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NOTES ON PHLEBOTOMUS FROM THE AUSTRALASIAN REGION (DIPT. PSYCHODIDAE).

By G. B. Fairchild,
Gorgas Memorial Laboratory, Panama.
(*Communicated by D. J. Lee.*)

(Seventy-seven Text-figures.)

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Synopsis.

The present paper outlines the results of a study of more than 300 specimens of *Phlebotomus*, most of which were collected in New Guinea during the last war and a few from New South Wales and Queensland. Methods of study are detailed and following this is a systematic review of the species. The only earlier paper on this group in Australia (Tonnoir, 1935) described the first species of this genus to be recorded from Australia, comprising three species and one subspecies. These are discussed herein and in addition three new species from the Australian Mainland together with eight new species and one new subspecies from New Guinea. Notes are also given on the characters of other specimens from New Guinea which, owing to the fragmentary nature of the material, must await further collections before description. The paper includes keys to both sexes of these flies for both Australian and New Guinea species.

The material on which this study is based consists of 326 specimens mounted in balsam on microscope slides. The bulk of the material is from various localities in New Guinea and was collected by personnel of the 5th Malaria Survey Unit, U.S. Army, under the direction of Maj. M. S. Ferguson and Maj. Owen H. Graham, who have already published a preliminary note on the field aspects of their work (Ferguson and Graham, 1948). Some of this material was sent us for study in 1945, the rest being sent to Mr. D. J. Lee, of the School of Public Health and Tropical Medicine, Sydney, Australia. In 1948 Mr. Lee very generously sent us not only his part of the Ferguson and Graham material, but also some material from various parts of Australia collected by Miss K. English and Col. C. B. Philip. Subsequently we received some further New Guinea material collected by Lt. H. Hoogstraal and Dr. L. E. Rozeboom.

Some of the material had been stored dry in pill boxes, but much of it was preserved in alcohol. The dry material has made satisfactory mounts, though in many cases the specimens were somewhat broken or damaged by mites. The alcoholic material has been impossible to clear satisfactorily and has made very poor mounts, though in most cases comparison with the dry preserved specimens has enabled identification to be made.

Since so little collecting of these interesting insects appears to have been done in Australia, some brief notes upon their habits and habitats, and methods of collection and preservation may be useful.

Sandflies are small hairy midges 2 or 3 millimetres long, with a characteristic way of holding their wings out from the body and slightly tilted upwards. Their flight is short and hopping, and when walking they progress in a jerky, erratic manner. Most species are quite strictly nocturnal, hiding away during the day in holes and crevices which are reasonably dark and relatively humid. Holes and crevices in ruined masonry, stone walls, hollow trees and crevices between the buttressed roots of large trees, animal burrows and deep crevices in the soil, especially in arid regions, provide favoured daytime resting places. From these habitats the sandflies may be flushed with tobacco smoke and collected by the use of a suction tube. Some species are attracted to lights and may be taken in various types of light traps. Sheets of paper coated with castor oil and placed near likely looking habitats will often catch numbers of specimens.

Sandflies should not be stored in alcohol for more than a short time, as the tissues become altered so that subsequent clearing in KOH becomes difficult or impossible. Dry storage in small cotton-plugged vials with naphthalene or para-dichlorobenzene is more satisfactory, but it is best to clear and mount specimens as soon as possible.

Since most of the taxonomic characters are internal, sandflies must be cleared and in many cases mounted. For preliminary clearing, wet the specimens with alcohol and place in liquid phenol, made by adding a little water to phenol crystals, or in a moist atmosphere, allowing the crystals to deliquesce in an open watch glass. Specimens will usually be sufficiently cleared to allow the spermathecae to be made out in 15–30 minutes. Such cleared material should be further processed by treatment in 20% KOH solution without heat for about an hour, or by brief boiling, followed by thorough rinsing in water to remove all muscle and tissue fragments that may remain. The cleaned "skeletons" resulting may be stored indefinitely in 70% alcohol, or mounted on slides.

Due to the tenuous nature of some structures, especially the spermathecae, satisfactory permanent mounts in resinous media are somewhat difficult to make. The procedure devised by us (Fairchild and Hertig, 1948) has proved relatively reliable and consists essentially in the use of liquid phenol (carbolic acid) as the clearing and dehydrating agent throughout the process. Material previously treated with KOH and washed is placed directly into a weak solution of acid fuchsin in phenol, where it is allowed to stain for about fifteen minutes and the excess stain washed off in clear phenol. The specimens are then placed in a weak solution of gum copal in phenol which is allowed to thicken gradually over a period of days, thus infiltrating the specimens gradually with the resinous medium and avoiding shrinkage and collapse of the spermathecae. When the medium has become sufficiently thick, the specimen is dissected on a cover glass in a small drop of the copal-phenol, the wings, head, thorax and abdomen arranged in a uniform manner, and the preparation allowed to dry gradually. Chips of cover slip should be stuck to the corners of the cover glass to prevent crushing, and the whole preparation turned over onto a drop of thick xylol balsam on a slide. The finished mount should be thoroughly dried with moderate heat to drive off any remaining phenol which might otherwise crystallize in the preparation.

We have had no difficulty with this technique in Panama, where temperature and humidity are always relatively high. In cool or dry climates, however, crystallization of the phenol occurs quite rapidly. The use of beechwood creosote or lacto-phenol may solve this difficulty, though we have made no tests along these lines. The use of aqueous mounting media or those containing water-soluble gums or sugars we have found totally unsatisfactory under our conditions, no specimen so preserved having lasted more than two years.

The technique outlined above yields permanent mounts with each part of the insect in the same relative position on the slides, thus greatly facilitating the examination of long series of specimens. Being first mounted on the cover slip, the specimens are close to the glass and may be examined with the oil immersion lens. The use of glass chips at the corners prevents crushing and distortion, and the arrangement is such that the various parts are right side up when viewed through the microscope. We do not find that the removal of the cibarium and pharynx or the spermathecae is necessary if the specimens are properly cleared of tissue, as they are quite adequately seen through the posterior wall of the head capsule or the abdominal wall. In some cases it is useful to split the male genitalia sagittally to enable a clear view of the inner aspect of the coxite and paramere, but some specimens should also be mounted undissected.

The terminology adopted here is that used in a previous paper (Fairchild and Hertig, 1947). It is essentially that used by Tonnoir (1935), with slight modifications. The "cibarium" is the buccal cavity of Tonnoir. The "chitinous arch" is a thickening of the ventral surface of the cibarium, forming a more or less complete curved band across the cibarium between the armature and the base of the proboscis. It is believed to be the attachment of the salivary muscle. The detailed measurements of palpi, antennae, wing veins, etc., so much a part of earlier work on *Phlebotomus*, are believed to be largely unnecessary. By themselves they are seldom of much use in separating closely related species or in associating the sexes. Certain proportions, however, seem to be

valuable supplementary characters, such as the relative lengths of certain sectors of wing veins, the first flagellar segment (segment III) of the antennae relative to the palpi, and the length of the genital filaments relative to the genital pump in the male. It is felt that figures give a better idea than tables of measurements in any case.

The holotype, allotype and a series of paratypes, where available, of the new species described here are to be deposited in the collections of the School of Public Health and Tropical Medicine, University of Sydney, Sydney, Australia. A set of paratypes, where available, will be deposited in the U.S. National Museum, Washington, D.C.

1. The Australian Species.

No work on the Australian species seems to have been published since Tonnoir's paper (1935) in which three species and one subspecies were recorded from Australia. The present material consists of 10 specimens collected by Miss K. English at Yass, New South Wales, and 9 specimens collected by Dr. C. B. Philip at Cairns, Queensland. No information as to habits or habitats accompanied this material.

The 10 specimens from Yass consisted of 1 ♀ *brevifilis* Tonn., 1 ♂, 1 ♀ *englishi* Tonn., 1 ♀ *queenslandi meridionalis* Tonn., and 6 ♀ *brevifiloides*, n. sp. The 9 specimens from Cairns consisted of 1 ♀ *queenslandi* Hill, 1 ♀ *pexopharynx*, n. sp., 4 ♂ *buccinator*, n. sp., and 2 ♂, 1 ♀ undetermined. One or both of the undetermined males may be *queenslandi*. They differ somewhat in structure of the cibarium, but whether these differences are specific or not, only additional material will tell. We have refrained from placing them under *queenslandi* due largely to the greater number of cibarial teeth in our material, about 20 in one and about 30 in the other, whereas *queenslandi* is said to have from 15 to 17 teeth. Also the pharynges of our specimens do not agree well with Tonnoir's description in having "a comparatively small number of shallow scales arranged so as to give the impression of a loose and slender net". The undetermined female is represented by only the abdomen and a wing. The spermathecae are thin-walled elliptical capsules, much like those of *queenslandi*, which the specimen may be. Unfortunately the spermatheca of our single complete *queenslandi* was not drawn before mounting, so that detailed comparisons are not possible. We deem it better to leave these specimens undescribed until adequate material becomes available.

Keys to the Australian Species.

Males.

1. Style with three strong spines. Genital pump large, filaments short, less than twice as long as pump, heavily sclerotized. Abdominal hairs mostly erect. A few setae on lower border of mesanepisternum ..... 2.
   Style with four strong spines all very close to the apex and a single fine seta beyond the middle of the segment. Genital pump small and slender, the slender filaments more than twice as long as the pump. Abdominal hairs recumbent. No pleural setae ..... 3.
2. Aedeagus a pair of short truncated cones, poorly sclerotized. Plunger of genital pump slender. Style with basal spine longest, widely separated from the two closely approximated terminal spines ..... *brevifilis*.
   Aedeagus long, tubular, the tips up-turned, heavily sclerotized. Plunger of genital pump stout, the apex trumpet-shaped. Basal spine of style not longer than others, separated from the subterminal spine by about twice the distance between the subterminal and terminal spines ..... *buccinator*.
3. Pharynx hairy ..... *meridionalis*.
   Pharynx scaly ..... 4.
4. Cibarium with about 16 teeth ..... *queenslandi*.
   Cibarium with about 43 teeth ..... *englishi*.

Females.

1. Pharynx rather heavily sclerotized and pigmented on basal two-thirds, apex densely beset with spines in a rather characteristic fan-shaped whorl. Cibarium with five to ten well-separated horizontal teeth and often small fine lateral teeth. Spermathecae thick-walled or annulated. A few small setae on lower border of mesanepisternum .... 2.
   Pharynx less heavily sclerotized and pigmented; apical armature very much less prominent, consisting of scarcely pigmented slender scales or hair-like spines not arranged in a fan-like whorl. Cibarium with much more numerous, fine, closely set horizontal teeth in a comb. Spermathecae oval, very thin walled. No pleural setae ..... 4.

2. Pharynx shaped like an inverted flask, the anterior plate densely beset with small pigmented spines in a fan-shaped whorl; posterior plates with numerous longer spines. Cibarium with about 10 short stout horizontal teeth. Spermathecae with subspherical thick-walled heads and very long smooth ducts which join to form a common duct of appreciable length ..... *pexopharynx*.
Pharynx less widened posteriorly. Spermathecae irregularly annulate, opening separately or with a very short common duct ..... 3.
3. Pharynx similar to *pexopharynx*, but the spines on anterior plate fewer and larger, on posterior plates longer and hair-like. Cibarium with five small well-separated horizontal teeth. Spermathecae with the anterior third irregularly annulate, the terminal knob sunk in a conical pit ..... *brevifilis*.
Pharynx less strongly pigmented, the terminal armature of the same pattern as the preceding species, but much reduced as to both number and size of the teeth. Cibarium with six to eight pointed horizontal teeth and a number of fine, lateral teeth. Spermathecae as in *brevifilis* ..... *brevifiloides*.
4. Pharynx beset with rather broad-based denticulate scales. Cibarium with a comb of very fine long horizontal teeth, 77 to about 85 in number, and a few small erect teeth below ..... *englishi*.
Pharynx beset with long slender spines. Cibarium with numerous well marked erect teeth below ..... 5.
5. Cibarium with a comb of about 45 moderately long horizontal teeth and with one and part of a second transverse row of well marked erect teeth below ..... *queenslandi*.
Cibarium with a comb of about 75-80 very fine horizontal teeth and erect teeth below as in *queenslandi* ..... *meridionalis*.

PHLEBOTOMUS BREVIFILIS Tonnoir. (Figs. 3, 4, 9, 44, 47.)

1935, *Bull. Ent. Res.*, 26:145–147, figs. 2*c*, *d* and 3*d*. (♂, ♀; Canberra and Yass, N.S.W., Australia.)

Phlebotomus (*Australophlebotomus*) *brevifilis*, Theodor, 1948, *Bull. Ent. Res.*, 39 (1): 99–100, 105, 108; fig. 8.

A single female specimen, slide 1420, lacking the palpi, is in the collection. It was taken at Yass, N.S.W., in March 1946, by Miss K. English and is thus topotypical. We give here figures of wing, antennae, cibarium and pharynx. The spermathecae are visible but too distorted and shrunken to be worth figuring; they agree with Tonnoir's and Theodor's figures as far as can be made out. The ascoids appear to be broken, and are probably a little longer than shown in the figure. The specimen is quite pale, the mesonotum but slightly infuscated. The wing measures 2·05 mm. in length and is indistinguishable from the wing of *brevifiloides*. The proboscis is long, equalling the head height, there are no post-spiracular setae, and the abdominal hairs appear from their insertions to have been erect.

Theodor (1948) has erected the subgenus *Australophlebotomus* for *brevifilis* Tonn., placing it in the genus *Phlebotomus*. The characters used to distinguish the group are the presence of erect abdominal hairs, lack of, or rudimentary, cibarial armature, presence of but three spines on the style, rudimentary aedeagus and incompletely annulated spermathecae. The finding of other obviously related species in Australia and New Guinea necessitates a re-evaluation of *Australophlebotomus*. If *brevifiloides*, n. sp., *buccinator*, n. sp., and *pexopharynx*, n. sp., be considered to be closely related to *brevifilis*, as I believe they are, then but one of the characters cited by Theodor is shared by all the group, the presence of erect abdominal hairs. While it is true that *buccinator* and an as yet undescribed species from New Guinea have three-spined

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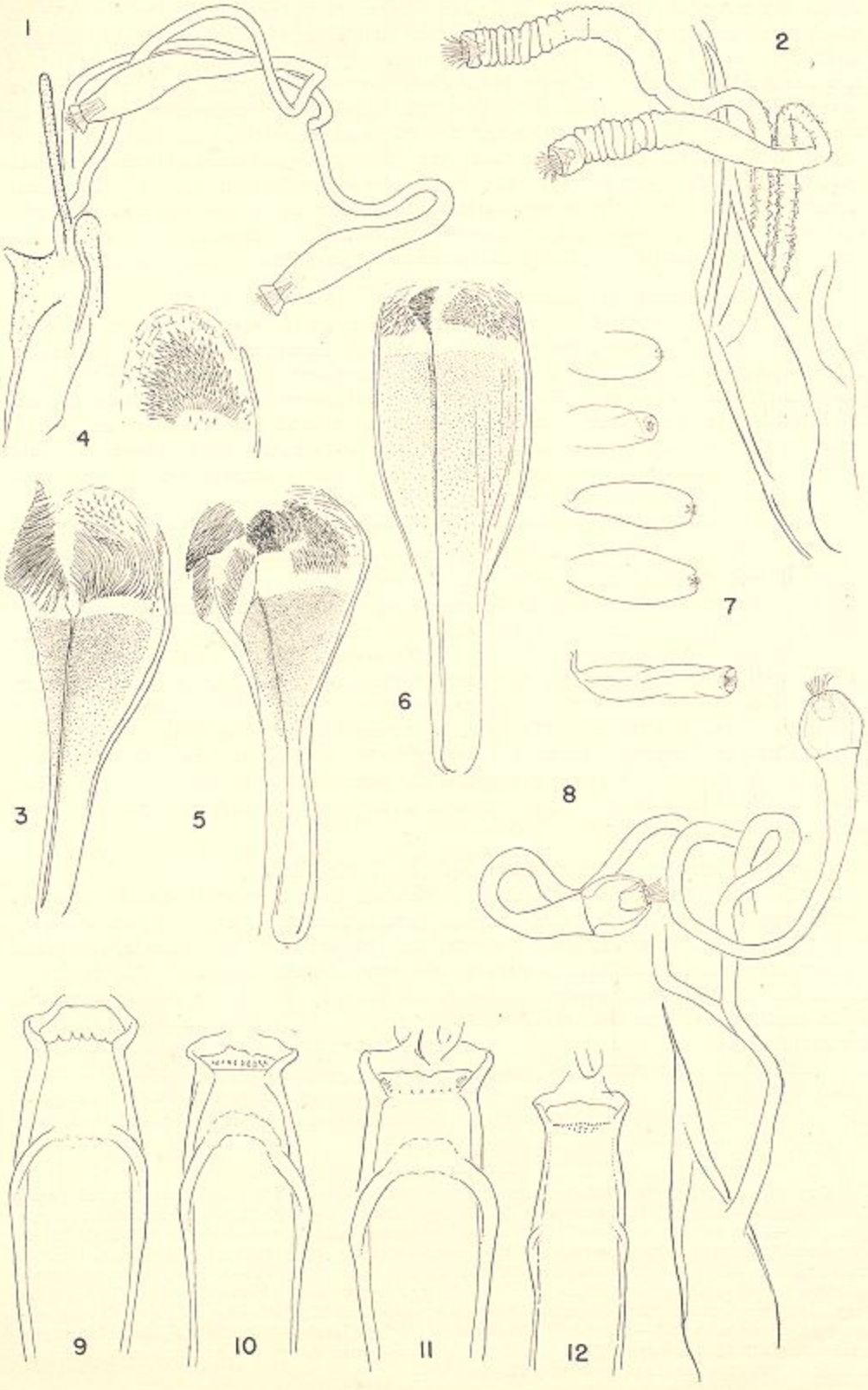
Text-figs. 1-12.

Fig. 1, *P. hoogstraali* holotype, spermathecae, drawn in phenol before mounting, the junction of individual ducts not visible.—Fig. 2, *P. brevifiloides* paratype, spermathecae drawn in phenol before mounting; individual ducts probably separate to vagina.—Figs. 3 and 4, *P. brevifilis* female, whole pharynx and anterior plate only.—Fig. 5, *P. pexopharynx* holotype female, pharynx.—Fig. 6, *P. brevifiloides* holotype female, pharynx.—Fig. 7, spermathecae of, from top to bottom, *P. brachycornutus* holotype, *P. sansaporensis* holotype, *P. fergusoni* paratype and holotype, and *P. dolichobyssus* holotype, all drawn from mounted specimens.—Fig. 8, *P. pexopharynx* holotype, spermathecae drawn in phenol, parts of the ducts not visible.—Fig. 9, *P. brevifilis* female, cibarium.—Fig. 10, *P. pexopharynx* holotype female, cibarium.—Fig. 11, *P. brevifiloides* holotype female, cibarium.—Fig. 12, *P. papuensis* paratype male, cibarium. All figures drawn to the same scale with camera lucida, approximtaely × 290.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styles, the males of *brevifiloides* and *pexopharynx* are unknown. All three species in which the females are known, *brevifilis*, *brevifiloides* and *pexopharynx* have definite teeth in the cibarium, not, in my opinion, rudimentary, while the male from New Guinea also has small horizontal and erect teeth. Both *buccinator* and the New Guinea species have a well-developed aedeagus or penis sheath, while the spermathecae of *pexopharynx* are quite unlike those of *brevifilis* and *brevifiloides*. Except for the erect abdominal hairs, these species could fit as well into *Sergentomyia* sensu Theodor as into *Phlebotomus*. The parameres of the males, the cibarial teeth, type of pharyngeal armature and the two types of spermathecae can nearly all be matched among various species placed by Theodor in *Sergentomyia*. It seems best, therefore, at least for the time being, to refrain from placing these species in any definite restricted category.

PHLEBOTOMUS BREVIFILOIDES, sp. nov. (Figs. 2, 6, 11, 67.)

Female. Wing length 2·1 to 2·2 mm. Abdominal hairs apparently erect. No post-spiracular setae on thorax. Mesonotum very slightly infuscated. Antennae lacking in all the specimens and only the basal palpal segments present. Proboscis long, greater than head height. Pharynx as figured, broad and well sclerotized. Cibarium as figured, the lateral teeth slender and transparent. Wing as figured. Spermathecae as figured, their posterior terminations not certainly visible, but probably opening separately into the vagina, at most with a very short common duct. Gonapophyses of the eighth sternite small and slender. Cerci short, moderately pointed.

Holotype female, slide 1414, and five female paratypes, slides 1412, 1413 and 1415 to 1417, Yass, New South Wales, Australia, March 1933, K. English coll.

This species differs from *brevifilis* Tonn. only in the structure of the cibarium and pharynx, *brevifilis* having a much greater development of the spinose area in the pharynx but fewer horizontal teeth and no lateral teeth in the cibarium. The spermathecae of our single specimen of *brevifilis* are somewhat shrunken and distorted, so that detailed comparisons are not possible, though they appear to have been very similar to those of *brevifiloides*. The finding of two such closely related females at Yass raises some question as to the status of the male described by Tonnoir. It is very probable that he correctly associated the sexes, as his figure of the male pharynx shows it to be more spinose than would be expected of the male of the present species. Further intensive collecting may turn up the male of *brevifiloides* and indicate that the species are ecologically separated.

PHLEBOTOMUS BUCCINATOR, sp. nov. (Figs. 13, 14, 48, 66.)

Male. Wing length 1·5 to 1·6 mm. Abdominal hairs apparently erect. No setae on the upper margin of the anepisternum (post-spiracular setae). Mesonotum very slightly infuscated. Ascoids simple, shorter than their respective segments, paired on all segments where it has been possible to see them, at least to segment IX. Proboscis as long as head height. Pharynx slender, not strongly pigmented, armed only with weak denticulate ridges and short digitate processes. Cibarium as figured, without horizontal or vertical teeth, but with a few fine transparent lateral teeth. Wing, palpi and basal antennal segments as figured. Genitalia as figured, the style with three strong spines but no accessory setae, parameres hooked, aedeagus long, cylindrical, the apices up-turned, heavily sclerotized. Genital filaments short, only a little longer

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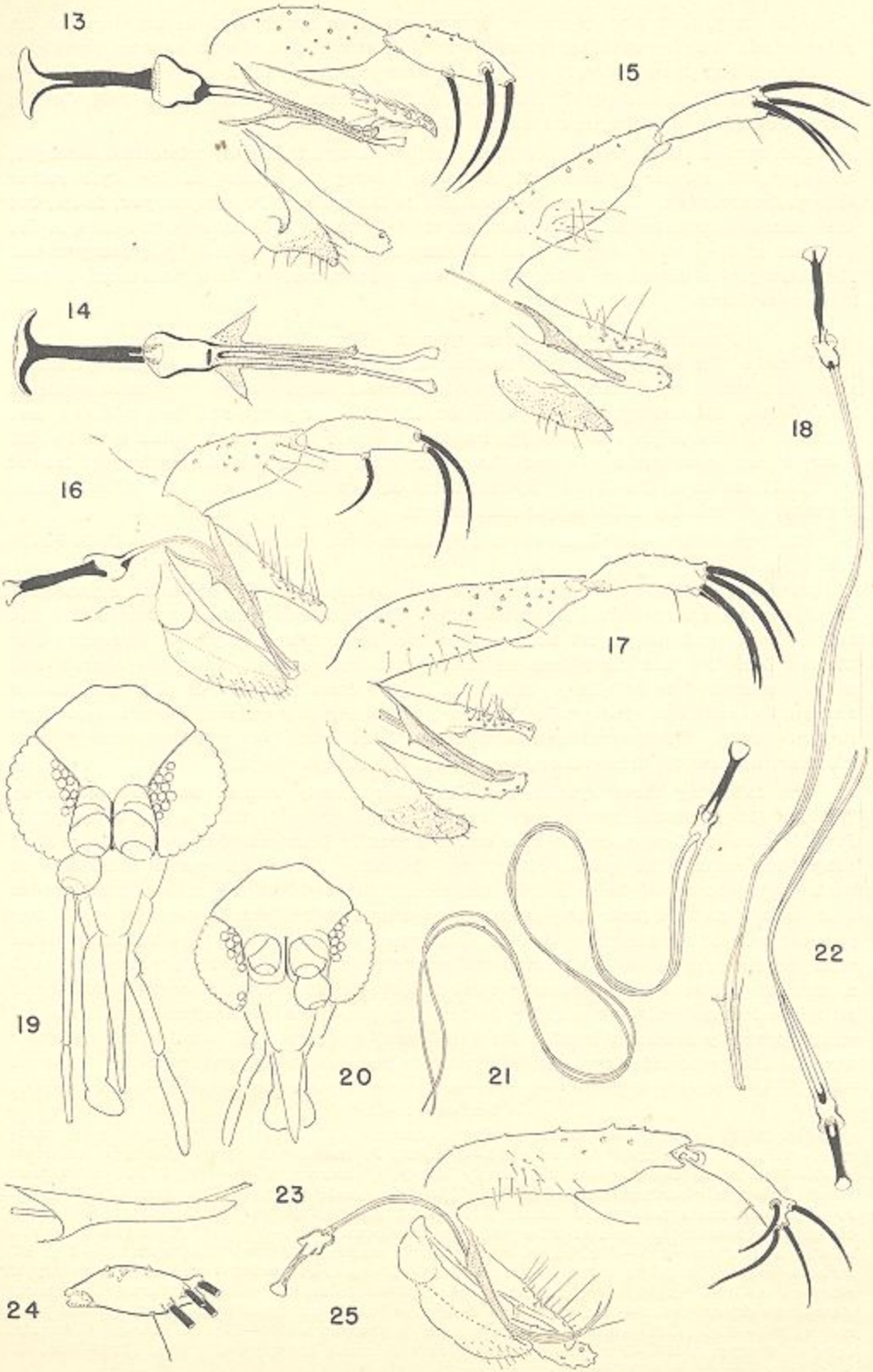
Text-figs. 13-25.

Fig. 13, *P. buccinator* holotype, genitalia, lateral aspect.—Fig. 14, same, genital pump, dorsal aspect.—Fig. 15, *P. sansaporensis* allotype, genitalia.—Fig. 16, *P. papuensis* paratype, genitalia.—Fig. 17, *P. fergusoni*, genitalia of specimen with short delta wing.—Fig. 18, *P. hoogstraali*, allotype, genital pump and filaments.—Fig. 19, *P. pexopharynx* holotype, head in frontal aspect.—Fig. 20, *P. queenslandi* female, head in frontal aspect.—Fig. 21, *P. dolichobyssus* allotype, pump and genital filaments, the latter drawn from measurements.—Fig. 22, *P. fergusoni*, pump and genital filaments of same specimen as Fig. 17.—Fig. 23, *P. dolichobyssus* allotype, aedeagus × 290.—Fig. 24, *P. hoogstraali* allotype, style.—Fig. 25, *P. quintus* paratype, genitalia. All figures except Fig. 23 and the two heads are drawn to the same scale, approximately × 215. The heads are about × 72.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than the pump, their tips expanded. Pump very large and heavy, the plunger with its anterior end greatly expanded, trumpet-shaped. Lateral lobes simple, unarmed, straight, but little longer than the cerci which are rather acutely pointed.

Holotype male, slide 1407, and three paratype males, slides 1404 to 1406, Cairns, North Queensland, Australia, no date, C. B. Philip coll.

This species differs from *brevifilis* in having a long and heavily sclerotized aedeagus, a larger and stouter genital pump, and in having the spines on the style rather differently arranged. It is possible that this is the male of *P. pexopharynx*, n. sp., but the reduced lateral teeth in the cibarium of that species and the lack of spines in the pharynx of *buccinator* coupled with the long spermathecal ducts of *pexópharynx* and the short genital filaments of *buccinator* make it seem inadvisable to pair them without further evidence.

PHLEBOTOMUS PEXOPHARYNX, sp. nov. (Figs. 5, 8, 10, 19, 46, 65.)

Female. Wing length 2·01 mm. Abdominal hairs apparently erect. No post-spiracular setae on thorax. Mesonotum very slightly infuscated. Palpi and basal antennal segments as figured. Ascoids apparently paired on the flagellar segments, but collapsed and distorted in the single available specimen. Proboscis long, greater than head height. Pharynx and cibarium as figured, the latter with scarcely visible vestiges of lateral teeth, not shown in the figure. Spermathecae as figured, the ducts not visible in their entirety but probably little longer than shown.

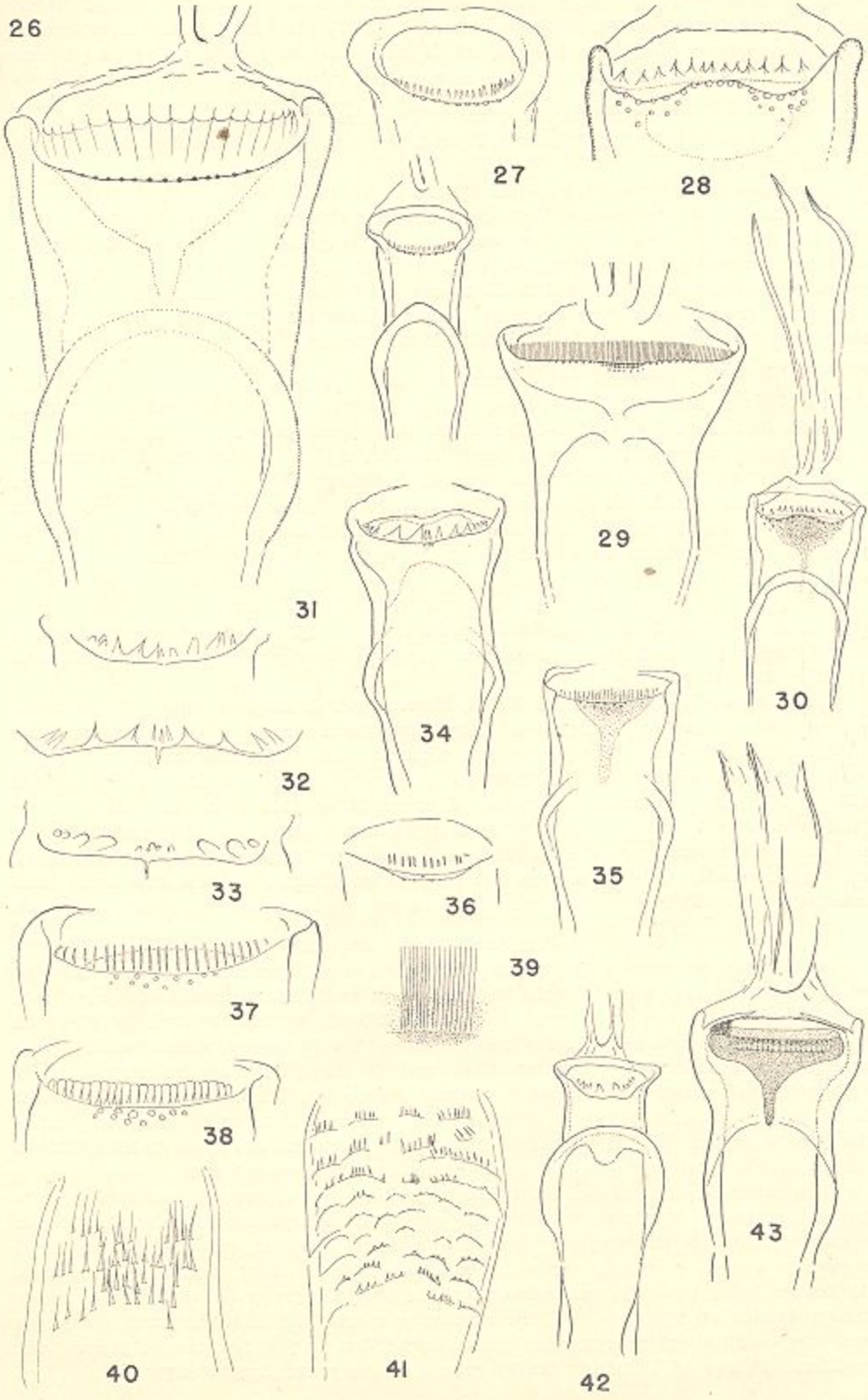
Holotype female, slide 1410, Cairns, N. Queensland, Australia, no date. C. B. Philip coll.

This species differs from *brevifilis* and *brevifiloides* externally in having a somewhat broader wing and relatively longer delta. The cibarium has more, about 10, and stouter teeth, and the lateral fine teeth are vestigial. The pharynx is somewhat like that of *brevifilis*, but the spines on the ventral or posterior plates are shorter and more numerous, less hair-like, while those on the dorsal or anterior plate are smaller and more closely set. The whole pharynx is more abruptly widened posteriorly, almost racquet-shaped. The spermathecae are of a quite different type from the other species, globular, apparently thick-walled, and with long smooth ducts.

The following three species are all rather closely related and are placed by Theodor (1948) in the genus *Sergentomyia*. This group is the "*minutus* group" or *Prophlebotomus* of previous workers and has usually been considered of no more than subgeneric rank. The species differ from the other Australian species considered in having the abdominal hairs mostly recumbent, the style of the male genitalia with four spines grouped near the apex, and a single more basal accessory seta. The spermathecae of the known Australian species are thin-walled oval or elliptical capsules with the terminal "knob" very small and sunk in a pit. The cibaria are provided with a comb-like series of fine horizontal teeth in both sexes, and the pharynges are armed with denticulate scales or slender hair-like spines. The Australian species are all small, generally markedly smaller than the *brevifilis* group, and usually with narrower wings. The proboscides are also relatively shorter, not or scarcely equalling the head

Text-figs. 26-43.

Fig. 26, *P. nocmforensis* female paratype, cibarium × 650.—Fig. 27, *P. quintus* male paratype, cibarium, upper × 650, lower × 290.—Fig. 28, *P. hoogstraali* female holotype, cibarium × 650.—Fig. 29, *P. englishi moresbyi* female holotype, cibarium × 290.—Fig. 30, *P. hoogstraali* female holotype, cibarium × 290.—Fig. 31, *P. fergusoni* male allotype, cibarium × 650.—Fig. 32, *P. fergusoni* female paratype, cibarium × 650.—Fig. 33, *P. fergusoni* female, cibarium showing common appearance of teeth at other than critical focus, × 650.—Fig. 34, *P. fergusoni* female, holotype, cibarium × 290.—Fig. 35, *P. sansaporensis* female paratype, cibarium × 290.—Fig. 36, *P. sansaporensis* male paratype, cibarium × 650.—Fig. 37, *P. sausaporensis* female paratype, cibarium × 650.—Fig. 38, same, at other than critical focus, the usual appearance in poorly cleared specimens, × 650.—Fig. 39, *P. dolichobyssus* female holotype, segment of cibarial tooth row × 1300.—Fig. 40, *P. queenslandi* female, apex of pharynx × 650.—Fig. 41, *P. englishi* female, apex of pharynx × 650.—Fig. 42, *P. brachycornutus* female holotype, cibarium × 290.—Fig. 43, *P. dolichobyssus* female holotype, cibarium × 290.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height. Most species of the group do not bite man, but are believed to feed mainly on cold-blooded vertebrates. Tonnoir recorded (1935) Miss English's observations on *englishi* and *queenslandi meridionalis*, which fed readily on lizards but refused human blood, while *brevifilis* would bite both man and lizards.

PHLEBOTOMUS ENGLISHI Tonnoir. (Fig. 41.)

1935, *Bull. Ent. Res.*, 26:144–145, fig. 3, Plate I, figs. *f*, *g*. (♂, ♀; Yass, New South Wales, Australia.)

Sergentomyia (*Sergentomyia*) *englishi* Theodor, 1948, *Bull. Ent. Res.*, 39 (1):111.

One male and one female, Yass, New South Wales, March 1933, K. English coll. There is little to add to Tonnoir's description of the species, but we give here figures of the pharyngeal armature of the female, as his photographs are not very clear on this point. The male armature is difficult to see in the single specimen, but appears to consist of groups of longer and more slender spines arising from similar, but less clearly marked, ridges or scales like those in the female.

PHLEBOTOMUS QUEENSLANDI Hill. (Figs. 20, 40.)

1923, *Bull. Ent. Res.*, 14:83–86, 6 figs. (♂, ♀; Townsville, N. Queensland.) Tonnoir, 1935, *Bull. Ent. Res.*, 26:140–142, figs. 2A, B, 3C (redescribed from the type series). *Sergentomyia* (*Sergentomyia*) *queenslandi* Theodor, 1948, *Bull. Ent. Res.*, 39 (1):111.

One female, Cairns, N. Queensland, C. B. Philip coll., agrees with Tonnoir's description and figures. We give here a figure of the pharyngeal armature for comparison with *englishi*, but have nothing to add to Tonnoir's full description except to note the presence of fairly numerous erect teeth in the cibarium below the comb of horizontal teeth.

PHLEBOTOMUS QUEENSLANDI MERIDIONALIS Tonnoir.

1935, *Bull. Ent. Res.*, 26, 142–143, fig. 3A, a, Pl. I, fig. *e*. (♂, ♀; Yass, New South Wales.) *Sergentomyia* (*Sergentomyia*) *queenslandi* var. *meridionalis* Theodor, 1948, *Bull. Ent. Res.*, 39 (1):111.

One female, Yass, New South Wales, March 1933, K. English coll. The specimen agrees with Tonnoir's description. The pharyngeal armature is essentially like *queenslandi*, though the teeth seem somewhat shorter. The pharynx is not in the best position, however, and this may be an illusion. The cibarial teeth are quite different: longer and more numerous. I count 77 on this specimen, which agrees fairly well with Tonnoir's "about 80". There is also a single complete transverse row and part of a second row of stout erect teeth below the fine comb of horizontal teeth, as in *queenslandi*. Only further careful study of good series of these two forms from intermediate localities will show whether they are good species or geographical races.

2. THE NEW GUINEA SPECIES.

Aside from the mention by Tonnoir (1935) of a single specimen from Port Moresby, no *Phlebotomus* have been hitherto known from New Guinea, although they appear to be fairly abundant and widespread there. The 300 odd specimens taken by Ferguson and Graham appear to be separable into not more than 19 species, none of which agree with previously described forms from elsewhere. Of these, 9 species are represented by sufficiently well preserved material to warrant description. The remainder can be seen to be distinct but are too poorly preserved for figures to be made or complete descriptions to be drawn up, and a residue of about 25 specimens are quite indeterminable, though probably belonging to one or another of the describable species.

The fauna is like that of Australia in lacking any representatives of the more typical groups of *Phlebotomus*, with one exception the species all belonging to the *minutus* group (*Sergentomyia*). Only two species, however, *papuensis*, n. sp., and *englishi moresbyi*, n. subsp., appear to be at all closely related to Australian species, the former being the only representative of the *brevifilis* group (*Australophlebotomus*) known outside of Australia. Of the remaining species, all have unarmed pharynges and oval or elliptical unsegmented spermathecae, but only a few can be placed with confidence in any of Theodor's (1948) groups of the genus *Sergentomyia*.

The relative paucity and lack of diversity in the Australasian fauna is of considerable interest, as it seems to indicate that the group had its origins elsewhere. Except for the *brevifilis* group, which seems to be a local Australian development, the species are similar in general to the other Old World Sergentomyias, failing to show either any marked "primitive" characteristics or any marked local modifications. There is no such wealth of bizarre developments as is found in the Neotropics, for example. It is interesting to note that no *Phlebotomus* are so far known from Chile, whose insect fauna in many groups shows such close affinity with that of Australia.

In the following list those species of which material is too fragmentary or too poorly preserved to warrant description are noted. All the species belong to the *minutus* group, and are to be separated very largely on small characters of the cibarium, antennae, etc. With two exceptions they are represented by single specimens and nearly all are very inadequate mounts, having been long in alcohol. The series from Biak and Owi Islands might have been described, but there is not a single really good specimen in the lot and the species is very close indeed to *sansaporensis*. These insects are difficult enough to separate at best, and I do not wish to add to the difficulty by perpetuating any names based on inadequate type material.

1 ♂. Dobadura, 22 Sept. 1944. Slide 2809. Cibarium with a comb of about 15 teeth. Genital filaments about 4 times as long as pump. Segment III of antennae about as long as first three palpal segments. Delta short, less than half alpha. This and the following males all have genitalia of the same type, like *sansaporensis*.

1 ♂. Aitape, 16 Sept. 1944. Slide 2654. Cibarium not visible. Genital filaments about 2·5 times as long as pump. Segment III of antennae slightly longer than first three palpal segments. Delta short, less than half alpha.

1 ♂. Dobadura, 21 Sept. 1944. Slide 2700. Cibarium broad, with a comb of at least 12 long teeth. Genital filaments about 7 times as long as pump. Segment III of antennae about equal to first three palpal segments. Delta short.

1 ♂. Sansapor, 11 Sept. 1944. Slide 2830. Cibarium broad, teeth indistinct, though apparently short and numerous. Genital filaments about 7 times as long as pump. Segment III of antennae very long, at least one-quarter longer than first three palpal segments. Delta short.

1 ♂. Dobadura, 7 Aug. 1944. Slide 1141. Cibarial teeth not visible, chitinous arch present. Genital filaments about 4 times as long as pump. Segment III of antennae about as long as first three palpal segments. Delta short. This may be same as Slide 2809.

14 ♂, 8 ♀. Biak and Owi Islands, 13 Sept. 1944, and 1 ♂ without data. The males have a faint comb of small teeth, while the cibarium of the female is similar in appearance to that of *sansaporensis*, though it appears to have fewer teeth. Genital filaments 3 to 3·5 times as long as pump. Segment III of antennae a little shorter than first three palpal segments. Delta short or minus.

1 ♀. Dobadura, 18 Aug. 1944. Slide 3517. Cibarium of about 22 teeth. Chitinous arch discernible at sides. Segment III of antennae about equal to first three palpal segments. Delta short.

2 ♀. Sansapor, 11 Sept. 1944. Slides 1149, 1152. Cibarium of about 26 teeth. Chitinous arch not visible. Spermatheca oval, thin walled, the terminal knob sunk in a pit. Antennae and palps missing. Delta long, half or more alpha.

1 ♀. Dobadura, 21 Sept. 1944. Slide 2713. Cibarium very broad with about 39 slender teeth, no chitinous arch. Segment III of antennae about three-fourths as long as first three palpal segments. Delta short.

1 ♀. Hollandia, 6 Sept. 1944. Slide 2824. Cibarium with fairly numerous very short teeth, not clear enough to count. No chitinous arch. Segment III of antennae shorter than first three palpal segments. Delta short. Mesonotum quite strongly infuscated.

Key to Males.

1. Style with 3 well-developed spines, 2 apical and 1 median. Genital filaments less than twice as long as pump. No post-spiracular setae, but a few small setae on lower border of mesanepisternum. Wing quite broad ..... *papuensis*
   Style with 4 well-developed spines, all beyond middle, and an accessory seta proximal to the spines. Genital filaments at least twice length of pump. No pleural setae on thorax. Wing very narrow ..... 2.
2. Style rather short, hardly 3 times as long as wide, with one of the more basal pair of spines quite widely separated from the other and the accessory seta at about middle of segment. Genital filaments about 6 times as long as pump ..... *hoogstraali.*
   Style longer, more cylindrical, about 4 times as long as wide, with all spines grouped close to the apex and the accessory seta inserted beyond middle of segment ..... 3.
3. Genital filaments at least 9 times as long as pump. Aedeagus rather long and broad. Cibarium with numerous short teeth in a straight row and a strong chitinous arch ..... *dolichobyssus.*
   Genital filaments less than 5 times as long as pump ..... 4.
4. Cibarium with rather irregular, large, triangular teeth, about 12 in number. Chitinous arch fairly well marked. Genital filaments about 4 times as long as pump ..... *fergusoni.*
   Cibarium with small slender teeth in a fairly regular row ..... 5.
5. Chitinous arch well developed, the whole cibarium heavily sclerotized. Genital filaments about 4 times as long as pump ..... *quinius.*
   Chitinous arch weak, obsolete in the middle. Genital filaments less than 4 times as long as pump ..... 6.
6. Genital filaments about 3 times as long as pump. Cibarial teeth fine, comb-like ..... *sansaporensis.*
   Genital filaments about twice as long as pump. Cibarial teeth more triangular, somewhat divergent from the centre ..... *noemforensis.*

Key to Females.

1. Cibarial teeth irregular in size and position ..... 2.
   Cibarial teeth in a regular comb of even subequal teeth ..... 3.
2. Cibarium with 4 large triangular teeth and a variable number of more slender teeth in the middle and at sides. Chitinous arch practically absent. Spermathecae oval, thin-walled, the terminal knob sunk in a pit. Delta at least half alpha ..... *fergusoni.*
   Cibarium with two large blunt teeth in the middle and a variable number of smaller teeth at the sides. Chitinous arch very prominent. Delta short, less than half the short alpha. Segment III of antennae very short, about equalling fourth palpal segment. Spermathecae as above ..... *brachycornutus.*
3. Cibarium with very numerous, 70 or more, fine teeth ..... 4.
   Cibarium with less than 30 teeth ..... 5.
4. Cibarium exceedingly broad, with about 80 long slender teeth. Pharynx broad, armed with groups of short spines. Chitinous arch absent. Segment III of antennae shorter than fourth palpal segment ..... *morsbyi.*
   Cibarium narrower, but with about 125 long hair-like teeth and a strong broad pigment patch. Chitinous arch weakly developed. Pharynx slender, unarmed. Segment III of antennae considerably longer than fourth palpal segment ..... *dolichobyssus.*
5. Cibarium with about 24 slender peg-like teeth. Chitinous arch obsolete in the middle ..... *sansaporensis.*
   Cibarium with less than 20 spine-like teeth ..... 6.
6. Cibarium with about 18 long slender teeth joined nearly to their tips. Erect teeth small, in a single transverse row. Pigment patch more or less triangular. Chitinous arch faint in the middle ..... *noemforensis.*
   Cibarium with about 13 short triangular teeth. Erect teeth large and numerous, not in an even row. Pigment patch oval, with a slender tail. Chitinous arch well sclerotized throughout ..... *hoogstraali.*

PHLEBOTOMUS PAPUENSIS, sp. nov. (Figs. 12, 16, 50, 63.)

Male. Wing length 1·53 to 1·67 mm. Dorsal abdominal hairs erect, as are those on the sternites. No post-spiracular setae. Mesonotum very slightly infuscated. Proboscis, from level of base of palpi to apex, about one-quarter less than head height from base of clypeus to vertex. Palpi and basal antennal segments as figured. Newstead's scales in a loose patch a little proximal to the middle of the third segment. Ascoids simple, long, paired at least to segment X and probably further. Pharynx slender, weakly sclerotized, not obviously spinose, but with faint indications of numerous small denticles at its posterior end, hardly visible in the poorly stained mounts. Cibarium as figured. Genitalia as figured, with two nearly terminal and one median spine but no accessory seta on the style. Aedeagus well sclerotized, slender, with a

triangular ventral extension near the base, not visible in all specimens, and probably representing a sclerotized area extending onto the base of the paramere. Paramere simple, with a small internal ventral triangular excrescence, not shown in the figure, as it lies behind the aedeagus. Genital pump large, with flaring plunger, the filaments rather stout, simple, their apices finely and faintly annulate, less than twice as long as the pump.

Holotype male, slide 1254, and 5 male paratypes, slides 1251–1253, 1255–1256, Dobadura, Oro Bay, Papua, 7 Aug. 1944, Ferguson and Graham colls. Taken in tree holes. One male paratype, slide 1128, same locality, 18 Aug. 1944, and 1 male paratype, slide 2666, same locality, 21 Sept. 1944.

There seem to be no females which can be associated with these males with certainty. The relatively very long antennal segments, especially the first flagellar, and the long palpi, combined with the broad wing and presence of setae on the lower border of mesanepisternum would seem to make the recognition of the female comparatively simple. This species seems clearly related to the Australian species with similar genitalia, *brevifilis* and *buccinator*, differing from the former in the long aedeagus, and from the latter in the less sclerotized aedeagus, more slender genital pump, arrangement of the spines on the style, and arrangement of the teeth in the cibarium.

PHLEBOTOMUS ENGLISHI subsp. MORESBYI, subsp. nov. (Figs. 29, 53, 71.)

Female. Wing length 1·56 mm. Dorsal abdominal hairs recumbent, those on the sternites possibly semi-erect on the margins. Mesonotum slightly infuscated. Pleural area not well preserved, probably without setae. Proboscis less than head height from vertex to base of clypeus. Palpi and basal antennal segments as figured. The very short antennal segments are noteworthy. Newstead's scales in a large dense patch on the proximal third of the third palpal segment. Ascoids simple, rather stout and relatively long, paired on all segments except the terminal one. Pharynx lamp-glass shaped, armed with short spines set in groups on short arcs, exactly as in *englishi*. Cibarium very broad, armed with a comb of very numerous fine horizontal teeth, about 80, and with a considerable number of not very distinct small vertical teeth. Spermathecae not visible in the single mount.

Holotype female, slide 1048, Port Moresby, 12-mile swamp, Papua, 13 Aug. 1944, Ferguson and Graham colls., taken in a tree hole or buttress.

This species is exceedingly close to *P. englishi* Tonn. from New South Wales, differing only in having an even shorter antennal segment III, ·112 mm. as against a minimum of ·134 given by Tonnoir for *englishi*; in a shorter alpha, ·240 mm., and delta, ·088 mm. as against minimum measurements of ·252 and ·091 respectively for *englishi*; in shorter wing-length, 1·56 mm. as against 1·70 mm. for *englishi*, and in having fewer teeth in the cibarial comb, 80 instead of 85. These differences are hardly sufficient grounds for erecting a species, yet the great differences in locality seem to call for some sort of recognition, hence the subspecific status. Further material from Papua and Australia may well make the name superfluous.

There is a single male, slide 3522, Port Moresby, 12-mile swamp, 12 Aug. 1944, which may be the male of *moresbyi*. It has similar wing measurements, length 1·35 mm., alpha ·184, delta ·036, and a short third antennal segment, ·120 mm. The pharynx bears spines set on short arcs, as in *moresbyi*, but the cibarium has but 12 rather broad-based triangular horizontal teeth. The genitalia lie in dorso-ventral position, but appear to have a style with four nearly terminal spines and the usual accessory seta. The genital filaments are twisted about the aedeagus, but appear to be at least three and possibly more times as long as the pump. The aedeagus is slender, hardly half as long as the parameres. The parameres do not appear to have the terminal ventral beak found in most species of this group, but this may be due to the position in which they are mounted. If this is truly the male of *moresbyi*, it is very different from male *englishi* and indicates that the two forms are distinct. However, the only available specimen is not adequate for accurate description and the association must remain tentative for the present.

PHLEBOTOMUS HOOGSTRAALI, sp. nov. (Figs. 1, 18, 24, 28, 30, 59, 60, 75.)

Female. Wing length 1·63 to 1·75 mm. Dorsal abdominal hairs mostly recumbent, but with a few erect hairs on the posterior margins of all tergites and the margins of all sternites. No post-spiracular or other pleural setae. Mesonotum very slightly infuscated. Proboscis short, less than head height from vertex to base of clypeus. Palpi and basal antennal segments as figured. Ascoids apparently paired on at least the basal flagellar segments, though only their bases seen with certainty. Newstead's scales in a small dense patch on the proximal third of the third palpal segment. Cibarium and pharynx as figured, the latter without visible armature of spines or scales. Wing as figured. Spermathecae as figured. Gonapophyses of eighth sternite short and slender.

Male. Wing length 1·44 mm. Externally like the female except that delta is relatively shorter and there appears to be but a single ascoid on each of the antennal segments. Cibarium with about eight small horizontal teeth. Male genitalia of the usual type for this group, but the style with one of the spines considerably more proximal than the others, as figured. Inner aspect of coxites with rather numerous fine setae. Aedeagus slender and pointed. Pump and genital filaments as figured, the filaments about 6 times as long as the pump.

Holotype female, slide No. 1446, Hollandia, Dutch New Guinea, January 1945. Taken at light. H. Hoogstraal coll.

Allotype male, slide 1445, and 1 paratype female, slide 1447, same data as holotype.

The sexes of this species are associated on the basis of the collecting data, the general similarity of external structures, and the long genital filaments and long spermathecal ducts, not conclusive evidence, but the best that can be done at present. This species will go into Theodor's "group *africana*" of the genus *Sergentomyia*, subgenus *Sergentomyia*, except that the cibarial armature is of the type found in *P. zeylanicus* with erect teeth as well as pointed horizontal teeth. The pharynx is lamp-glass shaped, but bears no visible teeth or spines.

PHLEBOTOMUS DOLICHOBYSSUS, sp. nov. (Figs. 7, 21, 23, 39, 43, 55, 56, 68, 70.)

Female. Wing length 1·26 to 1·33 mm. Dorsal abdominal hairs recumbent, except for a patch of erect setae on the first tergite and a few scattered erect setae on the posterior margins of the succeeding tergites. Sternites with semi-recumbent setae. Mesonotum moderately infuscated. No pleural setae. Proboscis longer than head height from vertex to base of clypeus. Palpi and basal antennal segments as figured. Newstead's scales in a dense patch on proximal third of third palpal segment. Ascoids as figured, long and slender, paired on all but the terminal segment, from which they appear to be absent. Pharynx unarmed, fairly well sclerotized, as figured. Cibarium broad and heavily sclerotized, no chitinous arch, a very large and dense pigmented area and a comb of exceedingly fine and numerous hair-like horizontal teeth and what appear to be several rows of erect or semi-erect teeth below, much obscured by the pigment patch. The teeth in the comb are so fine and numerous that it has not been possible to count

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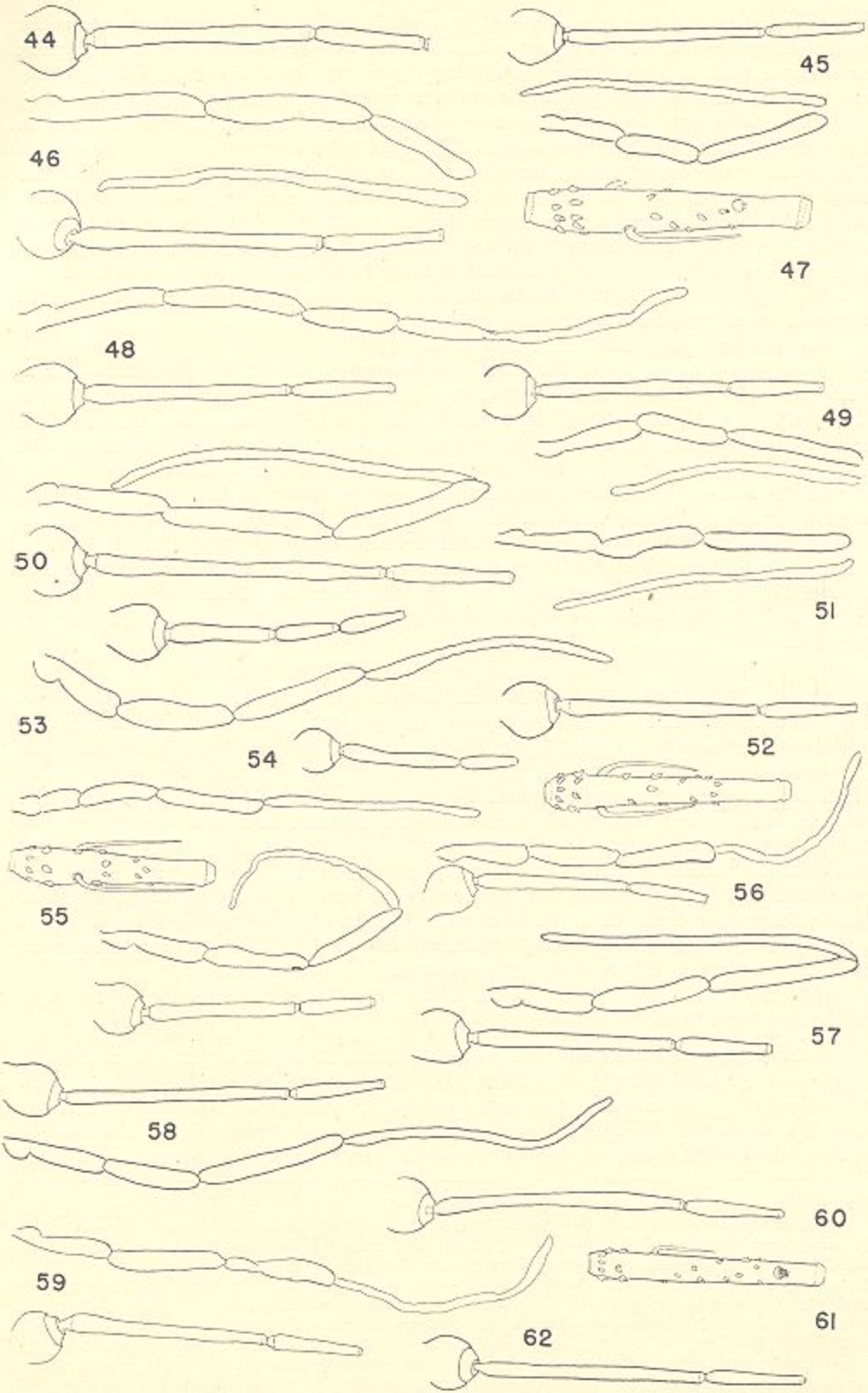
Text-figs. 44-62.

Fig. 44, *P. brevifilis* female, basal antennal segments.—Fig. 45, *P. fergusoni* male, short delta wing, basal antennal segments and palpus.—Fig. 46, *P. pexopharynx* female holotype, antenna and palp.—Fig. 47, *P. brevifilis* female, antennal segment showing ascoids.—Fig. 48, *P. buccinator* male holotype, antenna and palp.—Fig. 49, *P. sansaporensis* female paratype, antenna and palp.—Fig. 50, *P. papuensis* male paratype, antenna and palp.—Fig. 51, *P. noemforensis* female holotype, antenna.—Fig. 52, same, palp and antennal segment VII showing ascoids.—Fig. 53, *P. englishi moresbyi* female holotype, antenna and palp.—Fig. 54, *P. brachycornutus* female holotype, antenna and palp.—Fig. 55, *P. dolichobyssus* female holotype, ascoids, antenna and palp.—Fig. 56, same, male allotype, antenna and palp.—Fig. 57, *P. fergusoni* female holotype, antenna and palp.—Fig. 58, *P. quinfus* male paratype, antenna and palp.—Fig. 59, *P. hoogstraali* female holotype, palp and antenna.—Fig. 60, same, male allotype, antenna.—Fig. 61, *P. sansaporensis* male allotype, antennal segment IV showing ascoid.—Fig. 62, *P. fergusoni* male allotype, antenna. All figures of basal antennal segments and palpi are to the same scale, approximately ×145. Figures of single antennal segments to show ascoids are at greater magnification, about ×290.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them accurately, but they are estimated to number about 125. Spermathecae somewhat distorted, as figured, the ducts long, at least five and probably more times as long as the spermathecae and apparently opening separately into the vagina, although they are visible with great difficulty in the available material.

Male. Wing length 1·11 to 1·20 mm. Abodminal setae and colour as in the female. Proboscis slightly less than head height. Palpi and basal antennal segments as figured. Newstead's scales as in female, though fewer. Ascoids small and slender, apparently single on segments III to VII, paired on IX to XIII, remaining segments missing. Where paired, one ascoid is larger than the other. Cibarium as figured. Pharynx as in the female, but more slender. Genitalia characteristic of the group, but the genital filaments exceedingly long, between 9 and 10 times as long as the pump, as figured.

Holotype female, slide 1209, Hollandia, Dutch New Guinea, 6 Sept. 1944, in buttresses of forest trees. Ferguson and Graham coll.

Allotype male, slide 1208, same data as holotype.

Paratypes, 2 males, slides 2820, 2821 and 2 females, slides 2823, 2825, same data as holotype; 1 male, slide 2793, Hollandia, 16 Oct. 1944, in buttresses, 24th Malaria Survey Unit colls.; 1 male, slide 1449, and 1 female, slide 1448, Hollandia, Jan. 1945, at light, H. Hoogstraal coll.; 1 male, Hollandia, Feb. 1945, 1 female, no data, L. E. Rozeboom coll., 1 female, slide 2655, Aitape, 16 Sept. 1944, in buttress, 5th Malaria Survey Unit.

On the basis of the cibarial structure, this species would go into Theodor's "group *minuta*" of the genus *Sergentomyia*, but the type of spermatheca, unarmed pharynx and slender aedeagus indicate closer relationships with his "group *africana*". It is to be distinguished from *hoogstraali* on the structure of the style, longer genital filaments, shorter third antennal segment and very different cibarium. From *englishi moresbyi* it can be separated by the more numerous cibarial teeth and the longer third antennal segment.

PHLEBOTOMUS BRACHYCORNUTUS, sp. nov. (Figs. 7, 42, 54, 64.)

Female. Wing length about 1·17 mm., though both wings are somewhat distorted. Dorsal abdominal hairs mostly recumbent, though some erect hairs present on the posterior margins of tergites I, VI and VII. Sternites mostly with erect hairs and a few semi-recumbent lorate scales. Mesonotum apparently pale, though much broken and distorted. Proboscis greater than head height from vertex to base of clypeus. Third antennal segment and basal palpal segments unusually short, as figured. Ascoids simple, short, paired on at least the first five flagellar segments. Newstead's scales in a dense patch on the proximal third of the third palpal segment. Pharynx moderately well sclerotized and somewhat expanded posteriorly, without visible teeth, hairs, scales or spines, obscurely ridged. Cibarium as figured, the high and heavily sclerotized chitinous arch being especially characteristic. Spermathecae simple thin-walled oval structures, the ducts not discernible in the single specimen.

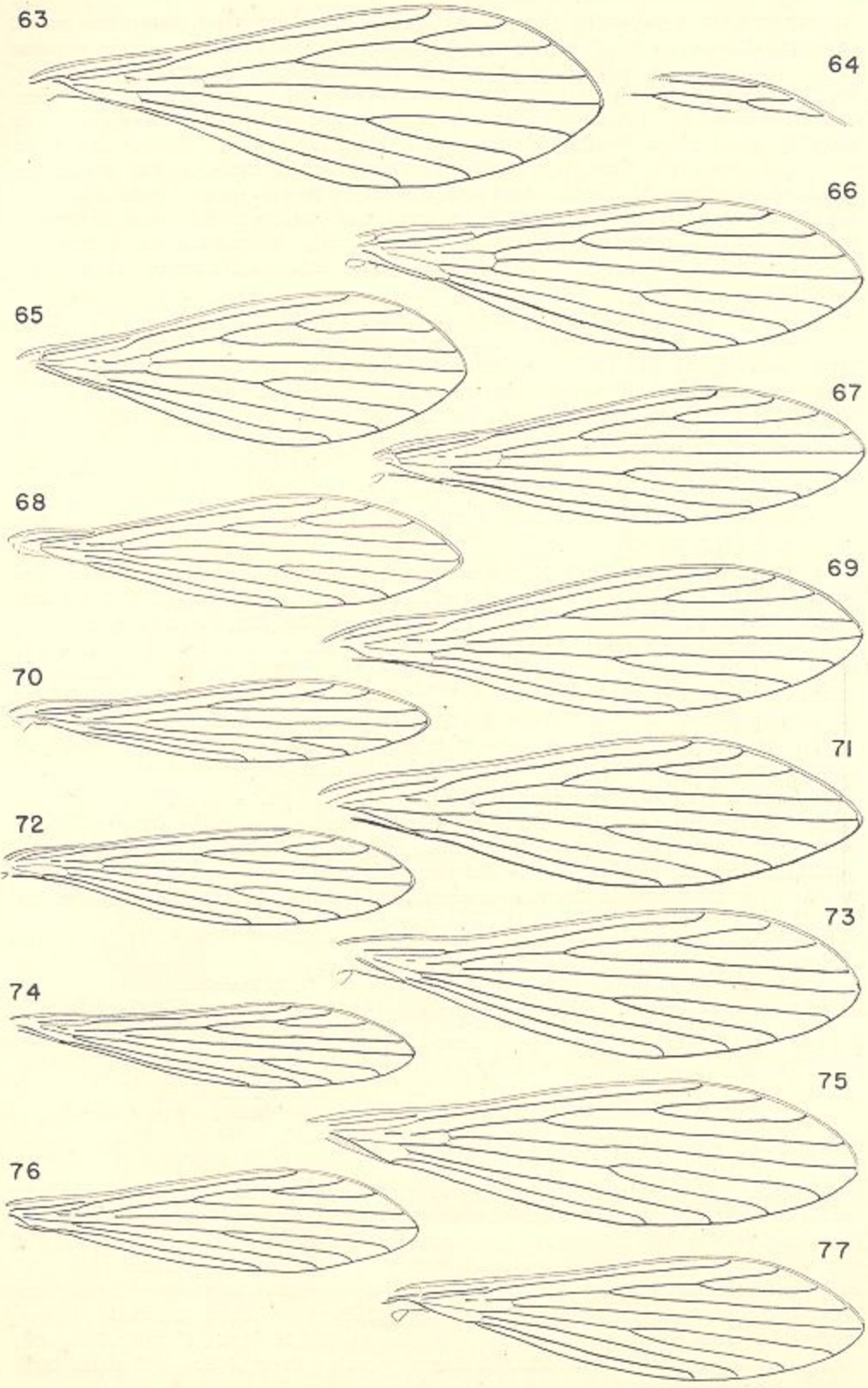
Holotype female, slide 1195. Toem, Dutch New Guinea, 9 Sept. 1944. Taken in buttress of forest tree.

PHLEBOTOMUS FERGUSONI, sp. nov. (Figs. 7, 17, 22, 31–34, 45, 57, 62, 69, 72, 77.)

Female. Wing length 1·386 to 1·710. Dorsal abdominal hairs recumbent, hairs on lateral and posterior margins of sternites apparently semi-erect. No post-spiracular or other pleural setae. Mesonotum very slightly infuscated. Proboscis less than height of head from vertex to base of clypeus. Palpi and basal segments of antennae as figured.

Text-figs. 63-77.

Fig. 63, *P. papuensis* male paratype.—Fig. 64, *P. brachycornutus* female holotype.—Fig. 65, *P. pexopharynx* female holotype.—Fig. 66, *P. buccinator* male holotype.—Fig. 67, *P. brevifiloides* female holotype.—Fig. 68, *P. dolichobyssus* female holotype.—Fig. 69, *P. fergusoni* female holotype.—Fig. 70. *P. dolichobyssus* male paratype.—Fig. 71, *P. englishi moresbyi* female holotype.—Fig. 72, *P. fergusoni* short delta male.—Fig. 73, *P. noemforensis* female holotype.—Fig. 74, *P. sansaporensis* male paratype.—Fig. 75, *P. hoogstraali* female holotype.—Fig. 76, *P. quintus* male paratype.—Fig. 77, *P. fergusoni* male allotype. All figures are of wings and are to the same scale, × 52·5, except Figs. 65 and 67, which are to a somewhat smaller scale, × 34·5. Both the latter are considerably larger than *P. papuensis*.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Ascoids apparently paired on at least the basal antennal segments, short, thin-walled and impossible to see on the majority of specimens. Newstead's scales in a dense patch on the proximal third of the third palpal segment. Pharynx slender, poorly sclerotized, the proximal end with very weakly sclerotized denticulate ridges only visible under optimum conditions. Cibarium as figured, usually with four large teeth and a group of small slender teeth in the middle and at each side. The apparent number, shape and position of the teeth vary considerably, as shown in the figures. The appearance indicated by Figure 33 is often seen and appears to be due to the teeth being bent down into the lumen of the cibarium, i.e. away from the observer. Wing as figured, the length of delta relative to alpha varying considerably. Spermathecae as figured, the ducts not visible. Gonapophyses of eighth sternite short and slender. Cerci short and blunt.

Male. Wing length 1·29 to 1·44 mm. Externally similar to the female. Wing, basal antennal segments and palpi as figured. Ascoids apparently single on at least the basal segments, thin-walled and difficult to see. Cibarium similar to that of the female but narrower and the teeth smaller, as figured. Wing as figured, delta relatively shorter than in the female. Genitalia not distinguishable from other members of the group, the filaments a little more than four times as long as the pump.

Holotype female, slide 1192, Toem, Dutch New Guinea, 9 Sept. 1944, in tree buttresses, Ferguson and Graham colls.

Allotype male, slide 1317, Lae, North-east New Guinea, 16 Aug. 1944, in tree buttresses. Ferguson coll.

Paratypes, 56 females and 17 males from the following localities: Dobadura, Oro Bay, Papua, 26 July, 7, 8, 13, 18 August, and 21 and 22 September 1944 (29 ♀, 3 ♂); Lae, North-east New Guinea, 16 Aug. 1944 (1 ♂); Popendetta, Oro Bay, Papua, 7 October 1944 (3 ♀); Nadzab, North-east New Guinea, 15 August and 1 October 1944 (6 ♀, 6 ♂); Finschhafen, North-east New Guinea, 29 August 1944 (3 ♀, 4 ♂); Tumleo Island, off Aitape, 16 September 1944 (4 ♀, 1 ♂); Toem, Dutch New Guinea, 9 September 1944 (6 ♀); New Guinea, no other data (5 ♀, 2 ♂). All were collected from tree holes or the crevices between the buttressed roots of large forest trees by Majors Ferguson and Graham or members of the 5th Malaria Survey Unit, U.S. Army.

In addition to the above specimens, there is a long series of males (37) and a single female which agree with the above in what can be seen of the cibarium, in the male genitalia and in palpal and antennal lengths, but which differ in having a consistently smaller delta and alpha and shorter average wing length, though there is an overlap of about 10% in this measurement. The pertinent measurements in mm. are given below, taken from all available specimens.

Paratypes:

	15 Males.			56 Females.		
	Alpha.	Delta.	Wing Length.	Alpha.	Delta.	Wing Length.
Max. ..	·280	·144	1·440	·420	·256	1·710
Min. ..	·184	·060	1·260	·220	·080	1·386

Other specimens:

	37 Males.			1 Female.		
	Alpha.	Delta.	Wing Length.	Alpha.	Delta.	Wing Length.
Max. ..	·176	·044	1·314	·168	·044	1·404
Min. ..	·080	·040	1·134			

Whether this material represents another species or is merely a subjective segregate cannot be decided, as most of the specimens with short wing measurements were among those long preserved in alcohol and the mounts are very unsatisfactory. The cibaria of only a few of these can be seen clearly enough to make out the presence of several large teeth similar to those of the paratypes. The localities of these specimens are listed here: 20 males, Dobadura, 18 Aug. and 21 Sept.; 6 males, 1 female, Aitape, 16 Sept.; 3 males, Nadzab, October; 1 male, Tumleo Id., 16 Sept.; 1 male, Hollandia, 6 Sept.; 2 males, Port Moresby, 12, 13 Aug.; 16 males, Toem, 9 Sept.; 5 males, New

Guinea, no other data. Except for the material from Hollandia and Port Moresby, these specimens were taken mainly together with typical *fergusoni*. This species seems to be quite abundant in the eastern part of New Guinea, specimens having been taken in most of the localities where collecting was done from Toem in Dutch New Guinea to Dobadura in Papua. No specimens have been identified in the fairly abundant material from Sansapor on the north-western tip of Dutch New Guinea nor from the islands in Geelvink Bay. The species does not seem to be very closely related to any previously described, though it bears certain resemblances to *P. iyengari* Sint. and its various forms, sharing with them the unarmed pharynx and long delta. It differs, however, in having considerably fewer and more irregularly arranged teeth in the cibarium and in the simple, thin-walled spermathecae.

PHLEBOTOMUS QUINTUS, sp. nov. (Figs. 25, 27, 58, 76.)

Male. Wing length 1·29–1·42 mm. Dorsal abdominal hairs recumbent. No pleural setae. Mesonotum slightly infuscated. Proboscis short, a little less than head height. Palpi and basal antennal segments as figured. Ascoids short and slender, apparently single, on all segments except the terminal three, which are nearly globular. Newstead's scales in a small dense patch on proximal third of third palpal segment. Cibarium as figured, quite heavily sclerotized. Pharynx slender, weakly sclerotized, the apex unarmed but with faint irregular transverse ridges. Wing as figured. Genitalia as figured.

Holotype male, slide No. 1206, Hollandia, Dutch New Guinea, 6 Sept. 1944, in tree buttress.

Paratypes, 1 male, slide 1207, same data as holotype, and 3 males, slides 1044, 2683 and 2685, Finschhafen, at Mape River, North-east New Guinea, 29 Aug. 1944, in tree buttresses. All collected by personnel of the 5th Malaria Survey Unit, U.S. Army, in honour of which the species is named.

PHLEBOTOMUS SANSAPORENSIS, sp. nov. (Figs. 7, 15, 35–38, 49, 61, 74.)

Female. Wing length 1·45 to 1·53 mm. Mesonotum rather strongly infuscated. Dorsal abdominal hairs recumbent. Ventral hairs semi-recumbent. Proboscis less than head height. Third antennal segment and palpi as figured. Newstead's scales in a dense patch on the basal third of third palpal segment. Ascoids short and slender, paired on all segments except the last three, which are abruptly shortened. Pharynx not widened posteriorly, unarmed, with weak ridges and digitate processes. Cibarium as figured, with about 24 relatively short teeth whose apices appear to be bent down into the lumen of the cibarial cavity. It is possible that these teeth represent thickenings on an otherwise tenuous membrane. At other than critical focus the refractive pattern shows a series of broad blunt contiguous structures quite characteristic for the species and easily seen in even the poorest mounts. Spermathecae distorted, apparently simple oval thin-walled capsules, as figured.

Male. Wing length 1·20 to 1·22 mm. Similar to female but alpha and especially delta relatively shorter than in female. Ascoids shorter and more slender than in female, single on all segments but the terminal three. Genitalia as figured. Genital filaments a little more than three times as long as pump. Cibarium as figured, probably with a complete row of smaller and finer teeth of similar type to those in the female, but only those figured visible in the available material.

Holotype female, slide 1151, Sansapor, Dutch New Guinea, 11 Sept. 1944, in tree buttresses at Mar village.

Allotype male, slide 1145, same data as holotype.

Paratypes, 13 males and 14 females, same locality, 11 Sept. and 28 Aug. 1944; 1 female, New Guinea, no other data.

PHLEBOTOMUS NOEMFORENSIS, sp. nov. (Figs. 26, 51–52, 73.)

Female. Wing length 1·40 to 1·53 mm. Mesonotum slightly infuscated. Dorsal abdominal hairs recumbent, at most with occasional erect hairs on the posterior margins of some tergites. Ventral hairs larger, semi-recumbent. Proboscis about equal to head height from vertex to base of clypeus. Third antennal segment and palpi as figured.

Newstead's scales in a small dense patch on proximal third of third palpal segment. Ascoids paired on all but the terminal three flagellar segments (which are abruptly shorter than the preceding segments), slender, short and subequal, as figured. Pharynx not widened posteriorly, unarmed, with faint ridges and obscure digitate processses. Cibarium broad, bearing a comb of about 18 pointed teeth, as figured. Spermathecae not well preserved, apparently thin-walled ovoid structures with the terminal knob sunk in a pit.

Male. Wing length 1·13 to 1·20 mm. Similar to the female, but delta and alpha relatively shorter and wing narrower. Ascoids more slender and shorter, single on each flagellar segment except the last three, from which they appear to be absent. Genitalia of the *Sergentomyia* type, all spines of the style close to apex and aedeagus long and slender. Genital filaments a little more than twice as long as pump. Cibarium much like that of female, but narrower, the teeth smaller, about 13 in number. Pharynx as in female.

Holotype female, slide 1167, Kornosoren, Noemfor Island, Geelvink Bay, Dutch New Guinea, 12 Sept. 1944. Ferguson and Graham colls.

Allotype male, slide 1174, same data as holotype.

Paratypes, 34 males, 11 females, same data as holotype.

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NOTE.—For the sake of those who may be stimulated to follow the lead of Dr. Fairchild's work, it is worth recording that the range of distribution of *Phlebotomus* in Australia is quite wide. Mr. K. R. Norris has recently drawn attention to the existence of specimens, collected by himself, from both Western Australia and South Australia. These specimens were originally examined by Mr. Tonnoir, who determined the one from Crawley, W.A., as *Phlebotomus* near *queenslandi* Hill, and the one from the Waite Institute, Adelaide, S. Aust., as *Phlebotomus englisi* Tonn.? These are now in the C.S.I.R.O. collection at Canberra. During the present year Mr. A. L. Dyce has recovered *Phlebotomus* in a light trap he has been operating at Moree, N.S.W.—ED.

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