

The Culicine Mosquitoes
of the Indomalayan Area

Part II
Genus *Heizmannia* Ludlow

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PART II:

Genus *Heizmannia* Ludlow

Synopsis

This is the second of a series of papers embodying a revision of the culicine mosquitoes of the Indomalayan area (Tenasserim, peninsular Thailand, Malaya, the Greater and Lesser Sunda Islands, Borneo, Celebes and the Philippines).

Introduction

The present paper follows the same lines as its predecessor which dealt with the genus *Ficalbia* (Mattingly, 1957). Just as the characters previously regarded as diagnostic of the subgenera of *Ficalbia* proved on closer examination to be unreliable, so also have those employed for the diagnosis of the present genus proved to be inadequate. In particular the use of wholly unsatisfactory diagnostic characters led Edwards (1932: 179) and after him Barraud (1934: 309) to include certain oriental species in the genus *Haemagogus*. This is unfortunate since the latter is in fact a purely Neotropical genus, and although closely related to *Heizmannia* differs from it very strongly indeed in male terminalia and can even be separated from it quite easily on the external characters of the female as is shown below. The larva and pupa, in so far as these are known, are also quite distinct. Edwards' and Barraud's action later led Vargas (1950: 65) to propose the inclusion in *Haemagogus* of several oriental species of *Aedes* subgenus *Finlaya*. As shown by Komp (1954: 264), this suggestion is wholly untenable. It is here proposed to restrict the genus *Haemagogus* entirely to Neotropical species, transferring all oriental species previously placed in it either to *Heizmannia* or to *Aedes*.

Genus *Heizmannia*

Heizmannia Ludlow, *Canad. Ent.*, **37**: 130, 1905.

Phoniomyia Theobald, *Ann. Hist. nat. Mus. hung.*, **3**: 114, 1905 (*partim*, *Ph. indica* n.sp. only).

Wyeomyia Theobald, *J. Bombay nat. Hist. Soc.*, **16**: 247, 1905 (*nec* Theobald, 1901).

Wyeomyia Leicester, *Stud. Inst. med. Res. F.M.S.*, **3**(3): 250, 1908 (*nec* Theobald).

Phoniomyia Leicester, *Ibid.*, p. 253, 1908 (*nec* Theobald).

Dendromyia Leicester, *Ibid.*, p. 254, 1908 (*nec* Theobald).

Bolbodeomyia Theobald, *Rec. Indian Mus.*, **4**: 31, 1910.

Haemagogus Edwards, *Indian J. med. Res.*, **10**: 449, 1922, and *J. F.M.S. Mus.*, **14**: 52, 1928 (*nec* Williston) (*partim*, *H. achaetae* only).

TYPE SPECIES: *H. scintillans* Ludlow.

From the above synonymy it will be seen that the present genus shows resemblances to the Neotropical Sabethini as well as to the genus *Haemagogus*. It differs from the sabethine genera, however, in the absence of spiracular setae, or in the case of *Limatus* of spiracular scales. It also differs from *Haemagogus* and almost all the numerous sabethine species available to me in having a patch of broad or moderately broad decumbent scales on the alula (Fig. 1a). In the South American genera in question these scales almost always form a fringe even in those few species in which they themselves are fairly broad (Fig. 1b). The only

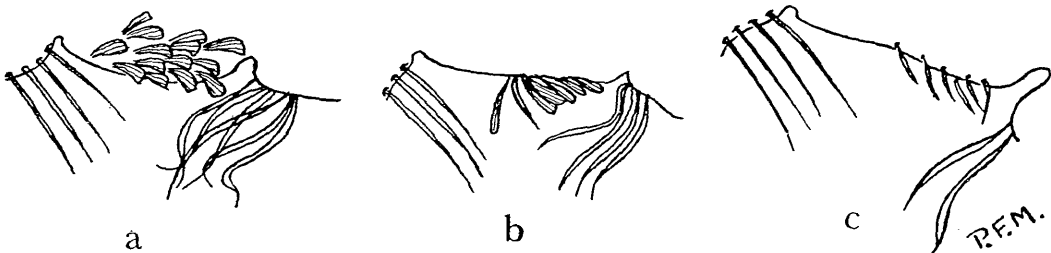


Fig. 1. Alula. a. *Heizmannia communis*, b. *Haemagogus panarchys* Dyar, c. *Haemagogus albomaculatus* Theobald.

exception, so far as can be seen from my material, is afforded by *Trichoprosopon fluviatilis* (Theobald). (The related *Tr. schedocyclius* (Dyar & Knab) is not available to me.) Another distinction from *Haemagogus* is afforded by the constant presence in *Heizmannia* of a lower mesepimeral bristle. On this point Edwards (1932a:179) is misleading. The two genera are very distinct with respect to male terminalia, those of *Haemagogus* recalling certain *Finlaya*. Of the species placed by Edwards (1922b:149, 1932a:179) and Barraud (1934:309) in *Haemagogus*, *H. achaetae* (Leicester) is here transferred to *Heizmannia* and *H. tripunctata* (Theobald) and *H. discrepans* Edwards to *Aedes* (see p. 20).

Examination of the type of *H. indica*, which was not available to Leicester, Barraud or Edwards, shows that it is not the same species as was referred to under the name *indica*

by these authors. It is here given a new name, *H. reidi* sp. n., and redescribed. *H. pilosa* Brug sinks as a synonym of *H. funerea* Leicester and both are provisionally placed in the synonymy of *H. scintillans* Ludlow, the type of which is not available to me. *H. funerea* of some authors (but not Leicester) is found to have consisted in part of *H. indica*. The following Indomalayan species are recognized.

1. *Heizmannia scintillans* Ludlow.
2. *Heizmannia indica* (Theobald).
3. *Heizmannia reidi* sp. n.
4. *Heizmannia metallica* (Leicester).
5. *Heizmannia communis* (Leicester).
6. *Heizmannia macdonaldi* sp. n.
7. *Heizmannia aureochaeta* (Leicester).
8. *Heizmannia stonei* sp. n.
9. *Heizmannia achaetae* (Leicester).

Included species from outside the Indomalayan area are: *H. viridis* Barraud, *H. himalayensis* Edwards and *H. chandi* Edwards from India; *H. greeni* (Theobald) from Ceylon, northern Thailand (?) and Yunnan (?)^{*}; *H. covelli* Barraud from India, Burma, N. Thailand and the Andaman Islands; *H. complex* Theobald from Assam, Burma, N. Thailand and Cochin China; *H. aurea* Brug from Halmaheira and *H. lii* Wu from China and Korea (p. 20). Borel (1930:164) recorded a species from Cochin China as *H. greeni*. His description does not agree with any known species and I prefer to list this as "*Heizmannia* sp. (Borel, 1930)".

The following keys should permit separation of those genera so far dealt with in the present revision from all others. They will be expanded in later papers in the series.

KEYS TO GENERA

KEY TO ADULT FEMALES

- | | | |
|--|---|---|
| 1. Spiracular bristles or scales present | <i>Theobaldia</i> , <i>Topomyia</i> , <i>Harpagomyia</i> , <i>Psorophora</i> ,
<i>Tripteroides</i> and sabethine genera. | |
| Spiracular bristles absent (Fig. 2a) | | 2 |
| 2. Alula bare | | 3 |
| Alula with scales (Fig. 1, p. 5) | | 4 |

^{*} Barraud (1929 bis 268, 1934:308) ascribed certain specimens from southern India to *H. greeni*. These specimens are in the British Museum and they clearly belong to a distinct species. Barraud's description of the external characters of *H. greeni* is misleading and should be ignored, reference being made to the original description by Theobald (1905b: 247). The Yunnan record is due to Chow (1949: 466). I have not seen any specimens from that area. The record from Thailand is based on a unique female adult in the U.S. National Museum, kindly lent me by Dr. Stone. Data are Rong Kwang, Prae Province, 13: xi: 1952, D. C. Thurman Jr. It shows small differences from topotypical *H. greeni* and may possibly be a distinct species. *H. greeni* was also recorded from N. Thailand by Causey (1937: 414).

3. Squama fringed **Ficalbia** subgenus **Mimomyia**
 Squama bare *Uranotaenia* s. str., *Zeugomyia*

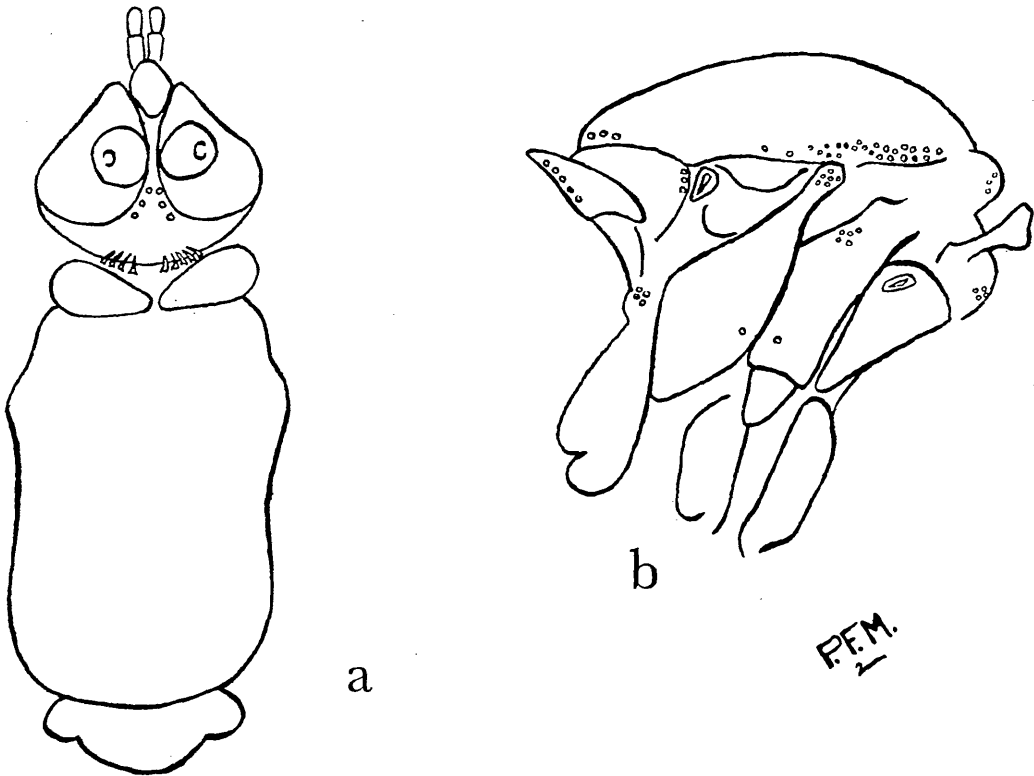


Fig. 2. *H. indica*. a. Dorsal view of thorax, b. Lateral view of thorax.

- III 4. Vein 6 ending about level with base of fork of vein 5 *Aedes* (part), *Hodgesia*, *Uranotaenia*
 (Pseudoficalbia)*
 Vein 6 ending well beyond this 5
- (7) 5. Basal segment of antennal flagellum at least twice as long as the fifth segment 6
 Flagellar segments all more or less equal in length 7
- (8) 6. Lower mesepimeral bristle present *Deinocerites*
 Lower mesepimeral bristle absent **Ficalbia** subgenus **Ficalbia**
- III (9) 7. Alula with narrow scales, or if with broad scales, then these restricted to the fringe (Fig. 1b, c, p. 5) *Haemagogus*, most *Aedes*, most other genera

* *Uranotaenia* s. str. and *Pseudoficalbia* ought almost certainly to be treated as distinct subgenera but discussion of this point must be postponed to a later paper.

Alula with a patch of broad flat decumbent scales (Fig. 1a) (some broad or narrow fringe scales sometimes present in addition) 8

- (49) 8. Antennal flagellum with segments abnormally short and thick; middle femur with a large scale tuft at tip *Aëdomyia*
 Antenna (Fig. 3a) and mid femur otherwise 9

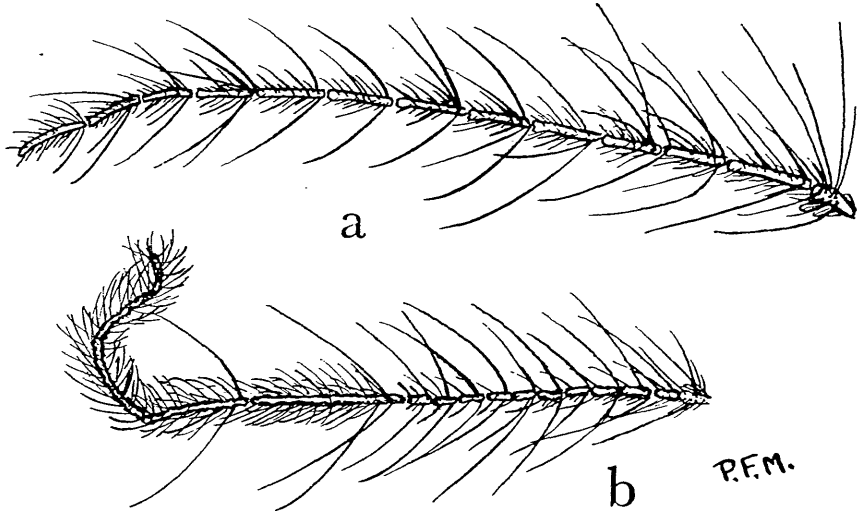


Fig. 3. *H. communis*. Antenna. a. Female, b. Male.

- (50) 9. Squama with a patch of broad scales **Ficalbia** subgenus **Ravenalites**
 Squama bare or with a fringe of narrow scales (Fig. 1) 10
- (51) 10. Wings with numerous pale scales 11
 Wings dark except sometimes for a small patch of pale scales near the root 12
- IV (52) 11. Postspiracular and lower mesepimeral bristles present . . . *Aëdes* subgenus *Diceromyia* (part)
 These bristles absent **Ficalbia** subgenus **Etorleptiomyia**
- IV (53) 12. Tarsi conspicuously banded *Aëdes* subgenera *Stegomyia* (part) and *Diceromyia* (part),
Udaya,* *Eretmapodites* (part)
 Tarsi (except occasionally the first) dark or very indistinctly banded 13
- (54) 13. Scutellum with broad flat scales at least on the middle lobe (Fig. 2b, p. 7) 14
 All scutellar scales narrow *Aëdes* subgenus *Aëdes* (part), *Culex* subgenus *Melanoconion* (part)

* It is preferred to treat this as a distinct genus and not as a subgenus of *Paraëdes* (see Thurman, 1954).

- III (59) 14. Paratergite bare *Eretmapodites* (part), *Paraædes* (part), *Aëdes* (part)
 Paratergite scaly (Fig. 2a) 15
- IV (65) 15. Mesonotum entirely covered with broad scales; tarsi dark; postspiracular bristles usually absent (1-2 occasionally present); postnotal bristles present in most species . **Heizmannia**
 Mesonotum with numerous narrow scales at least on the anterior part or hind tarsi banded or both; 1 or more postspiracular bristles present; postnotal bristles absent . *Aëdes* (part)

KEY TO ADULT MALES

1. Palps at least a third of the length of the proboscis, usually much more 2
 Palps at most about a quarter of the length of the proboscis, usually much less 5
- IV 2. Antenna fully plumose as usual 3
 Antenna not strongly plumose *Opifex*, *Trichoprosopon* (part), *Culex* (part)
3. Distal portion of proboscis very strongly swollen most **Ficalbia**
 Distal portion of proboscis at most lightly swollen 4
- III 4. Alula bare **Ficalbia** subgenus **Mimomyia** (part)
 Alula with scales Most *Aëdes*, most *Culex*, *Eretmapodites*, *Armigeres*, *Psorophora*, *Mansonia*,
Orthopodomyia, *Theobaldia*, *Udaya*, *Ayurakitia*, *Tripteroides* (part), *Trichoprosopon* (part)
- (32) 5. Distal portion of proboscis strongly swollen 6
 Distal portion of proboscis at most lightly swollen 8
- (39) 6. Spiracular bristles present; style modified, usually very strongly so *Topomyia* (part),*
 sabethine genera (part)
 Spiracular bristles absent; style simple 7
- (40) 7. Squama bare; vein 6 ending about level with base of fork of vein 5 *Uranotaenia* (part),
Harpagomyia
 Squama fringed; vein 6 ending well beyond this **Ficalbia** subgenus **Ficalbia** (part)
- IV (41) 8. Antenna strongly plumose *Culex* (part), *Haemagogus*, *Zeugomyia*, *Aëdomyia*, *Uranotaenia*
 (part), *Aëdes* (part), *Tripteroides*, sabethine genera (part)
 Antenna at most lightly plumose (Fig. 3, p. 8) 9
- (29) 9. Spiracular bristles present *Topomyia* (part), sabethine genera (part)
 Spiracular bristles absent 10
- (5) 10. Antenna with basal joints of flagellum elongated, the two terminal joints relatively short *Deinocerites*
 Antenna with basal joints not unusually long, the two terminal joints usually elongated † 11

* *T. spathulirostris* Edwards only.

† See below (p. 20).

- III (52) 11. Squama bare or with not more than 4 narrow scales *Uranotaenia, Hodgesia, Paraëdes, Aëdes* (part) 11
 Squama strongly fringed 12
- IV (52) 12. Scutum with numerous very broad scales; paratergite densely scaly; dorsocentral bristles absent **Heizmannia**
 Scutum without such scales; paratergite bare; dorsocentral bristles strongly developed
Culex subgenus *Mochthogenes* (part)

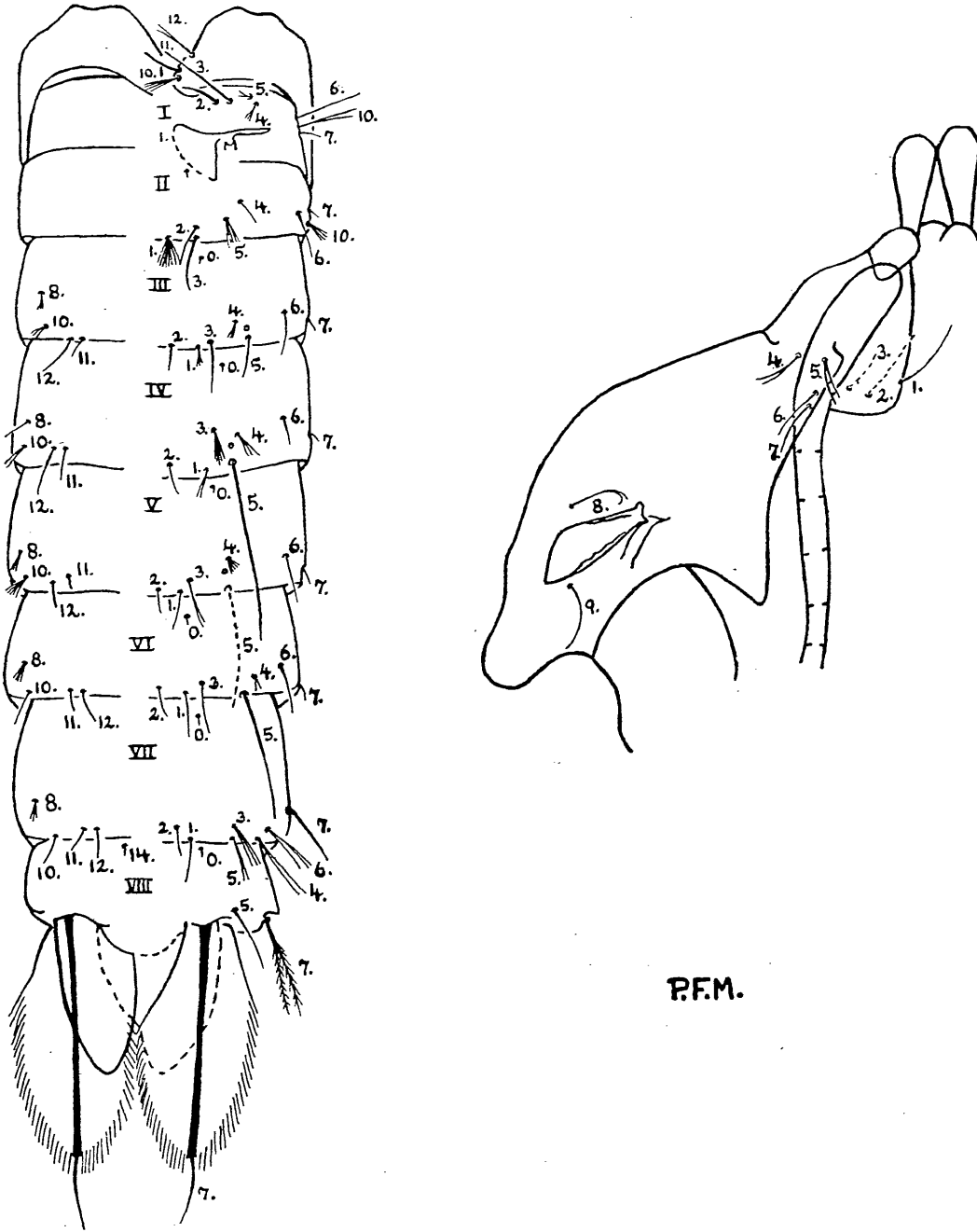
KEY TO PUPAE

1. Trumpets modified for piercing plant tissues 2
 Trumpets not so modified 3
2. Either with float hair of first abdominal segment large and dendroid or with paddle pointed at tip **Ficalbia** subgenus **Mimomyia** (part)
 Float hair of first abdominal segment reduced to a minute simple bristle; paddles notched or rounded at tip *Mansonia*
3. Float hair of first abdominal segment reduced to a minute single or bifid bristle 4
 Float hair at least forming a tuft of ~~three~~ or more fairly long branches, usually large and dendritic 5
4. Trumpets long and narrow; paddles either moderately long and narrow with spinose edge or enormously so with fringe **Ficalbia** subgenera **Etorleptiomyia** and **Ravenalites**
 Trumpets and paddles short and broad *Tripteroides* (part), *Eretmapodites* (part)
5. Seta 7 of segment VIII slender, not conspicuously modified 6
 This seta conspicuous, stout, multibranched, plumose or dendriform or with a combination of these characters 12
6. Trumpet divided into two movable leaflets *Hodgesia*
 Trumpet otherwise 7
7. Paddles with a fringe of long hairs reaching almost to base on both borders **Ficalbia**
 subgenus **Mimomyia** (part)*
 Paddles quite otherwise 8
8. Paddles pointed at tip with inner edge uniformly curved, deeply pigmented over most of their area with a fringe of coarse teeth on either side of the apical seta; trumpets at least about ten times as long as their breadth at half-way, usually more **Ficalbia** subgenus **Mimomyia** (part)
 Without this combination of characters 9

* *F. splendens* (Theo.) only.

- III 9. Trumpets at least 7 times as long as their breadth at half-way, tracheoid for almost half their length 10
 Trumpets much shorter than this or else tracheoid for at most a very short distance at base, usually both *Aedes* (part), *Uranotaenia* (part), *Deinocerites* (part),
Psorophora (part), *Theobaldia* (part)
10. Apical seta more than half length of paddle; no setulae present on segment IX
Deinocerites (part)
 Apical paddle seta much shorter than this; a pair of setulae present on segment IX 11
11. Paddles fringed, serrated or spiculate on both borders, at least towards apex
Uranotaenia (part)
 Paddles serrated on outer border only, inner border entirely smooth **Ficalbia** subgenus
Ficalbia
- III (15) 12. Paddles with a fringe of delicate hairs or hairlike spines reaching at least half-way down both borders (Fig. 4) 13
 Paddles very occasionally with short but slender spicules on about the apical third of both borders or with a long fringe on the outer border only, usually quite otherwise* *Harpagomyia*, *Aedomyia*, *Orthopodomyia*, *Opifex*, *Haemagogus*, *Culex*, most Sabethini, most *Aedes*, most *Tripteroides*, *Uranotaenia* (part), *Topomyia* (part), *Psorophora* (part), *Theobaldia* (part).
- III (16) 13. Seta 7 of segment VIII forming a large, conspicuous tuft of at least 5 branches, often more, which arise from the extreme base *Zeugomyia*, most *Topomyia*, *Wyeomyia* (part), *Eretmapodites* (part), *Tripteroides* (part), most *Armigeres*, *Aedes* subgenera *Skusea* (part) and *Stegomyia* (part).
 This seta less strongly developed (Fig. 4) either with 4 branches at most, usually less, or branched only towards tip 14
- VI. 64 (23) 14. Float hair with plumose branches which show little or no secondary subdivision except as an occasional aberration; segment I with seta 3 extremely stout and dark, frayed; † paddle with apical seta normally well to one side of tip of mid-rib *Eretmapodites* (part)
 Float hair dendritic with pronounced secondary branching; seta 3 of segment I slender, usually simple; apical paddle seta placed at or only slightly to one side of tip of mid-rib (Fig. 4) 15
- (24) 15. Paddles with distal portion of inner half expanded, narrowing abruptly just before base, apex in most cases distinctly emarginated *Uranotaenia* (part) ‡, *Armigeres* (part)

* *Aedes* (*Finlaya*) *echinus* Edwards is the only example of the first type with which I am acquainted. *Uranotaenia ascidiicola* De Meijere has a very long dense fringe but this is confined to the outer border, the inner border being minutely spiculate.
 † The setal nomenclature employed here is that of Belkin (1953). It should be noted that the original description of the pupa of *Heizmannia* (Mattingly, 1949 *bis*) employed the nomenclature of Knight and Chamberlain (1948) in which this is seta number 4. For definition of the term "frayed" and other descriptive terms applied to individual setae see Evans (1938:25).
 ‡ *U. bimaculata* Leicester and *U. novobscura* Barraud are the only species known to me which would run down here. The former has the apex of the paddle emarginated as well as possessing in some degree the deep basal emargination of the inner portion which is characteristic of this genus (see Roth, 1946: 71), while the latter has the apical half of the paddle more or less oval but is at once recognizable by the very deep basal emargination of the inner surface.



R.F.M.

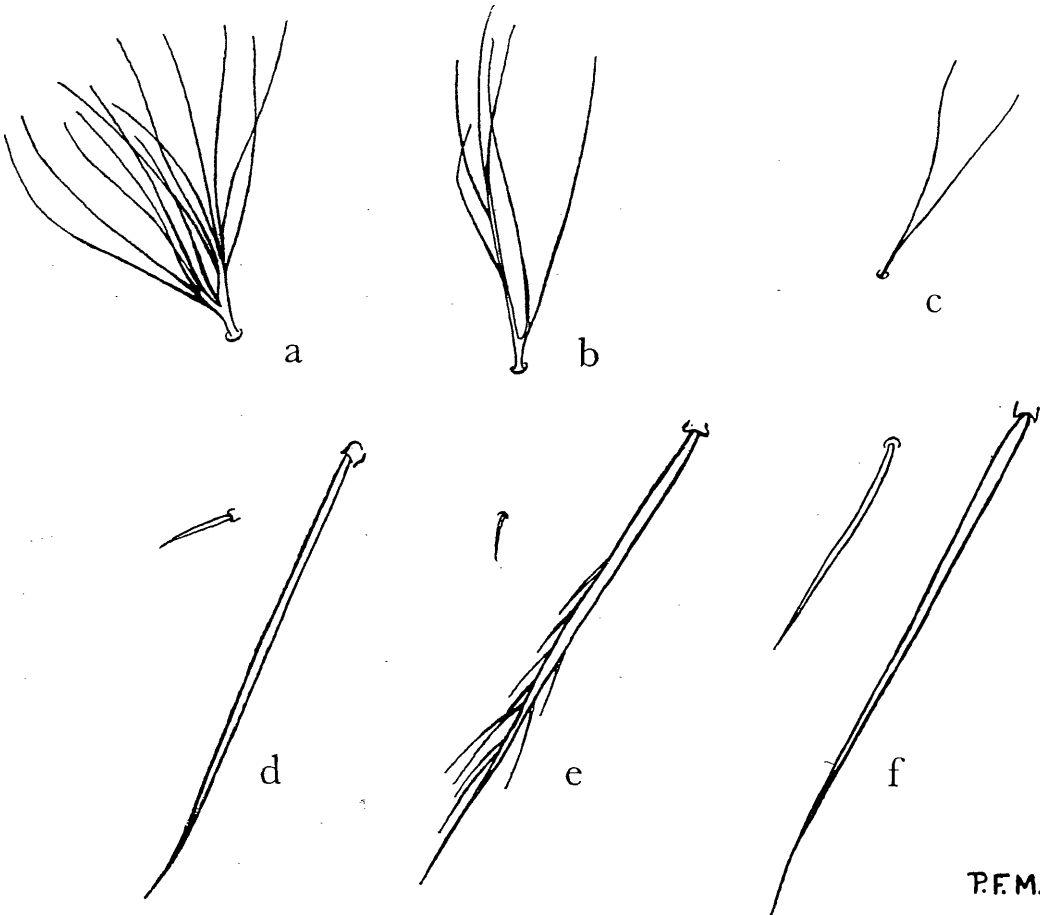
Fig. 4. *H. scintillans*. Pupa.

Paddles more or less symmetrical about the mid-rib, roughly oval in shape, at most very slightly invaginated at tip, apex usually smoothly rounded or pointed (Fig. 4) . . . 16

VI (2.6) 16. Paddles less than one and a half times as long as broad or seta 7 of segment VI not less than two-fifths of the length of seta 7 of segment VII (Fig. 5f) or both . . . *Aedes* subgenus *Stegomyia* (part)

Paddles one and a half times as long as broad or more; seta 7 of segment VI ~~minute~~ (Fig. 5d, e) . . . 17

less than 2/5 length of seta 7



P.F.M.

Fig. 5. Pupal setae. a-c. Seta 1 of segment II. a. *H. scintillans*, b. *H. himalayensis*, c. *Aedes* (*Dicromyia*) *iyengari* Edwards, d-f. Seta 7 of segments VI and VII, d. *H. scintillans*, e. *H. himalayensis*, f. *Aedes* (*Stegomyia*) *annandalei* (Theobald).

VI (2.6) 17. Seta 1 of segment II well developed with at least 4 branches (Fig. 5a, b) . . . **Heizmannia***

* An occasional aberrant specimen of *Aedes annandalei* or *Aedes* (*Stegomyia*) *albopictus* Skuse may run down here also.

This seta ~~minute~~, bifid (Fig. 5c) *Aedes* subgenus *Diceromyia* (part)*

KEY TO FOURTH STAGE LARVAE

1. Ventral brush absent or reduced to two pairs of setae or less 2
 Ventral brush with at least three pairs of setae, usually more 4
2. Siphon with at least two pairs of subventral setae, usually more . . . *Harpagomyia*, *Topomyia*,
Tripteroides, *Culex* (part), sabethine genera (part)
 Siphon with only one pair of subventral setae 3
3. Indomalayan and Malagasy species with ventral brush represented by two pairs of setae
Ficalbia subgenus **Ravenalites**
 Neotropical species with ventral brush represented by only one pair of setae (except in a few
Sabethes) sabethine genera (part)
4. Siphon modified for piercing plant tissues 5
 Siphon not so modified 6
5. Head setae B and C very long, much longer than the head **Ficalbia** subgenus
Mimomyia (part)
 Head seta C (and usually B) much shorter than the head *Mansonia*
6. Mouthbrushes composed entirely of stout pectinate setae adapted for predation . . . *Aedes*
 subgenus *Mucidus*, *Psorophora* subgenus *Psorophora*, *Culex* subgenus *Lutzia*
 Mouthbrushes with at least the outer setae unmodified 7
7. Mouthbrushes with the inner setae short, stout and pectinate 8
 Mouthbrushes with all setae slender, delicate and hairlike 9
8. Mentum wholly suppressed **Ficalbia** subgenus **Mimomyia** (part)†
 Mentum well developed *Uranotaenia* (part), *Zeugomyia*, *Armigeres*, *Haemagogus*,
Eretmapodites, *Aedes* (part), *Culex* (part), *Opifex* (part) *Theobaldia* subgenera *Theobaldia* and
Allotheobaldia‡
9. Siphon entirely devoid of setae *Culex* (part), *Psorophora* (part)
 Siphon not so, with at least two setae (which may, however, arise very near the base) 10
10. Siphon with one pair of subventral tufts or single setae (subdorsal setae sometimes present in
 addition) 11

* The only species included here is *Ae. iyengari*. All other known *Diceromyia* pupae have the paddles fringed with short spicules and so run down elsewhere in the key.

† *F. plumosa* (Theobald) only.

‡ During the course of the present study larvae of *Opifex* and of a few species of *Aedes* have been found to possess mouthbrushes both with and without pectinate setae. It seems that this may well be a very interesting example of balanced polymorphism related to the more efficient exploitation of breeding places but it requires further study. It is not known to have been noted previously in the literature.

Siphon with more than one pair of subventral or lateral tufts or with two or more tufts or single setae in line with one another close to the mid-ventral line *Culex* (part),
Deinocerites, *Theobaldia* subgenus *Climacura*

- (40) 11. Siphonal tufts situated very close to base of siphon 12
 These tufts situated at not less than a quarter of the distance from base to apex 14
- (41) 12. Siphon at most about three times as long as its breadth at base; comb a regular row of not more than 20 teeth 13
 Siphon at least about five times as long as its breadth at base; comb an irregular patch of more than 20 teeth *Theobaldia* subgenera *Culicella*, *Theomyia*, *Neotheobaldia* and *Austrotheobaldia*
- (42) 13. Head seta B double, pecten of only two teeth; ventral surface of anal segment without any setae proximal to the ventral brush **Ficalbia** subgenus **Ficalbia**
 Head seta B single; pecten of four teeth or more; ventral surface of anal segment with several very delicate setae proximal to the ventral brush *Hodgesia*
- (51) 14. Antennae greatly flattened; dorsal valves of siphon with a pair of large sclerotized hooks, ventral valves with a pair of multibranched setae *Aëdomyia*
 Antennae not conspicuously flattened; siphonal valves otherwise 15
- (52) 15. Anal segment completely ringed with setae of ventral brush penetrating the saddle along the mid-line almost to its base *Psorophora* (part)
 Anal segment otherwise 16
- (53) 16. Metathorax with a large fan-shaped dorsolateral seta, the three metapleural setae all single *Opifex* (part)
 Metathoracic setae otherwise, at least one metapleural branched 17
- (54) 17. Pecten absent or reduced to a single tooth 18
 Pecten with at least two teeth 19
- (55) 18. Antennae smooth, unjointed, at most about two-thirds of the length of the head *Orthopodomyia*
 Antennae jointed, strongly spiculate on the basal portion, at least about four-fifths of the length of the head **Ficalbia** subgenera **Mimomyia** (part) and *Etorleptomyia*
- (56) 19. Antennae with second joint elongated, freely articulated, first joint strongly spiculate, subapical setae very long, lower (outer) caudal seta with 3 or more branches **Ficalbia** subgenus **Mimomyia** (part)
 Without this combination of characters 20
- III (57) 20. Head seta C with at least 3 branches, usually more; head seta *d* very large and multibranched with swollen base (Fig. 6) 21
 Head setae otherwise *Aëdes* (part), *Uranotaenia* (part)



Fig. 6. Larval head, *H. scintillans*, showing variation in seta C. mx. Maxilla, m. Mentum.

- IV (42) 21. Either with seta B bifid, with very unequal branches (Fig. 6), or with comb composed of mixed scales and spines (Fig. 29, p. 49) or both *Heizmannia*,
 Head seta B otherwise; comb composed of scales or spines only *Aedes* (part)

The following are the principal generic characters of *Heizmannia*.

Genus HEIZMANNIA

Adult female with proboscis often somewhat swollen at tip but not grossly so, from about nine-tenths to one and a quarter times the length of the front femur. Palps dark, from about one-eighth to one-fifth of the length of the proboscis. Antenna with flagellar joints slender and of normal length, those at the base somewhat shorter and thicker than those at the apex. Basal joint of flagellum with small flat scales which may be pale or dark or both. Torus with very short, fine hairs on upper part of inner surface and very small dark scales below these. Clypeus usually bare, but occasionally with scales (p. 52). Eyes unusually widely separated (by about the width of one torus posteriorly, less than this anteriorly). About six stout setae projecting forward from the point of the vertex. The latter with broad, flat scales which are dark, usually with metallic reflection, except for a conspicuous white or silvery patch between the eyes, a pair of similar patches at the extreme sides and, in some cases, a narrow whiteish band round the eye margins. Some species, at least, have a small patch of upright forked scales on the nape, usually difficult to observe and best seen

in side view. Anterior pronotal lobes wedge-shaped when seen from above, the narrow ends of the wedges very closely approximated in the mid-line (Fig. 2*b*, p. 7), but less so in *H. achaetae* than in other species (Fig. 9*a*, p. 21). Posterior pronotum with numerous broad, flat scales and about 2-4 bristles along the upper posterior border close to the anterior lip of the spiracle. Very numerous broad, flat, white or silvery scales present on the paratergite, postspiracular and subspiracular areas, sternopleura and mesepimeron. Base of meron level with or at most very slightly above base of hind coxa. Upper mesepimeral and sternopleural bristles and a single lower mesepimeral bristle present. Lower sternopleurals reduced to a single strong bristle with, occasionally, 1-2 fine hairs in addition. Spiracular bristles absent. Postspiraculars usually absent, but 1-2 present in *H. complex* and *H. stonei* sp. n. Mesonotum covered with broad scales, usually with metallic reflection but duller in some species. Acrostichal and dorsocentral bristles absent. Prescutellars absent except for 1-2 in *H. himalayensis*. Scutellum with broad scales on all lobes. Postnotum with a group of small bristles posteriorly, except in *H. achaetae*, mixed with scales in *H. stonei* (Fig. 7).

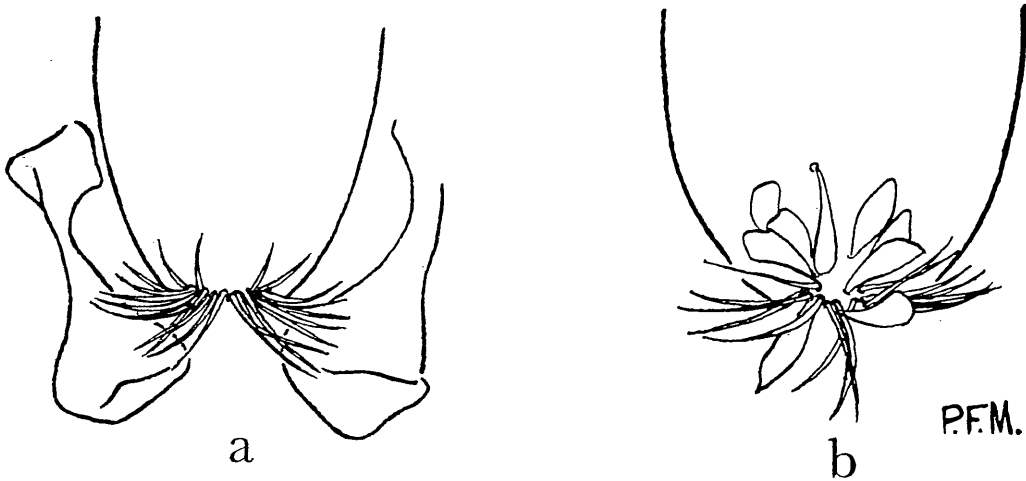


Fig. 7. Postnotum. a. *H. aureochaeta*, b. *H. stonei* sp. n.

Wings dark. Wing scales various. Anterior fork cell from a little less than twice to a little less than four times as long as its stem. Alula with a patch of broad decumbent scales (Fig. 1*a*, p. 5). Squama with a fringe of narrow, hairlike scales. Tarsi dark. Fore tarsal claws of female simple, except in *H. achaetae*. Fore tibial claw absent (perhaps represented by a minute setula which is present in approximately the correct position in some of the species examined). Terminalia as in Fig. 8. Cerci narrow to moderately broad, broader in *H. achaetae* than in other species (Fig. 8*b*). Insula not clearly differentiated in most cases. Apical edge of eighth sternite more or less strongly sclerotized and bilobed. Spermatheca triple.

Terminal portion of caecal duct strongly sclerotized. Adult male (unknown for *H. achaetae*, *H. stonei*, *H. aureochaeta*, *H. aurea* and *H. viridis*) with antenna various but never very strongly plumose. The two terminal joints are normally very greatly elongated (Fig. 3b,

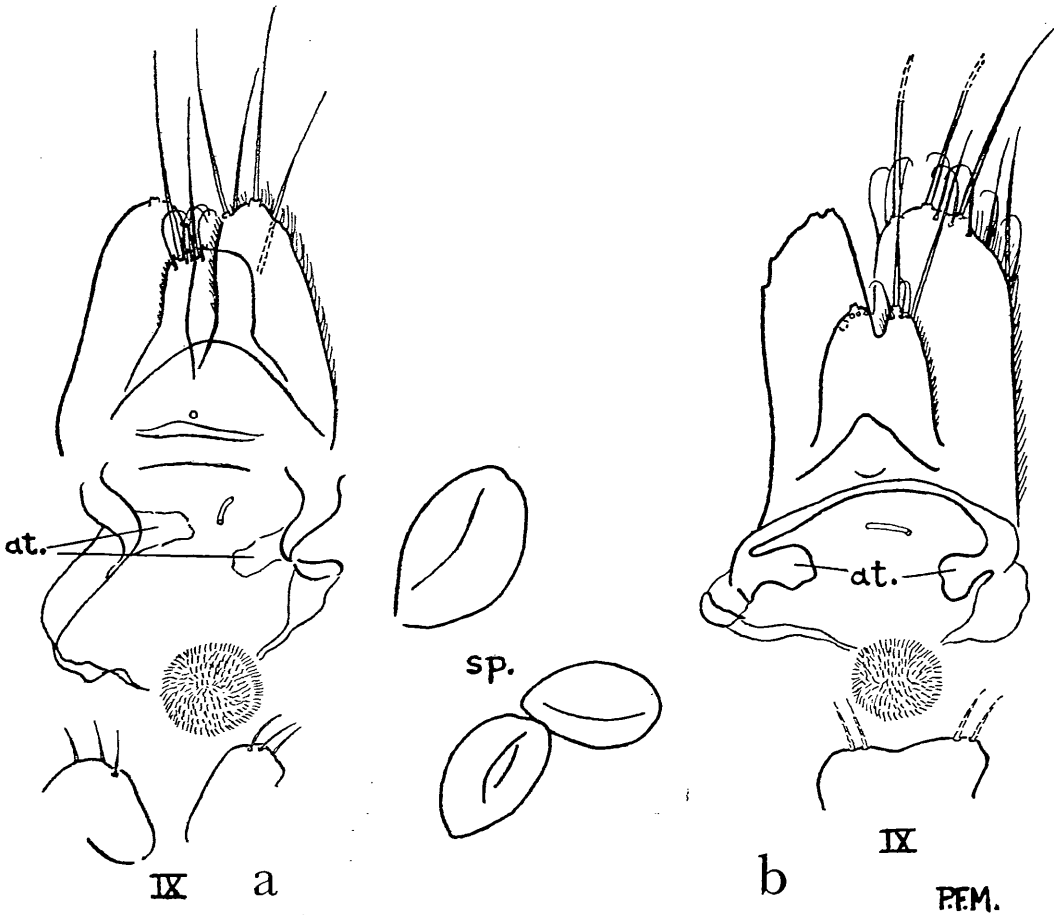


Fig. 8. Female terminalia. a. *H. reidi* sp. n., b. *H. achaetae*, sp. Spermathecal lobes, *H. metallica* at. Atrial plates, ix. Ninth tergite.

p. 8) but, as noted by Barraud (1934: 304), the only known Malayan male of *H. reidi* has the antennae almost as in the female. A similar situation apparently exists in *H. complex* in Indochina (Borel, 1930: 158). Indian males of *H. reidi* in the British Museum have antennae of the normal male type, and so, apparently, have Indian *H. complex* (Barraud, 1934: 302). It seems that this is an aberration, probably correlated with the general suppression of secondary sexual characters in the antenna and palps of this genus. Male palps not more than

about a fifth of the length of the proboscis, usually less. Tarsal claws simple except in *H. covelli*, which has the fore and mid claws toothed. Terminalia (Figs. 16, 19, 22, 23, 25, 27, pp. 31, 36, 40, 42, 45, 48) large in proportion to the width of the abdomen. Style highly complex, unless perhaps in the species erroneously attributed by Borel (1930:164) to *H. greeni*. Coxite usually, but not always, with one or two setigerous lobes arising from the membranous inner face. These are easily detached and are reminiscent of the proximal and distal claspettes of *Eretmapodites*. One of them sometimes bears a harpago very similar to that often encountered in *Aedes*. Sclerotized portion of coxite with a characteristic apical row or patch of modified setae and with a subapical lobe bearing one or two very stout spines. Phallosome divided into toothed lateral plates. Paraprocts various but always rather long and slender. Ninth sternite always well developed and greatly enlarged in some species. Ninth tergite in some cases with the sclerotized lateral lobes joined only by membrane. Pupa (Figs. 4, 5, 28, pp. 12, 13, 49) known only for *H. himalayensis* and *H. scintillans* which were described in detail by Mattingly (1949:219), the latter under the name *H. pilosa*, and for *H. macdonaldi* sp. n. Trumpets more or less expanded at tip, the meatus occupying almost the whole length, tracheoid only at the extreme base. Float hair large and dendritic. Seta 7 on segments VII and VIII rather short, stout and dark with at most 4 branches. Paddles rather narrow, ovate, only slightly emarginated on basal half of inner face. Mid-rib complete, conspicuously darkened. Terminal seta well developed, single to trifid, about a quarter of the length of the paddle, arising just to one side of the tip of the mid-rib. Fringe composed of slender hairs occupying about the distal two-thirds of both the inner and the outer face. Accessory paddle seta absent. No setulae on segment IX. Larva (Figs. 6, 17, 20, 26, 29, pp. 16, 33, 37, 46, 49) known only for *H. scintillans*, *H. indica*, *H. communis*, *H. macdonaldi*, *H. himalayensis*, *H. greeni*, *H. complex*, *H. covelli* (provisional attribution, see Barraud, 1934:305) and the species from Cochin China erroneously attributed by Borel to *H. greeni* (see above, p. 6). I have not seen larvae of *H. greeni* (for which see Carter & Wijesundara, 1948:142) or of *H. communis*, *H. complex* or Borel's species (for all of which see Borel, 1930). Antenna short, smooth or lightly spiculate, regularly tapering, the two basal joints completely fused. Mouthbrushes devoid of pectinate setae. Head seta B with two very unequal branches in most species (not described by Borel).^{*} Head seta *d* very strongly developed with expanded base and numerous branches. Mentum well developed, of normal type. Maxillary spine small and inconspicuous. Bases of thoracic pleural setae not enlarged, ornamented with small straight spines which may be single or bifid or may have several small secondary denticles. Comb of not more than 20 scales or spines or with both mixed (another very characteristic feature where present). Siphon short and stout, tapering more strongly on the distal than on the proximal half. Pecten with not more than about a dozen teeth on either side. A single pair of subventral setae arising just before half-way. Spines at bases of dorsal valves delicate, setuliform. Setae on ventral valves short.

^{*} This is a highly characteristic feature. The only other group in which I have seen a similar seta is *Aedes* subgenus *Christophersiomyia* which has head seta *d* very much smaller.

Distal edge of saddle spiculate. Upper caudal seta with 2-4 branches, lower single or, rarely, bifid. Setae of ventral brush single or bifid. Anal papillae large, their tips bluntly rounded.

Bionomics. Little has been published about adult bionomics. Mr. W. W. Macdonald tells me that adults are frequently taken biting in forest in Malaya, and this is in agreement with the few notes published by Leicester. See also Causey (1937:414). Most authors refer to adults as having been taken in forest, and it appears that the genus is largely or wholly restricted to this type of habitat. Recorded hosts include man, dog and horse (Causey, *loc. cit.*, Macdonald, *in litt.*). Leicester (1908 *bis*:268, 269) persuaded *H. metallica* to feed on patients suffering from filariasis and malaria, but without obtaining any infections. The early stages have been recorded from tree-holes and bamboo stumps only.

Distribution. Mainly oriental but *H. lii* Wu is found in China just north of the boundary of the Palaearctic and again still farther north in Korea (National Forest, specimen in U.S. National Museum kindly lent me by Dr. Stone and not previously published), while *H. aurea* Brug (1932:75) was found on Halmahera just inside the Australasian Region. Indian species have been found up to 7000 ft. in the Himalayan foothills (Barraud, 1934:304).

SPECIES GROUPS

The inclusion of *H. achaetae* in the present genus is provisional. This species is known only from the female adult, and a final decision as to its systematic position must await the discovery of the male and early stages. The two other oriental species formerly placed in *Haemagogus* (*discrepans* Edwards, 1922a:291 and *tripunctatus* Theobald, 1908:288) are rather less like *Heizmannia*. They may be said to be intermediate between *H. achaetae* and some species of *Aedes*, particularly *Aedes kanarensis* Edwards (in Barraud, 1934:444). The latter cannot be accepted as a *Cancraëdes*, as Edwards suggested, but it resembles *Aedes* in having the eyes contiguous, pronotal lobes well separated and a small number of postspiracular bristles. While recognizing that it may eventually be necessary to transfer some of these species to *Heizmannia*, possibly with the creation of a new subgenus, it is preferred to retain them for the present in *Aedes*. Their position will be further discussed in later papers in this series. *H. achaetae* is included in *Heizmannia*, where it is placed in a separate species group.

The remaining species are fairly uniform, and while it is possible to envisage certain species groups in outline it is felt desirable to postpone any such subdivision until the males and early stages are more completely known. Despite the fact that one of them is about the most brightly and the other the least brightly metallic species in the genus, *H. greeni* and *H. lii* have almost identical male terminalia and should certainly be grouped together. So also should *H. scintillans* and *H. indica* on the one hand and *H. complex* and *H. stonei* on the other. *H. communis* and *H. macdonaldi* form another species pair, and *H. aureochaeta* is in some respects intermediate between these two pairs. Broadly speaking the Indian species are

distinguished by their narrower wing scales and a greater tendency than in the Indomalayan species towards the formation of complete basal bands on the posterior abdominal tergites, but there is considerable overlapping. Pending the discovery of further material only the two following species groups are recognized.

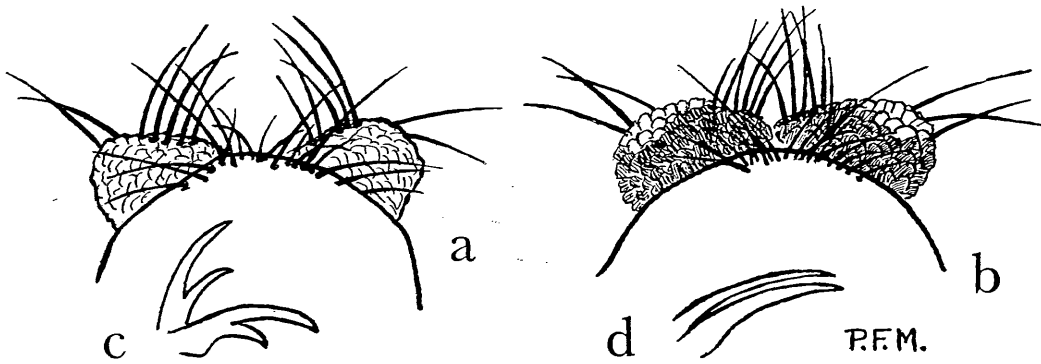


Fig. 9. a, b. Pronotal lobes from above, c, d. Fore tarsal claws of female, a, c. *H. achetae*, b, d. *H. scintillans*.

Group A. (*Heizmannia* s. str.). Pronotal lobes very closely approximated (Fig. 9b). Fore and mid-claws of female simple (Fig. 9d). Postnotum with a conspicuous group of setulae (Fig. 7, p. 17). Ninth tergite of female divided into two separate plates. Postgenital plate with distal edge smoothly rounded. (Fig. 8a, p. 18). Included species: all except *H. achetae*.

Group B. Pronotal lobes more widely separated though still unusually close (Fig. 9a). Fore and mid-claws of female strongly toothed (Fig. 9c). Postnotum entirely bare. Female ninth tergite undivided. Postgenital plate bilobed (Fig. 8b, p. 18). Included species *H. achetae* only.

NOTES ON TYPES

H. scintillans. Described from a unique female adult in the U.S. National Museum. This is the type specimen of the genus. I have not seen it but Dr. Stone has kindly examined it for me. The antennae are missing and one wing is mounted on a slide.

H. indica. Described from a unique male adult in the Hungarian National Museum. This, together with Theobald's other types, was fortunately on loan to the British Museum at the time of the recent holocaust and has survived. The terminalia are missing and it has not been possible to locate them.

H. aureochaeta. Described from a series of female adults which are said to have been taken in April and May (Leicester, 1908:257). The British Museum has a series of five specimens

none of which agrees as to date. Two were taken in December, one in September and one in March. The fifth has no data. Nevertheless one of them is labelled with the specific name by Leicester, and I believe them to have formed part of his type material. I have marked one of them as holotype and the others as paratypes, except for the unlabelled specimen which I have left unmarked. Data for the holotype are "Jungle 6 miles fr. Kuala Lumpur, Day. 1: 12: '03."

H. communis. Described from "a series of females and one male taken at 'The Gap', Selangor" (Leicester, 1908:255). The British Museum has the male, which I have marked as holotype, and a series of nine females of which only three agree as to data with the published description. I have marked one of these as the allotype and the other two as paratypes. There is, in addition, an undissected male with antennae missing which agrees with the published data except that it is dated 16:6: '04. I believe Leicester to have mistaken this for a female and I have marked it as a paratype. Data for the holotype are "The gap at edge of stream in jungle, 16:4: '04" and for the allotype "At edge of stream in the jungle The Gap, 16:4: '04".

H. funerea. Described from a unique female holotype which is in the British Museum.

H. metallica. As *H. funerea*.

H. pilosa. Described from three male adults of which one was designated as holotype (Brug, 1931 *bis*:248). This specimen and one of the others, which is marked as a paratype, are in the British Museum. Both specimens are accompanied by liaison larval and pupal skins. These are distinctly dimorphic and Brug (*loc. cit.*) characterized them as "specimen a" and "specimen b". The skins associated with the holotype constitute "specimen a" (see Mattingly, 1949 *bis*:219).

H. reidi. See below (p. 38).

H. achaetae. Described from "one specimen which is probably female though the genitalia are so entirely concealed and there is so little difference between the sexes in this genus that it might be a male" (Leicester, 1908:258). This holotype specimen is in the British Museum. I have not dissected it, but there can be no doubt that it is a female. The male terminalia in this genus are not so small as Leicester suggests. They are, in fact, large in proportion to the width of the abdomen and decidedly conspicuous.

H. aurea. The holotype is in the British Museum.

H. himalayensis. The holotype is in the Indian Museum (*per fide* Edwards, 1922a:290 and Barraud, 1934:306).

H. chandi. The holotype is in the British Museum. At the time when it was described, it was in the collection of the Central Malaria Bureau at Kasauli (Edwards, 1922a:291). Of two females in the British Museum one was referred to by Edwards (*loc. cit.*) as the allotype, but he did not mark it as such. I have marked both females as paratypes.

H. lii. Said to be represented by two co-types (male and female) in the Bureau of Entomo-

logy, Hangchow (Wu, 1936: 1). I have not seen these specimens. The British Museum has one male and five female paratypes.

H. complex was described from two co-types (male and female) which are in the Indian Museum except for the male terminalia and one wing of the male which are on slides in the British Museum (see Edwards, 1922b: 447). I have marked these two slides as the holotype.

H. covelli was described from two co-type males from the Andaman Islands, one male paratype from Sukna, N. Bengal and a female allotype "from the same place" (Barraud, 1929 bis: 266). The British Museum has all three males, and I have marked one of those from the Andamans (No. 2253, on pin with mounted terminalia on the same pin) as holotype and the other (No. 2252, on slide with terminalia on another slide) as a paratype. I have marked the male from Sukna (No. 2245, on pin with terminalia on slide) as a paratype. It is dated "vii:22" and not "ix:22" as stated by Barraud. The British Museum also has a female from the Andamans (unnumbered, on pin, dated 1926) and it seems likely that it is the allotype referred to by Barraud since he says (1934: 304) that this is in the British Museum. If this is so, then the data which he gives (Sukna, N. Bengal, x:1922) are erroneous. I have marked this specimen provisionally as a paratype. Data for the holotype are "Andaman Islands, vii:1926, Major Covell".

H. greeni was described from two co-types (male and female, Theobald, 1905b: 247). Both are in the British Museum. I have marked the male as holotype and the female as allotype.

H. viridis was described from "Three co-type females . . . from Yellapur . . . also other females of apparently the same species from Nagargali . . . and Malabar coast" (Barraud, 1929 bis: 266). The British Museum has two of the females from Yellapur and six of those from the Malabar coast. I have marked one of the Yellapur specimens as holotype and the remainder as paratypes.

KEYS TO SPECIES

KEY TO ADULT FEMALES

1. Postnotum with a group of small bristles (Fig. 7, p. 17); fore and mid-claws simple 2
 Postnotum bare; fore and mid-claws toothed (Fig. 9b, p. 21) *H. achaetae* (p. 53)
2. Posterior pronotum extensively pale scaled 3
 Posterior pronotum entirely dark scaled 5
3. Scutellum and postnotum with pale scales; wing scales narrow (Fig. 11i, p. 24)
H. stonei sp. n. (p. 51)
 Scutellar scales all dark (although a small pale spot may be present in front of the scutellum);
 wing scales broad (Fig. 11f, h) 4

- 4. Anterior pronotal lobes entirely or almost entirely pale above . . . *H. macdonaldi* sp. n. (p. 47)
- Anterior pronotal lobes pale above only along the anterior border . . . *H. aureochaeta* (p. 50)
- 5. Anterior fork cell about three times as long as its stem or more (Fig. 10a) 6
- This cell about two and a half times as long as its stem or less (Fig. 10b) 7

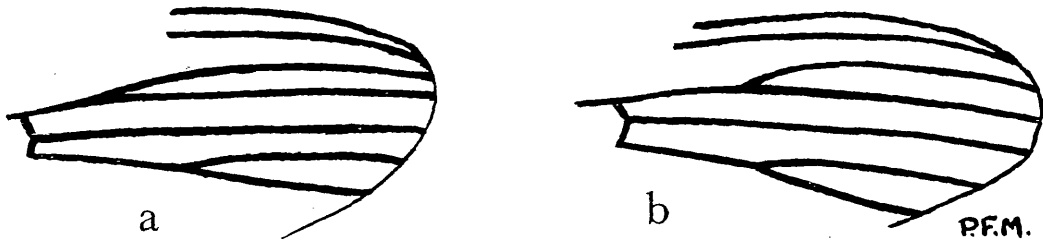


Fig. 10. Anterior fork cell. a. *H. reidi* sp. n., b. *H. indica*.

- 6. Proboscis shorter than front femur; palps about one-fifth of the length of the proboscis; anterior pronotal lobes largely or wholly pale scaled above *H. communis* (p. 43)
- Proboscis longer than front femur; palps about one-seventh of the length of the proboscis; anterior pronotal lobes pale scaled on only about the anterior half of the upper surface *H. reidi* sp. n. (p. 38)

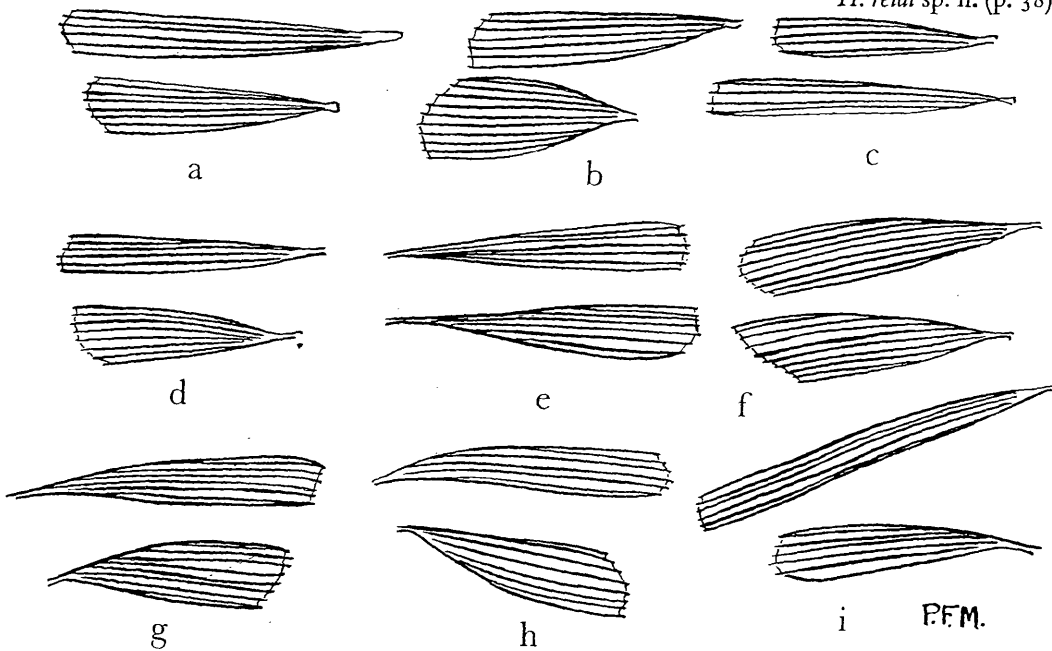


Fig. 11. Plume scales from middle third of vein 2+1. a. *H. scintillans* (type, after Stone), b. *H. communis*, c. *H. metallica*, d. *H. indica*, e. *H. reidi* sp. n., f. *H. aureochaeta*, g. *H. achaetae*, h. *H. macdonaldi* sp. n., i. *H. stonei* sp. n.

7. Plume scales on middle third of vein 2·1 mostly narrow (Fig. 11c, p. 24) . . . *H. metallica*,
 (p. 41)
 These scales mostly relatively broad (Fig. 11a, d) 8
8. Pale scales on upper surface of anterior pronotal lobes restricted to the anterolateral corners
 (Fig. 2b, p. 7); scaling of most of the scutum with blue or dark-green reflection; pale basal
 lateral patches on abdominal tergites relatively small (Fig. 18, p. 30) . . . *H. indica* (p. 34) / 18
 Pale scales on upper surface of anterior pronotal lobes encroaching to a variable extent along
 the anterior border (Fig. 9b, p. 21); scutal scales with more strongly metallic reflection, the
 blues and greens very strongly tinged with gold; pale basal lateral patches on abdominal tergites
 larger, extending well in towards the mid-line (Fig. 18, p. 35) . . . *H. scintillans* (p. 28) / 15

KEY TO ADULT MALES

The males of *H. achaetae*, *H. aureochaeta* and *H. stonei* are unknown.

1. Second and third hind tarsal segments with erect scales forming a conspicuous tuft (Fig. 12a)
H. scintillans (p. 28)
 Hind tarsus without any such tuft (Fig. 12b) 2

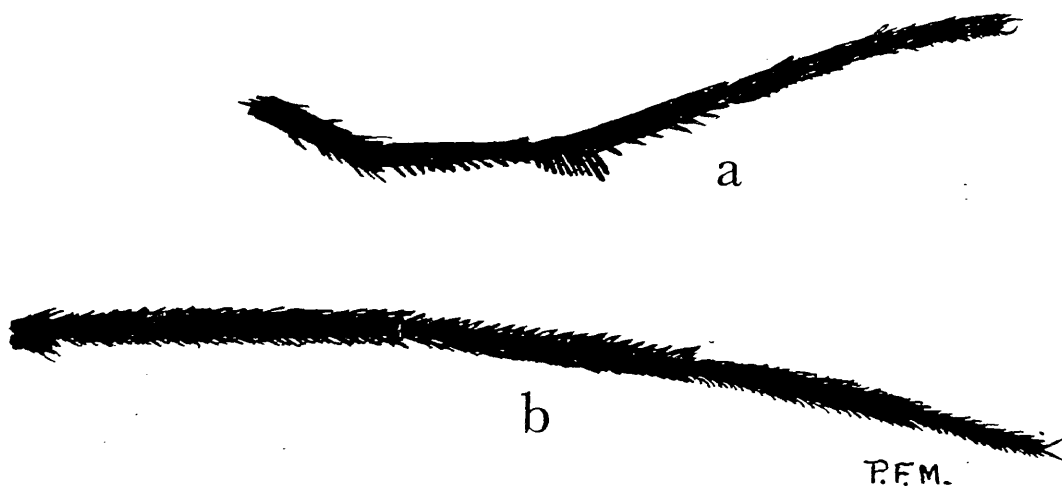


Fig. 12. Male hind tarsus. a. *H. scintillans*, b. *H. communis*.

2. Basal joints of antennal flagellum scarcely longer than broad, with few hairs . . . *H. metallica*
 (p. 41)*
 These joints at least twice as long as broad with more numerous hairs 3

* Fide Edwards (1922b: 447, 448). I have not seen the male of this species.

- 3. Anterior fork cell about twice as long as its stem; pronotal lobes largely dark above *H. indica* (p. 34)
 Anterior fork cell about three times as long as its stem; pronotal lobes extensively pale above 4
- 4. Proboscis at least a little shorter than the front femur; palps about one-sixth to one-fifth of the length of the proboscis (Fig. 13a) 5
 Proboscis about a quarter as long again as the front femur; palps less than one-tenth of the length of the proboscis (Fig. 13b) *H. reidi* (p. 38)

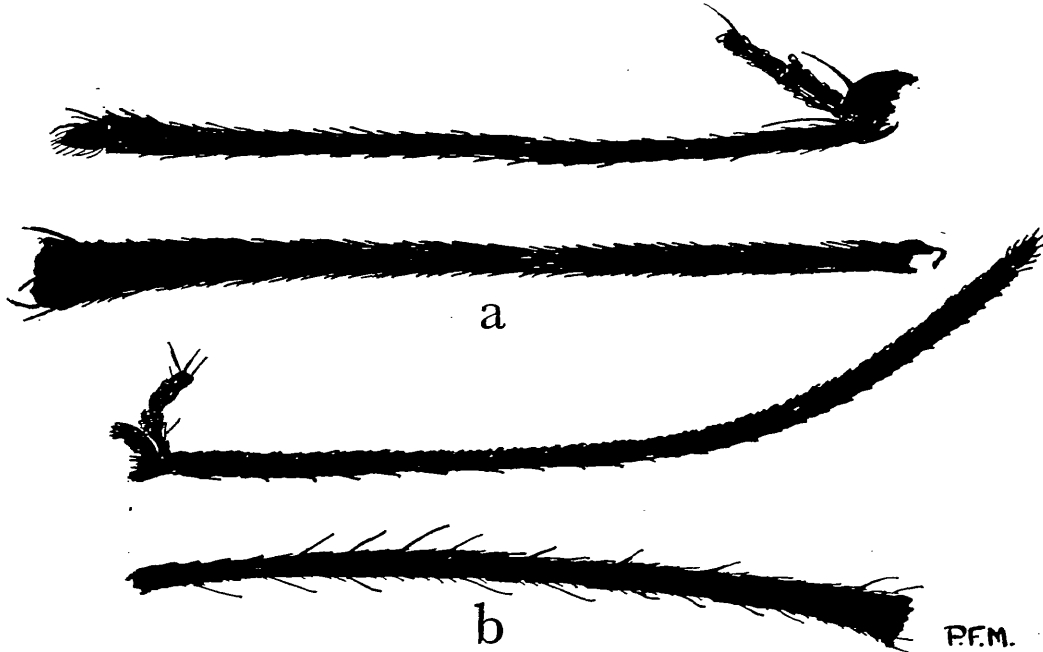


Fig. 13. Proboscis, palps and front femur of male. a. *H. communis*, b. *H. reidi*.

- 5. Posterior pronotum extensively pale scaled *H. macdonaldi* (p. 47)
 Posterior pronotum largely dark scaled *H. communis* (p. 43)

KEY TO PUPAE

H. scintillans and *H. macdonaldi* are the only Indomalayan species of which the pupa is known. The Indian *H. himalayensis*, the only other member of the genus with known pupa, is included here for comparison. The setal nomenclature employed is that of Belkin (1952) as amended by Belkin (1953).

- 1. Setae 2 and 3 of segment II subequal (Fig. 14d, p. 27) **H. scintillans** (p. 28)
 Seta 3 on segment II much longer than seta 2 on the same segment (Fig. 14b, 28a, p. 49) 2

2. Metanotum with seta 10 long, stout and single (Fig. 14a) *H. himalayensis*
 This seta with several branches (Fig. 28a, p. 49) *H. macdonaldi* (p. 49)

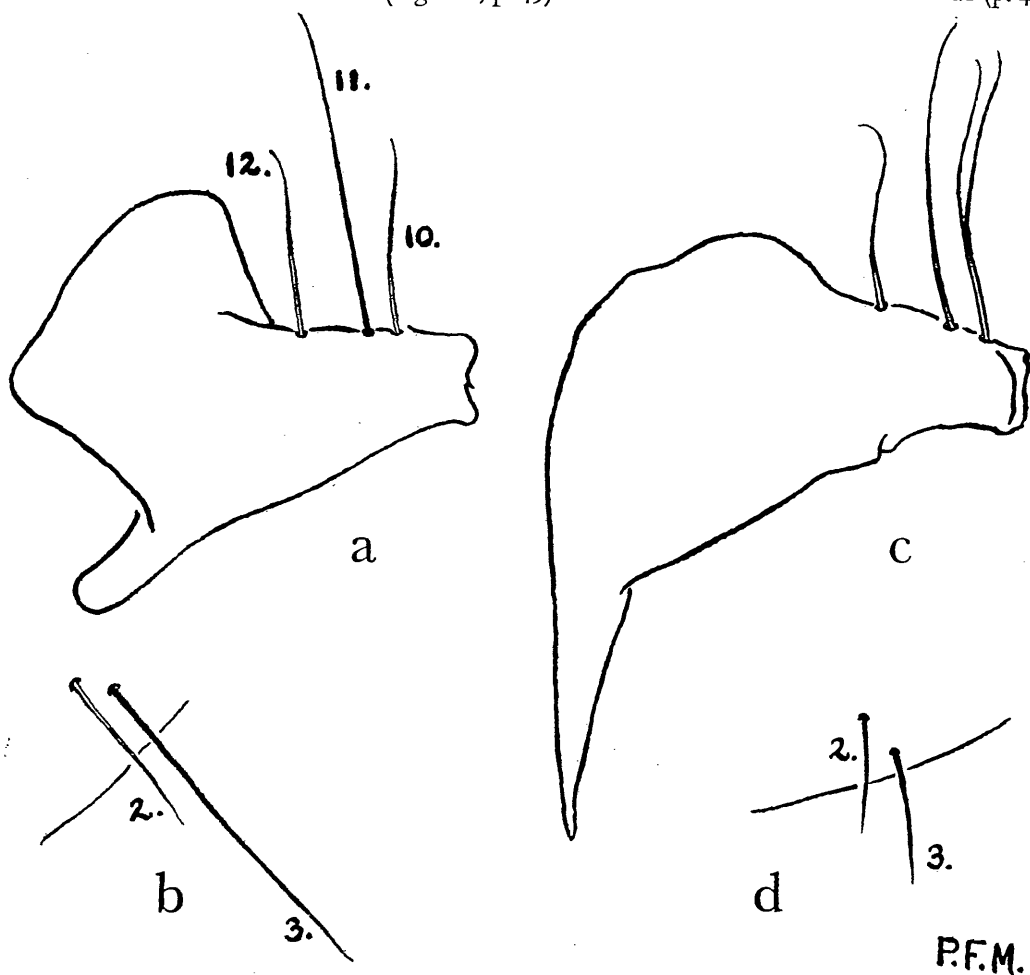


Fig. 14. Pupal setae. a, b. *H. himalayensis*, c, d. *H. scintillans*. a, c. Metanotum, b, d. Segment II.

The pupa of *H. himalayensis* is known only from a single skin. It differs from *H. scintillans* in having only 4 branches in seta 1 of segment II (Fig. 5b, p. 13). Unfortunately this seta is missing from all my skins of *H. macdonaldi*.

KEY TO FOURTH STAGE LARVAE

So few larvae of this genus are known that it has seemed best to include all the known species. *H. communis*, *H. complex* and *H. sp.* (Borel, 1930) are known to me only from Borel's descriptions

(Borel, 1930:161-167). *H. greeni* is known to me only from the description by Carter & Wijesundara (1948:142). As in the previous key, Indomalayan species are shown in heavy type. The larvae of *H. achaeta*, *aureochaeta*, *metallica* and *stonei* are unknown.

1. Antennal tuft represented by an unbranched seta; (comb teeth uniformly fringed at tip, pecten teeth simple) *H. complex*
Antennal tuft with at least two branches, usually more 2
2. Pecten teeth simple (Figs. 17, 20, pp. 33, 37); (comb a mixture of spines and scales in two or more rows) 3
At least some pecten teeth with basal denticles 4
3. Siphon relatively slender, index at least about 4 (Fig. 17) ***H. scintillans*** (p. 28)
Siphon markedly stouter, index at most about 3.5 (Fig. 20) ***H. indica*** (p. 34)
4. Comb teeth simple *H. greeni*
Comb teeth fringed or with secondary denticles at base 5
5. Comb of mixed spines and scales (about 10-20 in number and arranged in more than one row) (Fig. 29, p. 49) ***H. macdonaldi*** (p. 47)
Comb consisting entirely of either uniformly fringed scales or spines with hypertrophied median denticle 6
6. Comb teeth with apical fringe (Fig. 26, p. 46) 7
Comb teeth sharp pointed, without such a fringe but with secondary denticles at base *H. himalayensis*
7. Proximal setae of ventral brush branched (Fig. 26) ***H. communis*** (p. 43)
Ventral brush with at least some of the proximal setae single 8
8. Saddle hair single; siphonal index well over 3 *H. ? covelli*
Saddle hair bifid; siphonal index less than 3 *H. sp.* (Borel, 1930)

DESCRIPTIONS OF SPECIES

Heizmannia scintillans Ludlow

Heizmannia scintillans Ludlow, *Canad. Ent.*, **37**: 130, 1905.

Wyeomyia funerea Leicester, *Stud. Inst. med. Res. F.M.S.*, **3**(3): 252, 1908.

Wyeomyia funerea Moulton, *Rep. Sarawak Mus.*, **13**: 48, 1914.

Heizmannia funerea Edwards, *Indian J. med. Res.*, **1**: 448, 1928 (*partim*, holotype only).

Heizmannia funerea Edwards & Given, *Bull. ent. Res.*, **18**: 340, 1928.

Heizmannia pilosa Brug, *Tijdschr. Ent.*, **74**: 245, 1931.

Heizmannia pilosa Mattingly, *Proc. R. ent. Soc. Lond.*, **B, 18**: 219, 1949.

TYPES: *scintillans*, holotype ♀, Camp Stotsenberg, Angeles, Pampanga, Luzon, Philippine

Is., ix:190-, E. R. Whitmore, in U.S. National Museum; *funerea*, holotype ♀, Jungle, 6 miles from Kuala Lumpur on the Pahang road, 21:ix:1903, G. F. Leicester; *pilosa*, holotype ♂, Dermajoe, near Benkulen, Sumatra, xi-xii, 1929, S. L. Brug, both in B.M.

This is the type species of the genus. It is at present known with certainty only from the unique female holotype, which I have not seen. The above synonymy is based on numerous details of the type kindly supplied to me by Dr. Stone. Unfortunately one wing is missing and the other is embedded in glue so that Dr. Stone has not been able to measure the anterior fork cell. However Ludlow (1905:130) says "cells small". Howard, Dyar & Knab (1912:25) stated that the type had the eyes separated by "a broad strip of chitin, almost a third the entire width of the head". Edwards (1922b:447) used this as a key character but later (1929:4), on examining the type in Washington, he found that "the width of the front is not so great as has been stated, being only about equal to that of the first antennal segment". This may be presumed to refer to the maximum width between the eyes, which is thus very much the same as in most other species of the genus. Ludlow described the anterior pronotal lobes as "heavily covered with broad, flat white scales" but Dr. Stone informs me that in fact the upper surface has an extensive area of dark scales posteriorly. Others who have examined the type, though without adding materially to the available descriptions, are Dyar & Shannon (1925:73) and Bohart (1943:44).

The type material of *H. funerea* also comprises a unique female adult. Although in poor condition this fortunately shows all the diagnostic characters clearly. It could only be confused with *H. indica*, from which it differs quite strikingly in the colour of the mesonotal scales as well as in the extent of pale scaling on the pronotal lobes and the shape of the pale basal lateral patches on the abdominal tergites, or with *H. metallica*, from which it differs in all these characters and also in the shape of the wing scales. In my view Leicester deliberately excluded from his type description of *H. funerea* the two specimens of *H. indica* later placed under this species by Edwards (1922b:448) (see p. 34). It must be remembered that Leicester probably had the very great advantage of seeing these specimens in life. The synonymy of *H. funerea* with *H. pilosa* is not in my view open to serious doubt. The Indian *H. viridis* is very similar to the present species and is known only from the female. I have kept it distinct mainly because it has somewhat narrower wing scales. In addition to Ludlow's original description and the further details supplied by Dr. Stone the following description of the female is based on the holotype of *H. funerea*, a specimen from Sumatra kindly lent me by Dr. Bonne-Wepster (probably the one mentioned by Brug, (1931 bis:246) as caught in forest near the type locality), a specimen with associated larval and pupal skin from Singapore, kindly sent me by Dr. Colless, a specimen from Singapore collected by Given, a specimen from Kuala Lumpur collected by Stanton and three specimens from Selangor, one from "10th mile, Banting Road" and two from Ulu Gombak, taken in forest attacking a man and a dog respectively and kindly sent by Mr. Macdonald. A specimen from Cameron's Highlands collected by Hacker, specimens from Borneo and an

undescribed specimen in the British Museum from the Philippines are discussed below under variation.

Adult ♀. Palps and proboscis dark. Palps about one-seventh of the length of the proboscis. Proboscis about equal to or slightly longer than the front femur. Vertex dark except for the usual apical and lateral pale patches. No pale rim round eye margins. Eyes separated by at most the width of one torus or very slightly more. Upper surface of pronotal lobes (Fig. 9b, p. 21) dark with well-marked anterolateral pale patches which encroach to a variable extent towards the mid-line along the anterior border, but are in all cases more extensive than in *H. indica*. Scales of posterior pronotum all dark. Scutal scales mainly with green or blue reflection very strongly tinged with gold giving a brassy effect. Scutellar scales all dark. Postnotal bristles dark brown or blackish. Integument of postnotum rather pale at sides towards base. Wing scales fairly broad, the plume scales on the middle third of vein 2·1 with 6–8 longitudinal striations (Fig. 11a, p. 24). Anterior fork cell between two and two and a half times as long as its stem. Legs dark except for the hind femur which is pale anteriorly on about the basal three-fifths to four-fifths with dark dorsal stripe reaching to base. Abdomen (Fig. 15a) with first tergite pale laterally for the whole of its length, second with a large basal lateral pale triangle reaching the posterior edge of the tergite at

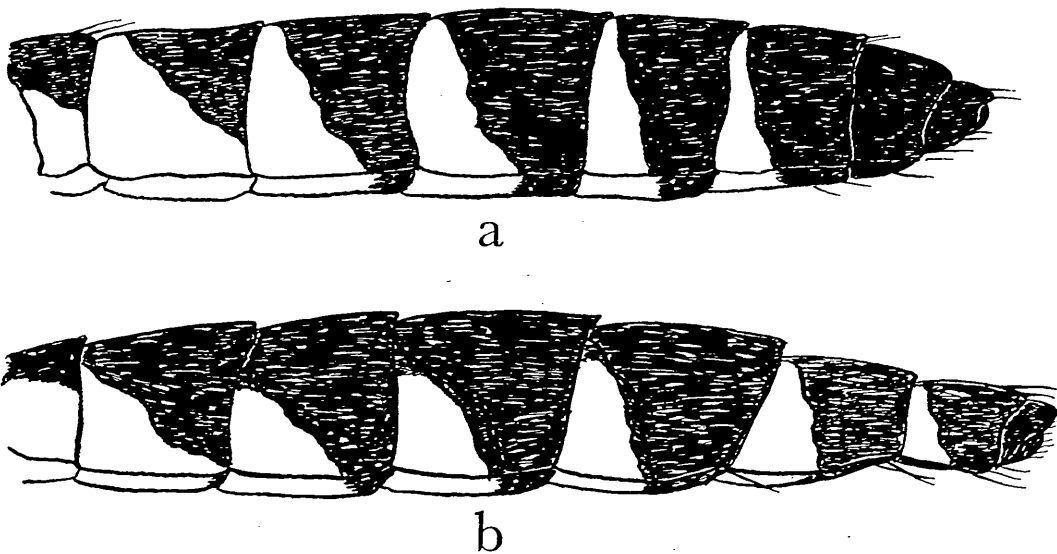


Fig. 15. Abdomen from the side. a. *H. scintillans*, b. *H. reidi*.

its apex, third with a similar triangle but with apex falling well short of the posterior edge, fourth to sixth tergites with the triangle progressively shorter. Seventh and eighth tergites entirely dark or seventh with a narrow pale basal band. First two sternites wholly pale,

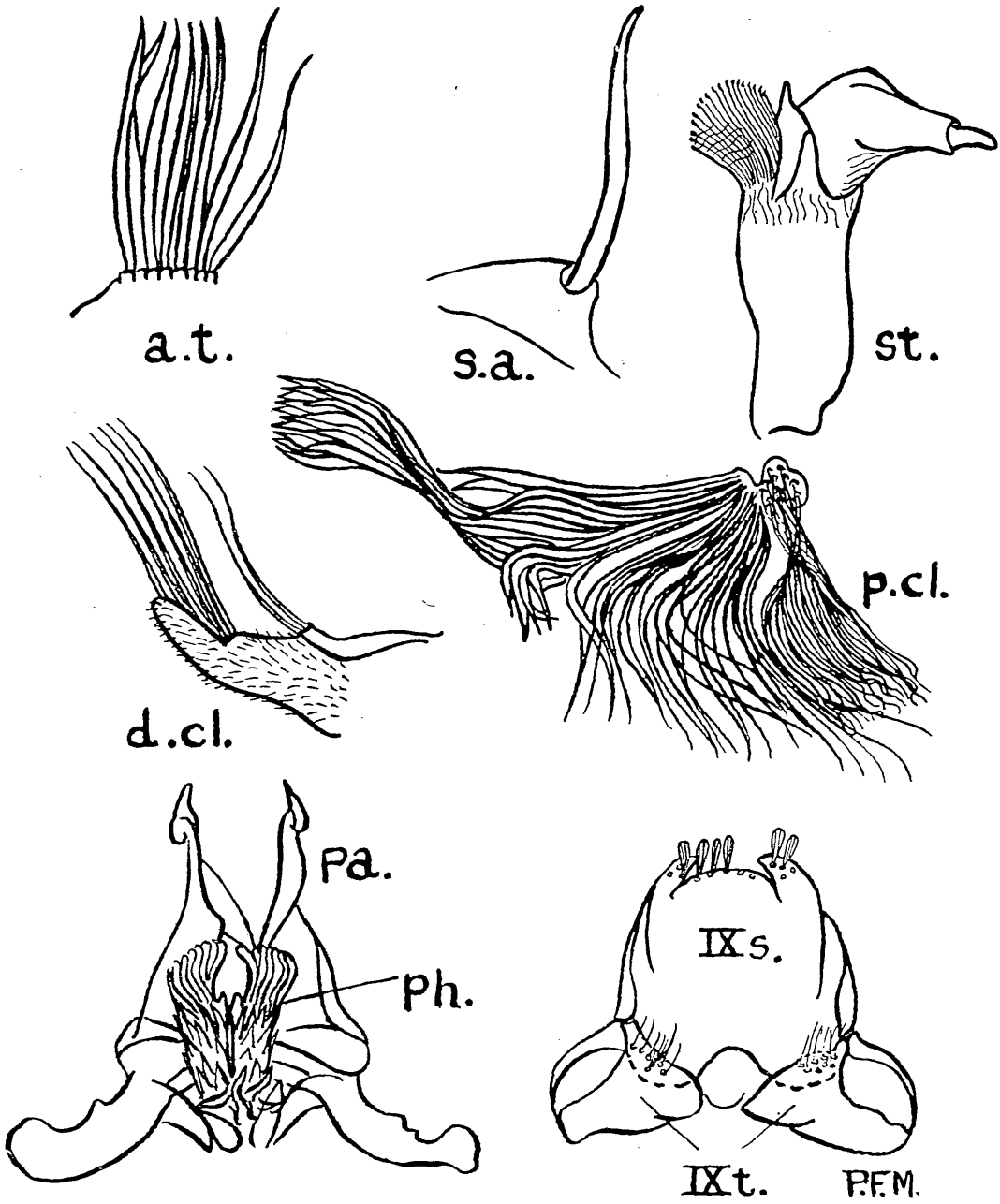


Fig. 16. *H. scintillans*. Male terminalia. *a.t.* Apical tuft, *d.cl.* Distal claspette, *pa.* Paraproct, *ph.* Phallosome, *p.cl.* Proximal claspette, *s.a.l.* Subapical lobe, *st.* Style, *IXs.* Ninth sternite, *IXt.* Ninth tergite.

third to sixth with broad apical dark bands, seventh and eighth dark. Terminalia very much as in *H. indica* (Fig. 8a, p. 18).

Adult ♂. The description which follows is based on the holotype and one paratype male of *H. pilosa*, both with associated larval and pupal skins, in the B.M., two paratype males of the same species lent me by Dr. Bonne-Wepster (Brug for some reason only mentions one) and a specimen from Singapore sent me by Dr. Colless. Antenna with last joint about twice as long as the last but one and equal in length to the remainder put together. Anterior fork cell only about half as long again as its stem. Third hind tarsal segment and to a less extent the second with a patch of suberect scales which is completely diagnostic. External characters otherwise as for the female. Terminalia (Fig. 16) much as in *H. indica* (p. 36) but with style of slightly different shape, apical tuft of coxite with its component setae more uniform in size and more flattened, distal claspette with the tufts smaller, proximal claspette very differently ornamented.

Pupa. (Fig. 4, p. 12). Described and figured (as *H. pilosa*) by Brug (1931:246) and Mattingly (1949 *bis*:219) from the two associated skins mentioned above. It is now possible to extend this description by incorporating the associated skin sent by Dr. Colless. The following alterations to my earlier description should therefore be made. Trumpets very much as figured for Brug's "specimen b", i.e. when flattened they are very much wider at the apex than at the base. After comparing Colless's specimen with Brug's I am satisfied that the seeming difference between the two specimens described by the latter is largely artificial. Cephalothorax with seta 4 single to tetrafid. Metanotum with seta 10 bifid or tetrafid. Segment II with seta 5 having 4-6 branches, seta 10 single or split into 2-5 branches at tip.* Segment III with seta 5 single to trifid, 8 also single to trifid. Segment IV with 4 trifid to penta-fid, 5 long, stout and single, 10 bifid or trifid. Segment VI with 10 single to trifid. Segment VII with 6 single to trifid, 8 bifid or trifid, 10 single or bifid. Segment IX without setae. Genital sac as figured.

Larva. (Figs. 6, p. 16, 17). Described and figured by Brug (1931:246) as *H. pilosa*. The following description is based on Brug's two skins, as in the case of the pupa, together with the skin, associated with pupal skin and female adult, sent me by Dr. Colless. Knight & Hull (1953:480) suggested that a larva described by them from Palawan and Balabac might be that of either the present species or *Aedes platylepidus*. In view of the fact that it has pectinate mouthbrush setae it appears very much more likely to be an *Aedes* than a *Heizmannia*.

Antenna smooth or with a small number of spicules confined mainly to the basal half, distal half lightly infuscated, terminal papilla (reduced third segment) slightly longer than the width of the antenna at tip. Antennal tuft with 3-4 branches. Head rounded, apparently scarcely as broad as long, pigmented in the occipital region and around the mouth. Mouthbrushes without pectinate setae. Clypeal spinè long, slender, simple. Maxillary

* The setal numbering employed here is that of Belkin (1953) and not that of Knight and Chamberlain, as in my original description.

spines pale, slender, inconspicuous. Mentum with 10 teeth on either side of the main central tooth. Head seta A with 9-15 branches, B bifid and very asymmetrical, C with 4-13 branches, *d* strongly developed with about 12-18 branches. Spines at bases of pleural setae

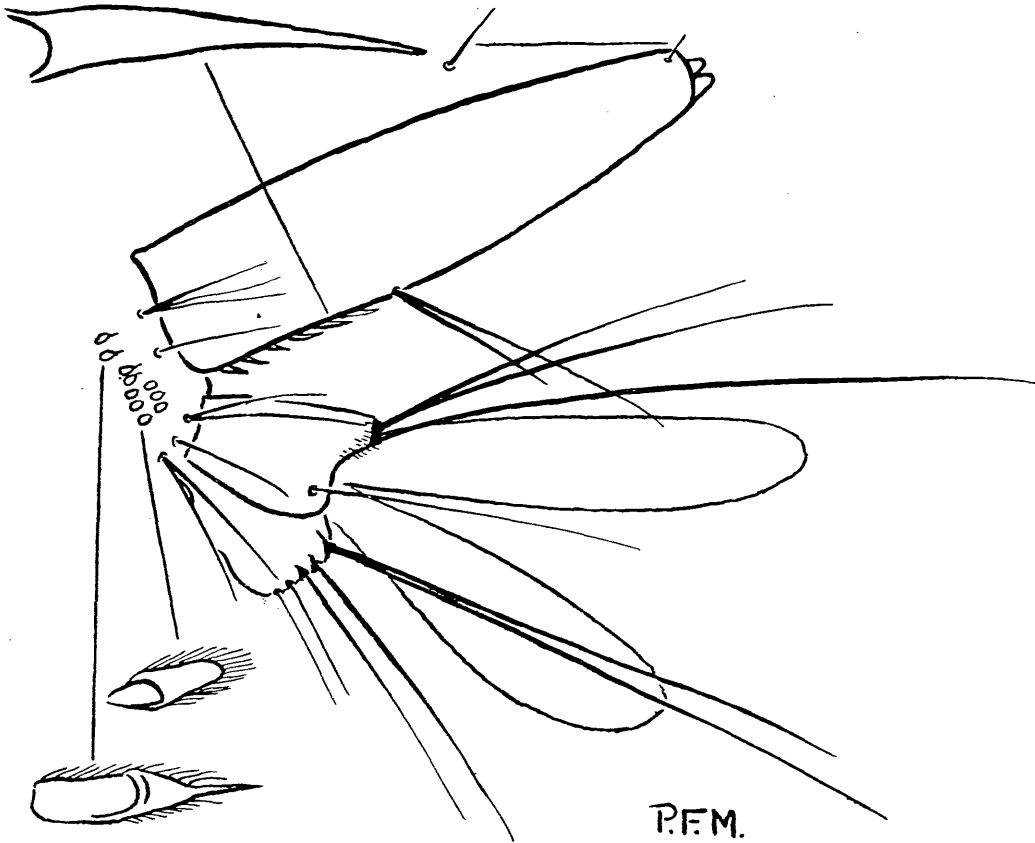


Fig. 17. *H. scintillans*. Terminal segments of larvae.

variable in size and shape, single to trifid. Comb with about 10-14 teeth which are mostly scales but with a few spines dorsally. Siphon of much the same shape as in *H. indica* but narrower. The index is difficult to estimate from my specimens, all of which have the siphon only partly crushed, but it is at least 3.0 fully crushed, i.e. 4.5 uncrushed, and certainly more than in *H. indica*. Pecten with 4-7 simple teeth (differences in shape figured by Brug, 1931:247, are an artefact). Subventral seta single or bifid, arising just beyond the distal pecten tooth. Acus absent. Setula at base of dorsal valves short and very delicate. Saddle incomplete, the degree of spiculation of the distal edge variable. Saddle hair single. Upper caudal seta bifid or trifid, lower single. Ventral brush with two single precratal

setae followed by two pairs of single setae in the barred area and distad of these a pair of bifid setae. Anal papillae broad and blunt ended, the upper pair about two and a half times and the lower about twice as long as the saddle.

Breeding place. Tree hole (Brug, 1931:246).

Variation. A female adult from Dansalan Forest, Lanao, Philippine Is. (Dr. A. Moore, 7:vi:1920) agrees closely with the above description. It has the proboscis very slightly shorter, though probably not significantly so. Three female adults from Kuching, Sarawak (30:vii:1914 and 2:ii:1915, J. C. Moulton), also agree closely, but one has a continuous narrow pale basal band on the seventh abdominal tergite, as has Given's specimen from Singapore, and the others have traces of such a band. One of these specimens was originally published as *H. funerea* (Moulton, 1914:48). In the specimen from Cameron's Highlands the pale basal lateral patches on the abdominal tergites do not extend so far in towards the mid-line as in the others. Three females in the British Museum from the Malabar coast (Khazan Chand, 1915) and one labelled "Marinbari Tea Estate, viii:28, S.R."* agree closely except that one of the Malabar specimens has almost complete pale basal bands on abdominal tergites IV to VII.

DISTRIBUTION. ? India (B.M.), Malaya (as *Wyeomyia funerea*, Leicester, 1908: 252, B.M.), Singapore (as *Heizmannia funerea*, Edwards & Given, 1928: 340, B.M.), Sumatra (as *Heizmannia pilosa*, Brug, 1931:245), Borneo (as *Wyeomyia funerea*, Moulton, 1914:48), Philippine Is. (Ludlow, 1905:130, B.M.).

***Heizmannia indica* (Theobald) †**

Phoniomyia indica Theobald, *Ann. Hist.-nat. Mus. hung.*, 3: 115, 1905.

Heizmannia funerea Edwards, *Indian J. med. Res.*, 10: 448, 1922 (*partim*, specimens other than type).

? *Heizmannia funerea* Barraud, *Faun Brit. Ind. Dipt.*, 5: 302, 1934 (Indian form only).

TYPE: holotype ♂, Singapore, 1902, —. Biró, in Hungarian National Museum.

Through the kindness of Dr. Soós and Dr. Mihályi I have been able to examine Theobald's type. This was not seen by either Leicester or Edwards or Barraud. It is incomplete, having lost the abdomen, but differs strikingly from the species accepted as *indica* by these authors. In particular it has the upper surface of the anterior pronotal lobes almost entirely dark scaled and the anterior fork cell of the wing only about twice as long as its stem. There can be no doubt that Leicester's original description was incorrect and his species is therefore redescribed below (p. 38) under a new name.

The following description is based on the holotype and three other males, one from "Jungle, Gombak Rd., 5 miles from Kuala Lumpur, 11:ii:04" (Leicester), one from "17th

* Possibly Mariambarrie in the Eastern Himalayas (see p. 39). The collector may have been Sobha Ram.

† Since going to press Stone (1957:173) has sunk this as a synonym of *H. scintillans*. This cannot be accepted. The distinctive anterior pronotal and mesonotal ornamentation are quite well shown by the type.

mile, Ulu Gombak, xii: 1955" (J. A. Reid) and one from Singapore (Given) and on one female from Malaya, without other data (Leicester), two others from "17th mile, Ulu Gombak, xii: 1955" (Reid) and a fourth from "Ulu Gombak, ii: 1956" (Reid). All these are in the British Museum. The larva is described provisionally from two unassociated skins from Singapore (Given) forming part of the material described by Edwards and Given (1928: 340) under the name *H. funerea*. I have not seen the specimen recorded from Bengal under the name *H. funerea* by Barraud (1929 *bid*: 263, 1934: 303) and this record is therefore queried.

Adult ♀. Closely resembles that of *H. scintillans* but differs in having a much bluer and less brassy reflection over most of the scutum and in the even more extensively dark pronotal lobes.

Palps and proboscis dark. Palps about one-seventh of the length of the proboscis. Proboscis about one and one-tenth times the length of the front femur. Antenna with scales on basal joint of flagellum appearing pale brown from some angles, darker from others. Vertex dark except for the usual apical and lateral pale spots. No pale rim round eye margins. Distance between eyes equal to at most the width of one torus. Upper surface of anterior pronotal lobes dark except for a small pale patch in the anterolateral corner. Scales of posterior pronotum all dark. Scutal scales with a greenish gold reflection in some areas, e.g. along the anterior border and above the wing root but in the main with a characteristic blue reflection, dark green in the central area. Scutellar scales all dark. Postnotal bristles blackish. Integument of postnotum rather pale brown. Wing scales fairly broad, the plume scales on the middle third of vein 2·1 with about 6-8 longitudinal striations (Fig. 11*d*, p. 24). Anterior fork cell about twice as long as its stem or a little more. Legs apparently as described for genus. Hind femur pale anteriorly on about the basal three-fifths with a dark dorsal stripe reaching to base (Fig. 18*a*). Abdomen (Fig. 18*b*) with first tergite entirely dark

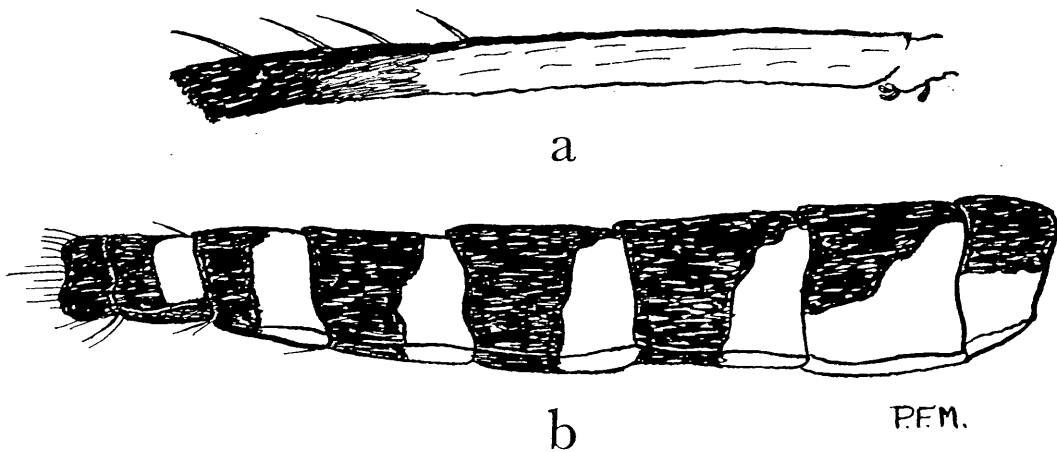


Fig. 18. *H. indica*. a. Anterior surface of hind femur, b. Abdomen from the side.

above, pale for its whole length at the sides, second with narrow lateral pale stripes extending from base to apex, visible from above only at the base where they are slightly wider, third to sixth with the lateral pale stripes progressively shorter and narrower, the expanded basal portions visible from above as small squareish basal lateral spots. Seventh with small basal lateral spots only. First two sternites entirely pale, third to sixth with broad, dark apical bands. Terminalia as for genus. Atrial plates very lightly sclerotized. Insula without clearly differentiated patch of setae.

Adult ♂. Described from the holotype and two other males as noted above. The holotype has lost the antennae, most of the proboscis, all legs except one front leg and one hind femur and tibia, one wing and all but the first two segments of the abdomen. The scaling of the pronotal lobes, the scutum and the remaining wing is, however, comparatively well preserved. This specimen resembles the female described above in all ascertainable particulars except that the anterior fork cell is slightly shorter (about 1.9× the length of its stem). Theobald (1905a: 115) noted that the proboscis was almost as long as the whole body. He described the pale basal lateral spots on the abdominal tergites as triangular, but I do not attach any importance to this since their shape is, in any case, somewhat irregular. The remaining front tarsus is wholly dark, and it may be inferred from Theobald's account that the same was true of the other tarsi. The other males agree with the female except that the antenna has the last joint about six times and the last but one about four times the length of the antepenultimate joint. The palps are distinctly shorter, about one-tenth of the length of the proboscis, and the anterior fork cell is about twice the length of its stem in one

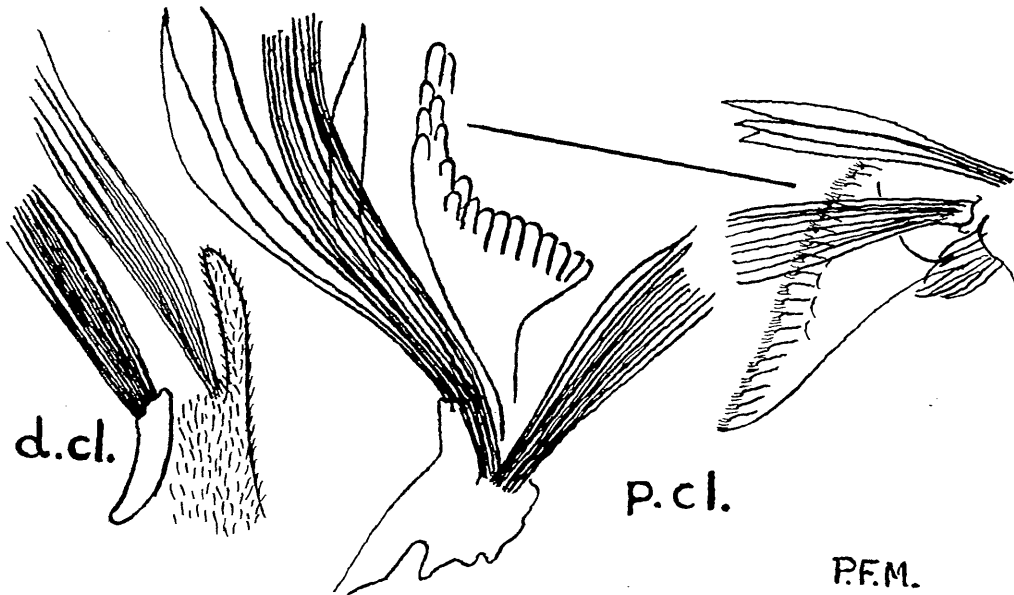


Fig. 19. *H. indica*. Claspettes. *d.cl.* Distal claspette, *p.cl.* Proximal claspette.

specimen and about 1.8 times this length in the other. Terminalia much as in *H. scintillans* (Fig. 16, p. 33) differing mainly in the ornamentation of the claspette (Fig. 19). Style highly complex. Apical tuft with 6-10 setae. Spine on subapical lobe single. Distal claspette with two tufts of moderately long setae, the more proximal one arising from a small sclerite. Proximal claspette with two tufts of long bristles and with a number (? 3) of modified leaf-like setae which are easily overlooked, since when seen edge on they appear unmodified. This claspette also has an appendage (? harpago) having a greatly expanded tip with numerous scale-like fimbriations. Phallosome divided into two lateral plates with fimbriated apical and spinose inner edge. Parameres small but well sclerotized. Paraprocts with greatly attenuated and curiously twisted tip. IXth tergite with the two sclerotized portions completely separate, each with 8-9 delicate setae. IXth sternite very large with scales and short setae distally.

Pupa. Unknown.

Larva. Apparently described by Edwards and Given (1928: 340) as that of *H. funerea*. The two fourth instar skins which they deposited in the British Museum are unassociated and the present attribution is provisional, being based on the fact that the siphon is much stouter than in the true *H. funerea* (= *H. scintillans*) (cp. Figs. 20 and 17, p. 33). Head rounded, scarcely as broad as long (*vide* Edwards and Given), pale except round the occipital region and the mouth. Antenna somewhat infuscated on the distal half, lightly spiculate,

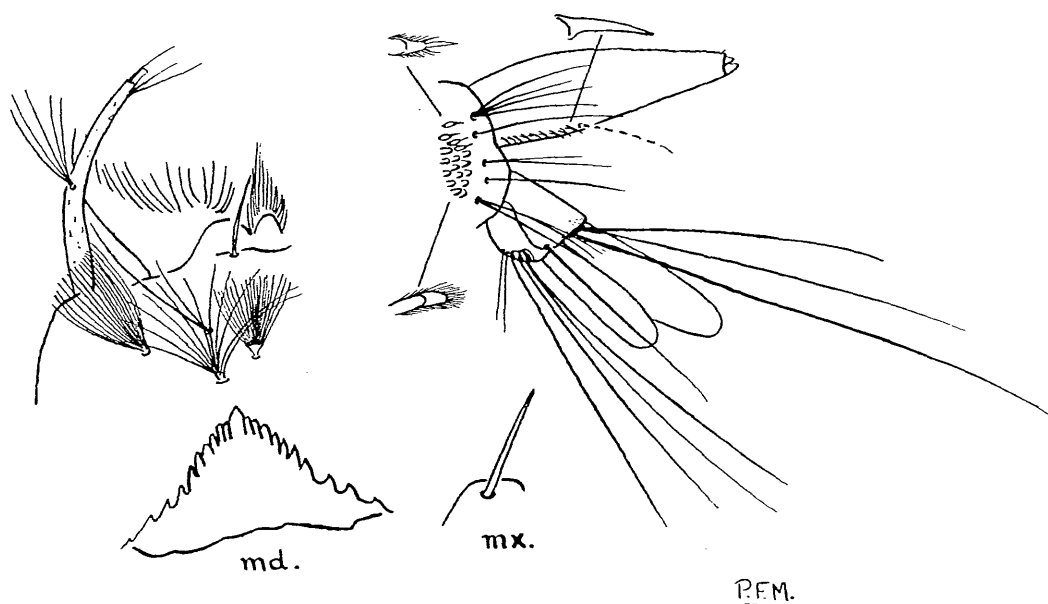


Fig. 20. *H. indica*. Larval head and terminal segments. *mx.* Maxilla, *m.* Mentum, *pl.* Metathoracic pleural spine.

terminal papilla as in *H. scintillans*. Antennal tuft with 4–5 delicately plumose branches, arising at about half-way and slightly more than half the length of the antenna. Clypeal spines long, slender, almost hairlike, simple. Mouthbrushes without pectinate setae. Head seta A with about 12–18 plumose branches, B with two branches of which one is very much shorter and more slender than the other, C with about 9–20 branches, *d* very strongly developed, expanded at the base with numerous branches. Maxillary spine slender and pale in colour. Mentum with 10 teeth on either side of the main central tooth. Spines at bases of mesothoracic and metathoracic pleural setae bifid, with or without a small number of secondary denticles. Comb much as in *H. scintillans* with about 15 teeth which are mostly uniformly fringed scales but with four or five spines with hypertrophied median denticles dorsally. Siphon of more or less uniform width basad of the subventral seta, narrowing progressively beyond this. Acus absent. Index, when fully crushed, a little less than 2.5 (i.e. about 3.5 uncrushed). Setula at base of dorsal valves short and very delicate. Subventral seta missing, its base at about two-fifths of the distance from base to apex of siphon. Edwards and Given (1928: 340) describe it as single. Pecten of 6–9 simple teeth all of which are proximal to the subventral seta. Saddle incomplete. Saddle hair single, about three times the length of the saddle. Upper caudal seta double, lower single. Ventral brush with three pairs of long stout setae in the well-developed barred area and two small precratal setae, the most distal pair of setae double, the others single. Distal edge of saddle very lightly spiculate. Anal papillae very broad with bluntly rounded ends, the dorsal pair about twice the length of the saddle.

Breeding place. Tree hole, in company with *Ficalbia fusca* Leic. (Edwards & Given, 1928: 340).

DISTRIBUTION. ? India (N. Bengal, Barraud, 1934: 303, as *H. funerea*), Malaya (B.M., see above), Singapore (Theobald, 1905a: 116, B.M.). Barraud's record was based on a unique female adult which I have not seen. The Malayan record is based on one male and one female in the B.M. and the Singapore record on the holotype together with a male and two unassociated larval skins in the B.M. The B.M. also has four immature larvae from Singapore.

***Heizmannia reidi* sp. n.**

Phoniomyia indica Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3): 253, 1908, *nec* Theobald.

Heizmannia indica Edwards, *Indian J. med. Res.*, 10: 447, 1922.

Heizmannia indica Barraud, *Indian J. med. Res.*, 16: 265, 1929 and *Faun. Brit. Ind. (Diptera)*, 5: 303, 1934.

TYPES: holotype ♂, Sukna, N. Bengal, ix: 1922, bred from tree hole, P. J. Barraud, allotype ♀, Tindharia, N. Bengal, ix: 1922, bred from bamboo stump, P. J. Barraud, both in B.M.

This is the species mistakenly attributed to *H. indica* by Leicester, Edwards and Barraud

(see p. 34). It differs markedly from the true *H. indica*, having a longer proboscis and much longer anterior forked cell. The following description is based on the type male and female, one male and one female from jungle on the Pahang road, 6 miles from Kuala Lumpur (the male taken at midday and the female taken biting), dated 19:x:03 and 25:x:03 respectively (G. F. Leicester), three females from Ulu Gombak, Selangor, collected in December, 1955 (J. A. Reid), three males and four females from Sureil, Marriambarrie and Tindharia in the Eastern Himalayas, mostly marked as bred out from bamboos (P. J. Barraud, ix-x: 1922), one male from a tree hole at Kurseong, also in the Eastern Himalayas (M. O. T. Iyengar, 22:vi: 1922), and one male from Doi Sutep, Chiangmai Province, N. Thailand, 4:iii: 1953, D. C. Thurman, in the U.S. National Museum kindly lent me by Dr. Stone.

Adult ♀. Palps and proboscis dark. Proboscis very long and slender, about one and a quarter times as long as the front femur or slightly more. Palps about one-tenth of the length of the proboscis. Scales on first joint of antennal flagellum mainly pale. Eyes separated by about the width of one torus. No pale border round eye margins. Anterior pronotal lobes with a large patch of white scales anteriorly occupying most of the anterior border and extending about half-way back towards the posterior border (Fig. 21a). Scales

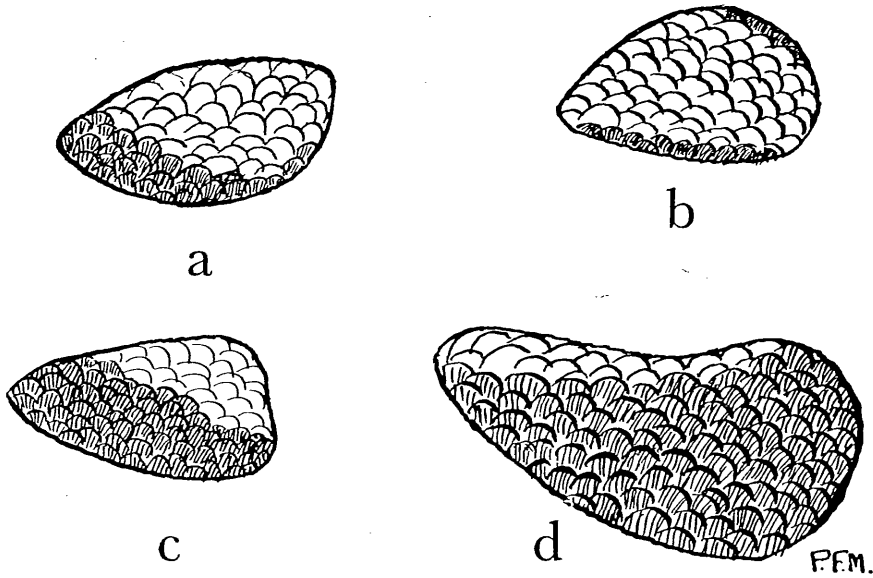


Fig. 21. Anterior pronotal lobes. a. *H. reidi*, b. *H. communis*, c. *H. metallica*, d. *H. aureochaeta*.

of posterior pronotum all dark. Scutal scales much as described for *H. indica* (p. 35). Scutellar scales all dark, the large scales at the apex of the mid-lobe appearing paler from some angles. Postnotal bristles dark. Wing scales moderately broad, the plume scales on

the middle third of vein 2·1 with about 6-7 longitudinal striations (Fig. 11e, p. 24). Anterior fork cell about three times as long as its stem or slightly more (Fig. 10a, p. 24). Legs dark except for the hind femur which is pale anteriorly for about the basal five-sixths and has a dark dorsal stripe reaching from base to apex and slightly expanded distally. Abdomen (Fig. 15b, p. 30) with the first tergite narrowly pale for the whole length at the sides, remaining tergites with basal lateral pale triangles which just reach the tip on the second segment and are progressively shorter on succeeding segments. These triangles barely

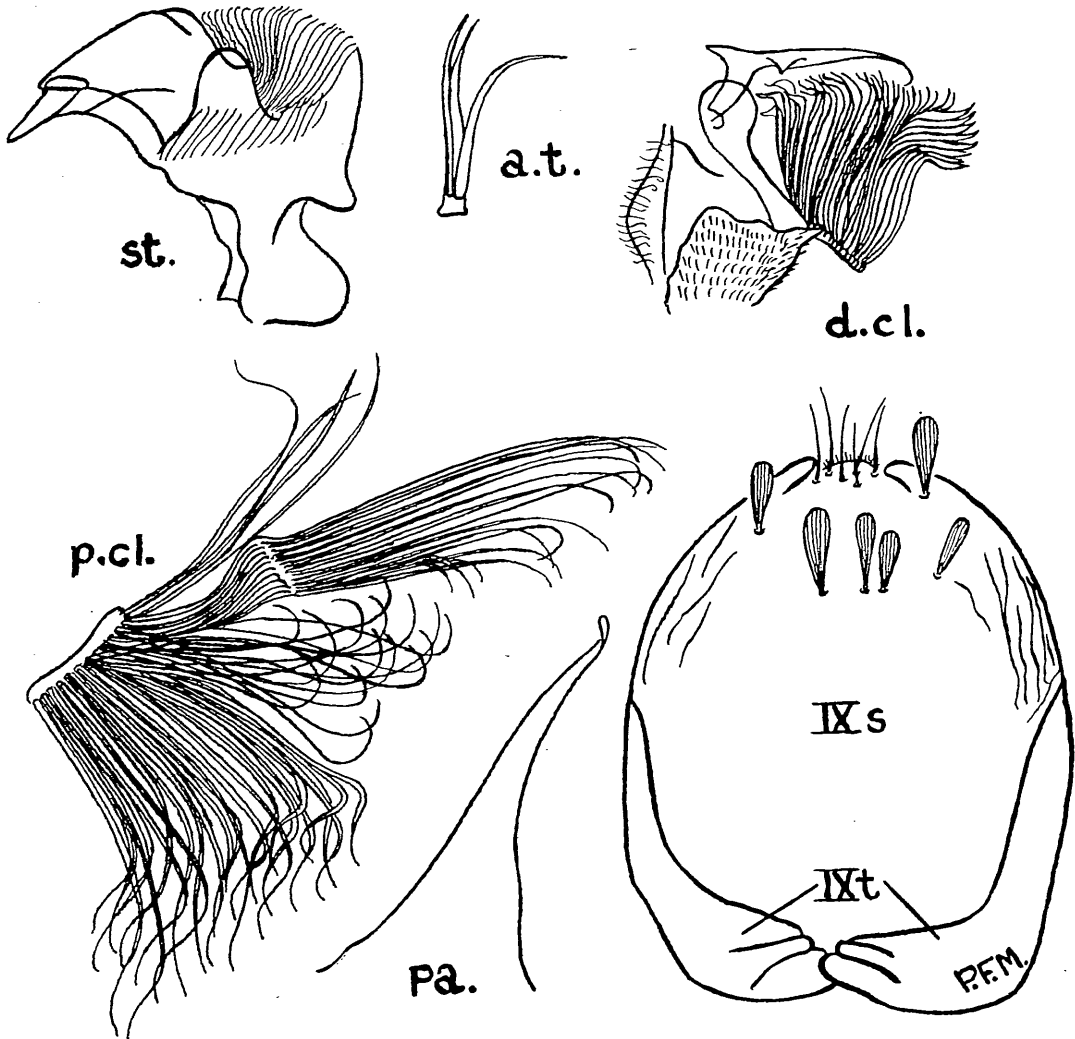


Fig. 22. Male terminalia. *H. reidi*. *a.t.* Apical tuft, *d.cl.* Distal claspette, *p.cl.* Proximal claspette, *pa.* Paraproct, *st.* Style, *IXs.* Ninth sternite, *IXt.* Ninth tergite.

visible from above. Seventh tergite with small but distinct basal pale triangles (distinction from *H. scintillans*), eighth entirely dark. Terminalia as in other species of the group except that the lobes of the IXth tergite are perhaps slightly broader and the insula is more clearly marked (Fig. 8a, p. 18).

Adult ♂. As ♀ except that the antenna has the terminal joint almost twice as long as the subterminal and about equal in length to the remaining segments. (In the male from Kuala Lumpur it is as in the female but this is almost certainly an aberration (see p. 18).) Palps about one-tenth of the length of the proboscis. Anterior fork cell from a little less than to somewhat more than three times as long as its stem. Terminalia (Fig. 22) differing from those of *H. scintillans* in having the style more strongly wrinkled, its terminal appendage larger, apical tuft of only about 3-4 small setae, distal claspette with an appendage strongly recalling the appendage of the harpago in some *Aedes* and, accompanying this, a dense patch of short hairs many of which are bent at the tip through approximately a right angle, ninth tergite of entirely different shape, either divided or undivided and without setulae, paraprocts more slender and less strongly twisted at the tip. Spiny armature of phallosome less strongly developed. Ninth sternite large.

Early stages. Unknown.

Breeding places. Tree holes and bamboo stumps (as *H. indica*, Barraud, 1934:304).

DISTRIBUTION. India (Eastern Himalayas, as *H. indica*, Barraud, 1934:304), N. Thailand (as *H. indica*, Causey, 1937:414, U.S.N.M., not previously published), Malaya (as *H. indica*, Leicester, 1908:254). Specimens from all these areas have been confirmed by examination of male terminalia. I have not, however, seen any of Causey's specimens.

Heizmannia metallica (Leicester)

Wyeomyia metallica Leicester, *Stud. Inst. med. Res. F.M.S.*, **3**(3): 251, 1908.

? *Heizmannia metallica* Leicester of Edwards, *Indian J. med. Res.*, **10**: 448, 1922.

? *Heizmannia metallica* Barraud, *Indian J. med. Res.*, **17**: 267, 1929 and *Faun. Brit. Ind. (Diptera)*, **5**: 307, 1934.

TYPE: holotype ♀ marked "Taken by Daniels in house, Bukit Kutu", in B.M.

This species is known with certainty only from the female adult. The only male ever ascribed to it is one from southern India (see below), and until males from Malaya are available for comparison this ascription must be regarded as doubtful, as must that of the female adults from southern India embodied in the following description.

Adult ♀. The following description is based on the holotype and on four other females collected by Leicester in the Kuala Lumpur area but not embodied by him in his original description. These are all in the B.M. One of them is without further data. The others bear the data "Edge of jungle stream, Ampang, 10/6/04", "Jungle patch, 5th mile, Gombak Rd., Kuala Lumpur, 5/12/03" and "Jungle, Pahang Rd., 4th mile, mid-day, Kuala Lumpur, 7/11/03" respectively. Also included is one female from Ulu Gombak, vii: 1956, J. A. Reid,

sent me by Mr. Macdonald. Specimens from India and Borneo are described below under variation.

Palps and proboscis dark. Palps between one-seventh and one-sixth of the length of the proboscis. Proboscis a little more than one-tenth as long again as the front femur. Scales on first segment of antennal flagellum pale. No pale rim round eyes. Eyes separated by not more than the width of one torus. Upper surface of pronotal lobes dark posteriorly, with silver scales on about the outer half of the anterior border. Scales of posterior pronotum all dark. Scutal scales mainly with blue reflection. Scutellar scales and postnotal bristles dark. Wing scales narrow, the plume scales on the middle third of vein 2·1 with 4-5 longitudinal striations (Fig. 11c, p. 24). Anterior fork cell about twice to two and a half times as long as its stem. Hind femur pale anteriorly on about the basal three-quarters. Abdominal markings much as in *H. scintillans* except that the seventh tergite has a fairly broad basal pale band or spot. (See also under variation below.) Terminalia with atrial plates well sclerotized in the specimen examined. Insula poorly differentiated but recognizable.

Variation. Indian specimens agree well but have the markings of the abdomen somewhat variable. Some have the seventh tergite dark except at the sides while others have not

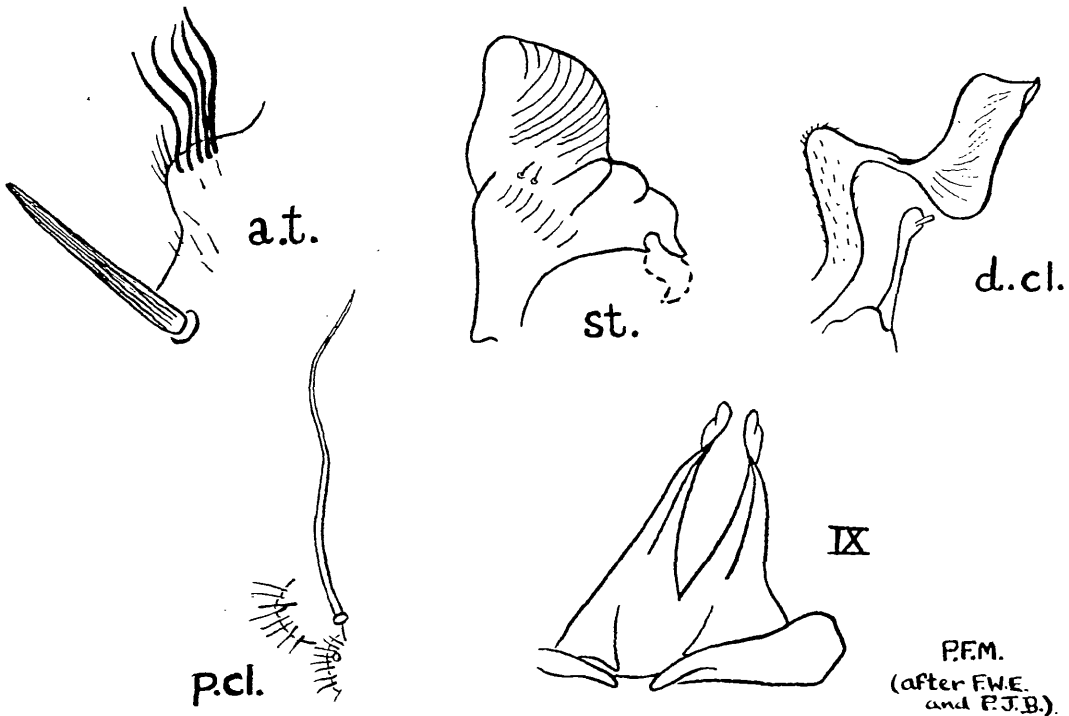


Fig. 23. *H. ? metallica*. Male terminalia (after Edwards and Barraud). *a.t.* Apical tuft and subapical lobe of coxite, *d.cl.* Distal claspette, *p.cl.* Proximal claspette, *st.* Style, *IX*. Ninth tergite and paraprocts.

only this but also the fifth and sixth with median pale basal spots. A specimen from Tarakan, dated 18:xii:1945, coll. A. G. Humes, in the U.S. National Museum, kindly lent me by Dr. Stone, agrees well. It has a median basal pale spot on the seventh tergite only.

Adult ♂. This is known only from a single specimen (No. 1281) from S.W. India reputed to be in the collection of the Central Malaria Bureau at Kasauli (Edwards, 1922b:448, Barraud, 1929 bis:267). I have not seen it. The following description is based on those given by Edwards and Barraud. The accompanying figure is based on Figs. 25-27 of Edwards (1929b) and Figs. 4 and 8 of Barraud (1929 bis, reproduced as Fig. 74d by Barraud, 1934:299). As already noted, the attribution must remain a doubtful one until Malayan males become available for comparison.

Antenna with terminal joint about twice as long as the subterminal, the latter distinctly longer than the remaining flagellar segments together. Terminalia (Fig. 23) with style as figured. Apical tuft of coxite a small tuft of twisted hairs. Subapical lobe with a single spine. Distal claspette with a terminal appendage of characteristic shape accompanied by a second process, as figured, but apparently without any setal patch. Proximal claspette with two patches of very short setae and a single very long sinuous seta. IXth tergite apparently in two separate pieces.

Early stages. Unknown.

Breeding places. Tree holes (Barraud, 1934:308).

DISTRIBUTION. ? India (Malabar coast, Eastern Himalayas, Barraud, 1934:308), Malaya (Leicester, 1908:252, B.M.), Dutch Borneo (Tarakan, U.S.N.M., previously unpublished).

I have seen material from all these areas except the Eastern Himalayas.

Heizmannia communis (Leicester)

Dendromyia communis Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3): 254, 1908.

? *Heizmannia communis* Leicester of Borel, *Moustiques de Cochinchine*, p. 161, 1930

? *Heizmannia communis* Bonne-Wepster, *Roy. trop. Inst. Amsterdam Special Publ.*, No. III, p. 97, 1954 (Sumatra form).

TYPES: holotype ♂ and allotype ♀, The Gap, Malaya, at edge of stream in jungle, 16:iv:1904, G. F. Leicester, in B.M. (see p. 22).

Adult ♀. The following description is based on the allotype, two paratypes and six other specimens collected by Leicester. Data for the paratypes are the same as for the allotype. Three of the other specimens have no data. Data for the remainder are "Jungle, 6 miles fr. Kuala Lumpur, Day 1/12/03", "Jungle, 5 miles fr. Kuala Lumpur, 16/11/03" and "Jungle, Raub, Eggs laid, 28/4/04, Hatched." Also included are four specimens from Ulu Gombak dated xi:1955, xii:1955 and iii:1956, two specimens from Ulu Langat, Selangor, dated 16:ii:1954 and 3:viii:1954, sent me by Mr. Macdonald and a specimen from

Cameron's Highlands, coll. H. P. Hacker, in the U.S. National Museum lent me by Dr. Stone.

Palps and proboscis dark. Palps about one-fifth of the length of the proboscis. Proboscis about nine-tenths of the length of the front femur. Scales on basal joint of antennal flagellum in part pale and in part dark. Vertex with the usual markings. No pale rim round the eyes. Eyes, in some specimens rather more widely separated than in the previous species, the maximum distance between them distinctly greater than the width of one torus. Upper surface of pronotal lobes (Fig. 21*b*, p. 39) largely or wholly covered with pale scales, at most with a few dark ones posteriorly. Scales of posterior pronotum all dark. Scutal scales mainly with purplish reflection shot with blue and gold. Scutellar scales all dark. Postnotal bristles brown, in some cases rather pale brown. Integument of postnotum dark. Wing scales (Fig. 11*b*, p. 24) broad, the plume scales on the middle third of vein 2·1 with about 7-10 longitudinal striations. Anterior fork cell about three and a half times as long as its stem or a little more. Hind femur (Fig. 24) with most of the anterior surface pale on about the basal half, the pale area narrowing beyond this but reaching nearly to the tip below. Abdomen (Fig. 24) with pale basal spots not extending far in towards the mid-line. Seventh

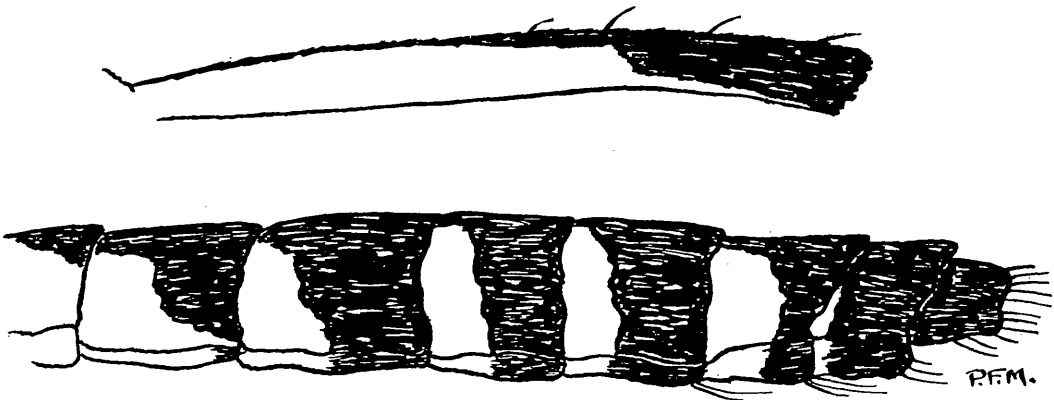


Fig. 24. *H. communis*. Left hind femur and abdomen.

tergite with or without a more or less continuous basal pale band. Terminalia without special features.

Adult ♂. Described from the holotype and one paratype with the same data except that it is dated 16/6/04, also a male from Ulu Gombak, dated xii: 1955, sent me by Mr. Macdonald.

Antenna with the last joint about twice the length of the last but one and equal in length to the rest of the flagellum. Anterior fork cell as in female. Hind tarsi without erect scales. Abdomen with the pale basal lateral triangles somewhat more prolonged posteriorly

than in the female, that on the third tergite just reaching the apex of the segment. Terminalia (Fig. 25) with style as figured, not strongly wrinkled, the terminal appendage very broad. Apical tuft represented by a row of unmodified setae. Subapical lobe with two unequal spines. Distal claspette with an appendage recalling the harpago of some *Aedes*. Associated

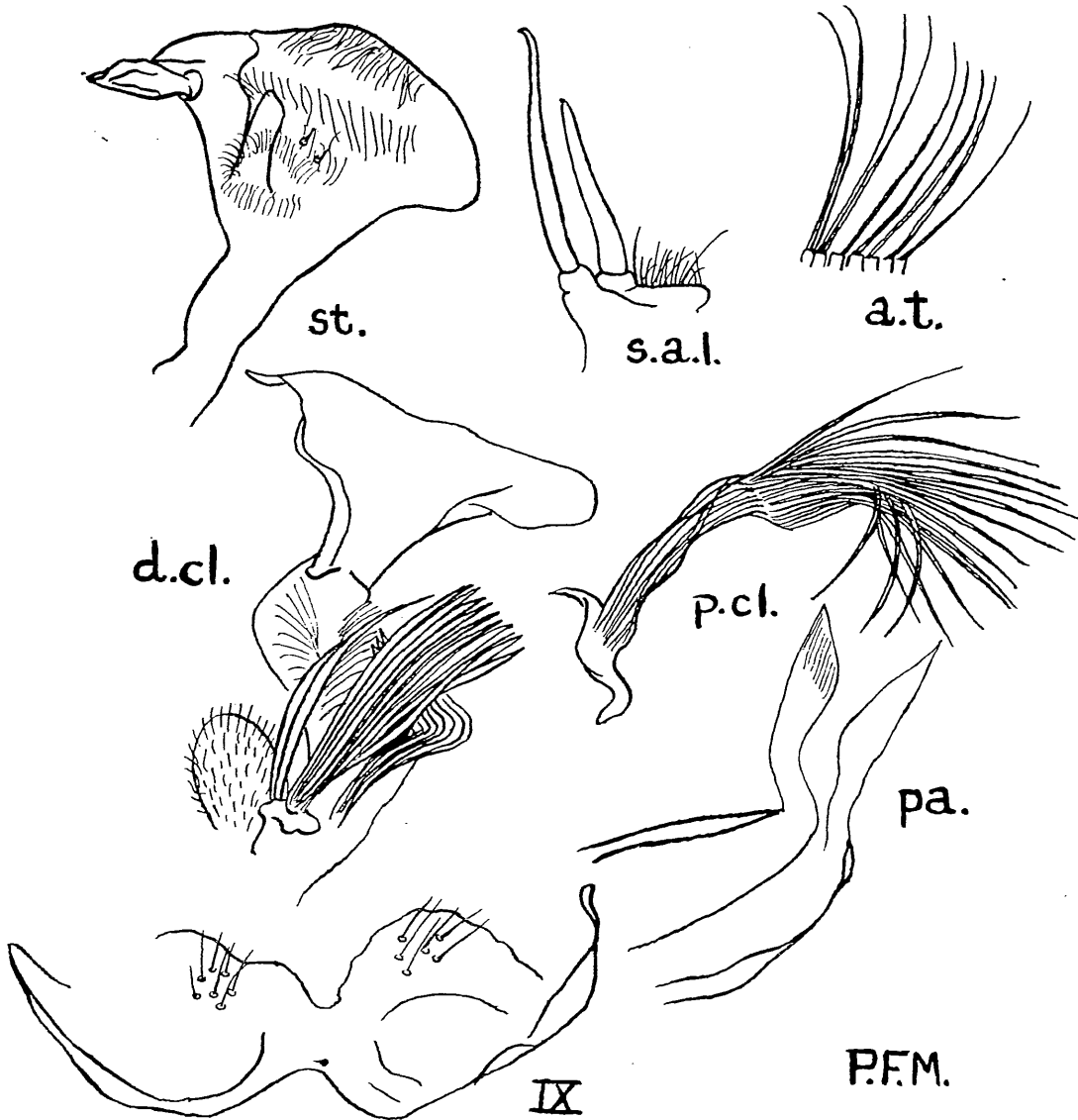


Fig. 25. *H. communis*. Male terminalia. *a.t.* Apical tuft, *d.cl.* Distal claspette, *pa.* Paraprocts, *p.cl.* Proximal claspette, *s.a.l.* Subapical lobe, *st.* Style, *IX*. Ninth tergite.

with this a bunch of conspicuous flattened setae and a complex patch of more delicate setae strongly bent at the tips. Proximal claspette with a bunch of long, twisted setae. IXth tergite with two separate sclerotized plates, each with 6-7 setulae in the inner posterior corner. Spiny armature of phallosome not strongly developed. Paraprocts membranous, much elongated, somewhat broadened and faintly striated at their tips. IXth sternite smaller than in some other species.

Pupa. Unknown.

Larva. The following description is based on that given by Borel (1930: 164 and Fig. 56). I have not seen any Indochinese material and the attribution should be regarded as provisional.

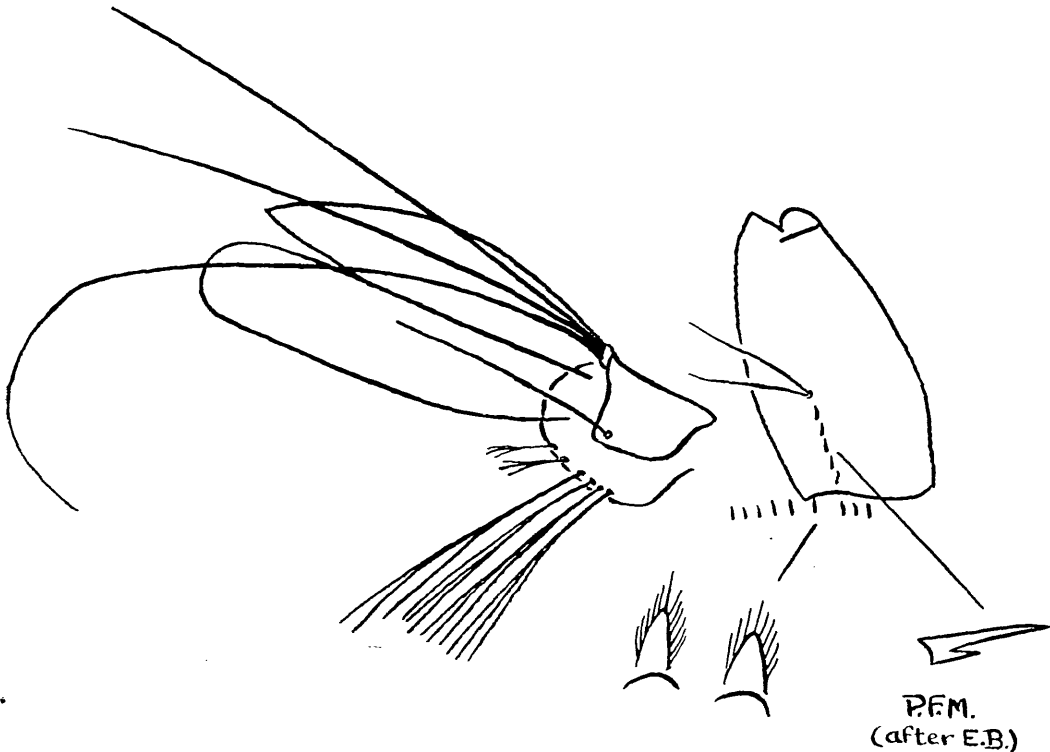


Fig. 26. *H. ? communis*. Terminal segments of larva. (After Borel.)

Antennal tuft of 4 branches. Mentum with 8 teeth on either side of the main central tooth. Spines at bases of pleural setae very small. Comb of 10 teeth in the form of completely fringed scales arranged in a single row. (It seems possible, however, from Borel's drawing that some at least may have the median denticle hypertrophied.) Siphonal index 2.5 (apparently after crushing). Pecten with 4-5 teeth. Subventral tuft arising a little before half-

way, bifid. Saddle incomplete. Upper caudal seta double, lower single. Saddle hair single. All setae of ventral brush figured as trifold. Anal papillae subequal, rounded at their tips.

Breeding places. Bamboos (Borel, 1930:161).

DISTRIBUTION. Malaya (Leicester, 1908:255, B.M., U.S.N.M.), ? Sumatra (Brug & Bonne-Wepster, 1947:185), ? Cochin China (Borel, 1930:161).

I have seen Malayan specimens only. The other records require confirmation.

Heizmannia macdonaldi sp. n

TYPES: holotype ♂ and allotype ♀, Ulu Langat Forest Reserve, 16:vi:1954, J. A. Reid and 3 paratype ♀♀ with the same data, all in the B.M. The holotype and allotype and two of the paratypes have associated larval and pupal skins.

This species closely resembles *H. communis*, differing from it mainly in having the posterior pronotum extensively pale scaled, the scutal scales with more subdued reflections and the male terminalia with distinctively ornamented claspettes and a marked difference in the shape of the tip of the paraprocts. It is named in honour of Mr. W. W. Macdonald of the Institute for Medical Research at Kuala Lumpur who sent me the specimens and who has supplied me with very much other valuable Malayan material.

Adult ♀. Described from the allotype and three paratypes. Palps dark, between a fifth and a quarter of the length of the proboscis. Proboscis mainly dark but with a very narrow pale line at least faintly indicated below, slightly more curved and thickened at the tip than in most species, from a little less than to a little more than the length of the front femur. Scales on first joint of antennal flagellum dark. Vertex with usual markings. No pale scales round eye margins. Eyes separated by at most a little more than the width of one torus. Anterior pronotal lobes entirely or almost entirely pale scaled above. Scales of posterior pronotum mostly pale. Scutal scales with dull bronze reflection which is more subdued than in most other Indomalayan species. Scutellar scales and postnotal bristles dark. Wing scales (Fig. 11*h*, p. 24) broad, the plume scales on the middle third of vein 2+1 with about 8 longitudinal striations. Anterior fork cell about three times as long as its stem. Hind femur and abdomen much as in *H. communis* except that in the type the second abdominal sternite can be clearly seen to have a dark apical band. Seventh tergite with or without a pale basal band. Terminalia not examined, unlikely to differ markedly from those of *H. communis*.

Adult ♂. Described from the holotype which is the only available specimen.

Antenna much as in *H. communis*. Other external features as in the female. Terminalia (Fig. 27) with style, subapical lobe and apical tuft much as in *H. communis*. Distal claspette with harpago and a single tuft of rather stout, dark bristles recurved at the tips. Proximal claspette with a tuft of long setae more or less fused towards the base and bent near the base through almost a right angle. Paraprocts as figured.

Pupa. Described from the four associated skins mentioned above. Differs from that of *H. scintillans* as follows. Cephalothorax with seta 1 bifid, 2 and 3 bifid or trifold, 5 bifid or

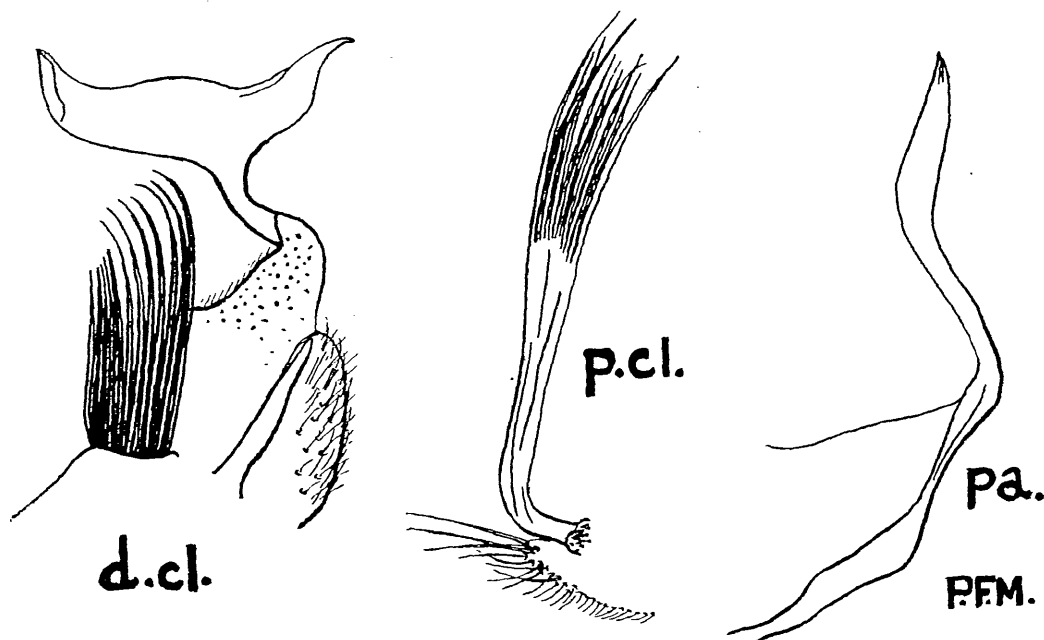


Fig. 27. *H. macdonaldi*. Male terminalia. *d.cl.* Distal claspette, *pa.* Paraproct, *p.cl.* Proximal claspette.

trifold, 7 single to trifold and 9 single or bifid. Metanotum (Fig. 28a) with seta 10 having about 3-6 branches and seta 12 about 2-4. Segment I with seta 4 having about 6-10 branches, 5 single or bifid, 10 bifid or tetrafid. Segment II (Fig. 28b) with seta 3 nearly four times as long as seta 2. Seta 1 missing from all specimens. Segment III with seta 1 single, 2 delicate, single or bifid, 3 missing in all cases, 4 bifid to tetrafid, 8 with about 6 branches, 10 with about 3-6, 11 single or bifid. Segment IV with seta 1 single, 3 with about 6 branches, 8 with about 3-4, 11 single or bifid. Segment V with seta 4 having about 5-7 branches, 5 very long, single or bifid, 8 trifold, 10 with about 6 branches, 11 single or bifid. Segment VI with setae 2 and 3 single or bifid. Segment VII with seta 3 single to trifold, 4 single to tetrafid, 6 with 5-7 branches, 7 with 2-4, 11 with 1-2. Segment VIII with seta single to trifold, 7 trifold or tetrafid, Apical paddle seta single to trifold.

Larva. (Fig. 29). Described from the four associated skins mentioned above.

Antenna lightly spiculate, more or less unicolourous. Antennal tuft with 4-7 branches. Clypeal spines very long, slender, setiform. Mentum with 9-10 teeth on either side of the main central tooth. Maxillary spine long, slender, setiform. Head seta A with about 8-12

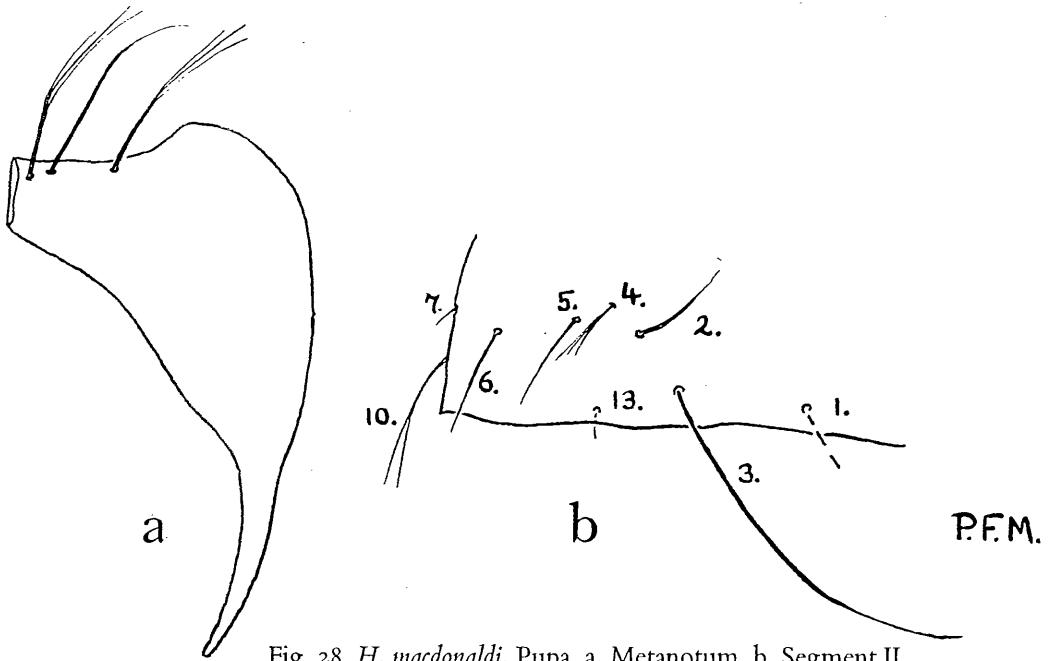


Fig. 28. *H. macdonaldi*. Pupa. a. Metanotum, b. Segment II.

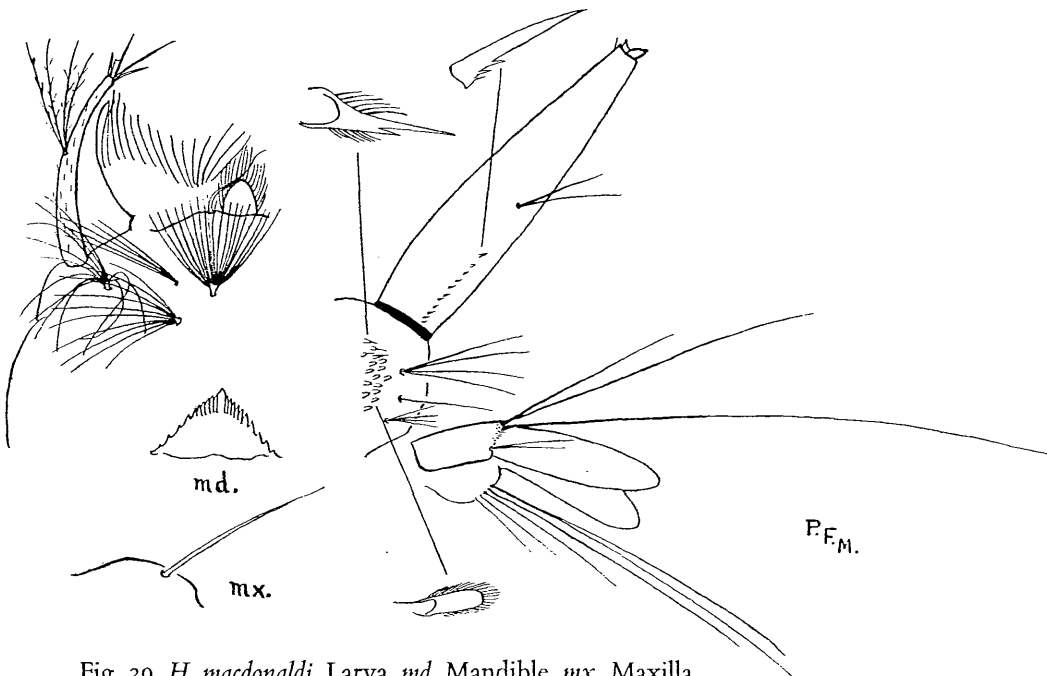


Fig. 29. *H. macdonaldi*. Larva. md. Mandible, mx. Maxilla.

branches, B with 3-5, C with 8-11, *d* with 16-20. Comb of about 16-21 teeth of which a few of the most dorsal are spines, the remainder being uniformly fringed scales. Siphonal index at least 6, uncrushed. Pecten of 8-12 teeth most of which have one or two delicate basal denticles. Subventral seta bifid. Saddle incomplete, the distal edge spiculate in the neighbourhood of the caudal setae. Saddle hair bifid. Upper caudal seta trifid, lower single. Ventral brush with 8 setae of which the two most distal are bifid, the remainder being single, two of them proximal to the barred area. Anal papillae large and unequal.

Breeding place. Bamboo.

DISTRIBUTION. Malaya (B.M.).

Heizmannia aureochaeta (Leicester)

Dendromyia aureochaeta Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3): 255, 1908.

TYPE: holotype ♀, Jungle, 6 miles from Kuala Lumpur, 1:xii:1903, G. F. Leicester, in B.M. (see p. 21).

Readily distinguished from species other than *H. macdonaldi* and *H. stonei* by the pale scaling on the posterior pronotum.

Adult ♀. Described from the holotype and three paratypes and one other specimen of Leicester's without data (see p. 21). One paratype has the data "Jungle patch, Gombak Rd., 5th mile, Kuala Lumpur, 5/12/03", another "Taken on person, Pahang Rd., Jungle, 5¼ miles fr. Kuala Lumpur, mid-day, 26/3/03" and the third "Pahang Rd. jungle, 5¼ miles fr. Kuala Lumpur, 8/9/03". Also included in the description are three specimens from Ulu Gombak, dated xi:1955, sent me by Mr. Macdonald and three others from the same locality dated xii:1955.

Palps and proboscis dark. Palps about a fifth of the length of the proboscis. Proboscis rather less than nine-tenths of the length of the front femur. Vertex with the usual pale markings except that there is a narrow line of pale scales of varying extent along the posterior margin of the eyes. Basal joint of antennal flagellum, where present, with rather conspicuous pale scales. The maximum distance between the eyes somewhat greater than the width of one torus. Upper surface of anterior pronotal lobes dark except for the anterior edge. The scales over most of the posterior pronotum broad, flat and whiteish, those in the upper posterior corner dark. Scutal scales mainly with dull bronze reflection, but two of the Ulu Gombak specimens with a small but conspicuous pale spot immediately in front of the median lobe of the scutellum. Scutellar scales all dark. Integument of postnotum dark. Postnotal bristles golden or pale brown. Wing scales very broad, the plume scales on the middle third of vein 2·1 with about 9-10 longitudinal striations (Fig. 11f, p. 24). Anterior fork cell from rather less than three and a half times to about four times as long as its stem. Anterior surface of hind femur pale on about the basal three-quarters to four-fifths (Fig. 30). Abdomen (Fig. 30) with basal lateral pale patches more extensively prolonged at the sides than in other species, reaching almost or quite to the posterior border on segments II,

III and VI and sometimes also on IV and V. These patches not extending far in towards the mid-line, visible from above only on segments V and VI. Segment VII without any basal

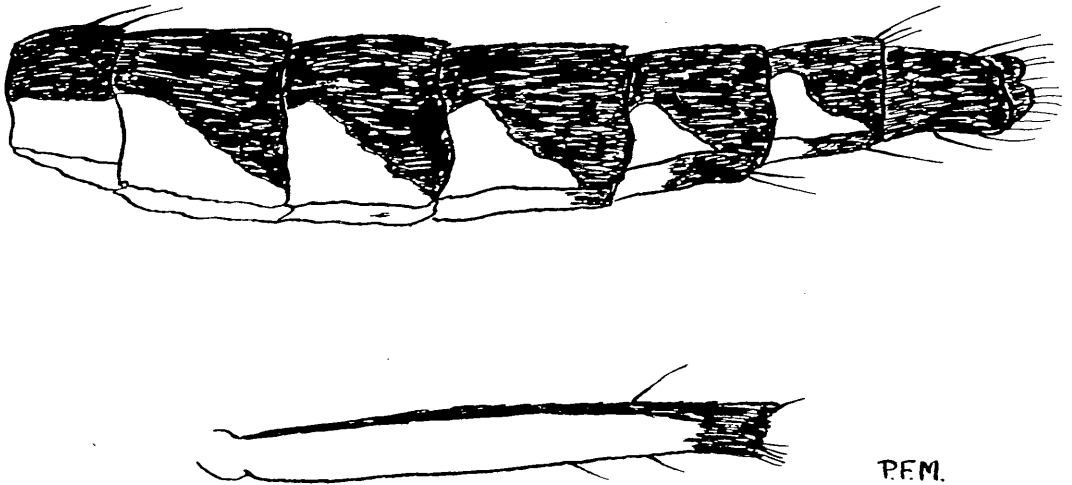


Fig. 30. *H. aureochaeta*. Left hind femur and abdomen.

pale spot. Terminalia with atrial plates and plates of IXth tergite very lightly sclerotized, the setal patch on the insula diffuse but recognizable.

Adult ♂. Unknown.

Early stages. Unknown.

Breeding places. Unknown.

DISTRIBUTION. ? N. and S. Thailand* (Causey, 1937:414), Malaya (Leicester, 1908:257, B.M.).

I have not seen any Thailand material. Causey says that, "Although this species is a day feeder, the females never venture out in open sunlight in search of food. They were always found in moist, densely shaded areas. Specimens were collected in Bangkok, Bon Pin and Chiang Moeang."

Heizmannia stonei sp. n.

TYPE: holotype ♀, Ulu Langat, Selangor, 3:vii:1954, J. A. Reid, in B.M. This species closely resembles *H. complex* Theobald, the type locality for which lies just outside the Indomalayan area in the Dawna Hills of southern Burma. It appears to differ from *H. complex* mainly in the presence of pale scales on the scutellum and postnotum. Unfortunately I have not been able to examine the types of *H. complex* which are in the Indian Museum.

* In the first paper in this series (Mattingly, 1957:29, 46) records of *Ficalbia minima* and *F. luzonensis* from Bangkok were listed as from N. Thailand. Since, however, Bangkok lies just within the Indomalayan area as here defined (Mattingly, 1957:7, Fig. 1) records from this locality will be quoted in future as from S. Thailand.

I have, however, seen two specimens from Assam which were compared with the types by Barraud (1929 *bis*:263) and are now in the British Museum. These differ from my material in having no scales on the postnotum and those on the scutellum entirely dark. Until topotypical material is available for comparison it must be presumed that the darker form is *H. complex*. Neither Theobald in his type description (1910*b*:31) nor Causey, who recorded *H. complex* from Thailand (1937:414), mentions pale scales in either of the positions indicated. This species is named after Dr. Alan Stone, who supplied me with a part of the material, in recognition of his many distinguished contributions to mosquito studies.

Adult ♀. The following description is based on the holotype, 4 paratypes from Ulu Gombak and one from "10th mile, Banting Road", Selangor and one paratype from Rong Kwang, Prae Province, Thailand, 13:xi:1952, M. Ratanapradith, which is in the U.S. National Museum and was kindly lent me by Dr. Stone. The Malayan specimens are all in the British Museum.

Palps and proboscis dark. Palps from about one-sixth to one-fifth of the length of the proboscis. Proboscis from slightly shorter than to slightly longer than the front femur, usually the former. Scales on basal joint of antennal flagellum pale. The specimen from Thailand has numerous broad, flat pale scales on the clypeus. These are absent from the Malayan specimens from which they may have been lost by rubbing. Vertex with a more or less complete pale border to the eyes which are separated by at most a little more than the width of one torus. Anterior pronotal lobes pale along the anterior border, dark behind. Posterior pronotum with numerous broad, flat pale scales. 1-2 postspiracular bristles present. Scutal scales with rather dull blue, green and purple reflections. Apical pale scales present on all three lobes of the scutellum and a few pale scales present on the scutum immediately in front of the mid-lobe of the scutellum at least in the majority of specimens.

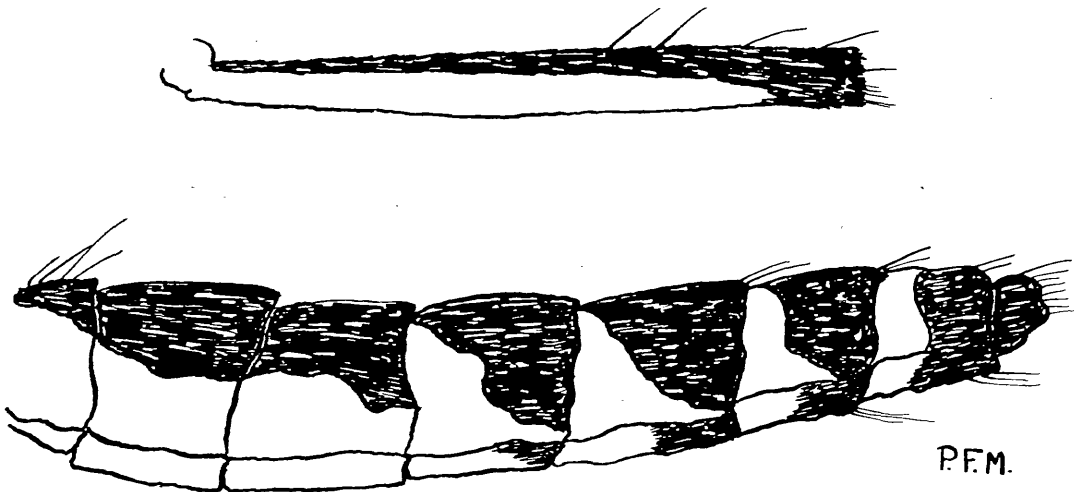


Fig. 31. *H. stonei*. Abdomen and anterior surface of hind femur.

Bristles on postnotum pale, accompanied by a number of broad, flat pale scales which are best preserved in the Thailand specimen (Fig. 7*b*, p. 17). Wing scales narrow, the plume scales on the middle third of vein 2·1 with about 5 longitudinal striations (Fig. 11*i*, p. 24). Anterior fork cell about two and a half to two and three-quarter times as long as its stem. Hind femur (Fig. 31) with pale basal stripe on anterior surface nearly reaching the tip below. Pale basal lateral patches on abdominal tergites in some cases extending inwards almost to the mid-line on segments IV–VI or V–VI, in other cases not. Segment VII with or without a median basal pale spot. Sternites I and II entirely pale. Remainder with dark apical bands.

Adult ♂. Unknown.

Early stages. Unknown.

Breeding places. Unknown.

DISTRIBUTION. N. Thailand (U.S.N.M.), Malaya (B.M.).

Heizmannia achaetae (Leicester)

Dendromyia achaetae Leicester, *Stud. Inst. med. Res. F.M.S.*, 3(3): 257.

Haemagogus achaetae Edwards, *Indian J. med. Res.*, 10: 450, 1922 and *Genera Insectorum*, Fasc. 194: 179, 1932.

TYPE: holotype ♀, Jungle patch, 5th mile, Gombak Road, Kuala Lumpur, 17:xii:1903, G. F. Leicester, in B.M.

As noted above (p. 20) this is a very different species from any other in this genus. When more is known about it it may be necessary to transfer it to another genus. It certainly deserves a separate species group or possibly subgenus. Nevertheless it keys quite easily with *Heizmannia* and would probably be placed in this genus on superficial inspection by anyone familiar with the Indomalayan fauna.

The following description is based on the holotype and six other females labelled "Gombak, 16th mile" with dates in November and December, 1955, kindly sent me by Mr. Macdonald.

Adult ♀. Palps and proboscis dark. Palps about one-sixth of the length of the proboscis or rather less. Proboscis approximately equal in length to the front femur. Markings of vertex as in other species of the genus but the lateral pale spots rather more extensive and the scales of which these and the median pale spot are composed more brightly metallic. No pale rim round eyes. Basal joint of antennal flagellum with dark scales. Distance between eyes at most equal to the width of one torus. Upper surface of pronotal lobes (Fig. 9*a*, p. 21) and all but the extreme upper portion of the posterior pronotum covered with bright metallic silvery scales. Scutal scales mainly with reddish purple reflections shot with gold. Mid-lobe of scutellum with broad silvery scales. Lateral lobes dark. Integument of postnotum dark. Postnotal bristles entirely absent. Wing scales broad or moderately broad, the plume scales on the middle third of vein 2·1 with about 6–8 longitudinal striations

(Fig. 11g, p. 24). Anterior fork cell less than twice as long as its stem. Anterior surface of hind femur (Fig. 32) pale on about the basal three-fifths, the basal portion of the dark dorsal stripe narrower than in other Indomalayan species. Fore and mid-claws (Fig. 9c, p. 21) strongly toothed (a distinction from all other species in the genus). Abdomen (Fig. 32) with

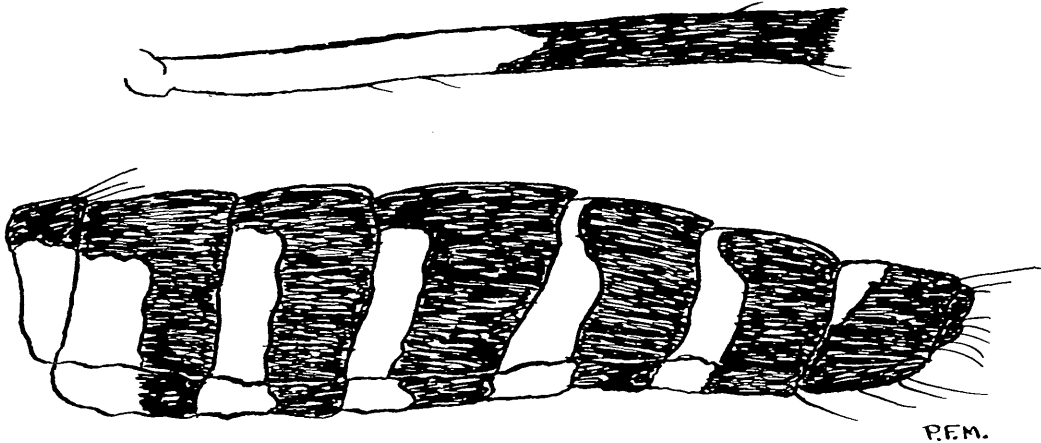


Fig. 32. *H. achaetae*. Left hind femur and abdomen.

basal lateral patches strongly metallic, silvery, shallower than in other species of the genus, not reaching the posterior edge of the tergite on any segment posterior to the first. Tergites V–VII with broad silvery basal bands, sometimes incomplete in the middle on segment V. Seventh sternite dark, the others with silvery basal bands. Terminalia (Fig. 8b, p. 18) differing from those of other members of the genus in having the ninth tergite completely sclerotized and a bilobed postgenital plate.

Adult ♂. Unknown.

Early stages. Unknown.

Breeding places. Unknown.

DISTRIBUTION. ? S. Thailand (Causey, 1937:414), Malaya (Leicester, 1908:258, B.M.).

I have not seen any material from Thailand. Causey says that “females were collected from a horse in Bon Pin, November, 1953”.

ZOOGEOGRAPHY

The genus *Heizmannia* is of particular interest in that it is annectent between a number of Old and New World groups of Culicini. Among the Old World Aëdine genera it is particularly close to *Aedes* itself. Its resemblance to the New World *Haemagogus* and the

sabethine genera has already been noted (p. 5). In the light of this it is perhaps not surprising to find that *Heizmannia* has a much more northerly distribution along the western shores of the Pacific than have most tropical groups.

The presence of relict populations of *Heizmannia lii* in the Hangchow area and in Korea (p. 20) indicates that this species must at one time have extended at least as far north as the Mukden area. The same area (which has long been predicated as a refuge during the glacial period) was apparently also reached at one time by group A of *Aedes* subgenus *Stegomyia* whose natural distribution is now exclusively Ethiopian (Mattingly, 1953: 5). The failure of *Heizmannia* to achieve so extensive a distribution as *Stegomyia* may be attributed to its much greater dependence on the forest environment. That it has spread as far north as it has may be attributed to the ameliorating effect on temperature and humidity of ocean currents, a factor not perhaps always given sufficient weight in considering the distribution of insects.

The apparent absence of *Heizmannia* from Java, Celebes, the lesser Sunda Islands and almost the whole of the Australasian Region is certainly due in part to climatic factors (possibly exaggerated by deforestation in Java), but it seems likely to be due also to the fact that this genus originally spread down into the Indomalayan area from the north. At the present time it is certainly very well represented in the general area of the Himalayan foothills, and the British Museum has a number of undescribed species from Assam.

Summary

Nine species of Indomalayan *Heizmannia* are recognized, including three new to science. *H. pilosa* Brug and *H. funerea* Leicester are sunk as synonyms of *H. scintillans* Ludlow. An examination of the type of *H. indica* Theobald shows that the species described under this name by Leicester, Edwards and Barraud is distinct, and this is therefore redescribed as *H. reidi* sp. n. Another new species, *H. stonei*, is described from N. Thailand and Malaya and a third, *H. macdonaldi*, from Malaya only. *H. achaetae* Leicester is transferred to *Heizmannia* from the genus *Haemagogus* where it was formerly placed, and it is shown that the latter is purely Neotropical. A specimen of *H. scintillans* Ludlow, the type species of the genus, is described for the first time. It is the first specimen other than the type to be recorded. Lectotypes are designated for all species of the genus for which this is necessary. Two species groups are recognized, *H. achaetae* being placed in one of them and the remaining species in the other. New generic and subgeneric keys to the Culicini, applicable on a world basis, are presented. They will be expanded in later papers in the series. They are believed to include the first world key to pupae yet produced. *H. lii* Wu is recorded for the first time from Korea, and it is pointed out that the presence of apparently isolated populations here and in the Hangchow area argues its former presence in the eastern glacial wooded refuge of Reinig where it would have mingled with various holarctic and even Ethiopian elements. The genus is considered to have entered the Indomalayan area from the north. Its present

restricted distribution is probably due to an exclusive dependence on the forest environment. Other new records include *H. reidi* and *H. ? greeni* Theobald from northern Thailand and *H. metallica* from Tarakan.

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