

NOTES ON THE PHLEBOTOMUS OF PANAMA

(Diptera, Psychodidae)

VI. PHLEBOTOMUS SHANNONI DYAR AND RELATED SPECIES¹

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The sandflies discussed in this paper form an ill defined group mostly lacking any outstanding peculiarities. Their grouping together is for convenience and does not imply any phylogenetic significance. The males are characterized by having four major spines but no accessory setae on the style; no basal, median or apical tufts of setae on the coxite; the parameres simple, without forks, branches or modified setae; the lateral lobes relatively long and without modified spines; the aedeagus and genital filaments of conventional form, the latter from two to four times as long as the pump and with simple tips. The flared anterior end of the plunger of the sperm pump is rather small.

Females have been associated by breeding in two species and on other good evidence in two further species. In *Phlebotomus shannoni* Dyar, *P. punctigeniculatus* Floch and Abonnenc and *P. pestanaei* Barretto and Coutinho, the cibarium bears four to eight horizontal teeth, the pharynx is unarmed and the spermathecae are shaped like stout sausages with short to long individual ducts joining a common duct of moderate length.

Both sexes have rather long palpi, the combined first and second segments subequal to the third, the fourth much shorter and the fifth longest. The fifth segment may or may not exceed in length the first three segments combined. The first flagellar segment of the antennae exceeds in length any palpal segment and may exceed any two segments. The ascoids are moderately long, from one-half to as long as their respective segments, except in the case of the first flagellar segment. In all those species where these structures have been described, the ascoids are biramous, bearing a proximally directed branch which may be short or exceed the base of the segment. Newstead's scales are borne on the dorsal inner aspect of the third palpal segment, being numerous and spread over the central two-thirds of the segment in those species we have examined. The second sternite is deeply divided,

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though often fused apically, in the four species we have examined, being similar in all to the figures of *shannoni* given here.

Those members of the group which we have seen are conspicuously long-legged, a character of practical utility in dealing with live specimens or in sorting out lots for identification. The tibiae are particularly long compared with the femora. The ratio of tibia to femur for the hind legs ranges from 2.0 to 2.2, which was approached but not equalled by only three species in the random sampling of 25 species from other groups, in which this ratio ranged from 1.3 to 1.95.

Of described species, the following agree with the above definition in both sexes: *P. shannoni*, *punctigeniculatus* and *pestanai*. Males of *texasus* Dampf and *minasensis* Mangabeira can perhaps be placed here. The female of *texasus* differs in having globose spermathecae and about 19 teeth in the cibarium, while the female of *minasensis* is as

TABLE OF MEASUREMENTS IN MICRA

	<i>shannoni</i> 10 males		<i>puncti- geniculatus</i> 9 males		<i>undulatus</i> 5 males		<i>volcanensis</i> 8 males	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Antenna III.....	424	264	308	240	332	304	480	404
Palp I-II.....	200	128	152	128	148	140	200	180
Palp III.....	156	100	128	96	116	108	176	140
Palp IV.....	76	48	96	48	68	60	84	72
Palp V.....	280	180	208	184	208	160	240	212
Wing length.....	2844	1580	2010	1740	1800	1692	2880	2610
Alpha.....	828	414	414	252	396	324	810	720
Beta.....	378	234	306	234	342	234	504	432
Gamma.....	360	162	342	216	288	198	414	270
Delta.....	216	108	90	-18	72	36	198	90

yet unrecognized. *P. maracayensis* Nunez-Tovar may have belonged in this group, but the description is inadequate and the types are no longer in existence. *P. lanei* Barretto and Coutinho, of which we have material, differs in having a somewhat elongate style, with all spines inserted well distally of the middle. The parameres are also of a different type. The proximal projections of the ascoids are very short and inconspicuous and the spermathecae are annulate.

In addition to the species discussed here, we have female specimens of two other species which may belong here. Both have long proximal branches on the ascoids, with wing and palpal measurements similar to *shannoni*. Spermathecae of one of these also have the evanescent envelope of *shannoni*, though they are differently shaped and with wholly separate ducts. The other has annulate spermathecae. We postpone their description in the hope of securing males.

Phlebotomus shannoni Dyar

(Plates I-II, figs. 1-14, Plate IV, figs. 29-30)

- 1929, Amer. Jour. Hyg., 10(1): 121, figs. 3-4 (♂; Cano Saddle, Gatun, Canal Zone). Barretto 1947, Arq. Zool. S. Paulo, 5(4): 222-223.
Phlebotomus limai Fonseca 1935, Mem. Inst. Butantan, 10: 61, figs. 1-3 (♀; Serra de Cantareira, São Paulo, Brasil).
Phlebotomus bigeniculatus Floch and Abonnenc 1941, Inst. Pasteur Guyane, Pub. 28, pp. 4-7, figs. 2-3 (♂, ♀; Cayenne, French Guiana).

Barretto (*l.c.*) has given complete references, which need not be repeated here. We have examined the types at the United States National Museum. The species has been bred in Brasil and the early stages described (Barretto 1941) so there is no question as to the association of the sexes.

We give here figures of the male genitalia, head, wing, palpi, antennae, female cibarium and spermathecae, second sternites of both sexes, together with measurements of a series of Panama specimens.

An outstanding character of the spermathecae, so far noted in only one other sandfly, the undescribed species mentioned above, is the presence of a sharply outlined, refractive envelope of uniform thickness, which can always be seen in phenol (figs. 11-12). It gives the impression of a melon cut longitudinally. The envelope may (fig. 11) or may not (fig. 12) enclose the "head" bearing the minute hairs (glandular ducts?). The envelope disappears with treatment in KOH. Tissue walls of varying thickness and degrees of visibility have also been noted in a number of other species surrounding not only the spermathecae but the ducts as well (*e.g.*, *vespertilionis*, Fairchild and Hertig 1947, Pl. I, fig. 2). In none, however, is this feature as constant and conspicuous as in *shannoni*.

The second palpal segment may bear one to three Newstead's scales on its distal end, in addition to those figured for the third segment. The pharynx, though classed as "unarmed," bears numerous very fine teeth, visible only at high magnification. This is also true of many species we have examined which do not have an obvious armature, so the term is relative.

We have examined and identified 221 males and 121 females from Panama. These were taken in 103 collections from 35 localities scattered throughout the country from sea level to 4600 feet elevation. There appears to be little seasonal variation in abundance, our material having been taken in every month of the year, ranging from four collections in October to nineteen in January. This variation probably reflects the amount of collecting done rather than the abundance of the species. The great majority of the collections (74) of this species come from crevices between the buttressed roots of forest trees, hollow trees containing bats (15) and hollow trees without bats (10). Six collections from light traps yielded this species; it has been taken twice in rock crevices and once each in an animal-baited stable trap, on an oiled paper trap on a tree trunk, and resting on a tree trunk. We have never taken it in an animal burrow, and a rather small proportion of the females have been engorged with blood. We do not know its preferred hosts. It is reported to bite man and domestic animals rarely in Sao Paulo, Brasil, in the forest, but to refuse both experimentally (Barretto 1943, Fonseca 1935, Galvao and Coutinho 1940).

Rozeboom (1944) reports it as biting man in the southern United States. In Panama we have no evidence of its biting man or, with the single exception of a specimen from a horse-baited mosquito trap, of its attacking the larger domestic animals.

In general, the species is not a dominant one, being usually outnumbered in collections from buttresses by *trinidadiansis* Newst. and from bat trees by *vespertilionis* F. and H. Most of the collections consist of one or two specimens, with rarely over a dozen taken at a single place and time.

Aside from the Panama material, we have seen specimens from Georgia and Florida (reported by Rozeboom, 1944, as far north as North Carolina), six localities in Costa Rica, Colombia, French Guiana, Brasil, Paraguay and Argentina. One of us (M. H.) during intensive forest collecting in Paraguay, March to May, 1950, obtained 12 male and 8 female *shannoni* out of a total of nearly 2000 sandflies so far identified. Three females were taken on a horse or burro (not determined whether actually biting or not), the others in a Shannon light-trap, hollow trees, buttresses or on a castor-oil paper trap. The characteristic envelope of the spermathecae was noted in phenol. The seven mounted males all had the typical *shannoni* distribution of setae on the parameres. In comparisons made in the field with mounted specimens from Panama no differences could be noted.

P. abonnenci (Floch and Chassignet, 1947, Inst. Pasteur Guyane, Pub. 157, pp. 1-3, ♂) appears to us to be but a variant of *shannoni*. Among several hundreds of *shannoni* examined we have found a fair number of specimens which agree closely with Floch and Chassignet's description. In any case, almost the sole difference from *shannoni* concerns the number of setae on the dorsal surface of the parameres. In typical *shannoni* they cover the distal half (fig. 1) but vary in a continuous series to a few setae near the tip (figs. 29-30). The latter forms have always been taken in company with *shannoni*. Soon after the discovery of the second sternite as a taxonomic character, it was noted that in *shannoni* they are deeply divided but often fused apically (Hertig and Fairchild 1950, fig. 4). It was hoped that this might aid in determining whether we were dealing with more than one species. About that time we received one lot with over twenty males, about half of which had the setae limited to the tips of the parameres. There was no correlation whatsoever between the open or closed sternites and any particular distribution of the setae. We are inclined to regard our material as all *shannoni*.

Through the kindness of Dr. Floch we have been able to examine a specimen of *abonnenci* from French Guiana. It agrees in all respects with our Panama material.

Phlebotomus punctigeniculatus Floch and Abonnenc

(Plate III, figs. 15-23)

1944 (July), Inst. Pasteur Guyane, Pub. 81, pp. 5-8, fig. 3. (♂, ♀; near Cayenne, French Guiana. In crevices in trees.) Barretto 1947, Arq. Zool. S. Paulo, 5(4): p. 220.

Phlebotomus christophersoni Damasceno and Causey 1944 (October), Mem. Inst. Oswaldo Cruz, 41(2): 347-349, Pl. 4, figs. 17-21; Pl. 5, fig. 25 (♂; States of Para and Amazonas, Brasil, in hollow trees.) Barretto 1947 (l.c.), p. 193.

The shape of the paramere as figured by the above authors differs considerably, but our material shows both conditions, depending on whether the tip is flattened out or curved inwards. In balsam mounts the tip is generally curved inwards, as shown in our figure. In phenol or aqueous media the tip is generally not recurved, as shown by Floch and Abonnenc. Measurements and other structures seem to agree closely, the short delta and structure of the ascoids being especially characteristic. Floch and Abonnenc in their latest key (1947) separate *punctigeniculatus* from *christophersoni* on small differences in the relative lengths of palpal segments and genital filaments, but we do not believe these are adequate in the present case.

The proportions of the head and distribution of Newstead's scales are essentially the same as in *shannoni*. The second sternites are also substantially the same. Only two of our specimens, both males, are mounted so that the sternites can be seen well. The one figured (fig. 20) is divided and open, while the other is fused apically.

We have examined a total of 40 males and 11 females of this species from Panama and the Canal Zone. All were collected at three localities, Chorrera, Juan Mina, and Chiva Chiva. The Chorrera station was a very large hollow espavé tree (*Anacardium excelsum*) containing numerous bats, growing on the steep banks of a stream in heavy gallery forest. The exposed roots of this tree were hollow and yielded most of our specimens. A few were taken in a smaller hollow tree with bats nearby. The Juan Mina and Chiva Chiva localities were also large hollow espavé trees with bats, and although both have been visited fairly regularly, *punctigeniculatus* has been taken at Juan Mina only five times in six years, and only once at Chiva Chiva. The Chorrera station has yielded specimens eight times, on nearly every visit. Specimens have been secured in March, April, May, July, October and December.

Phlebotomus undulatus sp. nov.

(Plate IV, figs. 24-28)

Male.—Genitalia as figured. Aedeagus short, triangular. Pump and genital filaments about as long as coxite and style, the filaments 2.5 to 3 times as long as the pump, their tips not recurved. Ascoids as in *shannoni*, with long proximal prolongations. Cibarium without visible horizontal teeth, the chitinous arch distinct, apparently as in *shannoni*. Pharynx unarmed. Newstead's scales appear to be similar in number and distribution to *shannoni*, while we can not see the structure of the second sternite in any of our mounts.

Holotype male, slide no. 406, near Esquintla, Guatemala, 25 May, 1945, in buttresses of large trees along roadside. Fairchild and de Leon colls.

Paratypes, two males, same data; three males, between Esquintla and San José, Guatemala, 3 June, 1945, in buttresses and hollow trees along roadside. Fairchild and de Leon colls.

This species is very close to *shannoni*. It differs in having the internal basal spine of the style inserted on a level with or proximally to the external basal spine, instead of distally as in *shannoni*, in the

relatively long lateral lobes, and in having the setae on the paramere longer, more numerous and with a reverse curve in the middle. No females were secured. The name refers to the waved or undulant hairs of the paramere. Although this character might seem quite a trivial one, it is well marked in all our specimens, which are otherwise also quite uniform.

***Phlebotomus volcanensis* sp. nov.**

(Plate V, figs. 31-36)

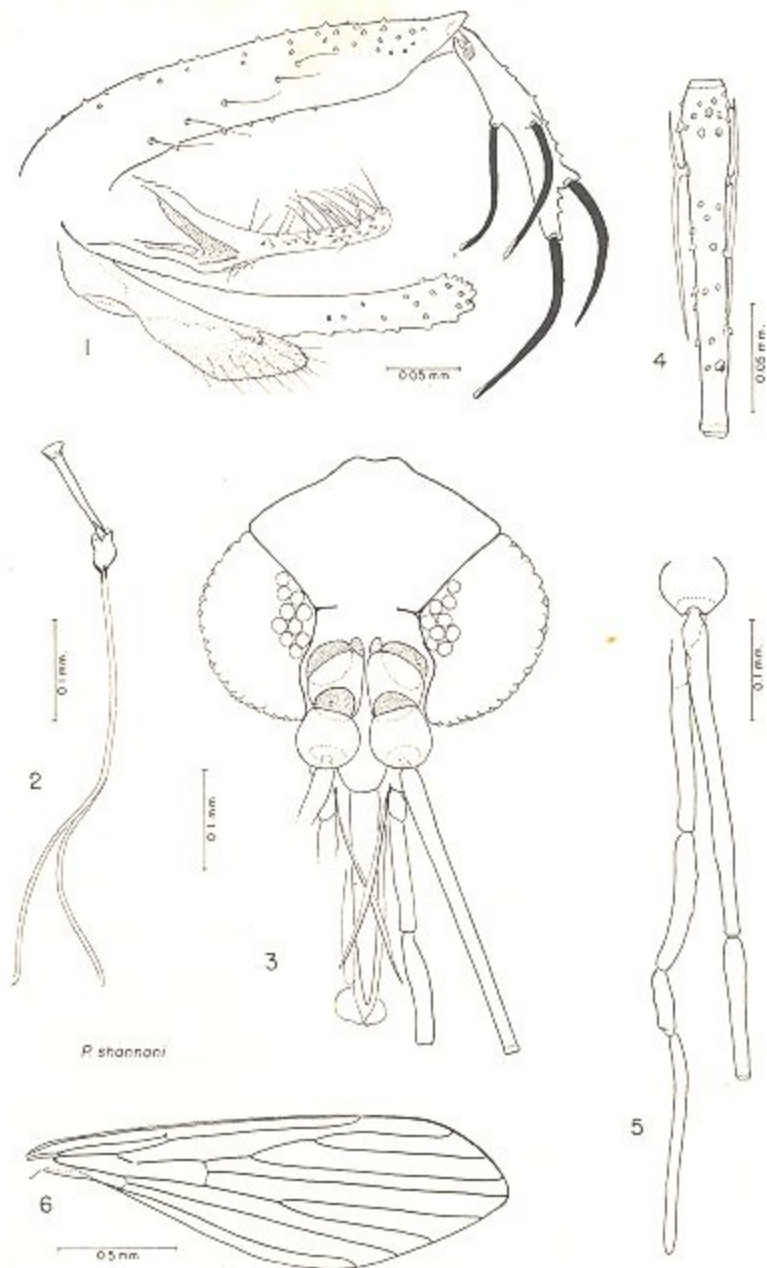
Male.—A large pale brownish species, the head and mesonotum rather dark. Genitalia as figured. Genital pump and filaments slightly longer than coxite and style, the filaments about 2.5 times as long as the pump, their tips slightly hooked. Cerci as in *shannoni*. Ascoids with long proximal prolongations, essentially as in *shannoni*. Cibarium without visible horizontal teeth, but with fairly numerous small vertical teeth. Chitinous arch well developed, its relative position similar to that of *shannoni*. Pharynx unarmed. The head proportions and the distribution of Newstead's scales also appear similar to *shannoni*, though none of our specimens show the latter well. The second sternite is mounted laterally in our series, but can be seen to be of the same type as in *shannoni*.

Holotype male, slide no. 652, and *Paratypes*, seven males, slides nos. 648, 649, 653-657, Cerro Punta, Volcán de Chiriquí, ≈6500 ft. elev., Chiriquí Province, Panama, 22 to 27 May, 1946. Galindo and Fairchild colls. The specimens were taken in hollow trees and buttresses in heavy forest around Finca Carinthia. Types to be deposited in the Museum of Comparative Zoology and the United States National Museum. These were the only *Phlebotomus* seen at this locality and were distinctly rare. No females were taken.

P. volcanensis appears to belong to the *shannoni* group on the structure of genitalia and ascoids. It differs from the other species treated here in its considerably larger size and in the structure of the paramere. Further comparisons must await the discovery of the female.

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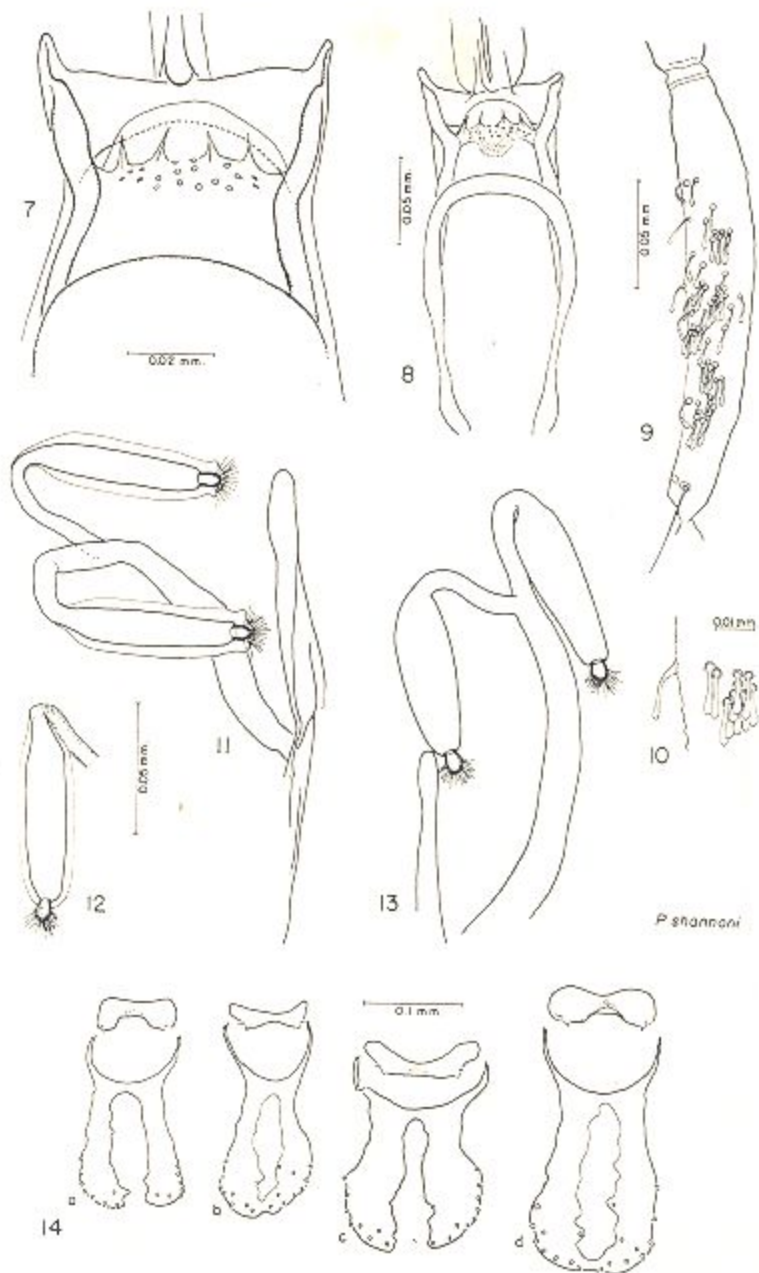
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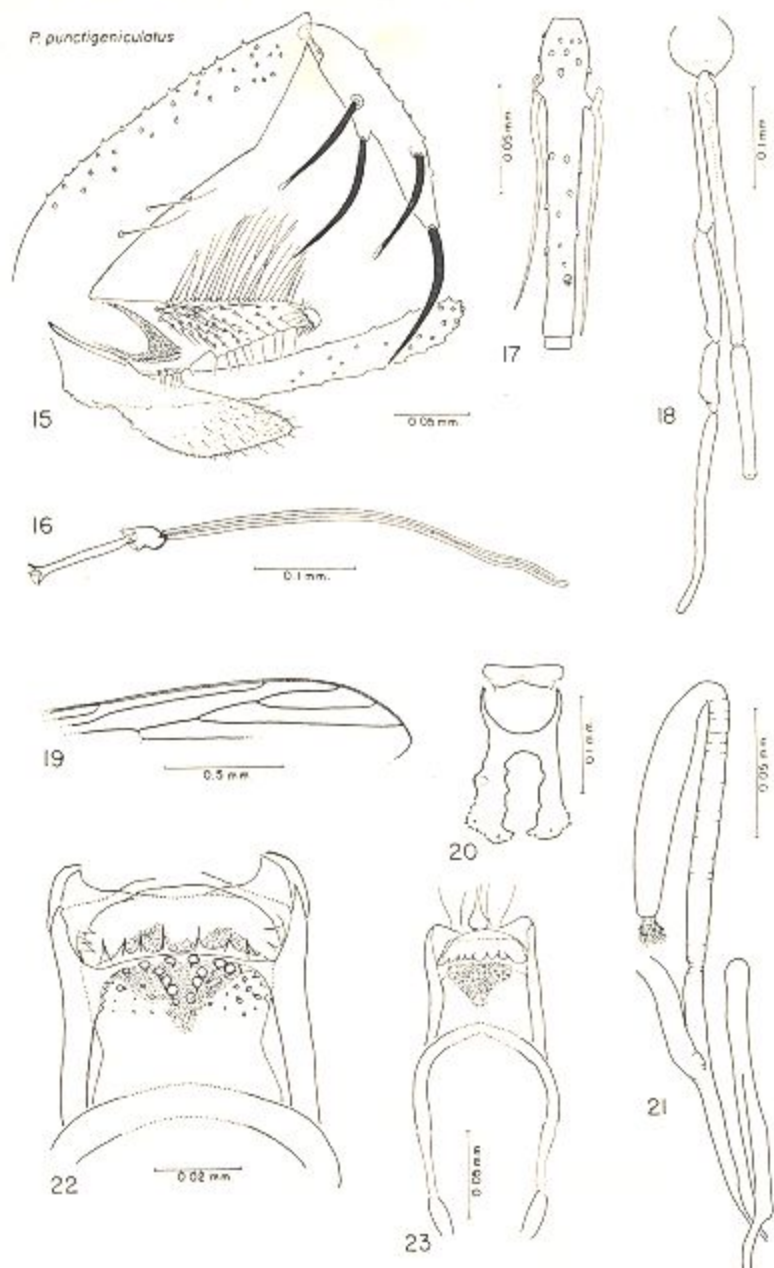
Phlebotomus shannoni. All figures are of males. FIG. 1. Male genitalia, inner aspect. FIG. 2. Genital filaments and pump. FIG. 3. Head, dorsal aspect. FIG. 4. Antennal segment IV, showing ascoids. FIG. 5. Palp and basal antennal segments. FIG. 6. Wing.

See also Plate IV, figs. 29-30, for variant form.

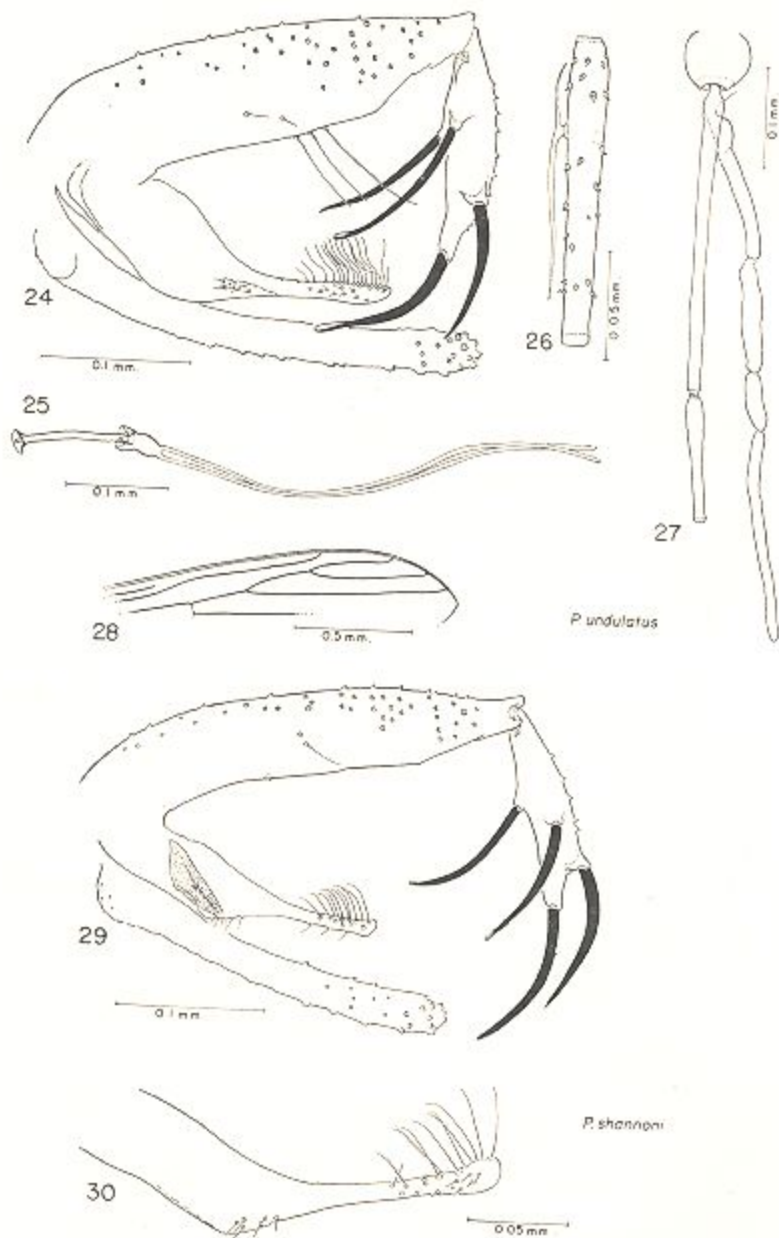
All figures of this and other plates were drawn by the authors with a camera lucida from balsam or copal-phenol-balsam slide mounts, unless otherwise indicated.



P. shannoni. All figures are from females except figs. 14-a, b. FIG. 7. Posterior end of cibarium, pigmented patch not shown. FIG. 8. Entire cibarium. FIG. 9. Third palpal segment, showing distribution of Newstead's scales. FIG. 10. A group of Newstead's scales enlarged. FIG. 11. Spermathecae, drawn in phenol before treatment with KOH to show outer envelope, which at times, as in this case, surrounds the "head." FIG. 12. Another spermatheca drawn in phenol before KOH treatment. FIG. 13. Same spermathecae as fig. 12, drawn in water after treatment with KOH. FIG. 14. First and second sternites, a, b, males; c, d, females.

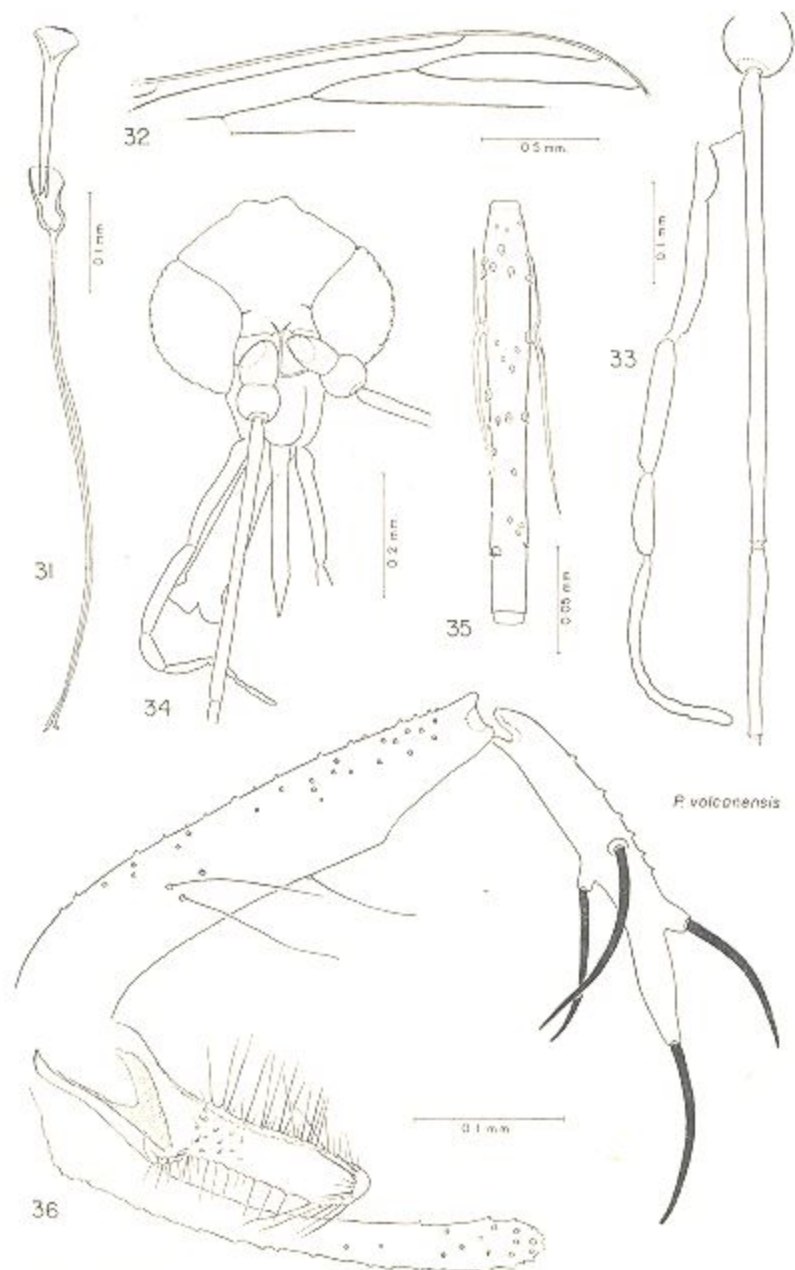
P. punctigeniculatus

P. punctigeniculatus. Figs. 15-20, males; figs. 21-23, females. FIG. 15. Male genitalia, inner aspect. FIG. 16. Genital filaments and pump. FIG. 17. Antennal segment IV, showing ascoids. FIG. 18. Palp and basal antennal segments. FIG. 19. Wing. FIG. 20. First and second sternites. FIG. 21. Spermatheca, drawn in phenol. FIG. 22. Posterior end of cibarium. FIG. 23. Entire cibarium.



P. undulatus, sp. nov. All figures are of males. FIG. 24. Male genitalia, inner aspect, slide no. 406, holotype. FIG. 25. Genital filaments and pump. FIG. 26. Antennal segment IV, showing ascoids. FIG. 27. Palp and basal antennal segments. FIG. 28. Wing.

P. shannoni. FIG. 29. Male genitalia, inner aspect, of the form with reduced numbers of setae on the parameres. FIG. 30. Paramere of fig. 29 at greater magnification.



P. volcanensis, sp. nov. All figures are of males. FIG. 31. Genital filaments and pump. FIG. 32. Wing. FIG. 33. Palp and basal antennal segments. FIG. 34. Head, dorsal view. FIG. 35. Antennal segment IV, showing ascoids. FIG. 36. Male genitalia, inner aspect, slide no. 652, holotype.