

The Culicine Mosquitoes  
of the Indomalayan Area

Part I  
Genus *Ficalbia* Theobald

By  
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## Foreword

The name *Ravenalites* is at present invalid as its author failed to designate a type species. In order to validate it prior to its inclusion in the present paper Dr. Doucet has kindly supplied the following type designation :

Dans nos publications et la première description des nouvelles espèces de Moustiques<sup>1</sup> auxquels nous avons donné l'appellation générique de *Ravenalites*, *R. roubaudi*, *R. bernardi*, *R. jeansottei*, nous avons omis de nommer le génotype.

Comme génotype nous choisissons *R. roubaudi* Doucet.



<sup>1</sup> Doucet J., 1950. Les Culicines de Madagascar. Mém. Inst. Sci. Mad., Série A., IV, p. 39.

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## Preface

THE INDOMALAYAN AREA, as here defined, comprises Tenasserim, peninsular Thailand, Malaya, the Greater and Lesser Sunda Islands, Borneo, Celebes and the Philippines. The choice of the area to be covered has been governed by many considerations, among them the extensive survey work at present in progress in Malaya, the excellent taxonomic work carried out in the past in the Philippines and Indonesia and the necessity, for practical purposes, of excluding essentially Indian species on the one hand and essentially Australasian species on the other. The fundamental reason is, however, the essential homogeneity of the mosquito fauna of the area and the necessity, if it is to be properly understood, of treating it as a whole.

The mosquitoes of this area have never been monographed as such. The nearest approach to such a monograph was G. F. Leicester's "The Culicidae of Malaya" which was published in 1908 seven years after the appearance of the first volume of Theobald's "Monograph of the Culicidae or Mosquitoes" which may be said to have initiated the modern study of the group. It will be readily understood that this work is badly in need of revision. More recently numerous specialist papers have appeared, particularly on the mosquitoes of the Philippines and Indonesia. Many of these are excellent but they are limited in scope and require to be related to one another and to Leicester's pioneer work. No apology is needed for omitting the Anophelini since these have already been adequately monographed elsewhere. Nor is it necessary to attempt to justify time and labour devoted to the taxonomy of the Culicini. Their importance as vectors of human filariasis has long been known and is thrown into greater prominence by the possibilities for control inherent in the new insecticides and in the awakening conscience of the more privileged peoples of the world. Still more important is, perhaps, the growing realization that culicine mosquitoes are involved in the transmission of a whole series of virus diseases, some of them until recently quite unknown, others constantly being recognised as more widespread than had previously been suspected and yet others, it can scarcely be doubted, still awaiting discovery. The growing body of research on these and allied problems at once places greater and greater demands on the services of the taxonomist and provides him with more and more material for study. Before his work can bear fruit a basic necessity is the provision of a reliable system of classification at least down to the species group together with some indication of the degree of reliance which can be placed on the

current diagnoses of species and subspecies and a suggestion as to those problems which stand in most urgent need of attention. This it is hoped the present series of publications will provide. Finally it is not perhaps too much to hope that the present enormous expenditure of effort and resources on the control of the mosquito-borne diseases may yield as a useful byproduct new knowledge of fundamental biological interest. With this in mind Mr. Mattingly has included brief notes as to the biology of the various species together with references to publications from which further information may be sought. Mosquito studies, like other branches of science, have suffered in the past from at least some degree of over-specialization. It is to be hoped that some benefit may result from the application, as in the present case, of knowledge and experience gained largely in the study of African mosquitoes, to those of an entirely different area.

It is proposed to publish this work as a series of about thirty parts which are expected to be ready at six monthly intervals.

W. E. CHINA,  
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# The Culicine Mosquitoes of the Indomalayan Area

## PART I:

### Genus *Ficalbia* Theobald

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#### Synopsis

This is intended as the first of a series of papers embodying a revision of the Indomalayan culicine mosquitoes. The Indomalayan area, as here defined, includes the Greater and Lesser Sunda Islands, Tenasserim, peninsular Thailand, Malaya, Borneo, Celebes and the Philippine Islands.

#### Introduction

The boundaries of the Indomalayan area, as here defined, are shown in Fig. 1. It will be seen that it comprises Wallace's Indomalayan Subregion together with the Celebesian Subregion of Sclater and Sclater (1899) and the Lesser Sunda Islands. The eastern boundary passes between the Soela Islands and Boeroe (Buru). This boundary does not wholly conform to any of those commonly accepted by zoogeographers (see Scrivenor et al., 1943). It is purely pragmatical, being designed to exclude Amboina, Ceram and the Moluccas since these harbour rather a large number of species having Australasian affinities and not known to occur further west.

Brug and Bonne-Wepster (1947) noted that numerous oriental mosquitoes extend to the east of Wallace's and even of Weber's line and that, so far as this group is concerned, the boundary between the Oriental and Australasian regions is consequently somewhat blurred. As against this, however, their own figures show that west of the Moluccas the number of Australasian species falls very sharply indeed. Thus about 35 per cent. of the mosquitoes occurring in the Moluccas (including the Aroe (Aru) and Tenimber (Timor Laut) Islands) are classified by them as Australian while the corresponding figures for the

Lesser Sunda Island, Celebes and Java are only 10 per cent., 5 per cent. and less than 1 per cent. respectively.

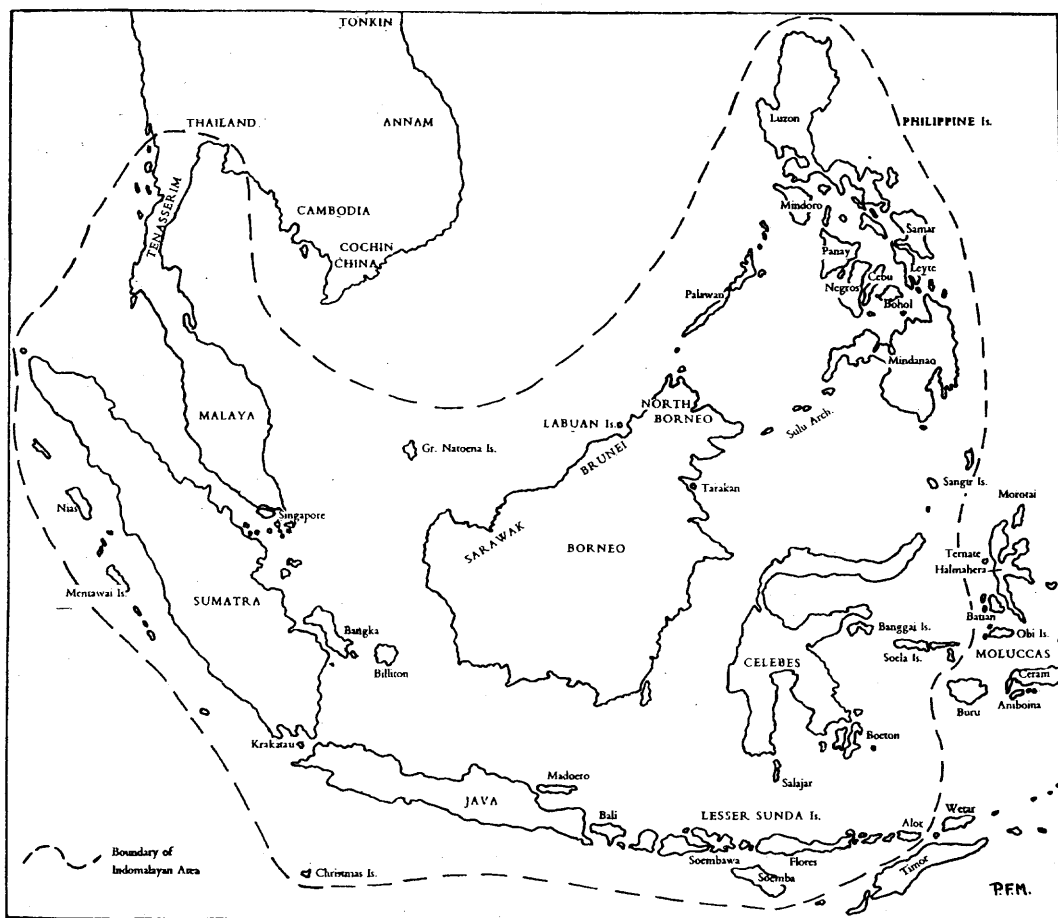


Fig. 1. The Indomalayan Area.

### Genus *Ficalbia*

*Ficalbia* Theobald, *Monogr. Culic.*, 3:296, 1903.

TYPE SPECIES: *F. minima* Theobald.

For synonymy see under subgenera.

This genus has recently been revised (Mattingly & Grjebine, in press). Four subgenera are now recognised. Three of these were recognised by Edwards (1932:110, 1941:74) but were defined by him mainly on characters used by Barraud (1929:1054) for the Indian

species and only of limited applicability to the genus as a whole. They have now been redefined, using other characters, and a fourth subgenus has been added. This is known as *Ravenalites* Doucet. It includes *Ficalbia fusca* Leicester and a new species from the Philippines described below for the first time. It also includes seventeen species from Madagascar, not all of which have as yet been described. The name *Ravenalites* is at present invalid since no type species has been designated. Monsieur Doucet has undertaken to validate it by designating one. *F. fusca* was originally placed in the monotypic genus *Dasymyia* Leicester (1908). This name has priority over *Ravenalites* but it is pre-occupied by *Dasymyia* Egger (1858:711).

The following Indomalayan species and named infraspecific forms of *Ficalbia* are here recognised.

1. *Ficalbia* (*Ficalbia*) *minima* (Theobald).
2. *Ficalbia* (*Ficalbia*) *ludlowae* (Brunetti).
3. *Ficalbia* (*Mimomyia*) *chamberlaini* (Ludlow).
4. *Ficalbia* (*Mimomyia*) *chamberlaini* var. *metallica* (Leicester).
5. *Ficalbia* (*Mimomyia*) *aurea* (Leicester).
6. *Ficalbia* (*Mimomyia*) *hybrida* (Leicester).
7. *Ficalbia* (*Etorleptiomyia*) *luzonensis* (Ludlow).
8. *Ficalbia* (*Etorleptiomyia*) *elegans* (Taylor).
9. *Ficalbia* (*Ravenalites*) *fusca* (Leicester).
10. *Ficalbia* (*Ravenalites*) *deguzmanae* sp. n.

The genus *Ficalbia*, as has often been noted, is defined mainly on negative characters. It is, however, an easy one to recognise and it should not be confused with any other except possibly *Ayurakitia* Thurman (1954) and the subgenus *Coquillettidia* of *Mansonia*. From both of these the subgenera other than *Ficalbia* s. str. are immediately recognisable by the character of the alula which is bare in *Mimomyia* and has a patch of broad scales in *Etorleptiomyia* and *Ravenalites*. The latter is further distinguished by having the squama also broad scaled (Fig. 2).

*Ficalbia* s. str. is distinguished from both *Ayurakitia* and *Coquillettidia* by the elongated basal joint of the female antennal flagellum, swollen male proboscis and short male palps (at most two thirds of the length of the proboscis and much shorter than this in all oriental species). All four subgenera are distinguished from *Ayurakitia* by the absence of a true lower mesepimeral bristle (see, however, p. 49). A good partial character is afforded by the broad plume scales on the wing of *Ficalbia*. These are, however, somewhat scanty in some *Mimomyia* while there are abundant broad scales on the wings of the north temperate *M. (Coquillettidia) richiardii* Ficalbi and *M. (Coq.) perturbans* Walker. In practice the group most commonly confused is, perhaps, the subgenus *Mochthogenes* of *Culex*.

That the resemblance to *Coquillettidia* implies a true phylogenetic affinity is suggested by the occurrence of certain striking resemblances in the larva and pupa, notably the modification of the larval siphon and pupal trumpet of some *Mimomyia* for piercing

subaqueous plant tissues (Fig. 6c, p. 14, 15, p. 40), lengthening of the second joint of the larval antenna in these species, reduction of the subventral tuft of the siphon in the same

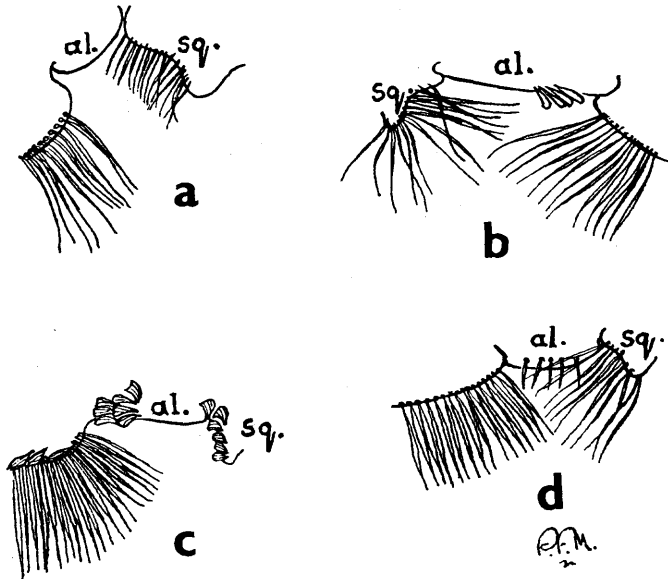


Fig. 2. Base of wing. a. *F. chamberlaini*, b. *F. luzonensis*, c. *F. fusca*, d. *F. minima*, al. Alula, sq. Squama.

species and in *Etorleptomyia* (Fig. 17a, p. 45), reduction of the dendroid seta (seta 1 of Belkin, 1952) of the first abdominal segment of the pupa of *Etorleptomyia* and *Ravenalites* (and of the Ethiopian *F. (Mimomyia) perplexens*) (Fig. 3a) and the form of the pupal paddles in a number of species.

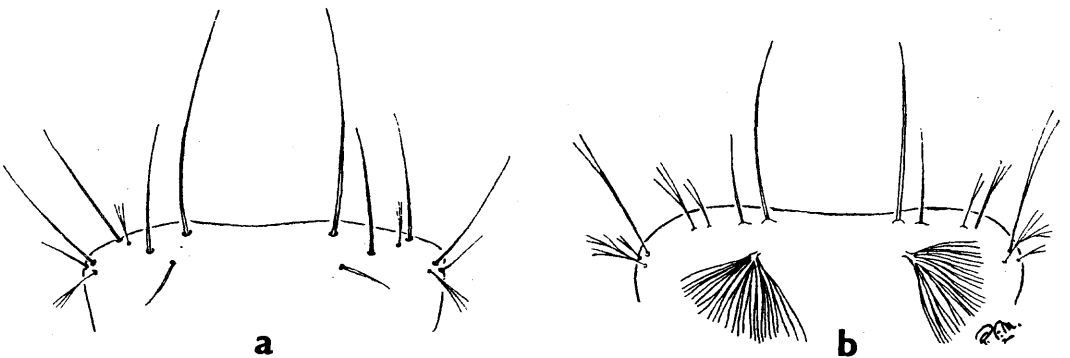


Fig. 3. First segment of pupal abdomen. a. *F. luzonensis*, b. *F. chamberlaini*.

The very numerous broad plume scales on the wings of nearly all *Ficalbia* distinguish these from all the tropical species of *Coquillettidia* but similar scales are present in abundance on the wings of the north temperate *M. (Coq.) richiardii* Ficalbi and *M. (Coq.) perturbans* Walker. It seems likely therefore, as on more general grounds, that the original causes of the divergence of these genera should be looked for in the alternate isolation and interpenetration of tropical and temperate fauna accompanying past climatic changes.

Variation in the larval siphon and in certain other larval and pupal characters has been discussed by Mattingly & Grjebine (in press). The existence of a piercing siphon, similar to that of *Mansonia*, in certain species has been noted above. A siphon of this type is found in *F. hybrida* and in the Ethiopian *F. pallida* Edwards. *Etorleptomyia* spp. also show a strongly tapered, though much longer, siphon with reduced valves and reduced subventral tuft. The Ethiopian *F. (Mim.) perplexens* Edwards is intermediate between the two and, very interestingly, this species shows the reduction of the dendroid seta on the first segment of the pupal abdomen which is found in *Mansonia* and *Etorleptomyia* but not in *F. hybrida*, *F. pallida* or other *Mimomyia*. *F. hybrida*, *F. pallida* and *F. perplexens* all have pupal trumpets modified for piercing but these are not found in *Etorleptomyia*. All these species, together with *Etorleptomyia* and *Ravenalites* lack the very long setae on the ventral valves which are found in normal *Mimomyia* larvae. In *Ravenalites* the shape of the siphon varies but in the oriental species it is reminiscent of *Etorleptomyia* (Fig. 22, p. 53).

The development of a piercing siphon in *F. pallida* and *F. hybrida* involves an obligatory association with *Pistia* or with certain other water plants (e.g. *Lemna*) with a floating habit and a similar association with such plants characterises certain species of *Ficalbia* s. str., though for a different reason. The only Indomalayan member of this group with known larva is *F. minima*. The larva of this species is characterised by the presence on the dorsal valves of the siphon of well developed articulated hooks (Fig. 11a, p. 28). The Ethiopian *F. malfeyti* Newstead, which has similar hooks, is also found in association with *Pistia*. These hooks are believed to be necessary for maintaining the tip of the siphon in contact with the submerged film of air on the undersurface of the *Pistia* leaf. Other *Ficalbia* s. str., e.g. the Oriental *F. jacksoni* Mattingly and the Ethiopian *F. uniformis* Theobald do not have them and these species are not associated with *Pistia* but occur instead among grass or other standing vegetation. The Ethiopian *F. (Mimomyia) splendens* Theobald has a similar siphon to that of *F. minima* and here the association with *Pistia* or *Lemna* is maintained. In other *Mimomyia* the siphon is longer and the association with *Pistia* is only partial although the hooks and the long setae on the ventral valves are retained (Fig. 12, p. 33). In *Etorleptomyia* the hooks are strongly developed and trifid though the long setae on the ventral valves are lost (Fig. 17, p. 45). In *Ravenalites* vestigial hooks are still retained, in spite of the change in breeding places, but they are very small and the long setae are lost (Fig. 22, p. 53).

The following are the diagnostic characters of the genus *Ficalbia*:

Adult female with joints of antenna slender; palps not more than one third of the

length of the proboscis; proboscis somewhat swollen at the tip; buccopharyngeal armature absent. Anterior pronotal lobes not unusually large; spiracular and post-spiracular bristles absent; true lower mesepimeral bristle absent (but see p. 49); base of meron well above that of hind coxa; postnotum without scales or bristles. Squama with a fringe of scales (these scales broad and very liable to loss by rubbing in *Ravenalites*); 6th vein reaching the posterior wing margin well beyond the base of the fork of vein 5; plume scales, in most cases, exceptionally broad. Tibial claw on front leg well developed (Fig. 4a, c) except in some *Ravenalites* and in the Oriental *Ficalbia* s. str. (Fig. 6d, e); last four segments of front tarsus together longer than the first segment; claws of all legs simple, pulvilli absent.

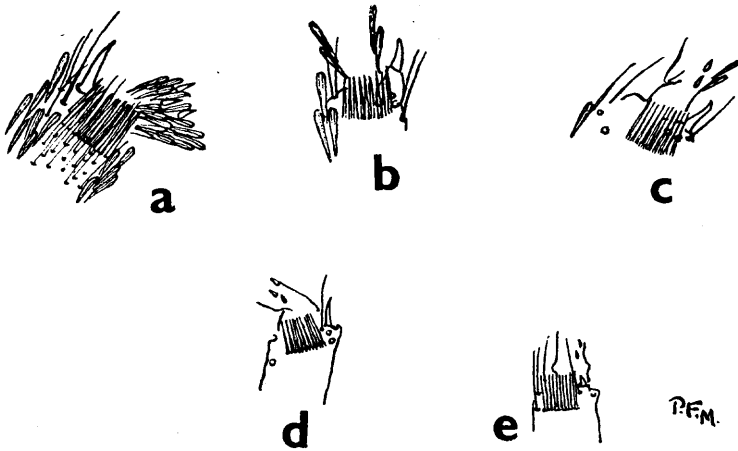


Fig. 4. Fore tibial claws. a. *F. chamberlaini*, b. *F. fusca*, c. *F. elegans*, d. *F. minima*, e. *F. ludlowae* (Javan specimen).

Abdomen blunt tipped; spermatheca single or triple. Adult male with palps from about one sixth to one and a third times as long as the proboscis; proboscis strongly swollen at tip. Coxite without subapical lobe; basal lobe rather poorly developed, ornamented with simple bristles; style slender, simple, with small terminal appendage; claspettes absent; phallosome a simple scoop without teeth (except in two Ethiopian species); paraprocts with only a small number of coarse teeth at tip (except in a few Ethiopian species); Xth tergite with a few small setulae near its point of attachment to the paraproct, as in most *Culex* (Fig. 14c, p. 39). Pupa with the trumpets longer and narrower than in most genera, sometimes enormously so; paddles also tending to elongation but very various; posterior corners of segment VIII often spinose, sometimes expanded to form distinct lobes; genital sac (IXth abdominal segment) of female usually spinose, sometimes intensely so. Larva with large sclerotised plates at the bases of the long

mesothoracic and metathoracic pleural setae (Fig. 21, p. 52), sometimes associated with pronounced outgrowths of the body wall especially in the Madagascan *Ravenalites*; antenna various, sometimes with four distinct joints but with all joints fused in *Ficalbia* s. str.; mentum normal in most cases but absent in the Ethiopian *F. plumosa* Theobald; mouthbrushes reduced in this and to a less extent in some other species; head setae B and C exceptionally long in most species breeding in ground waters; siphon with a single pair of subventral tufts which are variable in position; dorsal valves usually but not always with articulated hooks; ventral valves, in *Ficalbia* s. str. and most *Mimomyia*, with exceptionally long setae; pecten much reduced, with at most 4 teeth on either side, sometimes absent; comb plate usually absent but a rudimentary one present in the Ethiopian *F. perplexens* Edwards and occasionally as an aberration in other species. Ventral brush reduced to at most four pairs of long setae and two pairs of short ones, usually less. The larvae of some species have a distinctive red or blue colouration at least in life. Eggs (in *F. minima*, the only species for which they are known) bluntly ovate, broader at apex than base, laid in clusters attached at base to aquatic plants, with apical dehiscence (Fig. 11c, p. 28). Breeding places various but usually either in organic containers or in ground water with abundant vegetation. Swarming is believed to take place in some cases after sunset but Berner (1947) observed copulation on the wing, in full daylight, a few inches above the *Pistia* among which the mosquitoes (*F. splendens* Theobald) were resting. Some species have been known to enter houses and bite man but only occasionally. Adults of both sexes are taken both on the ground and in the canopy. (For review of adult bionomics see Mattingly & Grjebine, in press. Almost nothing is known, in this respect, about the oriental species).

*Distribution:* Old World tropics from West Africa to the Solomons, northwards to about 15° in the west and to Okinawa in the east.

#### KEYS TO SUBGENERA

Except where otherwise stated, the following keys are applicable to the whole genus throughout its range. They have been checked with all those species so far described and it is felt that there is a good chance that they will facilitate the correct allocation of any new species that may come to hand. Where it is felt that characters of more restricted application may be usefully employed for the separation of known Indomalayan species only, a note is added to this effect.

#### KEY TO ADULT FEMALES

1. First flagellar segment of antenna less than half as long again as the second (Fig. 5a); scutellar scales broad; alula with a patch of broad scales (Fig. 2b, c, p. 9) 2
- First flagellar segment at least half as long again as second (at least twice as long in known

oriental species), usually more (Fig. 5b); scutellar scales narrow, usually scanty; alula bare or with a fringe of narrow scales (Fig. 2a, d) . . . . . 3

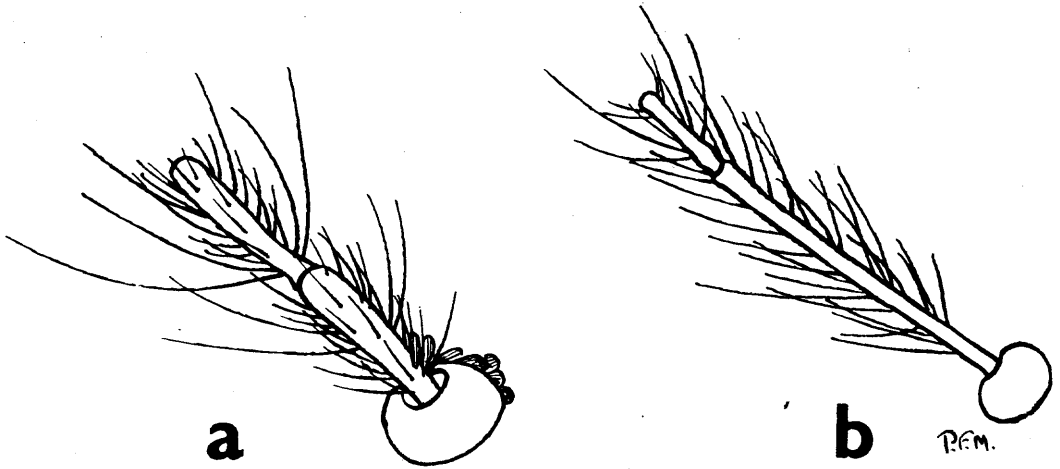


Fig. 5. Base of female antenna. a. *F. luzonensis*, b. *F. minima*.

2. Wing with conspicuous pale and dark markings (Fig. 16, p. 43); anterior fork cell at least three times as long as its stem; postspiracular area scaly; squama with a fringe of very numerous long narrow scales (Fig. 2b) . . . . . *Etorleptomyia*  
 Wing dark (except in some Madagascan species); anterior fork cell at most about twice as long as its stem; postspiracular area bare (Fig. 7a, p. 19); squama with a few broad scales only and these very liable to be lost by rubbing (Fig. 2c) . . . . . *Ravenalites*
3. Alula fringed (Fig. 2d); spermatheca single; anterior fork cell longer than its stem, often half as long again or more (always so in oriental species) . . . . . *Ficalbia* s. str.  
 Alula bare (Fig. 2a); spermatheca usually triple (always so in oriental species); anterior fork cell usually shorter than its stem, never more than a quarter as long again (at most about equal to it in oriental species) . . . . . *Mimomyia*

KEY TO ADULT MALES

1. Palps as long as or longer than the proboscis (longer in oriental species); alula without scales . . . . . *Mimomyia*  
 Palps shorter than the proboscis; alula with a patch of broad scales or a fringe of narrow ones . . . . . 2
2. Alula with a fringe of narrow scales; scutellar scales narrow and scanty; palps minute, not or little longer than the clypeus (known oriental species only; african species have them much longer) . . . . . *Ficalbia* s. str.  
 Alula with a patch of broad scales; scutellar scales broad; palps at least about three eighths of the length of the proboscis, usually longer . . . . . 3

- 3. Anterior fork cell of wing at least three times as long as its stem; squama with a fringe of very numerous long narrow scales . . . . . *Etorleptomyia*
- Anterior fork cell at most twice as long as its stem; squama with a patch of loosely attached broad scales often lost by rubbing . . . . . *Ravenalites*

KEY TO PUPAE

The terminology employed is that of Belkin (1952, 1953).

- 1. Seta 7 of segment VIII very large with about 7-24 plumose branches (about 7-17 in known

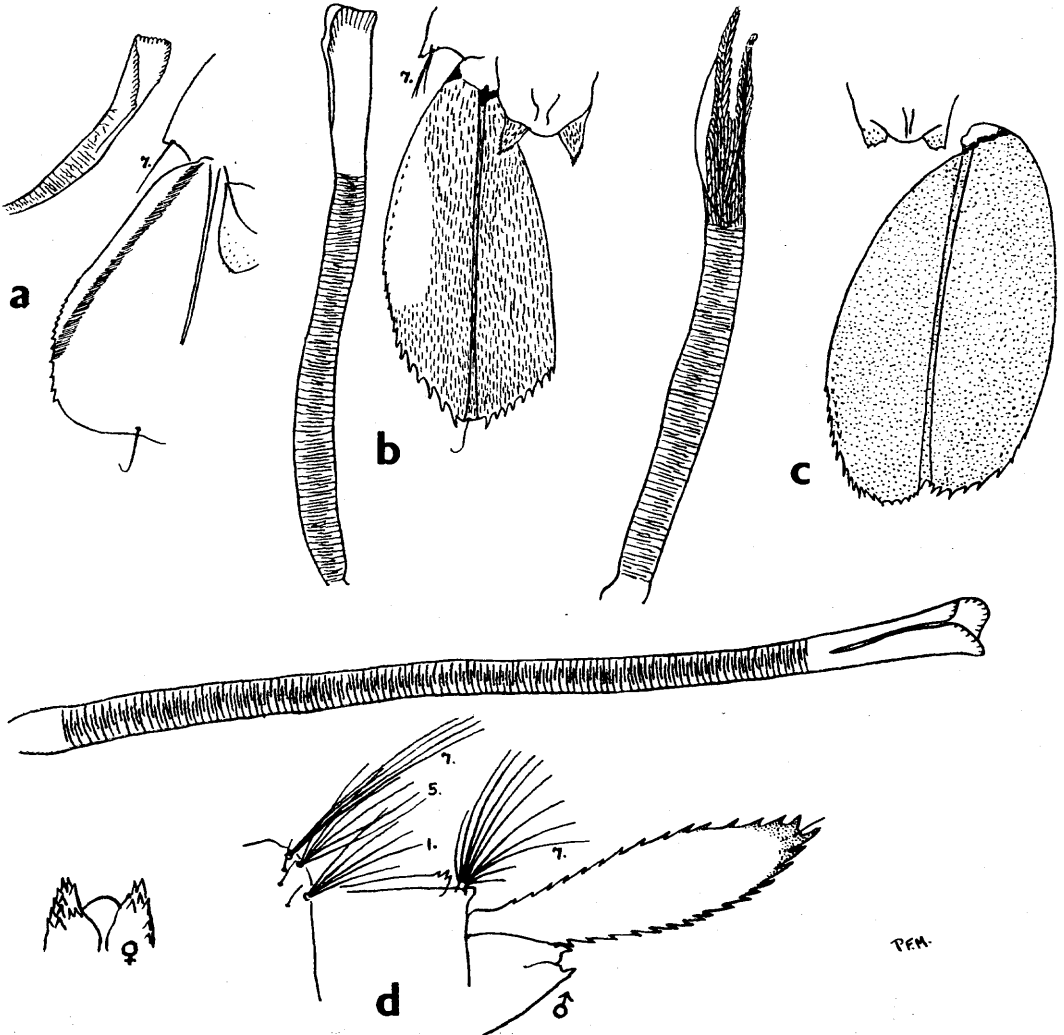


Fig. 6. Pupal trumpets and paddles. a. *F. minima*, b. *F. chamberlaini*, c. *F. hybrida*, d. *F. luzonensis*.

- oriental species) (Fig. 6*d*); paddles at least four times as long as their greatest breadth (Fig. 6*d*, 20*c*, p. 50); seta 1 of first abdominal segment small, single or bifid (Fig. 3*a*, p. 9); trumpets usually more than twenty times as long as their breadth at half way, sometimes more than fifty times this breadth (about 20-35 times in known oriental species) (Fig. 6*d*, 20*c*) . . . . . 2
- Seta 7 of segment VIII very small with not more than 5 delicate branches (not more than 3 in known oriental species) (Fig. 6*b*); paddles less than three times as long as their greatest breadth (Fig. 6*a*, *b*, *c*); seta 1 of first abdominal segment almost always large with numerous branches (always so in oriental species) (Fig. 3*b*, p. 9); trumpets less than twenty times as long as their breadth at half way (Fig. 6*a*, *b*, *c*) . . . . . 3
2. Paddles at most eight times as long as their greatest breadth; setae 1 and 5 of segment VII with at least three branches (Fig. 6*d*) . . . . . *Etorleptiomyia*  
 Paddles at least ten times as long as their greatest breadth; setae 1 and 5 of segment VII single or bifid (very occasionally with one aberrant seta trifid) (Fig. 20*c*, p. 50) . *Ravenalites*
3. Trumpets at least about twelve times as long as their breadth at half way (except in two aberrant Ethiopian species) (Fig. 6*b*, *c*); paddles with coarse fringe (except in the Ethiopian *F. splendens* which has a fringe of long hairs on both borders), this fringe continued beyond the apical bristle (Fig. 6*b*, *c*) . . . . . *Mimomyia*  
 Trumpets at most nine times as long as their breadth at half way; paddles with more delicate fringe which is confined to the outer border (Fig. 6*a*) . . . . . *Ficalbia* s. str.

KEY TO LARVAE

1. Second joint of antenna completely fused with the basal joint (~~Fig. 11*a*, p. 20~~); subventral tuft of siphon arising at not more than one eighth of the distance from base to apex; distal edge of saddle smooth (Fig. 11*a*, p. 28) . . . . . *Ficalbia* s. str.  
 This joint freely articulated (Fig. 12, 15, 19*a*, 22, 23, pp. 33, 40, 48, 53, 55); subventral tuft of siphon arising at not less than a quarter of the distance from base to apex (not less than a third of this distance in oriental species); distal edge of saddle spiculate (Fig. 12, 15, 17*a*, 22, 23) . . . . . 2
2. Ventral brush with 8 long setae (Fig. 12, 15, pp. 33, 40) . . . . . *Mimomyia*  
 Ventral brush normally with at most 6 long setae (one or two short ones or, rarely, one long one sometimes present in addition) (Fig. 17*a*, 22, 23, pp. 45, 53, 55) . . . . . 3
3. Terminal and subterminal antennal setae dendroid (Fig. 22, 23, pp. 53, 55); ventral brush with only two pairs of setae; spine on dorsal valve of siphon very inconspicuous, simple or bifid at tip (Fig. 22, 23) . . . . . *Ravenalites*\*  
 Terminal and subterminal antennal setae simple (Fig. 19*a*, p. 48); ventral brush with three pairs of setae (one or two supernumeraries sometimes present in addition); spine on dorsal valve of siphon trifid (Fig. 17*a*, p. 45) . . . . . *Etorleptiomyia*

\* This section applies to oriental *Ravenalites* only. The Madagascan species have normal antennal setae. The other characters are, however, diagnostic of the subgenus as a whole.

The following are the diagnostic characters of the various subgenera.

Subgenus **FICALBIA** s. str.

*Ficalbia* Theobald, *Monogr. Culic.*, 3: 296, 1903.

*Ingramia* Edwards, *Bull. ent. Res.*, 3: 43, 1912.

TYPE SPECIES: *F. minima* Theobald.

First flagellar segment of female antenna from twice to six times the length of the second; upright scales of head restricted to nape; eyes separate. Dorsocentral and acrostichal bristles present; scutellar scales narrow; postspiracular and prealar scales absent; bristles present on ridge below knob of sternopleura. Wings dark; squama and alula each with a fringe of narrow scales; anterior fork cell from about one and one tenth to one and four fifths times as long as its stem; broad squame scales, in most cases, numerous. Fore tibial claw present, sometimes very small (i.e., in all known oriental, but not in the Ethiopian species); hind femur with two bristles above at tip, Spermatheca single. Male palps various; male proboscis very strongly swollen on about the distal half. Phallosome very lightly sclerotised. Pupa with trumpets about 7-9 times as long as their breadth at half way; seta 1 of segment I large and multibranching; seta 7 of segment VIII small, slender, single or bifid; paddles about one and a half times as long as their greatest breadth. Larva with all joints of antenna completely fused; terminal and subterminal antennal setae single; siphon of more or less uniform width, short with large valves; dorsal valves with or without hooks; ventral valves with very long setae; siphonal index about 3 or a little more or less; ventral brush with 4 pairs of setae, one or two supernumary setae sometimes present in addition. Breeding places ground pools and swamp edges, usually with abundant vegetation but sometimes without.

*Distribution:* West Africa to Hong Kong.

Subgenus **MIMOMYIA** Theobald

*Mimomyia* Theobald, *Monogr. Culic.*, 3: 304, 1903.

*Boycia* Newstead, in Newstead et al., *Ann. trop. Med. Parasit.*, 1: 33, Feb., 1907.

*Ludlowia* Theobald, *Monogr. Culic.*, 4: 193, Mar., 1907.

*Megaculex* Theobald, *Ibid.*, p. 282.

*Radioculex* Theobald, *Rec. Indian Mus.*, 2: 295, 1908.

*Conopomyia* Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3): 113, 1908.

*Hispidimyia* Theobald, *Monogr. Culic.*, 5: 245, 1910.

TYPE SPECIES: *F. splendens* Theobald.

First flagellar segment of female antenna from one and a half to three times as long as the second. Scutellar scales narrow. Wings dark except sometimes at the base of

vein 1; squama with a fringe of narrow scales; alula bare; anterior fork cell from about three fifths to one and one fifth times as long as its stem; broad squame scales usually very scanty (but not in *F. hybrida*). Leg markings various; fore tibial claw well developed (except in the Ethiopian *F. splendens*). Male palps from about one and one tenth to one and a third times as long as the proboscis; male proboscis lightly to moderately swollen on about the distal third. Pupa with trumpets about 9-17 times as long as their breadth at half way; seta 1 of segment I large and multibranched (except in the Ethiopian *F. perplexens*); seta 7 of segment VIII very small with about 2-5 branches; paddles about one and a half to two and three quarters as long as their greatest breadth. Larva with joints of antenna freely articulated; terminal and subterminal antennal setae single; siphon various, index about 2-8; ventral brush with 4 pairs of setae. Breeding places as for *Ficalbia* s. str.

*Distribution:* West Africa to Taiwan, the Solomons and northern Queensland.

### Subgenus **ETORLEPTIOMYIA** Theobald

*Etorleptiomyia* Theobald, 1st Rept. Wellcome Res. Labs., p. 71, 1904.

*Oreillia* Ludlow, *Canad. Ent.*, 37: 101, 1905.

*Dixomyia* Taylor, *Trans. ent. Soc. Lond.* (1913), p. 702, 1914.

*Luzonus* Stone & Bohart, *Proc. ent. Soc. Wash.*, 46: 212, 1944.

TYPE SPECIES: *F. mediolineata* Theobald.

First flagellar segment of female antenna about one to one and a third times as long as the second; eyes well separated. Dorsocentral bristles present; scutellar scales broad; postspiracular area scaly; prealar knob devoid of scales; bristles present on sternopleural ridge. Wings with strongly contrasting light and dark scales; squama with a fringe of long narrow scales; alula with a patch of broad pale or dark scales; anterior fork cell from three to four and a half times as long as its stem; most wing scales very large and broad. Tarsi banded; fore tibial claw strongly developed; hind femur with 2-3 bristles above at tip. Spermatheca single. Male palps from about three fifths to four fifths of the length of the proboscis; male proboscis very strongly swollen on about the distal half; phallosome very lightly sclerotised. Pupal trumpets from about twenty to thirty times as long as their breadth at half way; seta 1 of segment I small, unbranched; setae 1 and 5 of segment VII very large and dark, each with at least 3 branches; seta 7 of segment VIII very large with about 8-11 plumose branches; paddles 4-5 times as long as their greatest breadth. Larva with joints of antenna freely articulated; terminal and subterminal antennal setae single; siphon rather long, markedly tapering, index about 6-8; articulated spines on dorsal valves trifold; ventral valves with short setae; ventral brush with 3 pairs of long setae and sometimes one or two supernumary ones. Breeding places as for previous subgenera.

*Distribution:* West Africa to Okinawa, the Solomons and northern Queensland.

Subgenus **RAVENALITES** Doucet

*Ravenalites* Doucet, *Mém. Inst. Sci. Madagascar, Sér. A*, 4: 47, 1950.

*Dasomyia* Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3): 102, 1908, nec Egger (1858: 711).

TYPE SPECIES: *F. roubaudi* Doucet.

First flagellar segment of female antenna from about 1.0 to 1.4 times the length of the second; upright scales of head variable in extent; eyes well separated. Dorsocentral bristles present, acrostichals present or absent; scutellar scales broad; postspiracular and prealar scales absent. Squama with a fringe of rather scanty, broad, loosely attached scales, liable to be lost by rubbing; alula with a similar patch of broad scales; anterior fork cell from about 1.3 to 2.1 times as long as its stem. All or most of the wing scales very large and broad. Tarsi and fore tibial claws various; hind femur with 1-4 bristles above at tip. Spermatheca single. Male palps from about three eighths to four fifths of the length of the proboscis; male proboscis strongly swollen on about the distal half; phallosome very lightly sclerotised. Pupa with trumpets from about twenty five to more than fifty times as long as their breadth at half way (except in one Madagascar species); seta 1 of segment I very small, single or bifid; setae 1 and 5 of segment VII normally single or bifid; seta 7 of segment VIII large with about 14-22 branches; paddles about 10-20 times as long as their greatest breadth. Larva with joints of antenna freely articulated; articulated spines on dorsal valves single or bifid at tip; ventral valves as in *Etorleptomyia*; ventral brush with only two pairs of setae. Breeding places cut bamboos, axils of *Ravenala*, *Pandanus* and *Typhonodorum* (Madagascan species), tree holes, bamboo stumps (oriental species).

*Distribution*: Madagascar, Andaman Is., Indomalayan area.

## KEYS TO INDOMALAYAN SPECIES

Most of the characters employed here will be familiar. Adult chaetotaxy and piloxtaxy follow Edwards (1941). Larval and pupal chaetotaxy follow Belkin (1952, 1953). The fore tibial spine has been very little used (but see Mattingly & Hamon, 1955, Mattingly & Grjebine, in press). It is recognisable by its position, by the fact that it is stouter than the setae by which it is accompanied, is mounted on a small eminence and always shows at least some sign of recurvature at the tip and, especially, by the fact that it is much more strongly articulated than the sensory setae by which it is surrounded and cannot be detached even by far harder rubbing than is needed to dislodge them. Its function is clearly mechanical but this is all that is known of it. Its distribution in other genera, so far as this is known, is discussed by Mattingly & Grjebine (in press). In the present genus it is best developed in *F. (F.) malfeyti* Newstead in which, as sometimes in the related *F. uniformis* Theobald, it is denticulate.

KEY TO ADULT FEMALES

1. Wings with very numerous scattered pale scales (Fig. 16, p. 43); alula with broad scales and squama with narrow ones (Fig. 2*b*, p. 9); anterior fork cell at least about four times as long as its stem; postspiracular area scaly . . . . . 2

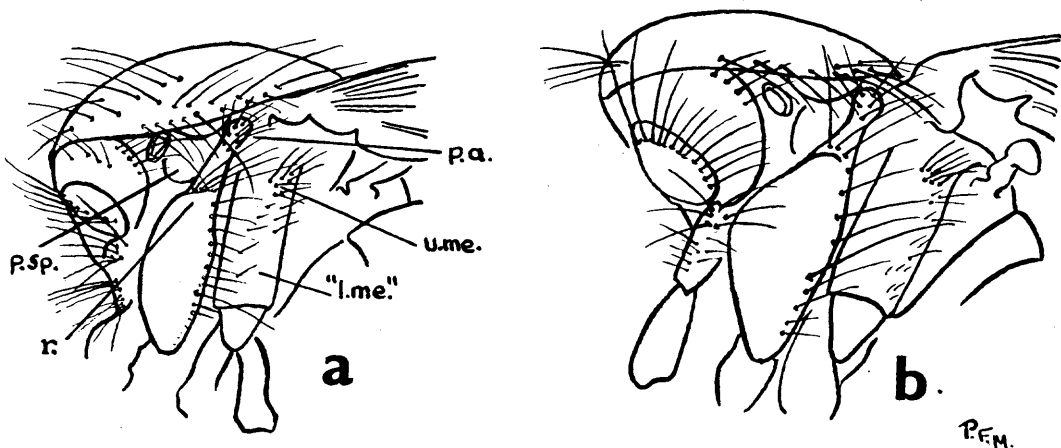


Fig. 7. Thorax in lateral view. a. *F. fusca*, b. *F. aurea*, "l.me." "Lower mesepimeral bristle", p.a. Prealar knob, p. sp. Postspiracular area, r. Ridge of sternopleura, u.me. Upper mesepimeral bristles.

Wings dark except sometimes at the base of the first vein; alula various, if with broad scales then squama also broad scaled (Fig. 2*a, c, d*); anterior fork cell at most about twice as long as its stem; postspiracular area bare (Fig. 7) . . . . . 3

2. Dorsal surface of abdomen largely pale except for a conspicuous broad median dark stripe; acrostichal bristles present (Fig. 8*a*); proboscis very narrowly dark at tip; second hind tarsal with two well separated dark spots (Fig. 18*a*, p. 47) . . . . . *F. luzonensis* (p. 42)  
Abdominal tergites largely dark with pale markings very small; acrostichals absent; proboscis broadly dark at tip; second hind tarsal with a broad dark band (Fig. 18*b*) . . . . . *F. elegans* (p. 46)
3. Squama and alula with patches of broad scales (liable to be lost by rubbing (Fig. 2*c*, p. 9); first flagellar segment of female antenna less than half as long again as the second (Fig. 5*a*, p. 13) . . . . . 4  
Squama with a strongly attached fringe of long narrow scales; alula either bare or with a fringe of narrow scales (Fig. 2*a, d*); first flagellar segment at least twice as long as second (Fig. 5*b*) . . . . . 5
4. Abdominal tergites with well marked basal lateral pale spots; sternites conspicuously pale, at least towards base . . . . . *F. fusca* (p. 49)  
Abdominal tergites and sternites wholly dark . . . . . *F. deguzmanae* (p. 53)

- 5. Alula bare (Fig. 2a, p. 9); anterior fork cell at most very slightly longer than its stem; acrostichal bristles absent (Fig. 8b); fore tibial claw strongly developed (Fig. 4a, p. 11); spermatheca triple 6
- Alula with fringe of narrow scales (Fig. 2d, p. 9); anterior fork cell half as long again as

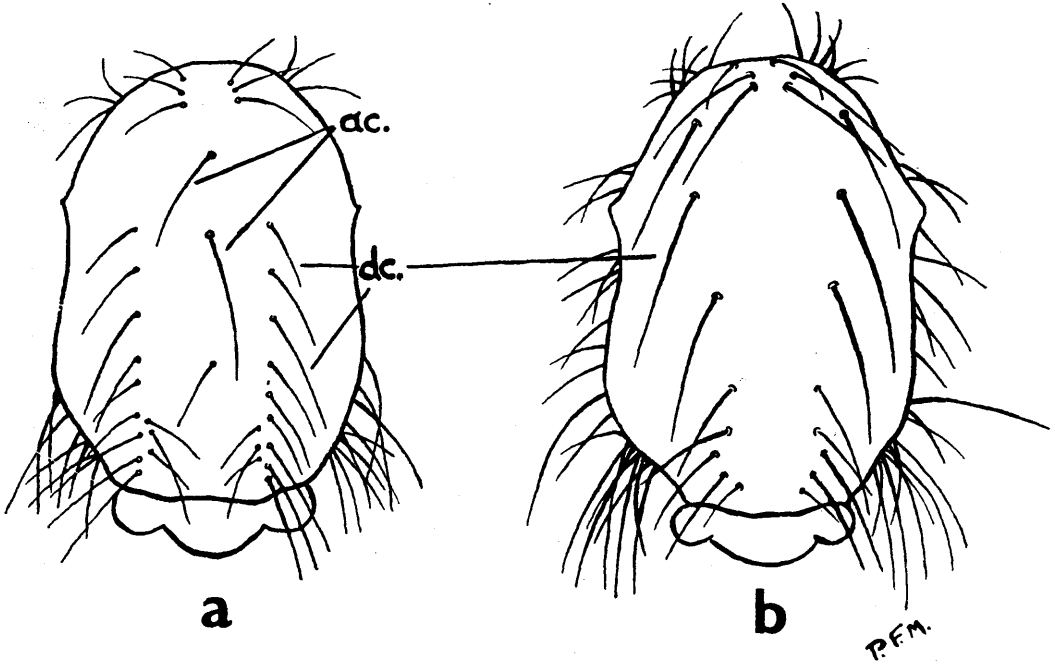


Fig. 8. Dorsal view of mesonotum. a. *F. luzonensis*, b. *F. hybrida*, ac. Acrostichal bristles, dc. Dorsocentral bristles.

- its stem or more; acrostichal bristles very strongly developed; fore tibial claw minute (Fig. 4d, e); spermatheca single . . . . . 9
- 6. Tarsi unbanded except sometimes at base of first segment; dorsocentral bristles strongly developed (Fig. 8b) . . . . . *F. hybrida* (p. 38)
- Tarsi with conspicuous pale bands; dorsocentral bristles absent unless immediately in front of scutellum . . . . . 7
- 7. Mesonotum entirely dark; posterior tergites with uniform yellow basal bands; palps largely yellow; mesepimeron with a row of setae extending down from the patch in the upper corner for some distance along the posterior border (Fig. 7b, p. 19) *F. aurea* (p. 37)
- Mesonotum with integument pale at sides and with a broad band of golden yellow scales along the outer margin posterior to the shoulders; palps largely dark; mesepimeral setae confined to the patch in the upper posterior corner (Fig. 7c, p. 19); tergites without continuous pale basal bands . . . . . 8

8. Pale markings on abdominal tergites confined to the extreme sides and the anterolateral corners . . . . . *F. chamberlaini* (p. 31)  
Tergites with median pale markings varying from a continuous pale stripe to a small pale spot on two or three posterior segments . . . . . *F. chamberlaini* var. *metallica* (p. 35)
9. Tarsi with well marked pale bands embracing the joints; fifth hind tarsal pale; pleurae largely pale . . . . . *F. minima* (p. 26)  
Tarsi dark or at most very indistinctly banded; 5th hind tarsal dark; pleurae largely dark . . . . . *F. ludlowae* (p. 29)\*

## KEY TO ADULT MALES†

1. Palps minute, not or little longer than the clypeus . . . . . *F. minima* (p. 26)  
Palps at least about three eighths of the length of the proboscis . . . . . 2
2. Palps longer than proboscis, strongly swollen at tip . . . . . 3  
Palps shorter than proboscis, not or only slightly swollen at tip . . . . . 6
3. Tarsi unbanded unless at base of first segment; IXth tergite very narrow (Fig. 14b, p. 39) . . . . . *F. hybrida* (p. 38)  
Tarsi with conspicuous pale bands; IXth tergite broader (Fig. 9b, 14a) . . . . . 4
4. Scutum entirely dark; abdominal tergites with more or less uniform basal yellow bands . . . . . *F. aurea* (p. 37)  
Scutal integument pale at sides, the pale areas with golden scales; abdomen otherwise . . . . . 5
5. Pale markings on abdominal tergites confined to the extreme sides and the anterolateral corners . . . . . *F. chamberlaini* (p. 31)  
Tergites with at least some trace of median pale markings if only on posterior segments . . . . . *F. chamberlaini* var. *metallica* (p. 35)
6. Squama with a patch of broad scales (liable to be lost by rubbing) (Fig. 2c, p. 9); wings dark; IXth tergite very narrow (Fig. 9d) . . . . . 7  
Squama with narrow scales (Fig. 2b); wings with numerous pale scales; IXth tergite broad, setigerous lobes well separated (Fig. 9c) . . . . . 8
7. Palps at least two thirds of the length of the proboscis; abdominal tergites and sternites wholly dark . . . . . *F. deguzmanae* (p. 53)  
Palps at most half the length of the proboscis; tergites and sternites with pale markings . . . . . *F. fusca* (p. 49)
8. Dorsum of abdomen pale with dark median longitudinal stripe; acrostichal bristles present; second hind tarsal with two distinct dark spots (Fig. 18a, p. 47) . . . . . *F. luzonensis* (p. 42)  
Dorsum of abdomen largely dark, pale markings very small; acrostichals absent; second hind tarsal with a complete dark band (Fig. 18b) . . . . . *F. elegans* (p. 46)

\* *F. jacksoni* from Hong Kong would also run down here (See p. 30).† The male of *F. ludlowae* is unknown.

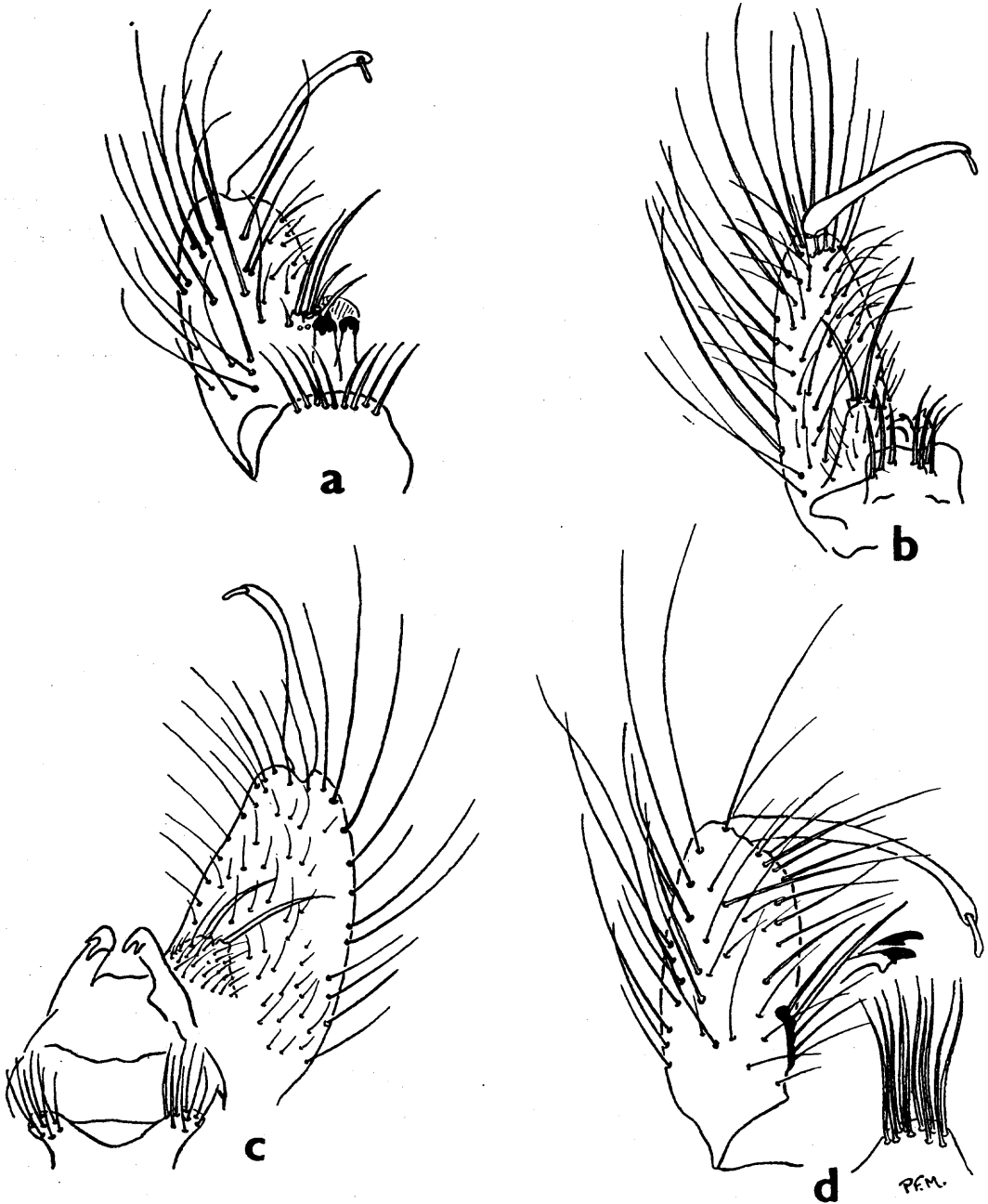


Fig. 9. Male terminalia.  
 a. *F. minima*, b. *F. chamberlaini*, c. *F. luzonensis*, d. *F. fusca*.

KEY TO PUPAE

The pupa of *F. ludlowae* is unknown. It would probably run down with *F. minima*.

1. Seta 7 of segment VIII very large with about eight or more branches (Fig. 6*d*, p. 14, 20*c*, p. 50); paddles at least four times as long as their greatest breadth (Fig. 6*d*, 20*c*); seta 1 of first abdominal segment small, single or bifid (Fig. 3*a*, p. 9); trumpets about twenty to thirty five times as long as their breadth at half way (Fig. 6*d*, 20*c*) . . . . . 2  
 Seta 7 of segment VIII small with at most three delicate branches (Fig. 6*a*, *b*, *c*); paddles less than three times as long as their greatest breadth (Fig. 6*a*, *b*, *c*); seta 1 of first abdominal segment large with numerous branches (Fig. 3*b*); trumpets less than twenty times as long as their breadth at half way (Fig. 6*a*, *b*, *c*) . . . . . 5
2. Paddles at least ten times as long as their greatest breadth setae 1 and 5 of segment VII single or bifid (Fig. 20*c*) . . . . . 3  
 Paddles at most eight times as long as their greatest breadth; these setae each with at least three branches (Fig. 6*d*) . . . . . 4
3. Seta 3 of segments II and III stouter (Fig. 20*a*) . . . . . *F. fusca* (p. 49)  
 These setae more slender (Fig. 20*b*) . . . . . *F. deguzmanae* (p. 53)
4. Paddles a little more than four times as long as broad (Fig. 6*d*) . . . . . *F. luzonensis* (p. 42)  
 Paddles about five or more times as long as broad . . . . . *F. elegans* (p. 45)
5. Trumpets modified for piercing (Fig. 6*c*) . . . . . *F. hybrida* (p. 38)  
 Trumpets not so modified (Fig. 6*a*, *b*, 13*a*, p. 37) . . . . . 6
6. Trumpets about nine times as long as broad; paddle fringe finer, confined to outer border (Fig. 6*a*) . . . . . *F. minima* (p. 26)\*  
 Trumpets at least about thirteen times as long as broad; paddle fringe coarser, extending well beyond apical bristle (Fig. 6*b*, 13*a*) . . . . . 7
7. Paddles pale on about the basal three quarters of the outer edge (Fig. 6*b*) . . . . . *F. chamberlaini* (p. 31)  
 Paddles with a small pale area on distal half only (Fig. 13*a*) . . . . . *F. aurea* (p. 37)

KEY TO LARVAE

The larva of *F. ludlowae* is unknown.

1. Terminal and subterminal setae of antenna dendroid (Fig. 22, p. 53, 23*a*, p. 55); ventral brush with only two pairs of setae (Fig. 22, 23*d*) . . . . . 2  
 Terminal and subterminal antennal setae simple (Fig. 11*a*, p. 28, 12, p. 33, 15, p. 40, 19*a*, p. 48); setae of ventral brush more numerous (Fig. 11*a*, 12, 13*b*, p. 37, 15, 17*a*, p. 45) . . . . . 3

\* *F. jacksoni* from Hong Kong would also run down here. For differences see p. 30.

2. Comb teeth mostly simple (Fig. 22) . . . . . *F. fusca* (p. 49)  
 Comb teeth complex (Fig. 23*d*) . . . . . *F. deguzmanae* (p. 53)
3. Second joint of antenna greatly elongated; siphon modified for piercing (Fig. 15)  
*F. hybrida* (p. 38)  
 Antenna otherwise (Fig. 11*a*, 12, 19*a*); siphon normal (Fig. 11*a*, 12, 13*b*, 17*a*) . . . . . 4
4. Second joint of antenna completely fused with basal joint; subventral tuft of siphon arising at not more than one eighth of the distance from base to apex; distal edge of saddle smooth; siphonal index not more than about 3 (Fig. 11*a*) . . . . . *F. minima* (p. 26)\*  
 Second joint of antenna freely articulated (Fig. 12, 19*a*); subventral tuft of siphon arising at not less than about a third of the distance from base to apex; distal edge of saddle spiculate; siphonal index at least about 4.5 (Fig. 12, 13*b*, 17*a*) . . . . . 5
5. Siphon tapering strongly beyond subventral tuft, index about 6-7, ventral valves small and without long setae, spines on dorsal valves trifold, pecten absent, subventral tuft at about a third of the distance from base to apex; ventral brush usually with only six long setae (one or two short ones or one long one occasionally present in addition) (Fig. 17*a*); maxilla without a conspicuous spine (Fig. 19*a*) . . . . . 6  
 Siphon tapering less strongly, index at most about 5, ventral valves large, each with a long seta, spine on dorsal valves single or bifid (sometimes with denticles at base), pecten present (may be reduced to a single tooth on either side), subventral tuft at nearly half way; ventral brush with 8 long setae (Fig. 12, 13*b*); maxilla with a conspicuous, strongly sclerotised spine (Fig. 12) . . . . . 7
6. Comb teeth forming a single row, their median denticle strongly hypertrophied (Fig. 17*a*); clypeal spines strongly barbed at base (Fig. 19*b*) . . . . . *F. luzonensis* (p. 42)  
 Comb teeth in a double row, more or less uniformly fringed (Fig. 17*b*); clypeal spines simple (Fig. 19*a*) . . . . . *F. elegans* (p. 46)
7. Head very dark, strongly contrasting with the body; pecten teeth very stout (Fig. 12)  
*F. chamberlaini* (p. 31)  
 Head paler, not much darker than body; pecten teeth more delicate (Fig. 13*b*)  
*F. aurea* (p. 37)

#### SPECIES GROUPS

Mattingly & Grjebine (in press) have divided the present genus into twelve species groups. Eight of these, Group B of *Ficalbia* s. str., Groups A, C, D and E of *Mimomyia* and Groups A, B and D of *Ravenalites*, are purely Ethiopian or Malagasy. The remainder are all represented in the Indomalayan area. Their diagnostic features are as follows.

\* *F. jacksoni* from Hong Kong and probably also *F. ludlowae* would run down here (see p. 30).

Subgenus *Ficalbia* s. str.

Group A (*Ficalbia* s. str.). Fore tibial claw small or very small. Male palps minute, about one sixth of the length of the proboscis. Subventral tuft of larval siphon at not more than about one tenth of the distance from base to apex.

Indomalayan species included in this group are *F. minima* and *F. ludlowae*. It is completed by the inclusion of *F. jacksoni* which is at present known only from Hong Kong. The inclusion of *F. ludlowae* is provisional since it is known only from the female adult. It may be noted that, despite the remarkable series of parallel characters discussed below (p. 30), the Ethiopian species are all placed in a distinct group (*Ingramia*) by reason of their long male palps.

Subgenus *Mimomyia*

Group B (*Ludlowia*). Upright scales of head restricted to nape. Eyes touching for some distance in the mid line. First flagellar segment of female antenna from two to three times as long as the second. Acrostichal bristles absent. Prealar and postspiracular scales absent. Bristles present on ridge of sternopleura and one or two of the bristles on the posterior edge of the sternopleura longer and stouter than the rest. Anterior fork cell from about three fifths to one and one fifth times as long as its stem. Phallosome very lightly sclerotised. Paraproct with only a small number of teeth at tip. Spermatheca triple. Pupal trumpet from about ten to seventeen times as long as its breadth at half way. Paddle with a fringe of short spines. Larval antenna about the same length as the head or longer, Mentum of normal type.

It is possible that this group should be further subdivided. *F. chamberlaini*, *F. aurea* and *F. intermedia* should probably go into a group by themselves, distinguished by the absence of dorsocentral bristles and the tarsal banding. *F. hybrida* and the Ethiopian *F. pallida* resemble one another in the modified larval siphon and pupal trumpets. The Ethiopian *F. perplexens* probably deserves a group to itself. It is intermediate with respect to the siphon and trumpets and, unlike the *F. hybrida* group, resembles *Etorleptomyia*, *Ravenalites* and the genus *Mansonia* in the reduction of seta I on the first segment of the pupal abdomen. The Indomalayan species included in this group, as at present constituted, are *F. chamberlaini*, *F. aurea* and *F. hybrida*.

Subgenus *Etorleptomyia*

*F. luzonensis* agrees closely in all respects with the Ethiopian species. The name *Dixomyia* is available for *F. elegans* but in my view this species resembles *F. luzonensis* too closely to warrant its inclusion in a separate group. The only group character by which it might be distinguished is the absence of acrostichal bristles.

Subgenus *Ravenalites*

Group C. (*Dasymyia* Auctt., nec Egger). Upright scales of vertex broad, restricted to nape. Acrostichal bristles present. Upper part of posterior pronotum devoid of scales.

Posterior pronotal bristles exceptionally numerous (10 or more, about 2-7 in other species of the genus). Bristles present on sternopleural ridge. Wing dark. Fore tibial claw strongly developed. Male palps about three quarters of the length of the proboscis. Larva with terminal and subterminal setae of antenna branched. Subventral tuft arising at about one third of the distance from base of siphon to apex. Included species *F. fusca* and *F. deguzmanae*.

#### DESCRIPTIONS OF SPECIES

### **Ficalbia (Ficalbia) minima** (Theobald)

*Uranotaenia minima* Theobald, *Monogr. Culic.*, 2: 262, 1901.

*Ficalbia minima* Theobald, *Monogr. Culic.*, 3: 297, 1903.

*Mimomyia minuta* Theobald, *Rec. Indian Mus.*, 2: 301, 1908 and 4: 30, 1910.

**TYPES:** *minima*, holotype ♂, Quilon, Travancore, in B.M. (see Mattingly & Grjebine, in press), *minuta*, holotype ♂, Sylhet, Assam, allotype ♀, Calcutta, both in Indian Museum.

**Adult ♀.** Wing length about 2 mm. Proboscis and palps dark, the former only slightly swollen at tip, the latter minute. Basal joint of antennal flagellum about three times as long as the second joint. Decumbent scales of vertex broad, flat, yellowish white, upright scales dark, very few in number. Integument of scutum dark brown, shiny, covered with rather scanty narrow curved dark brown scales, bristles stout and blackish. Anterior pronotum and pleura devoid of scales. Mesepimeron pale, anterior portion of pleura with dark patches. Coxites pale. Postnotum dark. Wings with fairly numerous broad plume scales especially on the distal half, dark scaled except for a small pale spot at extreme base. Upper fork cell about one and a half times as long as its stem. Halteres with knob largely dark, stem pale. Femora largely pale with dark dorsal stripes incomplete basally but expanding apically. White knee spot on fore femur minute, on mid femur larger and on hind femur larger still. Tibiae dark except for large whiteish knee spots. Fore tibial claw (Fig. 4d, p. 11) minute. Tarsi dark with pale bands above and below the joints. Fifth tarsal segment pale. Abdomen with first tergite wholly and second largely dark, remaining tergites with yellowish basal bands which are broad at the sides and very deeply constricted or even completely interrupted in the middle. Venter pale. Terminalia as in figure (Fig. 10a). IXth tergite with the two lateral patches of setae almost confluent as in the male.

**Adult ♂.** Much as in the female but with the proboscis strongly swollen on the distal half. Palps minute as in female. Terminalia much as in other members of the genus except that the shape of the IXth tergite is characteristic (Fig. 9a, p. 22).

**Pupa.** This has not previously been described. The following description is based on two associated skins from Bekassi, near Batavia, kindly lent me by Dr. Bonne-Wepster.

Trumpets (Fig. 6a, p. 14) about nine times as long as their breadth at half way, tracheoid on about the basal half. Meatus occupying about the basal two thirds. Palmate hair of first abdominal segment well developed, dendroid. Seta 7 of segment VIII small, very delicate, bifid. Paddles a little more than one and a half times as long as their greatest breadth, with a narrow longitudinal band of infuscation running inside and parallel to

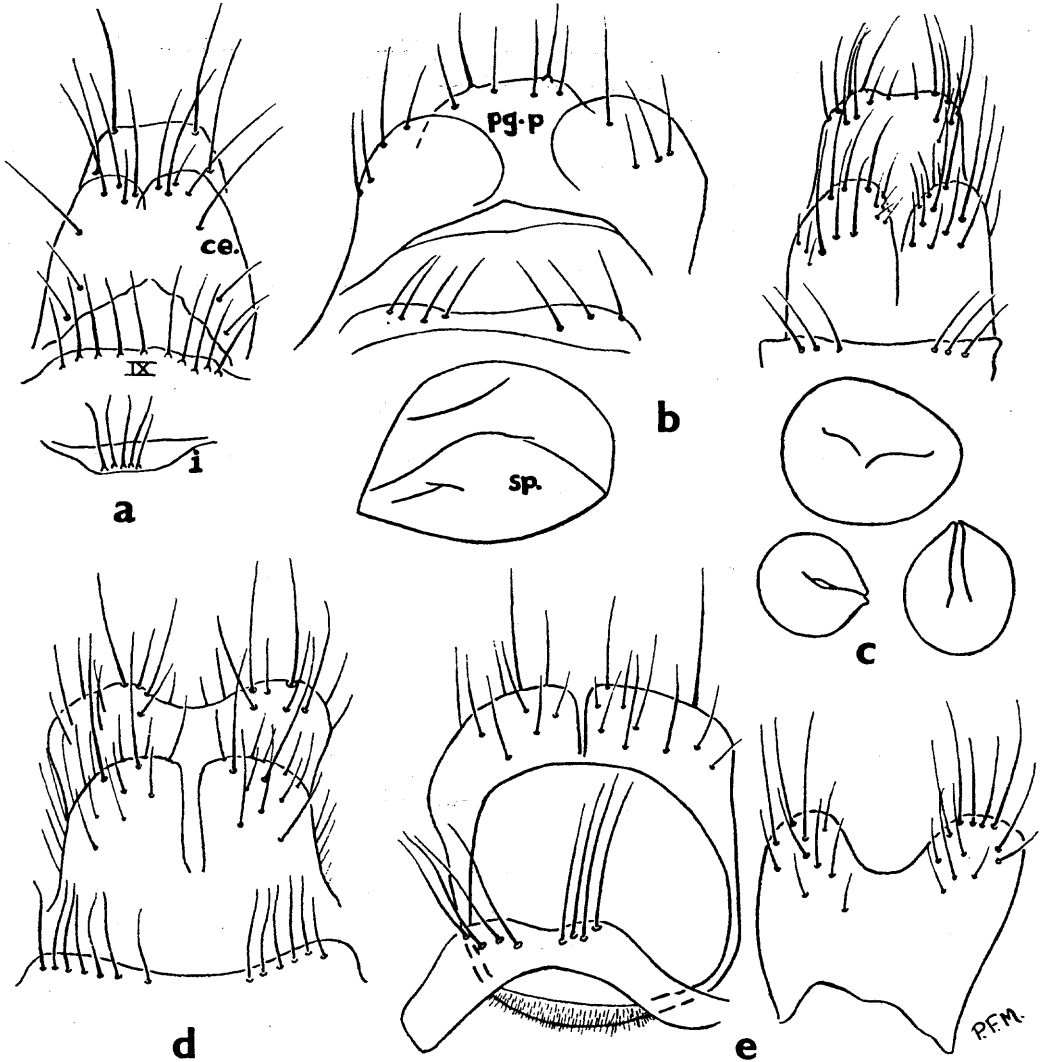


Fig. 10. Female terminalia. a. *F. minima*, b. *F. ludlowae* (Java), c. *F. chamberlaini*, d. *F. luzonensis*, e. *F. fusca*, ce. Cercus, i. Insula, pg.p. Postgenital plate, sp. spermatheca, IX. Ninth tergite.  
pg. p. Postgenital plate, sp. spermatheca, IX. Ninth tergite.

the outer edge. Outer edge with a fringe of rather delicate teeth on about the apical two fifths, not extending onto the distal border. Apical bristle single. Accessory bristle not seen. Genital sac of female with a few very minute spicules visible only under high power, of male not seen. Posterior corners of segment VIII smooth and unlobed. The only other known oriental pupa of this subgenus, that of *F. jacksoni*, differs in having the paddles pigmented at extreme base only and with the fringe extending well onto the apical border.

*Larva.* The following description is based on specimens from Hong Kong.

General colouration (including head and siphon) pale brownish.

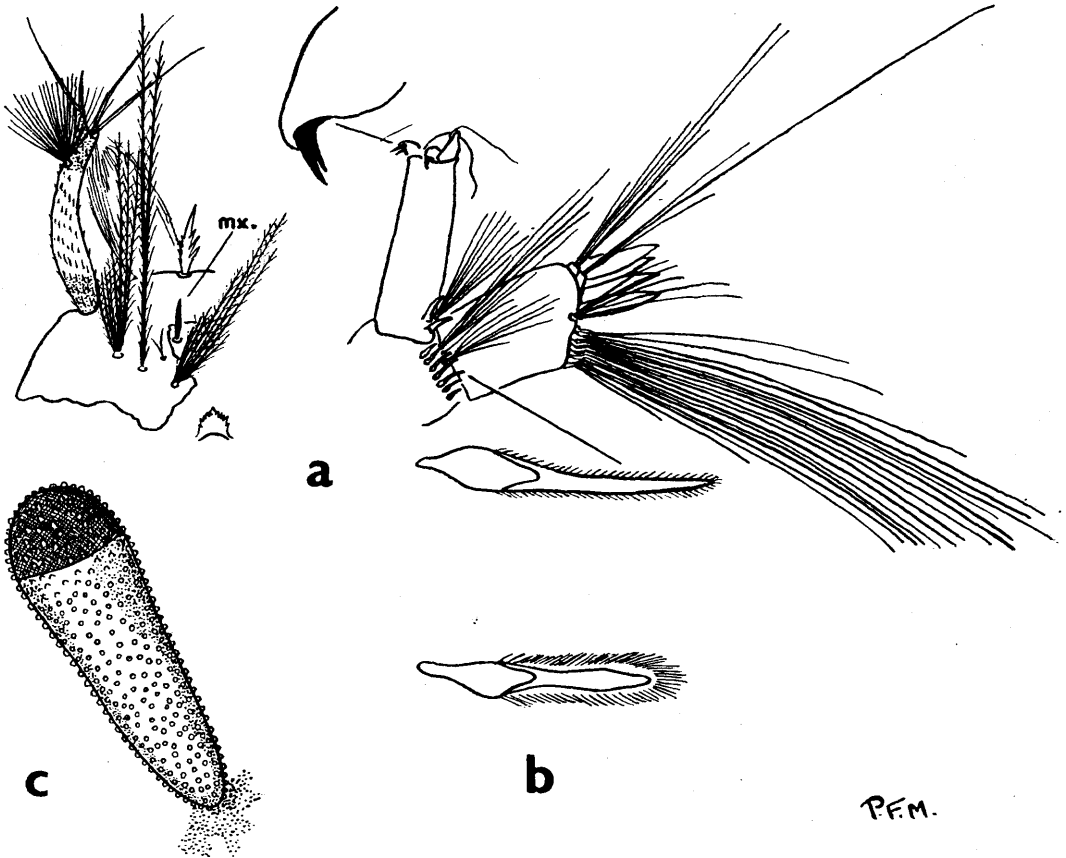


Fig. 11. *F. minima*. Larva. a. Head and terminal segments of specimen from Hong Kong, b. Comb tooth of specimen from Celebes, c. Egg (after Iyengar, 1935). *mx.* Maxillary spine.

Antenna (Fig. 11a) infuscated only at base and apex, pale in between. Clypeal spines with well developed secondary denticles at base. Head seta A with about 8 branches (Barraud, 1934: 118, says 8-10 and Galliard & Ngu (1949: 497) figure 6 for the Tonkin

form). B with two very stout branches, much longer than A, C with about 6-8. In seta A and seta C the branches are very unequal. Galliard and Ngu (*loc. cit.*) do not show seta B and it is presumed that this was missing from their specimen. It is very liable to become detached owing to its great length. Mentum very small. Maxilla with a very stout, dark, simple spine. Comb teeth with a very delicate fringe, difficult to see except under high power and in aqueous medium. Galliard & Ngu (*loc. cit.*) figure these teeth as simple. Barraud (1934: 117), on the other hand, shows the comb teeth of his Hong Kong material with the fringe greatly exaggerated. Pecten of two simple teeth. Dorsal valves of siphon each with a strongly developed sclerotised hook with a small or large denticle or denticles at base. Ventral valves each with a very long seta. A larva from Celebes (Bolaang Mongondon), provisionally attributed to this species, differs in its even paler general colouration and in having the fringe on the comb teeth rather better developed (Fig. 11b). The antennae are missing. It has well developed hooks on the dorsal valves and was found in a "Pistia" pond.

*Breeding places.* Always, so far as is known, among *Pistia* (see Iyengar, 1935).

*Egg.* (Fig. 11c). Described and figured by Iyengar (1935). The eggs are laid in small groups on the under surface of *Pistia* leaves. It is said that, unlike the eggs of *Mansonia* spp., they do not occur on the submerged parts of the leaves. Hatching is by dehiscence of the apical cap.

For other morphological details of all stages see under genus, subgenus and species group and in keys.

**DISTRIBUTION.** Bengal, Orissa, Travancore, Assam (Barraud, 1934: 118), Hyderabad (Qutubuddin, 1951: 31), Ceylon (Carter, 1950: 88), N. Thailand (Causey, 1937: 411, Thurman & Thurman, 1955: 222), S. Thailand (Iyengar, 1953: 746), Malaya (B.M.), Singapore (Edwards & Given, 1928: 349), Java, Dutch Borneo, Celebes (Brug & Bonne-Wepster, 1947: 183), Bali (B.M., not previously recorded), Cochin China (U.S.N.M., not previously recorded), Tonkin (Galliard & Ngu, 1949: 496), Hong Kong (MacFarlane, 1915: 67). I have seen specimens from all these territories except Ceylon and Thailand. I have seen only one whole larva from Celebes. (See above.)

Dutch New  
Guinea. Van  
den Assem 1958  
: 31.

Hainan, Feng I  
1958: 110

### **Ficalbia (Ficalbia) ludlowae** (Brunetti)

*Ludlowia minima* Ludlow, *Canad. Ent.*, **39**: 413, 1907, *partim*, female only. (Preoccupied by *Uranotaenia* (= *Ficalbia*) *minima* Theobald, 1901).

*Ficalbia ludlowi* Brunetti, *Rec. Indian Mus.*, **17**: 173, 1920. (*Nom. nov.*).

*Ficalbia ludlowi* Dyar & Shannon, *Insec. Inscit. menstr.*, **13**: 83, 1925.

**TYPE:** holotype ♀, Carandaugan, Mindanao, in U.S.N.M. (See Stone and Knight, in prep.).

This species was formerly treated as synonymous with *F. hybrida* (Edwards, 1932: 111, Barraud, 1934: 111). Bohart (1945: 39) noted certain colour differences and preferred to treat it as a distinct species while retaining it in the subgenus *Mimomyia*. I have not

seen the types, which are in Washington, but it is perfectly clear from details supplied to me by Dr. Alan Stone that the female is a *Ficalbia* s. str. Dr. Stone has kindly agreed to mark this specimen as the holotype and to publish it elsewhere. The male is apparently a *Mimomyia* and is here returned, provisionally, to the synonymy of *F. hybrida*. The following description of the female is based on the original description by Ludlow, Bohart's notes on colouration and details supplied by Dr. Stone.

*Adult* ♀. First segment of antennal flagellum more than three times as long as the second (about 3.25 to 4.5 times as far as can be seen). Decumbent scales of vertex yellowish, upright scales restricted to nape. Scutellum with narrow scales. Pleura mainly dark. Alula with narrow scales. Upper fork cell about 1.5 times as long as its stem. Legs dark with apical pale spots on femora and tibiae. Fore tibial claw not seen (possibly broken off). Abdomen with narrow ochraceous basal bands on the tergites widening into basal lateral spots. Sternites mainly pale. Spermatheca single.

A unique female adult from Java (Batavia, iv: 1929, S. L. Brug), now in the British Museum, is provisionally attributed to this species. It agrees well in having the first flagellar segment, four times as long as the second. It resembles *F. jacksoni* in many respects but differs from this species (and agrees with *F. ludlowae*) in having narrow yellowish basal bands on the abdominal tergites. In *F. jacksoni* the tergites are dark except for small and inconspicuous basal lateral patches visible from above only on some posterior segments. The Java specimen also has a slightly smaller fore tibial claw than *F. jacksoni* (Fig. 4e). It has the upper mesepimeral setae continued down the posterior edge of the mesepimeron as a row of very delicate hairs. The only known specimens of *F. jacksoni* have the pleurae in too poor condition for the presence or absence of such hairs to be determined with certainty.

*Early stages and breeding places.* These are unknown but from the resemblance of the adult to *F. jacksoni* it may be conjectured that they resemble those of this species rather than those of *F. minima*.

It has already been noted (p. 10) that *F. minima* resembles the Ethiopian *F. malfeyti* in breeding among *Pistia* and in the presence of sclerotised hooks on the dorsal valves of the siphon while *F. jacksoni* resembles the Ethiopian *F. uniformis* in breeding among vertical vegetation and in the absence of such hooks. Although they are placed in distinct species groups (p. 25) the two species pairs share a further remarkable series of parallel morphological characters. Thus in *F. minima* and *F. malfeyti* the antenna is dark at base and apex only (Fig. 11, p. 28), the clypeal spines tend to be more strongly denticulate, the comb teeth are stouter and have a narrower fringe, the first flagellar segment of the female antenna is somewhat shorter and the IXth abdominal tergite in both sexes has the lateral setal patches almost confluent (Fig. 10a, p. 27). In *F. jacksoni* and *F. uniformis*, on the other hand, the larval antenna is wholly or largely dark, the clypeal spines are simple or almost so, the comb teeth are more delicate with a broader fringe, the female first flagellar segment is longer and the lateral patches of setae on the IXth tergite are

well separated. It is interesting, and probably significant, to note that in addition to its other resemblances to *F. jacksoni* the Java specimen here provisionally attributed to *F. ludlowae* has the first flagellar segment and IXth abdominal tergite almost identical (Fig. 10b).

DISTRIBUTION. Philippine Is. (Mindanao), ? Java.

The record from Java is based on a unique female adult.

### **Ficalbia (Mimomyia) chamberlaini** (Ludlow)

*Mimomyia chamberlaini* Ludlow, *Canad. Ent.*, **36**: 297, 1904.

*Radioculex clavipalpus* Theobald, *Rec. Indian Mus.*, **2**: 295, 1908.

*Conopomyia metallica* Leicester, *Stud. Inst. med. Res. F.M.S.*, **3**(3): 113, 1908.

*Ficalbia chamberlainii* Dyar & Shannon, *Insec. Inscit. menstr.*, **13**: 83, 1925.

? *Ficalbia (Mimomyia) flavens* King & Hoogstraal, *Proc. ent. Soc. Wash.*, **48**: 188, 1946.

TYPES: *chamberlaini*, holotype ♂, Bayamban, Luzon, in B.M. (not in U.S.N.M. as stated by Barraud, 1934: 108. See Mattingly & Grjebine, in press), *clavipalpus*, cotype ♂ & ♀, Calcutta, in Indian Museum, *metallica*, hololectotype ♂ and allolectotype ♀, Kuala Lumpur, in B.M. (see Mattingly & Grjebine, in press), *flavens*, holotype ♂, Hollandia, Dutch New Guinea, in U.S.N.M.

*Adult* ♀. Wing length about 3 mm. Proboscis paler on about the basal two thirds, especially below, the apical third somewhat swollen. Palps about a fifth to a quarter of the length of the proboscis, largely dark. Basal joint of antennal flagellum about 2.5 times as long as the second joint. Decumbent scales of vertex broad, flat, yellowish. Some specimens have a well marked patch of darker scales with violet reflection to either side of the mid line in front. In others this colouring is less conspicuous or absent. Erect scales broad, dark, restricted to nape. Integument of scutum dark except along the lateral edges where it is clear yellow (only very narrowly so in front of the scutal angle). A broad lateral band of narrow bright golden scales runs back from the scutal angle to the posterior border. Prescutellar bare space usually with a border of narrow golden scales but this is very variable in extent (see p. 35). Remainder of scutum covered with narrow, curved, dark brown scales. Anterior and posterior pronotum devoid of scales. Scutellum with rather scanty, narrow, dark brown scales. Pleurae with a small patch of loosely attached broad golden scales on the sternopleura. Pleural integument pale yellowish brown. Mesepimeron without hairs other than those in the usual upper mesepimeral patch. Postnotum dark, somewhat paler at the sides. Wings with the broad plume scales scanty though some are present on the distal half. (The statement by Edwards (1941: 75) to the effect that in this subgenus the veins are "nearly bare except towards tip of wing" applies only to the plume scales. They have the normal complement of small flat squame scales). Anterior fork cell about three fifths to four fifths of the length of its stem. (The statement by Barraud (1934: 107) that this cell is "only about half length of stem" is extremely misleading and has caused much confusion. It may be presumed

to have been based on guess work. Some degree of optical illusion is involved and it is essential to employ a micrometer eyepiece). Halteres largely pale, the outer surface of the knob somewhat darkened. Fore femur yellowish, darker towards tip. Mid femur dark in front with pronounced violet reflection, pale behind. Hind femur more or less darkened in front, paler behind. Tibiae and tarsi with violet reflection. Fore tibia, in some cases, with a small apical pale spot. Hind tibia broadly pale at tip. First two fore and mid tarsals pale at base and tip, third pale at base and sometimes at tip, fourth sometimes pale at base. Hind tarsi with pale rings embracing all joints. Fifth hind tarsal pale. Fore tibial claw as in Fig. 4a (p. 11). Abdomen with tergites mainly dark with violet gloss, pale markings various (see p. 34). Sternites yellow. Terminalia with postgenital plate slightly more strongly bilobed than in *F. minima*. IXth tergite with lateral groups of setae well separated (Fig. 10c, p. 27).

*Adult ♂*. Much as female but with palps about one fifth as long again as the proboscis which is rather more strongly swollen on the distal third. Last joint of palps strongly swollen and with numerous setae on ventral surface and at tip. Proboscis pale almost to tip. Terminalia (Fig. 9b, p. 22) with basal lobe of coxite rather more sharply defined than in *F. minima* and IXth tergite of markedly different shape. Style about seven tenths of the length of the coxite.

*Pupa*. Trumpets (Fig. 6b, p. 14) about fifteen times as long as their breadth at half way. Meatus tracheoid, occupying about five sixths of the total length. Palmate hair of first abdominal segment well developed (Fig. 3b, p. 9). Seta 7 of segment VIII very small, bifid or trifid (Fig. 6b). Paddles (Fig. 6b) about twice as long as their greatest breadth, infuscated except for a clear area occupying about the basal three quarters of the outer quarter, with a fringe of narrow, dark, widely spaced teeth extending well onto the inner border. Apical seta very small, unbranched. Accessory seta apparently absent. Genital sac of male somewhat wrinkled but without spicules, of female with strongly pigmented spinose tip (Fig. 6b). Posterior corners of segment VIII produced into a small horn.

*Larva*. Head very dark brown, remainder pale brown. Antenna variously pigmented (see p. 34). Clypeal spines moderately slender, dark, simple. Head seta A with numerous stout, strongly plumose branches, B very long, more than half as long again as A, with about 3-6 branches. (Barraud, 1934: 110, says 2-4 but this appears to be an error since neither his specimens nor any others seen by me agree.) C similar to B with about 4-8 branches (for variation in this and seta B see p. 35). Maxilla with stout, dark simple spine. Comb a row of about 10-23 narrow scales with, usually, a distal row or rows of about 1-10 similar scales (see p. 35). Siphonal index about 4.5-5.0. Pecten of one to three small, simple teeth on either side, the two sides together totalling from 2 to 5 spines (see p. 35). Subventral tuft arising at or somewhat before half way. Dorsal valves each with a small, sinuous spine with a secondary denticle or denticles near the base (Fig. 12). Ventral valves with very long setae.

*Breeding places.* Ground pools and ponds, usually with abundant vegetation, often among *Pistia* but without obligatory association with this or other plants (Iyengar,

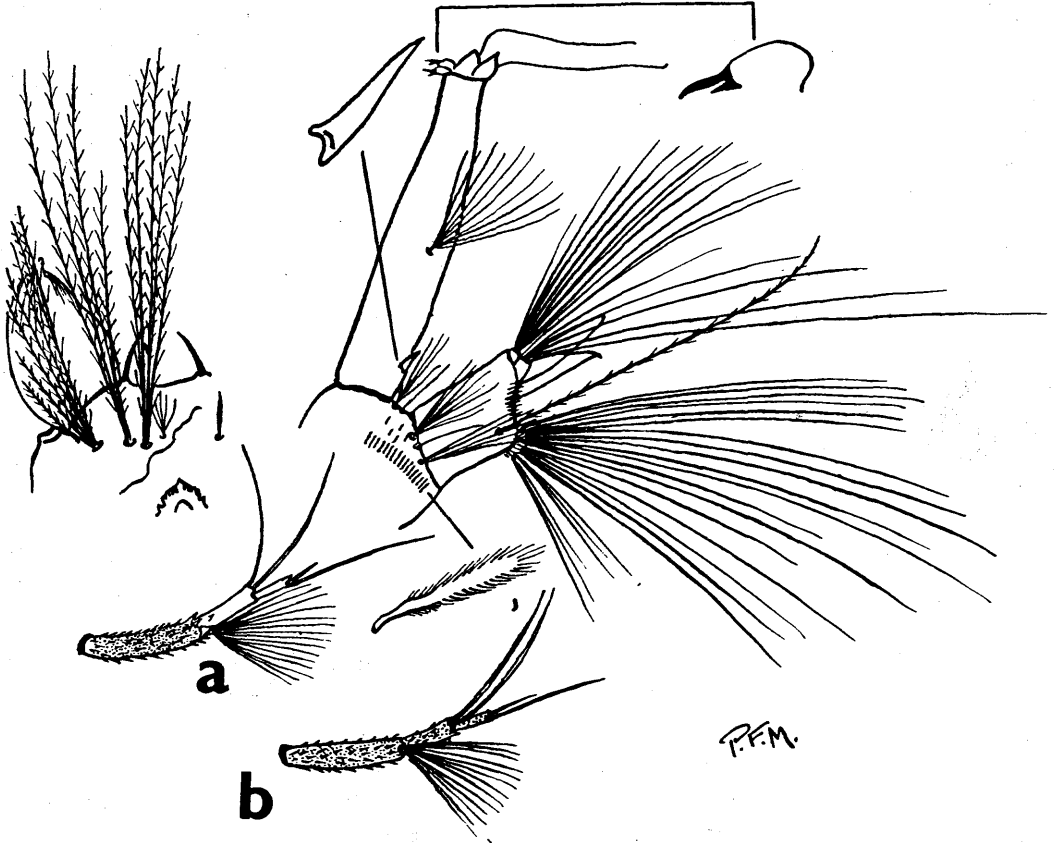


Fig. 12. *F. chamberlaini*. Larva. Head and terminal segments. a. Antenna of specimen from India, b. Antenna of specimen of var. *metallica* from Malaya.

1935: 425), grassy swamp (as *Mimomyia metallica*, Edwards & Given, 1928: 349), grassy pool (as sp. indet., King & Hoogstraal, 1946: 188, see p. 36).

**DISTRIBUTION.** Punjab, Peninsular India, Burma (Barraud, 1934: 111), Travancore (Iyengar, 1935: 425), Hyderabad (Qutubuddin, 1951: 31), Ceylon (Carter, 1950: 88), N. Thailand (as *F. chamberlaini* and *F. metallica*, Thurman & Thurman, 1955: 222), Malaya (as *F. metallica*, Leicester, 1908: 114, Edwards, 1928: 56 and see p. 35), Singapore (as *F. metallica*, Edwards & Given, 1928: 349), Sumatra (as *F. metallica*, Brug, 1931: 15), Java (as *F. chamberlaini* and *F. metallica*, Brug & Bonne-Wepster, 1947: 183), Celebes, Kabaena (as *F. chamberlaini* only, Brug & Bonne-Wepster, *loc. cit.*), Tonkin (as *F. metallica* and ? *F. chamberlaini*, Galliard & Ngu, 1949: 497, 498), Philippine Is. (Luzon) (Ludlow, Hawaiian, Feng-I, 1958: 110).

1904: 299, Bohart, 1945: 39 and see below, Taiwan (U.S.N.M., not previously recorded, see p. 36), Dutch New Guinea (B.M., not previously recorded, and (?) as *F. sp. indet.* and *F. flavens*, King & Hoogstraal, 1946: 188, 190, see p. 36), Queensland (as *F. metallica*, Taylor, 1929: 273, Lee, 1944: 44); ~~Dutch New Guinea, Van den Assen, 1958: 131.~~

I have seen specimens from India, Ceylon, Thailand, Malaya, Singapore, Sumatra, Java, Celebes, Tonkin, Philippine Is., Hong Kong, Taiwan, New Guinea and Queensland.

*Variation:* Barraud (1929: 1055) distinguished as var. *intermedia* a form from Assam having larger basal lateral yellow patches on the tergites than in the Indian form. The male style is also a little longer than in the latter (about three quarters of the length of the coxite vs. about seven tenths of this length). Females of this form have faintly indicated, but quite definite, pale median apical markings on the tergites (not mentioned by Barraud). In this respect they approach var. *metallica* more closely than the type form *F. chamberlaini*. Barraud suggested that var. *intermedia* might be the same as the type form from the Philippines since Ludlow (1904: 298) describes the latter as having "very large basal lateral light spots". In Ludlow's type, however, these spots are artefacts caused by denudation of the light coloured abdominal integument. Nor do any other Philippines specimens seen by me show true basal lateral pale spots of the kind seen in *F. intermedia*. In my *F. chamberlaini* from all parts of the range these spots are very small and scarcely visible from above although they are frequently prolonged backwards at the extreme sides of the tergites and may form a continuous pale longitudinal line in this region. In my view *F. intermedia* should be treated as a distinct species until more is known about it. (For note on types see Mattingly & Grjebine, in press). This form was recorded from Ceylon in addition to the type form by Carter (1950: 88).

The Indian form of *F. chamberlaini* (= *Radioculex clavipalpus* Theobald) differs from other forms, so far as can be judged from the limited material available to me, in a number of interesting partial characters of the larva. Thus the antenna is constantly pale on the distal segments in Indian larvae (Fig. 12a, p. 33) while in most Indomalayan specimens it is wholly dark. However, I have one larval skin with the Indian type of antenna from Malaya and it may be presumed that the larvae from Tonkin provisionally assigned to *F. chamberlaini* by Galliard & Ngu (1949: 497) also had antennae of this type. It is interesting to find that the Malayan skin is associated with the only adult which I have from that territory with complete suppression of median pale markings on the abdominal tergites. This is, however, of doubtful significance since the U.S. National Museum has adults from the Philippines with complete suppression of these markings associated with larval skins having wholly dark antennae. Other differences between the Indian form and those occurring in the Indomalayan and Australian areas are shown in Table I. Details of the Australian form are from Lee (1944: 44) and are based on Queensland material only. I have not seen any Australian larvae. The details given for the Indomalayan form are based on material from Malaya, Java, Hong Kong and the Philippines. The number of long spicules on the distal edge of the saddle is to some extent a matter

of subjective estimate since some spicules are of intermediate length. However, the difference seems quite clear and constant. (It was also noted, though in rather different terms, by Edwards & Given, 1928: 349).

Table I  
Larval characters in *F. chamberlaini*

	India and Ceylon	Indomalayan area	Australia
No. of branches in head seta B. ... ..	5-6	3-5	4
No. of branches in head seta C ... ..	6-7	4-6	5
No. of teeth in distal row(s) of comb ... ..	0-2	1-9	10
No. of long spines on edge of saddle (approx.) ...	14-18	16-24	?
No. of pecten teeth (both sides together) ...	3-5	2-3	3

It may be felt that these differences justify distinguishing the Indian form as a separate subspecies. The Australian form, on the other hand, does not appear to show significant differences, though I have not had the opportunity to study it in detail.

The question of variation within the Indomalayan area requires further consideration since it involves the difficult question of the status of the two forms which have hitherto been treated as distinct species under the names *F. chamberlaini* and *F. metallica*. In my view these are two forms of the same polymorphic species. The classical diagnostic character has been the occurrence in *F. metallica* of median pale markings on the abdominal tergites and the absence of such markings in *F. chamberlaini*. In Malaya complete intergradation between these conditions has been found to occur. I have specimens with a more or less continuous pale median line on the abdomen, others with this line reduced to one or two small spots on posterior tergites and one with abdomen completely dark above. As already noted (p. 34), this last specimen is associated with a larval skin having the distal part of the antenna pale while all my other Malayan larvae have the antenna entirely dark. This is another traditional distinction between *F. chamberlaini* and *F. metallica* and were no other evidence available one would be inclined to attribute the one specimen to the first species and the remainder to the second. As against this, however, Philippines specimens with all dark abdomen have larvae with all dark antenna. Other larval differences noted by Edwards & Given are dealt with in Table I. It will be seen that at best they are partial differences and they seem to represent differences between the Indian and Indomalayan forms rather than between *F. chamberlaini* and *F. metallica* as such. The only significant larval variation within the Indomalayan area appears to be the occurrence of an unusually small number of branches in head seta B<sub>2</sub> of the Philippines form (3-5, not less than 4 elsewhere) and a tendency for Malayan larvae to approximate to the Indian form in the reduced number of teeth in the distal row(s) of the comb (1-8, 3-10 elsewhere) and rather less strongly developed spiculation of the saddle edge. In the adult the only notable colour variation concerns the scaling of the prescutellar area.

In most cases this is quite extensively pale scaled. Malayan forms, however, tend to have the pale scaling greatly reduced or even absent and my one New Guinea specimen has this area wholly or largely dark. Australian specimens appear regularly to have this area very extensively pale scaled but I have seen individual specimens with it equally pale from Sumatra, Java and Tonkin. I do not think this variation is taxonomically significant.

In view of the striking difference in appearance between well marked specimens of *F. chamberlaini* and *F. metallica* it has seemed to me desirable to distinguish the latter as var. *metallica*, using the term "var." in the same sense as Edwards (1941: 2) as indicating "bridged variation in one area" as against the geographically representative variation associated with subspecies. This is a relatively precise definition of the term and in my view it justifies the traditional practise among mosquito workers of according varietal names the same treatment with respect to nomenclatorial priority as that applied to species and subspecies. The term "form" is used here in a different sense (p. 41) as indicating a group of specimens agreeing in salient features but whose status cannot be reliably assessed owing to the inadequacy of the available material. It is used in somewhat the same sense by Colless (1956: 37) with perhaps more emphasis in his case on the essential homogeneity of the material.

The known distribution of the four members of the *F. chamberlaini* complex which are here recognised is as follows:

*F. chamberlaini* ssp. *clavipalpus*. India, Ceylon.

*F. intermedia*. Assam.

*F. chamberlaini* s. str. Thailand, Malaya, Java, Celebes, Philippines.

*F. chamberlaini* var. *metallica*. Thailand, Malaya, Sumatra, Java, Tonkin, Philippine Is. (Luzon, 1 rather poor specimen in the U.S. National Museum, not previously recorded), Taiwan (very well marked specimens in the U.S. National Museum, not previously recorded), Dutch New Guinea (well marked specimen from Negeri Besar on the south coast of the Vogelkop, presented to B.M. by Dr. Bonne-Wepster, not previously recorded), Queensland.

It is possible that *F. chamberlaini* may be more widely distributed than here appears. The record of this species from Tonkin (Galliard & Ngu, 1949:497) is not included here as it is based on larvae only. It may well be genuine as I have in no case seen a larva with pale antenna associated with an undoubted adult of var. *metallica*. The only available specimen from Hong Kong, a larva with dark antenna, could equally well belong to either form. It may be inferred that the type, and only known specimen, of *F. flavens* from New Guinea has a wholly dark dorsum to the abdomen though this is not clearly stated (King & Hoogstraal, 1946:188). If so, it is probably *F. chamberlaini* s. str. Dr. Belkin has examined the unassigned larva found in the same locality (King & Hoogstraal, *loc. cit.*). He informs me that it undoubtedly belongs to the *F. chamberlaini* group although he is unwilling to assign it further as it is a third instar specimen only.

It will be seen that a dark abdomened form is the only one occurring in the extreme western part of the range (Peninsular India) while the form with striped abdomen is the only one occurring in the extreme eastern part (Queensland). A similar situation exists in *Etorleptomyia* and it may be thought to indicate that the present situation in *F. chamberlaini* has arisen by the overlapping of two previously geographically (but not reproductively) isolated forms, i.e. that *F. chamberlaini* and var. *metallica* are two subspecies, the geographical barrier between which has broken down so that they now represent no more than rather ill defined climatypes. Very much more material is however needed before this can be put forward as more than a most tenuous hypothesis.

### **Ficalbia (Mimomyia) aurea** (Leicester)

*Conopomyia aurea* Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3):116, 1908.

TYPES: holotype ♀, Raub, Malaya; allotype ♂, Kuala Lumpur; both in B.M. (see Mattingly & Grjebine, in press).

*Adult* ♀. Resembles *F. chamberlaini* in the general yellow and violet colouration but differs as follows. Palps about three tenths to a third of the length of the proboscis, mainly bright golden yellow with a small dark spot at extreme base and another of variable extent at the base of the terminal segment. Upright scales of occiput more numerous, paler, extending further forward onto the vertex although still confined to the base of the head. Upper part of posterior pronotum with numerous broad flat scales. A number of delicate hairs present on posterior border of mesepimeron, forming a ventral extension of

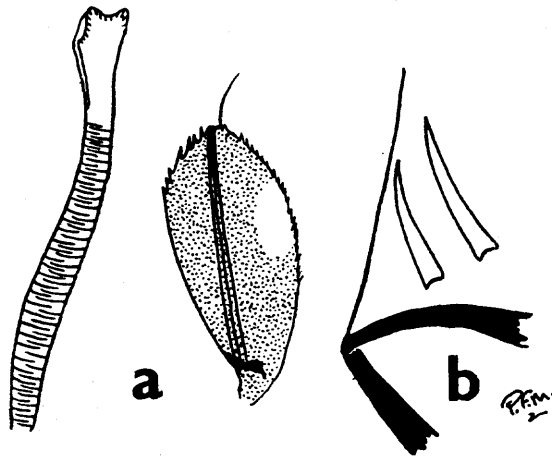


Fig. 13. *F. aurea*. a. Pupal trumpet and paddle, b. Larval pecten.

the upper mesepimeral setal patch (Fig. 7b, p. 19). Anterior fork cell up to about 0.85 times the length of its stem. Mid tibia with a well marked whiteish spot at tip. Mid and hind

femur each with a small silvery spot at tip. Pale tarsal bands decidedly broader. Abdominal tergites with broad yellow basal bands, constricted in the middle on anterior segments.

*Adult* ♂. Terminalia with style about three fifths of the length of the coxite. IXth tergite (Fig. 14a), perhaps slightly broader. The early stages have not previously been described. The following description is based on a larval and pupal skin, with associated adult, a whole pupa and eight whole larvae from Chabua, Assam (28:vii:1943 and 3:viii:1943, D. E. Hardy) in the U.S. National Museum.

*Pupa*. Differs from that of *F. chamberlaini* as follows. Trumpets (Fig. 13a) broader, about 13 times as long as their breadth at half way. Paddles dark except for a small pale area on the distal half of the outer edge.

*Larva*. (Fig. 13b). Closely resembles that of *F. chamberlaini* but differs in having the head paler and the pecten teeth more delicate. Head not much darker than the rest of the larva. Antenna pale beyond tuft. Head seta B with 3 branches, C with 4 in those specimens in which they have been preserved. Comb with more numerous teeth, apparently with 7-15 forming one to two distal rows in addition to the main row. Pecten of teeth which are rather more slender than in *F. chamberlaini*.

*Breeding places*. A marsh.

**DISTRIBUTION.** Assam (U.S.N.M., not previously recorded), N. Thailand (Thurman & Thurman, 1955:22), S. Thailand (Iyengar, 1953:746), Malaya (Leicester, 1908:117, Edwards, 1928:56), Singapore (Colless, in litt.), North Borneo (Moulton, 1914:48).

I have seen specimens from Assam, Malaya and Borneo.

### **Ficalbia (Mimomyia) hybrida** (Leicester)

*Conopomyia hybrida* Leicester, *Stud. Inst. med. Res. F.M.S.*, 3 (3):115, 1908.

No. 1 undetermined species Leicester, *Ibid*, 3(3):260, 1908.

? *Ludlowia minima* Ludlow, *Canad. Ent.*, 39:413, 1907 (*partim*, male only).

? *Ficalbia ludlowae* Brunetti, *Rec. Indian Mus.*, 17:173, 1920, (male only, nom. nov. for *Ludlowia minima* Ludlow).

? *Ficalbia (Mimomyia) modesta* King & Hoogstraal, *Proc. ent. Soc. Wash.*, 48:186, 1946.

**TYPES:** *hybrida*, holotype ♂, Kuala Lumpur, in B.M. (see Mattingly & Grjebine, in press), *minima*, holotype ♀ and allotype ♂, Carandaugan, Mindanao, in U.S.N.M. (see Stone & Knight, in press), *modesta*, holotype ♂ and allotype ♀, Hollandia, Dutch New Guinea, in U.S.N.M.

This is a very different species from the two previous ones and should probably be placed in a distinct species group (see p. 25).

*Adult* ♀. Differs from *F. chamberlaini* as follows. Palps from about one sixth to a quarter of the length of the proboscis. Scutal integument dark brown. Scutal scales mainly dark but some pale ones present along anterior border, at sides of prescutellar bare space and (? always) together with dark ones on the scutellum. These pale scales are

whiteish or creamy, not yellow. Dorsocentral bristles present, few in number but strongly developed. Upper part of posterior pronotum with numerous dark scales. Anterior fork cell of wing from about seven tenths of the length of its stem to about equal to it (see p. 41). Fore femur pale in front on about the basal half, darker distally. Mid femur with anterior surface pale for a short distance at base, narrowly pale beyond this to tip. Hind femur with anterior surface pale on about the basal half, pale below to tip. All tibiae with small pale spots at tip. First tarsals narrowly pale at base or all dark (see p. 41). Remaining tarsals entirely dark. First abdominal tergite dark, second with a small median basal pale spot or all dark, remainder either with basal lateral pale patches which are larger on the posterior segments or with narrow basal pale bands (see p. 41). In the darkest forms the pale lateral patches may be very inconspicuous. Terminalia much as in *F. chamberlaini* but lateral setal patches on IXth tergite perhaps with setae less numerous (one on one side and three on the other in the specimen examined).

*Adult* ♂. As ♀ but with palps about one fifth as long again as the proboscis and the latter somewhat more strongly swollen. Anterior fork cell from about seven tenths of the

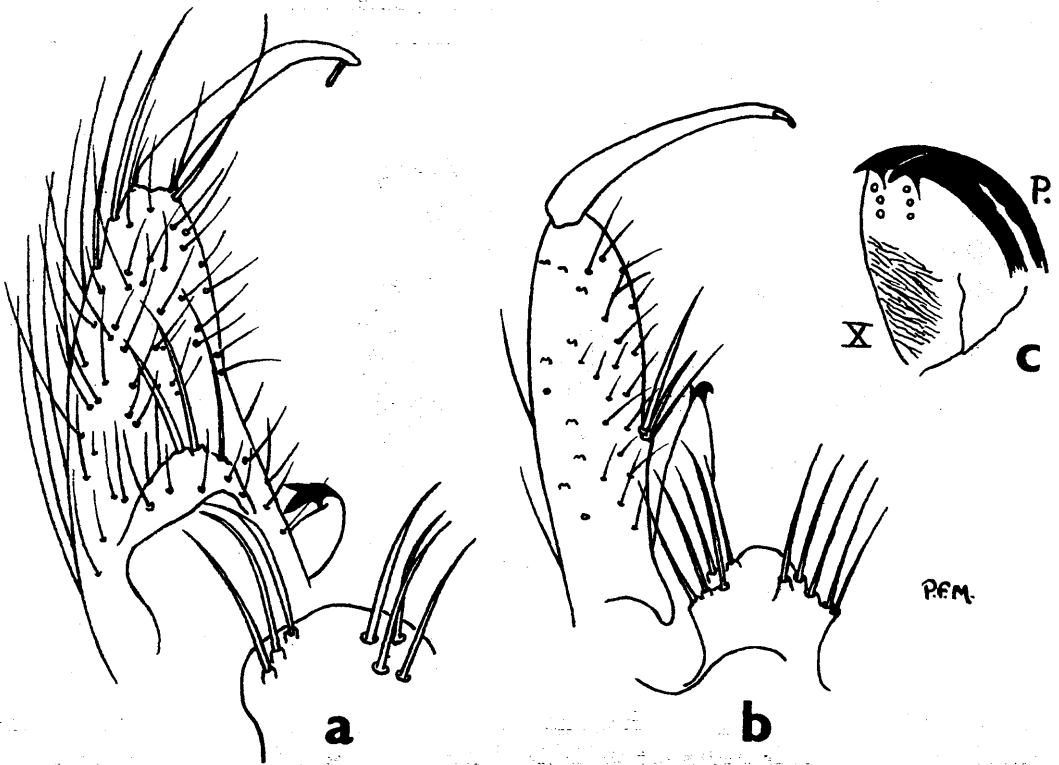


Fig. 14. Male terminalia. a. *F. aurea*, b. *F. hybrida*, c. Paraproct and Xth tergites, *F. deguzmanae*.  
p. Paraproct, X. Xth tergite.

length of its stem to almost equal to it (see p. 41). Terminalia with style about two thirds of the length of the coxite. IXth tergite decidedly narrower than in *F. chamberlaini* (Fig. 14b).

*Pupa.* Easily recognised from that of any other oriental mosquito, outside the genus *Mansonia*, by the modified trumpets (Fig. 6c, p. 14). Distinguished from *Mansonia* spp. by the shape of the paddles and structure of the paddle fringe (Fig. 6c) and by the relatively well developed seta 1 of the first abdominal segment. The principal setae of all the abdominal segments are also markedly different but the very poor state of the available material precludes a detailed description. The trumpets appear to be about 14 times as long as their breadth at half way (uncrushed) but are badly crushed in the available specimens. The paddles are about twice as long as their greatest breadth. They are uniformly dark and are minutely spiculate over their whole surface. Apical and accessory paddle setae not seen. Genital sac of female lightly spiculate, especially on the apicolateral corners, of male not seen. Distal corners of VIIIth segment not clearly visible.

*Larva.* Like the pupa this is known to me only from a few specimens from Java. It is clearly distinguished from all other oriental larvae, other than those of genus *Mansonia*, by the modified siphon and antenna (Fig. 15). From larvae of *Mansonia* it is easily distinguished by the much longer and more conspicuous head setae B and C.



Fig. 15. *F. hybrida*. Larval head and terminal segments.

Other details are as follows. Head not apparently very dark, though darker than the remainder. (No whole larvae are available to me). Clypeal spines long, simple, rather pale. Head seta A with about 13 branches, B with 3, C with about 5-8. Mentum of normal type. Maxillary spine longer than in *F. chamberlaini* (cp. Fig. 12, p. 33, and Fig. 15)

and much paler. Comb a row of about a dozen scales. In my three skins, which were also seen by Barraud, there seems to be an indication of a distal row formed by two detached scales. However, these skins are very wrinkled and Barraud (1934:112) and Bonne-Wepster (1932:72) mention only a single row. The figure given by Galliard & Ngu (1949:496, Fig. 1) suggests a single irregular row. Pecten of two very widely separated spines. Siphonal valves very strongly sclerotised and much reduced, the dorsal valves without spines and the ventral without setae.

*Breeding places.* Ground pools, always with *Pistia* (Bonne-Wepster, 1932:72, Iyengar, 1935:425).

*DISTRIBUTION.* Bengal (Senior-White, 1934:563), Bihar, Assam (Barraud, 1934:113), Travancore (Iyengar, 1935:425), Hyderabad (Qutubuddin, 1951:31), Ceylon (Carter, 1950:88), N. Thailand (Thurman & Thurman, 1955:222), Malaya (Leicester, 1908:116, 260), Singapore (Leicester, 1908:116), Sumatra (Dr. Bonne-Wepster's collection, not previously recorded), Java, Celebes (Brug & Bonne-Wepster, 1947:183), North Borneo (Labuan, per Dr. E. N. Marks, not previously recorded), Tonkin (Galliard & Ngu, 1949:495), ? Philippine Is. (Mindanao, Ludlow, 1907:414, as *Ludlowia minima*), ? Dutch New Guinea (King & Hoogstraal, 1946:186, as *F. modesta*).

I have seen material from Bengal, Thailand, Malaya, Sumatra, Java, Borneo, Celebes and New Guinea.

*Variation.* At least three forms can be distinguished. In my view the available material, particularly of early stages, is inadequate to permit a satisfactory assessment of their status. The three forms are as follows:—

*Form 1.* This is the type form. It includes Leicester's type male and also his "No. 1 undetermined species". It is distinguished by the presence of uniform narrow pale basal bands on the abdominal tergites and the relatively short anterior fork cell of the wing (from about 0.7 to 0.9 times the length of its stem). The posterior pronotum has numerous narrow scales above and broader, flat scales below. The scutellum has mainly narrow curved scales with some broader flat ones in addition. Distinct pale spots are present at the bases of the first tarsal segments of all the legs.

*DISTRIBUTION.* India, Thailand, Malaya, Celebes.

*Form 2.* Differs from Form 1 in having the pale basal bands on the abdominal tergites replaced by small pale basal lateral spots.

*DISTRIBUTION.* Malaya, Sumatra, Java.

*Form 3.* Differs from Form 2 in the longer anterior fork cell (equal to or very slightly longer than its stem in the female) and the suppression of the pale spots at the bases of the first tarsal segments.

*DISTRIBUTION.* North Borneo, ? Philippine Is., ? New Guinea; ~~Malaya, Form 1, (1958:110)~~

The type male of *F. ludlowae* is provisionally placed here since Dr. Stone informs me that its anterior fork cell is very nearly as long as its stem (about 6.0:6.2). It is in very poor condition. Ludlow's description (1907:413) would suggest that the abdominal

tergites had narrow basal bands in which case it would be annectent between forms 1 and 3. Bohart (1945:39) was unwilling to include this specimen in the synonymy of *F. hybrida* owing to certain colour differences from Leicester's description. However, Leicester (1908:114) is misleading in his description of the pleurae which are pale to mid brown, the posterior pronotum and postspiracular area being darker. The general colouration of the vertex varies somewhat from one specimen to another owing to variation in the size and depth of colour of the rather indistinct submedian dark patches which are characteristic of all the oriental species of *Mimomyia*. In the type these patches are rather unusually well developed so that the vertex appears largely pale brownish whereas in some other Malayan specimens it appears creamy. In my view a tentative attribution of this specimen to *F. hybrida* is reasonable. The type female is quite different and clearly belongs in a different subgenus (p. 30).

According to King & Hoogstraal (1946:186) *F. modesta* differs from Forms 1 and 2 of *F. hybrida* in the long anterior fork cell, suppression of the pale spots on the first tarsi and the presence of broad scales, only, on the posterior pronotum and scutellum. I can confirm these differences in part from the paratype female which, aside from a set of male terminalia, is the only specimen available to me. In this specimen, however, both the posterior pronotum and the scutellum are rubbed and since the narrow scales are more loosely attached than the broad ones they would probably have been lost even if they had originally been present. I do not think the validity of this character can be assessed without good fresh material. King & Hoogstraal also stress the presence of fine hairs on the lower half of the mesepimeron posteriorly. I have seen two or three fine hairs below half way on the posterior border of the mesepimeron of a few specimens of Form 1. They are very delicate and liable to be lost by rubbing. I should doubt that they are of much taxonomic value.

Specimens of the early stages of Form 1 from India are probably in existence and it is very desirable that they should be described. It is also desirable that an attempt should be made to find the early stages of the, possibly miscellaneous, forms here placed provisionally under Form 3. I have seen no specimens from Tonkin and so cannot place this form.

### **Ficalbia (Etorleptomyia) luzonensis (Ludlow)**

*Oreillia luzonensis* Ludlow, *Canad. Ent.*, **37**:101, 1905.

*Etorleptomyia completiva* Leicester, *Stud. Inst. med. Res. F.M.S.*, **3**(3):178, 1908.

*Ficalbia luzonensis* Dyar & Shannon, *Insec. Inscit. menstr.*, **13**: 83, 1925.

*Mimomyia* sp. Edwards & Given, *Bull. ent. Res.*, **18**:349, 1928.

*Aedes (Luzonus) clavirostris* Stone & Bohart, *Proc. ent. Soc. Wash.*, **46**:213, 1944.

TYPES: *luzonensis*, holotype ♀, Bayambang, Luzon, in U.S.N.M., *completiva*, holotype ♂, Singapore, in B.M., *clavirostris*, holotype ♂, Rizal, Luzon, allotype ♀, Pampanga, Luzon, in U.S.N.M.

Von dem ~~Reisem~~  
1955:131. Consider  
hybrida + modesta  
different.

*Adult* ♀. Wing length about 2.5 mm. Proboscis slightly swollen on about the apical one fifth, black all round at base for a distance equal to the length of the palps, remainder yellow with scattered black scales above and a very narrow black ring at tip. Labella pale. Palps about a sixth of the length of the proboscis, dark except for the extreme tips which are white and for one or two white scales at the tip of the subapical segment. Basal joint of antennal flagellum only slightly longer than the succeeding joint. Decumbent scales of vertex mostly narrow, curved, whiteish, a small patch of broad, flat, black scales at each side and outside this a patch of broad, flat, white ones. Upright forked scales large, extending fairly well forward, narrow and dark at base, broad and whiteish at tip. Scutum with integument dark, covered with numerous narrow, curved, dark brown and white or yellowish scales, the dark ones forming two well marked spots in front of the scutal angles and the pale ones occupying most of the median area and spreading outwards above the wing roots and back along the edges of the prescutellar bare space. Acrostichal and dorsocentral bristles present, the former rather few, the latter numerous. Scutellum with broad, flat, pale scales on all lobes and some narrow, curved ones present in addition on the lateral lobes. Some flat dark scales on median lobe. Anterior pronotum with broad pale

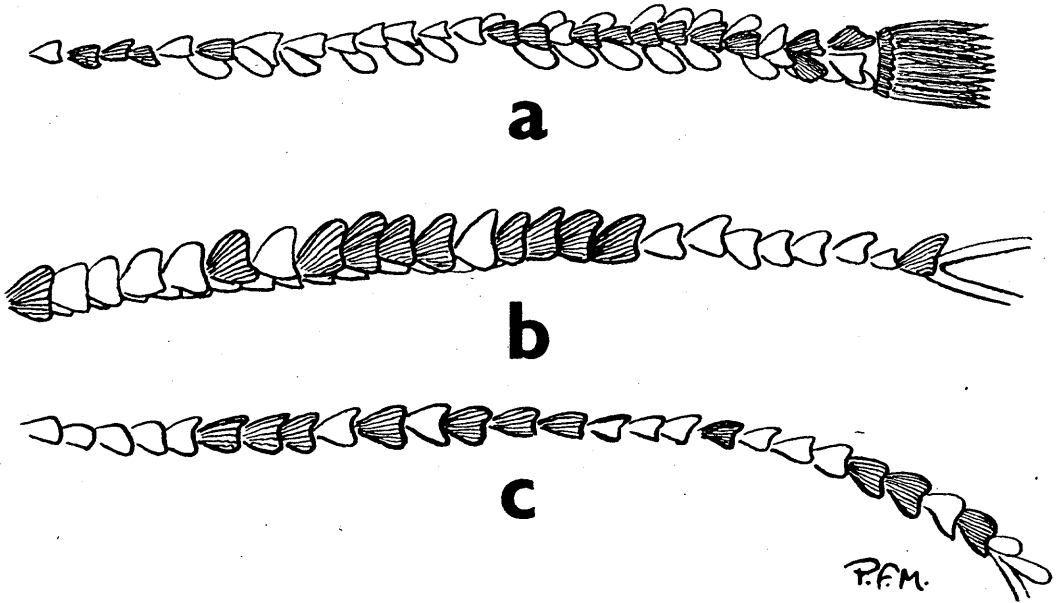


Fig. 16. *F. luzonensis*. Wing. a. Vein 3, b. Stem of vein 4, c. Vein 6.

scales and some narrow curved ones. Posterior pronotum covered with broad, flat, dark and pale scales, the dark ones predominating. Broad, flat, pale scales present on the post-spiracular area and prealar knob as well as on the body of the sternopleura. Some dark ones present in the upper sternopleural patch. Mesepimeral scales apparently confined to

a few on the upper part. Lower mesepimeral bristle absent. No hairs present on posterior border below the usual upper mesepimeral patch. Posterior pronotum, postspiracular area and anterior part of sternopleura dark, posterior part of sternopleura and mesepimeron pale. Postnotum mainly dark, somewhat lighter in the middle. Wing with very conspicuous dark and pale mottling. Vein 3 and fork of vein 4 with small pale and dark squame scales and numerous large pale plume scales. Stem of vein 4 with extremely large, asymmetrical, dark and pale squame scales. Stem of vein 5 and vein 6 with very large dark and pale heart-shaped squame scales (Fig. 16). Lower branch of vein 5 with small dark and pale squame scales, upper branch with squame scales larger, both with some plume scales. Veins 1 and 2 with dark and pale asymmetrical scales which tend to be larger on the central part of the wing and smaller towards the base and apex. Anterior fork cell about four times as long as its stem. Halteres with stem pale, knob mainly dark. Femora mainly dark in front with pale speckling, pale behind. Tibiae heavily speckled. First two tarsal segments yellowish with dark median and subapical markings which tend to coalesce but are clearly distinct on the second segments of the mid and hind tarsi (Fig. 18a, p. 47). Third, fourth and fifth tarsals with median dark rings, pale at base and tip. Fore tibial claw moderately developed. First abdominal tergite with mixed pale and dark scales. Other tergites mainly pale at the sides, with some dark scales, particularly in the posterolateral corners, the central portion dark, producing a continuous median longitudinal dark stripe. Venter pale with dark speckling. Terminalia (Fig. 10d, p. 27) with postgenital plate strongly lobed, IXth tergite only weakly sclerotised, its distal edge slightly concave, lateral bristles numerous and rather short. Spermatheca single.

*Adult ♂.* Much as female but proboscis strongly swollen on about the apical half, the swollen portion with pale and dark speckling, the narrow portion pale except at base. Palps about three quarters of the length of the proboscis, the shaft mainly yellow with scattered dark scales. Apical joint very short, dark with a subapical row of white scales and a few short bristles. Beyond these a few hairs and some narrow white scales. Terminalia (Fig. 9c, p. 22) with style about three fifths of the length of the coxite. IXth tergite fairly broad, very lightly sclerotised, its distal edge concave, the lateral setigerous lobes well separated, their setae very long.

*Pupa.* Trumpets about 25-30 times as long as their breadth at half way (Fig. 6d, p. 14). Meatus occupying about the basal five sixths, tracheoid from just beyond base to just below tip. Seta 1 of first abdominal segment short, rather stout and dark, single (Fig. 3a, p. 9). Setae 1 and 5 of segment VII each with about 3-4 branches. Seta 7 of segment VIII with about 8-11 branches. Paddles (Fig. 6d) a little more than four times as long as their greatest breadth with a continuous fringe of coarse teeth reaching nearly to base on both borders, pigmented at extreme tip only. Apical bristle single. Accessory bristle not seen. Genital sac of male with a well developed apical horn which is devoid of spicules, of female strongly spiculate (Fig. 6d). Posterolateral corners of segment VIII spiculate, slightly lobed.

Larva. (Fig. 17a). Described briefly by Edwards & Given (1928:349) as "*Mimomyia* sp." and provisionally attributed by them to *F. minima*. Head pale brown, not much darker than the body which in some cases has a reddish pigmentation (seen in one preserved

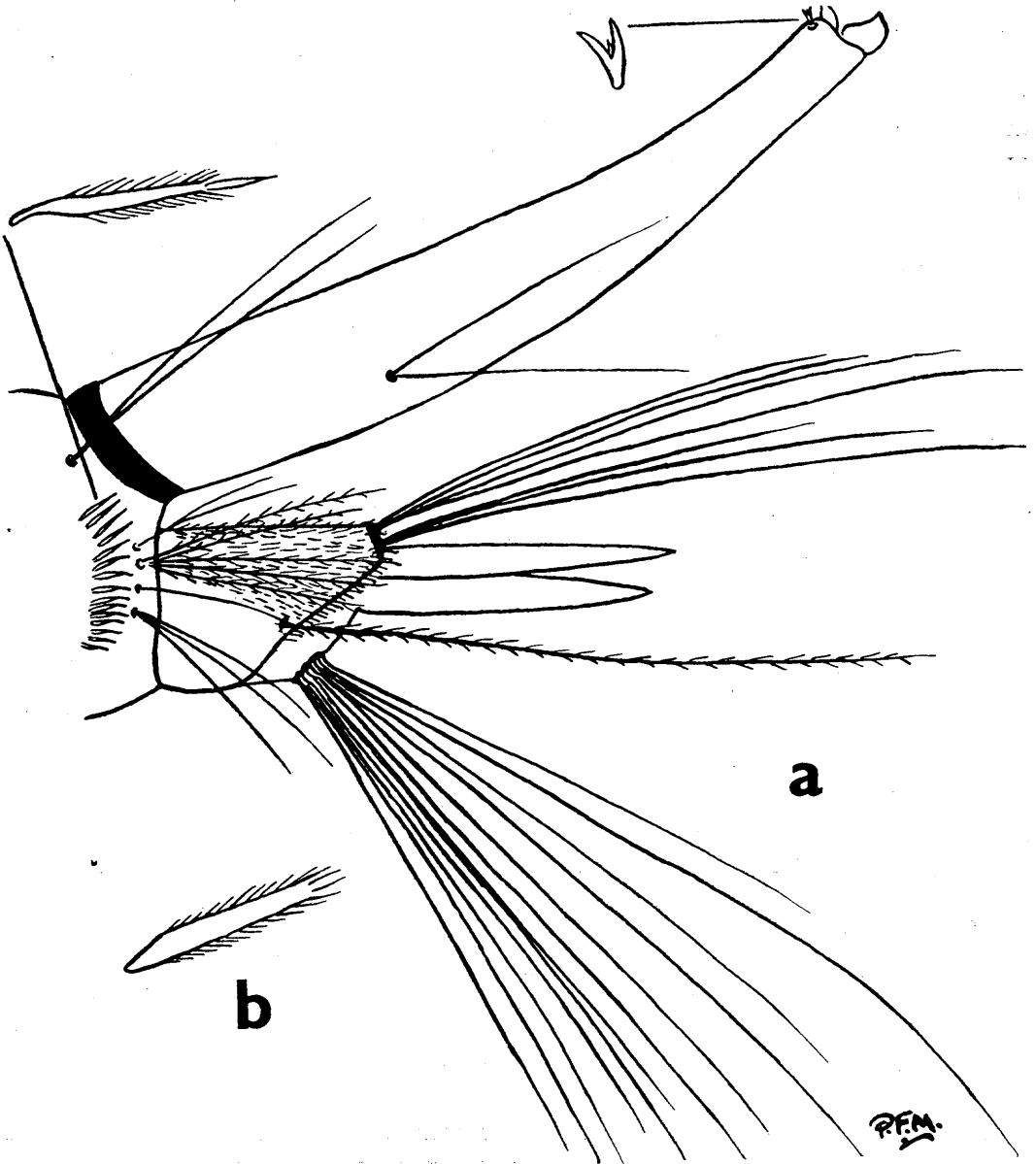


Fig. 17. Larva. a. *F. luzonensis*, terminal segments, b. *F. elegans*, comb scale.

specimen but not previously recorded). Siphon darkened for a short distance at extreme tip. Antenna entirely pale. Clypeal spines slender, pale, trifid from near base (Fig. 19b, p. 48). Maxilla without spine. Mentum normal with about ten teeth on either side of the central tooth. Head seta A with about 8-9 branches, B with 2-3, C with 5-6, *d* strongly developed with about 7-8 very unequal branches. Mesothoracic and metathoracic pleural setae with large chitinised bases tending to project from the sides of the thorax (Fig. 21a, p. 52). Comb a single row of about 14-17 narrow spines with hypertrophied median denticle and narrow lateral fringe (Fig. 17a) (Barraud, 1934:115, says 10-12 teeth). Siphon somewhat recurved, tapering sharply on distal half, index about 7. Subventral tuft at about one third of the distance from base to apex. Valves very small. Ventral valves without long setae. Dorsal valves with a characteristic trifid spine (Fig. 17a).

*Breeding places.* Ponds with *Pistia* but larvae with "free surface habits" (Qutubuddin, 1951:31). Tin cans (specimens in U.S.N.M. from Philippines).

*DISTRIBUTION.* Bengal (Barraud, 1934:115), Hyderabad (Qutubuddin, 1951:31), Ceylon (Senior-White, 1925:220), N. Thailand (Barraud & Christophers, 1931:280, Causey, 1937:411, Thurman & Thurman, 1955:222), Malaya (Leicester, 1908:178), Singapore (as "*Mimomyia* sp.", Edwards & Given, 1928:349), Java (Brug & Bonne-Wepster, 1947:183), North Borneo (Sarawak, Moulton, 1914:48), Dutch Borneo (Tarakan, U.S.N.M., not previously recorded), Tonkin (Barraud, 1934:115), Philippine Is. (Luzon, Ludlow, 1905:102 and, as *Aedes clavirostris*, Stone & Bohart, 1944:213, Mindanao, U.S.N.M., not previously recorded), Hong Kong (Jackson, 1934:140), Taiwan (U.S.N.M., not previously recorded), Okinawa (Bohart & Ingram, 1946:60). *Hawaii, Feag. I, 1952:110.*

I have seen specimens from Bengal, Ceylon, Thailand, Malaya, Singapore, Java, Sarawak, Tarakan, Tonkin, Luzon, Mindanao, Hong Kong, Taiwan and Okinawa.

*Variation.* The typical form from the Philippines and Borneo has the pale scales on the scutum rather coarse and creamy or yellow instead of very narrow and pure white as in the rest of the Indomalayan area and in Taiwan and Okinawa. This form also has the hind tibia and first hind tarsal segment darker than in other forms.

### ***Ficalbia (Etorleptomyia) elegans* (Taylor)**

*Dixomyia elegans* Taylor, *Trans. ent. Soc. Lond.* (1913), p. 703, 1914.

*Ficalbia elegans* Taylor, *Bull. ent. Res.*, 20:271, 1929.

*TYPES:* holotype ♀, plesiotype ♂ and ♀, Townsville, Queensland, in School of Tropical Medicine, Sydney.

Taylor (1929:273) designated a female neotype and a male allotype. It seems that the unique holotype female from which the species was originally described was still in existence, though badly damaged. Since neither specimen was incorporated in the original description they are, in my view, no more than plesiotypes in the sense of specimens "upon which subsequent or additional description or figure is based" (Ferris, 1928:154).

This species rather closely resembles *F. luzonensis*. It differs mainly as follows:

*Adult ♀.* Proboscis with black ring at tip much longer, at least half as long again as the maximum width of the proboscis. Palps slightly longer, nearly a quarter of the length of the proboscis, the white scaling at the tip of the subapical segment more conspicuous. Upright forked scales of vertex more numerous, those in front yellowish, those behind whiteish and a few black ones at the sides. Narrow decumbent scales yellow. Pale scales of scutum tawny, many of them relatively broad (Taylor, 1914:703, 1929:271, describes them as golden but I prefer to reserve this term for the much brighter yellow scales of such species as *F. chamberlaini* and *F. aurea*). Scutellum mainly with broad dark scales with small patches of mixed broad and narrow yellowish ones distally on each lobe. Posterior pronotum almost entirely covered with broad dark scales, with or without some pale ones in addition. (My only Queensland specimen has these scales entirely dark. Malayan specimens show a variable proportion of pale scales. My specimen from Sumatra is intermediate, having pale scales very few in number). Vein 3 and fork of vein 4 with squame scales larger. There are small differences in the distribution of dark and light scales as between Australian, Sumatran and Malayan specimens but there is so much variation even between the wings of the same specimen that these do not appear to be of taxonomic value. Anterior fork cell somewhat longer, between four and a half and five and a half times as long as its stem. Second mid and hind tarsal segments narrowly pale at base and tip, wholly or almost wholly dark in between (Fig. 18*b*). Fore tibial claw rather small (Fig. 4*c*, p. 11). First abdominal tergite with a well marked pale spot, second

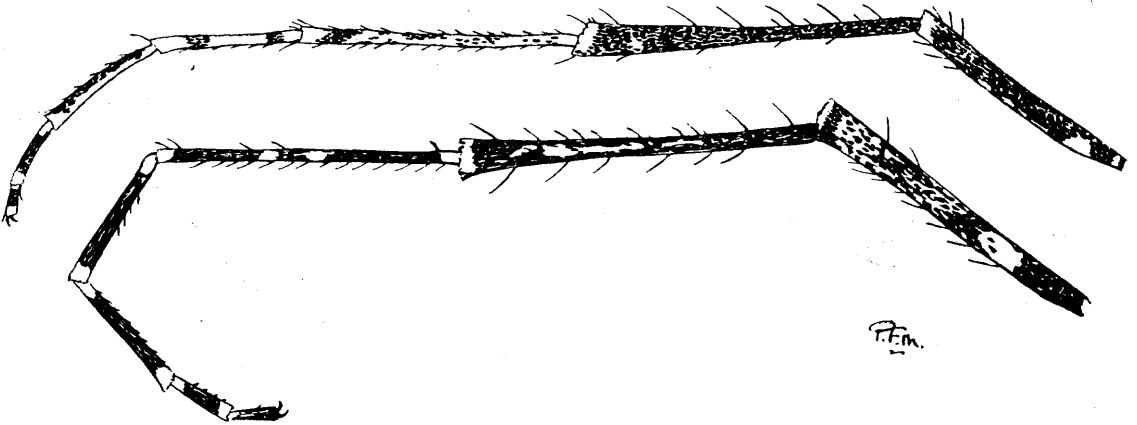


Fig. 18. Hind leg. a. *F. luzonensis*, b. *F. elegans*.

with a narrow pale basal band or spot, with or without small lateral pale spots in addition. The following tergites with lateral pale spots of variable size but smaller on the third than on the remainder. Small median basal pale spots occasionally present on third and fourth tergites. Sternites with both dark and pale scales, the more posterior ones largely dark,

the more anterior largely pale. IXth tergite with lateral setae less numerous in the specimen examined.

*Adult* ♂. Proboscis mainly dark, wholly so at extreme base, the remainder with scattered pale scales which are most numerous on the narrow part and which form a well defined pale ring immediately behind the swollen portion and a less clearly defined pale spot a short distance from the tip. Anterior fork cell shorter, about three and a half to four times the length of its stem. Terminalia very much as in *F. luzonensis* but more strongly sclerotised in the material examined.

*Pupa*. This and the larva are described from Australian material only. Trumpets perhaps slightly thicker than in *F. luzonensis*, from about twenty to twenty five times as long as their breadth at half way. Paddles perhaps somewhat longer, about five to eight times as long as their greatest breadth, without pigmentation. Apical bristle not seen.

*Larva* (Fig. 19a). Head distinctly darker than body. Clypeal spines simple. Seta *d*

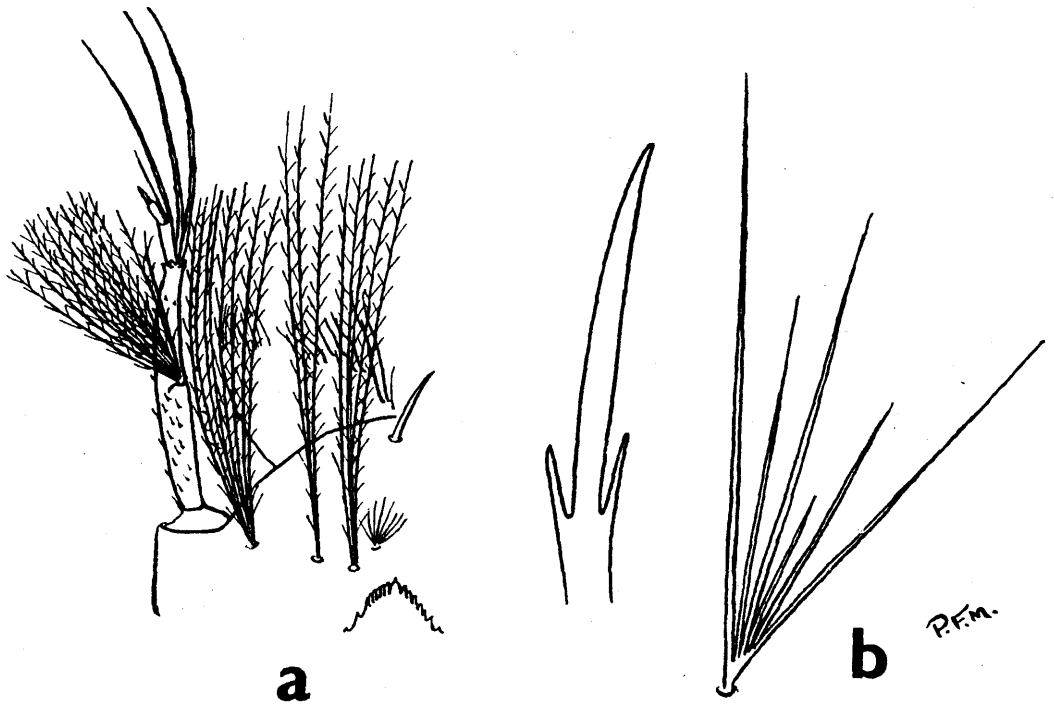


Fig. 19. a. *F. elegans*, larval head, b. *F. luzonensis*, clypeal spine and head seta *d*.

less strongly developed. Comb a double row of uniformly fringed scales (Fig. 17b, p. 45), about 12-16 in the proximal and 2-6 in the distal row.

*Breeding places*. Cattle hoof prints with decaying vegetation at edge of swamp, in

company with *F. chamberlaini* var. *metallica* (Taylor, 1929: 271), Fresh-water hole (Lee, 1944:43), dam and swampy area (B.M.).

DISTRIBUTION. S. Thailand (Iyengar, 1953:746), Malaya (B.M., not previously recorded), Sumatra (Brug & Bonne-Wepster, 1947:189), Philippine Is. (Mindanao, U.S.N.M., not previously recorded), Dutch New Guinea (King & Hoogstraal, 1946:188), New Britain (Taylor, 1934:233), ~~Solomon Is. (Iyengar, 1955:26)~~, Queensland (Taylor, 1914:704, 1929:273, Lee, 1944:43).

I have seen specimens from Malaya, Sumatra, the Philippines and Queensland.

### **Ficalbia (Ravenalites) fusca** (Leicester)

*Dasymyia fusca* Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3):102, 1908. (*partim*, holotype ♀ only).

*Ficalbia fusca* Leicester of Edwards & Given, *Bull. ent. Res.*, 18:349, 1928.

TYPE: holotype ♀, Malaya, locality uncertain (see Mattingly & Grjebine, in press, and below).

*Adult* ♀. Wing length 2-3 mm. Proboscis dark, swollen on about the apical two fifths, markedly so at tip. Palps dark, from about a quarter to three tenths of the length of the proboscis. Basal joint of antennal flagellum only slightly longer than the succeeding joint. Tori with numerous broad silvery scales. Decumbent scales of vertex broad and dark, a small spot of silvery scales at extreme apex, i.e. at the base of the frons. Leicester (1908:102), Barraud (1934:115) and Bonne-Wepster (1954:36) all mention a line of silvery scales round the eye margin. This is not apparent in Leicester's type or in a specimen of Dr. Bonne-Wepster's from Java or in any other specimens seen by me. It may be more conspicuous in fresh specimens (see Bonne-Wepster, 1954:36, footnote). From certain angles a patch of scales at the side of the head may be seen as whiteish or silvery. Upright forked scales dark, pale tipped in some lights, confined to nape. Integument of scutum dark brown, with a very small pale area behind the wing root, covered with rather sparse, very narrow, dark brown, curved scales. Acrostichal bristles small, dorsocentrals large and numerous. Scutellum with broad, flat, dark scales on all lobes. Anterior and posterior pronotum devoid of scales. Postspiracular area bare. Mesepimeron and sternopleura with large patches of silvery scales. Upper mesepimeral bristles continued well down the posterior edge of the mesepimeron as a row of hairs. A few scattered, very delicate hairs may also occur elsewhere on the mesepimeron and one of these may occupy the position normally occupied by the lower mesepimeral bristle of certain other genera (Fig. 7a, p. 19). Pleural integument and postnotum more or less uniformly dark, the latter with pale spots in the basal corners. Wings entirely dark. All veins except 5·2 and 6 with numerous large, asymmetrical plume scales. Squame scales heart shaped and mostly moderately large or large except on vein 6 where they are very large indeed. Anterior fork cell from about one and a half times to twice as long as its stem. Halteres with stem pale, knob dark.

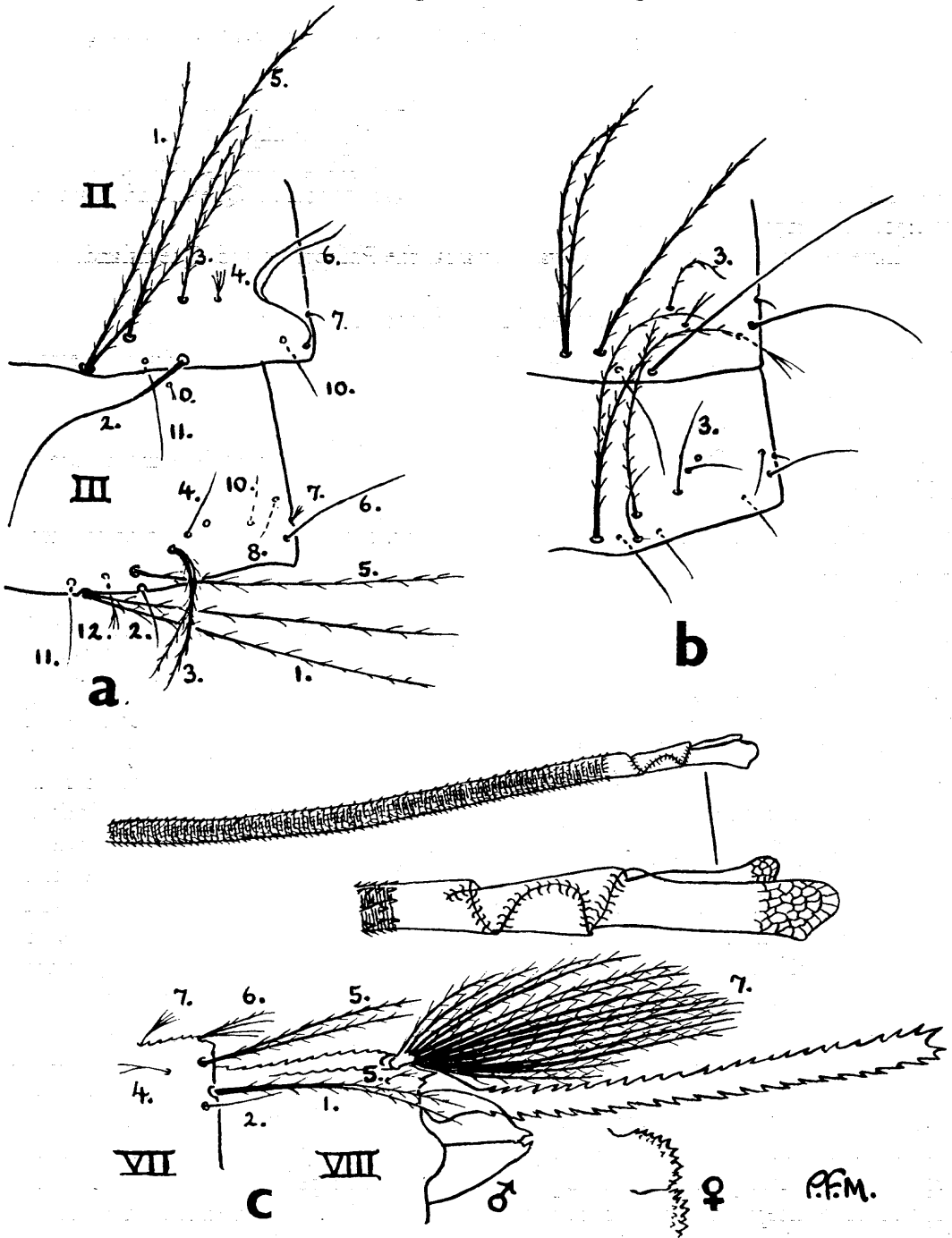


Fig. 20. Pupa. a, b. Segments II and III of abdomen, a. *F. fusca*, b. *F. deguzmanae*, c. Trumpet and paddle, *F. fusca*.

Legs mainly dark except for very small apical spots on the femora and for the fourth and fifth hind tarsals and the tip of the third which are creamy. Femora pale below, the pale area visible on the anterior surface for some distance towards the base especially on the hind femur. Fore tibial claw well developed (Fig. 4*b*, p. 11). Abdominal tergites mainly dark with strong blueish metallic lustre. Small basal lateral creamy spots present on all segments. Sternites mainly pale with some dark scaling apically, especially on posterior segments. IXth tergite well sclerotised, the bristles on the lateral lobes very long (Fig. 10*e*, p. 27). Spermatheca single.

*Adult* ♂. Much as female but with proboscis more strongly swollen. Palps from about three eighths to a half of the length of the proboscis. Basal lateral pale spots on tergites usually less conspicuous owing to folding but definitely present at least on most segments except in my only male from Borneo in which they appear to be present only on tergites VI and VII and very small even on these. Anterior fork cell from about 1.4 to at most about 1.8 times as long as its stem. IXth tergite (Fig. 9*d*, p. 22) very narrow, its lateral setal patches closely approximated, the setae very long and stout.

*Pupa*. Readily distinguished from that of all other known oriental mosquitoes (except *F. deguzmanae*) by the very narrow paddles (Fig. 20*c*). Separable from *F. deguzmanae*, in my material, by having seta 3 on segments II and III more strongly developed (Fig. 20*a*). This seta single to trifid. Trumpets from about 25 to nearly 35 times as long as their breadth at half way. Meatus occupying about the basal three quarters, tracheoid, densely spinose and deeply pigmented. The apical cleft portion is unpigmented and the cleft itself is apparently spiral, its edges being held together on about the basal half by fine, hairlike cross bridges. Edwards & Given (1928:349) and Barraud (1934:116) failed altogether to interpret this correctly. All the principal cephalothoracic and abdominal setae are black and spinelike and have at most two branches except for seta 7 of segment VIII which has about 14-17. Seta 1 on segment I is minute and single. Setae 1 and 5 of segment VII are bifid. Paddles about 10-20 times as long as their greatest breadth with a coarse fringe reaching nearly to base along both edges, the base somewhat bulbous. Apical and accessory setae not seen. Genital sac of female strongly spinose, of male with small apical horn as usual. Posterolateral corners of segment VIII spinose and distinctly lobed, the spines continued forward along the edges of the lobes. In most cases the edges of this and one or more of the more anterior segments are spiculate.

*Larva*. (Fig. 21*b*, 22). Easily distinguished, except from *F. deguzmanae*, by the dendritic terminal and subterminal antennal setae and from *F. deguzmanae* by the comb spines. Head (Fig. 22, p. 53) pale, not noticeably darker than the remainder. Spines on antenna slender, hairlike. Antenna entirely pale, the terminal and subterminal setae dendroid with numerous branches. Antennal tuft arising at less than a third of the distance from base to apex. Clypeal spines long, pale, slender, smooth or minutely spiculate at base. Maxillary spines very inconspicuous. Mentum of normal type. Edwards & Given (1928:350 and Fig. 6) say that the main median denticle is missing but this is incorrect.

In their specimens in the British Museum it is not missing but displaced from its normal position, apparently as a result of some genetical abnormality (Fig. 22). In other specimens from Singapore and elsewhere in Malaya it is normal. Head setae A, B, C and *d* all with very numerous branches. Setae of mouthbrushes rather short. Dorsal setae of thorax and abdomen mostly either palmate or stellate. Long mesothoracic and metathoracic pleural setae (Fig. 21*b*) with large chitinised bases, especially the metathoracic. These project only to about the same extent as in *Etorleptomyia* although in some Madagascan *Ravenalites* they are much more prominent (see, e.g. Doucet, 1950, Figs. 6, 7, 8). Comb an irregular patch of simple, curved spines increasing in size posteriorly, the most anterior being almost

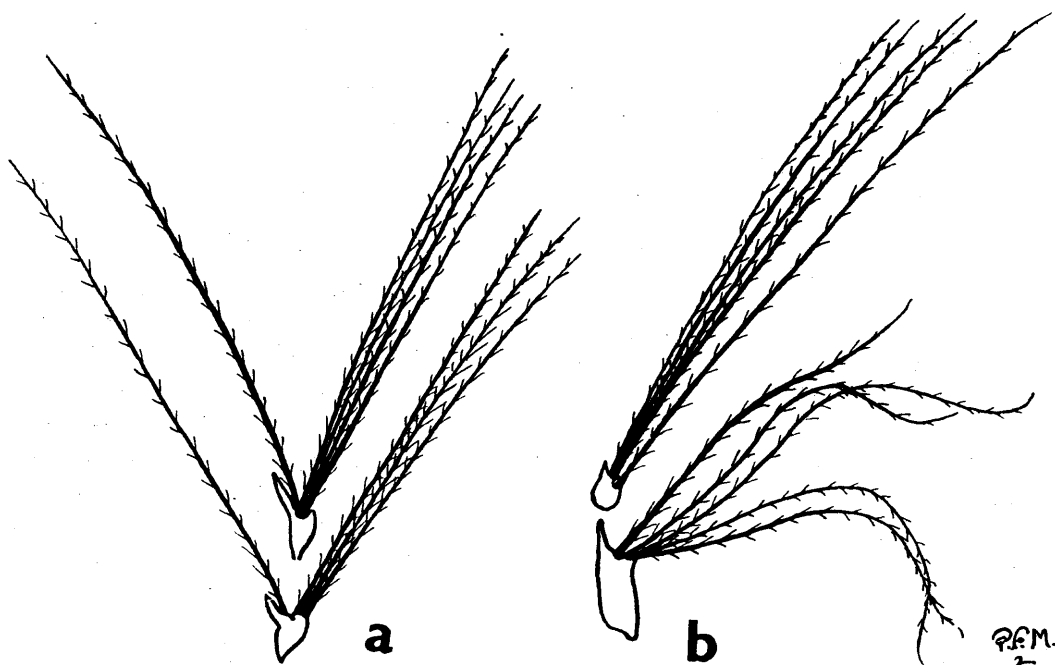


Fig. 21. Mesothoracic and metathoracic pleural setae. a. *F. luzonensis*, b. *F. fusca*.

hairlike and often having a small branch at base (but not in all specimens). Siphon only slightly tapering with recurved tip. Index about 6. A small acus of unusual shape present. Pecten absent. Sub-ventral tuft arising at about a third of the distance from base to apex. Spine at base of dorsal valves very delicate and inconspicuous, simple. Setae on ventral valves short and delicate. Saddle largely covered with delicate hairs which are stouter near the bases of the caudal setae. Ventral brush with one pair of long setae and one pair of short, the long ones trifid or tetrafid, the short ones single or bifid.

*Breeding places.* Tree holes (Edwards & Given, 1928:351, Bonne-Wepster, 1954:37, Colless, *in litt.*).

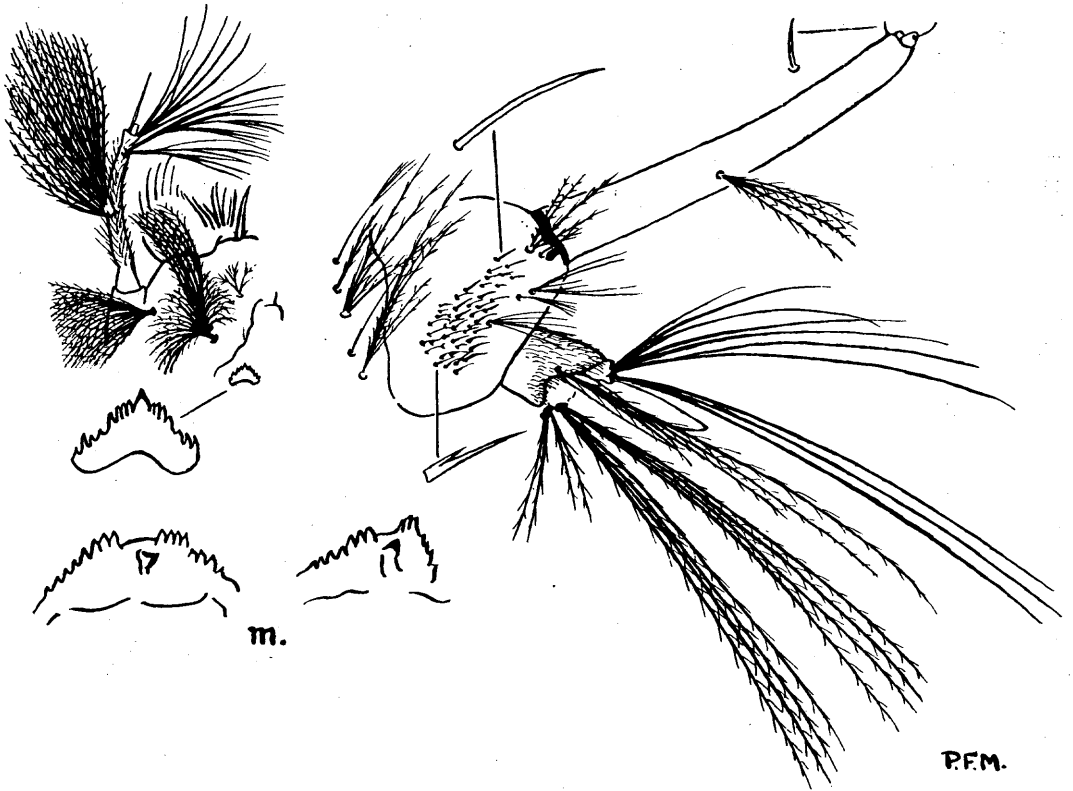


Fig. 22. *F. fusca*. Larval head and terminal segments. *m.* Mentum of two aberrant specimens from Singapore.

**DISTRIBUTION.** Malaya (Leicester, 1908:104, Edwards, 1928:57), Singapore (Edwards & Given, 1928:349), Java (Bonne-Wepster, 1954:37), Sarawak (Colless, *in litt.*), Brunei (B.M.).

I have seen specimens from all these territories except Sarawak.

**Ficalbia (Ravenalites) deguzmanae** sp. n.

? *Dasymyia fusca* Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3):102, 1908 (*partim*, allotype male only, see Mattingly & Grjebine, *in press*, and below).

? *Ficalbia fusca* Barraud, *Indian J. med. Res.*, 16:1057, 1929 and *Faun. Brit. India (Diptera)*, 5:115, 1934 (*partim*, Andamans form only).

This species, which is here described for the first time, is named, at the request of Mr. Baisas, after Dr. Milagros de Guzman.

TYPES: holotype ♂ with associated larval and pupal skins, Llavac, Sierra Madre Range, Infanta of Quezon Province, Luzon, 27:ii:1941, F. E. Baisas, from tree-hole, in B.M., allotype ♀ with associated larval and pupal skins from log hole, 3500', east slope, Mt. McKinley, Davao, Mindanao, 9:ix:1946, —. Heynman (*sic*), No. P.1130-2, in U.S.N.M. Paratypes, 6 pinned ♂♂, 1 ♀ on slide, 1 pupal skin, 5 whole larvae and some fragments on slides, all with data as for holotype except that the dates of collection vary as between 10:v:1940 and 28:ii:1941, 1 ♂, No. 1130-1 and 1 ♀, No. 1123-1, the former with data as for the allotype, the latter from 5800' on Mt. McKinley, both with associated larval and pupal skins, 6 ♀♀ and 10 ♂♂ from Mt. McKinley with various numbers, some coll. —. Heynman (*sic*), others coll. H. Hoogstraal, some from log holes or tree holes, others without data, 2 ♂♂ and 1 ♀, Barrio Pooc, Sierra Madre Range, Rizal, Luzon, 3:ii:1932, D. Santiago, 2 ♂♂, Caliraya, Lumban, Sierra Madre Range, Laguna Province, Luzon, 9:ix:1940 and 4:x:1940, 1 ♀, Sagarian, Lanao, from muddy pond, and 1 ♂, Beto, Dansalan, Lanao, from cut bamboo, both 25:iv:1946, S. A. Edgar et al., 1 ♂ and 3 ♀♀, Gattaran, Dagayan, Luzon, 10:viii-1945, D. F. Bray, the ♀♀ with associated larval and pupal skins, from bamboo stump, 1 ♀, Surigao, Mindanao, 24:viii:1931, W. V. King, 2 ♂♂ and 1 ♀, Fabrica, Occidental Negros, 4:ii:1931, W. V. King, 27 slides of unassociated larval and pupal skins without data but similarly labelled to those from Mt. McKinley, 1 slide with 2 whole larvae from Gattaran with the same data as the other specimens from this locality and 3 larvae from Baguio, Luzon, 10:viii:1945, one labelled as from cardboard container. These paratypes will be shared between the U.S. National Museum, the British Museum and the Public Health Research Laboratories, Manila, the majority being placed in the U.S. National Museum.

The head of the allotype ♂ of *Dasymyia fusca* Leicester is missing. It seems clear, however, from the descriptions given by Leicester (1908:104) and Edwards (1928:57) that the palps were at least two thirds of the length of the proboscis (Leicester says three quarters). In this it resembles the present species rather than *F. fusca*. In his description of the genus *Dasymyia*, however, Leicester (1908:102) says that the male palps are scarcely half the length of the proboscis. He clearly saw more than the two specimens which have been preserved since he states that one specimen came from Bukit Kutu and "the others" from Ulu Gombak. It seems, therefore, that his original series probably included males of both species. The allotype ♂ also differs from all others of *F. fusca* seen by me (and agrees with the present species) in having the abdominal tergites and sternites completely dark (parts of the sternites sometimes giving a false impression of pallor in oblique lights). I have therefore provisionally assigned this specimen to the present species. As against this, however, the anterior fork cell of the wing is slightly shorter than in any of my specimens of *F. deguzmanae* (about 1.3 times the length of its stem) and it is possible that when further material comes to hand it may prove to belong to yet a third species.

The specimen described by Barraud (1929:1057) from the Andamans was stated by him to be a female with the abdomen entirely dark dorsally. Later (1934:115) he described it as a male and implied that the palps were three quarters of the length of the proboscis. It seems that, whatever, its sex, the specimen in question agreed better with *F. deguzmanae* than with *F. fusca* and I have therefore provisionally assigned it to the present species. I have, however, seen no material from the Andamans.

*Adult ♀.* Very similar to that of *F. fusca* but with abdominal tergites and sternites wholly dark. Anterior fork cell twice the length of its stem or very slightly more or less. Femora entirely or almost entirely dark at tip.

*Adult ♂.* Palps about three quarters to four fifths of the length of the proboscis (excluding the labella), possibly rather shorter in the Malayan and Andamans forms but at least two thirds of the length of the proboscis even in these. Proboscis, in general, rather

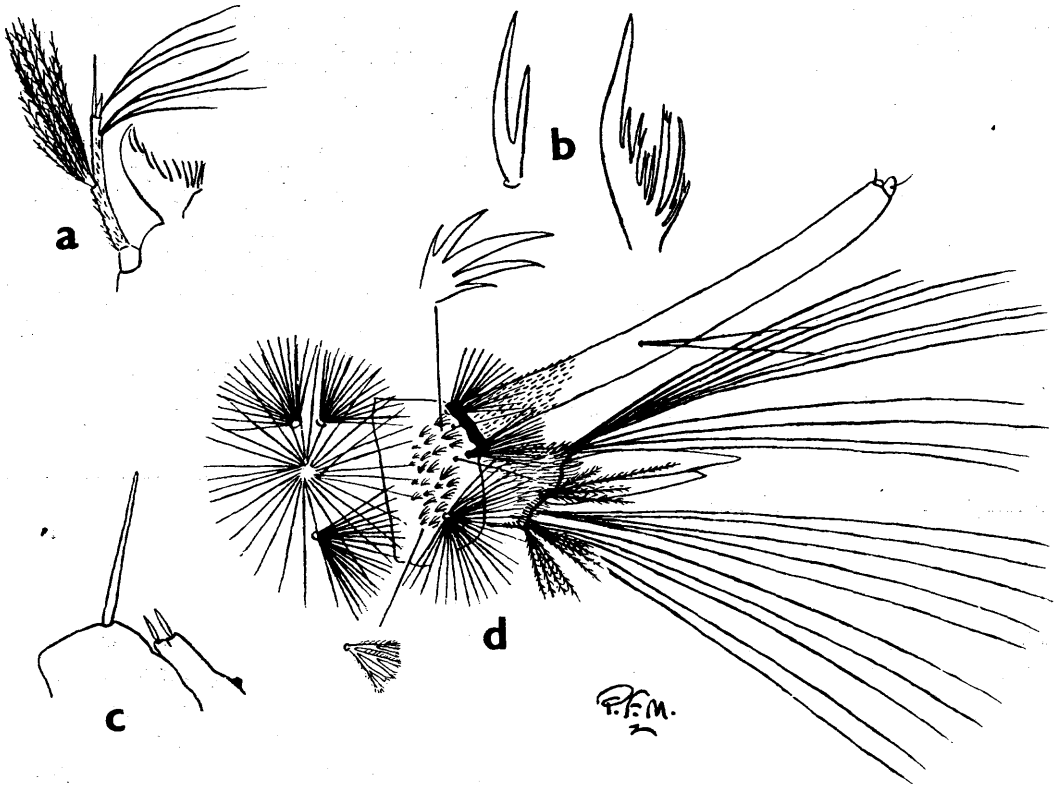


Fig. 23. *F. deguzmanae*. Larva. a. Antenna, b. Clypeal spine, c. Maxilla, d. Terminal segments.

more strongly swollen. (Edwards, 1928:57, also noted this for the type ♂ of *F. fusca*). Anterior fork cell about 1.3 to 1.8 times as long as its stem. Otherwise as for female.

*Pupa.* Trumpets from about 30 to about 35 times as long as their breadth at half way. Seta 1 on segment I single or bifid. Seta 2 of segments II and III more slender than in *F. fusca* (Fig. 20b, p. 50). Paddles about 15-20 times as long as their greatest breadth. Posterolateral corners of segment VIII without hypertrophied spicules (the whole lateral area of this and the preceding segment to some extent spiculate. Male genital sac with a simple apical horn.

*Larva* (Fig. 23). Variable, but always quite distinct from that of *F. fusca*. Terminal and subterminal antennal setae with variable number of branches. Clypeal spines always strongly toothed at base, though variable (Fig. 23b). Maxillary spine larger, darker, variable but always relatively conspicuous. Stellate setae of thorax and abdomen with branches much shorter, stouter, stiffer, almost spinelike, also more numerous. Comb teeth deeply incised, each with three or more prongs. In good mounts the teeth of the more anterior teeth can be seen to be fringed. Siphon variable, index from about 4.5 to about 7.5, the basal portion spiculate, spicules exceptionally extending to about two thirds, as in the skin of the holotype which has an unusually short siphon. Subventral tuft with about 2-5 branches. Spines on saddle more strongly developed. Ventral brush with one pair of long setae and one pair of short, but these with more numerous branches than in *F. fusca*. Saddle hair usually with four or more branches. Owing to the very strongly developed stellate setae the general appearance recalls that of a *Tripteroides* larva.

*Breeding places.* Tree holes, log holes, bamboo stumps, a cardboard container (one record only), a muddy pool (one record only, perhaps an accidental introduction). The log holes are stated to have been deeply shaded and to have contained many leaves and much debris.

*DISTRIBUTION.* ? Andaman Is. (as *F. fusca*, Barraud, 1929:1057, 1934:116) ? Malaya (as *F. fusca*, Leicester, 1908:102, type ♂ only), Philippine Is. (Luzon, Mindanao, Negros, B.M., U.S.N.M., Dept. Hlth., Manila).

I have not seen Andamans specimens. This species, like *F. fusca*, seems to occur mainly at fairly high altitude.

#### ZOOGEOGRAPHY

Most points of interest have been raised elsewhere in the present paper. The genus as a whole occupies virtually the whole of the Ethiopian and Oriental Regions with a small incursion into the Australasian Region (New Guinea, New Britain, the Solomons and Queensland). Although it appears to have some Palearctic affinities (see p. 10) it does not quite extend into the Palearctic at the present time, its most northerly extension being, apparently into Okinawa (p. 46). As a genus it is mainly associated with ground waters except for the subgenus *Ravenalites* which breeds in tree holes and plant axils. Despite this it is by no means restricted to areas of high rainfall since river systems, such as those associated with the Nile and Niger, provide it with the necessary swampy conditions and

may permit even forms normally associated with the humid West African Subregion to extend far north into comparatively arid country (see Mattingly & Hamon, 1955:494). It may be conjectured that such systems have played a part in its dissemination in the past and there is every reason to suppose that it must have extended well into the southern Palaearctic, at least at the western and eastern ends of its present range, during the warmer and wetter quaternary interglacials. This is probably reflected in the very close affinities between the Oriental species and their Ethiopian counterparts. The occurrence of overlapping eastern and western forms in the *F. chamberlaini* complex (p. 36) and in *Etorleptomyia* (pp. 46 and 49) might suggest that these groups originated to the north of the Indomalayan area and entered it both in the east and the west with subsequent overlapping.

The subgenus *Ravenalites* is exclusive to the Indomalayan area (and the Andamans) and the Malagasy Region (Madagascar and the Comoro Is.) and thus forms part of a fauna which has been a traditional bone of contention among zoogeographers. (For summary see Millot, 1952).

Too little is known regarding the details of behaviour and habitat to permit a discussion of distribution in relation to ecology. This has, however, been attempted for certain Ethiopian *Ficalbia* s. str. (Mattingly & Hamon, 1955:494) and it is noteworthy that a parallel series of morphological characters, apparently also associated with habitat, is to be found in the Oriental species of this subgenus (p. 30). It is unfortunate that this is easily the least known of the four subgenera in the Oriental Region.

With regard to distribution within the Indomalayan Area too few data are available for much to be said. The occurrence of a distinctive form of *F. luzonensis* in the Philippines and North Borneo is interesting (p. 46) particularly as it seems possible that a similar phenomenon may be encountered in *F. hybrida*. Since no Philippines material of this species is at present available it is impossible to be sure of this and the most that can be said at present is that the Celebes form certainly resembles the Malayan form more than it resembles the form occurring in North Borneo. Attention has already been drawn to the fact that the "Australasian" *F. chamberlaini* var. *metallica* and *F. elegans* penetrate as far west as Thailand, but not as far west as India, while the "Indian" *F. chamberlaini* and *F. luzonensis* do not, so far as is known, enter the Australasian Region. It is likely, however, that further discoveries may complicate this picture, especially in the case of the *F. chamberlaini* complex.

## Summary

Nine species and one colour variety of Indomalayan *Ficalbia* are recognised. A fourth subgenus, *Ravenalites* Doucet, is added to those currently recognised. This name is at present invalid but its author has undertaken to validate it by publication of a genotype. Included in *Ravenalites* are *F. fusca* Leicester and a new species from the Philippines, here described for the first time. *F. fusca* was originally placed in a monotypic genus, *Dasymyia*

Leicester. This name is preoccupied. *F. ludlowae* Brunetti is transferred from subgenus *Mimomyia* to *Ficalbia* s. str. after designation of the type female as holotype. The allotype ♂ is retained in *Mimomyia* in the synonymy of *F. hybrida* Leicester. *F. metallica* Leicester is considered to be a colour variety of *F. chamberlaini* Ludlow. *F. flavens* King & Hoogstraal is also placed provisionally in the synonymy of this species. The Indian form of *F. chamberlaini* is provisionally distinguished as ssp. *clavipalpus* Theobald. *F. intermedia* Barraud is recognised as a distinct species. *F. modesta* King & Hoogstraal is provisionally placed in the synonymy of *F. hybrida* Leicester. The pupa of *F. minima* Theobald and the early stages of *F. aurea* Leicester are described for the first time. The cotype male and female of *F. fusca* Leicester are considered to belong to different species. The female is designated as holotype and the male is provisionally transferred to the new Philippines species. New distribution records include *F. minima* from Bali and Cochin China, *F. ludlowae* from Java (doubtful), *F. chamberlaini* s. str. from Malaya, Hong Kong, Taiwan and (?) Dutch New Guinea, *F. aurea* from Assam and Singapore, *F. hybrida* from Sumatra and Labuan, *F. chamberlaini* var. *metallica* from the Philippines, Taiwan and Dutch New Guinea, *F. luzonensis* from Tarakan and Taiwan, *F. elegans* from Malaya and the Philippines and *F. fusca* from Brunei and Sarawak. Keys are given for subgenera and species. The former employ almost entirely new subgeneric characters for all stages. Bionomics and zoogeography are briefly discussed.

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### References

- BARRAUD, P. J., 1929, A revision of the culicine mosquitoes of India. Part XXV. The genera *Mucidus*, *Mimomyia*, *Ficalbia*, *Rachionotomyia* and *Hodgesia*. *Indian J. med. Res.*, **16**: 1052-1063.
- BARRAUD, P. J., 1934, The fauna of British India: *Diptera*, **5** (CULICIDAE: Megarhinini and Culicini). London.

- BARRAUD, P. J. and CHRISTOPHERS, S. R., 1931, On a collection of anopheline and culicine mosquitoes from Siam. *Rec. Malar. Surv. India*, **2**: 269-285.
- BELKIN, J. N., 1952, The homology of the chaetotaxy of immature mosquitoes and a revised nomenclature for the chaetotaxy of the pupa. *Proc. ent. Soc. Wash.*, **54**: 115-130.
- BELKIN, J. N., 1953, Corrected interpretations of some elements of the abdominal chaetotaxy of the mosquito larva and pupa (Diptera, Culicidae). *Ibid*, **55**: 318-324.
- BERNER, L., 1947, Observations on the mating of *Ficalbia (Mimomyia) splendens* (Theo.). *Ent. News*, **58**: 101-102.
- BOHART, R. M., 1945, A synopsis of the Philippine mosquitoes. *U.S. Navy, Navmed* 580.
- BOHART, R. M. and INGRAM, R. L., 1946, Mosquitoes of Okinawa and islands in the central Pacific. *U.S. Navy, Navmed*, 1055.
- BONNE-WEPSTER, J., 1932, A mosquito with larval habits like *Taeniorhynchus*. *Bull. ent. Res.*, **23**: 69-72.
- BONNE-WEPSTER, J., 1954, Synopsis of a hundred common non-anopheline mosquitoes of the Greater and Lesser Sundas, the Moluccas and New Guinea. *Roy. trop. Inst. Amsterdam, Special Pubn.*, No. 106.
- BRUG, S. L., 1931, Culiciden der Deutschen Limnologischen Sunda-expedition. *Arch. f. Hydrobiol.*, Suppl. Bd., **9**: 1-42.
- BRUG, S. L., and BONNE-WEPSTER, J., 1947, The geographical distribution of the mosquitoes of the Malaya Archipelago. *Chronica Naturae*, **103**: 179-197.
- BRUNETTI, E., 1920, Catalogue of the oriental and south asiatic Nematocera. *Rec. Indian Mus.*, **17**: 1-300.
- CARTER, H. F., 1950, Ceylon mosquitoes: list of species and names of mosquitoes recorded from Ceylon. *Ceylon J. Sci. (B)*, **24**: 85-115.
- CAUSEY, O. R., 1937, Some anopheline and culicine mosquitoes of Siam with remarks on malaria control in Bangkok. *Amer. J. Hyg.*, **25**: 400-420.
- COLLESS, D. H., 1956, The *Anopheles leucosphyrus* group. *Trans. R. ent. Soc. Lond.*, **108**: 37-116.
- DOUCET, J., 1950, Les culicines de Madagascar (Dipt.). *Mém. Inst. Sci. Madagasc.*, Sér. A, **4**: 39-65.
- DYAR, H. G. and SHANNON, R. C., 1925, The types of Philippine mosquitos described by Ludlow and other notes on the fauna. *Insec. Inscit. Menstr.*, **13**: 66-89.
- EDWARDS, F. W., 1912, A synopsis of the species of African Culicidae other than *Anopheles*. *Bull. ent. Res.*, **3**: 1-53.
- EDWARDS, F. W., 1928, Diptera Nematocera from the Federated Malay States museums. *J. F.M.S. Mus.*, **14**: 1-139.
- EDWARDS, F. W., 1932, *Genera Insectorum*. Fasc. 194 (Diptera, Culicidae), Brussels.
- EDWARDS, F. W., 1941, Mosquitoes of the Ethiopian Region, **3** (Culicine adults and pupae). London: Brit. Mus. (Nat. Hist.).

- EDWARDS, F. W. and GIVEN, D. H. C., 1928, The early stages of some Singapore mosquitos. *Bull. ent. Res.*, **18**: 337-357.
- EGGER, J., 1858, Dipterologische Beiträge. *Verh. zool.-bot. Ges. Wien*, **8**: 701-716.
- FERRIS, G. F., 1928, The principles of systematic entomology. *Stanf. Univ. Publ. (Biol.)*, **5**(3).
- GALLIARD, H. and NGU, D. V., 1949, Culicinés du Tonkin II. Les genres *Ficalbia* et *Mochtogenes*. *Ann. Parasit. hum. comp.*, **24**: 495-502.
- IYENGAR, M. O. T., 1935, Eggs of *Ficalbia minima* Theo., and notes on breeding habits of three species of *Ficalbia*. *Bull. ent. Res.*, **26**: 423-425.
- IYENGAR, M. O. T., 1953, Filariasis in Thailand. *Bull. Wld. Hlth. Org.*, **9**: 731-766.
- IYENGAR, M. O. T., 1955, Distribution of mosquitoes in the South Pacific region. South Pacific Commission technical papers, No. 86.
- JACKSON, R. B., 1934, Annual report of the Work of the Malaria Bureau for the year 1933. *Med. sanit. Rep. Hong Kong*, pp. 137-187.
- KING, W. V. and HOOGSTRAAL, H., 1946, Two new species of mosquitoes of the genus *Ficalbia* from Netherlands New Guinea. *Proc. ent. Soc. Wash.*, **48**: 186-190.
- LEE, D. J., 1944, An atlas of the mosquito larvae of the Australasian Region. Tribes Megarhinini and Culicini H.Q., Australian Military Forces.
- LEICESTER, G. F., 1908, The Culicidae of Malaya. *Stud. Inst. med. Res. F.M.S.*, **3**(3): 18-261.
- LUDLOW, C. S., 1904, Mosquito Notes, No. 2. *Canad. Ent.*, **36**: 297-301.
- LUDLOW, C. S., 1905, Mosquito Notes, No. 3. *Ibid*, **37**: 94-102.
- LUDLOW, C. S., 1907, Mosquito Notes, No. 5 continued. *Ibid*, **39**: 266-268.
- MACFARLANE, H., 1915, The *Stegomyia* survey in Hong Kong. *Bull. ent. Res.*, **6**: 67-68.
- MATTINGLY, P. F., 1949, *Ficalbia* (*Ficalbia*) *jacksoni* sp. n., a new species of mosquito (Diptera, Culicidae) from Hong Kong. *Proc. R. ent. Soc. Lond.*, **B**, **18**: 9-11.
- MATTINGLY, P. F. and GRJEBINE, A., 1957, A revision of the genus *Ficalbia* Theobald with a discussion of the systematic position of *Ravenalites* Doucet (Diptera, Culicidae). *Mém. Inst. Sci. Madagasc., Sér. A*, in press.
- MATTINGLY, P. F. and HAMON, J., 1955, Position taxonomique et synonymie de quelques *Ficalbia* de la Région Ethiopienne (Diptera, Culicidae). *Ann. Parasit. hum. comp.*, **30**: 488-496.
- MILLOT, J., 1952, La faune Malgache et le mythe Gondwanien. *Mém. Inst. Sci. Madagasc., Sér. A*, **7**: 1-36.
- MOULTON, J. C., 1914, The mosquitoes of Borneo. *Rep. Sarawak Mus.*, **13**: 46-48.
- NEWSTEAD, R., DUTTON, J. E. and TODD, J. L., 1907, Insects and other Arthropoda collected in the Congo Free State. *Ann. trop. Med. Parasit.*, **1**: 3-112.
- QUTUBUDDIN, M., 1951, The culicine mosquitoes of Hyderabad-Deccan City and their bionomics as observed during 1943-45. *Pakistan J. Hlth*, **1**(2): 26-32.
- SCLATER, W. L. and SCLATER, P. L., 1899, The geography of mammals. London.

- SCRIVENOR, J. B., BURKILL, T. H., SMITH, M. A., CORBET, A. S., SHAW, H. K. A. RICHARDS, P. W. and ZEUNER, F. E., 1943, Discussion of the biogeographic division of the Indo-australian archipelago, with criticism of the Wallace and Weber lines and of any other dividing lines and with an attempt to obtain uniformity in the names used for the divisions. *Proc. Linn. Soc. Lond.*, **154**: 120-165.
- SENIOR-WHITE, R., 1925, Notes on Ceylon mosquitoes I. *Spolia zeylanica*, **13**: 213-222.
- SENIOR-WHITE, R., 1934, Three years mosquito control work in Calcutta. *Bull. ent. Res.*, **25**: 551-596.
- STONE, A. and BOHART, R. M., 1944, Studies on mosquitoes from the Philippine Islands and Australasia (Diptera: Culicidae). *Proc. ent. Soc. Wash.*, **46**: 205-225.
- TAYLOR, F. H., 1914, The Culicidae of Australia, I. *Trans. ent. Soc. Lond.* (1913), pp. 683-708.
- TAYLOR, F. H., 1929, Notes on Australian Culicidae (Dipt.). *Bull. ent. Res.*, **20**: 271-277.
- TAYLOR, F. H., 1934, The Diptera of the territory of New Guinea I. *Proc. Linn. Soc. N.S.W.*, **59**: 229-236.
- THEOBALD, F. V., 1901, A monograph of the Culicidae or mosquitoes, I. London: Brit. Mus. (Nat. Hist.).
- THEOBALD, F. V., 1903, *Ibid*, III.
- THEOBALD, F. V., 1904, The mosquitoes of Egypt, the Sudan and Abyssinia. *Rep. Wellcome trop. Res. Lab.*, **1**: 62-83.
- THEOBALD, F. V., 1907, A monograph of the Culicidae or mosquitoes, IV.
- THEOBALD, F. V., 1908, First report on the collection of Culicidae and Corethridae in the Indian Museum, Calcutta with descriptions of new genera and species. *Rec., Indian Mus.*, **2**: 287-302.
- THEOBALD, F. V., 1910a, A monograph of the Culicidae or mosquitoes, V.
- THEOBALD, F. V., 1910b, Second report on the collection of Culicidae and Corethridae. *Rec. Indian Mus.*, **4**: 3-33.
- THURMAN, D. C., 1954, *Ayurakitia*, a new genus of mosquito from northern Thailand (Diptera, Culicidae). *J. Wash. Acad. Sci.*, **44**: 197-200.
- THURMAN, D. C., and THURMAN, E. B., 1955, Report of the initial operation of a mosquito light trap in northern Thailand. *Mosquito News*, **15**: 218-224.
- WALLACE, A. R., 1876, The geographical distribution of animals. London.