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A REVIEW OF THE INDO-CHINESE PHLEBOTOMINAE

(Diptera: Psychodidae)

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Abstract: One new species each of *Nemopalpus* and *Phlebotomus* is described. Keys and distributional records are given for all and illustrations for most of the 13 species of *Phlebotomus* known to occur in the Indo-Chinese area. The faunal relationship of the Indo-Chinese *Phlebotomus* is close to that of India.

The purpose of this paper is to review the species of Phlebotominae in the Indo-Chinese area and to present a more satisfactory means for the identification of the species than is now available. Two new species are described. The study is based on collections made in Viet Nam and Laos during 1960 by me and my wife and material from the U. S. National Museum. The area included covers Thailand, Laos, Cambodia, Viet Nam, southernmost China and Hainan.

The Indo-Chinese phlebotomines have been quite thoroughly described and illustrated in a series of papers by Raynal and Gaschen (1934, 1935) and Raynal (1935a, b, 1936a, b, 1937). Parrot and Clastrier (1952) re-described and re-illustrated eight species of Indo-Chinese *Phlebotomus*. Less important references to this sand fly fauna have been made by Sinton (1931b), Theodor (1938), Causey (1938) and Yao and Wu (1941).

One species of *Nemopalpus* and thirteen of *Phlebotomus* are included. *P. kachekensis* Yao and Wu is not treated as I have seen neither the specimens nor the original description of this species. Specimens of all but four of the included species have been seen by me. Those four are placed in the key on the basis of published descriptions.

The Indo-Chinese phlebotomine fauna is not a rich one, although there probably will be found here additional species from surrounding area and some new species in the remoter mountains and primary forests. The strongest relation is shown with the Indian subregion

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where eight of the Indo-Chinese phlebotomines also occur. Less strong relation is shown with the Malayan subregion where five (or possibly six) of the species are found, but future collections in Malaya will probably alter the present pattern, for little intensive collecting of sand flies has been done there.

Earlier workers have applied varietal names to those specimens which they considered to differ taxonomically from the "typical" forms. Since that time the practice of applying formal, Latinized names to individual variants has been discontinued. The older varieties that are nothing more than individual variations within populations are no longer given formal recognition. On the other hand, some of the named varieties consistently differ from other segregates of the species and are geographical subspecies, which are named as trinomials. Named varieties of the species included in this paper have been studied in the light of the above and all have been found to be individual variants and not geographical segregates. Consequently, they are relegated to synonymy with their appropriate species.

The terminology of certain parts of the wing veins is changed from that usually employed in most *Phlebotomus* studies to conform to terms more widely used in the family Psychodidae and other Diptera. Vein R_{2+3} is the "beta" applied to *Phlebotomus* wings and is that part of the radial sector from the base of R_4 to the radial fork (the distal fork of the radius). Vein R_2 is the equivalent of "alpha" and is the anterior vein of the radial sector beyond the radial fork. The terms "R_{2+3}" and "R_2" are as simple as "beta" and "alpha" and have the advantage of not being used in only one group of insects. "Delta" is retained for that part of Sc that extends beyond the radial fork and overlaps R_2 (or a negative delta indicates Sc doesn't reach the radial fork). This is a useful feature in the identification of *Phlebotomus* and there is no other common term for it.

The "leg ratio" in the descriptions is the relative lengths of the femur, tibia and basitarsus. Each unit is equivalent to 0.05 mm. In the ratios of the palpal segments each unit is equivalent to 0.003 mm. References are intended to be complete only for the Indo-Chinese subregion.

Scale lines in the illustrations of the wings represent 1.0 mm, of the heads 0.5 mm, of the male genitalia 0.1 mm and of the spermathecae, pharynx, and cibaria 0.05 mm, or as otherwise marked.

Most of the material collected by the Quates will be deposited at the B. P. Bishop Museum. Specimens collected by the Thurmans and others in Thailand will be returned to the U. S. National Museum.

Subfamily PHLEBOTOMINAE

Genus **Nemopalpus** Macquart, 1838

The genus *Nemopalpus* was placed in the subfamily Bruchomyiinae until recently when Fairchild (1955) reduced that group to a tribe of the Phlebotominae. Because of the similarities of head, antennae, and wing venation of *Nemopalpus* to *Phlebotomus*, I concur with Fairchild's classification. This arrangement of genera makes the Phlebotominae more in line with the subfamily Psychodinae and shows a clearer relationship of the psychodid genera.

There are only 16 existing species of *Nemopalpus* known and all are confined to the tropics. Until this time, only two were known in the Oriental Region and the addition of the third is noteworthy. The most complete treatment of *Nemopalpus* available is that of Fairchild (1952), which includes a catalogue of species and descriptions of the New World species.

Nemopalpus vietnamensis Quate, n. sp. Fig. 1.

Female. Thorax largely pale brown with brown stripe on midline and over humeral angle of scutum. Eye without eye bridge; labellum bulbous; palpus 5-segmented, segment 3 with many Newstead scales on basal 2/3 of inner face, ratio of segments=20 : 45 : 60 : 70 : 220. Antenna tip lacking (but probably 16-segmented as other members of the genus), flagellar segments cylindrical, segment 3 little longer than 4 (flagellar segment 1 of right antenna longer than left, see fig. 1c), ascoids V-shaped. Wing with radial fork little distad of and base of R_5 on same level as medial fork, R_5 weakly and angulately joined to R_4, R_{2+3} about 1/3 length of R_2. Abdominal tergites and sternites with 2 bands of hairs, one near center and other on apical border. Ventral apex of abdomen as figured; spermatheca single, subulate, heavily sclerotized, with long, coiled duct.

Wing length 4.2 mm; wing width 1.3.

Holotype ♀ (BISHOP 3163), Viet Nam, Dalat, 1500 m, 30. IV. 1960, tree hole, Quate.

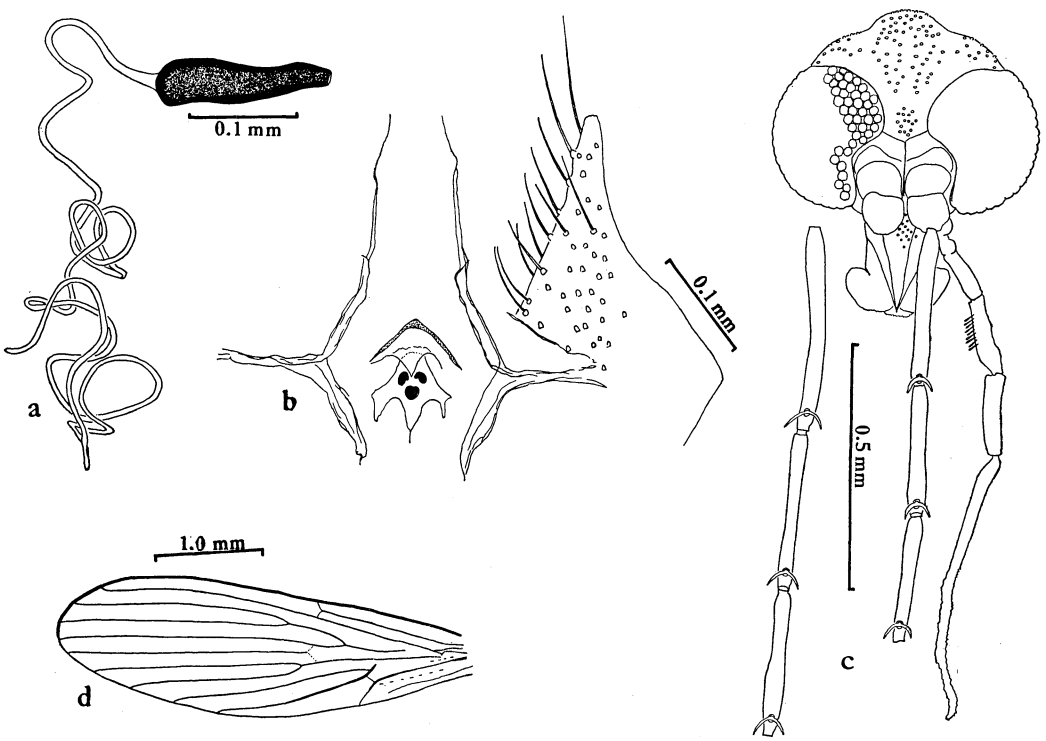

Fig. 1. *Nemopalpus vietnamensis*, ♀. a, spermatheca; b, abdominal apex, ventral view; c, head, with rt. antenna base detached; d, wing.

The only other species of *Nemopalpus* in this area in the Malayan *orientalis* Edwards, recently re-described by Satchell (1958). *N. vietnamensis* differs from *orientalis* in having ascoids V-shaped rather than triangular, a shorter R_2, and undoubtedly in genitalic features which are still unknown, since the two species are known only from the opposite sexes.

Genus **Phlebotomus** Rondani

Key to Indo-Chinese species of Phlebotomus

1. Abdominal hairs erect, sockets on tergites 2 to 6 as large as on 1; palpal segment 4 often only 1/2 length of 3; ♂ dististyle with 2 or 3 spines in center; pharynx armed apically, cibarium at most with weak and irregularly developed teeth (subgenus *Phlebotomus*) 2

   Abdominal hairs on tergites 2 to 6 recumbent, sockets much smaller than on tergite 1; palpal segment 4 longer than 1/2 length of 3; ♂ dististyle with all spines distad of center (except *sylvestris* and *khawi*); pharynx armed or unarmed, cibarium of ♀ usually with well developed teeth (subgenus *Sergentomyia*) 4

2 (1). Male dististyle with 5 spines; ♀ with antennal segment 3 ending well before tip of proboscis 3

   Male dististyle with 4 spines; ♀ with antennal segment 3 extending to tip of proboscis and cibarium with 2 teeth considerably larger than others..... **stantoni**

3 (2). Male genitalia with 2 small lobes below larger, main lobe on paramere, and long, slender spine on each side of aedeagus; ♀ spermatheca with distal part as broad as basal; ♀ cibarium with several central teeth larger than others..... **argentipes**

   Male paramere simple, without ventral lobes; ♀ spermatheca with distal part reduced to slender neck; ♀ cibarium with all teeth of about same size ... . **chinensis**

4 (1). R_{2+3} (beta) subequal to or longer than R_2 (alpha); delta 1/2 or less length of R_2..... 5

   R_{2+3} much shorter, less than 1/2 length of R_2; delta at least 3/4 length of R_2; ♀ pharynx armed, ♂ unarmed; ♀ cibarium with row of fine, numerous teeth, pigment patch well sclerotized and top-shaped; ♂ cibarium with fewer and smaller teeth and pigment patch slender, carrot-shaped..... **brevicaulis**

5 (4). Males 6

   Females 13

6 (5). Dististyle with 2 apical spines and 2 clearly basad of apex; antennal segment 3 very long, extending well beyond proboscis 7

   Dististyle with all spines apical or subapical, coxite not elongate; antennal segment 3 shorter than or not greatly exceeding proboscis 8

7 (6). Dististyle with 2 spines near center; palpal formula=1–4–2–3–5 or 1–2–4–3–5 ..... **sylvestris**

   Dististyle with 2 spines at apical 1/4; palpal formula=1–2–3–4–5..... **khawi**

8 (6). Antennal segment 3 ends before proboscis tip..... 9

   Antennal segment 3 extends beyond proboscis tip 11

9 (8). Paramere ends in down-curved, pointed apex; pharynx slender and sides near-

ly straight, unarmed; Newstead scales on palpal segment 3 only; ridge bearing cibarial teeth concave (curvature opposite that of pigment patch) 10

Paramere ends in bluntly rounded apex; pharynx expanded distally and armed with few spines apically; Newstead scales on palpal segments 2 and 3; ridge bearing cibarial teeth straight or convex; pleuron with scales ..... **squamipleuris**

10 (9). Accessory spine of dististyle on about same level as subapical spine; basistyle with many (more than 20) non-deciduous hairs; sides of cibarium suddenly expanded posteriorly to nearly form a right angle ..... **bailyi**

Accessory spine of dististyle clearly basad of subapical spine; basistyle with few (less than 15) non-deciduous hairs; sides of cibarium expanded but not strongly enough to form right angle ..... **barraudi**

11 (8). Genital filaments 3–4× length of pump 12

Genital filaments very long, 5–6× length of pump; basistyle with patch of non-deciduous hairs; cibarium with 7–9 well defined teeth and few, smaller lateral ones on either side ..... **morini**

12 (11). Palpal formula=1–2–4–3–5 or 1–(2–4)–3–5; 8 cibarial teeth weak and granular ..... **sylvaticus**

Palpal formula=1–2–3–4–5; cibarium with about 14 teeth, central 4 about 1/2 size of lateral ones ..... **iyengari**

13 (5). Pharynx armed with thick cluster of spines apically 14

Pharynx unarmed 15

14 (13). Pigment patch terminating anteriorly as single point; Newstead scales on palpal segments 2 and 3; spermatheca spherical with many setose annulations and thick apical knob ..... **squamipleuris**

Pigment patch terminating anteriorly as 2 points; Newstead scales only on palpal segment 3; spermatheca ovoid, smooth, without setae ..... **barraudi**

15 (13). Antennal segment 3 ending well before proboscis tip 16

Antennal segment 3 extending nearly to or beyond proboscis tip 17

16 (15). Palpal formula=1–2–3–4–5, rarely 1–2–(3–4)–5; antennal segment 3 very short, extending only to about center of proboscis; cibarium with irregular double row of small, faint teeth ..... **bailyi**

Palpal formula=1–2–4–3–5; antennal segment 3 extending to about distal 1/4 of proboscis; cibarium with 4–6 teeth in center and patch of 8–10 smaller ones on each side ..... **sylvaticus**, *pars.*

17 (15). Palpal formula=1–2–3–4–5 or 1–2–4–3–5 18

Palpal formula=1–4–2–3–5; cibarium with about 16 large teeth; pigment patch dark, ovoid with anterior extension and with about 10 large, dark rectangles below teeth ..... **sylvestris**

18 (17). Cibarium with weak, rectangular or no pigment patch and less than 10 distinct teeth 19

Cibarium with large, distinct pigment patch and 14 or more teeth 20

19 (18). Palpal formula=1–2–4–3–5; antennal segment 3 extends to about proboscis tip; cibarium with 4–6 teeth in center larger than patch of 8–10 on each side; pigment patch small, rectangular; pharynx slender, little expanded apically ..... **sylvaticus**

Palpal formula=1–2–3–4–5; antennal segment 3 extends well beyond proboscis tip; cibarium with number of small, indefinite teeth; pigment patch absent; pharynx broadly expanded apically ..... **tonkinensis**

20 (18). Cibarium with 14 to 17 vertical teeth, 4 central ones of which reduced; erect teeth absent or variably to 2 rows of 20 in each row; pigment patch hemispherical or top-shaped with anterior projection reaching arch ..... **iyengari**

Cibarium with 20, equal-sized teeth; erect teeth in 2 rows of 20 in each row and a third, incomplete row with 4 teeth on either side; pigment patch beet-shaped and anterior projection not reaching arch ..... **khawi**

Phlebotomus (Phlebotomus) argentipes Annandale and Brunetti

Phlebotomus argentipes Annandale & Brunetti, 1908: 101.—Raynal & Gaschen, 1935: 737.—Raynal, 1935b: 245.

Phlebotomus (Phlebotomus) argentipes, Quate & Fairchild, 1961: 211.

DISTRIBUTION: India to Borneo.

THAILAND. Chieng Mai, 28. X. 1952, D. C. & E. B. Thurman; 1 ♂.

LAOS. Luang Prabang, 5. VI. 1960, L. Quate; 1 ♂.

VIET NAM. 22 km S of Nha Trang, 25. XI. 1960, hole in rubber tree, C. M. Yoshimoto; 1 ♀.

Phlebotomus (Phlebotomus) stantoni Newstead Fig. 2.

Phlebotomus stantoni Newstead, 1914: 190 (type—Malaya).—Sinton, 1931b: 99.—Raynal & Gaschen, 1934: 670.—Raynal, 1935b: 237.—Theodor, 1938: 269.—Yao & Wu, 1940: 773, 1941: 76.

Phlebotomus (Phlebotomus) stantoni, Parrot & Clastrier, 1952: 154.

Phlebotomus maynei Sinton, 1930: 195 (type—India).

DISTRIBUTION: Ceylon, India to Malaya, S. China, Hainan.

LAOS. Vientiane, 3. VI. 1960, burned tree hole, S. Quate; 2 ♂♂.

VIET NAM. 22 km S of Nha Trang, 25. XI. 1960, hole in rubber tree, C. M. Yoshimoto; 2 ♂♂, 2 ♀♀.

Phlebotomus (Phlebotomus) chinensis Newstead

Phlebotomus major var. *chinensis* Newstead, 1916: 191.

Phlebotomus chinensis, Raynal, 1937: 41.—Yao & Wu, 1941: 76, 79.

DISTRIBUTION: Middle East to China. No material of this species seen by me.

Phlebotomus brevicaulis Quate, n. sp. Fig. 3.

Large species with recumbent hairs on tergites 2–6. Head, anteriolateral and median band of scutum, lower part of pleuron, coxae and legs brown; posteriolateral part of scutum and most of pleuron pale. Ratio of fore leg=13 : 14 : 8, mid leg=14 : 17 : 10, hind leg=14 : 24 : 11.

Female. Cibarium (fig. 3d) with a comb of numerous, very fine vertical teeth and close below a single row of about 50 erect teeth; pigment patch large, well sclerotized

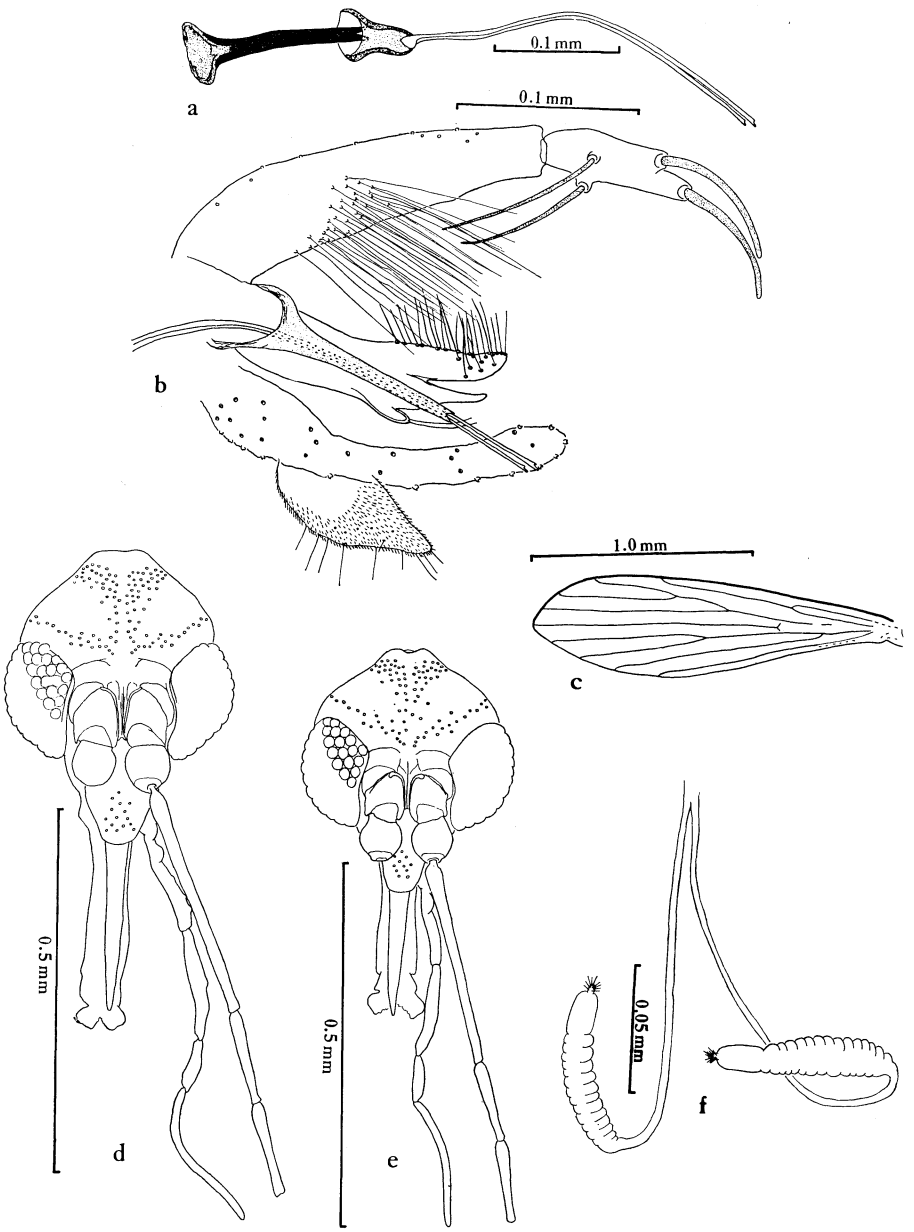

Fig. 2. *Phlebotomus stantoni.* a, ♂ genital pump and filaments; b, ♂ genitalia, lateral view, mesal surface; c, wing, ♂; d, head, ♀; e, head, ♂; f, ♀ spermathecae and ducts.

and top-shaped; arch absent across most of cibarium and only weakly developed at sides; sides of cibarium concave just above arch; pharynx (fig. 3c) rather slender, armed apically with numerous, fine, but distinct spines. Palpus long, with few Newstead scales on

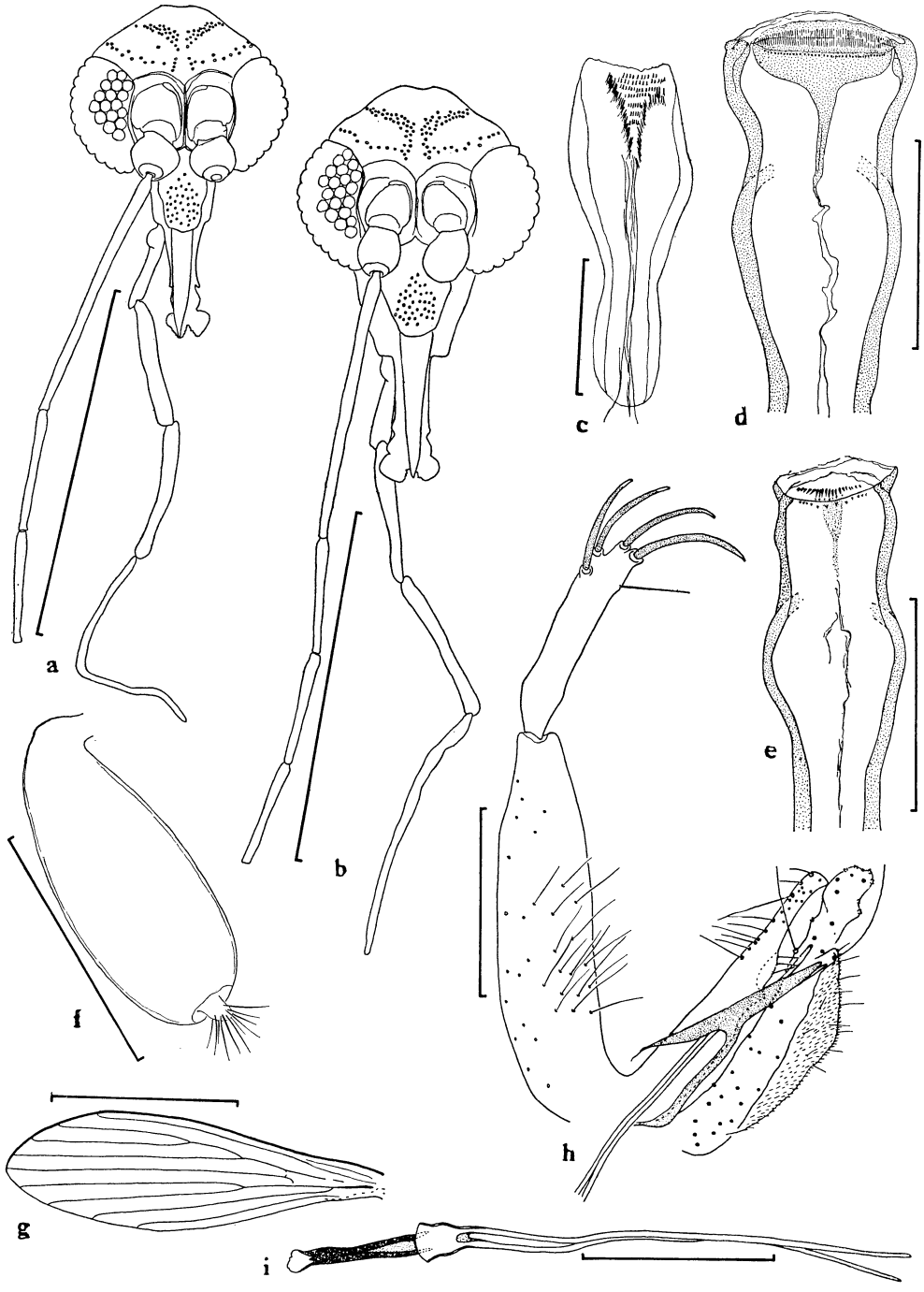

Fig. 3. *Phlebotomus brevicaulis.* a, head, ♂; b, head, ♀; c, pharynx, ♀; d, cibarium, ♀; e, cibarium, ♂; f, ♀ spermatheca; g, wing, ♀; h, ♂ genitalia, lateral view, mesal surface; i, ♂ genital pump and filaments.

basal 1/4 of segment 3, formula=1–2–3–4–5, ratio of segments=14 : 40 : 70 : 80 : 140. Antenna with segment 3 extending beyond tip of proboscis by about 1/4 its length, pair of simple ascoids on segments 3–15. Wing (fig. 3g) with short R_{2+3} (beta) and long R_2 (alpha) and delta, base of R_4 and medial fork on same level before center of wing. Spermatheca simple, ovoid, without annulations, apical knob set in small depression, ducts about as long as spermatheca.

Holotype: Wing length 2.1 mm, wing width 0.6; paratypes not significantly different.

Male. As ♀ except: Cibarium (fig. 3e) with fewer and smaller vertical and erect teeth, pigment patch carrot-shaped with long stem, lightly sclerotized; pharynx unarmed; antenna with single ascoids, segment 3 exceeding proboscis tip by about 1/3 its length. Genitalia (fig. 3h) as figured; dististyle (style) with 4 spines, 3 apical and 1 subapical, seta little proximal of all spines; basistyle (coxite) with sparse patch of non-deciduous hairs on inner face; paramere little shorter than lateral lobe; genital filaments 3× length of pump.

Wing length 1.65–1.9 mm, holotype 1.9; wing width 0.5.

Holotype ♀, allotype ♂ (BISHOP 3164), Viet Nam, 20 km S of DiLinh (Djiring), 1200 m, 26 and 27. IV. 1960, tree cavity, L. & S. Quate. Paratypes (BISHOP, USNM, BMNH): 2♂♂, 9♀♀, same data, except 2 collected 25. IV. 1960. Type locality is in the coast range on the highway between DiLinh and the coastal town of Phan Thiêt.

The most distinctive features of this species are the short R_{2+3}, the long R_2 and delta, and structure of the cibarium. In wing venation and size it resembles *P. malabaricus* Annandale (Sinton, 1924 : 1007, 1932 : 61, 1933 : 420), but the ♀ of that species (if identified correctly) and ♂ have fewer cibarial teeth and the pigment patch is of different shape; also, the seta on the ♂ dististyle of *malabaricus* is distad of the subapical spine rather than basad as in *brevicaulis*. *P. zeylanicus* Annandale (India, Ceylon) also has a short R_{2+3} and long R_2 and delta, but its ♂ genitalia and cibarium are clearly different from *brevicaulis* (see Theodor, 1938).

Phlebotomus (Sergentomyia) squamipleuris Newstead Fig. 4, a–c.

Phlebotomus squamipleuris Newstead, 1912 : 366.—Sinton, 1923 : 65, 1931b : 104.—Causey, 1938 : 487.—Yao & Wu, 1940 : 776, 1941 : 77.

Phlebotomus squamipleuris var. *indicus* Theodor, 1931 : 470; 1938 : 269. **New Synonymy.**

Phlebotomus (Prophlebotomus) squamipleuris var. *indicus*, Parrot & Clastrier, 1952 : 164.

DISTRIBUTION: Widely distributed from Africa to Malaya, Indochina and S. China.

THAILAND. Chieng Mai, IV, V. 1958, light trap, Notananda; Loei Prov., Tha Li Dist. (north Thailand), 9. VI. 1959, at light, Manop; Nong Khai Prov., Meung Dist. (on Mekong R. near Vientiane, Laos), 10–14. VI. 1959, at light, Manop; Udon Thani Prov., Meung Dist. (50 km S of Nong Khai), 17–20. VI. 1959, at light, Manop; Khon Haen, 20–24. VI. 1959, at light, Manop; Nakhonratchaaima Prov., Meung Dist. (about 200 km NE of Bangkok), 8–10. VII. 1959 and 5–7. XII. 1959, at light, Manop; Sara Buri Prov., Phraphutthabat Dist. (about 100 km NNE of Bangkok), 29. XII. 1959, Manop; Ayutthaya (about 75 km N of Bangkok), 2. I. 1959, Manop; Bangkok, 12. V. 1959, at light, Manop; Samut Prakan (25 km S of Bangkok), 22. XII. 1958, Manop. 55 ♂♂, 38 ♀♀.

LAOS. Vientiane, 3, 14. VI. 1960, light trap, L. & S. Quate; Luang Prabang, 5. VI.

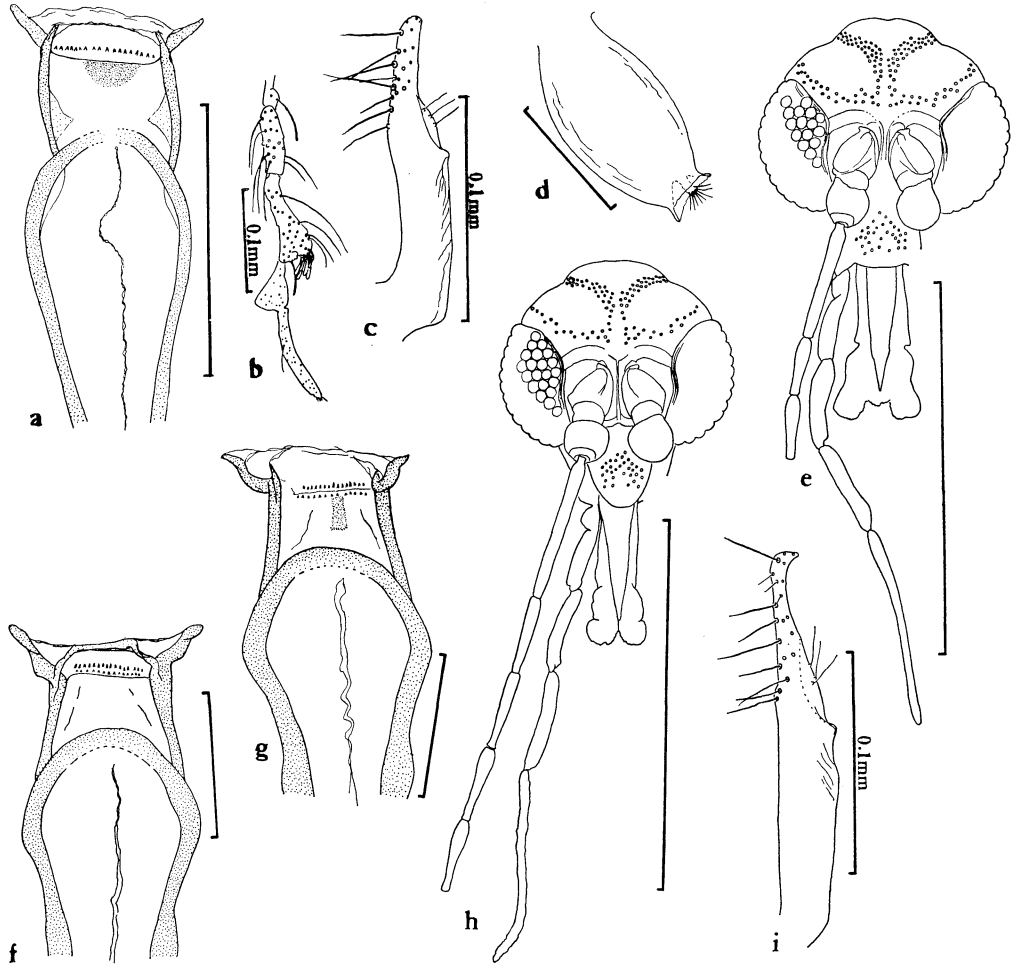

Fig. 4 a–c. *Phlebotomus squamipleuris*, ♂. a, cibarium; b, rt. palpus, aberrant; c, paramere. d. *Phlebotomus barraudi*, ♀, spermatheca. e–i. *Phlebotomus bailyi*. e, head, ♀; f, cibarium, ♀; g, cibarium, ♀: h, head, ♂; i, ♂ paramere.

1960, light trap, L. & S. Quate. 5 ♂♂, 9 ♀♀.

P. squamipleuris var. *indicus* Theodor (1931) was proposed for Indian specimens having the antenna shorter, fewer cibarial teeth, a differently shaped pigment patch, and a more heavily sclerotized pharynx than the African ones. In the material studied by me, I find variations which include those given for both the nominate form and the variety. Thus, my specimens have antennal segment 3 varying from 0.13 to 0.15 mm and the number of cibarial teeth from 33 to 44. The pigment patch also varies and some seem similar to that of the African *squamipleuris*. In view of this, *indicus* is recognized neither as a variety nor subspecies and considered a synonym of *squamipleuris*. (I have seen no specimens from Africa and cannot compare the degree of sclerotization of the pharynx.)

The males of *P. squamipleuris* and *bailyi* may be confused, especially those variants

with a short delta and the cibarial pigment patch absent or faint. The most reliable characters for separation of the two are the relative lengths of antennal segment 3, the shape of the pharynx, the shape of the ridge bearing the cibarial teeth and the apex of the paramere. In *squamipleuris*, antennal segment 3 extends only to about the center of the proboscis and the pharynx is expanded apically so the sides are rounded and there are a few small spines present. In *bailyi*, antennal segment 3 extends to the distal 1/4 of the proboscis, the pharynx is slender, the sides are nearly straight and a little divergent posteriorly and the apex is unarmed except for minute denticles. The ridge bearing the cibarial teeth in *squamipleuris* is straight or convex (i. e. its curvature parallels that of the pigment arch) but definitely concave in *bailyi*. Of course, the top- or beet-shaped pigment patch of *squamipleuris* is dissimilar to the rectangular patch of *bailyi*, but often the patches are absent or too faint to be used with confidence. The paramere of *squamipleuris* (fig. 4c) ends in a bluntly rounded point; that of *bailyi* (fig. 4i) has a sharply angulate apicoventral point. Unlike those of *bailyi*, the tips of the genital filaments of *squamipleuris* are expanded and paddle-like, but frequently they are in the aedeagus and obscured. There are only 10–15 non-deciduous hairs on the inner face of the basistyle of *squamipleuris* and about 40 on *bailyi*. The Newstead scales on palpal segment 2 are unique to *squamipleuris*, but they are not always readily evident. The scales on the pleuron of *squamipleuris* are, of course, lost in slide mounting and of no value in specimens thus mounted.

One male from Chieng Mai has aberrant palpi. The left one has an expansion at the base of segment 5. The right palpus (fig. 4b) has large swellings on segments 3 and 4, 4 is reduced and fused to 5.

Phlebotomus (Sergentomyia) barraudi Sinton Fig. 4d.

Phlebotomus barraudi Sinton, 1929 : 716 (type – India).— Raynal & Gaschen, 1934 : 559; 1935 : 113.—Raynal, 1935b : 285.

Phlebotomus (Prophlebotomus) barraudi, Parrot & Clastrier, 1952 : 158.

Phlebotomus barraudi (?) var. Theodor, 1938 : 268.

Phlebotomus barraudi var. *siamensis* Causey, 1938 : 488 (Thailand). **New Synonymy.**

Phlebotomus barraudi var. *kwangsiensis* Yao & Wu, 1941 : 67, 77 (Kwangsi, China). **New Synonymy.**

DISTRIBUTION: India, Thailand, Laos, Cambodia, Viet Nam, S. China.

THAILAND. Chieng Mai, IV, V. 1958, light trap, Notananda; Sara Buri Prov., Phraphutthabat Dist. (about 100 km NNE of Bangkok), 29. XII. 1958, Manop; 4 ♀♀.

LAOS. Vientiane, 3. VI. 1960, in partly destroyed, earthen termite mound about 1 m high, L. Quate; 11 ♂♂ 2 ♀♀.

VIET NAM. DiLinh (Djiring), 23. IV. 1960, 1200 m and 9 km S of DiLinh, 24. IV. 1960, 900 m, hollow tree, L. & S. Quate; 3 ♂♂, 3 ♀♀.

P. barraudi varieties *siamensis* Causey and *kwangsiensis* Yao and Wu were proposed for individuals with the number of cibarial teeth and pharyngeal spines differing from the original Indian specimens. The number of teeth of the species appears to vary from about 45 to 70. The spines of the pharynx may also vary in size and number. These differences are not geographically segregable. The range of variation in many populations may include the above varieties and consequently the varieties should not be recognized by formal names.

Phlebotomus (Sergentomyia) bailyi Sinton Fig. 4, e–i.

Phlebotomus bailyi Sinton, 1931a : 821.

Phlebotomus bailyi var. *campester* Sinton, 1931a : 822; 1931b : 104.—Raynal & Gaschen, 1934 : 563, 858.—Raynal, 1935b : 277.—Theodor, 1938 : 268.—Causey, 1938 : 487.—Yao & Wu, 1940 : 782, 1941 : 77. **New Synonymy.**

Phlebotomus (*Prophlebotomus*) *bailyi* var. *campester*, Parrot & Clastrier, 1952 : 155.

DISTRIBUTION: India, Malaya, Thailand, Laos, Viet Nam, Hainan.

THAILAND. Pechaburi (near Bangkok ?), 27. XII. 1958, Manop; 1 ♀.

LAOS. Vientiane, 3. VI. 1960, burned tree hole, S. Quate; 6 ♀♀, 13 ♂♂.

The above specimens were collected in cavities which had been cut and burned to gather resin from trees. The trees were growing on the edge of dry padi (rice field) near secondary forest in the river plain several kilometers east of Vientiane.

The few, sparse and scattered teeth and expanded apical cup of the cibarium, the rather short antennal segment 3, wing venation and large, obovate or fusiform spermathecae are the main distinguishing features of *bailyi*. For further discussion, see *squamipleuris*.

The specimens agree in important characters with the descriptions of Sinton and Raynal and the quanitative variations are similar to those obtained by Raynal. Sinton (*l. c.*) erected the variety *campester* on the basis of a rectangular pigment patch in the cibarium. Others (Raynal, 1935; Theodor, 1938) have found this the most abundant form in the Indo-Chinese peninsula. Most of the material studied by me, however, possesses no pigment patch. Only two females and one male have a faint one (heavier staining, perhaps, would make it more conspicuous). It appears the pigment patch is variable within populations and should not be recognized nomenclatorially. For this reason, the variety *campester* is synonymized with *bailyi*. Illustrations of the head, cibarium and paramere are given for comparison with the other species. It will be noted the cibarial teeth appear different from those in Raynal's drawing (*l. c.*, figs. 1, 4).

Phlebotomus (Sergentomyia) sylvaticus Raynal and Gaschen Fig. 5, a–g.

Phlebotomus sylvaticus Raynal & Gaschen, 1935 : 592 (emendation, p. 779)(type – Viet Nam).
Phlebotomus silvaticus, Raynal, 1935b : 265.
Phlebotomus (*Prophlebotomus*) *silvaticus*, Parrot & Clastrier, 1952 : 162.

Medium sized species with few erect hairs on lateral margins of ♀ but only recumbent hairs on ♂ tergites 2–6. Proboscis, abdomen and median stripe, humeral angles and lower part of pleuron brown; head, remainder of thorax, and legs pale. Ratio of fore leg=10 : 11 : 6, mid leg=10 : 14 : 7, hind leg=11 : 16 : 8.

Female. Cibarium (fig 5c) with 4–6 small, disjointed teeth in center and patch of 8–10 smaller ones on either side; pigment patch small, elongate and rectangular; arch moderately strong laterally and faint medially; sides of cibarium expanded at arch, narrower and convergent between arch and teeth, strongly expanded and angulate apically; pharynx slender, little expanded posteriorly, unarmed except several apical rows of minute denticles. Palpus with Newstead scales from basal 1/4 to distal 1/4 of segment 3, formula=1–2–4–3–5 or 1–4–2–3–5, ratio of segments=10 : 30 : 40 : 32 : 70. Antenna with segment 3 short,

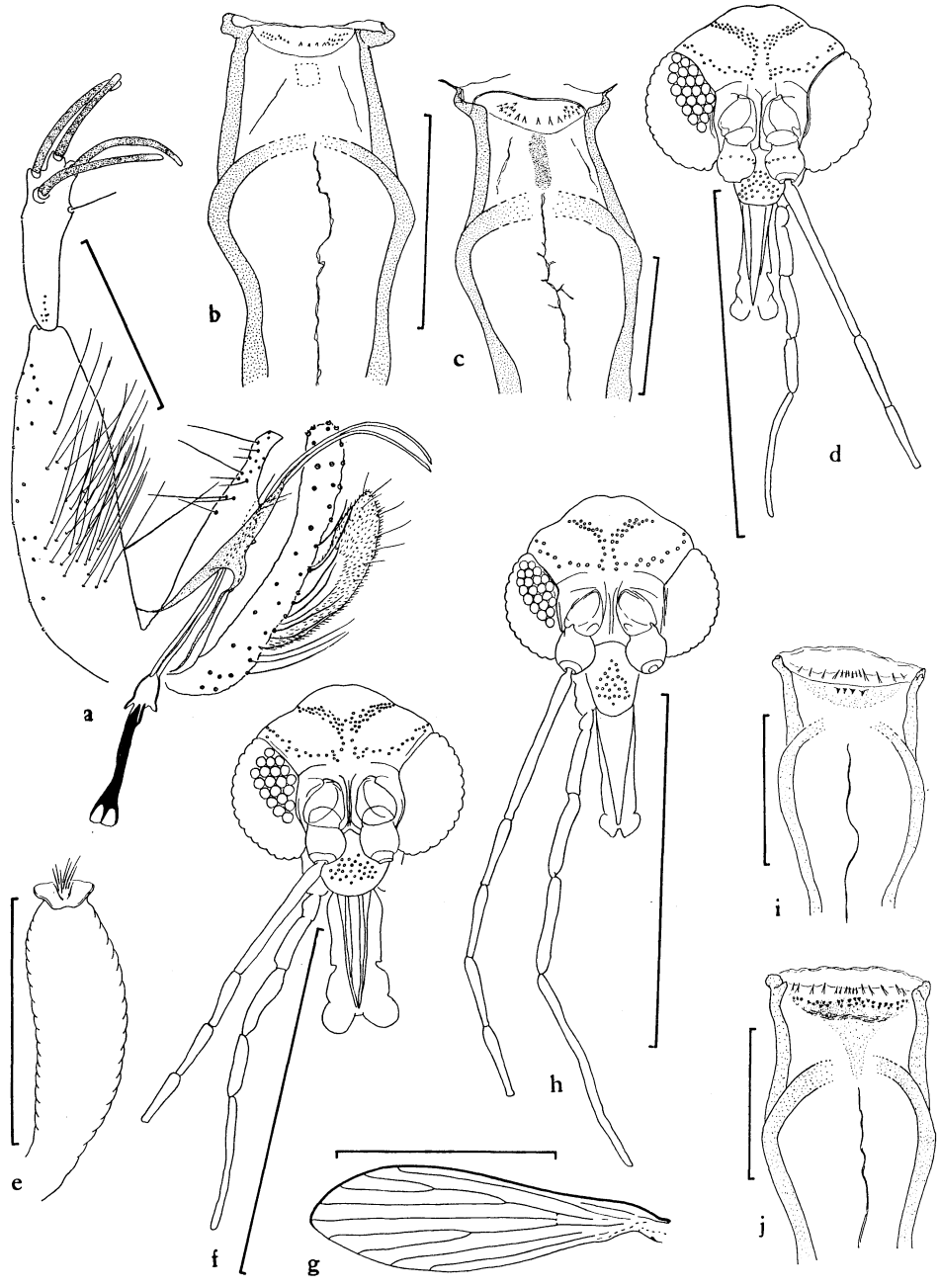

Fig. 5 a–g. *Phlebotomus sylvaticus.* a, ♂ genitalia, lateral view, mesal surface; b, cibarium, ♂; c, cibarium, ♀; d, head, ♂; e, ♀ spermatheca; f, head, ♀; g, wing, ♀. h–j. *Phlebotomus iyengari,* ♀. h, head; i, cibarium; j, cibarium.

extending to basal 1/4 of palpal segment 3 and not beyond tip of proboscis; ascoids paired on segments 3–15, those on segment 3 very short, others longer but extending only to distal 1/4 of segments. Wing with R_{2+3} and R_2 short, delta about 1/2 length of R_2, base of R_4 basad of medial fork. Spermatheca (fig. 5e) subcylindrical, with incomplete annulations, apical tuft surrounded by collar, length of duct indistinct but apparently much longer than length of spermatheca.

Wing length 1.5–1.6 mm; wing width 0.5.

Male. As ♀ except: Cibarium (fig. 5b) with single row of small, granular teeth, pigment patch smaller and fainter, pharynx more slender and less expanded apically; palpal formula=1–2–4–3–5 or 1–(2–4)–3–5; antennal segment 3 longer (fig. 5d), extending beyond tip of proboscis to base of palpal segment 4, single ascoid on each segment, small, about 1/3 length of segment 4 and following; R_2 shorter, about 2/3 length of R_{2+3}, delta 1/3–1/2 length of R_2; genitalia (fig. 5a) as figured, basistyle with sparse patch of non-deciduous hairs on mesal face, dististyle with 3 apical and 1 subapical spine and seta little basad of subapical spine, paramere ending in weakly beak-like apex, genital filaments short, about 3× length of pump.

Wing length 1.3–1.4 mm; wing width 0.4.

DISTRIBUTION: Viet Nam, Cambodia, Laos (Malaya ?).

LAOS. Vientiane, 3. VI. 1960, burned tree hole, L. & S. Quate; 2♀♀, 3♂♂. Collected in burned tree holes with *P. bailyi*; further information on habitat given with that species.

The above specimens agree with the description of *sylvaticus* with several exceptions. Antennal segment 3 of *sylvaticus* ♀ is described as being 0.25–0.27 mm long and the chitinous arch is illustrated as being weak and incomplete. My specimens have a shorter antennal segment 3 (0.18 mm) and a strong arch. The ♂ cibarium would appear to differ from the original illustration of *sylvaticus*, but I am certain that illustrated by Raynal and Gaschen (1935, fig. 4) is not of a ♂, since the teeth are as well developed as in the ♀ (fig. 1) (unlike other species) and the only difference is the lack of pigment patch, which is variable. Aside from these discrepancies, my specimens fit the description of *sylvaticus* in general size, wing venation, palpal formula, cibarial and pharyngeal structures and ♂ and ♀ genitalia and seem properly identified as *sylvaticus*.

From *bailyi*, the species with which it was associated in Laos, *sylvaticus* can be separated by its relatively longer antennal segment 3 and a different palpal formula, cibarium, and spermathecae. Both species have the cibarial apex broadly expanded, but it is deeper and wider in *bailyi* and smoothly rounded without the angulation seen in *sylvaticus*; differences in the cibarial teeth are as illustrated. The large, ovate spermatheca of *bailyi* are quite dissimilar to the smaller, rather cylindrical, annulate ones of *sylvaticus*.

Phlebotomus (Sergentomyia) tonkinensis Raynal and Gaschen

Phlebotomus tonkinensis Raynal & Gaschen, 1935 : 742.—Raynal, 1935b : 273.

DISTRIBUTION: Viet Nam. No material seen by me.

Phlebotomus (Sergentomyia) morini Raynal and Gaschen

Phlebotomus morini Raynal & Gaschen, 1935 : 731.—Raynal, 1935b : 301.

DISTRIBUTION: Viet Nam. No material seen by me.

Phlebotomus (Sergentomyia) sylvestris Sinton

Phlebotomus perturbans Annandale (*nec* de Meijere, 1909), 1910 : 48.—Sinton, 1924 : 1015.
Phlebotomus sylvestris Sinton, 1924 : 1017 (type – India).—Raynal & Gaschen, 1935 : 219.—Raynal, 1935b : 257.
Phlebotomus (Prophlebotomus) sylvestris, Parrot & Clastrier, 1952 : 167.

DISTRIBUTION: India, Laos, Cambodia, Viet Nam.

LAOS. Vientiane, 2, 3. VI. 1960, tree hole and burned tree hole, L. & S. Quate; 4♂♂. Collected with *bailyi* and *sylvaticus* in tree holes cut and burned for the gathering of resin several km E of Vientiane.

Phlebotomus (Sergentomyia) khawi Raynal

Phlebotomus khawi Raynal, 1936 : 529 (type – Peiping, China).—Yao & Wu, 1941 : 77.
Phlebotomus (Prophlebotomus) khawi, Parrot & Clastrier, 1952 : 160.

DISTRIBUTION: N. China, Cambodia. No material seen by me. Indo-Chinese record based on a single ♂ from Phnom Penh identified by Parrot & Clastrier.

Phlebotomus (Sergentomyia) iyengari Sinton Fig. 5, h–j.

Phlebotomus iyengari Sinton, 1933 : 221 (type – India).—Raynal & Gaschen, 1935 : 507.—Raynal, 1935b : 294.
Phlebotomus (Prophlebotomus) iyengari, Parrot & Clastrier, 1952 : 159.
Phlebotomus hivernus Raynal & Gaschen, 1935 : 582 (emendation, p. 779) (type – Viet Nam). **New Synonymy.**
Phlebotomus hibernus, Raynal, 1935b : 293.
Phlebotomus iyengari var. *hivernus*, Theodor, 1938 : 267.
Phlebotomus iyengari var. *malayensis* Theodor, 1938 : 266. **New Synonymy.**
Phlebotomus iyengari var. *hainensis* Yao & Wu, 1940 (?) (type – Hainan), 1941b : 77.

DISTRIBUTION: India to Malaya, Hainan.

THAILAND. Khon Kaen Prov., Ban Pai Dist. 30. V. 1959, at light, Manop; Udon Thani Prov., Meung Dist. 20. VI. 1959, at light, Manop; Nong Khai Prov., Ta Bo Dist., 16. VI. 1959, at light, Manop (3 localities in northeast Thailand); Sara Buri, 29. XII. 1958, Manop (about 100 km N of Bangkok); Chieng Mai, IV, V. 1958, light trap, Notananda; Chieng Mai Prov., Doi Sutep, 31. III. 1953, below waterfall, Thurman; Loei Prov., Tha Li Dist. 9. VI. 1959, at light, Manop (northern Thailand); 10 ♀♀.

LAOS. Muong Sing, 7. VI. 1960, at light, L. & S. Quate. 1 ♀.

The most characteristic and consistent features of this species are the general size, the 14 to 17 sharp, vertical teeth with the 4 central ones reduced, the top-shaped or hemispherical pigment patch and the tubular spermatheca with a deepset apical knob surrounded by a high collar and with long setae.

In this species are found variations of the wing venation, number of erect teeth and shape of the pigment patch. The vein R_{2+3} (beta) is longer or shorter than R_2 (alpha), the ratio of R_{2+3}/R_2 varies from 0.6 to 1.3. Delta varies from 0.3–0.6× the length of R_2. Previous authors also have observed these variations and have not relied on them for species or varietal discrimination.

The erect teeth are apparently entirely absent or variable number from a single row of

4 teeth (fig. 5i) to a double row of up to 20 in each row (fig. 5j). The pigment patch may have a thick anterior projection (fig. 5j), a small projection or apparently none at all, which leaves the patch hemispherical (fig. 5i). The Thailand specimens show the variation from few erect teeth and absent or faint projection to many teeth and a thick projection. I am of the opinion that previously named forms of this species are merely individual variations and should not be recognized nomenclatorially.

Raynal and Gaschen (1935) described the species *hivernus* from Viet Nam (Annam and Tonkin) largely on the basis of the irregular row of 11 teeth in ♀ and 8 in ♂. Theodor (1938) reduced this to a variety of *iyengari* and I propose its suppression as an outright synonym.

Raynal and Gaschen (1935) gave illustrations of an annulate spermatheca for *iyengari* and a smooth one for *hivernus*. In a later paper, Raynal (1935) provided photographs (Pl. V) of *iyengari* spermathecae, in which they appear granulose and only indefinitely annulate. The illustration of the definite annulation is apparently the artist's interpretation of the photo and probably none of the spermathecae are as clearly annulate as drawn. Also, the apparent annulation might be produced by the internal granulation. One of my specimens, which had been stored in alcohol, has granulose (but not annulate) spermathecae and other specimens have none. I believe the granulation may be artifically produced either by the alcohol or in the slide mounting process and this may have been the case with the single ♀ on which Raynal and Gaschen based their description of *iyengari*. The differences attributed to the spermathecae of *iyengari* and *hivernus* are therefore regarded as insignificant.

Theodor (1938) erected *iyengari* var. *malayensis* (Malaya) for specimens having a double row of erect teeth with 20 in the anterior row, about 9 in the posterior and a reduced projection on the pigment patch in the ♀ and 8 to 10 erect teeth in the ♂. Theodor also detected some differences in the ♂ genitalia, but the ♂ of *iyengari* is known only from Raynal and Gaschen's description and, as Theodor noted, their illustration may not be entirely accurate. The ♂ genitalia of *hivernus* seems to agree closely with that of var. *malayensis*. Since the variety falls within the variation range of cibarial characters noted above and there don't seem to be any real differences in the ♂ genitalia, it is hereby synonymized.

P. iyengari var. *hainanensis* appears to be merely an individual with well developed cibarial teeth and pigment patch similar to that illustrated in fig. 5j. Since it too falls within the range of variation noted above, the variety is suppressed as a synonym of *iyengari*.

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