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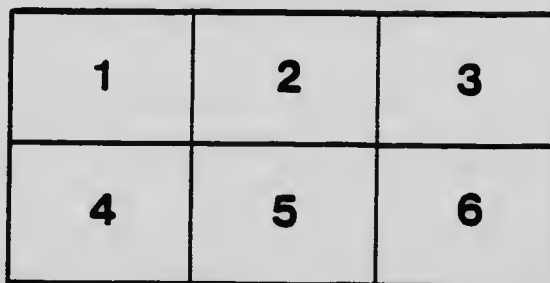
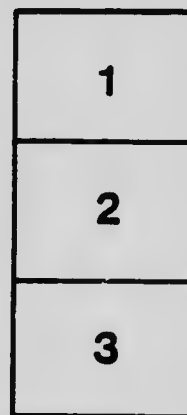
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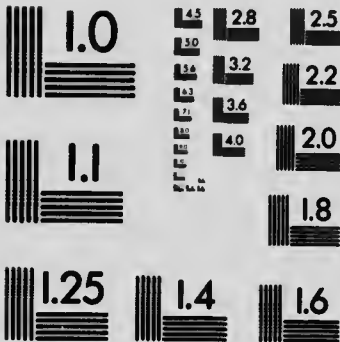
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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Insects Affecting Vegetables

By C. J. S. BETHUNE.

Every vegetable grower, whether in town or country, on a small or a large scale, finds from time to time that his plants are attacked by some destructive insect and that serious injury is threatened to his crop. It is desirable, therefore, that some convenient manual should be provided for the identification of the ordinary pests and to describe the remedies which experience has proved to be the



Fig. 1.—Winged Aphis and wingless form
—much magnified.



Fig. 2.—Winged and Wingless Aphids—
greatly magnified.

most effective in each case. In the following pages an effort is made to furnish in simple terms and without the use of technical language the information which will fulfil these requirements.

As a general rule it will be found that thorough preparation of the soil, a short rotation of crops, ample manuring and clean cultivation are the best of all remedies. All refuse remaining on the ground after the crop has been removed, such as stalks, roots, and leaves, should be got rid of by feeding to pigs or cattle, burning or burying, in order to leave no shelter for wintering insects. Weeds of all descriptions, especially in fence corners and waste places, should be cut down before they go to seed, or plowed under from time to time; they harbour many of our worst pests in summer and winter, and often afford convenient breeding places for enemies which the vegetable grower is endeavoring to combat on his cultivated plants.

GENERAL FEEDERS.

Before taking up in order the insects that attack the various plants grown in our vegetable gardens, attention may be drawn to a number of kinds that are general feeders, not limiting themselves to any particular varieties, but attacking almost everything that comes in their way; on that account they are the most serious foes that we have to contend against and in many cases the most difficult to keep under control.

APHIDS or PLANT LICE (Figs. 1 and 2) are minute, pear-shaped, soft-bodied insects that may be found on almost every kind of plant, usually in dense colonies clustered thickly on the terminal twigs and buds, on the under-side of leaves, on



Fig. 3.—Lady-bird beetles and a larva.

stems and other parts, and even underground on roots. Wherever situated they are occupied in the same manner—sucking out the life-juices of the plant and multiplying their own numbers by constant reproduction of living young all through the summer. There are a great variety of species, most of them varying shades of green in color, some are shining black, others bright red; some again are covered with waxy filaments resembling threads of cotton wool, and others with a dusting of a mealy substance composed of the same material. Singly they are insignificant creatures, but occurring as they do in enormous numbers and multiplying with amazing rapidity, they are able to seriously injure and often to destroy the vegetation they attack. Fortunately they are devoured by many predaceous insects, such as Ladybird beetles and their larvæ (Figs. 3 and 4), and those of the



Fig. 4.—Lady-bird beetle, pupa and larva.

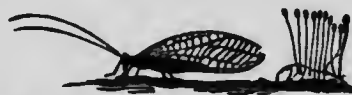


Fig. 5.—Lace-winged fly and its eggs on stalks.

Lace-winged (Fig. 5) and Syrphus flies and other creatures; washed off and drowned by heavy rains, and reduced in numbers by internal parasites; otherwise they would in time destroy all vegetable life. Ants are usually to be found prowling about the colonies; they do not eat the aphids, as might be suspected, but are attracted by the sweet "honey-dew" that exudes from them, and take them under their special protection.

In gardening operations nature's checks are not sufficient, but require to be supplemented with artificial remedies such as kerosene emulsion, strong washes of soap-suds or tobacco decoction. In greenhouses they can be kept in control by burning the commercial preparation of tobacco.

Soap washes are made by dissolving one pound of whale-oil soap in four gallons of warm water for black or brown Aphids, and one pound in six gallons for green Aphids. Common laundry soap will answer, using a larger proportion.

"Black-Leaf-40," a preparation of tobacco, which can be procured at the large seed stores, is a most effective remedy for Aphids and many other sucking insects.

ANTS. These insects are often suspected of injuring the plants over which they are seen running, but as a rule they are only indirectly responsible. A few species, such as the large black Carpenter Ants, form their galleries in trunks of trees, posts and timber and do a considerable amount of damage, but the great variety of smaller species which infest our gardens do not feed upon foliage or injure growing plants. Sometimes they may be found upon unopened flower buds, but they are only attracted by some sweet secretions on the surface; as a rule their presence indicates that there is a colony of aphids near by, which they take under their protection in order to obtain from them the sweet "honey-dew" exuded by these minute creatures. The worst injury for which they are responsible is the establishment of colonies of Aphids upon the roots of many plants; the ants collect

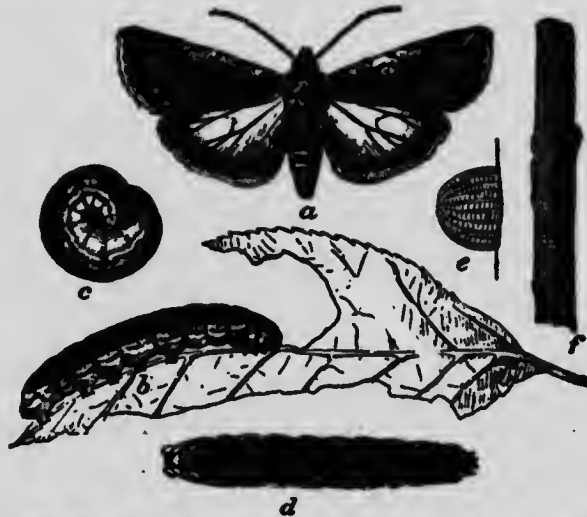


Fig. 6.—Variegated Cutworm: (a) moth; (b c d) caterpillars; (e) egg (magnified); (f) eggs on a stem.

the eggs and take care of them during the winter and when growth is sufficiently advanced carry them to the roots and look after them during the summer, in order to have a constant supply of "honey-dew." These colonies increase rapidly, soon check the growth of the plant, and ultimately destroy it. Where ants' nests abound, frequent digging and stirring of the soil, and in field cultivation repeated disking and harrowing, will get rid of many, or they may be treated with carbon bisulphide; a small quantity should be poured into the entrance of the nest or into a hole made with a stick and quickly covered with earth; the fumes will speedily kill all the inmates. It is best to perform the operation towards evening when all the ants are within the nest. This is a very effective mode of getting rid of the large colonies which make mounds of rubbish on lawns and in fields.

CUTWORMS (Figs. 6, 7 and 8). At the beginning of the growing season the gardener often finds in the morning young plants cut off near the surface of the ground that the evening before were strong and healthy. On stirring up the soil nearby he may find hidden in the ground a greasy-looking caterpillar, the culprit in

the case. Cutworms, so called from this habit, are the caterpillars of dull-colored night-flying moths of a great variety of species and varying to some extent in their habits. As a general rule they are partly grown at the approach of winter and hide away in a torpid state during the cold weather; when restored to activity by the warmth of spring, which causes the buds to open and the growth of plants to begin, these worms come out in search of food and attack any kind of tender vegetation they meet with. They are nocturnal in their habits and hide away during the hours of daylight under any shelter they can obtain or just below the surface in the loose soil of newly made beds. Owing to their destructive practice of cutting off a whole plant in order to devour a portion of its foliage, they do a great deal of apparently needless damage.

After they have become fully grown they change to the chrysalis stage in the ground and in early summer the moths appear, many of them making their presence known in our houses by their attraction to light. Before very long another brood of caterpillars comes upon the scene, often more numerous and more destructive than the first. Some of them climb up into fruit trees and destroy the



Fig. 7.—Cutworm moths.



Fig. 8.—Cutworm and moth.

foliage, others attack farm crops, vegetables, grape vines, the plants in flower gardens, etc., while occasionally a single species appears suddenly in enormous numbers and sweeps like an army over the land, devouring everything that comes in its way.

Happily, a very simple and completely effective remedy has been found for these destructive creatures. It is called the "poisoned bran-mash" and is made in the following manner: Mix half a pound of Paris green in 20 lbs. of bran (the proportion for larger or smaller quantities is 1 to 40); the poison should be added to the dry bran little by little and stirred all the time till the whole is tinged with the green color, then add water sweetened with sugar or molasses, till the mixture is sufficiently moistened to fall like sawdust through the fingers. Two gallons of water and half a gallon of molasses are the usual quantities. The addition of two or three lemons renders the bait more attractive. The juice of the fruit should be squeezed into the mixture and the pulp and rind added after being minced in a meat chopper. If bran cannot be procured, shorts or flour may be used, and for field work may be distributed by means of a seed drill. The mash should be scattered about the plants that are liable to attack in the evening, and strange to say the worms will devour it in preference to their ordinary vegetable food. When they begin to feel the effects of the poison they wander off to find a hiding place or burrow in the ground and there die. Their dead bodies will be readily found in the morning just below the surface of the ground, often in surprising numbers. Young plants, such as cauliflowers, tomatoes, etc., may be protected when set out

by wrapping a bit of newspaper around the stem between the root and the leaves and reaching a little below the surface of the ground. The worms will not attempt to bite through or climb over it.

FLEA-BEETLES (Fig. 9). There are several species of these minute insects which attack a large variety of plants; some confine their attentions to one or two kinds, while others are general feeders. The beetles are about one-tenth of an inch in length, oval and convex in form, usually shiny black or bronzed in color, sometimes ornamented with broad, pale stripes along the back; they all possess enormously developed thighs on the hind legs, by means of which they are enabled to jump with great agility, and hence have acquired the name of Flea-Beetles. They appear in early spring, often in large numbers, and eat small holes in the foliage of young plants, preferably the thick seed-leaves. The larvæ, as far as known, feed

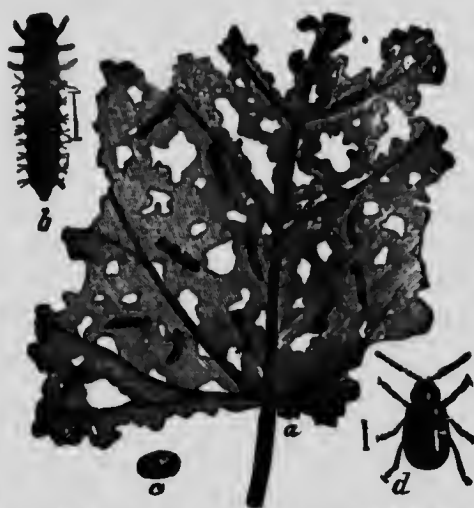


Fig. 9.—Flea-beetle.—(a) leaf with larvæ at work upon it; (b) larva, greatly enlarged; (c) pupa; (d) beetle, magnified.

for the most part on the roots of weeds, as well as upon some garden vegetables; clean cultivation, especially of fence corners and bits of waste land, is therefore of much importance in the control of these and many other kinds of insects. The beetles may generally be found all through the summer, when they especially attack the foliage of potatoes, turnips, beets, tomatoes and many other plants. In many cases fungus diseases, such as Potato Blight, find suitable places for the growth of their spores in the holes made in the leaves by these beetles.

Cheese-cloth screens are very effective in warding off attacks upon young plants, such as cucumbers, etc., but where their use is not convenient or practicable the beetles may be controlled by the use of the poisoned Bordeaux mixture, the combination being effective against both the insects and the fungus diseases. For tender foliage arsenate of lead is preferable to Paris green as it is not so likely to cause injury by burning.

GRASSHOPPERS (or Locusts, as they should be called)—Fig. 10—are often very destructive in the later summer months, especially if the weather should be dry. They are general feeders, few kinds of vegetation coming amiss to them. They are numerous and the supply of food is at all scanty. Usually

they are most abundant in dry pastures and the neighboring grain fields, this is due to the fact that their eggs are laid in grass lands, especially where the soil is dry and sandy, and the young nymphs grow there to maturity. They do not pass through any chrysalis stage, but gradually become bigger after each moult till the full-winged adult stage is reached. Many mechanical devices have been employed for their destruction, but the use of these troublesome methods can now be dispensed with since the discovery of the "Criddle mixture," a poisoned bait which derives its name from Mr. Norman Criddle, of Aweme, Manitoba, who proved its complete efficiency after a series of experiments. It is made and applied as follows: Take a three-gallon patent pail and fill it with fresh horse droppings, then empty into a barrel repeat this five times. As each pailful is poured in, mix thoroughly with the manure about a quarter of a pound of Paris green and half a pound of salt which has been dissolved in water. There would thus be used about one pound of Paris green and two pounds of salt to half a barrel of manure. The mixture may be drawn in a cart to the infested places and scattered broadcast with

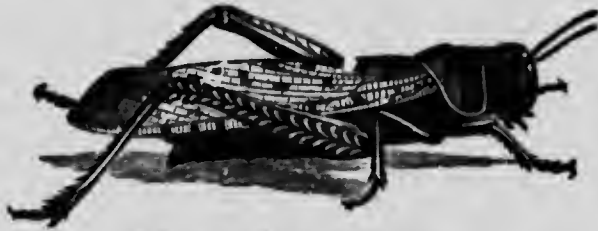


Fig. 10.—Grasshopper or Locust.



Fig. 11.—Tarnished Plant-bug.

a trowel or wooden paddle. The grasshoppers are attracted to it from considerable distances and are killed in large numbers. It has been found most effective to distribute the mixture on alternate days, a little at a time, rather than to use larger quantities at longer intervals. In the case of grain fields, oats being especially liable to attack, the mixture should be thrown into the grain along the sides of the field and the grasshoppers will eat it in preference to anything else. Care should be taken not to allow cattle or poultry to have access to it. In some localities, however, this mixture has been found to have no attraction for the grasshoppers, but another method, which is effective wherever tried, has been discovered. This is the use of the poisoned bran wash recommended for the destruction of Cutworms (page 4). Double the quantity of Paris green should be employed, that is 1 pound to every 20 pounds of bran, and the mixture should be applied in the morning between 5 and 7 o'clock by scattering so thinly over the infested field, fence corners, and roadsides, that the above quantity will cover four or five acres. It may be necessary to make a second application a few days later. It is advisable to apply this remedy as early in the season as possible, that is, as soon as the young grasshoppers are observed. They are then more readily killed by the poison and have also inflicted less damage than if allowed to devour the grass or crops for several weeks longer.

PLANT-BUGS In the American use of the word, the name "Bug" is erroneously applied to insects of every kind—to a beautiful butterfly or moth as well as to the disgusting bed-bug. The name, however, when correctly employed, denotes insects belonging to the order Hemiptera, which are provided with sucking and not biting mouth-parts, and which do not pass through any quiescent chrysalis stage, but are gradually developed from the newly hatched nymph to the winged adult. To the true bugs belong two species which are very abundant in gardens, attacking plants of all descriptions, flowers and vegetables alike. These are the Tarnished and Four-lined Plant-bugs.

THE TARNISHED PLANT-BUG (*Lygus pratensis*)—Fig. 11—is to be found all through the season on plants of almost every kind, sucking the juices of flower buds and foliage and sometimes of the leaves of young fruit trees. The mature insects are oblong in form with a triangular head and prominent eyes, and tapering to a rounded angle at the other end. The color is variable, usually grayish-brown, marked with yellowish and black dashes, and having a slight bronzy reflection;

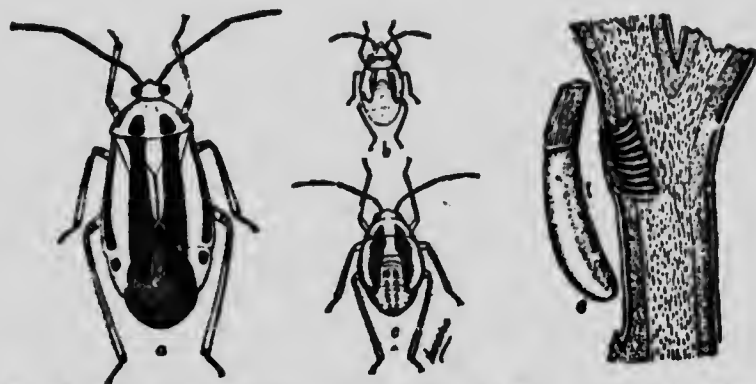


Fig. 12.—Four-lined Plant-bug: (a) adult; (b and c) immature nymphs; (d) eggs laid in a slit. (After Luggar).

its length is a little over a quarter of an inch. They are very active insects, taking flight readily when disturbed or dodging round to the other side of the plant.

THE FOUR-LINED PLANT-BUG (*Poecilopsus lineatus*)—Fig. 12—is much the same size and shape as the preceding, but is yellow in color, with dark lines down the back and four black dashes along the thorax. Its attacks are most noticeable in early spring, when it may be found on mint, sage, currant and gooseberry bushes, and often also on potatoes. It sucks the juices of the tender terminal leaves, causing them to shrivel up and turn black, and frequently severely injuring the plant. The standard remedy for these and other sucking insects is spraying with strong kerosene emulsion; where this cannot be applied, as in the case of many flowering plants, dusting with pyrethrum insect powder has been found quite effective. Much may be done by knocking off the bugs with a stick into a pan containing a little water covered with a film of coal oil; this should be performed in the cool of the morning when the insects are less lively than during the heat of the day. For the control of both these bugs it is important to keep the surroundings clean of weeds and rubbish, which afford them shelter in winter and convenient breeding places in summer.

SLUGS. These are not insects, but belong to the same family of creatures as snails, but are destitute of shells. As they are often very troublesome, especially in shady or damp city gardens, they may be referred to here. Like cutworms, they are nocturnal feeders, hiding under any convenient shelter in the daytime, and devouring during the night whatever succulent vegetation they may be able to reach. One method of getting rid of them is to go round the garden, where their presence has been made known, with a lantern at night, and dust their slimy bodies with lime or salt, which will soon destroy them. Another plan is to scatter freshly slaked lime over the ground for three successive nights; when the slugs come in contact with it their powers of mischief are at an end. Many may be got rid of in small gardens by laying pieces of shingle here and there on damp ground; the slugs will take shelter in such places when daylight sends them into hiding, and by going round in the morning they may easily be scraped off and crushed under foot.

WHITE GRUBS (Fig. 13). These are the larvæ of May-beetles or "June-bugs" (*Lachnosterna*), which breed for the most part in old pastures. The beetles appear about the end of May or early in June and attack the tender

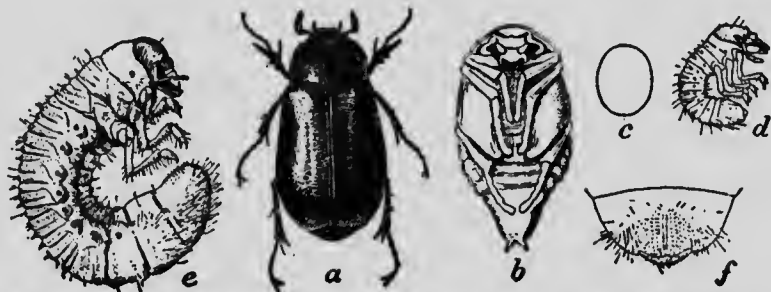


Fig. 13.—White grubs: (a) beetle; (b) pupa; (c) egg; (d) young grub; (e) mature grub. (*Chittenden, U.S. Dept. Agric.*)

foliage and buds of fruit and ornamental trees, often inflicting a considerable amount of damage. They come out at night and swarm about the trees, making a loud buzzing noise; many are attracted by lights in houses; and cause some consternation among the inmates through their clumsy flight about the room and the noise that they produce; as they can neither sting nor bite no alarm need be caused by their presence. During the night they feed and by morning all disappear, hiding underground where the soil is loose and under grass or rubbish about fences and buildings. At this period boys might be employed to search for and kill them; trap-lanterns have sometimes been used with advantage, and spraying the trees they frequent with Paris green will destroy large numbers. The beetles deposit their eggs on the stems or roots of grasses just below the surface of the soil; from these the grubs hatch out and feed for two or three years underground. During the summer of their third season they change to the pupal state and transform to beetles about September, but do not come out until the following spring. This long larval stage accounts for the fact that in some localities the beetles only appear once in three years.

The grubs, when fully grown, are thick, fat creatures, white in color—hence their name—with body partially curled up and the last segments discolored from the food showing through the skin. When an old pasture is broken up they live for a time on the grass and roots that have been turned under and then attack

whatever plant may be grown. The first and second crops usually suffer most, especially strawberries and corn; clover is least affected by them and may be seeded down with rye, then small grains followed by corn or potatoes. Late and deep ploughing will break up the winter quarters of the grubs and beetles and expose them to the frost and also to the various animals that prey upon them. Pigs and poultry greedily devour them; crows and other birds and skunks also destroy large numbers when they can get access to them.

In gardens digging deeply and trenching in the fall is very useful, but in the flower beds where perennials are grown this is impracticable, and therefore recourse can only be made to disturbing the soil between the plants as much as possible in late autumn and early spring. Lawns and golf-links are frequently very badly affected as they are left for many years undisturbed; sometimes the roots of the turf have been so completely eaten off that the sod may be rolled up like a carpet. In such cases the best plan is to dig up the part affected and destroy the grubs, put in a fresh layer of soil and resod or sow with grass seed.

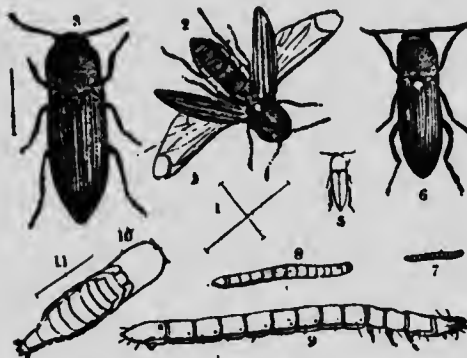


Fig. 14.—Wire-worms and Click-beetles.



Fig. 15.—(a) Wire-worm; (b) Click-beetle.

For small patches, watering with kerosene emulsion, and washing it well in with plenty of water from the garden hose, will kill the grubs. Where large areas are found to be affected on golf-links or in pastures, the most effective plan is to enclose the place with hurdles and turn in a few young pigs; they will soon root out and devour all the grubs, and may then be removed to another spot.

WIREWORMS are the larvæ of Click-beetles (Figs. 14 and 15), so called from their curious habit of springing up in the air with a "click" when laid upon their backs. The beetles are long and narrow, rounded above with very short legs and usually dull gray or black in color. The grubs are long and cylindrical, with a very hard integument from which they get the name of "Wireworms," and yellow or whitish in color. The life history is very similar to that of the White Grubs; they breed chiefly in old pastures, take two or three years to mature, and feed upon the roots of any plants that may be convenient to them; they are especially injurious to corn, and often may be found during the winter feeding inside potatoes, in which they burrow great holes. No treatment of the soil with salt, poisons, etc., has any effect upon them; the only remedy is a short rotation of crops as in the case of White Grubs; ploughing in August and cross-ploughing again in September will destroy large numbers of them. In gardens, as the beetles usually spend the winter under any shelter they can find, clean cultivation,

especially along the fences, is of great importance; in spring many may be destroyed by placing bunches of clover or weeds or slices of potatoes poisoned with Paris green under shingles or bits of board where the beetles go for shelter.

ASPARAGUS.

ASPARAGUS BEETLES (Figs 16, 17 and 18). The two species, the Blue (*Crioceris asparagi*) and the 12-spotted (*C. 12-punctata*), have spread over a great part of Ontario during the last few years and in many places are very abundant. Both species are often to be found upon the same plant; the former is shining blue-black in color, with creamy-white blotches on the wing-covers which vary a good deal in size and shape, and sometimes form a cross of the ground color of the back; the sides and the thorax are dull red and the head black. The

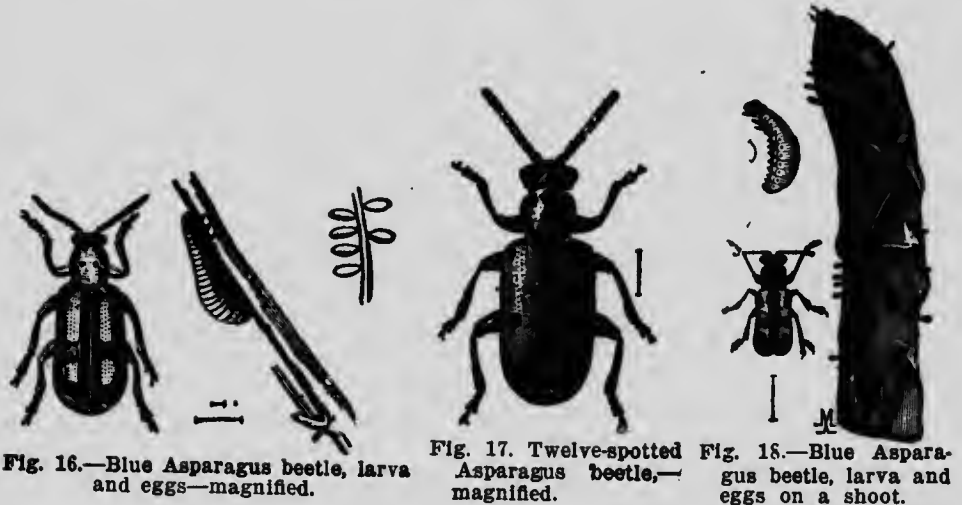


Fig. 16.—Blue Asparagus beetle, larva and eggs—magnified.

Fig. 17. Twelve-spotted Asparagus beetle,—magnified.

Fig. 18.—Blue Asparagus beetle, larva and eggs on a shoot.

other species is the same length, about a quarter of an inch, but is somewhat stouter; the whole insect is dull red and polished and has twelve round black spots on the wing-covers.

Both these beetles pass the winter in the adult stage and are ready to attack the asparagus shoots as soon as they appear above ground in the spring: these they gnaw and spoil for table use and the Blue species deposits upon them its shiny black eggs which are attached by the tip to the plants. Later on the eggs of both species may be found upon the growing plants and the larvæ soon appear. Those of the Blue beetle are dark olive gray grubs, which feed openly upon the foliage; the grubs of the 12-spotted are yellowish or somewhat orange in color, feeding at first upon the tender foliage, but boring into and devouring the pulp of the seed capsules as soon as they are large enough to attack. The life cycle of both kinds requires only six or seven weeks for its completion and we therefore find all through the season, till sharp frosts come in the autumn, eggs, larvæ and beetles in great numbers at the same time; the pupal stage is passed beneath the surface of the ground.

REMEDIES. The simplest and most efficient remedy is to let poultry have the run of the beds; they will devour both beetles and grubs and will not touch the asparagus.

Where this is not practicable, the young shoots should be dusted with fresh air-slaked lime when the morning dew is on the plants; this, of course, should be washed off before cooking. At the same time some slender shoots may be allowed to grow and attract the beetles, which may then be killed with Paris green or arsenate of lead. If the plants have many eggs upon them, they should be cut off and burnt and others left to grow in their place.

After the cutting season is over the plants should from time to time be sprayed with one of the arsenical poisons, but when the seed capsules are formed this will be of no avail against the grubs of the 12-spotted species. To get rid of it, the seed bearing plants should be cut off and burnt. In early autumn it will be well to cut down and burn the whole of the plants.

BEANS.

THE BEAN WEEVIL (*Bruchus obtectus*). (Fig. 19.) This insect has been reported from only a few places in Ontario and Quebec, and does not appear to have become established as a pest. It is a very small beetle, one-tenth of an inch long, only half the size of the Pea-weevil, which in other respects it closely resembles. It is grayish-brown in color, due to a coating of dense fine hair; the wing-covers are marked with a series of lines running lengthwise and have a mottled appearance. The beetle is oval in shape, the head is bent down and terminates in a short square beak; the end of the abdomen is not covered by the wings, and differs from that of the Pea-weevil in being destitute of the two oval black spots which are characteristic of the latter.

The eggs of the insect are laid upon the young bean pods; the grubs, as soon as they are hatched, bore through and enter the beans inside, several making their way into a single bean. Maturity is reached in the autumn, when the beetles emerge if the season is warm; otherwise they remain all winter in the ripened bean. If unmolested they will increase and multiply in the dry seeds and continue their work of destruction for a long time. It is therefore useless to hold over the seed for a year, as may be done to get rid of the Pea-weevil.

REMEDY. Whenever this insect is found to be present, the beans should be fumigated as soon as practicable after they are harvested. This is done by putting them in a barrel or tight bin and pouring on them one ounce of bisulphide of carbon for every 100 lbs., and then closing the receptacle tightly and leaving it for 48 hours. At the end of this time every insect will be dead. As the fumes of this substance are inflammable and explosive, it should not be used near any light or fire. Beans that have been injured by the insect should on no account be used as seed, as most of them will fail to germinate, or at any rate will produce only feeble plants.

THE BEAN PLANT-LOUSE (*Aphis rumicis*). Windsor or Broad Beans and Horse-beans are not much grown in this country, though in some places they are found of value as an addition to ensilage. Some difficulty is experienced in obtaining satisfactory crops owing to their liability to attack by this black Aphis, which is a serious pest in Europe. At the time of flowering the colonies of this insect are to be found covering the tips of the plants so thickly that they look as if dusted with soot; if let alone they soon multiply enormously and greatly reduce the vitality of the plants.

REMEDIES. The most successful plan is to cut off the tips of the affected plants and destroy the colonies of Aphids by burning or trampling under foot.

This has the additional benefit of checking the growth and causing the pods to fully develop. Spraying with kerosene emulsion or strong soap-suds will also be effective.

ROOT MAGGOT. Beans are occasionally attacked by the Seed-corn Maggot (*Phorbia fusciceps*), which also injures peas and several other vegetables. The chief mischief is done to the thick seed-leaves when they first push their way above ground; afterwards the maggots attack the roots and destroy the plant. Spraying with a carbolic wash has been found useful in deterring the parent flies from

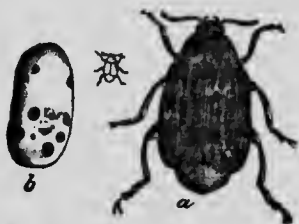


Fig. 19.—(a) Bean-weevil, much enlarged and natural size; (b) Infested bean.



Fig. 20.—Blister-beetles, magnified.

depositing their eggs. Good soil, well fertilized, to ensure a rapid growth of healthy plants, will enable them to resist the attack of the maggots and escape serious injury.

OTHER INSECTS. Beans, like other vegetables, are liable to be injured by Cutworms when the plants are small, and later on in the season by the Tarnished Plant-bug. Broad beans are also subject to attack by the Black-Blister-beetle, which is one of the enemies of the potato plant, and sometimes appears in destructive numbers.

BEETS AND SPINACH.

Beets and Spinach are liable to be attacked by many of the common garden pests that are general feeders, such as Cutworms which bite off the young plants close to the surface of the ground, Wire-worms and White-grubs which feed upon the roots, Plant Lice, Flea-beetles, Leaf-hoppers, the Tarnished Plant-bug and Grasshoppers which affect the foliage. Descriptions of these insects and the methods of dealing with them will be found elsewhere in the Bulletin. Mention may be made of a few other insects which occasionally attack these plants in injurious numbers.

BLISTER BEETLES (*Epicauta cinerea*, *Pennsylvanica*, etc.) (Fig. 20.) These are long, narrow, soft-bodied insects which belong to the same family (*Meloidae*), and possess the same blistering qualities as the "spanish-fly," which is used by druggists in the preparation of certain plasters. There are three species found in Ontario which may be distinguished by their color: the Black, the Gray and the Spotted; a fourth, the Striped, is occasionally to be found. Of these the Black is the most common and may often be seen feeding harmlessly on the flowers of the Golden-rod. At times these beetles appear in swarms and rapidly devour the foliage of beets, potatoes and a few other plants, and after inflicting a considerable amount of damage suddenly disappear. They may be controlled by spraying with Paris green, but this should not be resorted to unless the attack is serious, as their grubs have the very useful habit of feeding upon the eggs of grasshoppers and may therefore be included amongst the beneficial insects. A

better remedy, which has been employed with success, consists in driving the beetles away from an infested field by a party of men or boys walking in a line across and weeding branches from side to side. The beetles thus disturbed fly ahead, and by following them up may be cleared out entirely; once they are driven out of a field they seldom return. Spraying with Bordeaux mixture will keep them off the plants, and may be employed if necessary.

THE BEET LEAF-MINER (*Pegomyia vicina*). Blotches may often be seen on the leaves of beets and spinach, which are found on investigation to be caused by a minute maggot which feeds on the green tissue below the skin. The parent insect is a two-winged fly about a quarter of an inch in length, which deposits its eggs on the foliage of these plants; the maggots when hatched immediately burrow beneath the surface and cannot therefore be reached by any applications. The only method that seems at all available is to pick off and destroy the infested leaves, a laborious plan which can only be adopted where the plants are grown on a small

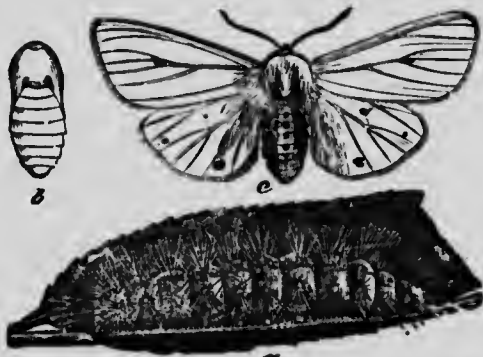


Fig. 21.—Yellow Woolly-bear: (a) caterpillar; (b) chrysalis; (c) moth.



Fig. 22.—White Cabbage Butterflies.

scale. If the attack is serious it would be worth while to adopt this method in order to get rid of the trouble and guard against its repetition.

CATERPILLARS. The foliage of beets and spinach is liable to be attacked by some caterpillars, but as a rule they are in small numbers, widely scattered over the plants and seldom inflicting much damage. This does not apply to the extraordinary outbreaks on rare occasions of the Army-worm and the Variegated Cutworm, which devour every green thing that they come to, beets as well as everything else. Among the others referred to may be mentioned the Yellow Woolly-Bear (*Diacrisia virginica*) (Fig. 21), which is a hairy caterpillar, readily seen from its bright yellow color, and attaining to an inch and a quarter in length when fully grown. It turns into a beautiful snow-white moth, with a few black dots on its wings and rows of black and yellow spots on its body. When feeding they are conspicuous, and may be picked off by hand; but usually they are beneath the leaves when at rest. If numerous, Paris green may be employed. They are general feeders and do not confine themselves by any means to garden vegetables, but attack many kinds of weeds as well.

CABBAGE AND CAULIFLOWER

These plants are subject to a series of attacks by insects from their first appearance above the ground to maturity. Cutworms destroy a great many seedlings and young plants when they are set out in the spring. Later on gray Plantlice make their appearance, and cover the leaves with their colonies, sucking out the sap and causing the foliage to dry up and wither; they become excessively numerous towards the close of the season, and in addition to the injury they inflict, cause the plants to present a disgusting appearance. Throughout the summer the leaves are liable to be devoured by several caterpillars, and in August and September by Grasshoppers, while the roots are frequently caused to rot by the Maggots of a small fly. Aphids, Flea-beetles, Cutworms and other general feeders are treated elsewhere; reference will therefore be made here only to such insects as are peculiar to the Cabbage and other Cruciferous plants.

THE WHITE CABBAGE BUTTERFLY (*Pontia rapae*)—(Fig. 22). This insect, which came to us from Europe about sixty years ago, is now one of our commonest butterflies, and may be seen flitting about everywhere from early spring till cold weather sets in. It is one of the worst pests that the cabbage grower has to contend with unless measures are taken to prevent its ravages, and happily this is a matter of no great difficulty. The butterfly lays her eggs on the leaves of the food-plant; the caterpillars are velvety green and almost exactly the color of the leaves upon which they are feeding; when at rest they lie at length upon the midrib and are not easily seen. There are two broods in the year, the later being much the more numerous, and sometimes a third if the autumn should be fine and warm. The caterpillars riddle the outer leaves and then burrow into the heads, devouring the substance and spoiling the plant for table use by their excrement. Besides Cabbages and Cauliflowers, they attack also mignonette, stocks and nasturtiums.

REMEDY. Pyrethrum insect powder is thoroughly effective. One pound should be mixed with four pounds of cheap flour and kept in an air-tight jar or canister for twenty-four hours so that the poison may be thoroughly incorporated with the flour. The plants infested by the caterpillars should then be dusted with the mixture, which can be applied with a small bellows, or in a cheese-cloth bag tapped lightly with a slender rod. This powder will kill insects but is perfectly harmless to human beings. Powdered White Hellebore may also be used in a similar manner. Another method, which is more rapid in its effects upon the worms, is to dissolve two ounces of the Pyrethrum powder in three gallons of lukewarm water and spray at once. The liquid kills immediately all the caterpillars it reaches, while the dry powder often takes many hours to produce the same result. Paris green and other virulent poisons should never be applied to cabbages and vegetables of any kind that are intended for table use.

THE ZEBRA CATERPILLAR (*Mamestra picta*)—(Fig. 23). There may often be found feeding upon cabbages and some other garden plants of the same family, a handsome caterpillar about two inches long, when fully grown. It is velvety black on the back and has two bright yellow stripes along the sides, which are connected by a series of irregular yellow lines on a black ground-color; the head and feet are reddish. These strikingly contrasting colors render the caterpillar a conspicuous object on the green foliage that it feeds upon, and make it an easy task to pick them off by hand. There are two broods in the year, the moths, which are dull reddish-brown with white underwings, appearing in May and August. The young caterpillars when first hatched feed in colonies and devour the green substance of the leaves, thus producing white blotches on the foliage and rendering

their presence easily noticeable. Should they be too numerous to be destroyed by hand picking, resort may be had to Pyrethrum powder applied as mentioned above, or to white hellebore, which may be dusted on the leaves or sprinkled by mixing one ounce in two gallons of warm water, stirring from time to time to prevent the powder from settling at the bottom of the watering can.

THE CABBAGE PLUSIA (*Autographa brassicae*, Riley)—(Fig. 24). A pale green caterpillar, with whitish lines running lengthwise of the body, may sometimes be found devouring the leaves of cabbages, lettuce and other vegetables, feeding usually on the under side of the foliage. It is called a "Semi-looper" from its raising the middle of the body when walking, owing to the absence of some of the usual prolegs. Though abundant and destructive in the neighboring States, it has not often been found in injurious numbers in Ontario, but may at any time prove a serious pest. In the early part of the season they may be got



Fig. 23.—Zebra caterpillar and moth.



Fig. 24.—Cabbage Plusia: caterpillar, chrysalis and moth.

rid of by dusting with a mixture of one pound of Paris green in twenty pounds of lime, applying the powder to the underside of the leaves. A liquid spray may also be used of the ordinary composition.

THE DIAMOND-BACK MOTH (*Plutella maculipennis*, Curtis)—(Fig. 25)—is from time to time a serious pest, as its caterpillars appear in large numbers and devour the foliage of cabbages, turnips and other cruciferous plants. These worms are much smaller than those of the preceding species; are green in color and remarkably active when disturbed; they will then wriggle about in a violent manner and drop to the ground by a silken thread from the leaf on which they are feeding. As they devour all the green substance of the foliage the plant attacked soon withers and dies. There are usually two broods in the year, the first set of caterpillars appearing at the beginning of July, and the second towards the end of the summer; in favorable seasons there may even be a third. The winter is spent in the pupal stage, the lace-like cocoon enclosing the chrysalis being attached to the underside of the leaves. The moth is a beautiful little creature, dark or ashen gray in color, with a series of white marks on the forewings which form, when the wings are closed, a row of diamond-shaped markings down the middle of the back; from this characteristic the moth receives its name.

The remedy that seems most effective is spraying the underside of the leaves wherever attacked with kerosene emulsion, at the same time applying fertilizers,

such as nitrate of soda, to induce a vigorous growth. As a preventive measure all remains of stalks and foliage, after the crop has been taken in, should be destroyed in order to get rid of the wintering chrysalis. Though the insect is an importation from Europe, it is largely kept in check by parasites and only occasionally becomes a serious pest.

THE CABBAGE MAGGOT (*Phorbia brassicae*)—(Fig 26)—is one of the most serious insects that growers of this vegetable have to contend with. Young plants, soon after being set out in the spring, are often found to have their roots infested with these maggots, their presence being indicated by the dying of the plants. They are white, footless larvæ, the offspring of slender two-winged flies, smaller than the ordinary house fly; the eggs are laid on the stems of the plants close to or just beneath the surface of the ground; when hatched, the maggots burrow down into the roots, where they tear the tissue with the hooks which take the place of jaws, and live upon the sap; the breaking up of the cells of the plant causes a rot to set in and the entire destruction of the root soon follows. When full grown the maggots form their reddish-brown puparia in

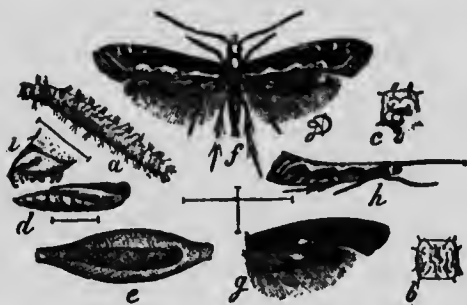


Fig. 25.—Diamond-back moth: (a) caterpillar; (d) pupa; (e) cocoon; (f and h) moths—all much enlarged.



Fig. 26.—Cabbage maggot, puparium and fly—enlarged.

the soil near by, and from these a second brood of flies soon emerges. Working under ground as they do it is a difficult matter to apply any effective remedy; the one that has proved most useful is a solution of corrosive sublimate, four ounces to 50 gallons of water. The earth is drawn away from the root of an affected plant and half a teacupful is poured in; the soil is then replaced and hilled up around the stem. This treatment should be applied soon after the plants are set out and repeated once a week for five weeks. This substance is a deadly poison and must be used with the greatest care; also it should not be brought in contact with anything of metal but put into wooden or crockery vessels. Cyanide of potassium may be used in the same proportions, but is more expensive at the present time. A decoction of pyrethrum insect powder or white hellebore, using quarter of a pound to a gallon of water, has been found effective and is not a dangerous poison as far as human beings are concerned.

Preventive measures are less troublesome and usually more effective. One of the best is the screening of newly set-out cabbages and cauliflowers with cheesecloth. Light frames of slats are made 8 feet long, 2 wide and 2 high; over these is tacked cheesecloth which should reach to the ground on all sides, and be prevented from blowing about by heaping a little earth on the edges. These frames cost very little and can readily be moved when required and stowed away for

future use; they should be put on as soon as the plants are set out and left until they are well-grown. The frames not only prevent the flies from laying their eggs on the plants, but also keep off the other insects which are liable to attack them.

Another method of protection, which is now largely employed and is found very effective, is the use of tarred felt paper discs, which are placed around the stems of the young plants when they are being set out. These discs should be made of one-ply paper, not of the thick tarred building paper. For garden purposes the paper may be cut into three-inch squares, with a slit running to the centre, but for field crops it is worth while to procure a tool for cutting the paper into hexagons with a slit to a star-shaped cut at the centre. The discs should be carefully fitted to the stem so as to leave no space for the deposit of eggs by the fly, and should be pressed flat upon the ground. The time and labor required for making and applying these protectors are inconsiderable, and their adoption has proved to be a great success.

In the case of this and other root-infesting maggots, it is important that the same kind of plant should not be grown where an attack has occurred during the previous year, and that all refuse should be removed and destroyed after the crop has been gathered in.

CARROTS.

THE BLACK SWALLOW-TAIL BUTTERFLY (*Papilio asterias* [*polyzenes*])—(Fig. 27). There may often be found feeding on the foliage of carrots and parsnips a handsome velvety green caterpillar ornamented with bands of yellow. This is the larva of one of our largest and most beautiful butterflies, black in color, ornament-



Fig. 27.—Black Swallow-tail Butterfly.

ed with rows of bright yellow spots. The caterpillars do not feed in colonies and consequently are not often injurious, the amount of foliage consumed by an individual seldom affecting the vitality of a plant. Being conspicuous, they may, if sufficiently numerous to require repression, be picked off by hand and crushed under foot. They are kept in check, however, by a large parasitic fly, which lays an egg on a caterpillar from which hatches out a grub that feeds within the body of its host until the chrysalis is formed, and then completes its work by devouring all that remains, a fly with four clear membraneous wings coming out instead of the butterfly.

THE CARROT RUST-FLY (*Psila rosae*)—Fig. 28)—is a much more serious enemy to the plant than the preceding species. It is a comparatively recent importation from Europe, having been first observed in this country about thirty-five years ago. It is a great pest in the Maritime Provinces, but so far is only locally found in Ontario. Its attack may first be noticed in spring when the leaves of young carrots turn reddish, and on examination the roots will be found covered with rusty blotches—hence the name of the insect. The parent of the mischief is a small two-winged fly, quarter of an inch long, body dark green, head and legs pale yellow and the eyes red. From the eggs, which are laid on the stem below the surface of the ground, the young maggots make their way into the root, and tear the tissues in a similar manner to the cabbage maggot described above; the attack causes the rusty blotches to appear. The maggots of a later brood infest the full-grown roots and continue their work of destruction in the root-house during the winter. Celery and parsnips are also attacked.

Preventive measures seem to be the only remedies available. To deter the fly from laying her eggs, the rows of young carrots, when ready for thinning out, should be sprayed with kerosene emulsion, or dusted with sand or plaster in



Fig. 28.—Carrot Rust-fly: 1, 3, 4, 5, 7, natural size; 2, 6, 8, enlarged.

which coal-oil is mixed, half a pint being used to a pailful of the material. The application should be made weekly, and especially after hoeing, until about the middle of July.

In gardens where carrots are grown for table use and size is not an object, late sowing is found to be advantageous, the plants thus escaping the egg-laying of the fly. Repeated sowings a week or so apart, will secure the freedom of some of the crops from attack. The plants should not be grown two years running on the same piece of ground. Stored roots, if found affected in the winter, may be treated with carbon bisulphide, one ounce to 100 lbs. of roots, placed in pans on top of the pile, provided that they are in fairly air-tight bins. They should be left for 48 hours and then exposed to the air in order to get rid of the fumes, which are very inflammable; no light or fire should be anywhere near when this substance is being employed.

CELERY.

Celery, as a rule, is not much affected by injurious insects, those that do attack it are the same as the enemies of carrots and parsnips, to which reference is elsewhere made. There are some caterpillars of the Black Swallow-tail Butterfly (*Papilio asterias*) which can be found eating the foliage, but they are never very

serious and can easily be controlled by handpicking. A small caterpillar called the **CELERY LEAF-TIER** (*Phyllocnistia ferrugalis*) is sometimes abundant and injurious; it feeds for the most part at night; when young it eats small holes in the leaves which are hardly noticeable, but as it grows larger it becomes more voracious and consumes a considerable amount of foliage. When fully grown it rolls up a leaf and ties its edges together with silk, forming thus a convenient case in which to pass the chrysalis stage. The moth is about three-fourths of an inch in expanse of wings, pale brown in color with a reddish suffusion; the wings are marked with irregular cross lines of black and some circular spots. There are at least two broods in the year. The insect is sometimes known as the Greenhouse Leaf-tier from its attacking a variety of hot-house plants; out-of-doors it by no means confines itself to celery, but may be found on a great variety of vegetables. As soon as the caterpillars are noticed the plants attacked should be sprayed with Paris green, applied to the underside of the leaves. In the greenhouse any infested leaves should be cut off and destroyed.

The most serious enemies of celery is the Rust-fly described among the insects affecting carrots. The maggots attack the thick part of the roots of young plants and prevent their proper growth; they also produce the characteristic rusty blotches on the stems and spoil them for table use.

CORN.

The insect enemies of Indian Corn are legion, and may be found attacking every part of the plant, root and stem, leaves and ears, the tassel and silk, and the ripe harvested corn; about 350 different species are recorded from North America. Happily a large number of these insects are not found in Canada and many others are only of occasional occurrence; it is, therefore, unnecessary to describe more than a few species which are always with us and against which constant warfare has to be waged.

Attacking the roots we find White-grubs and Wire-worms very destructive, especially when corn is planted on old pasture land broken up a year or two before. These have already been described. Another serious enemy is the Corn Root-aphid, which is attended by its ant protectors; it is especially injurious to the plants when young. The winged forms migrate to various common weeds such as plantain, pigweed, etc., showing the importance of keeping fields and gardens free from these places of refuge.

As soon as the tender blades of corn appear above the soil they are liable to be cut off by those nocturnal marauders, the Cutworms, which can be circumvented by the use of the poisoned bran-mash. The grubs of the 12-spotted Cucumber beetle often infest the roots of corn when the plants are young, and a great deal of loss is occasioned by them. Later on, as the plants grow bigger, they may be attacked by Grasshoppers and seriously injured.

THE CORN STALK-BORER (*Papaipema nitela*)—(Fig. 29)—is an occasional destroyer of the plant. The caterpillar, which grows to an inch and a half in length, lives inside the stem and devours all the interior to such an extent that the plant withers and dies; when approaching maturity the worm works its way down to the root and there changes to the chrysalis stage. The moth, which is fawn-colored and has the front pair of wings crossed by a pale curved line, comes out in the autumn and lay her eggs on the stems of a variety of plants as well as on the corn. The caterpillar is known to infest the tomato, potato, dahlia, and

many other cultivated plants as well as many kinds of weeds. The only remedy seems to be clean cultivation and the destruction in the fall of all stems and roots of plants which are likely to have eggs laid upon them. Being an internal feeder

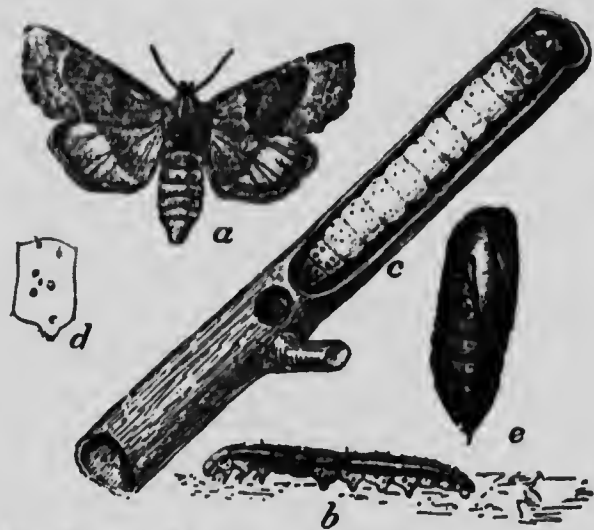


Fig. 29.—Corn Stalk-borer: (a) moth, (b) half-grown caterpillar; (c) mature larva in stalk; (e) pupa. (Chittenden, U.S. Dept. Agric.)

there is no way of poisoning the caterpillar, and usually its presence in a stalk is only known by the premature withering of the plant.

THE CORN EAR WORM (*Heliothis armiger*)—(Fig. 30)—is another general feeder, which includes corn in its attacks. In the south it is the notorious "Boll-worm" which is so destructive to cotton; here it attacks tomatoes and a few other

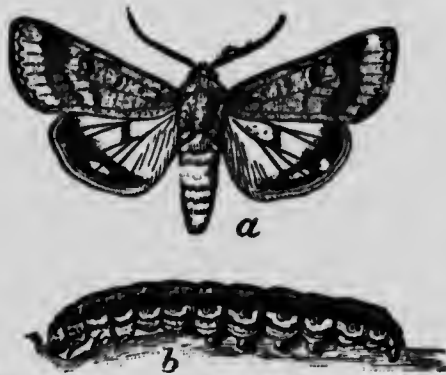


Fig. 30.—The Corn-Ear Worm: (a) moth; (b) caterpillar.



Fig. 31.—Chinch-bug, greatly magnified.

plants as well as corn. The presence of the caterpillar is first made known by small holes to be seen in the leaves enveloping the growing ear; on investigation the worm will be found devouring the milky grains and spoiling the ear by its excre-

ment and the rot which usually sets in; sweet corn is especially liable to be spoiled by this attack. Any ear that is seen to be affected should be opened and the caterpillar destroyed; this seems to be the only thing that can be done. The moth is a handsome creature, ochre yellow in color, with darker bands across the wings, which measure an inch and a half when expanded. With us there is but one brood in the year, and much may be done to keep the insect in check by clean cultivation in the fall of the year.

In the great corn-growing States to the west and south the crop is very seriously injured year after year by the CHINCH-BUG (Fig. 31), a small black bug, with a white mark on each side of the wings. As it appears in millions, these hosts inflict an enormous amount of damage by sucking out the juices of the plant. We are fortunately free from this pest in Canada, though occasionally a colony has been found in Ontario.

CUCUMBER, MELON AND SQUASH.

CUCUMBER BEETLES. The Striped (*Diabrotica vittata*)—(Fig. 32)—and the Spotted (*D. 12-punctata*)—(Fig. 33). The former of these insects may be found all through the season on cucumbers, melons, squashes and pumpkins from

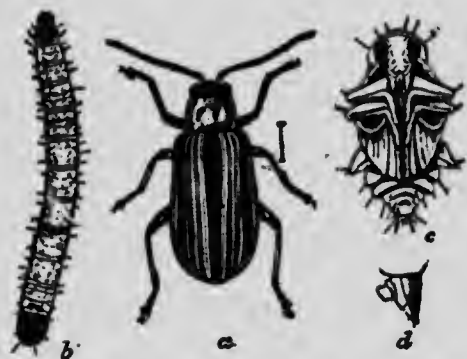


Fig. 32.—Striped Cucumber-beetle, grub and pupa, much enlarged.



Fig. 33 Spotted Cucumber beetle, somewhat enlarged.

the time that the plants are first set out till the frost destroys the foliage in the autumn. The beetles hibernate in the adult stage and are ready to attack the seedling plants as soon as they appear above the soil; oftentimes they are sufficiently numerous to kill the tender plant by eating the leaves and gnawing the stem; later on they may be found in the flowers, where, however, they seem to feed on the nectar and not to do much harm. The beetle is less than half an inch in length, oval in shape, yellow in color, with a black head and three black stripes down the back. The larvæ are slender white grubs which feed upon the roots of the plants and sometimes burrow up into the stem, continuing their injuries for about a month, when they change to the pupal stage and later on come out as a second brood of the beetles. The latter are very lively insects, flying quickly from plant to plant when disturbed; sometimes when their usual food is not available they attack the young pods of peas and beans, and may be found on a variety of other plants.

THE SPOTTED CUCUMBER BEETLE (Fig. 33) is larger than the Striped, and less oval, broadening considerably towards the posterior end of the body; its color is yellowish green, with a black head and three rows of four black spots, making twelve in all, on the wing-covers. It is a more southern insect than the Striped beetle, and in many parts of the United States it does serious injury to the roots of corn. In Ontario it is usually found associated with the other species on cucurbitaceous plants, but in fewer numbers; it is also a much more general feeder, attacking a great variety of plants; its life history is somewhat similar to the preceding, but it seems to feed mostly upon the pollen of blossoms in the beetle stage, the grubs being the chief cause of injury by their attacks upon roots and stems.

The treatment for both these insects is chiefly preventive. Young cucumber and melon plants should be protected as soon as they are set out with the cheesecloth screens described as a protection against Flea-beetles, or by smaller screens made with two flexible sticks crossed at right angles and with their ends securely fixed in the ground, and then covered with a piece of cheesecloth, which can be kept from being blown about by heaping a little earth on the edges. These screens may be safely removed when the plants have grown too big to be covered by them. Another plan is to grow a few squash plants earlier than the others so as to attract the beetles to them, and then treat them with Paris green, one pound mixed with 50 lbs. of lime or plaster; this may be dusted over the plant when the beetles congregate upon it. In the autumn all the refuse of the vines should be gathered up and either burned or buried in a compost heap, so as to kill the hibernating beetles. Spraying the young plants with poisoned Bordeaux mixture has also been found effective.

THE SQUASH-BUG (*Anasa tristis*)—(Fig. 34). This insect is usually very abundant and injurious through all the south-western counties of Ontario, but during the last few years it has almost entirely disappeared. It will not be long before it again becomes numerous and troublesome. The bugs are much larger insects than the beetles described above, being nearly three-quarters of an inch in length, of a dirty blackish color above and speckled creamy beneath; they have the usual repulsive odor common to the "stink-bugs," to which family they belong. Late in autumn the bugs may be found in all sorts of places, crawling about in search of winter quarters, and should then be crushed under foot. In the spring they come out, and begin their injurious work of sucking out the juices of young cucurbitaceous plants. The eggs, which are metallic in color, are laid in batches on the underside of the leaves near the base of the plant; from them soon hatch out the young bugs, but not all at once, so that we may find nymphs of all sizes on the underside of the same leaf. They not only injure the foliage by sucking out its juices, but also poison it as well, causing a speedy wilting of the leaves they attack. If any withering leaves are observed they should at once be inspected, and if a colony is found at work it can soon be exterminated by crushing under foot.

These bugs are difficult to get rid of, as the usual remedies for sucking insects, kerosene emulsion, for instance, have but little effect upon them, except when applied to the colonies of young nymphs. The methods recommended above for Cucumber Beetles are also the best remedies for these disagreeable insects. In the early part of the season the parent bugs may be trapped by laying pieces of shingle or board near the plants; the bugs will be found taking shelter under them in the morning, and can easily be destroyed.

FLEA-BEETLES, described above, are often very injurious to young cucumber and melon plants, and also a species of Aphis. Occasionally the fruit is attacked when green by small caterpillars, one called the Pickle-worm (*Diaphania nitidalis*) and the other the Melon Caterpillar (*D. hyalinata*); both turn into beautiful little moths. In the south they are regularly injurious year after year, but with

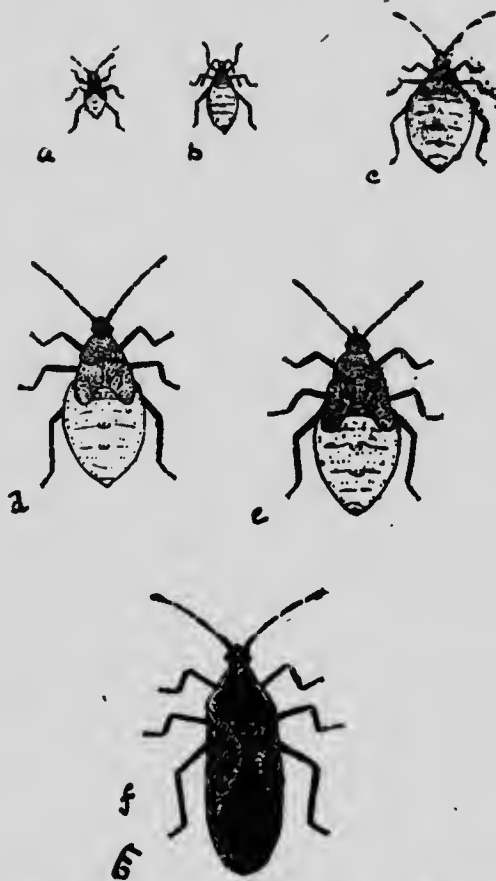


Fig. 34.—Squash-bug: (a to e) nymphs in different stages of growth; (f) adult bug, much enlarged.

us, happily, they are quite rare; should they become numerous at any time they could be easily controlled by the use of arsenical poisons.

ONION.

THE ONION MAGGOT (*Phorbia ceparum*)—(Fig. 35)—is very similar in mode of attack and life-history to the Cabbage Maggot already described; it is unnecessary, therefore, to repeat these particulars. It is often extremely destructive, and has almost driven market gardeners to despair. The preventive measures referred to above are hardly suitable for a plant whose style of growth is so different from that of a cabbage, and few persons would take the trouble to protect

onion beds with cheesecloth screens, nor could tarred paper disks be employed. There is, however, a simple method of protection which has been found effective; as soon as the tiny shoots of the onions begin to appear above the soil, the rows should be treated with a whitewash made of lime and water and thick enough to form a thin crust over the surface. The effect of this is to close up all crevices and openings in which the parent fly would lay her eggs, and prevent the maggots which may hatch from any eggs laid above ground from reaching the roots beneath. The young plants penetrate through the thin crust of lime without difficulty.

Another method, which is even better, is the employment of a poisoned sweet bait to kill the flies before they lay their eggs. It is made by dissolving five grams of commercial sodium arsenite in a gallon of boiling water, and adding one pint of cheap molasses. The mixture should be applied along the rows in the form of a coarse spray of large drops once a week throughout the summer. A watering can with a finely perforated nozzle could be employed.

When hoeing, any plant that is not growing satisfactorily should be cut out and crushed underfoot so as to destroy the maggots. Furthermore, onions should not be grown a second time on, or close to, a bed which has been infested with these insects. Pyrethrum insect powder or white hellebore may be applied in the same manner as recommended for the Cabbage Maggot. Many other substances, such as salt, plaster, Paris green, etc., have been tried without any satisfactory results. When taking up the onions in the fall any bulbs infested by maggots should be carefully destroyed.

PARSNIP.

THE PARSNIP WEBWORM (*Depressaria heracliana*). When parsnips are left in the ground all winter and allowed to grow up for seed-bearing purposes during the following season, they are very liable to be attacked by this insect. Towards the end of June, when the stems are tall and bear fine umbels of flowers, it is often found that the bloom is disfigured with webs which draw the whole into an untidy mass, and on examination a colony of small caterpillars will be found at work within. When they have finished consuming the flowers, they burrow into the stem and feed upon the soft inner lining. Here they change to the chrysalis stage during the latter part of July, and are often so numerous that the hollow stems will be found packed with larvæ or pupæ. The caterpillars are of a dirty green color and yellowish on the sides and beneath; most of the segments are furnished with shining black warts, each of which terminates in a fine bristle. The moths come out about the first of August and hibernate in any shelter that they can obtain, often coming into houses for the purpose; they are dusky gray in color, with no conspicuous markings, and with the body much flattened; the expanse of the wings is less than an inch, and the length of the body under half an inch. The insect is a European species.

These caterpillars may be found in abundance working in a similar manner on celery plants that have grown up for seed and on wild carrot and other umbelliferous plants. In the garden they should be treated with Paris green as soon as they are noticed; if the umbels are drawn into a web they should be cut off and burnt, and if the stalks are perforated the same operation should be performed on them. Wild carrots and parsnips should be cut down wherever they may be found in neighboring fields or waste places.

Parsnips are also attacked by the insects already mentioned in connection with carrots and celery.

PEAS.

THE PEA-WEEVIL (*Bruchus pisorum*)—(Fig. 36). The life history of this insect resembles in many respects that of the Bean-weevil, already described. The beetle is about one-fifth of an inch in length, brownish-gray in color, with two conspicuous oval black spots on the end of the abdomen which is not concealed by the wing-covers. The head is bent under the front of the body and ends in a square-cut beak. When peas are in blossom these little beetles may be found upon them, waiting for the young pod to be disclosed; on it the minute eggs are laid, and the grubs, as soon as hatched, bore through and enter the small green peas, one beetle only infesting a single pea. Here the grub remains, feeding upon the substance of the pea, passing through the pupal stage, and only attaining maturity

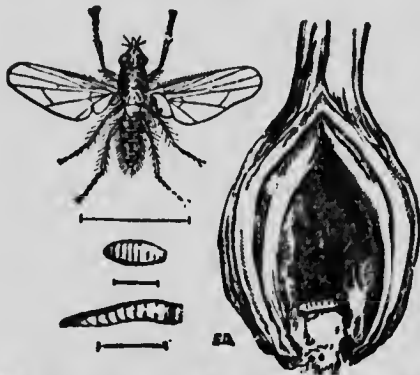


Fig. 35.—Onion maggot: puparium, fly and infested bulb.



Fig. 36.—Pea-weevil, natural size and much enlarged.



Fig. 37.—Pea-moth and caterpillar; moth greatly enlarged and natural size; infested peas.

when the peas are ripe and ready for harvesting. Most of the beetles remain inside the peas until they are sown the following spring, but some emerge when the peas become ripe, and remain in the field or in the barn all winter. Unlike the Bean-weevils, this species does not increase and multiply in the stored peas, but will die if they are kept over for another year.

TREATMENT. The pea crop should be harvested early, a little on the green side, so that the pods will not shell out before removal from the field; threshing should be done as soon as possible, and all refuse from the machine should be swept up and burnt. If any weevils are noticed in the peas, the crop should be put into bins or barrels and fumigated with carbon bisulphide in the manner recommended for the Bean-weevil. Peas that contain weevils, even though they are dead, should not be sown, as the plants grown from them will be stunted owing to the lack of food material in the pea; a considerable proportion would probably not grow at all, owing to the germ having been devoured by the beetle. The re-

mains of the crop not taken from the field should be raked up and burnt. If every pea-grower would adopt these methods we should soon be rid of the pest, as the beetle does not attack any other plant.

THE PEA MOTH (*Semasia nigricans*)—(Fig. 37)—is not often found in Ontario, but is very common and at times extremely destructive in the Maritime Provinces; its occasional occurrence with us renders it necessary to be on our guard against it. The parent moth is small, less than half an inch in expanse of wings, and of a dull, slaty-gray color. It lays its eggs on the growing pods of peas; the caterpillars soon hatch out and bore their way into the pod, where they feed upon the young peas, consuming many of them and filling the space with a mass of excrement. When full grown the worms leave the pods and form their small oval cocoons below the surface of the ground.

Where there is reason to expect an attack, the pea vines should be sprayed, as soon as blossoming is over, with a liquid wash of one pound of soap in twenty-five gallons of water in which has been thoroughly mixed four ounces of Paris green; the spraying should be repeated a couple of times at intervals of a week or ten days. The object is to poison the young caterpillars when they are eating their way through the pod.

Sowing early varieties as early as possible in the season has been found useful, the pods being too far advanced to be injured when the worms appear. Very late sowing is also recommended in order that the blossoming may not take place till after the moths have ceased egg-laying.

An important point is to plow or dig deeply in the fall any piece of land where infested peas have been grown, in order to bury the cocoons and prevent the moths coming out in the spring. All unripe pods should be plowed up, as they may contain worms, and peas should not be grown again upon or near the same piece of ground the next season.

THE PEA APHIS (*Nectarophora destructor*). This large green plant-louse during recent years has become extremely destructive to the vines of peas. In some parts of the neighboring States, where large acreages were devoted to this crop for canning purposes, the annual loss was estimated at many millions of dollars, three-fourths of the crop being in some instances destroyed. The usual remedies for plant-lice have already been referred to under "Aphis," but they are of little value when contending with an attack on a very large scale. A method that has been found effective is to sow the peas with drills and wide enough apart for a cultivator to work between the rows, instead of the usual broadcast plan. As soon as the plants are seen to be infested, boys are employed to brush the insects off, and they are followed at once by the cultivator, which buries the lice and prevents their getting back on the vines. The operation has to be repeated a few times, but the results have proved entirely satisfactory and to warrant the labor and expense.

POTATO.

THE COLORADO POTATO BEETLE (*Leptinotarsa decemlineata*)—(Fig. 38)—is so familiar to everyone that it is hardly necessary to give any description of the destructive creature. The adult beetles come out of their winter hiding places about the end of May and feed at once upon the earliest appearing potato plants; soon after this the females lay their bright orange-colored eggs on the underside of the leaves in batches of various numbers up to fifty or more. The grubs hatch out in about a week and set to work to devour the foliage; their dark orange color

renders them somewhat conspicuous, so that an attack can hardly fail to be noticed. When fully grown the insect changes to the pupal stage in a cell a few inches below the surface of the ground. A period of about eight weeks is required to complete a life cycle, and then a second brood of beetles appears, lays its eggs and starts new colonies of grubs; the third brood comes out in September and may be observed crawling or flying about in search of winter quarters. The broods are by no means distinct, as all the grubs do not mature at the same time, consequently the insect may usually be found in all its stages at any time during the summer.

The well-known and long-tried remedies are Paris green or arsenate of lead combined with Bordeaux mixture, the latter ingredient assisting in warding off the attacks of fungus diseases and also in destroying Flea-beetles, when they are



Fig. 38.—Colorado Potato-beetle.

present, as they commonly are. Spraying should be done early in June as soon as any grubs are to be seen, again a month later, and three times, at intervals of a fortnight, between the end of July and the first of September.

THE THREE-LINED POTATO BEETLE (*Lema trilineata*)—(Figs. 39 and 40)—looks very like the Striped Cucumber Beetle, but is larger and of a darker yellow color. Before the coming of the Colorado beetle this was the chief insect enemy of the potato, but now, though common, it is not usually particularly destructive; its life history is much the same, the adult beetle coming out in the spring and laying her eggs on the underside of the leaves of the young plants; these are yellow in color and are laid along the midrib of the leaf. The larvæ have the extraordinary habit of piling their excrement on top of their backs, possibly as a protection against their enemies, and thus present a disgusting appearance. The grubs appear in June and go through their transformation in time for another brood to come forth in August; the beetles from this later brood do not emerge till the following spring.

When this insect is at all abundant, it can be easily controlled by the application of Paris green; the measures everywhere taken to check the Colorado Beetle have no doubt prevented this species also from becoming numerous.

THE POTATO FLEA-BEETLE (*Epitrix cucumeris*) is one of the most serious pests of the potato plant. The tiny creature—it is less than one-twentieth of an inch long—eats small holes all over the surface of the leaves and causes much injury in this way; but a worse result is that the spores of a fungus disease called "Blight" find a suitable place in these holes for germination and the complete destruction of the leaf soon follows. Flea-beetles as a class have already been



Fig. 39.—Three-lined Potato-beetle.



Fig. 40.—Three-lined Potato-beetle; eggs, larva and pupa.

referred to; it is unnecessary, therefore, to do more than state that spraying with Bordeaux mixture is a satisfactory remedy for both the insect and the Blight.

BLISTER BEETLES are often reported from the northern parts of the Province as appearing suddenly in great swarms in the potato fields and greedily devouring the foliage. An account of them has already been given under insects attacking beets and spinach.

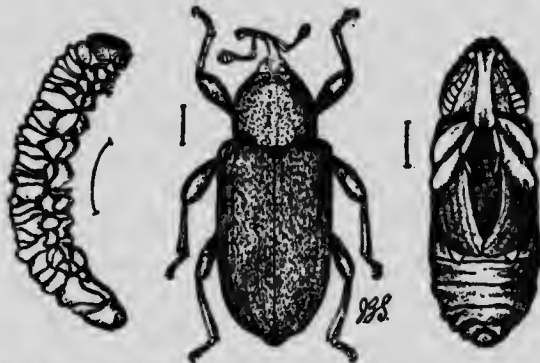


Fig. 41.—Potato-stalk Borer: beetle, grub and pupa.

THE POTATO STALK BORER (*Trichobaris trinotata*)—(Fig. 41)—is only an occasional cause of injury to the plant in this country, but in some of the States to the west and south it is considered almost as great a pest as the Colorado Beetle. As the name indicates, the attack is made by boring the stalk; this is done by the grubs, which are whitish in color and without legs. The small beetles, about a quarter of an inch long, are ashen-gray in color and belong to the family of weevils or snout beetles, having the head developed into a long beak; the base of the wing-covers is marked with three distinct black spots, which readily distinguish it from similar species. About the month of June the parent makes a hole in the stalk of

the potato with its snout and deposits an egg and repeats the operation a number of times. The grubs which hatch from them burrow up and down in the stalks, devouring the interior, and when full-grown, about the beginning of September, form their chrysalis inside the stalk near the base of the plant; the beetles emerge later on, but remain in this retreat all winter.

No application of poison is of any avail, as the grubs are out of reach in the stalk, but much may be done to terminate the insect by cleaning up and burning all the remains of the plants after the potatoes are dug in the fall; this is advisable also in order to destroy the germs of fungus diseases.

RADISH.

Radishes are very liable to attack and serious injury when they first come up in the seed beds by the minute Flea-beetles described among the insects that are general feeders; cheesecloth screens are found to be the best protection. The Radish Maggot (*Phorbia*) is the same or a very closely allied species to that which attacks the roots of cabbages, and may be treated in much the same way; protection with cheesecloth is by far the simplest and an entirely effective method of securing perfect radishes in the spring.

TOMATO AND TOBACCO.

These two plants may be associated together, as the same insects are liable to attack both; but it is highly probable that the growth of tobacco on a large scale



Fig. 42.—Tomato worm.



Fig. 43.—Chrysalis of Tomato worm.

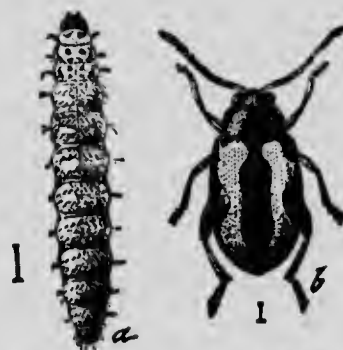


Fig 44.—The Turnip Flea-beetle and larva, greatly enlarged.

in the south-western counties of Ontario will cause other enemies of the latter plant to make their unwelcome appearance. Cutworms early in the season are very destructive to the young plants, but may be warded off by the use of the poisoned bran-mash. The leaves are liable to be attacked by Flea-beetles, the Tarnished Plant-bug and Grasshoppers. The most conspicuous enemy of both plants is:

THE FIVE-SPOTTED HAWK MOTH, or Tomato Worm (*Protoparce celeris*)—(Figs 42 and 43). This is a large caterpillar, attaining to a length of nearly four inches when fully grown and correspondingly thick. It has a series of oblique pale lines along the sides and a prominent tail; in color there are three varieties, pale green, dark green and almost black. They are very voracious feeders, and soon strip the foliage from a plant, but being so conspicuous they can be readily got rid of by hand picking. When growth is completed, the caterpillars burrow into the earth and form a cell in which they transform to a dark brown chrysalis,

which has attached to the head and underside of the thorax a projection resembling the handle of a jug and containing the enormously long sucking tube with which the moth is provided. The moths come out in the autumn if the weather should be warm, otherwise they do not appear till the following summer. They are large, handsome, swiftly flying creatures, ashen-gray in color with a variety of paler and darker lines and markings; the abdomen is ornamented with five large orange spots on each side which give the insect a very characteristic appearance. These Tomato Worms have often been supposed to be poisonous, and many marvellous tales have been told of their deadly stings and bites; they are, however, quite incapable of either stinging or biting, and may be handled without the least danger.

THE CORN EAR WORM (*Heliothis armiger*), which has been fully described above, frequently attacks green tomatoes before they are fully grown, and bores large holes which utterly destroy the fruit. It also feeds on tobacco, eating into the unripe seed capsules and devouring the contents. In the case of tomatoes the only plan seems to be to cut off and destroy all the infested green fruit. Where tobacco is extensively grown, if there should be an annual attack of these caterpillars, it would be advisable to grow a strip of corn as a "trap-crop" along the sides of the field; the moths would lay their eggs on the young ears of corn in preference to the tobacco plant, and these could be gathered and burnt or fed to pigs before the worms attain to maturity.

TURNIPS.

Turnips are attacked by several of the insects already described as enemies of the cabbage, viz., the Zebra Caterpillar, the Diamond-back Moth, the Cabbage Maggot, and the same species of Plant-louse (*Aphis*). The last mentioned insect has been more complained of recently by turnip growers than any other pest; its ravages in late summer and autumn are widespread over the Province, when there is prolonged dry, warm weather, which is favorable to their increase, and in many cases whole fields are rendered worthless. The usual remedies, kerosene emulsion and strong soapsuds, are found effective when applied in time; but in most cases the attack is not noticed till the damage is beyond repair. Much may be accomplished by keeping a sharp look-out for the colonies of plant-lice when hoeing is being done; an affected plant should be at once cut out and the lice crushed under foot; early measures of this kind will prevent a serious infestation later on.

THE TURNIP FLEA-BEETLE (*Phyllotreta vittata*)—(Fig. 44)—differs from our other species in having a wavy, yellowish stripe down each side of the wing-covers, but its habits are much the same as those of the rest of the family. Its attacks on the young plants when they first come up are often very serious and prevent the growth of a large proportion of the crop, necessitating a resowing. As the first brood of beetles disappears toward the end of June, it has been found that turnips sown during the third week of that month escape attack, and produce as good a crop as those sown earlier. When the beetles are observed to be attacking the young plants they may be got rid of by dusting with Paris green and land plaster, one pound of the poison to two of the plaster; this should be done when the plants are moist with dew in the early morning. A condition of the soil which induces rapid and vigorous growth is of great importance, as it enables the young plants to get beyond the danger point before much injury has been sustained.

INSECTICIDES.

PARIS GREEN AND BORDEAUX MIXTURE.

Four pounds of fresh lime, 4 pounds of bluestone, and 4 ounces of Paris green, thoroughly mixed in 40 gallons of water. In all cases where spraying with Paris green is recommended in the foregoing pages it is advisable to add the bluestone (or Bordeaux mixture) in order to counteract fungus diseases at the same time as the insects are destroyed. The bluestone (copper sulphate) should be dissolved by suspending it in a wooden vessel containing 4 or 5 gallons of water, and the lime slaked in another vessel; if lumpy, the lime should be strained through coarse sacking. Pour the bluestone solution into a barrel and half fill with water; dilute the slaked lime to half a barrel and mix the two together. The Paris green should be made into a paste with warm water, poured into the barrel and stirred thoroughly. The mixture is then ready for use. The addition of the lime prevents the poison from scorching the foliage.

For garden purposes one teaspoonful each of Paris green and lime in a pail of water may be used.

ARSENATE OF LEAD.

Arsenate of soda	10 ounces.
Acetate of lead	24 ounces.
Water.....	150-200 gallons.

"The arsenate of soda and the acetate of lead (sugar of lead) should be dissolved separately and then poured into a tank containing the required amount of water. A white precipitate of lead arsenate is immediately formed, and when thoroughly stirred is ready for spraying. Its finely divided condition keeps it in suspension for hours and thus simplifies the work of spraying. The preparation may be used several times stronger without the least danger of scorching the most delicate plants. When sprayed upon the foliage it forms a coating which adheres so firmly that it is but little affected by ordinary rains." (Bulletin 154, Harecourt and Fulmer). For use in small quantities, one tablespoonful of the paste arsenate is enough for one gallon of water.

KEROSENE EMULSION.

The following is the formula recommended by Dr. Fletcher (Central Experimental Farm, Bulletin No. 52):-

Kerosene (coal oil)	2 gallons.
Rain water	1 gallon.
Soap.....	$\frac{1}{2}$ pound.

Boil the soap in water till all is dissolved; then, while boiling hot, turn it into the kerosene and churn the mixture constantly and forcibly with a syringe or force pump for five minutes, when it will be of a smooth, creamy nature. If the emulsion is perfect, it will adhere to the surface of glass without oiliness. As it cools it thickens into a jelly-like mass. This gives the stock emulsion, which must be diluted with nine times its measure of warm water before using on vegetation. The above quantity of three gallons of emulsion will make 30 gallons of wash.

Kerosene emulsion may also be made conveniently by using an equal amount of sour milk instead of the soap and water in the above formula, and churning for the same time to get the stock emulsion.

Another method is to use lime, which will hold the kerosene in suspension, or the following, where lime cannot be obtained:

The requisite amount of kerosene is placed in a dry vessel and flour added in the proportion of 8 ounces to one quart of kerosene. It is then thoroughly stirred and two gallons of water added for every quart of kerosene. The whole is then vigorously churned for from two to four minutes, and the emulsion is ready for use. It has been found that by scalding the flour before adding the kerosene, an

excellent emulsion, which does not separate in the least after standing for a week, can be prepared with 2 ounces of flour, by mixing the resulting paste with one quart of kerosene and emulsifying with two gallons of water.

TOBACCO WASH. (For destroying Aphids). Soak 4 pounds of tobacco waste in 9 gallons of hot water for four or five hours (in cold water for four or five days); dissolve one pound of whale-oil soap in one gallon of hot water; strain the decoction into the dissolved soap and apply with a spray pump as forcibly as possible. "Black Leaf 40" and "Nicotine" are very satisfactory commercial preparations, which can be obtained at the large seed-stores, with directions for use. When added to a soap-wash they are very effective.

SOAP WASHES.

Dissolve one pound of whale-oil soap in four gallons of warm water for black or brown Aphis, and one pound in six gallons for green Aphis.

Another remedy for Aphis is the following: Boil 8 pounds of quassia chips in 8 gallons of water for an hour, dissolve 7 pounds of whale-oil soap in hot water; strain the quassia decoction and mix with the soap solution; then dilute to make 100 gallons. Spray forcibly while hot; this will kill the plant-lice and not injure the plants.

COOK'S CARBOLIC SOAP WASH.

Hard soap, one pound, or soft soap	1 quart.
Crude carbolic acid	1 pint.
Water (boiling)	1 gallon.

Dissolve the soap in the boiling water; while still hot add the carbolic acid; emulsify thoroughly. This is the stock solution. For use, dilute with 30 to 50 times its bulk of water. Very effective against root-maggots of cabbage, radish and onion.

HELLEBORE.

White hellebore (fresh)	1 ounce.
Water.....	2 gallons.

PYRETHRUM OR INSECT POWDER.

Pyrethrum powder (fresh)	1 ounce.
Water.....	3 gallons.
Or,	
Pyrethrum powder	1 ounce.
Flour (cheap)	5 ounces.

Mix thoroughly, allow to stand over night in a closed tin box, then dust on plants through cheesecloth.

THE POISONED BRAN MASH.

For Cutworms and Grasshoppers.

Bran	20 pounds.
Paris Green	1 pound.
Molasses	½ gallon.
Water	About 2 gallons.
Lemons	2 or 3 fruits.

Mix thoroughly the bran and Paris Green dry in a tub or any large receptacle. This may be done the night before. On the morning of using squeeze the juice of the lemons into the water, run the pulp and rind through a meat chopper, and add this and also the molasses to the water. Stir well, and then pour the liquid upon the poisoned bran, and mix so thoroughly that every part is moist and will fall like sawdust through the fingers.

For cutworms in small gardens use one quart of bran, one teaspoonful of Paris green, one tablespoonful of molasses, with enough water to moisten the bran.

The mash should be applied in the evening for cutworms, and in the early morning for grasshoppers.

