your obedient servant,

J. H. GRISDALE,

Director, Dominion Experimental Farms.

OTTAWA, February 28th, 1912.

MR. J. H. GRISDALE,

Director, Experimental Farms Branch,
Department of Agriculture,
Ottawa.

SIR,—I have the honour to submit herewith for publication a Bulletin (No. 3 of the Division of Entomology) on "Cutworms and Army-worms" which has been written at my request by Mr. Arthur Gibson, Chief Assistant Entomologist.

Every grower of field and garden crops, 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. Consequently, the information contained in this Bulletin will be of value to a very large number of people.

It may be pointed out that this Bulletin includes many new and hitherto unpublished observations on the life-histories of several species, to the study of which Mr. Gibson has devoted much time for a considerable number of years. Such observations are of great importance especially as they indicate to the farmer when the appearance of the cutworms may be expected and the length of time they and their attacks may persist. Remarkable though it may appear, the information which we possess concerning the life-histories and habits of several of our commoner species of noctuid caterpillars is still very meagre and we are endeavouring gradually to fill in these gaps in our knowledge.

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

C. GORDON HEWITT,
Dominion Entomologist.

February, 1912.

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CUTWORMS AND ARMY-WORMS.

SUMMARY.

Cutworms and army-worms 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 and army-worms feed at night. As the name "cutworms" 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 hands, 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 realised.

Poisoned bran, that is, bran poisoned with Paris green, is the best remedy for the destruction 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.

For army-worms, and cutworms which assume the marching habit, furrows should be ploughed across the fields ahead of the caterpillars. In these furrows, at intervals of about ten feet apart, post holes should be dug. The caterpillars, when they reach the furrows, wander along 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.

CUTWORMS.

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 which 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.

The moths of these cutworms belong to the familly Noctuidæ, of which in North America there are over two thousand different kinds. In Canada, fortunately, not more than about twenty 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 half way 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 habits, they were given the popular name of "owlet-moths".

The eggs 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.

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 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.

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.

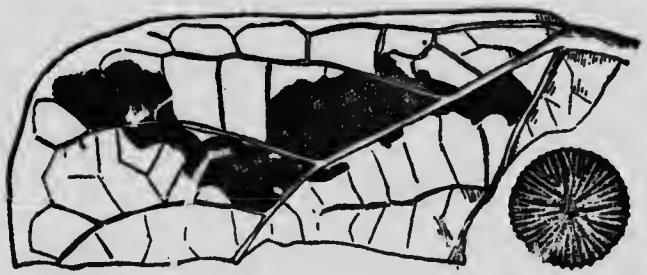

Fig. 1—Egg mass of *Peridroma saucia* on cowpea leaf, and single egg much enlarged, on right. (Chittenden, Bull. 29, N.S., Div. of Ent., U. S. Dept. Agr.)

The eggs of cutworm moths, as a rule, are laid in clusters or masses on the leaves of trees, shrubs, weeds and 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 3 to 20. The number of eggs laid by a female varies considerably. In some clusters there will be less than one hundred 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 mid-summer. Those of some species, however, may be deposited as early as the end of April.

Fig. 2.—Earthen cell and pupa.

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. Some of these are parasitic insects, laying their eggs upon the bodies of the cutworms. These eggs hatch and the young maggots or grubs feed internally upon the living caterpillar until they have ultimately destroyed it. Others are predaceous and are constantly hunting for cutworms to devour. One of the most important of these latter is the Fiery Ground Beetle, *Calosoma calidum* Fab., the grub of which is known as the Cutworm Lion. This beetle, both in the adult and the grub state, destroys large numbers of cutworms. It 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 important enemy is the black Ground Wasp, *Ammophila luctuosa* Smith. This wasp digs the cutworms out and stores them in its nest as food for its young grubs.

Fig. 3—*Winthemia 4-pustulata* fly, with larva at left and puparium at right: fore part of the body of Army-worm with tachina eggs attached below—somewhat enlarged. (After Comstock.)

Fig. 4—*Calosoma calidum; a*, larva; *b*, beetle. Natural size. (After Riley.)

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, 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.

Parasitic fungous diseases, such as species of *Empusa*, help to reduce outbreaks of cutworms. These caterpillars 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 these clusters of eggs 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.

Fig. 5—Method of protecting young seedlings from cutworms by means of small tin cylinders.

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 six inches long and two and a half 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.

To protect fruit and other trees from climbing cutworms, a band of cotton batting four 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.

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. One half a gallon of water, in which half a pound of sugar has been dissolved, is sufficient to moisten fifty 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 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 actually 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. From fifty to one hundred pounds of poisoned bran is sufficient to treat an acre, the actual amount depending upon the closeness of the plants. In fields, where standing grain is attacked, the mixture may be distributed by means of a wheel seeder, or it can be thrown from a wagon, by means of a shingle, to a distance of twenty feet. In large fields of such plants as beets, the mixture may be distributed on the surface by means of a beet drill, the spouts of which should not be allowed to become clogged, or it may be spread by hand. In southern Alberta, where cutworms often do very serious damage in fields of beets, it has been found that a 16 year old boy can apply the bran to eight or ten acres in a day, and in such crops some growers have found it necessary to use only from twenty to thirty pounds of mixture to the acre. The method is to have a sack filled with the bran, hung about 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. Where rows are to be treated, it can be quickly placed in the manner described above by walking down between the rows.

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 all surface feeding cutworms. For such cutworms 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 small grain crops the following year as free as possible from long grass and weeds. Prairie or sod land

which is to be broken for seeding the next year should be fed off as late as possible or mowed before breaking. 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, 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 ten feet apart are dug in the furrow, hundreds of the cutworms will fall into them and they can 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 remedies for Army-worms are given on pages 28 and 29.

THE COMMONER SPECIES OF CUTWORMS.

The Red-backed Cutworm, *Euxoa ochrogaster* Gn.

(Figure 1 on plate.)

Appearance. As its popular name indicates, this cutworm is red along the upper side, or back. When full-grown, it is about one and a half 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 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 grayish 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.

The moth of this cutworm is extremely variable in colour and markings. In size, it ranges from about one and three-eighths inches to one and five-eighths 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.

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, cauliflowe . beets, radishes, etc., are attacked every year and in the western provinces ı:: ch injury is done to wheat, oats, etc., oftentimes whole fields of grain or othe. crops, being entirely destroyed.

The moths of this cutworm appear in 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 in the latter half of July and during early August. At Ottawa, the species is known to pass the winter in the egg state, but whether this is always the case, is not known. Eggs deposited in October did 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.

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 one to two 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.

(Figure 2 on plate.)

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-gray, although some individuals are decidedly blackish. Down the center 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.

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 fore-wings are dark purplish-brown suffused with pale brown, particularly in the outer

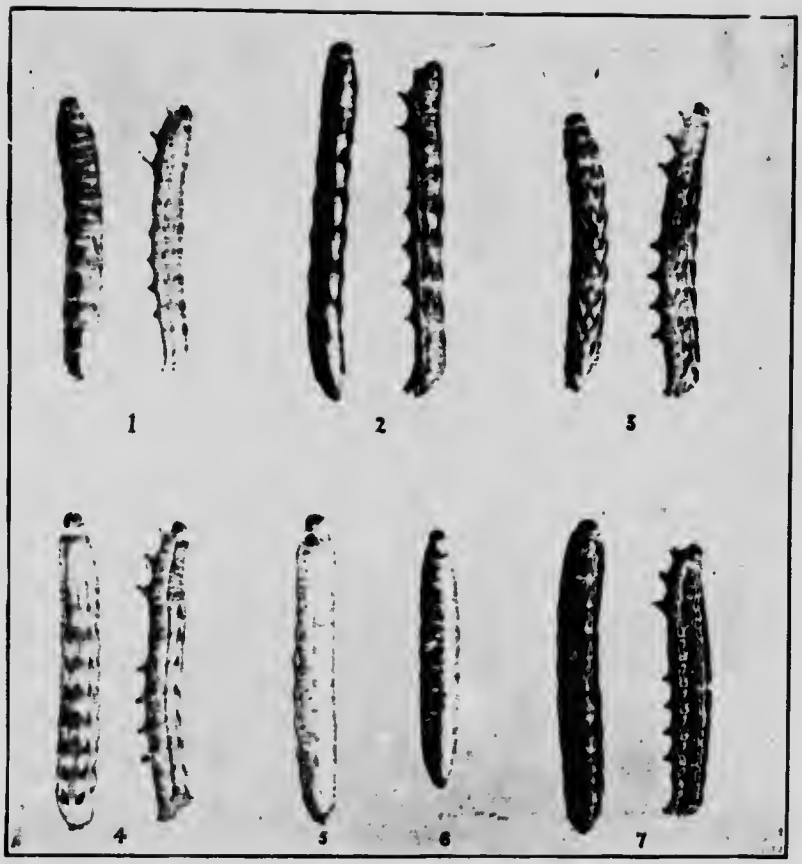

Photo by H. T. Güssow.

1. Red-backed Cutworm, back and side view. *(Euxoa ochrogaster.)*
2. Greasy Cutworm, back and side view. *(Agrotis ypsilon.)*
3. W-marked Cutworm, back und side view. *(Noctua clandestina.)*
4. Spotted Cutworm, back and side view. *(Noctua c-nigrum.)*
5. White Cutworm, back view. *(Euxoa scandens.)*
6. Dingy Cutworm, back view. *(Feltia ducens.)*
7. Black Army-worm, back and side view. *(Noctua fennica.)*

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 grayish-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.

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 4 to 7, 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.

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.

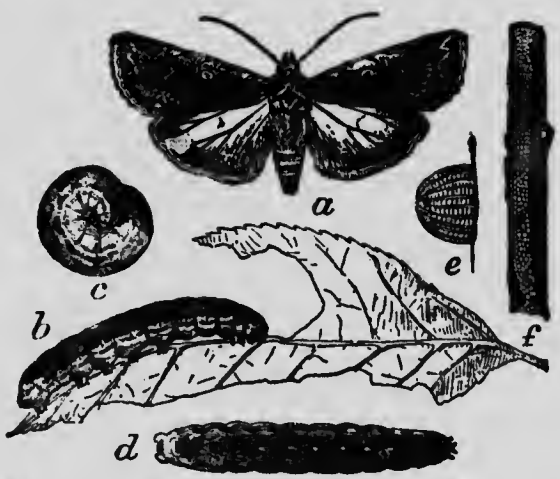

Fig. 6—The Variegated Cutworm; *a*, moth: *b*, *c*, *d*, caterpillars: *e*, egg—enlarged: *f*, egg mass on twig. (After Howard.)

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 and eating the leaves. It is also occasionally found attacking plants in greenhouses. In 1900, a phenominal 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 apparent 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 British Columbia, as many as 50 clusters of eggs undoubtedly of this species were found on June 28 on clothes which had been hung out to dry. On the same day they were also found on windows, verandahs 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 larva collected at Ottawa emerged on September 6. The pupa of this cutworm is of a mahogany-brown colour, and in size is about five-eighths of an inch long to 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 grayish, 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. 7—The Dark-sided Cutworm and moth. (After Riley.)

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 gray 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 tbe top of the stalks and eating downwards.

Unfortunately, tbe life-history of this insect is not as yet known. Tbe moths occur commonly in many widely separated districts. In Ontario and Quebec they are on the wing in August and September. At Toronto tbe moth bas 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 15, (1904).

The White Cutworm, *Euxoa scandens* Riley.

(Figure 5 on plate).

Appearance. When full-grown, the White Cutworm is about one and three-quarter inches long. It is of a light yellowish-gray 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.

The moth varies considerably in the colour of the front wings, which may be either ash-gray, or gray 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 fore-wings 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, tbis moth expands about one and three-eigbtbs 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., (Aug. 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 (13-sixteenths of an inch), and were hibernating in soil where cabbages bad been grown the previous year.

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

(Figure 3 on plate.)

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 and 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 one and three-eighths inches long.

The moth of the W-marked Cutworm expands about one and five-eighths 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 late 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.

The Spotted Cutworm, *Noctua c-nigrum* Linn.

(Figure 4 on plate.)

Appearance. The general colour of this cutworm is pale brownish, or ashy-gray, 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.

The adult moth is about one and a half 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 place(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 the same season a cluster of eggs found at Niagara, Ont., upon an apple leaf, was sent to the Division. 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 greenish 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 tubercules, each of which bears a single hair. The front feet 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. 8—Glassy Cutworm: moth and caterpillar.

The fore-wings of the moth vary in colour from pale ashy-gray 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 feeds 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. In Manitoba, also, much injury has been done in wheat fields.

The insect is widely distributed in North America, and in Canada the moths have been found commonly from Nova Scotia across 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. 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.

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-gray colour, without markings. When mature it is about an inch and a half long.

The moth 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-gray. In some specimens the cross lines are distinct being of 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 one or two 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. The pupa is of the same size and colour as that of the Glassy Cutworm. Some 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-gray with pale yellowish spots and streaks. The head is pale-yellowish, or pale-greenish, with white mottlings. When mature, this cutworm is about two 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 latter 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 one and a half inches in width.

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 Division 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, 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.

The Dingy Cutworm.

(Figure 6 on plate.)

In Fletcher's report for 1888 this cutworm is described as follows: "Head gray, shiny and speckled; thoracic shield on first segment bearing three white stripes. General colour of the body gray and three indistinct stripes along the sides. The bristle bearing tubercles black and conspicuous. When full-grown it is about an inch in length."

In the early reports of the Division of Entomology and Botany, 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.

The specimen of the larva of *ducens* figured on the plate is of a dull grayish-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.

Of late years, no reports have come to us of injury by the Dingy Cutworm. According to Fletcher, this caterpillar has attacked in eastern Canada all kinds of garden crops—turnips, cabbages, etc. In the United States it is a serious enemy to 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 usually in August.

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 prairie provinces the caterpillars of *Chorizagrotis auxiliaris* Grt., *C. introferens* Grt. and *C. agrestis* Grt. have attacked all kinds of succulent plants. In Alberta, in 1911, the larvæ of *Porosagrotis delorata* Sm. appeared for the first time as an injurious cutworm and destroyed large areas of wheat. In one instance a correspondent claimed that 320 acres of wheat had been destroyed by this latter cutworm before June 21. In British Columbia the caterpillars of *Paragrotis perexcellens* 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.

ARMY-WORMS.

In Canada there are two different kinds of army-worms which are periodically responsible for much damage to certain crops. Both of these noctuid caterpillars are present in more or less numbers every year, and in seasons of

ordinary abundance they have the same habit as cutworms, feeding during the night and hiding by day. When, however, conditions favour their increase and they become enormously abundant they soon devour all nearby available food and march ahead at any time of the night or day in army-like fashion, in search of new fields to conquer and destroy. Owing to such habit they are commonly called army-worms. They are in general similar to cutworms, to which, in fact, they are closely allied being of the same shape and having the same number of legs, namely, sixteen.

The Army-worm, *Heliophila unipuncta* Haw.

Appearance. When full-grown this army-worm is about an inch and a half long. It is a brown or blackish caterpillar with three conspicuous yellowish or pale-coloured stripes above, one down the middle and the others on either side of the back. A broad dark band is present on each side of the body, bordered above with a yellow line. Along the lower edge of the breathing pores is a wide yellowish band flushed more or less with red. Beneath, the body is greenish, mottled with brown. The head is brown marked with a network of darker brown; on each side are two curved blackish-brown bars. The feet are pale brown.

The moth is about from an inch and a half to rather more than an inch and three quarters in width when the wings are spread. The fore-wings are of a reddish-gray, or fawn colour, with a conspicuous white mark about the centre of each. The round and kidney-shaped spots are indistinct in some specimens but in most appear as two yellowish-red patches. A row of small black spots near the outer margins of the wings and a dark streak from each apex to these spots, completes the important markings. The hind wings are brown, darker at the outer margins. The thorax is of the same colour as the fore wings and the abdomen is similar to the hind wings.

Fig. 9—Army-worm.

Fig. 10—Eggs, pupa and moth of Army-worm.

Habits and life-history. Serious outbreaks of the Army-worm have occurred in Canada from time to time. In the United States, in certain years, the caterpillars have destroyed crops to the value of many thousands of dollars. In one year alone (1881) the damage done by the Army-worm to the oat crop of Indiana and Illinois was estimated at $750,000. In Canada, oats and timothy are the two crops which have suffered most, but corn, rye, barley and wheat have been attacked to a lesser extent, as well as even garden vegetables such as peas, beans, lettuce, etc. These latter crops, however, are only attacked, as a rule, when the

favourite food plants are scarce. In ordinary years of abundance these caterpillars feed at night, as in the case of cutworms, remaining hidden during the day. In such seasons, therefore, they are seldom noticed but when conditions favour their increase they breed very rapidly and after eating all available food supply in the immediate vicinity they assume the army habit marching ahead in search of new plants to devour. They do not like the sun, and consequently, during bright warm days, they hide beneath pieces of earth, sod, boards, etc., and in early evening, after sundown, come out to feed.

In Canada, there are two annual broods of the Army-worm, the moths appearing in June and again in August and September, specimens even occurring abundantly, some years, in October. Those which emerge in late summer lay eggs which hatch in about ten to twelve days. The young larvæ winter in a partially grown condition beneath tufts of grass and other low herbage, and in spring complete their growth, feeding chiefly on grasses. In June moths from these caterpillars appear and lay eggs producing another brood of caterpillars. A single female moth is capable of laying as many as 700 eggs. They are deposited in patches on wild or cultivated grasses, corn, etc. and in about a week the young larvæ appear. These at first are greenish in colour and loop when walking. The favourite breeding place is among low, rank-growing grasses.

In almost every instance where invasions of this insect have occurred in Canada, the injury has been done by the brood of caterpillars which appeared in July and the beginning of August. Fortunately, the Army-worm is seldom abundant in enormous numbers in the same locality for two years in succession. After an outbreak, many parasitic insects, as well as parasitic diseases attack the caterpillars and bring their numbers again down to normal. Although it is not altogether thoroughly understood how such insects increase in numbers so suddenly it would appear that dry weather is favourable to their development. This was instanced in one of the more recent of the serious outbreaks of this insect which we have had in Canada. In Ontario, the season of 1895 was dry and this was followed by a mild winter and another dry summer in 1896. In this latter year the Army-worm was present in very large numbers, particularly all through the western part of the province, and devastated fields of oats, timothy, wheat, rye, barley and corn. In the following year (1897) not a single report of the presence of the insect was received.

When mature, the Army-worm enters the ground to the depth of an inch or so and changes to a reddish-brown pupa about three-quarters of an inch in length and in about two weeks the moth emerges. The adult moths conceal themselves during the day but at night they are very active flying about and being readily attracted to the well-known "sugar," a bait applied to trees by collectors of insects, for the purpose of collecting noctuid moths.

Natural enemies. In years of abundance as mentioned above, these caterpillars are attacked by many important insect parasites, among which are several two-winged tachinid flies which deposit their white, seed-like eggs usually upon the fore parts of the living worms. As many as fifty of these eggs are stated to have been found upon a single worm. From each of these eggs there soon hatches a small maggot which enters the body of the caterpillar, feeding entirely within and gradually killing the worm. In addition to these very useful tachinid flies, there are several species of four-winged flies which lay their eggs within the body of the caterpillars and the young grubs of these also feed upon the juicy and fatty tissues within. Some of our common ground beetles are also predaceous upon the Army-worm. Several of our wild birds, too, freely eat these larvæ, as for instance, crows, blackbirds, bobolinks, robins, etc. Even the English Sparrow has been seen devouring them in large numbers. Parasitic fungi, such as *Empusa* also play no small part in the control of these caterpillars.

Preventive and remedial measures. It has been found possible by watching carefully, to control an infestation of the Army-worm before the caterpillars leave their native breeding places. This has been done by ploughing around such breeding places a few deep furrows and when the caterpillars collect in the furrows, they can be killed by crushing them, or the vegetation surrounding the breeding places may be sprayed with a strong Paris green, or arsenate of lead, mixture, using one pound of the former, or six pounds of the latter, in every one hundred gallons of water. When the caterpillars are seen marching ahead, however, it will be necessary to plough deep furrows across their path. The sides of the furrows furthest away from the worms should be made perpendicular, if necessary by a spade, so as to render it difficult for them to climb. Along each furrow a series of post holes about a foot deep and about ten feet apart should be made. The caterpillars when they reach the furrow will wander along it and soon fall into one of the holes, when they can then be killed by either crushing them with the blunt end of a post, or fence rail, or by pouring a little coal oil over them. If any of the worms should succeed in getting over the furrow, the plants ahead of them should be sprayed, as above mentioned.

In the autumn following a severe outbreak of the Army-worm in any locality, it is a good practice to burn over the old grass and stubble and then plough deeply. In this way, young hibernating caterpillars will be destroyed and the place rendered unattractive for egg laying for the moths of these and our common species of injurious cutworms.

As with cutworms, promptness and thoroughness of action are most essential in dealing with the Army-worm, if crops are to be saved from its ravages.

The Black Army Worm, *Noctua fennica* Tausch.

(Figure 7 on plate.)

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 center 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 fold behind the head being black. All the feet are of a pale brownish colour.

The moth, like the caterpillar, is of rather handsome appearance, and with wings spread it measures about an inch and a half across. The front wings reddish-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 the Black Army-worm are very similar to those of our common cutworms; 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. In one instance at Ottawa the larvæ in the third week of May spread from a clover field to a three 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. When mature the caterpillar enters the earth in a similar way to ordinary cutworms, and in due time the moths appear. The full-life history of the insect is not as yet known.

Natural enemies.—On several occasions when these caterpillars were abundant in eastern Ontario, they were largely destroyed by a parasite fungus, viz. *Empusa virescens* Thaxter. In fields, as has been recorded by Fletcher, they were seen in large numbers on stones, fences, stems of grasses and other plants upon which they had crawled and to which they were fixed by the fungus. This army-worm is also attacked by parasitic insects. At Ottawa, the eggs of tachinid flies have been frequently observed on their bodies.

Remedies.—As the Black Army-worm 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.

When the caterpillars are present in ordinary numbers, however, they can be easily controlled by applying poisoned bran as mentioned on page 14. In years, when they are abundant enough to assume the marching habit, the remedies mentioned for the true Army-worm, on page 28, may be adopted. In one instance, near Ottawa, further damage was prevented by spraying a strip of peas 50 feet wide, ahead of the caterpillars, with a strong solution of Paris green, one pound in 100 gallons of water, to which four pounds of soap were added to make the mixture adhere better.

NOTE.

Farmers and others are invited to send specimens of cutworms, or of other insects, which are found causing injuries to their crops, should they wish to have them identified. Such specimens should be enclosed with a supply of food plant or grass in a tin or wooden box (not a paper box) which may be mailed "Free" if addressed to the Dominion Entomologist Central Experimental Farm, 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.