

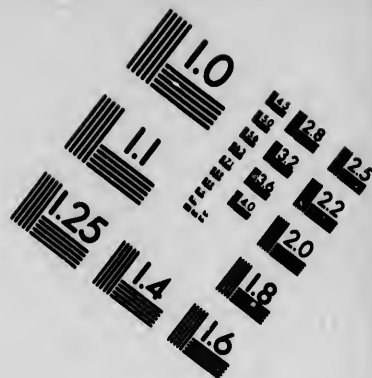
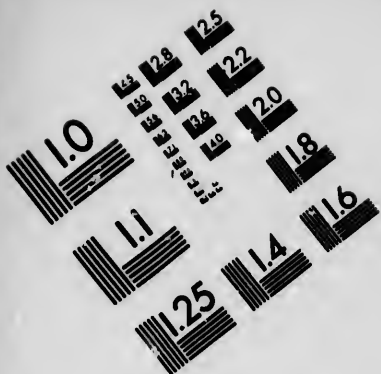
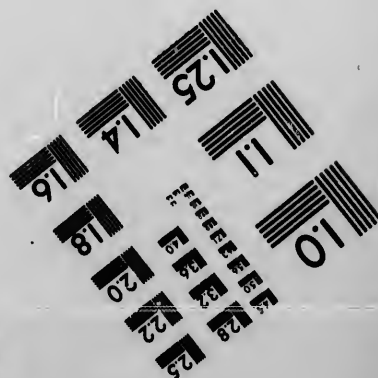
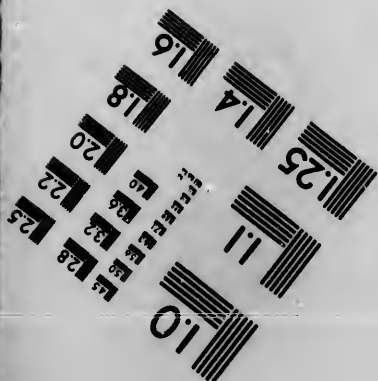
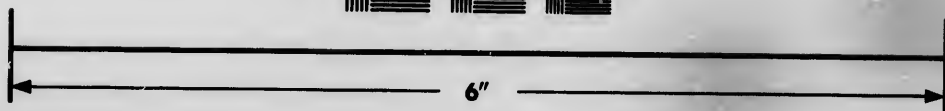
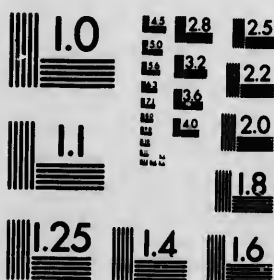


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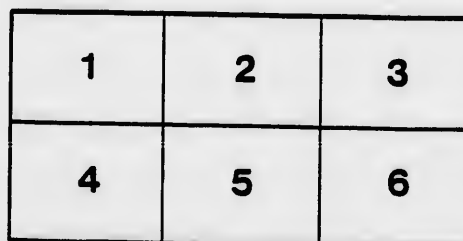
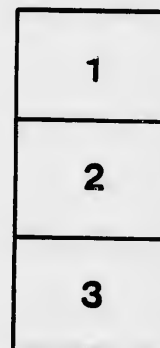
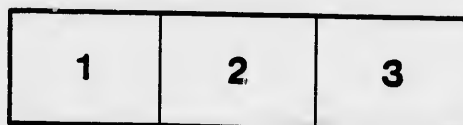
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CENTRAL EXPERIMENTAL FARM.

DEPARTMENT OF AGRICULTURE,
OTTAWA, - - - CANADA.

BULLETIN No. 11.

Recommendations for the Prevention of Damage by
some Common Insects of the Farm, the
Orchard and the Garden.

MAY, 1891.

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To the Honourable

The Minister of Agriculture.

Sir,—I have the honour to submit to you herewith Bulletin 11 of the Central Experimental Farm, which has been prepared under my direction by Mr. James Fletcher the Entomologist and Botanist of the Dominion Experimental Farms. The injuries caused by insects fall heavily on both the farmer and fruit-grower, and seriously reduce the profits arising from their labour. Much of this loss may be prevented by carrying out the recommendations given in this Bulletin. The concise accounts of the life-history of the injurious insects treated of, together with the illustrations, will enable the reader to readily distinguish the species referred to, and as the season is now approaching when these foes are most active, it is hoped that this timely warning may be heeded. The remedies suggested are easy of application, can be supplied at small cost, and I believe, if generally used, will result in much benefit.

I have the honour to be,

Your obedient servant,

WM. SAUNDERS,
Director Experimental Farms.

OTTAWA, 15th May, 1891.

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RECOMMENDATIONS
FOR THE
PREVENTION OF DAMAGE BY SOME COMMON INSECTS
OF THE
FARM, THE ORCHARD AND THE GARDEN,
BY
JAMES FLETCHER,

Entomologist and Botanist to Dominion Experimental Farms.

The frequent enquiries for information concerning even the commonest and most injurious enemies of cultivated crops and fruits render it advisable to issue, in concise form for reference, an account of some of the more important of these, together with approved remedies and convenient methods of applying the latter. The insects treated of are those which have been most frequently enquired about by my correspondents during the last two seasons. Where possible, illustrations are given, so that those concerned may not only know the latest remedies, but at the same time may become familiar with the appearance of their enemies.

Economic Entomology is the name given to a special study of the habits of insects with the view of finding out and protecting such as are beneficial and of destroying those which are injurious.

As year by year larger areas of land are brought under cultivation the various injurious insects which attack special crops will become more and more numerous as the cultivation of their favourite food-plant is extended. It is estimated that there is no crop grown which is not diminished by an average of at least one-tenth, by the depredations of insect enemies, and this loss in some years runs up to one-

fourth or one-half of the whole crop. Of this loss there is no doubt that a large proportion can be saved by the adoption of simple methods founded on general principles, with which all can easily become acquainted. For the effective use of remedies to destroy injurious insects a certain amount of knowledge of their structure and habits is highly desirable, so that the most appropriate remedy may be adopted, and also that it may be used at the period when the enemy is most susceptible of injury.

The lives of insects are divided into four well marked periods. These are: 1. The egg; 2. The caterpillar or larval stage, during which, as a rule, they are most injurious; 3. The pupa or quiescent stage, in which, except in a few orders, they lie quiet, and are without the power of motion; and 4. The perfect insect. Some insects are injurious in three of their stages; but the larger number in one only, so that unless we try to know them in all their forms we may lose the best opportunities of destroying them. It is clear that in this warfare the one who possesses this information has a great advantage over those who do not.

Insects may be divided into two classes by the nature of their mouth parts. In the first or larger division, Biting Insects, they are furnished with mandibles or biting jaws, by means of which



Fig. 1.

they consume the substance of their food, as with caterpillars, beetles, etc. In the second class, Sucking Insects, they have instead of mandibles a beak or tube (Fig. 1), by means of which they suck up their food in a liquid form from beneath the surface, as with the true bugs, plant-lice and flies. It is evident that

with the insects of the first class all that is necessary is to place some poisonous substance on the food plant, which they will eat together with their food. With the second class, however, this would be useless, for they would push their beaks through the poisonous covering on the outside of their food-plant and would extract the juices upon which they live from the interior. For this class, therefore, some substance must be used which will kill by mere contact with their bodies. Now, for both of these classes of insects we have cheap and available remedies, of which I will speak further on.

Remedies for injurious insects are either Preventive or Active, and must be applied in accordance with the circumstances of the case and the habits of the attacking insects.

PREVENTIVE REMEDIES.

These are of two kinds:—1. Agricultural; 2. Deterrent.

1. Agricultural.—These consist chiefly in the adoption of such agricultural methods as:—High Culture, which will stimulate a vigorous and healthy growth of the crop and push it on to maturity as soon as possible; Clean Farming, by which all weeds are kept down and rubbish is prevented from accumulating; Early or Late seeding, so that a crop liable to attack is presented to its enemies, at the time they make their appearance, in such a condition that they cannot injure it; Rotation of Crops, by which insects attracted to a locality by a certain crop will not have, in that place, the same crop to feed on the following year.

2. Deterrent.—Under this head come such operations as painting the trunks of fruit trees with poisonous, alkaline, or other obnoxious washes to keep out borers, by deterring the female insects from depositing their eggs upon the bark; the placing of mechanical contrivances on trees to prevent the ascent of insects, as climbing cut-worms, or the wingless female canker-worm moths, which leave the ground in autumn and spring and crawl up the trunks of trees to lay their eggs.

Destroying or masking the natural odour of some vegetables by scattering amongst them substances possessed of a stronger or disagreeable odour, as gas lime or carbolic acid.

ACTIVE REMEDIES.

Under this head comes the practising of such methods as may be called generally "hand-picking," or the seeking out of insects in their different stages and destroying them. These methods can be best explained under the several insects for which they are useful. The most important active remedies, however, comprise the application of the various insecticides or poisonous substances which are now so largely used for destroying insects, and which are treated of separately further on. Before passing on to a consideration of these it may be well to devote a few lines to the different methods and apparatus for applying insecticides.

APPARATUS.

Nearly all of the insecticides may be used both as a dry powder and as a wet mixture. In the case of the arsenical poisons it is necessary to mix them with some other substance as a diluent, on

account of their caustic action upon tender vegetation, also for convenience of distribution, and to economise the material in use. For dry applications suitable diluents will be found in flour, land-plaster, air-slaked lime, and finely sifted ashes or road-dust. It is of the utmost importance that these should be perfectly dry and in a very fine state of division, so as to mix thoroughly with the insecticide used and to allow of being distributed evenly over the plants as a very fine powder. The proper quantity of the diluents to be used with the different insecticides will vary with the insects to be treated and the plants to which they are applied.

There are several instruments for distributing dry poisons, such as bellows, insect-guns, dusting-boxes, etc. Any operation requiring the body to be kept for a long time in a stooping posture while walking soon becomes extremely tiresome. It is therefore necessary for field application to devise some means for distributing the poison, so as to waste as little as possible of the material and yet allow the body to be kept in its natural position. This is best done by placing the powder to be distributed in a small bag of very fine muslin (two thicknesses, if necessary), and then tying this to the end of a short stick so that it swings freely. It will be found that by tapping the bag lightly with another stick held in the other hand that the operator can walk erect, and do much better work than by stooping along over his crop with an aching back. Prof. Lintner recommends "a tin box of a convenient size (half a pint), with a cover, and having the bottom covered with wire gauze—the box to be fastened to a stick about three feet long. With this a person can walk along the plants to be dusted, and by gently striking the handle with another small stick the powder can be uniformly distributed with the greatest care." Dry mixtures should be applied when plants are wet with dew or in still weather. It is found by experience, however, that during the spring months, when insecticides are most needed, there are often periods of several days when these conditions do not occur. It therefore becomes necessary to apply the poisons in some other way, so that the material may be evenly distributed over the plants to be protected, and not blown away by the wind. For this purpose mixing with water and spraying is the most convenient plan, and there are a great many kinds of pumps and other appliances for the purpose. After considerable experience I have come to the conclusion that it will repay anyone who has to apply insecticides to go to the expense of

procuring a pair of proper bellows for dry mixtures and a force pump for liquid applications. Such make-shift contrivances as ordinary watering cans, whisks, whisks of hay, or bunches of leaves, which are frequently used, actually cost far more in wasted time and materials than would pay for the best special instruments; added to which, when the work is done it is neither satisfactory nor effective.

PUMPS AND OTHER DISTRIBUTORS.

For dry applications the "Woodason bellows," made by Thos. Woodason, 451 East Cambria street, Philadelphia, is one of the most highly recommended. It is made in two sizes, which sell at \$1 and \$2, respectively. The same firm also manufactures the "Woodason atomizer," for the application of a liquid spray upon a small scale. For more extensive operations force pumps of various sizes are necessary. These can be procured at prices ranging from \$2 to \$5 for small hand pumps. These are obtainable from most of our Canadian seedsmen. Very useful machines are the "Knapsack" sprayers, consisting of a tank of 4 or 5 gallons capacity, with a force-pump and spraying nozzle attached. They are carried on the back, and are very convenient for the treatment of low-growing crops, as cabbages, turnips, etc., as well as for small fruits. Of these the most highly spoken of are, the "Galloway Sprayer," manufactured by Albinson & Trusheim, 2026 Fourteenth street, Washington, D.C.: Cost, \$14. Another machine which is highly approved is the Knapsack, manufactured by the Field Force-pump Co., of Lockport, N.Y., which sells for the same price. An excellent but more expensive machine is the "Eureka," made by Adam Weaver, Vineland, N.J.: Cost, \$21. All of these are supplied with the "Vermorel" nozzle mentioned further on.

For field-work larger machines are necessary, and there are several in the market. The Field Force-pump Co. manufacture for \$12 the "Perfection" pump which can be attached to a barrel. This pump has an extra discharge hose by which the poison is kept constantly stirred up in the barrel, a most important thing with Paris Green and London Purple mixtures. Gould's Manufacturing Co., of Seneca Falls, N.Y., also send out a machine which has given great satisfaction, called the "Standard Double-acting Spray Pump." This also may be fitted to the top or side of a barrel, and has two discharge tubes. It costs about \$14 complete. The Nixon Nozzle and Machine

Co., of Dayton, Ohio, make two machines which are highly praised by all who have tried them. The larger the "Little Giant," consists of a square metal tank with force-pump, and is mounted on wheels. It can be drawn or pushed by means of a handle and driving wheel; but for use in an orchard the tank can be taken off the wheels and mounted in a waggon. Cost, \$35. The same company also make a smaller machine, the "Climax Tripod No. 2," which sells for \$15. It is very convenient, and can be taken apart and shipped in a very small box. It can be attached to any kind of vessel or tank by means of brass connections, which are supplied with it, as well as 20 feet of hose and 2 nozzles. I am so frequently asked where pumps and spraying apparatus are to be obtained that I have given the addresses of the above firms who have sent me their catalogues. A good pump, called the Orchard and Garden Force Pump, is made by W. Robertson, Oakville, Ont. I do not know of any other Canadian firms manufacturing these special forms of apparatus. Anyone intending to buy a spraying outfit would do well to send for catalogues before deciding on purchasing any particular machine, so as to procure the most suitable.

NOZZLES.

Of equal importance with a proper force-pump, in the distribution of poisonous applications, is a proper nozzle, by means of which the liquid is distributed evenly. Prof. Riley says "the desiderata in a spray nozzle are ready regulation of the volume to be thrown; greatest atomizing power with least tendency to clog; facility of cleansing, or ready separation of its component parts; cheapness; simplicity and adjustability to any angle."

There are a great many spraying nozzles in the market—some good, some decidedly otherwise. The best of these are the Riley or Cyclone, with its various modifications, and the Nixon. Prof. J. B. Smith says (Bul. 75, N. J. Ag. Col. Exper't. Station):—"The Cyclone, with the 'Vermorel' modification for clearing the nozzle of obstructions, is the most widely applicable for spraying low plants and bushes, like cabbages, pumpkins, currants, blackberry and others. This projects a fine spray in an eddy from a central discharge orifice, and makes a perfect and, for a short distance, forcible spray. Fastened to a rod of convenient length, and set at an angle with the rod, all parts of the cabbage can be thoroughly wet in a few seconds. All who have ever used this nozzle are

delighted with it. It is manufactured by the Field Force-Pump Co., Lockport, N.Y."

The Nixon nozzle is equally valuable for a somewhat different range of work. The stream is projected through a small central nipple against a screen at the end of a brass cylinder, and is broken there into a fine spray, retaining considerable force. This is furnished by the Nixon Nozzle and Machine Co., and is an excellent nozzle for orchard use.

The question of elevating the spray, so as to reach the tops of trees, is merely one of attaching the discharge pipe of the pump to one end of a small brass or rubber tube, bearing the nozzle at the other end, and running it through (or lashing it to the side of) a bamboo or other light pole of the required length. A wedge-shaped washer, cut out of thick sole leather, placed just below the nozzle, will prevent the drip from trickling down the pole upon the operator.

REMEDIES.

For convenience of reference in the latter part of this Bulletin, I append a short statement concerning each of the best known remedies, which will be referred to by the numbers which precede them:—

I. *The Arsenites*.—The best known of these are Paris Green (Arsenite of copper) and London Purple, (chiefly Arsenite of lime). The former is in more general use in Canada, and from my own experience and that of my correspondents I consider it the safer of the two to use on vegetation. The latter, however, is highly praised by some who have used it, and it will probably be found more useful than Paris Green, on account of the lime it contains, for mixing with Bordeaux mixture and other fungicides for the combined treatment of insects and fungi. Paris green is a sure remedy for all mandibulate or biting insects; but is also very poisonous to man and the domestic animals. Care must, therefore, be taken to keep it out of the reach of children, ignorant people and animals.

If applied too strong to the foliage of plants it is also very destructive. Some plants are much more easily injured by the arsenites than others, it therefore becomes necessary to use them with caution until the quantity that may be applied to a certain plant is known. For apple trees, a mixture containing $\frac{1}{2}$ lb. of Paris green to 50 gallons of water may be used; for plums and cherries about the same strength; but as some varieties are tenderer than others,

the effect of the application should be watched and the strength reduced if necessary. For peach trees it should not be used stronger than 1 lb. to 300 gallons of water, and even then there will be considerable risk of injury. Where it is necessary to spray two or three times in the season later applications of the poison should be reduced in strength.

In mixing Paris green it should first be made into a paste with a small quantity of warm water, and the paste subsequently mixed with the larger amount of water required.

In spraying foliage the spray must be forcibly applied, so as to reach every part; but should be shifted from place to place as soon as the liquid begins to drip from the leaves.

To lessen the corrosive injury of the arsenites, Prof. Riley advises the addition of a quart of common flour to every 12 gallons of water. He says (5th Rep., U. S. Entom. Com., p. 33): "The flour seems to keep the poison from taking effect on the leaf, preventing, to some extent, the corrosive injury which otherwise obtains when the poison is coarsely sprinkled or too strong."

The effects of Paris green, strange as it may seem, are often less severe upon young foliage than upon that which is mature. In applying liquid washes of Paris green and other insecticides it will be found difficult to make them adhere to some plants, such as cabbage, Swede turnips, etc. This difficulty can be overcome by mixing a little soap with the water used. For dry applications, Paris green may be mixed with 100 times its weight of perfectly dry land-plaster, air-slaked lime, flour or sifted wood ashes, etc.

II. *Kerosene Emulsions*.—Next in importance to the arsenites are the emulsions of kerosene. These are particularly valuable against such insects as plant-lice, scale insects and animal parasites. The best formula as recommended by Prof. Riley, is:

Kerosene (coal oil) 2 gallons.

Rain water, 1 gallon.

Soap, $\frac{1}{2}$ lb.

Boil the soap in the water till all is dissolved; then, while boiling hot, turn it into the kerosene, and churn it constantly and forcibly with a syringe or force pump for five minutes, when it will be of a smooth, creamy nature. If the emulsion be perfect it will adhere to the surface of glass without oiliness. As it cools it thickens into a jolly-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 3 gallons of emulsion will make 30 gallons of wash. Insects breathe through small openings along their sides. The effect of kerosene emulsion is to suffocate them, by stopping up these breathing pores.

III. *White Hellebore*.—This is a vegetable poison—the finely powdered roots of *Veratrum album*. It is very useful for the leaf-eating insects of small fruits, especially saw-fly larvæ. Although very poisonous to insects, it can be safely used where the arsenites would be dangerous. It can be applied as a dry powder or as a liquid mixture, 1 oz. to 2 gallons of water.

IV. *Insect Powder*, (*Pyrethrum*, *Buhach*).—This is another vegetable insecticide of special value, from the fact that although it is extremely active in its effects upon nearly all insects, it is practically harmless to human beings and the higher animals. It is the pulverised flowers of some plants belonging to the genus *Pyrethrum*. It is useful for many household pests, as flies, mosquitoes and wasps, all of which are quickly affected, either by having a small quantity thrown into the air of a room by means of an insect-gun or small bellows, or by a small quantity, (a teaspoonful,) being ignited and allowed to smoulder. It seems to have a marked effect upon the breathing organs of insects. Where practicable, a dry application gives the best results. If mixed with four times its weight of common flour, and then kept in a tightly closed vessel for twenty-four hours, the mixture will kill nearly all caterpillars it is applied to, and in this strength becomes the best remedy for the caterpillar of the Imported Cabbage Butterfly. It can also be used mixed with water, 1 oz. to 2 gallons of water.

V. *Alkaline Washes*.—A wash largely used in Canada is that noted by Prof. Saunders in his "Insects Injurious to Fruits," and consists of "soft soap reduced to the consistence of thick paint by the addition of a strong solution of washing soda in water. If applied during the morning of a warm day this will dry in a few hours, and form a tenacious coating not easily dissolved by rain."

Soap-suds made from whale-oil soap, 1 lb. to 8 gallons of water is a useful remedy for the destruction of plant lice.

VI. *Carbolic Acid*.—I have not found this substance so generally useful as I anticipated from its powerful odour. Prof. A. J. Cook, however, has experimented extensively with it and claims that no fruit-grower or lover of shade trees can afford to be ignorant of the Carbolic Acid Emulsion. He says: "I make it just as I do the

kerosene emulsion, only stronger, one part of carbolic acid—I use the crude material—to from 5 to 7 parts of the soap solution (1 quart soft soap, or 1 lb. hard soap, in 2 gallons of water) is of the proper strength. This is the best preparation I know of to protect against the apple-tree bark-lice and apple-tree borers."

It is applied to the trunks and larger limbs by means of a stiff brush or cloth about 20 days after the trees blossom.

Carbolic Acid Wash.—Prof. Cook also recommends for radish maggots a preparation made by adding 2 quarts of soft soap to 2 gallons of water, to which, when heated to the boiling point, 1 pint of crude carbolic acid is turned in. For use, one part of this mixture is mixed with 50 of water and sprinkled directly upon the plants once a week from the time they appear above the ground.

Carbolized Plaster.—This is simply one pint of crude carbolic acid well mixed with 50 lbs. land plaster. It is said to be very efficient as a deterrent remedy for flea-beetles.

7. *Tobacco.*—This has been used for a long time for fumigating greenhouses; but from recent experiments it seems to be worthy of wider application. Prof. J. B. Smith found that a very useful decoction could be made by boiling down 1 pound of tobacco until 1 pint of liquid contained all that could be extracted from it. This was diluted with 1 gallon of water, and was very effective in killing plant-lice, flea-beetles and other insects.

Tobacco has also been used as a wash for freeing stock of vermin, and is very effective; but is inferior, for this purpose, to kerosene emulsion.

PART II.

INSECTS INJURIOUS TO GRAIN AND FORAGE CROPS.

1. THE AMERICAN FRIT FLY. (*Oscinis variabilis*, Loew).—This is an insect which has only been recently noticed as a serious crop pest. Its life history has not yet been carefully worked out; but it seems to be very similar to those of the Hessian Fly and Wheat-stem Maggot. It is known that as a small yellowish-white maggot, $\frac{1}{12}$ inch in length, it attacks severely spring wheat and many grasses at the base of the stem, just beneath the surface of the ground, and also that it passes the winter in the same situation upon winter wheat and grasses, and may be found in the spring as a pale brown pupa $\frac{1}{12}$ inch in length, of the shape shown, greatly magnified, at Fig. 2.



Fig. 2.

Remedies.—Until more is known definitely about the number of broods there are of this insect during the year, I would suggest the following: (i) Late sowing of winter-wheat; (ii) Harrowing of stubble soon after the crop is carried, so as to start the volunteer crop quickly, this latter to be ploughed in early in September; (iii) The application of a special fertilizer as a top-dressing when winter wheat is known to be attacked. This will help the injured plants to overcome the injury.

2. CLOVER-SEED MIDGE (*Cecidomyia leguminicola*, Lintner).—The heavy loss from this insect in the clover-seed districts has awakened farmers to the necessity of practising the simple remedy advised by entomologists. This consists of feeding off or cutting clover before the end of June when the larva of the first brood matures and leaves the clover head to enter the ground and complete its changes. The perfect insects, forming the second brood, emerge from the ground just as the second crop of clover is coming into flower, and the females lay their eggs amongst the forming blossoms. From these eggs hatch minute, pink, legless maggots, which penetrate the pod and destroy the seed. About the time the seed is ripe they leave the clover and enter the ground, to pass the winter and emerge again the next spring just at the time the clover comes into flower.

3. HESSIAN FLY (*Cecidomyia destructor*, Say).—Two or three small whitish maggots embedded in the crown of winter wheat, or, in summer, just above the first or second joint (Fig 3). When full grown these maggots harden and turn brown, when they resemble small flax seeds. These change to small smoky-winged gnats, which appear in spring and autumn. The vast losses due to this insect are too well known to farmers, and even then there is no doubt that only a small proportion of the damage is recognised as caused by it.



EO

Fig. 3.

Remedies.—(i.) Delay sowing winter wheat until after the third week in September, so that it does not come up until after the last brood of the Hessian Fly has disappeared; (ii.) Burn all rubbish from the threshing machine: in this way many of the flax seeds or pupæ will be destroyed as well as many weed seeds; (iii.) Harrow the stubble directly the crop is carried, so as to start a volunteer crop for the flies to lay their eggs upon—this latter to be ploughed in early in September; (iv.) Apply special fertilizers in spring to help a weak or injured crop to overcome the injury.

4. THE PEA WEEVIL (*Bruchus pisi*, L.).—A small, brownish-grey, very active beetle, $\frac{1}{8}$ inch long, with two conspicuous black spots on the end of the body, which emerges from seed pease in autumn or in spring, leaving a small round hole. The egg is laid on the young pod and the grub eats its way into the pea, where it passes all its stages, emerging the same autumn or the following spring.



Fig. 4.

Remedies.—(i.) Clean seed. Of great importance is sowing unfested seed. When weevily pease are sown as seed the beetles emerge soon afterwards, and remain about the fields feeding on the plants until the young pods are formed. It is sometimes alleged that weevily pease are almost as good for seed as sound grain, and that the insect will not thrive in the colder parts of Canada. The use of weevily pease as seed is a great mistake, the germ of a very large proportion being, as a rule, destroyed, and those which do germinate producing weak plants. Although I have found that extreme cold (below 15° below zero, Fah.) certainly killed the weevils in two samples of pease, it would be a most unjustifiable

experiment to introduce infested seed into a district, trusting to the climate to destroy the weevils. In addition to this, the crop grown the first year from the infested seed would certainly be much injured.

(ii.) Bisulphide of Carbon.—When seed is known to be infested there are several ways of destroying the contained insects. The remedy most widely used by seedsmen, who have all the conveniences, is to place the seed to be treated in some close vessel and subject it to the vapour of bisulphide of carbon. This chemical vaporises when exposed to the air, and the vapour is so much heavier than air that it will run down through the mass of any seed upon the top of which it has been placed, and will destroy all contained insects. The quantity required is small, $\frac{1}{4}$ lb. being enough to disinfect 3 cwt. of pease. The method of using it is to place the grain in a perfectly tight bin or barrel, and then pour some of the bisulphide into a shallow vessel, and place it on the top, put on the cover and keep it tightly closed for forty-eight hours. The bisulphide does not injure the seed in any way, but it must be used with care, on account of its extreme inflammability. The seed must be emptied out, out of doors, and no light must be brought near it or an explosion will occur.

(iii.) Warm Storage.—If seed pease are stored in a warm room, in bags of canvas or strong paper, during the winter the weevils will emerge and die before the seed is required for sowing.

(iv.) Holding over Seed.—Pease can be held over until the second year after harvesting without injury, and the defective seed can be sorted out before sowing.

(v.) Soaking.—If seed be found to contain weevils at the time of sowing, and it is inconvenient to hold it over, the weevils can be drowned by placing the seed in soak for twelve hours before sowing. It must, however, be sown or dried at once, when taken out of the water.

5. **WHEAT MIDGE**, "Weevil" (*Diplosis tritici*, Kirby).—Several small reddish maggots, $\frac{1}{8}$ inch long, crowding around the grains of wheat in the ear and causing them to shrivel. Some of these, when full grown, fall to the ground and pass the winter beneath the surface. Others remain in the ears of wheat and are harvested with the grain.

Remedies.—(i.) Burn all rubbish and screenings from the threshing machine, particularly in localities where the midge is prevalent ;
(ii.) Deep ploughing as soon as the crop is carried.

6. WHEAT-STEM MAGGOT (*Meromyza Americana*, Fitch).—A glassy-green, slender maggot, $\frac{1}{4}$ inch long, which attacks the base of the top joint of barley and wheat, causing the ear to turn white before the rest of the crop is ripe, also occurring in the root-shoots of winter wheat and rye and many grasses, where it passes the winter, to emerge the following spring as an active, yellowish-green fly, $\frac{1}{4}$ inch long, with shining green eyes and three dark stripes down the back.

Remedies.—The same as recommended for No. 1, the American Frit-Fly.

INSECTS INJURIOUS TO FRUITS.

7. APPLE APHIS (*Aphis mali*, Fabr).—During the winter small, shining black eggs may be found upon the twigs of apple trees. From these eggs, early in spring, emerge green plant-lice, which attack the leaves.

Remedy.—Spray the trees, just before the buds burst, with kerosene emulsion. (Remedy II.)

APPLE WORM.—See CODLING MOTIL.

8. BEAUTIFUL WOOD NYMPH (*Eudryas grata*, Fabr).—On grape vines may be found, in the month of August, highly coloured caterpillars with the body blue, ringed with orange bands and fine black lines, head orange and the whole body dotted with black tubercles. Fig. 6. These drop to the ground when full grown and turn to rough brown pupæ beneath rubbish or



Fig. 5.

near the surface of the ground. In the following spring the beautiful moth shown at Fig. 5 appears. The upper wings are creamy-white and seal-brown; the under wings, deep yellow, bordered with deep brown.



Fig. 6.

Remedy.—Hand-picking is usually practicable. Where very numerous, spraying with white hellebore or Paris green may be used. (Remedies I and III.)

BORERS (APPLE)—See Nos. 12 and 25.

9. CANKER-WORMS (*Anisopteryx vernata*, Peck, and *A. pometaria*, Harris).—There are two kinds of caterpillars which attack apple



Fig. 7.

trees, and which are known as Canker-worms. Of one, the Spring Canker-worm, the wingless female moths appear chiefly in the spring and lay oval pearly-white eggs in irregular masses beneath flakes of bark, etc. Of the other, the Autumn Canker-worm, most of the moths appear late in the season and lay eggs which are flattened at the top (Fig. 7, a, b, c,) and laid regularly in clusters of about 100 or more on the outside of the bark.

When full-grown the caterpillars of both are much alike, and are brownish-looking larvae, about an inch in length. At Fig. 7 is shown the caterpillar and eggs of the Autumn Canker-worm. The females of both kinds are spider-like, wingless creatures; but the males are delicate moths, with gauzy gray wings.

Remedy.—There are several mechanical contrivances for keeping the females from ascending the trees to lay their eggs; but none of these can compare for efficacy with spraying the trees in the spring time with Paris green, 1 pound to 200 gallons of water. If this be done immediately after the flowers have fallen both the Canker-worm and other leaf-eating insects, as well as the Codling Moth, will be killed at the same time.

CHERRY SLUG.—See PEAR-TREE SLUG.

10. CODLING MOTH (*Carpocapsa pomonella*, L.)—This is the destructive Apple-worm so well known to all growers and consumers of apples all over the world. The best remedy is spraying the trees once, immediately after the blossoms fall, with Paris green, at the rate of 1 pound to 200 gallons of water.

CURRENT-WORM, GOOSEBERRY-WORM. See IMPORTED CURRENT SAW-FLY.

11. FALL WEB-WORM (*Hyphantria cunea*, Drury).—The unsightly webs made by colonies of this insect at the tops of branches upon fruit and shade-trees in the autumn are well known to every one.

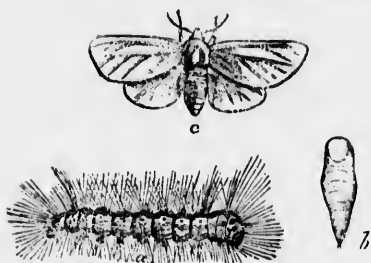


Fig. 8.

The eggs are laid by the female moth (Fig. 8), during June, and the webs are generally noticeable in July. From the habit these caterpillars have of always remaining inside the web until a short time before they change to pupae, an easy way of dealing with this pest is to cut off the web and destroy the contained caterpillars by crushing them under foot. If not attended to before they leave the web, of course, spraying the trees with Paris green will destroy this as well as all other leaf-eating insects.

12. FLAT-HEADED APPLE-TREE BORER (*Chrysobothris femorata*, Fab.).—During June and July very active bronze beetles, about half an inch in length, and of the shape shown at Fig. 9, *d*, may be found laying eggs upon the trunks and large limbs of apple, mountain ash and other trees. These eggs soon hatch into the curious flat-headed or horse-shoe-nail shaped grubs shown at Fig. 9, *a*. These, after a time, eat into the trunk and bore broad and flat tunnels, which seriously injure the tree.

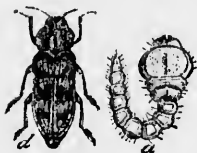


Fig. 9.

Remedy.—Undoubtedly the best remedy for this and all other borers which, as a rule, confine their depredations to a certain part of a tree, is of a preventive nature, and consists of applying an alkaline or poisonous wash to the trees just before the time the eggs are usually laid. For this purpose Remedy V or VI should be applied in the beginning and at the end of June.



Fig. 10.

13. GRAPE-VINE FLEA-BEETLE (*Graptodera chalybea*, Illig).—At the time grape-vines are beginning to expand their buds a blue-black flea-beetle, $\frac{1}{4}$ inch long, is sometimes very abundant and injurious from destroying the buds and undeveloped flower-bunches.

16.
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Remedies.—Spraying the vines with Paris green, $\frac{1}{2}$ lb. to 50 gallons of water, at the time the beetles appear, and clean culture in the autumn, by which all leaves and rubbish are destroyed, amongst which the mature beetles would pass the winter, are the best remedies.

14. **GRAPE-VINE LEAF HOPPER** (*Erythroneura vitis*, Harris).—This insect, shown much enlarged in Fig. 11, and generally known by the misleading name of "Thrip," is one of the worst enemies of the grape and ornamental Virginian creeper. Like the last-mentioned insect, it passes the winter in the perfect form beneath rubbish and clods of earth. Clean culture is therefore beneficial. When the insect is abundant its presence is indicated by the white and blotched appearance of the leaves. The most successful treatment is to syringe the vines, as soon as the leaf-hoppers are observed, with kerosene emulsion. (Remedy II.)



Fig. 11.

15. **IMPORTED CURRANT-BORER** (*Aegeria tipuliformis*, L.).—Early in June a beautiful little fly-like moth, with three bright yellow bands round the body (Fig. 12), may be seen darting about amongst currant bushes. This is one of the most troublesome enemies of the different kinds of currants. In my experience it has been far more injurious to black currants; but in some other parts of Canada it more generally affects the red and white varieties. The eggs are laid at a bud on the young wood, and the caterpillar when hatched eats its way into the cane and destroys the pith. It remains in the wood during the winter, and emerges the next June.



Fig. 12.

Remedy.—The only remedy is close pruning, and whenever a hollow cane is detected in pruning, the caterpillar must be hunted out and destroyed. Indications of the presence of the borer must also be looked for about the time the flowers are opening, when the leaves of infested shoots have a less healthy appearance.

16. **IMPORTED CURRANT SAW-FLY** (*Nematus ribesii*, Scop.).—Of all enemies to small fruits, there is not one perhaps which is more persistent than this insect. Soon after the leaves expand, early in May, the perfect insects, which are a little larger than a house-fly, may be seen flying about beneath gooseberry and currant bushes. The eggs

are laid in regular rows along the ribs beneath the lower leaves, and soon the well-known "Currant-worms" make their appearance.

Remedies.—There are at least two broods in the season. The caterpillars of the first of these appear in May, and for this first brood only a weak mixture of Paris green ($\frac{1}{4}$ oz. to a pailful of water is sufficient) may be sprayed on the bushes, or a dry mixture of 1 oz. of Paris green to 6 lbs. flour, well mixed together, may be dusted over the bushes after a shower, or when damp with dew. For the second brood of caterpillars, which appears just before the fruit ripens, Paris green must on no account be used, owing to its poisonous nature; but instead of it white hellebore, dusted on dry or in water, 1 oz. to a pailful of water.

17. OYSTER-SHELL BARK-LOUSE (*Mytilaspis pomorum*, Bouché).—



Fig. 13.

Some might not at first recognise us insects the little roughnesses on the bark of apple trees shown in Fig. 13. Such however they are, and extremely injurious insects too. Their life history is peculiar. About the 1st June minute white mite-like insects, with six legs, emerge from beneath the scales on the bark and for two or three days run about seeking for a suitable place to attach themselves. They then pierce the young bark with their beaks and live on the sap of the tree. They never move from that place again. The waxy scale is gradually secreted, and by August the insect has transformed itself into a scale covering a cluster of eggs. These remain unchanged through the winter, and the young do not hatch again until the next June.

Remedies.—This insect, like many others, thrives most on unhealthy trees. When detected, therefore, measures should be adopted for inducing a vigorous growth, as well as for the removal of the scale insects. Spraying just before the buds open with kerosene emulsion (Remedy II) will destroy many of the scales—and again at the time the young lice are active, for at this time they are most susceptible to injury. Scrubbing the trunks and branches of young trees with alkaline washes (Remedy V and VI) during the winter or early in spring will also keep down the number of this pernicious insect.

18. PEAR-TREE SLUG (*Selandria cerasi*, Peck).—In June and August slimy greenish-brown slug-like caterpillars, $\frac{1}{2}$ inch long,

occur on the leaves of pear and cherry trees, feeding on the upper surface.

Remedies.—The same as for No. 16.

19. PLUM CURCULIO (*Conotrachelus nenuphar*, Herbst.)—There is perhaps no insect so well known by name as the Plum Curculio. The perfect insect (Fig. 14) belongs to the family known as snout-beetles, from the shape of the head, which is elongated into a beak. It is a small, rough, grayish beetle about $\frac{1}{2}$ inch long. The females lay their eggs in the young fruit of plums and cherries, frequently destroying the whole crop.



Fig. 14.

Remedies.—The beetles are sluggish in the early morning, and drop from the trees if a sudden jar be given to the trunk. For this purpose a metal spike is driven into the trunk, which is struck sharply with an iron hammer. This gives the sharp jar necessary to dislodge the beetles which fall on sheets or into receptacles placed beneath the trees. They are then collected and destroyed.

Of late years abundant evidence has proved the efficacy of spraying the trees, as soon as the fruit has formed, with Paris green, 1 lb. to 200 gallons of water, and ten days afterwards a second time with a weaker mixture, 1 lb. to 300 gallons. Should heavy rains occur immediately after these sprayings they must be repeated.

20. RASPBERRY BORER (*Oberia bimaculata*, Oliv.)—Towards the end of June the tips of the young shoots of raspberries may frequently be seen to fade and droop. If these be examined there will be found, at the base of the faded portion, two rows of punctures half an inch apart, and between them a small hole leading into the heart of the cane, where one large yellow egg lies embedded. After a few days this egg hatches, and the young grub eats its way down the centre of the stem towards the root. It becomes full grown about August, when it is about $\frac{3}{4}$ inch long. The perfect insect (Fig. 15) emerges the next June as a narrow black beetle, with long feelers, and the thorax or middle portion of the body yellow, and bearing three black spots. It also attacks the blackberry.



Fig. 15.

Remedy.—This is simple, but requires prompt action. The faded shoots are quite conspicuous, and when seen should at once be picked off. They separate from the cane with a light touch, and when removed the girdled portion should be examined, to see that the grub has not hatched and bored down into the stem.

21. RASPBERRY-CANE MAGGOT (*Anthomyia*?).—There is another pest which affects the young wood of raspberries similarly; but does not produce the two rings of punctures. This is the maggot of a small black fly which lays a single egg in the axil of one of the upper leaves. The young maggot bores down the stem until full grown, and then changes to a brown puparium inside the stem.

Remedy.—After a time the young cane turns black at the tip and must be cut down as soon as seen. This is a more injurious pest than the last, where it occurs, because it burrows further down the stem before the indications of its presence are visible.

22. RASPBERRY SAW-FLY (*Selandria rubi*, Harris).—About the time raspberries are in flower the leaves are noticed to be riddled with small holes. On examination this will be found to be the work of a green, bristly caterpillar (Fig 16). From the close resemblance in colour to the leaves on which they feed, these caterpillars are seldom recognized as the cause of the injury. They disappear from the canes before July, and form oval cocoons beneath the ground. From these the perfect insect, a small, dark four-winged fly, $\frac{1}{4}$ inch long, appears the next May.

Remedy.—Sprinkle the foliage as soon as the caterpillar's work is detected with white hellebore, 1 oz. in a pailful of water.

23. RASPBERRY PLUME-MOTH (*Oxyptilus nigrociliatus*, Zeller).—

In June another small caterpillar, somewhat like the last, but with finer bristles and of a paler green colour, may be found injuring the foliage in a very similar manner to the last. This, however, turns to a very beautiful little moth, bronze, dotted with silvery white (Fig. 17), which may be found flying about the canes in July.

Remedy.—The same as for No. 22.

24. RED-HUMPED CATERPILLAR OF THE APPLE (*Ædemasia concinna*, Sm. Ab.)—Late in summer large clusters of voracious waxy-looking, yellow, white and black caterpillars (Fig. 18), with their heads and a hump on the fourth ring of the body of a bright red, are sometimes found on young



Fig. 16.



Fig. 17.

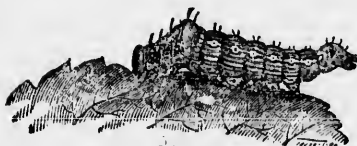


Fig. 18.

apple trees, to which, unless they are removed, they are very destructive. Late in autumn they leave the trees and spin close but thin cocoons amongst fallen leaves. The caterpillars remain in these unchanged until the next spring, and the small brown moths emerge during June and July.

Remedy.—These caterpillars are nearly always found on young apple trees within reach from the ground. When this is the case the branch can be cut off and the caterpillars crushed under foot. When too high up for this a spraying with Paris green would dispose of them.

25. ROUND-HEADED APPLE TREE BORER (*Saperda candida*, Fab.)—This borer nearly always works near the base of the tree it infests. The grub is much thicker than that of the flat-headed borer, and takes three years, instead of one, to complete its changes. The beetle is pale-brown with two white stripes down the body. It is shaped somewhat like No. 15, but is stouter and about $\frac{3}{4}$ of an inch long.

Remedies.—During the first year the grub lives just beneath the bark in the sap wood, hollowing out a chamber about an inch or more in diameter. The bark becomes discoloured in a characteristic way which is soon recognised. It is also betrayed to the experienced eye by the castings which its pushes out of its burrows. By cutting through the bark the grub can be destroyed. If it has penetrated into the wood it can be killed with a piece of stout wire. The best remedy, is undoubtedly, a regular treatment every June, with deterrent washes. See Remedies V and VI.

26. TENT CATERPILLARS (*Clisiocampa Americana*, Harris, and *C. distria*, Hubn.)—The caterpillars, Fig. 20, which make the large, unsightly webs too often seen in the forks of branches of fruit and shade trees, hatch in May from rings of eggs which have been on the twigs of the trees all through the winter. They grow rapidly, and the perfect insect, an active brown moth, with two white bands across the wings, comes out in July. These insects are so well known that further description is unnecessary.

Remedies.—Where apple trees are sprayed for codling moth these caterpillars will also be destroyed. Hand-picking of the eggs in winter, and cutting off the webs when first formed in May, and when, owing to



Fig. 19.

the sparseness of the foliage, they are very conspicuous, are both practical remedies.

INSECTS INJURIOUS TO ROOTS AND VEGETABLES.

27. CABBAGE APHIS (*Aphis brassicae*, L.)—Grey plant-lice are frequently very troublesome during the summer on cabbages, and in August and September on smooth-leaved turnips.

Remedies.—(i.) In years of only moderate attack good results have been obtained by picking off the first clusters of plant-lice by hand and destroying them.

(ii.) The most satisfactory treatment, however, was upon a crop of heavily infested Swedish turnips with kerosene emulsion. This must be applied by means of a force-pump and spray nozzle, so set that the spray may be thrown up under the leaves where the plant-lice congregate.

(iii.) Prof. J. B. Smith recommends very highly whale-oil soap, 1 lb. to 8 gallons of water, for all plant-lice.

28. CABBAGE MAGGOT (*Anthomyia brassicae*, Bouché)—From one to many white maggots attacking the roots of young cabbages as soon as pricked out. These are produced from eggs laid by small gray flies, one-third smaller than house flies.

Remedies.—(i.) White hellebore, 2 oz. in a pailful of water, or (ii.) kerosene emulsion (Remedies II and III), syringed around the roots, and the earth kept well hoed up to the collar, have proved useful remedies; (iii.) Nitrate of soda, 1 tablespoonful around each plant, is highly recommended.

CABBAGE-WORM.—See Imported Cabbage Butterfly.



29. COLORADO POTATO-BEETLE (*Doryphora 10-lineata*, Say).—In reply to frequent enquiries, I would state that for this insect no remedy can compare with Paris green, 1 lb. to 160 gallons of water (=1 oz. to 10 gallons). It is Fig. 20. at once the cheapest and easiest applied remedy known.

30. CUCUMBER FLEA-BEETLE (*Epitrix cucumeris*, Harris).—Very small black flea-beetles, with yellowish legs and feelers and covered with short, silky pubescence which eat a great many small holes in the leaves of cucumbers, potatoes, etc., etc.

Remedies.—These can be easily controlled by dusting Paris green and flour, 1 part to 50 of the diluent (Remedy I), over the plants when the dew is on them.



Fig. 21.

worms one kind of which is shown at (Fig. 22) are smooth greasy-looking dark caterpillars, ranging from about $\frac{1}{2}$ an inch to 2 inches in length at the time they injure crops. They feed at night and hide during the day time. The eggs of most species are laid in autumn, and the young caterpillars make about a quarter of their growth before winter sets in. They pass the winter in a torpid condition, and are ready in spring to attack the young crops as soon as they come up. The full growth of most species is completed by the first week in July, when the caterpillar forms a cell in the earth and changes to a chrysalis, from which the moth appears about a month later.



Fig. 22.

Remedies.—(i.) Clean Culture. As the young caterpillars of many species hatch in autumn, the removal of all vegetation from the ground as soon as possible in autumn deprives them of their food supply and also prevents the late-flying moths from laying their eggs in that locality. Fields or gardens which are allowed to become overgrown with weeds or other vegetation late in the autumn are almost sure to be troubled with cut-worms the next spring.

(ii.) Traps.—Large numbers may be destroyed by placing between the rows of an infested crop, or at short distances apart on infested land, bundles of any succulent weed or other vegetation which has been previously poisoned by dipping it, after tying in bundles, into a strong mixture of Paris green. The cut-worms eat the poisoned plants and bury themselves and die. In hot, dry weather these bundles should be placed out after sun-down, and a shingle may be placed on each to keep it from fading.

(iii.) Banding and Wrapping. (a.) It will be found to well repay the trouble and expense to place a band of tin around each cabbage or other plant at the time of setting out. These may very easily be made by taking pieces of tin 6 inches long and $2\frac{1}{2}$ wide and bending them around a spade or broom handle so as to form short tubes. In placing them around a plant the two ends can be sprung apart

to admit the plant, and then the tube should be pressed about half an inch into the ground. I have found this a useful means of disposing of empty tomato and other cans. To prepare these easily, they need only be thrown into a bonfire, when the tops and bottoms fall off and the sides become unsoldered. The central piece of tin can then be cut down the centre with a pair of shears, and forms two tubes.

(b.) Wrapping a piece of paper round the stems of plants when setting them out will also save a great many.

(c.) Hand-picking or digging out the cut-worm whenever a plant is seen to be cut off should, of course, always be practised.

Natural Enemies.—There are two enemies which deserve especial notice, and, from the good service they do, should be known by sight to every cultivator. They are the Fiery Ground-beetle or Cut-worm Lion (*Calosoma calidum*, Fab.) and the Black Ground Wasp (*Ammophila luctuosa*). Both



Fig. 23.

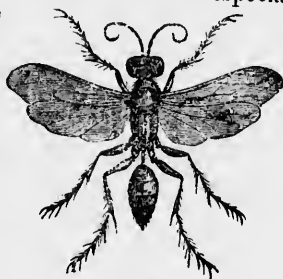


Fig. 24.

of these are desperate enemies of cut-worms, the former feeding on them in all of its stages, the latter digging them out and storing its nest with them as food for its young grubs.

32. IMPORTED CABBAGE BUTTERFLY (*Pieris rapae*, L.).—The white butterflies which fly over cabbage beds during summer lay eggs on the leaves, from which are hatched the troublesome Cabbage-worms.

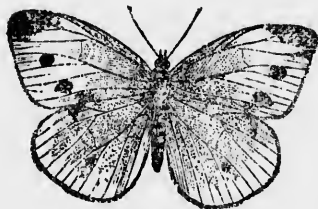


Fig. 25.

Remedies.—The best remedy for this insect is undoubtedly insect powder diluted with four times its weight of common flour, as directed under Remedy IV.

33. ONION MAGGOT (*Phorbia ceparum*, Meigen.)—Equalling in destructiveness and more difficult to deal with than the Cabbage and Radish Maggots, is the Onion Maggot (Fig. 26.)

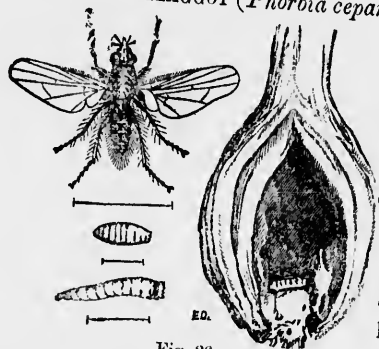


Fig. 26.

Remedies.—Rich, well-worked soil and early planting are advised.

(i). Kerosene emulsion watered along the rows when the onions are found to be infested has proved successful.

(ii). A sprinkling of gas-lime, sown broadcast over the beds every two weeks, was also found to protect the crops considerably, and was thought to act as a good fertilizer.

Suggestion.—I would suggest the use of Nitrate of Soda, at the rate of 200 lbs. to the acre; this is a valuable fertilizer, and has been found of marked use in checking the ravages of the Cabbage Maggot.

34. RADISH MAGGOT (*Anthomyia radicum*, Bouché).—The most serious pest of radishes is the root maggot. This is the larval form of a small fly closely resembling the fly of the Onion maggot (Fig. 26).

Remedies.—Early sowing and the use of new ground are recommended, but are by no means sure remedies. I have obtained the best results from using Prof. A. J. Cook's carbolic wash, Remedy IV. The use of salt and gas lime are also beneficial, but are not infallible remedies.

35. SQUASH BUG (*Anasa tristis*, De Geer).—Numbers of large, ill-smelling, dark-brown bugs, paler beneath, $\frac{3}{8}$ inch long, clustering round squash vines about the end of June and sucking the tops. The eggs are laid on the leaves, and the young are soon found with the full grown bugs.



Fig. 27.

Remedies.—Constant hand-picking, from the vines when they first appear, and by placing shingles close to the hills beneath which the bugs hide during the day time, are generally effective. Coal oil and plaster scattered amongst the vines will drive away many.

36. STRIPED CUCUMBER BEETLE (*Diabrotica vittata*, Fab.)—As soon as squash, cucumber or melon plants appear above the ground they are attacked by small, yellow-striped beetles, which if not noticed will soon destroy the plants.

Remedies.—Sifting dry ashes and Paris green (1 to 50) over the vines is the best application to protect the vines. Ashes alone are also useful. A remedy much adopted in the United States is described by Dr. C. M. Weed in a Bulletin of the Ohio Agricultural Exper't. Station for September, 1889, and consists of covering the vines with a piece of gauze or cheesecloth, supported by two or three sticks stuck into the ground, and with the edges held down by a handful of earth on each side.

37. TURNIP FLEA-BEETLE (*Phyllotreta vittata*, Fab.)—There is, perhaps, no insect better known or more execrated by farmers than "the fly" or flea-beetle of the turnip (Fig. 28). The perfect beetles, black, with white marks on the wings, pass the winter beneath rubbish or clods of earth, and appear on various plants of the cress family early in spring. As soon as the young turnips appear they attack the seed leaves, and very frequently destroy the whole crop. The grub state is passed under ground on the roots of plants of the cress family.

At Fig. 28. The perfect beetle and the grub are shown much enlarged.

Remedies.—I have found the most successful treatment of this insect to be the sowing of perfectly dry land plaster or ashes, with 50 parts of which 1 part of Paris green had been mixed (Remedy I). Other experimenters speak highly of a decoction of waste factory tobacco, 1 lb. in 2 or 3 gallons of water. This latter remedy is useful upon Garden Cress, where Paris green cannot be used. See also remedy for No. 36.



Fig. 28.

TO CORRESPONDENTS.

All enquiries about insects will be gladly replied to. They should always, when possible, be accompanied by specimens, which may be packed in any small tin or wooden box; when alive, place with them some of the foodplant. The box should be as tight as possible, and no air-holes are necessary. When the specimens are dead they should be rolled in paper or cotton. Specimens should never be sent unprotected in a letter or they are almost certain to be crushed beyond recognition. When writing for information as full particulars as possible should be given of the crop injured, and the part attacked, how long it has been noticed and the amount of damage done. Packages should be marked with the name and address of the sender, and should be directed to

THE ENTOMOLOGIST,
CENTRAL EXPERIMENTAL FARM,
OTTAWA, ONT.

N.B.—No postage is necessary on either letters or packages when addressed as above.

