Fruit Flies

Bulletin No. 409

By D. C. SWAN, M.Sc.
Waite Agricultural Research Institute
University of Adelaide

Issued by Dept. of Agriculture, South Australia, February, 1949

FRUIT FLIES

By D. C. Swan, M.Sc. Waite Agricultural Research Institute,
The University of Adelaide.

Introduction

FRUIT flies are among the worst pests of cultivated fruits, and cause serious loss of production in most of the principal orchard areas of the world. They are major pests, for instance, in New South Wales, Queensland, and Western Australia.

Until recently, no fruit flies of economic importance occurred in South Australia. In the summers of 1947 and 1948, however, two distinct kinds of these insects were found to be firmly established in relatively small patches in certain Adelaide suburbs; limited recurrences of each kind have been found this summer (January and February, 1949).

All cases met so far have been restricted to fruit grown in suburban back-gardens, and no instance of spread to commercial orchards has been detected. A campaign is in progress to stamp out all traces of these insects, while they are restricted to few localities in the suburbs of Adelaide. Failure to do so will result in their spread to the main orchard districts of the State, where their establishment would impose a serious handicap to fruit production; decreased output and higher operating costs would result inevitably. Adverse effects on export markets, and on backyard fruit cultivation are also certain.

To bring this campaign to a successful conclusion, it is essential that all occurrences of these insects should be recognized promptly, and reported. In this the co-operation of the public is essential. They already rendered invaluable service in many ways to those carrying out the difficult task involved.

In this leaflet information is given that will assist landholders to recognize fruit fly damage; details are also given of the life history, habits, and economic importance of these insects.

The Fruit Fly Family

The name "fruit fly" is in the strict sense given to members of a single, rather distinctive family of true flies known as Trypetidae. They are small insects, usually not as large as house flies; they are readily recognized by the specialist by a number of characters. There are some thousands of different kinds. Most fruit flies have mottled or banded wings, which are carried outspread; some species raise and lower them rhythmically while walking about. A characteristic feature of the family is the possession by the females of a sharp, tubular ovipositor, by means of which eggs can be laid into fruits. As the name suggests, most of these flies breed in fruits; not all members of the family have this habit however. Many kinds breed only in the seed-heads of flowers of the daisy family (Compositae); the maggots of many other species tunnel in leaves or buds of various plants, while others again inhabit plant galls that form as a result of their presence.

Fruit flies occur in all countries of the world. Most kinds have quite harmless habits, and attract no attention. A number of species select commercial fruits for breeding purposes, however, and among these are included many important orchard pests. The so-called Mediterranean fruit fly, which is a native of Africa and which has been widely spread by commerce, ranks first among these. Few native Australian fruit flies have been found to attack cultivated fruit, but one of them, the Queensland fruit fly, is a serious pest in that State and New South Wales. These insects will be discussed in more detail later, as they are the species that were discovered in the past two summers in Adelaide. The other foreign pest fruit flies have been confined to their present limits by the plant quarantine regulations of the various countries of the world.

It should be added that there are, in addition to the family of true fruit flies, various other families of flies that resemble them in size and often in superficial appearance, both as larvae and adults. Members of some of these families may be encountered in Adelaide gardens. Most

of them breed in the soil, in decaying plant material; a few have maggots that feed in fruit. However, all such species are scavengers, invading fruit that has been damaged already by some other agency (for example, bird pecks, rain, hail, "split-stone," other insects); they never lay eggs into sound fruit as do fruit flies. They may invade fruit after the fruit fly has left it.

The ferment flies and the metallic tomato fly come into this category; they will be mentioned again in a later section. They are often confused with fruit flies and cause many false alarms; they are of no economic importance as far as the fruitgrower is concerned.

The Adelaide Outbreaks

Until two years ago fruit flies of economic importance were unknown in South Australia. In January 1947, fruit fly maggots were identified from a home garden in Glen Osmond. An intensive survey showed that backyard fruit was affected at a number of points through the suburbs of Unley, Fullarton, Glen Osmond and Glénelg, and within the city area proper (Angas Street). The insect concerned was found to be the Queensland fruit fly (*Strumeta tryoni* Froggatt). A campaign to eradicate this insect was at once undertaken by the Department of Agriculture (Horticultural Branch); this involved the removal and disposal of all fruit capable of serving as a breeding place, within a mile of any known infested situation, as well as other measures designed to kill any living adult flies in the locality. Detailed searches made since that time failed to reveal its survival at any point during 1948; a recurrence involving a single tree was located at Hawthorn in January, 1949.

In January 1948, an infestation by the Mediterranean fruit fly (*Ceratitis capitata* Wiedemann) was discovered at Goodwood, where it was strongly established in apricots. A second more extensive area of infestation was located at Wayville, while a single fly was caught in a trap near the south-east corner of the Adelaide city block. The same eradication procedures as those used the previous year were again followed. Details of the methods used, which are essentially those employed in the successful eradication of the historic Florida outbreak of 1929-30, are given in a later section.

The results of the campaign have been checked by continuous search for signs of surviving flies. No evidence of their presence was found during the remainder of 1948; a single surviving focus of Mediterranean fly infestation was found on 14th January, 1949, in five neighbouring backyards at Wayville in an area that was heavily infested the previous year. This locality, and that associated with the infestation mentioned above, have been stripped of susceptible fruit, and the same measures will be applied as were used last year in attacking the problem.

A further infestation was located in February 1949, in two adjacent home gardens at Norwood; the fly concerned in this case is Queensland fruit fly.

The Life History and Habits of Fruit Flies

The life-cycle of the various kinds of fruit flies follows a closely similar pattern; the Mediterranean fruit fly can be taken as an example.

The female fly selects a ripe or ripening fruit. A small group of eggs (usually five to nine) is laid in an "egg-pocket" just beneath the skin (see Figure 1,B) by means of the ovipositor, which is capable of penetrating sound fruit. Several egg pockets may be found in a single fruit, and the same or different flies may later lay more eggs into the same pocket. The egg-laying punctures are sometimes called "stings." Fruit fly stings are not readily detected except by those with special experience. A depressed or discoloured area usually forms around the puncture within a day or so, and a gummy exudation sometimes flows from it.

The eggs hatch within a few days in summer and the tiny maggots burrow inwards. In stone fruits they usually feed close to the stone; in citrus fruits they may damage only a segment of the flesh, or if numerous, destroy all the flesh. They can live in the pulp-layer of relatively thin-fleshed fruits.

The maggots feed by rasping away the flesh of the infested fruit with their hooked mouthparts. The fruit is invaded by decay organisms—bacteria, yeasts, and moulds—which may reduce the part in which maggots are feeding to a mushy pulp. In firm-fleshed and partly ripe fruits, the flesh may remain dry; the maggots produce a characteristic network of tunnels, which is shown in Figure 3. A notable feature of fruit fly damage is that the fruit usually appears

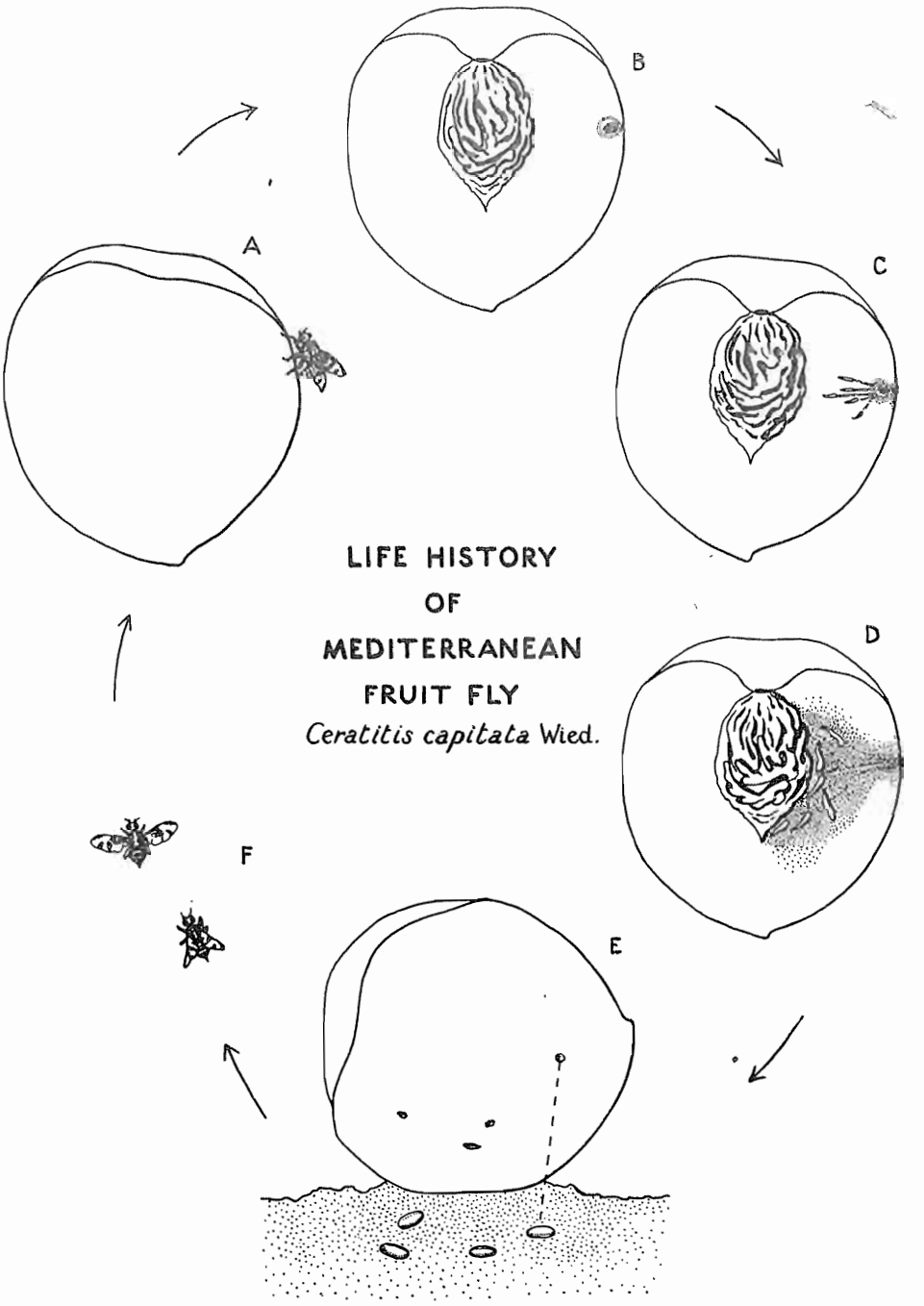

Fig. 1.—Life-cycle of the Mediterranean fruit fly.

A. A fly pierces the skin and lays a group of three to 10 eggs.

B. The eggs lie in a pocket beneath the skin.

C. The eggs hatch and the young maggots burrow inwards.

D. Advanced stage of feeding, showing internal breakdown of the fruit. There may be a discoloured patch around the egg-laying puncture, but otherwise the fruit appears sound externally.

E. The fruit may fall before the maggots emerge, or may remain on the tree. In either case, the maggots cut their way out, drop to the ground, and transform to pupae in the top soil.

F. After a period of 10 to 20 days in summer, adult flies emerge from pupae in the soil. They return to the shelter of foliage, in which they live for some days before beginning to lay eggs.

sound externally, even when severe internal damage has taken place.

In warm weather maggots complete their development in 10 to 12 days; they then burrow out of the fruit and enter the soil to pupate. Heavily-infested fruit usually drops before the maggots leave it (Figure 1, E). In many cases, maggots may leave it while it hangs on the tree; the exit holes can often be found in such cases. Premature fruit-drop should be regarded with suspicion, as being a possible indication of the presence of fruit fly.

Pupation usually takes place in the top inch of soil, though penetration as far as six inches has been reported. Pupae are light brown, shining, seed-like structures, about three-sixteenths of an inch long. They remain in the soil for varying periods, depending on temperature. Under average summer conditions this stage lasts 12 to 14 days; in winter it may last 25 to 50 days.

When transformation to the adult condition is completed, the fly breaks its way out of the pupal integument, and works its way to the soil surface. It is capable of forcing its way through surprising depths of soil, and may emerge when the pupa is buried two feet beneath soil of average texture. Simple burial is therefore not effective as a means of disposal of infested fruit; the most satisfactory method of sterilizing it is to boil it.

Newly-emerged flies return to the shelter of vegetation. They are strongly attracted to trees that are in flower; they drink nectar, and relish the sugary excretions (honey-dew) produced by scale insects and aphids. They feed also on the exudations from damaged or decaying fruits. Adult flies feed in this way for four to seven days before the first eggs are laid.

The length of the life-cycle varies greatly according to season. In mid-summer the combined duration of egg, maggot and pupal stage may be as short as 13 days, but usually is about 18 to 20 days. Allowing say, a week for the newly emerged female to become capable of laying eggs, it is clear that a generation in summer can be completed in less than a month. The above figures are based on available information relating to the behaviour of the Mediterranean fruit fly in other countries; it indicates that five or six summer and autumn generations could be expected under South Australian conditions. The adult fruit fly is relatively long-lived under favourable circumstances, an active life of many months being reported by some investigators. In Western Australia the time is stated to be 28 to 40 days in summer, and up to 65 days in winter. Since the female fly may lay some eggs every day, in a few weeks the offspring of early spring broods will be laying eggs alongside their parents, and it becomes impossible to distinguish a clear-cut succession of generations.

It will be apparent that this fly possesses a high reproductive potential, and that any unchecked occurrence among susceptible fruit can reach large proportions rapidly.

During the winter, the life processes of the fly are greatly lengthened by low temperatures. Adult flies probably survive well into the winter, as they are known to do in the somewhat milder winters of Western Australia; late-emerged flies (say in May) can there survive outdoors long enough to oviposit in early-ripening spring fruits, such as loquats, or in late oranges.

The winter is usually bridged in the following way:—maggots that grow slowly in late-hanging autumn fruits pupate in May; these pupae remain dormant through the low temperatures of winter and early spring, and the adult flies emerge to find loquats and other early spring fruits available for egg-laying. Their offspring represent the first summer generation.

The Economic Importance of Fruit Flies

All authorities agree that fruit flies are among the most serious of fruit pests, and the Mediterranean fruit fly is usually placed as the most destructive single pest of fruit. The Queensland fruit fly, which is still restricted to eastern Australia, and which has not become established outside Australia, is equally destructive where it occurs.

The losses that might be expected to result to all growers of fruit, should either of these insects become permanently established in South Australia, can be stated briefly as an indication of the reasons for undertaking an eradication campaign of the size and practical difficulty of that which is at present in progress.

The most serious loss results from fruit rendered inedible or unsaleable as a result of infestation. The main commercial crops are readily attacked by either or both of the two fruit flies in question; almost all kinds of fruits are attacked in some measure and may serve as breeding places, although in many of them the rate of infestation is not high. The most vulnerable crop is stone fruits, though citrus fruits, particularly grapefruit and Valencia orange may suffer severely. Pears are subject to heavy infestation, and apples are freely attacked by the Queensland fruit fly. Some fruit varieties

are blemished by the oviposition stings.

The percentage loss in uncontrolled orchards can be devastating, and may be so high as to make it unprofitable to pick the fruit. The loss is particularly high in suburban gardens, where effective control measures against fruit flies are difficult to maintain. Under these conditions, very large populations of flies may be built up, and few fruits are likely to escape infestation. It is usually found, in localities where fruit flies are permanently established, that domestic cultivation of vulnerable fruit crops is abandoned. In all such areas regulations to protect commercial fruit growing are imposed, which require the householder to spray his trees regularly and to dispose of infested fruit.

The commercial grower would also be inconvenienced by the fact that at the time of picking infested fruit usually appears quite sound, and does not show marked damage until it has reached market, the retailer, or the consumer. Much fruit is condemned after it has left the grower, due to the subsequent development of damage of this kind.

The cost of fruit production is increased considerably by the presence of fruit flies. The orchardist must maintain regular foliage bait spraying, and must pick up and dispose of all fallen fruit in the orchard. In spite of these precautions much commercial fruit is lost in bad fruit fly years.

Many export problems are raised by the presence of fruit flies. The most important of these is the loss of certain markets abroad in countries where the Mediterranean and Queensland fruit flies are not present. The State of South Australia has been able to export large quantities of fruit to them in view of its status as a fruit-fly free area. The most important market at present closed is the U.S.A., but in addition New Zealand, the East Indies, and the Philippine Islands are likely to be affected.

Many accounts have been published of the effects of fruit fly establishment on the horticultural activities of the affected area. The statement of Back and Pemberton* that follows, may be quoted as an example:—

"The Mediterranean fruit fly was discovered at Honolulu in the Hawaiian islands in 1910. Since that time it has spread to all the islands of the Hawaiian group, and because of the equable climate and abundance of host fruits, has effected a serious and permanent check to horticultural pursuits, and put an end to all export trade in fruits except that in pineapples and bananas."

The Eradication Programme

The campaign that has been undertaken in Adelaide is based on the known habits of the fruit flies concerned; it follows the general lines of the plan successfully used to deal with the Florida outbreak of Mediterranean fruit fly in 1929-30.

The United States of America has always guarded jealously its freedom from foreign fruit flies; this is maintained by rigorous quarantine measures. When a small occurrence of the Mediterranean fruit fly was detected at Orlando, Florida, in April 1929, immediate action to eradicate it was initiated. In view of its close bearing on the present situation at Adelaide, the following account is now given of the extent of the Florida problem, and of the manner in which it was attacked.

Direction of the campaign was assumed by the United States Department of Agriculture. A distinct organization was set up to carry out the work, with departments of Inspection, Prevention of Spread, Labour and Equipment, Publicity, Permits, and others, and a Research Section with divisions of Host plants, Insecticides, Identification, Traps, Baits, etc. An immediate appropriation by Congress of four and a quarter million dollars was made, and subsequent appropriations up to the conclusion of the campaign brought the total expenditure to seven and a half million dollars.

Intensive surveys to discover the extent of fruit fly distribution were at once made; it was found that the insect was already established at a number of widely separated points. The State was divided into (*a*) *infested zones,* which included the area within one mile of any property on which infestation had been determined; (*b*) *protective zones,* which included the area within nine miles of the outside boundary of any infested zone.

In 1929 a host-free period was maintained during the summer. This involved the stripping of all soft fruits known to be suitable for fruit fly breeding, along similar lines to the present Adelaide programme. Prior to this period, the regulations required the shipment, destruction or processing of all ripe or ripening fruits growing within the protective zones, and prohibited the planting or growing of vegetables that would mature or reach the stage of suscep-

* Bulletin 536 United States Department of Agriculture 1918.

tibility during the host-free period. The only host fruits or vegetables permitted to grow or exist in the protective zones at any time were citrus fruits on trees in such stage of immaturity as not to be susceptible to infestation, and host fruits and vegetables in storage or on retail sale for immediate consumption. Robbed of fruits in which to lay their eggs and multiply, any carry-over of the insect would have to be by means of adult flies originating before the host-free period was inaugurated.

To prevent any carry-over of adult flies, poisoned bait sprays were used throughout the infested area. Small quantities were sprayed on the foliage of wild and cultivated plants at regular intervals. The extent of the Florida spraying programme during 1929 can be judged from the quantities of some spray materials that were used:—

Sugar	2,218,000 lb.
Lead arsenate	300,000 lb.
Molasses	375,000gall.

In modern bait spray formulas lead arsenate is usually replaced by tartar emetic.

Official forces sprayed as much as 110,000 acres a week, and roadside spraying amounted to the equivalent of one spraying along 18,500 miles of highway. To do the work of eradication the following machinery was employed:—

Trucks	187
Tractors	92
Sprayers	60

In one month of the campaign 6,300 persons were employed.

The area within which infestations of the fly were found was designated the "eradication area"; this embraced about 10 million acres (between 15,000 and 16,000 square miles). Within this area was located 72 per cent of the bearing citrus trees of Florida, or 120,000 acres of citrus and 160,000 acres of other fruits and vegetables. Almost exactly one thousand distinct occurrences of fruit fly infestation were found scattered through this area.

A year later two small recurrences were found, and these were again dealt with by the methods outlined above. Since then no further fruit flies were discovered, and this position has continued to the present time. The Florida campaign stands as the most notable example of the eradication of an insect; it was conducted in an area of intensive horticulture, in which the fly was widely dispersed at the time of its discovery.

The Florida achievement provides strong encouragement for expecting a successful conclusion to the present Adelaide campaign. The Adelaide occurrences involve a very much smaller area, but one which is all under close suburban occupation, instead of being in orchard country. The programme is therefore complicated by the scattered and irregular distribution of the fruit-bearing plants that must be dealt with, and by the great diversity of the kinds of plants cultivated; they thus provide an unbroken succession through the year of host plants suited to fruit fly breeding.

The measures adopted in the Adelaide campaign resemble closely those used in Florida; the following brief account indicates their nature and purpose.

Immediate removal of fruit within a quarter mile of each occurrence is intended to eliminate all maggots in the locality. The fruit is destroyed by dumping several miles out to sea, as being the most certain and convenient method available.

Adult flies are attacked by means of foliage bait-sprays. These consist of a solution of the following composition:—

Sugar	2½ lb.
Tartar emetic	2oz.
Water	4gall.

The spray is applied here and there on the foliage of fruit and ornamental trees; the flies find it in their movement about the trees. It is not necessary to apply it uniformly, which represents a considerable economy in labour and materials. It may be added that the spray is not poisonous as far as humans are concerned, and fruit on which it has fallen can be eaten with confidence. As a precaution it should be washed under running water before eating.

A further valuable weapon against fruit flies has been supplied by the new insecticide D.D.T. It has been used for dealing with such problems as heavily-fruited kaffir apple hedges, which it is impracticable to strip. Heavy and repeated D.D.T. spraying of inaccessable fruit-bearing plants can be expected to make them uninhabitable by fruit flies.

Stripping serves two main objectives; first to remove infested and possibly-infested fruit, so preventing the ultimate emergence of a further brood of flies; and second, to establish a host-free area extending to the maximum flight-range of the adult flies. The latter precaution means that flies which may already be present in the soil as pupae, or adults that escape bait sprays, will find no fruits into which eggs may be laid.

The available information from all sources indicates that a flight range of a mile is exceeded only under rare circumstances; this distance was selected by the directors of the Florida campaign as a basis for determining the area in which eradication measures should be taken, and it has been adopted in the Adelaide programme.

Early maturing fruits such as loquats, and late-hanging citrus fruits, play a vital part in the survival of any flies that emerge in spring from winter pupae in the soil. It is particularly important that any such flies should find no ripe or ripening fruit within their possible flight range, in which to lay eggs. One of the objects of stripping is to ensure the removal of all fruits coming within this category.

Figs provide a hazard of a different kind, in that some may hang on the trees until well into autumn. They provide a favourable situation for maggots, which develop slowly in them and pupate in the soil in early winter. The removal of figs is therefore important in preventing fruit flies from bridging the winter.

The list of fruits attacked by Queensland or Mediterranean fruit flies is remarkably extensive, and few kinds of fleshy fruits escape at least slight attack. While the damage many kinds sustain in permanent fruit fly areas is not commercially important, they serve as breeding places in which a few maggots may complete their life cycle. When the objective of a campaign is *eradication* rather than *control,* it becomes necessary to remove all fruits that will in the slightest way provide a means of survival of any flies.

The progress of the campaign is followed by means of regular inspections. This involves the examination of new-season fruit in the outbreak areas and elsewhere for maggots, and the search for adult flies by means of traps and other methods. Glass traps are maintained at localities where infestation has at any time been discovered. Many hundreds of thousands of insects of many kinds have been caught by these traps; their catches are examined for the presence of fruit flies.

The fruit fly eradication campaign is being carried out by the Horticultural Branch of the South Australian Department of Agriculture, to whom enquiries should in general be addressed. Information on entomological aspects of the campaign has been provided by the Department of Entomology, Waite Agricultural Research Institute, University of Adelaide.

Recognition of Fruit Flies

The presence of fruit flies in a locality is most easily detected by the damage caused to fruits by the maggots. The general effect of their presence in stone fruit is shown in Figure 2. Damage of this kind is extremely suspicious, if white or creamy maggots are found, and if the fruit appears sound externally.

The maggots taper towards the head end, but no clearly defined head can be seen with the unaided eye. Fruit fly maggots can jump when placed an a dry surface; this is done by curving the body in a circle, and then flicking it straight again. By this means a jump of perhaps twelve inches can be made. It is not a character found only in the fruit flies however; the maggot of the metallic tomato fly, mentioned later, also jumps in this way. The best characters for identifying fruit fly maggots can be seen only with the microscope. The two posterior openings by which air is taken in lie flat on the body surface, unlike those of the ferment fly, where they lie on distinct prominences. The maggot stages of both the Queensland and Mediterranean fruit flies resemble each other very closely in habits and appearance; they are however readily distinguished from other maggots by means of the microscope.

Fruit flies have earned much of their evil reputation because they attack sound fruit; when the skin is unbroken, few other insects attack it in South Australia. There are however, some insects that occur among fruit and which may produce effects that resemble fruit fly damage.

Of these the commonest is the caterpillar of a small moth related to codling moth, known as the light-brown apple moth. This caterpillar is found commonly on all fruit trees, and chews shallow grooves on the surface of green and ripening fruit, usually where they touch a leaf, twig, or another fruit. Copious gum-production often follows their damage. Inside a split fruit feeding is accompanied by masses of pellet-like droppings.

Sometimes these caterpillars tunnel more deeply, especially in plums. Their damage is usually superficial however, and heals over. If deep enough, fungal and bacterial rots may invade the fruit, causing it to break down. This

caterpillar, when found in such surroundings, is often suspected to be a fruit fly maggot. It is however, pale green in colour, with a well developed head, and has the habit of wriggling violently when touched. The codling moth caterpillar is sometimes found in stone fruits, when it causes rather similar damage.

Ripening fruit may be damaged in a variety of ways that enable rots to get a footing. Of these, bird-pecks, "split stone," splitting after rain, and light brown apple moth damage are the commonest causes in suburban gardens. Fruits in this condition are invaded by various flies; when their maggots are encountered, there may be a strong resemblance to the effects produced by true fruit flies. Such flies are, however, scavengers; they do not attack sound fruits, but follow up injuries already present. The immature stages (grubs) and adults of certain beetles, particularly those known as fruit beetles, also occur in decaying fruit.

The commonest invaders of damaged fruit are the ferment flies. The small brown flies can be seen wherever fermenting fruit is present. Their maggots soon swarm in damaged fruit; they are however, much smaller than mature fruit fly maggots, and differ from them in carrying the two posterior breathing apertures on a short projecting tube.

The metallic tomato fly, as its name suggests, commonly invades tomatoes. It lays its eggs in tomatoes damaged by birds, cutworms or by splitting. It often lays eggs in damaged orchard fruits while they are still on the tree. As mentioned earlier, its maggots jump in a similar fashion to the true fruit flies, and may easily be mistaken for them. Certain other fly maggots are met from time to time in fruit. To be certain of the kind involved in any case, it is necessary to submit the fruit for examination; their identification requires the aid of a microscope.

Fig. 2.—**Peach, showing full-grown maggots of the Mediterranean fruit fly, and the nature of the damage caused. The fruit appears sound externally. The dark marginal areas represent red-coloured sound flesh.**

Little has been said about the recognition of adult flies. This is because the chance that they will be encountered by members of the public is extremely small. Under present circumstances very few indeed of these flies are likely to be on the wing in Adelaide. In the past three summers during which outbreaks have been found in Adelaide, not a single specimen has been caught by a householder. All authentic cases of

fruit fly infestation have been recognized from the characteristic damage to fruit produced by the maggots. All the many insects submitted for identification as possible fruit flies have been other insects. The only adult fruit flies caught in this period have been taken in glass traps by officers of the Department of Agriculture, on properties where infested fruit had previously been found.

The adult Queensland fruit fly is about the size of a house fly; it is a pretty, wasp-like insect, with a dull reddish body, marked on the thorax with bright yellow patches. It is well illustrated on the poster that has been displayed widely in connection with the campaign.

The Mediterranean fruit fly is rather smaller, more thickset in form, and does not closely resemble the Queensland fly in appearance. The general colour of the thorax is black; of the abdomen, orange, with two dark transverse bands. Each wing has three cross bands of orange on a clear background.

It is desired to stress, however, that fruit flies are almost invariably brought to notice by recognition of the characteristic damage to fruit. This damage is most often detected in stone fruit.

The chief suspicious features are—(*a*) the premature falling of fruit (though this does not always take place); (*b*) the presence of white or creamy maggots in *apparently sound* fruit.

Dissemination of Fruit Flies

It has already been mentioned that the Mediterranean fruit fly is a native of the African region; it has been spread by commerce to many of the important fruit-growing areas of the world that are suited to it. It was recognized at Perth, Western Australia, in 1897, and at Sydney, New South Wales, a year later. In each case it was thought to have been introduced with shipments of oranges consigned from Mediterranean ports. This fly soon became widespread in orchard districts; it remains to the present day the chief pest of fruit in Western Australia. It was regarded as an equally serious problem in New South Wales, but was there gradually supplanted by the Queensland fruit fly.

The latter insect is a native of Queensland and northern New South Wales; it appears to have spread southwards, and during the past twenty years or so has replaced the Mediterranean fruit fly wherever the two flies came into contact. The Mediterranean fruit fly is now a rare insect in New South Wales. Nothing has been gained by the substitution; the Queensland fruit fly is equally destructive, and has, if anything, a greater range of preferred host fruits. The Queensland fruit fly has continued to spread southwards, and is now established as far as the Gundagai district, which is approximately in the latitude of Adelaide. Recent reports indicate that it has also appeared at a number of localities in the extreme easterly corner of Victoria.

The Mediterranean fruit fly is now established throughout the principal stone-fruit and citrus growing areas of Western Australia; the Queensland fruit fly throughout similar districts in Queensland and New South Wales (except the inland areas of low natural rainfall where fruit is grown under irrigation). Fruit obtained from any of the above areas may carry the eggs or young maggots of fruit flies; modern travel facilities enable travellers to bring infested fruit to South Australia before the maggots have matured and left it. If such fruit is found to be inedible on arrival at a destination in this State, and thrown away, the larvae are likely to survive and produce adult flies.

From what has been said about the known distribution of these two fruit flies in Australia, the following conclusions can be drawn about the origins of the two Adelaide outbreaks:—first, the Queensland fruit fly was introduced with fruit that originated in Eastern Australia; second, that in view of the rarity of the Mediterranean fruit fly in the area just mentioned, it is highly likely that it was introduced in fruit from Western Australia, where this fly is common.

Commercial fruit cannot be imported into South Australia from fruit fly areas within or outside Australia, with the exception of bananas, pawpaws, and some similar fruits which must arrive in South Australia in green unripe condition. This latter provision ensures that fruit which is admitted must have been so unripe at the time of harvesting as not to be liable to fruit fly attack if grown in areas where these are established.

Inspection of all fruit entering the State is carried out by officers of the Department of Agriculture; this inspection is very detailed in the few types of tropical fruit permitted entry from Queensland or New South Wales.

In seeking to analyse the way in which such infested fruit could reach Adelaide while still bearing the immature stages of fruit flies, it is inevitable that the development of air travel should be blamed. It is undoubtedly important, and the risks are obvious.

It has been pointed out, however, in an earlier section that the maggots require about ten days to complete their development at usual summer temperatures; they do not leave fruit until mature, and ready to pupate. There is thus a period of at least ten days during which fruit remains infested; in that time journeys by train could be completed between Brisbane, Sydney, or Perth, and Adelaide. Finally, the motorist must be regarded as a possible carrier of infested fruit. The fruit fly infested areas of New South Wales are not more than three days distant from Adelaide by car; the long-distance motorist is perhaps most likely of all travellers to carry fruit during his journey. He may dispose of damaged fruit along the roadside near his destination, or at his own home after arrival; emerging fruit flies could find favourable conditions for survival close at hand.

It will be noted that emphasis is placed on the risk of introducing fruit flies by means of eggs or maggots contained in fruit. The maggots normally pupate in soil, but may do so in luggage or wrappings, and flies could emerge from such places in due course. In general it is believed that the risk of transport of adult flies is extremely small. They prefer the shelter of foliage, and are unlikely to stray far enough in the open to reach an aircraft standing on an airfield, and to survive a flight in sufficient numbers to establish themselves at the other end. The most important means of spreading fruit flies long distances in Australia is undoubtedly by the carriage of fruit by travellers.

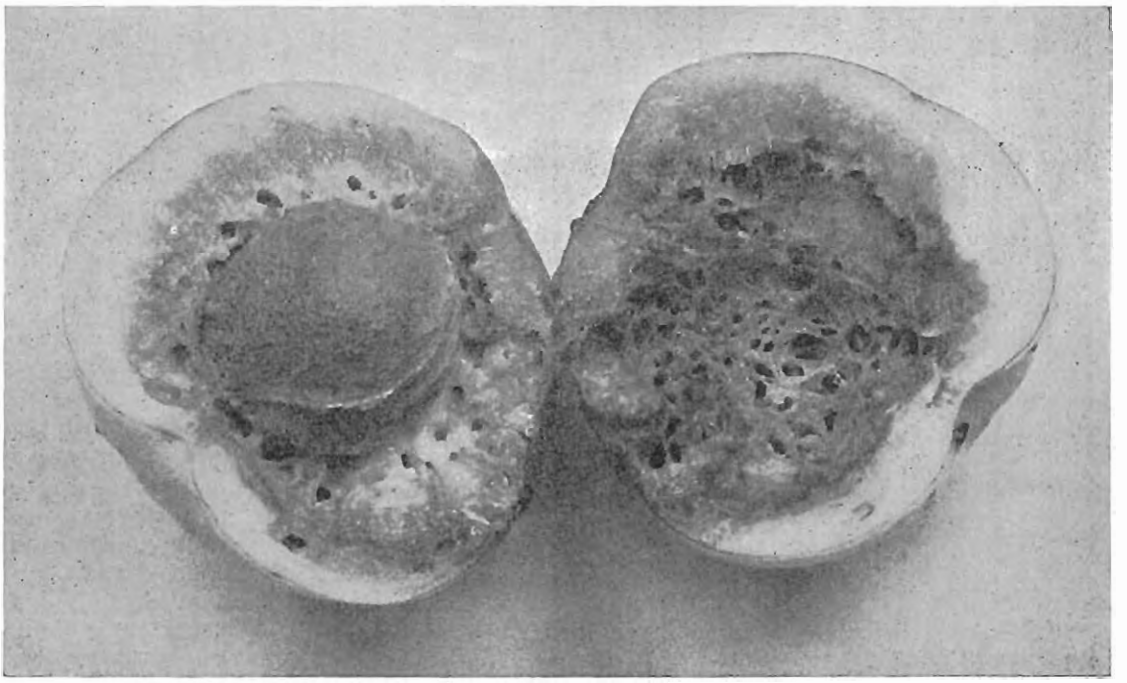

Fig. 3.—**Damage to apricot by Mediterranean fruit fly. The fruit was firm and under-ripe. Maggots had already left it. Note spongy nature of damage.**

It is therefore very desirable that every traveller to South Australia should know the risk that exists of introducing fruit flies, if fruit obtained in either Western Australia, Queensland, or New South Wales is carried with him. Regulations to prevent it are in force, but are difficult to police, and are often broken by those in ignorance of them. The best protection against further importations of these insects (and of other serious pests not yet known in South Australia) lies in public awareness of the risks involved. It is a safe rule

never to carry fruit into the State from outside its borders.

A certain amount of movement of fruit in small lots takes place into South Australia by postal transmission; it involves risks of the same kind as those just stated, though it is usually intercepted by postal inspection services.

Once fruit flies have become established in a new favourable locality, they are spread within it by two agencies. The first is again the movement of infested fruit, either as gifts, or as fruit for sale. There is also a possibility that they might be transported to another locality in the course of garbage disposal by municipal authorities that do not incinerate refuse. Suspected fruit should be boiled before it is disposed of in this way.

The second means of dispersal is by flight movements of the adult flies. This appears to take place from tree to nearby tree, and accounts for the expansion of individual centres of infestation. However, active flight to considerable distances is known to occur as a response to attractive scents; the flowering of certain trees, such as citrus, may cause a movement of adults in this way. Wind dispersal is of some significance, and turbulent winds are believed to move flies to distances of a mile or even more. Few observations bearing on this point have been reported from countries where fruit flies are permanently established.

Summary and Conclusions

Two species of fruit flies have gained a foothold in Adelaide. All available information indicates that they are confined at present to three small areas, one at Wayville, one at Hawthorn, and one at Norwood in the southern and eastern suburbs of the city. No evidence has been obtained of their occurrence in other parts of the metropolitan area, or elsewhere in the State. This view is supported by the results of extensive searches made during the past three years, and by the examination of large numbers of samples of suspected fruit, and of insects submitted as suspected fruit flies.

Most of the inspection and survey work has been done by officers of the Horticultural Branch of the Department of Agriculture; they have also maintained a large number of sampling traps by which the appearance of fruit flies on the wing could be detected.

An important contribution to the progress of the campaign has been made by members of the public. Many thousands of specimens of fruit and insects have been received by the Department of Agriculture and the Waite Institute; these have come from all suburbs of Adelaide, and from most fruit-growing areas in the State. With the exceptions already described, however, none of this material has yielded evidence of the presence of fruit flies.

The continued interest and support of the public will be essential to bring the present campaign to a successful conclusion, and to guard against the introduction of fruit flies elsewhere in the State. In these matters early detection of any infestation is most important; this depends in a large measure on the individual user of fruit. Official inspection services are concerned mainly with commercial fruit, and cannot deal with the large amount of domestic fruit produced in South Australia. It is therefore most desirable that any fruit showing damage resembling that described in this article should be referred for examination to the address given at the end of this pamphlet.

It has been pointed out that the present campaign has as its objective the eradication of the fruit flies concerned; their restricted distribution at the time of their discovery, and the heavy cost to the fruit industry that would be entailed by their permanent establishment, made the decision to undertake such a campaign the only reasonable one. The details already given of the biology of these insects show the basis for the various steps in the programme.

The most difficult phase in such a campaign is the concluding one, when eradication is almost complete, and the remnants of the original population are being sought out. The final success of such a campaign depends on the elimination of these scattered survivors. If they escape, their normal rate of increase may be expected to restore their numbers quickly to serious proportions. Should they then become dispersed into other districts, the task of eradication may well be too great for the labour and financial resources available. The Adelaide campaign may justifiably be said to be at present at this stage.

For the above reasons, the campaign must continue to depend on stripping of fruit along the lines prescribed, on spraying with D.D.T. and foliage baits, on the prohibition of movement of fruit in, or out of, the affected areas, and on the removal from such localities of fruits ripening early in the subsequent summer. The

task involved in carrying out this programme is extremely difficult; it is complicated by the fact that the outbreak areas are heavily populated, and by the abundance and variety of the fruits grown in backyards. Not only do these provide a difficult stripping problem; they also provide a complete succession of fruits suitable for fly breeding. Another difficulty experienced has been the shortage of labour available for the work of the campaign.

The campaign to the time of writing has, as far as can be determined, achieved the following results:—Outbreaks of two distinct species of fruit flies, distributed widely in various Adelaide suburbs, have been reduced to three small centres; no evidence has been detected of their spread to other suburbs, or to the orchard districts of the State.

The gratitude of all producers of fruit, great or small, has been earned by those who have been charged with the conduct of the present campaign. If it is successful, it will take a high place among the rare instances of successful eradication of a newly-established insect pest; it will confer direct and lasting benefits on all fruit producers. The public at large will gain also by being spared the higher prices and relative scarcity of fruit that could be expected if fruit fly became permanently established. It has been pointed out, however, that the greatest economic advantages would be those resulting to the horticultural industry, one of the State's major primary industries.

Identification of Suspected Material

Insect specimens should be enclosed in small containers, with packing such as cotton wool or tissue paper, to prevent damage in transit. Full details of the locality and date at which any specimen was obtained should accompany it.

It will greatly assist in the progress of the present campaign if all cases of suspected fruit fly are reported, and the damaged fruit submitted for examination. It will be sufficient to place the specimen in a screw-capped jar. It should be sent as promptly as possible to:—

The Horticultural Branch,
Department of Agriculture,
Victoria Place, off Wakefield Street,
Adelaide.

Telephone: Cent. 684. (Postal address—Box 901E, G.P.O., Adelaide).

K. M. STEVENSON, GOVERNMENT PRINTER, ADELAIDE.