

April 1935] *Fruit Flies and Their Economic Importance in S. India* 127

flourishing villages in the neighbourhood; and there are at present only three streets with three hundred houses. The people are too poor to take any interest in cultivation and much less in fruit growing.

It is but natural that when a Royal family shows some interest in any particular occupation, the people also take interest in it; such was the state of affairs in Sathgudh during the period of The Muhammadan rulers.

It is however gratifying to note that one ryot has planted a small area of about an acre under orange in the village last year. It is hoped that this will be a forerunner to many others who may renew the old reputation of the place by extending the area and that it may again be the chief centre of producing good fruits.

The writer acknowledges with thanks the encouragement and suggestions given by Mr. M. Kanti Raj, Assistant Director of Agriculture, Vellore, in preparing this article.

FRUIT FLIES AND THEIR ECONOMIC IMPORTANCE IN S. INDIA *

By T. V. RAMAKRISHNA AYYAR, B.A., Ph. D.,
(*Entomologist, Madras Agricultural Department*).

In a tract like South India where the benefits of a liberal use of fruits in the daily dietary of our households has not yet been sufficiently appreciated as in many western countries, neither the cultivation of fruit crops nor the study of the diseases and pests they are subject to has received that serious attention which such problems deserve. It is needless to add that fruit trees are as much subject to the attentions of insect pests as are many of our staple food and other cultivated crops and if one takes some little trouble to estimate the loss caused by insect pests to our fruit trees, it will be found proportionately as substantial as is the loss caused by pests of paddy, cotton and other field crops. Among the various insect pests attacking fruit trees those popularly known as "Fruit flies" occupy a very important status in all the fruit growing areas of the world. In this province, though we find different kinds of these fruit flies attacking various fruits and damage to crops is generally realised, we have hardly any previous records on the biological or economic aspects of South Indian fruit flies excepting a few references of a taxonomic nature. In these days of quick and easy transportation facilities between different parts of the world, insect pests of different kinds have more frequent and easier opportunities of getting dispersed from place to place and, in many cases, undesirable insects get admission into areas where they

* Paper presented to the Agricultural Section of the Indian Science Congress, Calcutta, 1935.

were unknown before; among such forms fruit flies play a very important role. As such, it is believed that, some knowledge of the general features and habits of these insects might be of help to fruit growers not only in South India but also in most fruit growing areas of other provinces in recognising a fruit fly pest when it appears and to adopt prompt measures to control the same. Though attention has been previously paid to these insects by the writer occasionally since 1907, a closer study of the insects was taken up only recently and in this paper are briefly presented the results of an investigation on the general features and habits of the fruit flies noted so far in South India indicating at the same time some methods to control them accompanied by an annotated list of the species of fruit flies so far recorded from this province.

General features and life history of fruit flies. Though among scientists the term 'fruit flies' is a well recognised and accepted term for these insects, a more suggestive and apter designation for them would be "fruit maggots". Every fruit grower and almost every layman is familiar with the whitish fleshy worm-like maggots often found inside healthy fruits like mangces, guavas, etc., and knows how these maggoty fruits are unfit for consumption and do not command a sale in fruit stalls. These creatures belong to the family Trypanidae of the insect order Diptera (two-winged flies) and the maggots boring into the fruit are the young ones of the active flies—popularly known as fruit flies. Of course, numerous minute flies are very often found hovering about various damaged fruits and decomposing vegetables and some maggots are also seen in the rotting mess; but these flies or maggots are not the real pests referred to in this paper but they are only scavengers following up rot or decomposition and do not visit sound and healthy fruits. Though fruit flies more or less resemble the domestic fly in their fundamental build and external structural features, belonging as they both do to the same order, the former are entirely different in structural details, form, color and life habits. These flies are generally short, stout built and pretty looking; they generally have the wings banded or mottled and the body has a brownish or darkish color often with markings of brown and yellow. The head and thorax bear prominent sharp bristles which are often of great taxonomic value. The male shows four and the female five segments in the abdomen; the latter has a horny ovipositor often long and conspicuous. In size, some are as big as the housefly while there are a few which are bigger or smaller. In their habits they are invariably vegetable feeders, attack healthy fruits and pass the greater part of their early life inside the host fruit. The adult fly is generally found hovering about the host plant feeding on the sweet fluid inside various flowers; it does not do any direct harm to fruits. The life history of these fruit flies is more or less similar in most cases. Small cigar-shaped

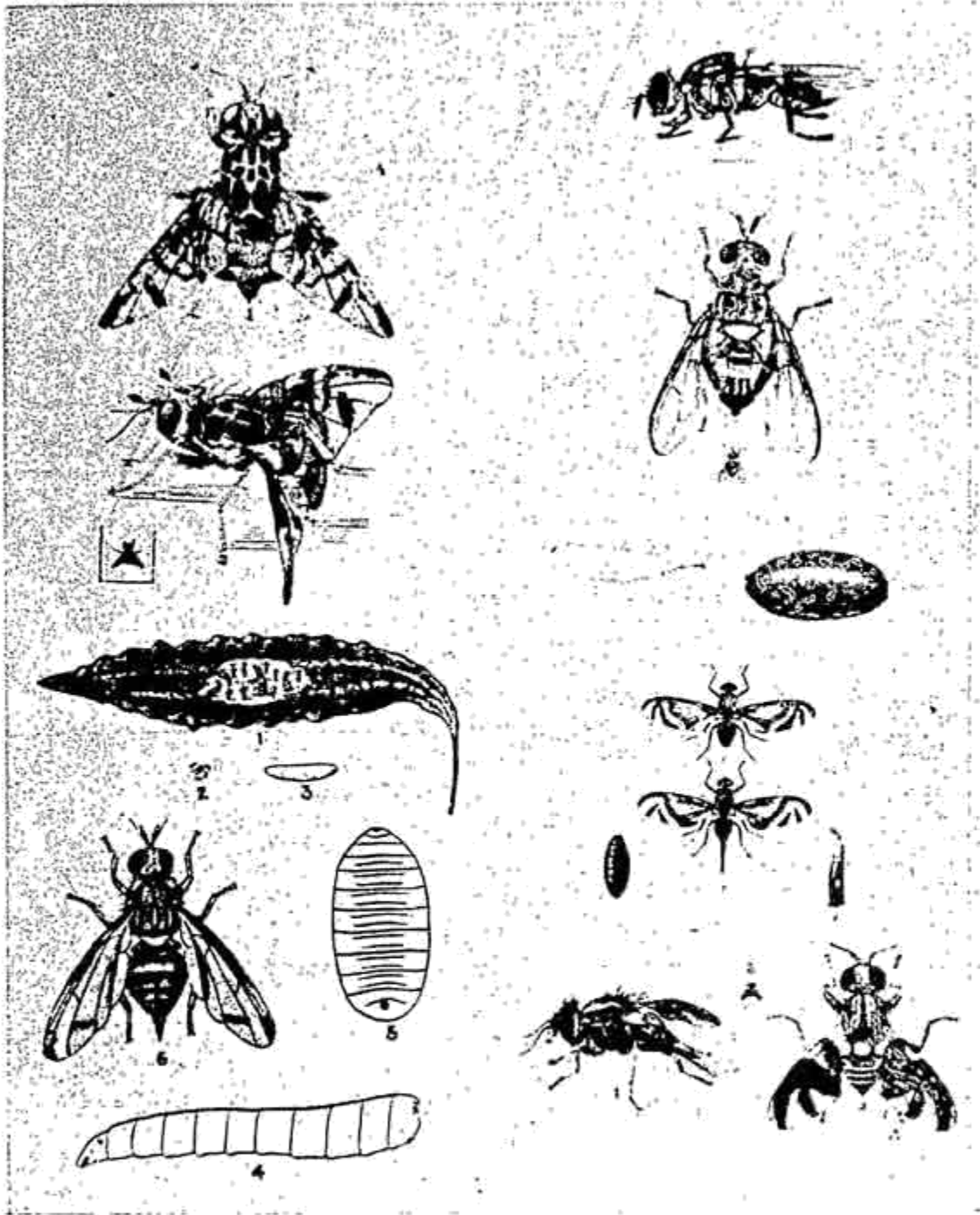
whitish eggs are thrust by the parent fly just under the rind of ripening fruits with the help of its needle-like ovipositor. The fine punctures thus made on the fruit surface become closed as the fruit ripens and an infested fruit generally appears quite sound externally until the time when the fruit gets badly bored and drops down rotting. These eggs inside the fruit hatch (which takes just three or four days) into the maggot stage and the maggots start feeding on and burrowing into the pulp of the fruit. The maggots generally vary from whitish to yellowish or brownish white according to the color of the fruit pulp they feed on; these smooth cylindrical worm like larvae are footless and measure about $\frac{1}{2}$ " to $\frac{5}{8}$ " in length. They have a pointed head and a truncated posterior end and the former shows the dark mouth parts. The larvae of many fruit flies often exhibit the peculiar habit when exposed, of bringing the two ends of the body together and jumping high into the air. The just hatched maggots inside the fruit at first feed on the surrounding tissue and gradually approach the centre, by which time the infested area quickly spreads as a putrid mass and, in many cases, causes the fruit to drop; this latter contingency varies with different kinds of fruits and their inner consistency. When the maggot is full fed it finds its way out and drops into the soil for pupation; this is generally the habit of all fruit fly maggots. The soft larva changes into a barrel shaped seed like pupa of hard consistency and has a brown or yellowish brown colour; this pupa remains in the soil until the adult insect flies out of it. Ordinarily, one generation of the fly from the egg to the adult stage takes about a fortnight or three weeks though, in certain cases, the pupal stage may be found to occupy longer periods. Due to various seasonal and other factors the insect does sometimes suffer mishaps; many maggots may not hatch due to lack of the necessary temperature especially in cold weather; many maggots may fail to reach the soil to pupate and a good many pupae may not be able to emerge as adults from the soil due to unforeseen changes in the soil conditions such as heavy rains, flooding, hardening, etc. In spite of all these possible factors, their fecundative and rapidly multiplying powers, their protected condition inside fruits away from insect enemies and safe against insecticidal operations, help these creatures to maintain their important status as major pests.

South Indian fruits subject to fruit maggot attack. As a rule, fruit flies are found distributed chiefly in the tropical regions being found abundantly in Asia and Africa. They are fewer in Europe and America. In S. India we have a variety of fruits attacked by fruit flies. These fruits subject to fruit fly attacks can be brought under three important categories, viz., those consumed as fruit, those used as cooked or green vegetables and a third set including wild fruits not used for edible purposes. Under the first category--edible fruits, we have the mango, guava, jak, sapota, peaches, custard apples, loquat, oranges, *Zizyphus*, *Eugenia*, melons of all kinds, plums, perisimmon and pomelos—

all of them being commonly subject to fruit fly attacks. Coming to the second category, viz., fruits used as cooked or uncooked vegetables, we have the brinjal, tomato and cucurbits like bittergourd, snakegourd, bottlegourd, ribbed gourd, cucumber, etc. Of these, bitter gourd and cucumbers often get severely attacked in vegetable gardens. Under the third group which includes wild fruits, we have so far found fruit flies breeding in fruits of sandal (*Santalum*), *Calotropis*, *Coccinia*, *Alangium*, *Cephalandra*, *Nux vomica*, *Garcinia* and *Careya arborea* and the writer has reared a fruit fly from tender bamboo shoots also; it is very probable that many other wild fruits harbour fruit flies of sorts. Of the edible fruits in which we have not as yet met with fruit flies in S. India, the most important are the banana, figs, papaya, Bael (*Algoëfe*) and coffee which have been noted to be subject to fruit flies in other countries. In speaking of the food plants of South Indian fruit flies, though we find that some of the common species are found breeding on more than one kind of fruit, there are a few which have been found to confine their attention to only a single food host; well noted examples of these latter are the two species of fruit flies, one found on the *Calotropis* and the other on the *Zizyphus jujuba* fruits; these two have not been found so far on any other fruits. The melon or cucurbit fly also shows a marked partiality for cucurbitaceous fruits.

Economic status of fruit flies. Among insect pests of fruits, fruit flies occupy a very important position; for, unlike some of the other pests of fruit trees in S. India—like the mango hopper, the citrus caterpillar, the pomegranate butterfly, etc., which are specific pests confining their attentions exclusively to one or other of the various fruit crops, many of these fruit maggots attack a variety of fruits all over the world. And, unlike some of the other pests of fruit trees, Nature has endowed these creatures with some special facilities which make their depredations far more serious and comparatively difficult to check; for, these maggots bore into and remain inside fruits and as such, they are protected from outside and beyond the reach of any measures like spraying, dusting, etc.; their habitat also makes them comparatively immune to the attacks of natural enemies like parasites and predators once they are inside a fruit. In addition, they are also carried from place to place safely harboured in fruits both by human and other agencies. Their rapid multiplication and the capacity under ordinary circumstances, to pass through numerous generations in the year also help them to maintain their major status as fruit pests. Though we have no regular statistics of the loss caused by fruit flies in S. India, any one interested in this problem can easily get some idea of the substantial loss caused to fruit growers and sellers if he visits some of the mango and other gardens in Salem, Bangalore, Chittoor, Alamanda, Panayam, etc. In other countries like S. Africa, Australia and the Mediterranean region, the loss caused by fruit flies to oranges,

Plate I. Some notorious Fruit flies of the world.



Left top—Two views of the Mediterranean fruit fly (*Ceratitidis capitata*, W).

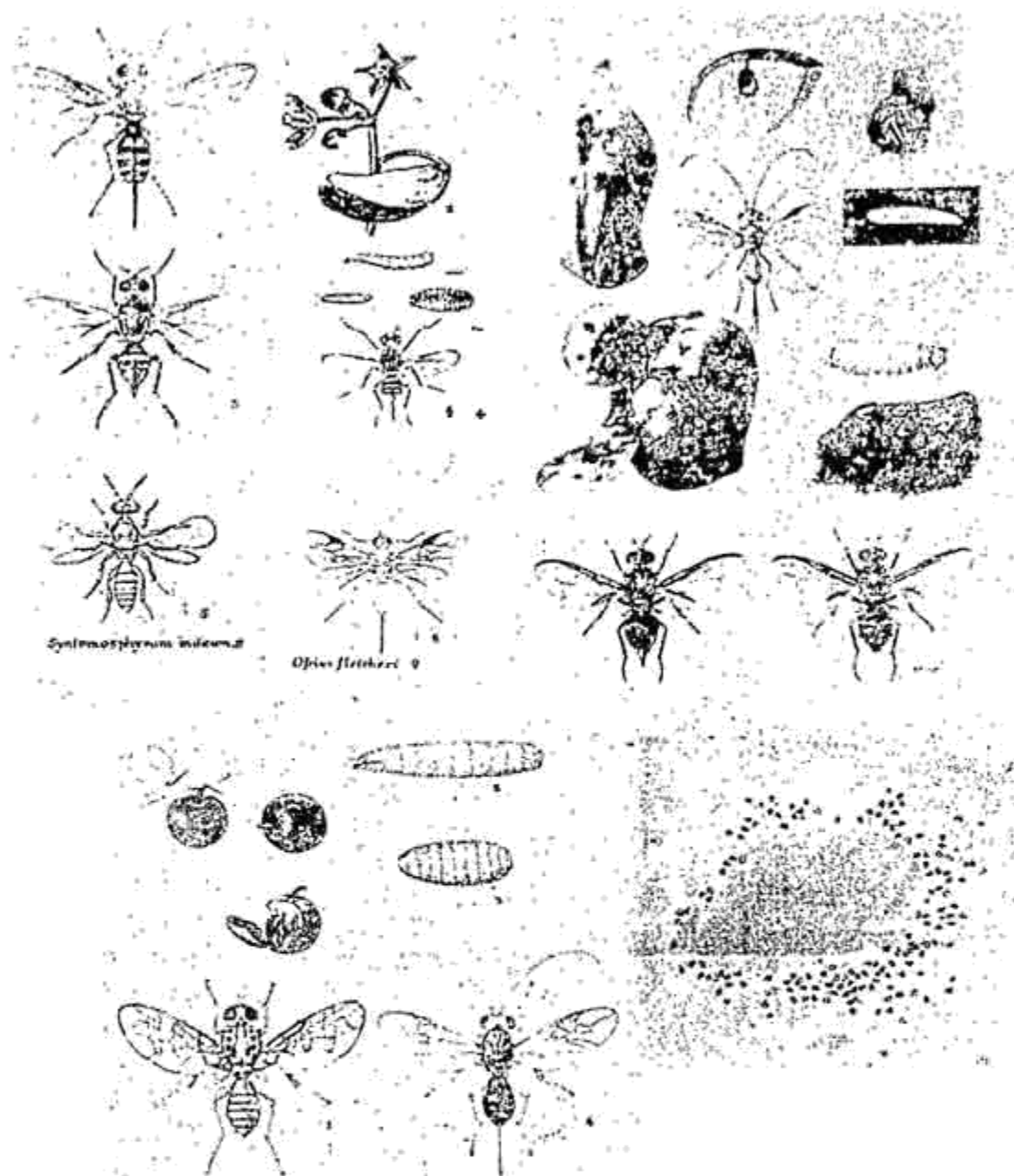
Left bottom—The Indian melon fly. Figs. 1 & 2—eggs in bitter gourd, fig. 3—magnified egg, fig. 4—maggot, fig. 5—pupa and fig. 6—fly.

Right top—Two views of the Queensland fruit fly (*Chaetodacus tryoni*, F), maggot and pupa.

Right middle—The Mexican fruit fly (*Anastrepha ludens*, L) male, female, maggot and pupa.

Right bottom—Two views of the American apple worm-fly (*Ragoletis pomonella*, R).

Plate II. Some Indian fruit flies and their parasites.



Left top—Fig. 1—The Calotropis fruit fly (*Dacus longistylus*, W), fig. 2—damaged Calotropis fruit, fig. 3—Guava fruit fly (*Chaetodacus incisus*, W), fig 4—different stages of the Three-striped fruit fly and figs. 5 & 6—two parasites fruit flies.

Left bottom—Figs. 1—3—Different stages of the Zizyphus fruit fly (*Carpomyia vesuviana*, Ac.) and attacked fruit, and fig. 4—parasite.

Right top—Different stages of the Mango fruit fly (*Chaetodacus ferrugineus*, F) eggs, maggots, pupa etc, damaged mango fruits showing eggs and maggots, a parasite and male and female flies.

Right bottom—Peach fruit flies attracted to Citronella oil (Chemotropism).

olives, peaches, etc., has been enormous as may be judged from the various strict control measures adopted by the Governments of these countries in connection with fruit pests; a reference to this is made in a succeeding para.

Control Measures. As stated above, these insects are borers and feed from inside the fruit; as such, control measures against these creatures consist almost entirely of prophylactic methods directed in the first place to prevent the parent fly from breeding and secondly not to allow the maggots in the affected fruits from emerging out as adults and starting a fresh generation. The more important of these preventive measures consist in keeping the fruit garden thoroughly clean and sanitary by the gathering of all fallen fruits and disposing them off either by deep burial, boiling or feeding hogs or domestic poultry with them when possible, by not marketing suspected fruit which would help in the dispersal of the pest and collecting or trapping the adult flies and destroying them.

In addition to such clean culture campaigns, the trapping and destruction of the adult flies is also done by using a poison spray; this latter generally consists of sweet syrup (molasses usually) mixed with some poison salt such as Sodium or Potassium arsenate often spiced with some fruit juice. These mixtures are sprayed over the foliage in orchards where the fly is a regular pest; the flies lap the droplets of the poisoned syrup and drop dead. It has also been found that substances like Kerosene, Clove oil, Citronella oil, Eugenol, etc., have also some attraction for some of these fruit flies. Howlett (1912) succeeded in attracting two species of Indian fruit flies (*Chaetodacus zonatus* and *C. diversa*) with citronella in Pusa; but all the flies attracted were found to be males. In S. India we have attracted different species of *Chaetodacus* (*ferrugineus*, *diversus*, *zonatus*, *correctus*, etc.) with citronella, clove oil, isoeugenol and ocimum flowers. The Mediterranean fruit fly (*Ceratitis capitata*) appears to have some attraction for kerosene. As far as we know, trials with attractive chemicals do not appear to have given very encouraging results anywhere since in some of these cases only the males are trapped, and not the other sex. It is believed that the male is attracted by some ingredient in these volatile oils which is exactly similar to the smell of its female mate and that this tropism is the result of a natural adaptation to bring the sexes together. Very little work, however, has been done so far in this interesting line.

In different parts of the world, enthusiastic entomologists have also attempted biological methods of controlling fruit flies with the natural enemies of these insects. In 1907, at the instance of the then Director of Agriculture, the writer made a tour of the different tracts like Cuddappah, Kurnool, Anantapur, Coimbatore, etc., to note fruit

flies and look for parasites; and as a result of this tour and later studies he has been able to breed a few of these natural enemies from the common fruit flies found on melons, guavas, zizyphus and mangoes (Ramakrishna Iyer, 1927). A list of the parasites so far noted on fruit flies in S. India is added to the list of fruit flies and given at the end of this paper. During the same year, the writer also helped the well-known Californian parasite collector Geo Compere to collect specimens of these parasites especially the small dark chalcid (*Syntomosphyrum indicum*, S.) which was described by Silvestri as a new species from guava fruits in Bangalore gardens and carry thousands of them alive to Australia. Unfortunately, the writer did not, however, have sufficient opportunities to make any serious trials with the natural enemies of fruit flies. Trials have been made in this direction in different parts of the world, especially in Hawaii, South Africa and Australia by enthusiastic and earnest workers; though such trials have added very considerably and substantially to our knowledge of the bionomics of fruit flies and their various natural enemies, there is considerable difference of opinion as to the real benefits derived from such methods in checking fruit flies—particularly because of the numerous complexities and varying climatic and other conditions which such biological methods have often to contend against. Prominent among those who have carried out work in this direction with great optimism is Professor Silvestri of Italy and his report on his expedition to Africa on behalf of the Hawaiian Board of Agriculture is a very substantial contribution to our knowledge of fruit flies and their natural enemies. Dr. Fullaway, another well known Entomologist from Hawaii, visited India in 1915 and took with him live specimens of the parasite *Opius fletcheri*, S. and has reported the attempts with this parasite as a success in checking the melon fly *C. cucurbitae* found as a serious pest in Hawaii. It might be interesting to note in this connection that—in spite of the work of its parasites—the cucurbit or melon fly is one of the worst fruit fly pests all over India. The Australian Entomologist Froggatt in his report on fruit fly studies, however, maintains the view that “while we succeed with parasites to a certain extent and in some instances for scale insects, aphids and even cutworms and other lepidoptera, yet under the present conditions of fruit growing, we will have to resort to other methods in reducing fruit fly pests.” Some years ago, the writer had the privilege of spending two days with Mr. Froggatt in Bangalore and getting some information regarding his ideas on pest control by parasites and the writer is convinced that there are numerous difficulties for one to depend on that method of control for fruit flies. There are thus two different schools of Entomologists as far as this question of biological control is concerned.

The parasites generally attacking fruit fly maggots belong chiefly to two or three groups of wasps of which the sub family *Opiinae* appears to include a greater number of representatives than others.

Observations made on these parasites so far go to confirm the views of previous workers, viz., that the egg of the parasite is deposited in or upon the host larva in one of its immature stages and the host larva assumed the pupal stage before it is killed by the parasite and the parasitic grub pupated inside the puparium of the fly and emerged as an adult wasp where the adult fly would have emerged. Thus the fly is killed in its pupal stage. The essential thing for artificial breeding of these parasites is therefore a plentiful and perpetual supply of parasitised puparia of the fly pest.

The Future Outlook Regarding Fruit Flies in S. India. Landed proprietors and persons interested in fruit culture are nowadays evincing some interest in the production of various fruits both indigenous and imported, and all over the country large areas are now being brought under fruit cultivation. It will be advantageous to these people therefore to possess some ideas of the possible troubles that may arise from different kinds of insect pests affecting fruit crops and the consequent need for taking early steps to check them. This is all the more essential in the case of important fruits for consumption which are particularly liable to carry fruit flies of different kinds. In this connection, it might be pointed out that, one of the undesirable foreign insect pests which we do not want in India, (Ramakrishna Ayyar 1919) is the notorious Mediterranean fruit fly (*Ceratitidis capitata*) and this creature has already invaded East Africa, S. America, Bermuda, Australia, Egypt and Palestine and it is perhaps only a question of time when it might get entry into India unless proper measures are taken to keep out this undesirable pest or the country and its conditions are exceptionally ceratitidis proof. It may also be added that the Government of India have recently forwarded to all the Local Governments a copy of a Decree which has recently been issued by the Governor-General of Indo-China regarding importation of fruits into Indo-China, especially in relation to this Mediterranean fruit fly. In the opinion of the writer, therefore, it is highly desirable in the interests of the fruit industry of the country that a regular survey of the fruit pests of the country is made so as to get some clear ideas as to what pests we already have in the country and which are the ones we have to guard against and that both external and internal quarantine regulations are promulgated by Governments to check not only the importation of infested foreign fruits but also to regulate the movement of infested fruit from one part of the country to another. We also know that there are plant diseases and quarantine regulations with special reference to fruit pests in many countries such as Canada, United States of America, Mexico, Australia, South Africa, etc. It is, perhaps, well known that fruit sellers from different parts of S. India are importing consignments of apples and other fruits from Australia and other countries where the Mediterranean fruit fly pest is found

and it is also found that parcels of apples, pears, etc., are got down even by post from Kashmir, Kulu and other Himalayan orchards where there is a chance of another undesirable pest—the San Jose scale (*Aspidiotus perniciosus*) lurking to be transported to the Southern plains. The Imperial Council of Agricultural Research has recently recognised the danger of the likely spread of this scale insect and has addressed the Madras Government suggesting that necessary measures may be taken to prevent the spread of this notorious pest. In a recent paper (Ramakrishna Ayyar 1933) the author has sounded a warning pointing out the danger of allowing undesirable plants and animals to enter the country and adding to our already existing troubles; this warning applies with special emphasis to some fruit flies and scale pests of fruits. It is therefore high time that proper precautions are taken to check such thoughtless and undesirable though often unconscious importations and the necessary quarantine laws introduced.

AN ANNOTATED LIST OF FRUIT FLIES AND THEIR PARASITES NOTED FROM SOUTH INDIA.

Of the various genera of fruit flies recorded from different parts of the world the most important ones from an economic point of view are (1) *Ceratitis* (including the notorious Mediterranean fruit fly *C. Capitata*, W.), (2) *Dacus* (including the olive fruit fly of Italy *D. oleae*, G.), (3) *Chaetodacus* (including some of the commonest Indian forms like the melon fly (*C. Cucurbitae*) fly, and the Queensland fly (*C. tryoni*), mango fly etc. (4) *Rhagoletis* (including the apple worm of America (*R. pomonella*), and (5) *Anastrepha* (including the Mexican orange worm (*A. ludens*, L). The following are the species noted from South India till now.

Family *Trypanecidae* Sub Family 1. *Dacinae*

This sub-family includes most of the common fruit flies found in this province. Of about nine or ten genera included in this group the genera *Dacus* and *Chaetodacus* appear to include some of the commonest of Indian fruit flies. No species of the genus *Bactrocera* have so far been noted from India though this name was wrongly used till recently for some species of *Chaetodacus*; the latter genus includes about eighteen Indian forms noted so far.

Dacus, F.

1. *Dacus (Leptoxyda) longistylus*, Wied. Found breeding in the fruits of the common plant *Calotropis gigantea* in different parts of the province. The fly has a dull reddish color with bright yellow bands on abdomen; the scutellum yellow; wings dusky brown narrowly along foremargin near apex. The female has a fairly long and conspicuous ovipositor; the fly is found to breed only on this host plant everywhere; it has been noted in different parts of Africa also in the same fruit. The Mysore Entomologist, T. V. Subramaniam, published an interesting note on the bionomics of this fly in 1916.

2. *Dacus brevistylus*, B. A small fulvous brown form with two large dark spots on the face. This is an African species and was first recorded from India from specimens in the Coimbatore collection reared from melons in the Ceded Districts; noted also on melons and *Cephalandra* fruits in Coimbatore.

Chaetodacus, B.

3. *Chaetodacus ferrugineus*, F. This species includes a few closely allied varieties though the different forms are often found in the same fruit. These

varieties are typical *ferrugineus*, and varieties *dorsalis*, *incisus* and *versicolor*, the two of the former having been previously described as different species. The typical *ferrugineus* form has a more or less uniform reddish brown body without any dark mesonotal markings. This has been noted on mango in Salem and Godavari, on orange in Kotagiri, Nilgiris, 5000 ft.; it has been attracted to Clove oil and Citronella oil in Godavari and Nilgiris. Previously noted as bred from Guava, Loquat, Pomelo and Peach in N. India and Burma.

4. *Chaetodacus ferrugineus dorsalis*, H. In this variety the head is red with dark spots. Bred from mango in Coimbatore. Noted on mango, chillies, pomelo, etc., in other provinces.

5. *Chaetodacus ferrugineus incisus*, W. This is a very common form and found breeding on a variety of fruits. It has a general blackish color. Noted breeding in mango in Coimbatore, guavas in Bangalore and Nilgiris and in tomatoes, oranges and plums on the Nilgiris. Found also on wild *Solanum* fruits in Coimbatore; was attracted by isoeugenol and citronella; found visiting *ocimum* flowers in Coimbatore and Nilgiris. It has been bred on Jak and *Careya arborea* fruits also from Coorg.

6. *Chaetodacus ferrugineus versicolor*, B. Very close to typical *ferrugineus*, F. Bred on mango in Coimbatore. Though it is possible to spot out the dark *incisus* variety fairly easily further structural studies have to be made with more material to clearly separate *ferrugineus* and the other two varieties *versicolor* and *dorsalis*.

7. *Chaetodacus zonatus*, Saunders. This species has been found to be synonymous with *persicae* of Bigot and *mangiferae* of Cotes. It is fairly small sized and of a uniform reddish brown color with yellow markings and only different from typical *ferrugineus* in the wing pattern. Noted on mango and *Eugenia* in Kistna district, Custard apple in Anantapur and on melons and *Hibiscus rosasinensis* in Bangalore, Nilgiris and Coimbatore; found attracted to Clove oil in Godavari. The writer has also collected the fly on the Bababuddin Hills, Mysore, 4,700 ft. It was also bred on *Careya arborea* fruits in North Malabar and Coorg. It is recorded on Bilva (*Aegle*) fruits from Coorg and in bottlegourd from Central Provinces.

8. *Chaetodacus correctus*, B. This species erected by Bezzi to rename a form which he named as *zonatus* in 1913 is very close to the latter but with some distinct differences in color and minor structural features. Bred from fruits of mango, guava, *Zizyphus*, *Murrayia* and sandal in Coimbatore and *Eugenia* in the Nilgiris; it was also attracted to Clove oil in the Nilgiris.

9. *Chaetodacus diversus*, Coq. This is known as the three striped fruit fly due to the striking yellow markings. The female has a fairly longer ovipositor compared to that of the other allied species; collected from Godavari, found on cholam leaf in Coimbatore and bred from mango in numbers in Bangalore. It was originally noted breeding on oranges. Noted by Shroff in bananas in Burma.

10. *Chaetodacus maculipennis*, Dol. A very distinct form with affinities to *diversus*; has four scutellar bristles. Fly collected on cholam in Coimbatore; appears to be a rare species in South India.

11. *Chaetodacus cucurbitae*, Coq. This is a very common and large species having a very wide distribution all over the tropics. It was first described by Coquillett from larvae in cucumbers in Hawaii (1899). It has a reddish brown color and the wings show fuscous markings. It is found breeding in all cucurbitaceae—chiefly bittergourd, luffa, cucumler and melons. This is the well known Indian fruit fly figured by Lefroy and Fletcher and is the commonest of the fruit flies attacking vegetables. It has also been reared from stem galls on *Coccinia* in Coimbatore and from *Nux vomica* fruits in Malabar. It is regarded as a very serious pest in Hawaii.

12. *Chaetodacus caudatus*, F. This fly was bred out from snake-gourds by the author in 1908 in Coimbatore. Recently noted to breed in *Coccinia* fruits in the Siruvani Hills, Coimbatore, 2,000 ft. was collected also from the Shevaroy, 4,000 ft. and from Taliparamba, Malabar. It is a large form different from many other species in having four scutellar bristles.

13. *Chaetodacus scutellaris*, B. Described by Bezzi from a single specimen collected by Fletcher from South Mysore in 1913.

14. *Chaetodacus bipustulatus*, B. General coloration is dark brown and the wings are hyaline with no dark markings. Very rare; only noted till now from Mysore and Nilgiris.

Mellesis, B.

15. *Mellesis nummularia*, B. A small reddish wasp like fly with an oval dark spot at apex of forewing; a rare species. It was found attracted to Clove oil in the Nilgiris slopes.

16. *Mellesis crabroniformis*, B. Originally described by Bezzi as *Monachrostichus crabroniformis* from a solitary specimen collected at Yercaud on the Shevaroy Hills, 4,500 ft.

Sub Family 2. Trypanecinae

This sub family includes, among others, the notorious Mediterranean fruit fly (*Ceratitidis capitata*, Wied.). This is a serious pest of fruits in various parts of the world and one which has always to be guarded against. Though it has not as yet been noted in India, we cannot say when it may enter India in the near future unless very strict precautions are taken.

Carpomyia, A. C.

17. *Carpomyia vesuviana*, A. C. This is a small yellow black spotted species with distinct cross bands on the wings. It is commonly found all over the province breeding in both wild and cultivated *Zizyphus jujuba* fruits and is a fairly serious pest on the cultivated long fruited variety in Kurnool and other districts, though occasionally found parasitised by small wasps. It is a well known pest of this fruit in the Central Provinces and Khare [1922] has written a paper on this insect. It is also known from the Mediterranean areas.

Stictaspis, B.

18. *Stictaspis* sp. A stout black spotted species with banded wings has been collected from the Western Ghats by the writer. Another fly was recorded by the writer from bamboo shoots on the Nilgiris. Both these appear to be species of *Stictaspis*.

Callistomyia, B.

19. *Callistomyia pavonina*, B. A reddish brown insect with distinctly banded wings; a single specimen collected in Samalkot, Godaveri.

Senior White [1924] records the following species also in his catalogue of Indian Trypanecidae in addition to the species noted above *Gastrozona melanista*, B., *Acidia fossata*, F., *Sphenella indica*, Sch., *Tephritis brahma*, S, and *Trypaena asteria* from different parts of South India.

PARASITES NOTED ON SOUTH INDIAN FRUIT FLIES

Opius fletcheri, Silvestri. Noted on different species of *Chaetodacus*. A medium sized glistening uniformly testaceous brown species. Very commonly found on the cucurbit fly (*Chaetodacus cucurbitae*).

Opius incisi, Silvestri. Similar to the above but with some dark markings on the abdomen; found on species of *Chaetodacus* attacking plums, etc., on the Nilgiris.

Biosteres compensans, Silvestri.

Biosteres persulcatus Silvestri.

Biosteres sp.

Trichopria sp.

Microbracon fletcheri, Silvestri.

Bathyanlax trypaniphaga, Ramakrishna. Found on *Chaetodacus* on *Alangium* fruits.

Bathyanlax carpomyiae, Ramakrishna. Found on the *Zizyphus* fly *carpomyia*.

Gahan, in his paper on Opiinae, is of opinion that the genera *Biosteres*, F. *Diachasmimorpha*, V., are the same as the genus *Opius*, W. The writer is also inclined to believe that Silvestri's *Bracon fletcheri*—a *Bathyanlax* is same or very closely allied to the writer's *Bathyanlax trypaniphaga*. Further studies are being made in this direction and it is the writer's idea to gather further material for a paper on the bionomics on these parasites.

The above list is by no means a complete one since, in the Coimbatore, collections, there are still a few which have to be studied and identified; nor can we say that we have collected all the fruit flies inhabiting South India.

The writer is indebted to the Imperial Institute of Entomology, London, for help in getting the identifications of many of the flies and parasites confirmed and for naming some doubtful species submitted to them. The published papers of Prof. Bezzi, the well known authority on these insects have also been used in the preparation of this list.

Literature Cited.

1. Ayyar, Ramakrishna, T. V. (1919) "Some foreign insect pests which we do not want in India"—*Agri. Journ. Pusa*, XIV.
2. " " (1921) "Some insects recently noted as injurious in S. India"—*Bull. No. 101, Imperial Dept. Agr. Pusa*.
3. " " (1927) "Parasitic hymenoptera of economic importance from S. India"—*Bull. Ent. Res. London*, XVIII.
4. " " (1933) "The economic danger in the introduction of some foreign animals and plants"—*Madras Agr. Journ.*, XXI.
5. Bezzi, M. (1913) "Indian Trypaenidae in the Indian Museum"—*Memoirs of the Indian Museum*, III (3).
6. Froggatt, W. W. (1908) "Report on a world tour in connection with fruit flies"—Published by the *New South Wales Department of Agriculture*.
7. Fullaway, D. T. (1919) "Control of melon fly in Hawaii by parasite introduced from India."
8. Howlett, F. M. (1912) "The effect of citronella on two species of *Dacus*"—*Trans. Ent. Socy.* pp. 412—418.
9. Khare, J. L. (1922) "Ber fruit and its fly pest"—*Bulletin No. 143 of Pusa*.
10. Senior White, R. (1924) "Catalogue of Indian Insects—Part IV Trypaenidae—*Government of India Publication*.
11. Silvestri, F. (1914) "Report on African expedition in search of fruit fly enemies"—*Bulletin No. 3 of the Hawaiian Board of Agriculture and Forestry*.
12. Subramaniam, T. V. (Mysore 1916) "Note on the *Calotropis* fly"—*Bombay N. H. S. Journal* XXIV, pp. 613—614.