fringements of the Act, and at the same time to keep under close observation foreign fruit offered for sale. Special vigilance has been exercised in regard to the jam and cider factories. These are visited to prevent codlin-moth-infested fruit from being sold without a permit. An eye is also kept on fruit awaiting shipment by rail or steamer, and occasionally, when thought desirable and necessary, a package is opened to ascertain if the shipper is complying with the law. The regulations relating to the prevention of the spread of the codlin-moth are gradually being more strictly enforced Spraying or bandaging is being insisted upon. The method which has given the best results in controlling codlin-moth, and which several growers have expressed themselves as thoroughly satisfied with, is to combine the timely spraying with arsenate of lead with bandaging, and frequent gathering of infected fruit, destroying the grub within.

Fruit-flies.

In 1897, after my visit to Australia and a careful investigation of the damage done by the maggots of the fruit-flies, I recommended that the importation of any fruit infected by any species of fruit-fly be totally prohibited.

An illustrated article was issued in October, 1897, giving a full account of the fruit-fly, and pointing out the risks we ran, as follows :—

THE QUEENSLAND FRUIT-FLY (*Tephrites Tryonii*).

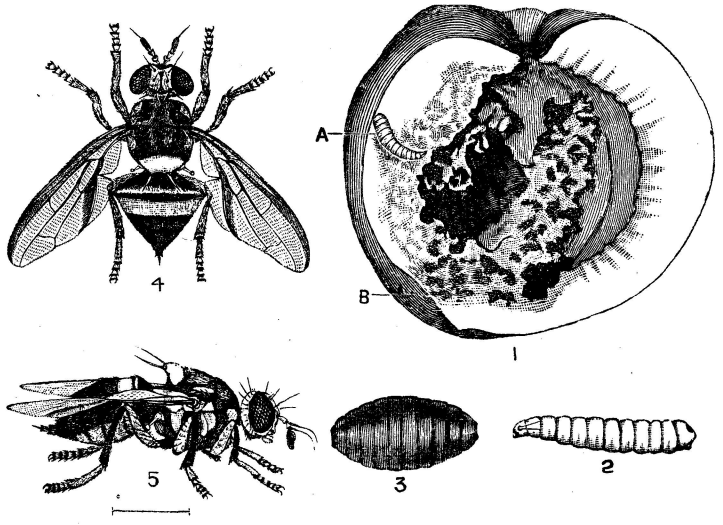


Fig. 1. Infested apricot. A. Maggot. B. Holes where maggot has escaped. After Claude Fuller. Fruit infested by the Queensland fly (*Tephrites Tryonii*) not being obtainable at the time of my visit, the drawing of an apricot attacked by the West Australian fruit-fly (*Halterophora capitata*) is reproduced here to give an idea of the appearance of infested fruit, the mode of attack being described as similar. Fig. 2. Maggot, magnified, *Tephrites Tryonii*. Fig. 3. Pupa, magnified. After Froggatt. Figs 4 and 5. Back and side view of fly, magnified. Original. The line below Fig. 5 shows the natural length.

Mr. Froggatt and Dr. Cobb, of New South Wales, and Mr. Tryon, of Queensland, have paid so much attention to this subject, and favoured me with so large an amount of information, that I cannot do better than reproduce portions of their notes: —

"*General Appearance of Fruit attacked.*—When the eggs are deposited in the fruit before it is ripe, which is often the case, it shows very slight outward evidence of disease, but when ripening it shows darker spots where the skin has been pierced by the ovipositor of the flies. As the newly hatched maggots begin to feed they gnaw irregular passages towards the centre of the fruit, and in the case of apples, quinces, and other core-fruit soon reduce that portion surrounding the core into a rotten mass, which, when opened out, is seen to contain a number of pale-coloured maggots. In the case of peaches, apricots, and stone-fruit, though the maggots feed inwards, the whole of the side first attacked soon begins to decay.

"The maggots are semi-transparent when about a quarter grown, with the head-portion slender, the body thickening towards the extremity, and sharply rounded at the tip. With an ordinary lens they can be easily identified from codlin-moth or any other fruit-grub by the general elongated form, the two curious black hooks at the mouth, and a pair of cephalic spiracles, tinged with yellow, at the opening at the back of the head, which stand out very distinctly. Their mode of progress is by crawling, but, though without legs, when placed upon a smooth surface, by arching up their backs and drawing the tip of the body down to the head, they can, with a sudden jerk, jump a considerable distance in a similar manner to the jumpers in cheese.

"They live in the fruit until it is perfectly putrid, and when full grown are of a dull yellow colour, measuring about half an inch in length. At this stage they crawl out of the fruit and bury themselves in the earth just beneath the surface, and transform into elongate, oval, brown pupæ, enclosed in a brown hard shell, like those of the house-fly so common in stables.

"The flies vary somewhat in size in sexes, the female fly, as is often the case in insects, being considerably larger than the male, with the body more robust, and produced at the tip into a needle-like ovipositor, with which she does all the damage. She measures nearly half an inch across the expanded wings, which are semi-transparent except along the front nervure, with an oblique clouded line near the shoulder. The head is broad, with large reddish-brown eyes; the antennæ yellow, with the third joint long, tipped with a bristle; the thorax is stout, of a dull yellowish-brown colour, with a few long hairs on the side, and a bright yellow patch on each side and another over the scutellum at the junction with the body; the latter constricted at the base, swelling out in the centre, and tapering again to the tip; it is of a general dark reddish-brown colour, showing a very distinct transverse yellow band across the upper half of the abdomen.

"*Remedies.*—The only way to check the spread of this pest is for all fruit-growers to be on the watch and examine and destroy all fruit found to contain these maggots, while all fallen fruit should be gathered up and destroyed. As the maggots do not leave the fruit the moment it drops, as the codlin-moth caterpillar does, there is a much better chance of killing most of them in this stage. Lime, or some caustic top-dressing, could be spread under infested trees, the surface of the soil having been first raked over, and if this was done a few days before the dressing the magpies and other wild birds, as well as the farmyard fowls, would make short work of a great number."

Note by Dr. Cobb on the Fruit-fly, or so-called "Queensland Fruit-fly."

"The fruit-fly attacks principally peaches, apricots, plums, nectarines, apples, and pears, though other sorts are not exempt.

"The injured fruit may be known by the following appearances: Although it retains its form, there appears under the skin, at one or more places, a discoloration as if the flesh had turned watery, and had become somewhat decayed. On opening the fruit it is found to be honeycombed and rotten at the centre, and the dirty-brown, often semi-liquid, flesh contains one or more fly-blows or maggots, which are never quite so large as those of the common blow-fly, but otherwise to the ordinary observer much the same. These appearances are seen only in ripening fruit. The fly does not attack green fruit. A small pore in the skin of the fruit is often seen near the centre of the watery-looking discoloration.

"The fly—*i.e.*, the adult winged insect—is seldom seen, even in orchards where it is very prevalent, in which respect this pest resembles the codlin-moth, though not for the same reason.

"The female fly lays her egg under the skin of the fruit, and this is the reason that the insect is so hard to combat. The egg of the codlin-moth being laid in the eye of the apple, the grub, when it hatches, has to eat its way into the apple; consequently, if the apple be sprayed with Paris-green the young codlin-moth grub getting a bite of it is poisoned, and thus got rid of. The grub of the fruit-fly, however, hatching as it does inside the fruit, cannot be poisoned in the same manner as that of the codlin-moth.

"The grub of the fruit-fly requires about three weeks to develop, so that a number of broods follow each other each season. This fact will account for the great number of the grubs to be found in some Queensland orchards.

"The common small brown fly that attacks decaying fruit in swarms should not be confounded with the pestiferous fruit-fly. This common little brown swarming fly thrives only on decaying or fermenting fruit.

"*Remedies.*—These must be directed towards destroying and warding off the fly in all its stages. Spraying is useless. Constant vigilance is absolutely necessary if the pest is to be got rid of where it has once become well established.

"1. Destroy all infested fruit as fast as it is found. Boil it for the pigs, or poultry, or other stock.

"2. Cultivate the ground under the trees frequently. The grub leaves the fruit and goes into the ground to propagate before changing into a fly. It goes in only a little way, and cultivation is likely to so disturb it (*i.e.*, bury it or bring it up into the sunshine, where birds also can pick it up) that its death ensues before it can come forth to propagate.

"3. The ground under the trees can be poisoned with kerosene and a variety of other substances that are fatal to the grubs and pupæ.

"4. Poultry are said to pick up the flies and grubs to a certain extent, but the evidence on this head seems to me not very satisfactory.

"5. Trees have been covered with a very fine-meshed netting for a month before the fruit is ripe, and the flies have thus been kept off the fruit.

"6. Undoubtedly, the most effective way to fight this pest would be by concerted action under the administration of the Government. There is now nothing to prevent infested fruit from being sent from one part of the colony to another, and thus spreading the pest at a rapid rate. If

the Minister for Agriculture had power to inspect and condemn and destroy in the Sydney market alone any such diseased fruit it would put a strong check on the spread of the pest.

"7. Any one who takes any of the above precautions should induce as many as possible of his fruit-growing neighbours to adopt them also.

"8. In their own interests fruit-merchants might reasonably refuse to buy fruit from orchards or districts where the fly is known to be prevalent. Fruit in store and in market should be picked over and the infested part removed and destroyed.

"9. Various attempts have been made by hanging in the fruit-trees substances having an obnoxious odour to drive away the flies—not, however, with much success.

"10. A remedy I have myself conceived (of course, it may also have been thought of by others) is to trap the flies with fruit. If when the fruit is picked for market a tree with tempting fruit be left near the middle of the orchard, all the flies will resort to it as the only place to deposit eggs. In due time the destruction of all the fruit of this tree, and a careful treatment of the ground underneath, would put a great check on the number of flies. I believe this idea may be capable of development into the most economical and effective means of fighting this pest. It would not be necessary that the fruit should be displayed on the tree alone; it might also, after plucking, be so placed as to form an effective 'bait,' the idea being to attract a large number of flies into comparatively a small quantity of fruit, where they could be easily destroyed. Comparatively useless fruit might be utilised for this purpose." *

There are other dangerous insects the importation of which from Australia should be guarded against, and the statement that we have already one, at least, of them in this country should not be allowed to stand in the way of applying all possible means to prevent further supplies from entering our colony. I refer more particularly to the red-scale and the San Jose or pernicious scale. Although I should be sorry to see anything done which would check the free interchange of colonial fruit, believing as I do that only by this means will the fruit industries of Australasia reach their fullest development, yet I must most strongly urge that at least the three insects above named be placed on the same footing as the codlin-moth, and the importation of fruit infected with either of them totally prohibited.

In New South Wales there is at present no legislation for the suppression of insect and fungus pests, except those affecting the vine, but efforts are now being made to remedy this defect. Many orchardists, however, adopt careful and systematic spraying as a means of keeping disease in check, and in most instances with satisfactory results. The same complaint is, however, heard there as from energetic growers in this country —viz., that careless neighbours nullify the effects of their exertions.

In South Australia strong efforts are being made to check all insect and fungus pests, and strict regulations are being enforced against those

---

The following regulation has been brought into force in Queensland since the report was written :—

"*Fruit-fly.*—All fallen fruit, of whatever kind (and whether harbouring insects or not), shall be gathered before noon of each day by the occupier or owner, or his or her agent, of any place where fruit-trees are being grown, and all pest-infected fruit shall be submitted to the process of boiling, or be buried beneath not less than 1 ft. 6 in. of solid earth."

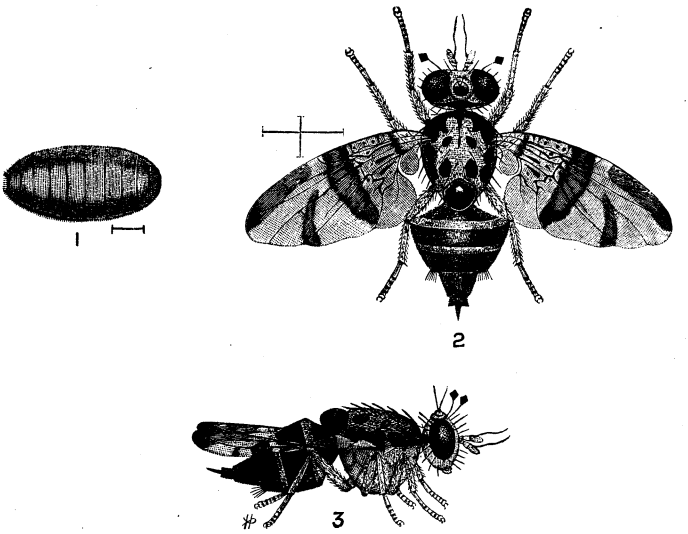
who neglect to properly attend to their trees. Here Mr. Quinn, the Orchard Inspector, has found that the best treatment for scale-insects on citrus trees is cyanide gas. (For description see my report for 1895–96.)

In Victoria most stringent examination is made of all plants, &c., imported, and they are dipped or fumigated by Government officials before being handed over to the importers.

In Tasmania, where the conditions and fruit-productions most nearly resemble those found in our colony, orchardists are compelled to bandage their trees and examine the bandages at stated intervals in order to kill the grubs of codlin-moth. On orchards of any extent women are employed to do this duty, and it is work that they may well undertake.

THE WEST AUSTRALIAN FRUIT-FLY (*Halterophora capitata*)

The figures in the attached drawing are all from specimens bred by me from condemned fruit.



MEDITERRANEAN FRUIT-FLY (*Halterophora capitata*).—Fig. 1. Chrysalis. Fig. 2. Fly with wings expanded. Fig. 3. Fly, side view. All from nature. The lines near Figs. 1 and 2 indicate the natural sizes.

These flies are already established in Queensland, West Australia, New South Wales, Tasmania, and South Africa.

Their life-histories are practically identical, so that no lengthened description is necessary here. Several shipments of fruit, both stone and citrus, containing the larvæ of both insects, have been condemned by me; but, in spite of all our care in immediately destroying all infested fruit, the fly is almost certain, sooner or later, to appear in orchards, in consequence of the impossibility of searching passengers who may at any time walk ashore with a few fruits in their pockets or hand-bags. It is therefore desirable to afford facilities for identification. This is easily done by means of the wings—a mere glance at the two drawings being sufficient to distinguish them.

The female punctures the skin of the fruit and places her egg within the tissues. It is evident that no remedial measures are practicable, and therefore the pest is likely to become more serious than the codlin-moth.

Any person finding a white-pointed maggot resembling the maggot of a blow-fly in fruit is requested to at once send fruit and insect to this office.

The impossibility of applying remedial measures has led Inspectors Benson and Boller, of the Queensland Department of Agriculture, to conduct a series of experiments to endeavour to discover some substance which would act as a deterrent to the female when egg-laying, and so protect the crop. The results are, however, disappointing. The following is their report:—

"The hanging of cotton-waste saturated with strong-smelling substances has not been a success, flies having been seen on fruit within a few inches of the waste, and the trees so treated being as badly infested as any untreated trees in the orchard.

"Spraying the trees and fruit with strong-smelling substances has been partially successful, certain mixtures having had a distinctly deterrent effect for the time being. The mixtures that proved to be the most deterrent were those that, besides having a strong smell, adhered least to the fruit.

"No spray used has, however, been a complete success, even though numerous applications have been made; but some have certainly the properties of keeping the fly from the fruit for a certain time after their application, as, in the case of the same varieties of fruits or trees that have been sprayed, we have been unable to detect a single fly at work (viz., laying its eggs), whereas they were numerous and busy on adjacent trees. No spray has, however, been lasting, as, where the applications have been from a week to ten days apart, part of the fruit has been infested, but not to the same extent as in untreated trees, thus showing that the applications must be frequent during the ripening of the fruit.

"We believe that careful and frequent sprayings will protect a considerable portion of the crop, but, at the same time, we are confident that to be of any value the spraying must be very carefully carried out, and must be backed up by destroying all infested fruit.

"The second series of experiments were conducted with a view of determining the possibility of attracting, catching, or poisoning the mature insect. In this respect we are sorry to say that we have had no success, as we have failed to attract the flies. We have used highly-scented sticky baits, highly-scented poisoned baits, and poisoned-fruit baits; but, though numerous insects of various kinds have been caught or destroyed, the fruit-fly has escaped."

In Western Australia and in New South Wales nothing has been found of any use against the fly. At the Cape of Good Hope the only successful method has been by covering the trees with mosquito-curtain whilst the fruit was ripening.

The maggots are of a creamy-white colour, and when removed from the fruit will frequently hop about much the same as cheese-jumpers do; when full grown they are about one-third of an inch in length. The pupa is of a pale reddish-brown colour, and about one-quarter of an inch in length. The fly itself is a handsome insect, being prettily variegated with brown, yellow, and cream; the eyes are very beautiful

when the insects are alive, but become of a reddish-brown after death. It can be readily distinguished from all other flies by two most extraordinary appendages to the head of the male.

The male can live for about five days under absolute starvation in an airtight box, the female for about seven days.

In 1898, when examining fruit on the Wellington wharf, I found the maggot present in a consignment of ninety cases of peaches. This was the first time it was detected in New Zealand, and showed that the Proclamation was issued none too soon. From the maggots in this condemned fruit I reared the perfect flies of the Mediterranean species, and it was from these that the accompanying illustrations were drawn.

The flies thus reared were placed in a wire-gauze cage and fresh fruit placed with them. In two days they were depositing eggs on the fruit, and in twenty-nine days from these eggs there emerged perfect flies. This experiment was repeated each year, yet there were many persons who maintained that the fly could not withstand our New Zealand climate.

Extracts from my 1905 report, given below, should have convinced growers of the fearful risk they ran in not strenuously opposing the efforts of interested persons to secure a relaxation of the regulations. The extracts are :—

FRUIT-FLY MAGGOT.

(1.) The discovery by Captain Broun of the pupa of the fruit-fly in the soil accompanying imported plants shows the necessity for careful examination of all plants.

(2.) The condemnation and destruction by Mr. Palethorpe, at Wellington, of forty-seven cases of New South Wales apples, infested with fruit-fly maggot as well as codlin-moth grub.

(3.) The discovery by Mr. Cockayne of a chrysalis of this maggot inside the fruit. They usually pupate in the soil.

We have now had to burn consignments of the following fruits, because they were infested with this dreaded maggot:—

Peaches,
Apricots,
Nectarines,
Cherries,
Pears,
Apples,
Mangoes,
Shaddocks,
Mammee-apples,
Pineapples,
Tomatoes,
Loquats,
Persimmons,
Plums,
Mandarins,
Oranges,
Bananas,
Maupi fruit,
Grenadillas.

Should this pest ever become established here it will mean the ruin of the stone-fruit industry of the North. It will be seen that practically all varieties of fruit are attacked, and the measures taken to keep this fly out of New Zealand cannot be too severe.

Some persons, evidently quite without knowledge of the subject, have expressed the opinion that New Zealand is too cool for the fruit-fly to breed. There is absolutely no ground for such an opinion to rest on, as the following will show:—

(*a.*) It was found breeding in an orchard at Launceston in Tasmania, and most drastic measures were taken to exterminate it before it could become established. If this pest can breed in Tasmania it would readily do so in any portion of our North Island.

(*b.*) Every year since 1898 numbers have been reared in a plain wire-gauze cage placed on the window-sill of my office in Wellington. The same has been done in Auckland. These flies have paired, and laid eggs in fresh fruit placed in the cage by myself. These eggs hatched, and in turn became full-grown maggots.

(*c.*) With a view of ascertaining whether subjecting the fruit to a low temperature would kill the maggots, and also to determine the effect on the fruit, I gave instruction that successive trials should be made by placing a certain number of cases in the cool-store at various temperatures from freezing upwards. The following are the results:—

Fifty oranges infested with maggots and also one of unaffected fruit kept in the freezing-chamber from the 17th to the 20th April, 1903. All fruit frozen hard. Three of the infested oranges examined as soon as taken out of store—fifteen maggots found in these three fruit—all dead. The remainder not examined till the 24th, so as to give a chance for any maggots not killed to recover. Out of forty-seven oranges 242 maggots were taken, eighteen out of one fruit and twenty-three out of another. All maggots were killed. The freezing did not seem to hurt the ripe fruit, but ruined the unripe.

In May of the same year a further trial was made, the fruit being stored for three days at a temperature of 32° Fahr. Nearly half the maggots were alive.

In May, 1904, another trial was made. The particulars are as follows: The temperature of this chamber was 32° Fahr. throughout. No. 1: Ten oranges stored for thirty-six hours—result, eighteen maggots dead, five alive. No. 2: Twenty oranges stored for forty-eight hours—result, thirty-four maggots dead, nine alive. These oranges did not suffer from the chilling; but it is evident that if the maggot can stand a temperature of 32° Fahr. for forty-eight hours, it would certainly breed readily, say, in Auckland orchards.

Unfortunately, the efforts of importers to secure a relaxation of the regulations were successful, and instructions were given to allow the imported fruit condemned at Auckland to be sorted over.

In October of last year a very large consignment of fruit containing maggots was distributed from Auckland, and reached various parts of the colony. Directly this was discovered officers were despatched to trace this fruit, and whenever possible to seize and burn it. They showed great zeal, and the Department is greatly indebted to the fruit-vendors for the prompt and willing assistance rendered.

The horticultural officers were instructed to make the most careful inspection possible of orchards, and to let this work take precedence of all other. This rendered it necessary to curtail the ordinary visits of instruction and inspection.

In spite of this energetic action, small quantities got into consumption, and the infected fruits were naturally thrown away by householders. The result was that later on in the season, during energetic inspection, Mediterranean fruit-flies were found breeding in peaches in several small gardens on the Hill at Napier, and in both peaches and tomatoes near Blenheim, in the South Island.

All infested fruit found was destroyed, and the ground under the trees or where infested tomatoes had grown was several times sprayed with kerosene. The same treatment was followed later in the season with a garden at Napier, where oranges on a single tree were found attacked. The inspection has been so strict that, as no other attacks have been discovered, it is reasonable to hope the pest has been controlled. This, however, cannot be ascertained with certainty till next fruit season.

Immediately it was ascertained that maggot-infested fruit had been passed at Auckland, the Hon. the Minister directed that the old arrangements be resumed—viz., that on discovery of infection the whole of the cases under that mark be immediately burned. This has been strictly enforced.

The following is a proof positive that the insect will breed in the colony :—

(1.) Two Mediterranean fruit-flies from fruit grown in Napier were placed in a breeding-cage on the window-sill of this office on 16th February; some sound peaches were placed in the cage. The flies began laying eggs almost immediately, and flies from the eggs laid hatched out on 12th March; a second generation appeared on 9th April.

(2.) A consignment of infested peaches grown at Napier was received from Hawke's Bay on 8th March, and a large number of Mediterranean fruit-flies hatched out on the 27th of the same month. Some fresh fruit was then placed in a clean breeding-cage, and flies bred from the above-mentioned consignment were placed in the cage with the fruit on 29th March. Flies hatched from the eggs then laid emerged on 30th April.

From the above it will be seen that the whole life-cycle, under ordinary conditions, is one month. In the winter, however, I have had the insect remain in the chrysalis stage for seven months and then emerge.

In this connection Mr. Boucher, Pomologist for the North Island, remarks,—

For some years there has been considerable controversy, especially in Auckland, as to whether fruit-fly will exist in New Zealand or not.

Those who have followed the history of the introduction of pests and legislation dealing with fruit and other pests into this and other countries will have noticed that the plausible argument as to inadaptibility to varying climatic conditions has frequently been adduced, with the result

in many instances of pests becoming introduced and permanently established before the growers had become sufficiently alarmed to take any steps to prevent them; for it must be remembered that the ordinary grower has not sufficient time to post himself so thoroughly in economic entomology to be able to detect any new pest that may make its appearance, so that until a pest has become established to such an extent that appreciable injury results to trees or fruits, or both, the pest passes unnoticed.

In protecting the fruit-growing interests of a country against the introduction of pests, insects, and fungi, it may be taken as a general rule that where a fruit will thrive all the pests that are known to attack that fruit will also thrive. There are, I know, exceptions to this rule, especially with regard to the degree of severity with which fruits may be attacked by pests under varying climatic conditions, but the exceptions are not sufficiently numerous or important for serious consideration, as against the urgent necessity for preventing the introduction of fresh troublesome pests which must necessarily increase the difficulty and expense of fruit-production, and place another burden on the shoulders of our fruit-growers.

After our experience lately, the argument of nonadaptability to climatic conditions, especially with regard to the fruit-fly, will surely never again be advanced; and it certainly would not be if those who have held that opinion could realise the anxiety and worry that the outbreaks this season have brought upon those whose duty it is to endeavour to stamp out the pest before it is too late.

Mr. Blackmore, Pomologist for the South Island, reports,—

The marked feature of the season, apart from the prevalence of the codlin-moth, is the discovery of the fruit-fly in peaches from several trees in a small orchard at Springlands, near Blenheim. On this discovery being reported to the Department I visited the orchard, according to instructions, and examined the fruit still remaining on the trees. The principal portion of the crop had been harvested, but fortunately had not been distributed outside the district. Fruit-fly maggot was found in several peaches which I gathered. I next visited several small gardens in the same street. The peach-trees growing in these gardens consisted of from one to half-a-dozen small to medium-sized trees. An examination of the fruit was made, with the result that about 1 per cent. was found to be affected with fruit-fly maggot. I at once took prompt measures to stamp out the pest. With the assistance of the Orchard Inspectors, and the cooperation of the owners of the trees of each orchard or garden, the whole of the fruit was gathered and boiled, and the soil beneath the trees and extending for some distance beyond was sprayed with kerosene.

The Orchard Inspectors were instructed that wherever fruit-fly maggot had been discovered, they were to keep each place under continual observation, and to carefully examine all fruit in the gardens of the adjoining districts. A week later fruit-fly maggot was found in two peaches from a tree growing in a small garden not far from the first, and on the following day Mr. Rabbits reported having found fruit-fly maggot in tomatoes. As soon as possible I inspected the plots of tomatoes, and as doubt had been expressed respecting the nature of the maggots found in the tomatoes, I made careful investigations, and found that many of the tomatoes lying on the ground were infected with maggots of the common blow-fly, but at the same time I found tomatoes upon the plants that were undoubtedly affected with maggots of fruit-fly. With the willing assistance of the owners, a similar course as at Springlands was pursued; the whole of the

tomato-plants within the affected area, and the crop, were destroyed, and the ground was treated with kerosene. A careful inspection has been made by the Inspectors of the whole of the Blenheim district: each garden or orchard has been visited without finding further traces. I hope, therefore, that the visitation is confined to a small area only, and that the methods adopted to cope with it have been successful in stamping it out. As a further precaution one of the Inspectors has been instructed to keep the affected area and the adjoining districts continually under strict observation, and this work will be under my close supervision.

In reference to the report forwarded from Nelson to the Department that fruit-fly maggot had been discovered in fruit forwarded to the local office of the Department, I visited the garden in question, situated at Appleby. I was unable to find any trace of the pest, either in the fruit submitted for examination or in fruit gathered personally from the trees; nor could I find it in tomatoes anywhere in the Nelson District, although a careful examination was made of tomatoes growing over a considerable extent of country.

In the chief fruit-growing districts of Canterbury and Otago the orchards and gardens have during the whole of the fruit season been kept under close observation, further safeguarded by my writing early in the season to representative fruit-growers in each district asking them to be on the alert for the appearance of fruit-fly, and if anything of a suspicious character was noticed to at once notify me by wire. I am pleased to report that Canterbury, Otago, and Southland are free from the pest.

During the early part of the season there were discovered at Christchurch, in several retail fruiterers' shops, oranges affected with fruit-fly maggot. The fruit had just been received from the auction-marts, and had been picked over in Auckland and shipped south. You dealt with it personally.

Since 1897 the fruit-flies, especially the Mediterranean species, have spread rapidly over Australia and the South Sea islands and South Africa. Each year this area has increased. That it is also spreading in the south of Europe, its original home, is shown by the following article by Mons. A. Giard, which has been translated by my assistant, Mr. A. H. Cockayne:—

UPON THE SPREAD OF THE FRUIT-FLY (*Ceratitis capitata*) IN THE NEIGHBOURHOOD OF PARIS.

(By A. GIARD. *Comptes Rendus*, August 20, 1906.)

Six years ago I reported the unexpected appearance of a very destructive exotic dipterous insect (*Ceratitis capitata**) in the suburbs of Paris. At that time the insect was very rare, being observed in a few apricot-orchards in the vicinity of Courbevoie, and it would have been an easy matter to have hindered its acclimatisation. In such cases energetic measures taken at the commencement of an outbreak are generally quite efficacious. Take, for example, the way the Germans have on several occasions stopped the spread of the Colorado potato-beetle, and quite

* This is another name for the Mediterranean fruit-fly, but for the convenience of orchardists in New Zealand I have retained the original name (*Halterophora capitata*).

lately, acting on my advice, the market-gardeners of Argenteuil have conserved the cultivation of asparagus from the attacks of a fly, closely allied to the fruit-fly, namely *Platyparea pœciloptera*, which was threatening to become established.

With regard to Ceratitis my recommendations previously made have been in vain, owing to the indifference shown by the growers directly interested and the agricultural journals. However, the insect has insidiously increased its ravages, and at the present moment the results that I forecast in 1900 are in part realised. Peaches are now seriously affected in many localities around Paris, and immediate action must be taken if we wish to avoid disasters such as the fruit-fly has caused for many seasons past in the Cape of Good Hope.

The present note is written solely to sound a new alarm, as the combating of Ceratitis when once it becomes established is a very difficult matter. I have already indicated in my previous memoir the various methods most suitable to check this pest. There are still many lacunæ in our knowledge of the life-history of this insect, and it is very important to find out if it will become modified under our change of climate. (The changes that insects undergo under new environment are very considerable, and require to be studied with care, to find out if their manner of living varies also. A few days ago I received from Professor Parrott, New York, specimens of a Polydrosus, which turned out to be common *P. impressifrons*. Introduced into the United States, this species has become a serious enemy of the poplar, while with us it is looked upon as perfectly harmless.) Investigations are urgently needed to find out under what conditions Ceratitis hibernates, and it is very important to find out if this insect has not already formed a host of one of our native fruit-bearing trees, and which would account for the production of broods of this fly which appear before our domestic fruits have ripened.

All these questions can only be answered with the co-operation of growers, whose attention is only secured in the majority of cases when the pests that menace them can no longer be controlled by practical measures.

POISONED BAIT FOR THE FRUIT-FLY.

(By T. F. Dreyer, B.A., Assistant to Entomologist, Cape of Good Hope.)

The fruit-fly (*Ceratitis capitata*, Wied.), despite the serious losses which it inflicts on fruit-growers, and the consequent constant attentions of economic entomologists, is still one of the pests which can be controlled only to a very slight extent. Control methods that have been used in this country will be found discussed by the late Eastern Province Entomologist (C. W. Mally, M.Sc.), in the *Agricultural Journal* of December, 1904 (Vol. xxv, No. 6). These consist in the destruction of fallen fruit and in covering the trees with light cotton netting of ten meshes to the linear inch. In the same article Mr. Mally also suggests that poisoned bait might prove of value, and gives the following mixture as such a bait to be sprayed coarsely on the trees to be protected :—

1 lb. of arsenate of lead.
25 gallons of water.
5 gallons of treacle.

This mixture he found to adhere well, and also to remain soft enough for the flies to remove it readily. It was tried on various farms around Grahamstown by Mr. Mally in the season 1904–5, but his results were nullified by the great scarcity of the flies.

Mr. Mally's successor, Mr. W. R. Dewar, continued these experiments during the 1905–6 season. He commenced operations with a mixture composed of 1 lb. of arsenate of lead, 25 gallons of water, and 7 lb. of treacle, but found that when the water evaporated the film of treacle was too thin to allow the flies to remove it readily, he accordingly gradually increased the proportion of treacle till it reached 18 lb. This mixture he found to give the best adhesive results, and also to give a thick film of treacle which would remain soft for a considerable time. Owing to an invasion of fruit-moth in January, 1906, his results were not conclusive, but they were most encouraging. Afterwards, at Sunnyside, near Grahamstown, where the mixture was used, there was no trouble with the pest in the apples, while other farms all over the Eastern Province suffered more heavily, as regards apples, than they had ever done before; whole crops were in some cases ruined by the fruit-fly.

This season (1906–7) Mr. Dewar is continuing in Albany the spraying with the same mixture, but owing to continual rains his work so far has been nullified. He also mentions that the fly is very scarce in Albany this year again.

Poisoned bait for the fruit-fly seems also to have exercised the minds of entomologists in Europe. Professor Antonio Berlese, of Florence, Italy, has issued a pamphlet giving the results of experiments with the olive-fly (*Dacus oleæ*, Rossi), and he suggests that the same method may be sufficient for the fruit-fly. The following is a free translation of this pamphlet, for which we have to thank the courtesy of the acting Italian Vice-Consul :—

"It is a long time now since entomologists and fruit-growers . . . . first endeavoured to discover some satisfactory means of fighting the fruit-fly, but up to the present no practical results have been obtained. Quite recently the effect of special internal parasites on some of the Trypetids (fruit-flies) has been observed—as, for instance, in the case of *Hexamerocera brasiliensis* on *Ceratitis capitata*. For the present, however, only artificial means of fighting them need be taken into account. During the years 1903, 1905, and 1906 I had occasion to try, with excellent results, a method of combating the olive-fly (*Dacus oleæ*, Rossi). This method, already tried in 1903, consists in sprinkling the leaves of the plant to be protected, beginning during the period when the fruit is liable to be spoiled by the fly, with a poisoned sugary solution. This solution is made up by taking of honey 31 per cent., molasses 65 per cent., glycerine 2 per cent., and arsenate of potash 2 per cent. The mixture can be stocked indefinitely, and when required for use must be dissolved at the rate of 10 parts of the mixture to 90 of water.

"It is well known that when the flies appear on the wing their eggs are undeveloped and require, in order to be brought to maturity and made ready for laying, a period of about ten to twelve days, during which the flies must subsist on saccharine mixture, for which they are very greedy : they are made to eat it, and get poisoned before the eggs are laid. However, the poisonous substance, in order to be easily lapped up by the flies, must always be in a liquid state on the plants, and, from observations I made, it remains in that state for a fortnight, after which the operation must be repeated and the mixture again sprinkled on the trees. The same operation must also be repeated in case the mixture has been washed away by the rain.

"If the plantation of olive-trees to be saved is situated at a distance of a few kilometers from other plantations which have not yet been

treated, or if the treatment is general for a pretty entensive area, so that the possibility of a new invasion of the flies from the infested plantations can be prevented, there is no need for a second or third treatment; if it is not so situated, in order to save the produce the treatment must be continued until the olive-trees come to maturity. The quantity of solution to be sprinkled on each plant is about half a liter for each treatment [*i.e.*, about a pint.—Ed.].

"I have carried on the above experiments on 16,000 trees in three different localities, and have obtained absolute results, having succeeded in keeping sound until they were ripe all the olives on the trees which had been treated. This I did, although in the surrounding plantations the olives were maggot-eaten and destroyed as early as September. Since the mixture is very soluble, the autumnal rains, which fall generally a little before the gathering of the fruit, are sufficient to wash off the poisoned substance which was sprayed on to the olives. When, however, copious rains do not occur, it is necessary, before sending the olives to the press, to wash them in water in order to prevent any risk of poisoning.

"Considering that *Rhagoletis cerasi*, L., and *Ceratitis capitata*, Wied., are similar in their habits to the *Dacus oleæ*, Rossi, I believe that it is possible to fight successfully against the said flies, as also against other Tripedidæ, with the method employed by me in coping with the flies of the olive.

"I think it very desirable that, in regions devastated by cherry, fruit, or any similar flies, a trial be given to this method, which has given such good results against the olive-fly, introducing such modifications as experience would prove necessary, and not forgetting to inspect the fruit before gathering, so that, in case it should be soiled by the mixture employed, it may be submitted to a careful washing before being offered for sale."

In the Western Province this method would likely be of much greater value than it would be in the Eastern Province. In the former the summers are dry, and the mixture will not be washed off so quickly by the rains. In the Eastern Province, however, the winters are dry, and the mixture may then be applied to citrus trees to destroy the winter adults.

The mixture given by Berlese would be much more expensive than the one recommended by the Eastern Province Entomologist, and it is not probable that its efficacy will be correspondingly greater. It is however desirable that this mixture should be given a trial, seeing the great success Berlese has had with it, while in this country the work was still in an experimental stage. It is singular that in two countries a parallel line of experiments on such an important question should have been carried on without either party apparently knowing what the other was doing. Farmers who wish to try Berlese's mixture should do so with much caution at first, since the arsenate of potash is soluble, and might scorch the trees, especially as he recommends it to be used at the same strength as our arsenate of lead, which contains less than three-quarters as much arsenic, and that in an insoluble form.

The only objection to the adoption of the "poisoned bait" method would be the possibility of poisoning the bees: this question can only be settled by observation, and then only with difficulty.

Bees come to broken fruits very readily, particularly in the absence of flowers, and it has been observed in America that they get poisoned through feeding on spray-poisoned blossoms. But it remains to be determined if many would be attracted to small drops of poisoned, nearly or quite dry, sweet substance present on the foliage.

Any way, this method deserves a thorough trial, as against the possibility of poisoning some bees we have the certainty of killing large numbers of fruit-flies, since the latter eagerly lap up any sugary fluid which they come across. Parties who may experiment with either mixture are requested to report their results to the Government Entomologist.

In conclusion, I desire to record my appreciation of the way in which the members of my very limited staff responded to the call upon their already overtaxed energies. They spared neither time nor energy —worked cheerfully from daylight to dark—each realising that if this dreaded insect once established itself here it would mean ruin to the fruit-growing industry of New Zealand.

Codlin-moth Parasite (*Caliephialtes messer*).

Considerable attention has been directed to the discovery of a parasitic insect enemy of the codlin-moth. This insect was introduced to California, and appeared to promise well. The Department ascertained that, owing to unforeseen circumstances, the Horticultural Commissioner of California found it difficult to procure codlin grubs in sufficient numbers to breed up the parasites as rapidly as he wished. I therefore authorised Mr. Boucher to collect and despatch large consignments of each by the San Francisco mail-steamers. This he did with his usual energy and thoroughness. In exchange for this assistance the President of the State Board of Horticulture promised a colony of the parasites. As the Board has been requiring £1,000 from each country desiring parasites, the gift was an extremely generous one, and the thanks of the colony are due to Mr. Elwood Cooper, the President, and the Horticultural Board for the gift.

Mr. Boucher was later despatched to California to report on the progress of the fruit industry since he left that country, and to bring back the colony of parasites. His instructions, dated 9th April, 1906, were,—

Visit to California.

Adverting to our conversation of the 30th ultimo, in which I desired you to prepare to leave for California, I have to request your attention to the following instructions:—

1. You will proceed to California by the mail-steamer leaving Auckland on the 13th instant.

2. Take with you another shipment of codlin-moth grubs for feeding the parasites now being reared by Mr. Cooper, Horticultural Commissioner for California.

3. Arrange to bring back with you, if practicable, the colony of parasites promised by him.

4. (*a.*) Inspect typical orchards in California, and investigate any improvements or developments which have taken place since you left that country.