

PROCEEDINGS  
OF THE  
BIOLOGICAL SOCIETY OF WASHINGTON

FLEAS COLLECTED BY THE CHICAGO NATURAL HISTORY  
MUSEUM EXPEDITION TO THE PHILIPPINES, 1946-1947\*

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Our knowledge of the ectoparasite fauna of the Philippines is very scanty. Even such medically important insects as the fleas are poorly known, particularly from the higher elevations. Thompson (1), in 1938, listed only two species as having been recorded from the Philippines. The collection made by the Chicago Natural History Museum Expedition would therefore be appreciated for these reasons alone. Furthermore, a total of two new genera and five new species are represented, and the new forms present highly interesting adaptations, modifications and affinities. The two new genera are being described elsewhere (3, 4), and herein are described three new species. Once more I am indebted to Mr. Harry Hoogstraal, leader of the Expedition, and to the Chicago Natural History Museum, for some splendid contributions to the study of Siphonaptera.

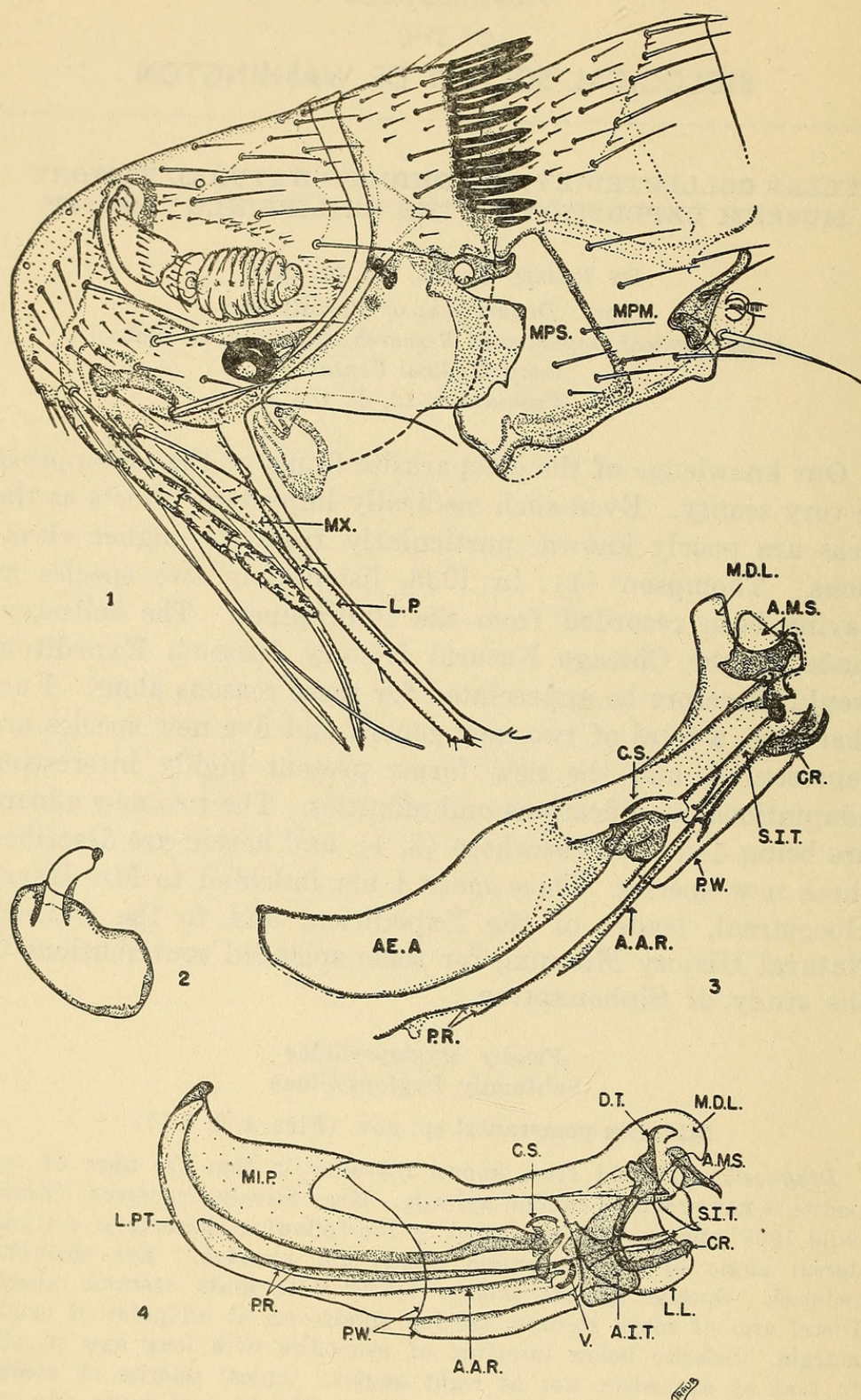
Family Pygiopsyllidae  
Subfamily Pygiopsyllinae

*Stivalius pomerantzi* sp. nov. (Figs. 1, 3, 5-10)

*Diagnosis.*—Distinct from known *Stivalius* in that the apex of exopodite is not produced caudad apically. Near *Stivalius robinsoni* (Rothschild 1905), but readily separated by the following characters: Anterior dorsal angle of metepisternum acute, not rounded. Eye somewhat reduced. Special spinose process below male ninth sternum absent. Distal arm of ninth sternum lacking spiniforms at midpoint of caudal margin. Sclerite below insertion of exopodite with long axis parallel to that of exopodite, not at right angles. Apical sclerite of median dorsal lobe of aedeagus apically truncate (fig. 3), not acute (fig. 4). Armature of inner tube of aedeagus reduced; not represented by a

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FIGURES 1 & 3 *STIVALIUS POMERANTZI* N. SP.

FIGURES 2 & 4 *STIVALIUS ROBINSONI* (ROTHSCHILD, 1905)



very large sclerite flanking each side of the tube. Trough of aedeagal endchamber extending only to near apodemal strut, not to cephalic third of aedeagus.

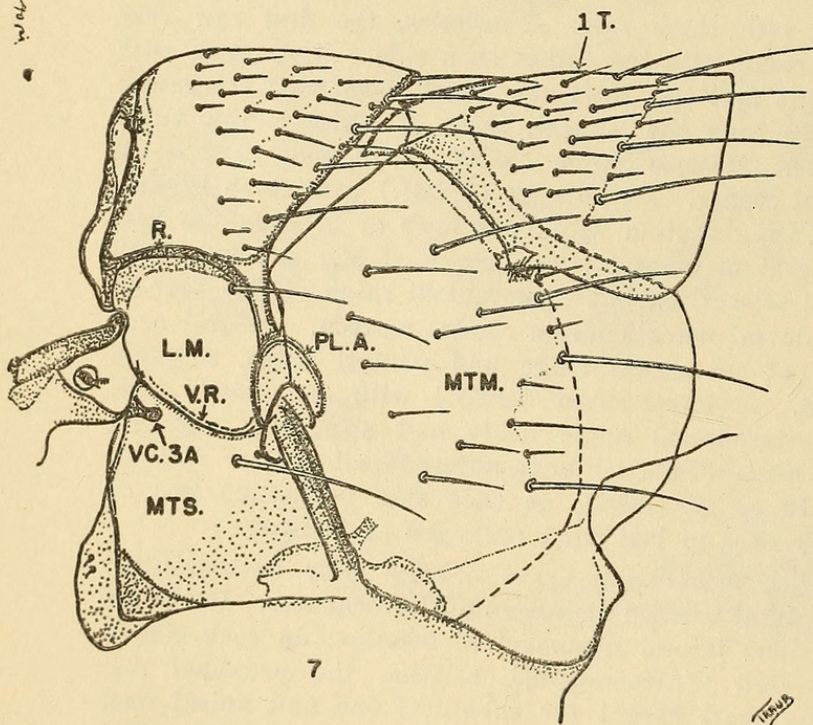
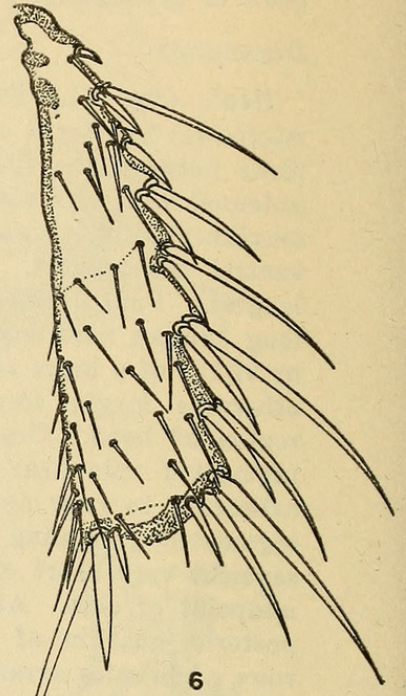
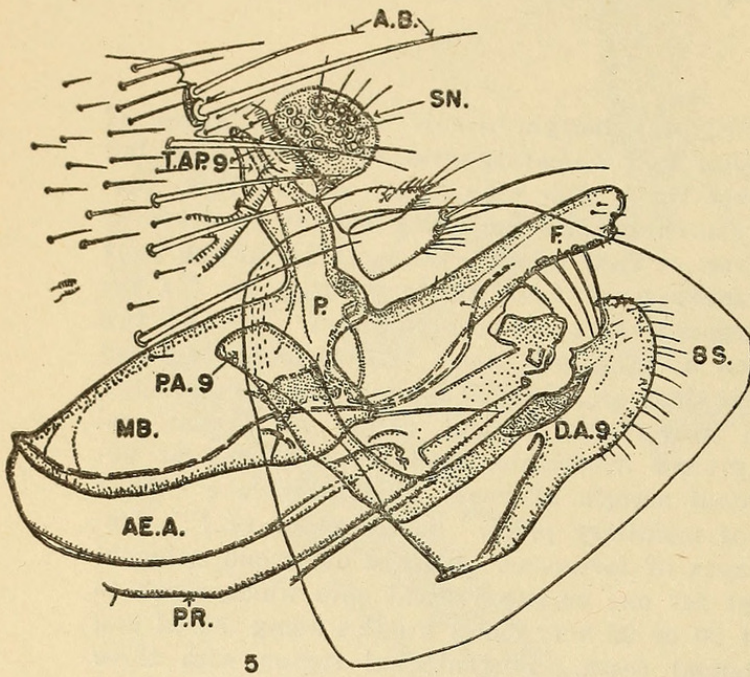
#### *Description*

*Head* (fig. 1).—Frontoclypeal margin evenly rounded. Pores of microsetae scattered anterior and dorsal to first row of bristles, but those between the first and third rows with larger setae. First preantennal row with six or seven bristles, excluding two at insertion of maxillary palpi. Second row of four bristles, the most dorsal and most ventral the longest. Third row of four, the uppermost by far the longest. Fourth row consisting of a small bristle near eye and two long bristles near insertion of maxillary lobe. Eye somewhat reduced by virtue of a large ventral sinus extending about one-third its diameter, otherwise large; located near posteroventral corner of preantennal region of head. Genal process acuminate, enclosing a triangular unpigmented area near ventral margin of head. Maxillary lobe (*MX.*) extending to near apex of maxillary palpi. Labial palpi (*L.P.*) five-segmented, extending to apex of forecoxae. Bristles of second antennal segment very short except for one or two ventral ones which reach to midpoint of club. About 20 or 22 very small bristles along dorsal and posterior margin of antennal fossa. Postantennal region with three rows of bristles arranged 3(4)-5-6 with a large intercalary bristle near antennal fossa, between basal bristles of second and third rows.

*Thorax*.—Pronotum with three rows of bristles, the first row very incomplete. Pronotal comb with ten spines on a side. Mesonotum with five rows of bristles, the first two rows very small, somewhat irregular; bristles of the last two rows the longest, those of ultimate row twice as long as penultimate. Mesepisternum (*MPS.*) with four bristles all near or in ventrocaudal corner. Mesepimere (*MPM.*) with seven bristles arranged as in figure. Metanotum with four rows of bristles, the first row incomplete. Lateral metanotal area (fig. 7, *L.M.*) distinct, with dorsal ridge (*R.*) well sclerotized but with ventral ridge (*V.R.*) feeble; with a bristle where dorsal margin meets caudal margin. Pleural arch (*PL.A.*) at junction of metanotal ridge and pleural ridge, strongly convex, well-developed. Metepisternum (*MTS.*) with one bristle near dorsocaudal angle; anterodorsal angle acute and upturned; with an accessory link or vinculum (*VC.3A.*) near anterodorsal angle. Metepimere (*MTM.*) with 16 or 17 bristles on each side (including two or three small intercalary ones in last row) arranged as in figure.

*Legs*.—Metacoxa with mesal thin short bristles near anteroventral angle, and with two lateral bristles at insertion of trochanter. Profemur with about 12 thin, short lateral nonmarginal bristles; on each side a row of widely separated ventromarginal bristles, the proximal one fairly long, the others short except for subapical one and apical one. Mesofemur with a similar row of ventromarginal bristles but with apical three long. Metafemur as mesofemur in this regard. Metatibia (fig. 6) with but one unpaired dorsolateral large bristle and five pairs of such bristles; with three apical bristles below the last pair, that near dorsolateral margin the longest, the middle one next longest. Metatibia with about 27 small lateral bristles, excluding strictly marginal ones.





STIVALIUS POMERANTZI N. SP.



Measurements of tibiae and segments of tarsi (petiolate base deleted) shown in microns:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	243	104	82	66	47	100
Meso-	330	190	118	83	58	112
Meta-	450	363	220	134	82	120

None of tarsal bristles reaching beyond apex of following segment. Fourth metatarsal segment only slightly wider apically than proximally. Fifth segment of pro- and mesotarsi with five lateral plantar bristles and four subapical ventral short stout bristles. Fifth metatarsal segment similar but with only two ventral subapical bristles.

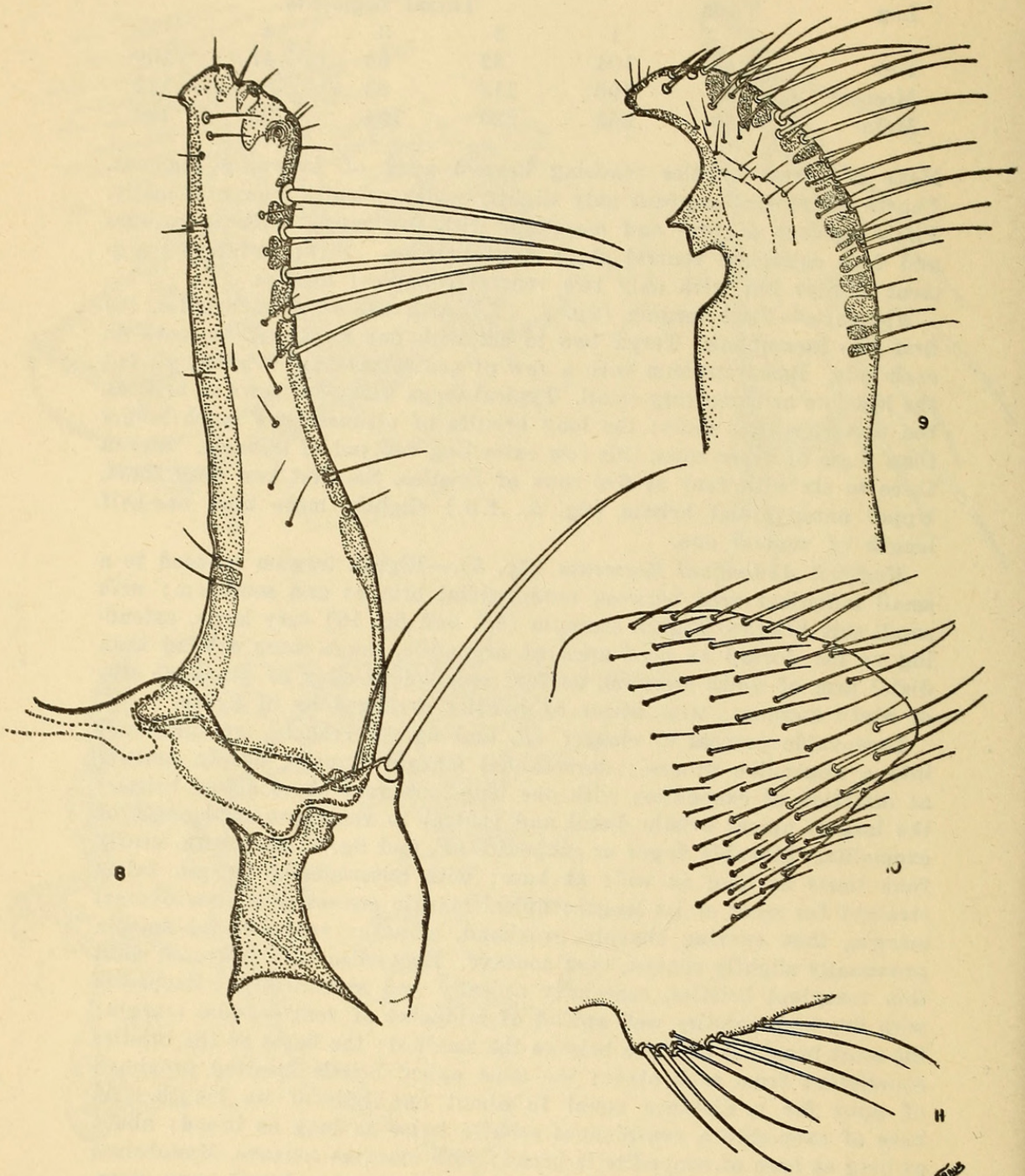
*Abdomen.*—First tergum (fig. 7, 1*T.*) with five rows of bristles, the first two incomplete. Terga two to six with one small apical tooth on each side. Basal sternum with a row of ventromarginal bristles, all but the last two or three very small. Typical terga with four rows of bristles, the first row very short; the long bristles of ultimate row much longer than those of other rows, this row extending ventrad of spiracle. Sterna three to six with four or five rows of bristles, the first two rows short. Upper antepygidial bristle (fig. 5, *A.B.*) slightly more than one-half length of ventral one.

*Modified Abdominal Segments* (fig. 5).—Eighth tergum reduced to a small indistinct area between antepygidial bristles and sensillum; with small thin bristles. Eighth sternum (8*S.* and fig. 10) very large, extending as far dorsad as near apex of exopodite, much more caudad than distal arm of ninth sternum, as far cephalad as apex of proximal arm of ninth sternum; with about 67 bristles arranged as in figure.

Immovable process of clasper (*P.* and fig. 8) reduced, not produced into a finger-like process; dorsocaudal margin sinuate, deeply concave at insertion of exopodite; with one long, one very short apical bristle; the largest apical bristle distal and ventral to ventroproximal angle of exopodite. Movable finger or exopodite (*F.* and fig. 8) very long, nearly four times as long as wide at base; with anterodorsal margin fairly straight for most of its length; apical margin convex near anterodorsal margin, then curving sharply proximad, sinuate; ventrocaudal margin proximally slightly convex, then concave. Exopodite with scattered short thin marginal bristles, especially apically and subapically. Exopodite with five long bristles well apicad of midpoint of ventrocaudal margin; the most proximal of these bristles the smallest; the bases of the bristles equidistant from each other; the most apical bristle inserted proximad of apex for a distance equal to about one-sixth of its length. At base of exopodite a conspicuous sclerite twice as long as broad; about as long as base of exopodite is broad; with margins concave. Manubrium (*MB.*) broad, almost half as broad as long, even broad near apex. Ninth tergum greatly reduced to an indefinite area between its apodeme and clasper lobe.

Ninth sternum roughly boomerang-shaped. Proximal arm of ninth sternum (*P.A.9*) truncate apically. Distal arm of ninth sternum (*D.A.9* and fig. 9) broad; apical half of ventral margin strongly convex; talon-like apically; dorsal margin biconcave, the lobe between the con-





FIGURES 8 TO 10 *STIVALIUS POMERANTZI* N. SP.  
FIGURE 11 *STIVALIUS RALIUS* N. SP.



cavities also with a sinus; with three subapical short stout bristles, almost suggesting spiniforms, on ventral margin; with about 20 long or longish ventromarginal bristles extending proximad nearly to midpoint; no bristles on dorsal margin, except for one subapical small one.

Aedeagal apodeme (fig. 3, *AE.A.*) slightly longer than aedeagus proper. Trough of endchamber extending slightly cephalad of apodemal strut. Wall of aedeagal pouch (*P.W.*) ventrally fairly well sclerotized. Median dorsal lobe (*M.D.L.*) bifid apically, each branch truncate, the upper one subvertical. Within each side of median dorsal lobe, a large apical sclerite (*A.M.S.*) which consists of a more heavily sclerotized mesal portion and a larger, more dorsal, lateral, less sclerotized section. Ventral portion of endchamber obscured by distal arm of ninth sternum in specimens extant. A sickle-shaped sclerite (*CR.*) denoting ventro-apical portion of crochets. Sclerotized inner tube (*S.I.T.*) straight, relatively unarmed, ventral in position. Apodemal strut supporting inner tube of usual type, but lobes not sharply differentiated. Crescent sclerite (*C.S.*) well developed. Penis rods (*P.R.*) uncoiled, short, not reaching to cephalic end of aedeagal apodeme; united for virtually all their length. Aedeagal apodemal rod (*A.A.R.*) present, arising from base of aedeagus. Vesicle (*V.*) at apex of *A.A.R.* fairly well-developed.

Tenth abdominal segment conspicuous by virtue of the large convex sensillum (fig. 5, *SN.*), which is almost as high as long. Dorsal lobe of proctiger with a subapical row of bristles and very small dorsomarginal ones. Ventral lobe of proctiger with ventromarginal bristles at apical half; the apical bristles very long.

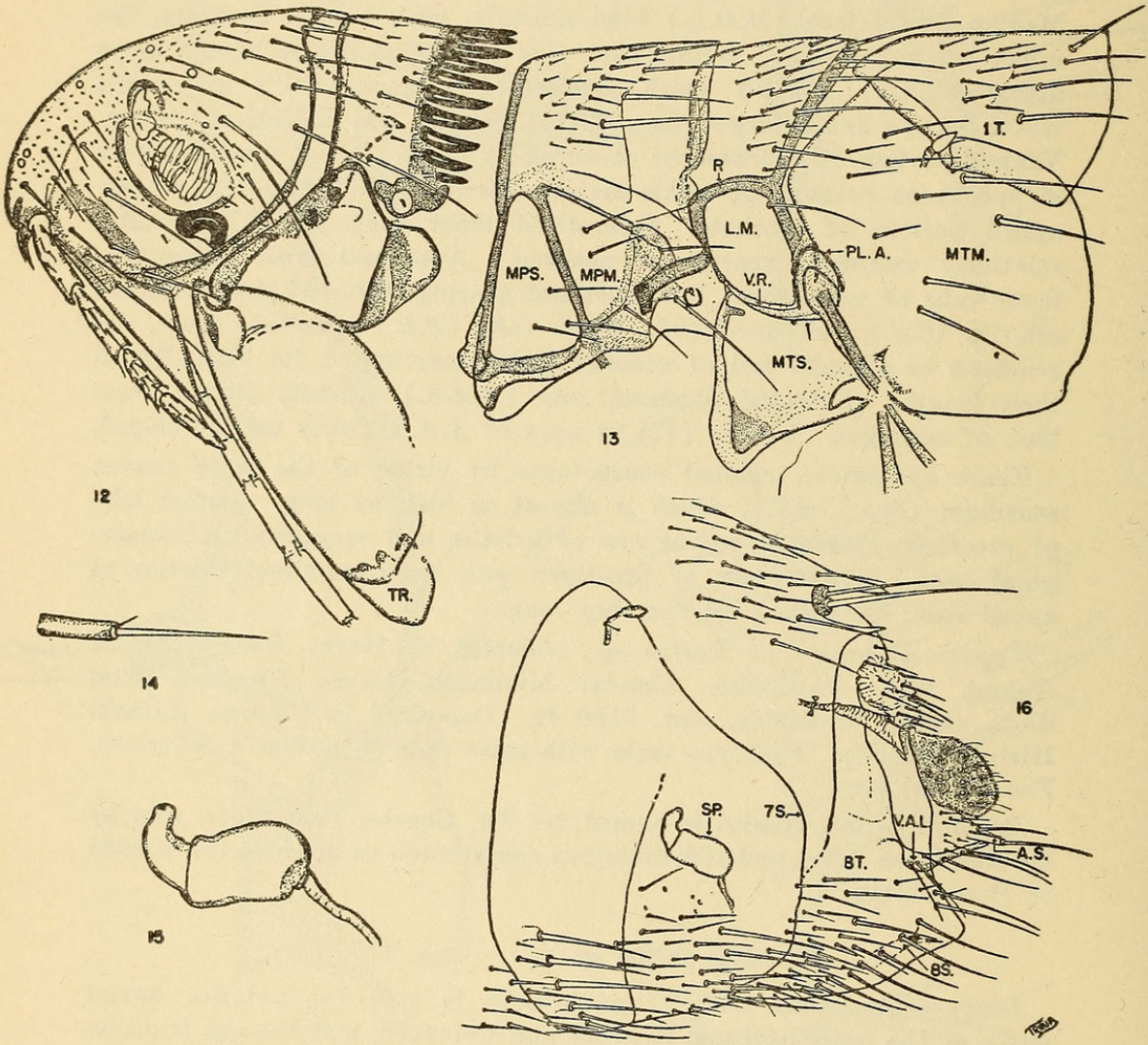
*Types.*—Holotype ex *Rattus* sp., collected by Harry Hoogstraal, 20 August 1946. Philippine Islands: Mindanao, Davao Province, East Slope of Mt. McKinley, elev. 3300 ft. Deposited in Chicago Natural History Museum. Paratype male with same data in author's collection. Female unknown.

*Remarks.*—This species is named for Mr. Charles Pomerantz, who by his studies on mites and rickettsialpox contributed so much to the science of Parasitology.

*Stivalius ralius* sp. nov. (Figs. 11-16)

*Diagnosis.*—Agrees with *S. pomerantzi* in that the anterior dorsal angle of the metepisternum is acute and upturned, and the eye is somewhat reduced. Distinct in that there are two almost contiguous marginal sensory pits on clypeus, not one; the preantennal region bears 14 longish bristles, not 16; the mesepisternum three bristles, not four; the mesepisternum five, not seven, the metepisternum 11 longish bristles, not 13 or 14; the metatibiae bear two stout unpaired dorsomarginal bristles following the first paired set, not merely one; metatibia with only about 20 small lateral bristles; the labial palpi extend beyond apex of forecoxae instead of to near apex. Readily separated from *S. robinsoni* (Rothschild 1905) by the absence of a distinct sinus on the seventh sternum, by the fact that the tail of the spermatheca (fig. 15) does not distinctly enter the head and by the absence of the deep median dorsal sinus on the spermatheca (fig. 2, *S. robinsoni*).





STIVALIUS RALIUS N. SP.



*Description.*

*Head, Thorax.*—(Only salient differences from *S. pomerantzi* are included here. Distinctions believed to be secondary sexual characteristics, such as shape of head and length of antennae, are excluded.) Preantennal region with bristles arranged roughly 4-3-4-2-1, the median bristle at eye level the longest (fig. 12). Unpigmented portion of eye extending to about midpoint of eye. Postantennal bristles 5-6-7, and, in addition, a large intercalary bristle near midpoint of antennal fossa. Labial palpi extending to about middle of trochanter. Bristles of mesepisternum (fig. 13, *MPS.*) arranged 1-2; those of mesepimere (*MPM.*) arranged 3-2. Metepisternum (*MTS.*) with apparently two bristles, at least one very small. Metepimere (*MTM.*) with six bristles anterior to and/or slightly ventral to spiracle, and two longer ones caudad of spiracle; three additional bristles on ventral half.

*Legs.*—Femora lacking a complete row of ventromarginal bristles, but with two proximal ventromarginal bristles on pro- and mesofemora, and three on metafemora. (In *Stivalius*, the females frequently have fewer such bristles than the males.) Dorsolateral bristles of metatibiae arranged 1-2-1-1-2-2-1-3. Measurements of tibiae and segments of tarsi (petiolate base deleted) shown in microns:

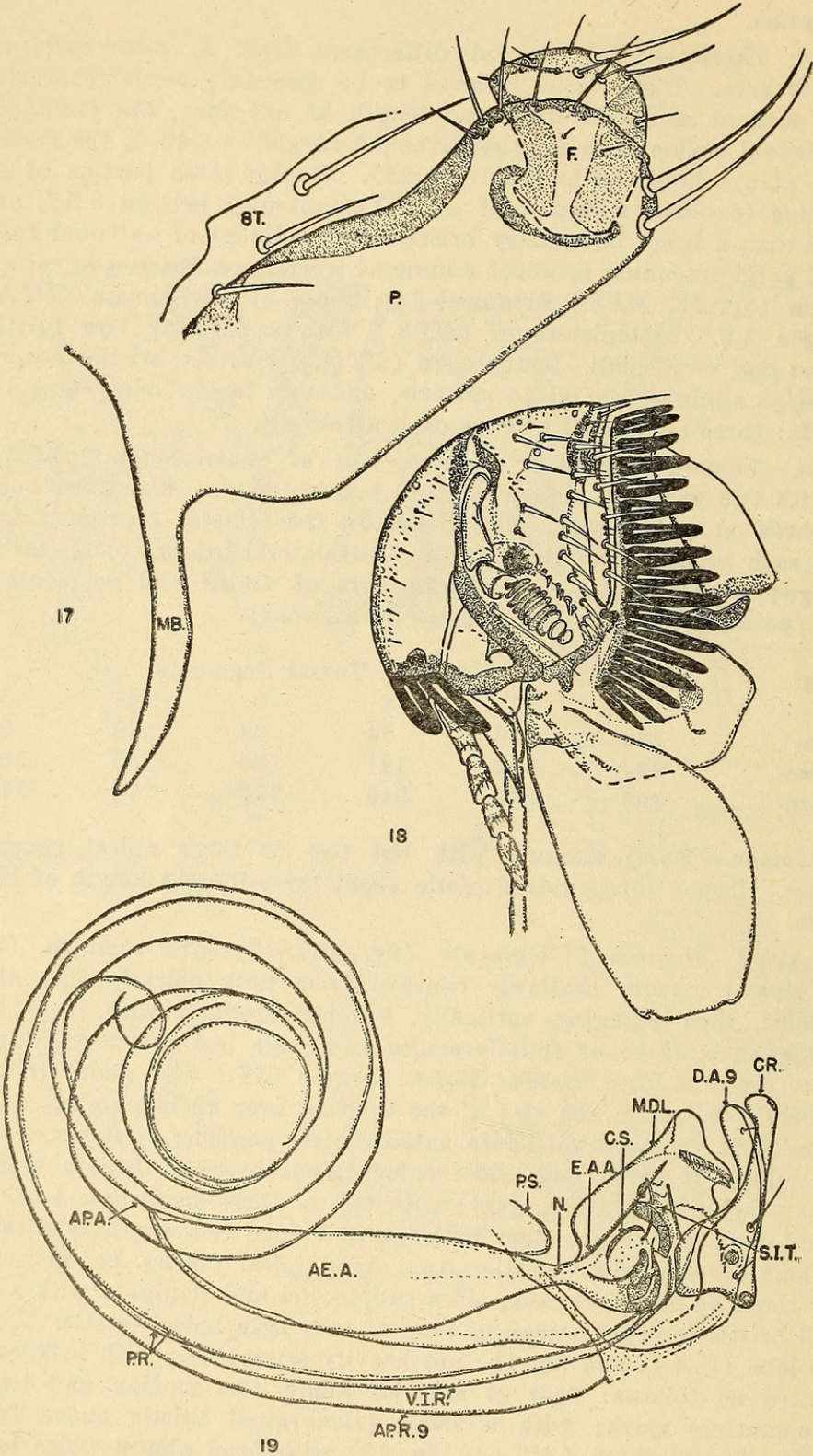
Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	220	110	74	63	46	95
Meso-	330	193	121	80	45	101
Meta-	495	372	240	137	78	110

*Abdomen.*—Basal sternum with but two or three apical marginal bristles. Upper antepygidial bristle about three-fourths length of lower bristle.

*Modified Abdominal Segments* (fig. 16).—Seventh sternum (7*S.*) with dorsal margin shallowly concave from near spiracle just above midpoint, then plunging vertically. Seventh sternum with more than 30 bristles in three or four irregular rows, the last row consisting of five or six very long bristles. Eighth tergum (8*T.*) with about 12 small bristles by spiracle; the rest of the bristles, over 40 in number, on the ventral half, most crowded into anteroventral portion; most conspicuous is a fringe of seven long stout submarginal bristles. Eighth sternum (8*S.*) very reduced, inapparent; with two or three small apical bristles. Dorsal anal lobe of proctiger with ten or twelve very small bristles and one long dorsomarginal bristle. Anal stylet (*A.S.* and fig. 14) more than four times as long as broad; sides subparallel and straight; with a very small bristle inserted dorsad of base of very long apical bristle. Ventral anal lobe (*V.A.L.* and fig. 11) not heavily sclerotized; with bristles distributed as follows: four at anterior angle, two median and two at three-quarters mark; with a small submarginal bristle above fourth bristle. Spermatheca (*SP.* and fig. 15) with head almost twice length of tail but scarcely broader at point of insertion; dorsal and ventral margins of head subparallel in the main.

*Type.*—Holotype a female *ex* undetermined species of *Apomys*, Philippine Islands, Mindanao, Davao Province, East Slope of Mt. McKinley,





THAUMAPSYLLA LONGIFORCEPS N. SP.



elev. 3100 ft. Collected by Floyd Werner, 23 September 1946. Deposited in Chicago Natural History Museum. Male unknown.

*Remarks.*—This specimen may prove to be the female of *S. pomerantzi* sp. nov. However, the differences listed in the diagnosis seem too great to be merely sexual.

*Stivalius robinsoni* (Rothschild 1905)

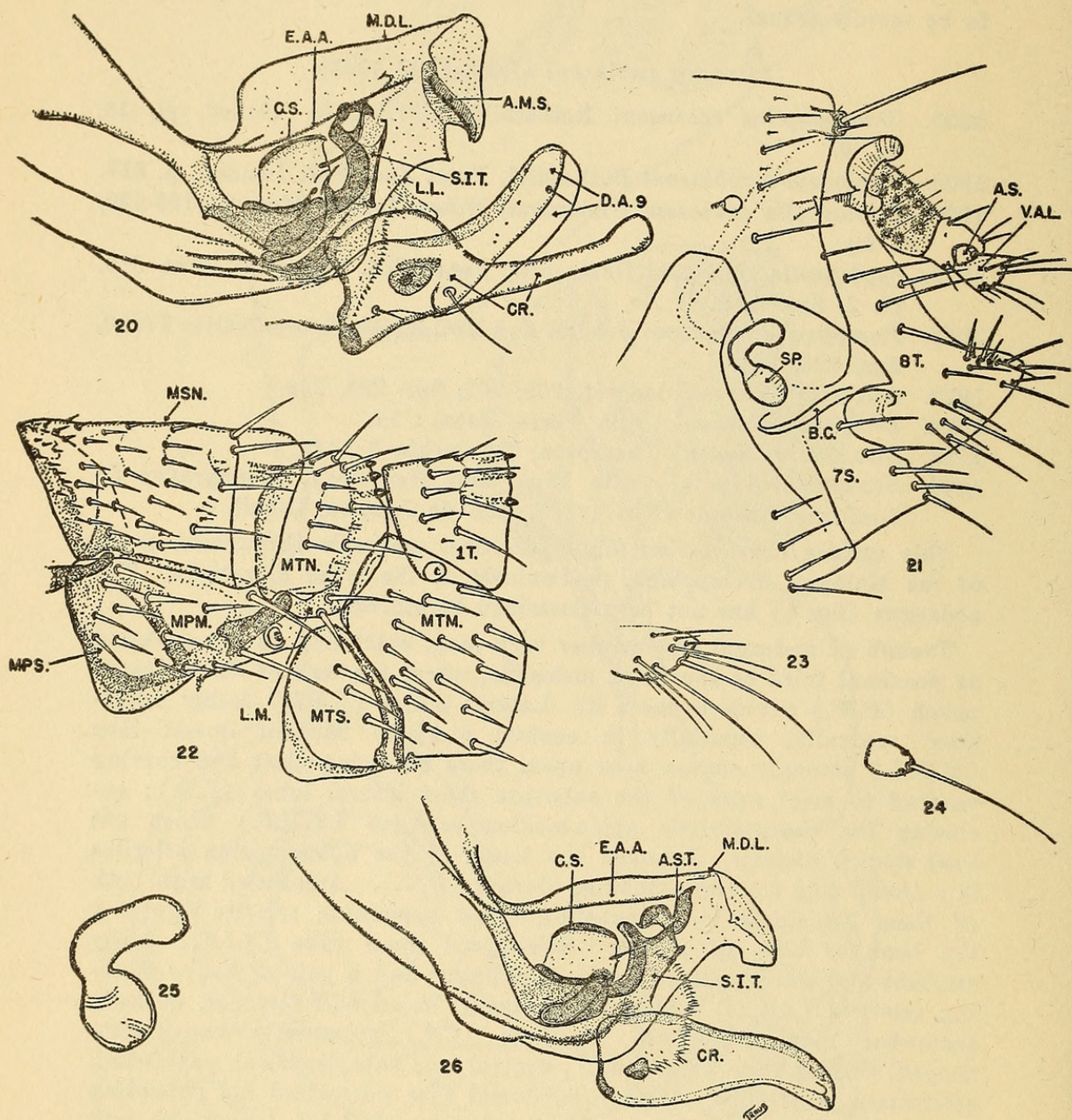
1905. *Ceratophyllus robinsoni* Rothschild, Nov. Zool. 12:483, pl. 13, fig. 6.  
1908. *Pygiopsylla robinsoni* Rothschild, Proc. Zool. Soc. London, p. 617.  
1909. *Pygiopsylla robinsoni* Oudemans, Notes, Leiden Mus. 31:195-200, 1 fig.  
1919. *Pygiopsylla robinsoni* Rothschild, Jour. Fed. Malay St. Mus. 8:5, pl. 2, figs. 4, 5.  
1922. *Pygiopsylla robinsoni* Jordan and Rothschild, Ectoparasites 1:230, figs. 223, 224.  
1922. *Stivalius robinsoni* loc. cit. 259, 265, figs. 223, 224.  
1924. *Stivalius robinsoni* Dalla Torre, Catal.: 11.  
1938. *Stivalius robinsoni* Thompson, Teminekia 3:144.  
1946. *Stivalius robinsoni* Costa Lima and Hathaway, Monografias do Instituto Oswaldo Cruz 4:325. Rio de Janeiro, Brazil.

This species characteristically parasitizes squirrels throughout much of the Malayan Archipelago, particularly at the lower elevations. The aedeagus (fig. 4) has not been described heretofore.

Trough of aedeagal endchamber very long, extending as far cephalad as proximal third or fourth of aedeagus, where the wall of the aedeagal pouch (*P.W.*) curves to meet it. Lateral plates (*L.P.T.*) feebly sclerotized ventrally, especially in central section. Median dorsal lobe (*M.D.L.*) strongly convex near apex, there becoming cleft and curving ventrad to meet apex of the subovate short lateral lobes (*L.L.*); enclosing the characteristic apico-median sclerites (*A.M.S.*) which are beak-shaped distally. Between the bases of the apico-median sclerites is a thumb-like sclerite extending dorsad (*D.T.*). Associated with both of these structures is a ventrad-directed acuminate sclerite opposing the beak or claw of *A.M.S.* Sclerotized inner tube (*S.I.T.*) fairly straight and simple except for a dorsal spur and a pair of heavy flanking sclerites (*A.I.T.*) which are ventrally broad and straight, dorsally somewhat bluntly pointed. Crochets (*CR.*) apparently boomerang-shaped, arising from near *A.M.S.*, ventral arm subcylindrical, paralleling sclerotized inner tube. With a subdorsal thin sclerotized rod extending cephalad from near base of *A.M.S.* and apex of *A.I.T.* to a point well past the apodemal strut. Crescent sclerite (*C.S.*) well-developed. Apodemal strut somewhat of usual type, but with ventral lobe extending below level of the penis rods. With a well-developed vesicle (*V.*) at apex of aedeagal apodemal rod (*A.A.R.*). Penis rods (*P.R.*) short, thick, uncoiled, united for virtually all their length.

*Records.*—(All from Palawan Province, at or near sea level, unless otherwise specified): 1♂ *ex Sciurus*, Palawan Islands, Brook Point, Coll. D. Rabor, 2 May 1947 (R.T. #6509); 1♀, *ibid* but Coll. M. Celestino, 28 April (R.T. #6505); 2♂♂ *ex Tupaia*, loc. cit., Coll. D.





FIGURES 20 TO 25 THAUMAPSYLLA LONGIFORCEPS N. SP.

FIGURE 26 THAUMAPSYLLA BREVICEPS ROTHSCHILD 1907



Rabor, 26 April 1947; 1 ♂, 2 ♀ ♀ *ex Sciurus*, Palawan Island, Lapulapu, Iwahig, Coll. F. Werner, 4 March 1947 (R.T. #6507); 1 ♂ *ex Sciurus*, Culion Island, Siuk, Coll. M. Celestino, 4 April 1947 (R.T. #6499); 2 ♂ ♂, 3 ♀ ♀, *ibid* but 5 April (R.T. #6500); 2 ♂ ♂, 2 ♀ ♀, *ibid* but 7 April (R.T. #6502); 1 ♂, *ibid* but at Mohupa, Coll. H. Hoogstraal, 28 March 1947 (R.T. #6496); 1 ♂, *ibid* but 8 April (R.T. #6501); 1 ♂, 2 ♀ ♀, *ex Paradoxurus* (Palm Civet), Culion Island, San Pedro, Coll. H. Hoogstraal, 29 March 1947 (R.T. #6497); 1 ♂, 1 ♀, *ex Sciurus*, *ibid* (R.T. #6498); 1 ♀ *ex Sciurus*, Palawan Islands, Puerto Princesa, Bacungan, Coll. G. Castro, 21 March 1947 (R.T. #6511); 1 ♂, *ibid* but Coll. F. Werner, 30 March 1947; 1 ♂, 1 ♀, *ex Viverra zibetha*, Palawan Prov., Busuanga Island, Dimaniang, Coll. H. Hoogstraal, 16 and 19 March 1947 (R.T. #6493 and #6494); 1 ♂ *ex Tupaia*, *ibid* but 22 March 1947; 6 ♂ ♂, and 4 ♀ ♀, *ex Sciurus*, *ibid* but 17 March (R.T. #6492); 1 ♀ *ex Sciurus*, Cotabato Prov., Mindanao, Upi, Burungkok, elev. 1500 ft., Coll. F. Werner, 8 January 1947 (R.T. #6520).

*Stivalius spiramus* Jordan 1926

Advantage is taken of this paper on Philippine records to include a note from Dr. Karl Jordan (*in litt*). He states that his *Stivalius spiramus* (1926) is at most a subspecies of *Stivalius cognatus* J. & R. 1923; he was misled by the badly preserved females available at time of description.

Family Ceratophyllidae

Subfamily Ceratophyllinae

*Dasypsyllus gallinulae* (Dale, 1878)

This species was supposed to be holarctic, but I have a series from Panama, which, altho showing some slight differences, is still regarded as representing the typical form (verified by Dr. Karl Jordan). The occurrence of this species in the Philippines is even more surprising. The genus occurs in the Malayan Archipelago, *D. klossi* Rothschild 1919 (female only) having been described from Sumatra. The morphological differences of the Philippines specimen probably do not validate the erection of a subspecies.

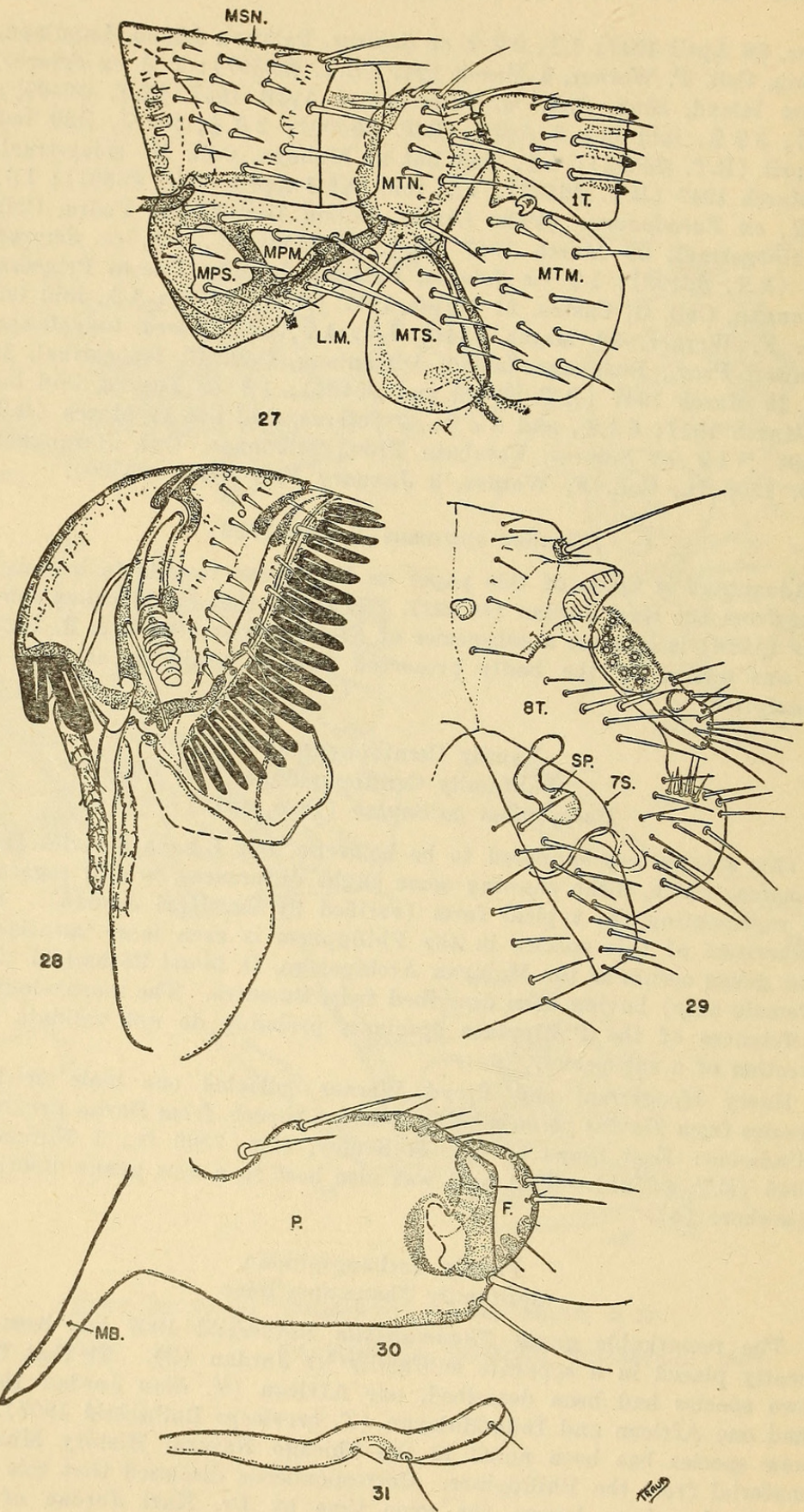
Harry Hoogstraal and Floyd Werner collected one male of this species from *Turdus poliocephalus kelleri*, a thrush, from Davao Province, Mindanao: East Slope of Mt. McKinley, elev. 7800 ft., 1 November 1946 (R.T. #6529). This bird was also host to a new genus described elsewhere (4).

Family Ischnopsyllidae

Subfamily Thaumapsyllinae

The remarkable genus *Thaumapsylla* Rothschild 1907 has been recently placed in a separate subfamily by Jordan (2). At that time, two species had been described, one African (*T. dina* Jordan 1937), and one African and Indo-Malayan (*T. breviceps* Rothschild 1907). A new species has been noted in the Chicago Natural History Museum material from the Philippines. Correspondence disclosed that this new species has been known for some time by Dr. Karl Jordan of the





THAUMAPSYLLA BREVICEPS ROTHSCILD 1907



British Museum at Tring and by Mr. G. H. E. Hopkins, who is now also working at Tring. At their suggestion, this species is described by me at this time. I wish to thank Dr. Jordan and Mr. Hopkins for their generosity and for furnishing additional records.

***Thaumapsylla longiforceps* sp. nov.**

*Diagnosis.*—Close to *Thaumapsylla breviceps* Rothschild 1907 but readily separated by the following characters. Immovable process of clasper (fig. 17, *P.*) much longer, being nearly thrice as long (measured from dorsocaudal angle of manubrium) as the fifth metatarsal segment; its dorsal margin with a shallow sinus; the caudal margin rounded. In *T. breviceps*, *P.* (fig. 30) is only about twice the length of the fifth metatarsal segment; its dorsal margin is convex; its caudal margin above the acetabular bristles is virtually straight. In the new species, the exopodite *F.* (fig. 17) extends above the dorsal margin of *P.*; in *T. breviceps* the apex of *F.* is below the dorsal margin of *P.* In *T. longiforceps*, the aedeagal crochets (fig. 20, *CR.*) are cleaver-shaped with the handle pointing distad and somewhat subglobular apically; there is a sclerotized fold (*A.M.S.*) near the apex of the dorsal lobes of the aedeagus (*M.D.L.*), but no heavy sclerite at the apex of the sclerotized inner tube. In *T. breviceps* the aedeagal crochets (fig. 26, *CR.*) are of a very different shape, being smaller, narrowing only gradually, apically subacuminate and curved ventrad or caudad; *A.M.S.* is inapparent, but there is a well-developed sclerite (*A.S.T.*) by the apex of the sclerotized inner tube.

In the new species the basal abdominal sternum of the female bears two bristles, rarely one; the seventh sternum (fig. 21, *7S.*) bears about five to eight long bristles (usually five or six, rarely eight) and has a very large sinus; the lobe above the sinus somewhat acuminate. In *T. breviceps* the basal sternum is nude, while the seventh sternum (fig. 29, *7S.*) bears about eight to eleven bristles (usually eight or nine) and has a very small sinus, the dorsal lobe of which is rounded.

In *T. longiforceps*, the posterior row of postantennal bristles consists of an uninterrupted row of about 11 or 12 bristles, whereas in *T. breviceps* this row typically consists of about eight or nine bristles, a gap occurring between about the sixth and eighth bristles near/on the dorsal heavily sclerotized area. Other differences in chaetotaxy, altho somewhat variable, are pointed out in the description of *T. breviceps* which follows that of the new species.

*Description.*

*Head* (fig. 18, male).—Frontoclypeal margin evenly rounded. With a submarginal row of five short thin bristles; between each of these bristles an irregular row of three to six tiny setae. With one very long bristle inserted along middle of anterior antennal ridge. Cephalic comb consisting of two subtruncate stout spines. Genal process broad, somewhat rounded. Eye reduced to a mere vestige in lower genal angle. Maxillary lobe extending to about third segment of maxillary palpi. Labial palpi extending somewhat less than three-fourths the length of the forecoxae. Bristles of second antennal segment minute. With about three to five short stout bristles bordering dorsal ridge



above antenna; postoccipital region with three rows of bristles: the first row consisting of two or three short stout bristles, the ventral (or middle) one much the longer; the second row of three or four short stout bristles (in male, an additional clump of three to six tiny hairs beneath and between the ventral two large ones); the third row of about ten to twelve stout bristles, the lowest two or three at antennal groove shorter than the rest, the uppermost three or four inserted on a densely sclerotized area.

*Thorax*.—Pronotum very short, with a row of six bristles; densely sclerotized beneath the uppermost two of these; the row of bristles set off from the comb is bordered by a vertical suture with non-sclerotized margins; with two very small intercalary bristles between the larger ones. Pronotal comb remarkable for its length, extending well onto prosternum; consisting of about 17 spines on a side. Mesonotum (fig. 22, *MSN*.) with a posterior row of five long stout bristles, with two to four tiny hairs intercalated between the bases of all but the upper two of this row; with about 23 additional shorter thicker bristles irregularly arranged in three or four rows and, in addition, anterior to these 10-15 much shorter submarginal bristles or hairs. Mesonotal flange usually with two mesal pseudobristles, probably presenting vestigial spiniforms. Mesepisternum (*MPS*.) variable, frequently with six bristles arranged 3-2-1. Mesepimere (*MPM*.) with about six to eight bristles, including those on the sclerotized band between the two sclerites. Metanotum (*MTM*.) with two rows of bristles, those of posterior row about twice the length of those of first row; with three apical spinelets on each side. Lateral metanotal area (*LM*.) not set off as a distinct sclerite, its dorsal ridge not sclerotized; with two bristles. Lacking a definite pleural arch at junction of metanotal ridge and pleural ridge. Metepisternum (*MTS*.) with three bristles near posterior margin. Metepimere (*MTM*.) with 16-21 bristles, arranged somewhat as in figure.

*Legs*.—Procoxa heavily bristled from base to apex, but mesocoxa nude except for a few apical bristles; metacoxa nude except for some sub-apical and apical bristles. Tibiae with many of dorsolateral bristles unpaired, forming a prominent comb. Protibia and mesotibia each with a row of four or five lateral bristles; metatibia with seven or eight in this row; in each case the apical bristle is inserted near the three-fourths mark.

Measurements of tibiae and segments of tarsi (petiolate base deleted) shown in microns:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	165	39	47	42	36	88
Meso-	253	61	69	66	44	88
Meta-	357	132	102	72	44	88

Fifth segment of all tarsi with four pairs of lateral plantar bristles and a basal pair displaced toward midline, inserted between first lateral pair.

*Abdomen*.—First tergum (*1T*.) with two rows of stout bristles, those of second row much longer; with three apical spinelets on each side. Basal sternum with two (rarely one or three) lateral bristles. Sterna



two and three with about four long bristles, usually preceded by about three tiny hairs. Usually only the anterior abdominal terga have the first row of bristles developed; the second row of bristles extending ventrad of spiracle. Middle antepygidial bristle well-developed, others minute, altho ventral one slightly longer than upper.

*Modified Abdominal Segments. Male.*—Eighth tergum with two or three long bristles posterior to spiracle (fig. 17, 8T.). Eighth sternum large, about twice as broad as long; caudal margin straight; with four submarginal large bristles. Immovable process of clasper (fig. 17, P.) very long, about two and one-half times as long as broad (measured from origin of manubrium), dorsal margin sinuate, the shallow sinus at apical two-thirds; with four or five thin marginal bristles as dorsal margin curves ventrad; caudal margin convex; ventral margin concave at junction with manubrium but soon becoming convex, then fairly straight to insertion of two stout acetabular bristles at junction with caudal margin. Exopodite (F.), or movable finger, longer than broad and slightly broader at apex than near base; slightly inclined cephalad; apical margin evenly convex; apical margin with five bristles, the middle one of which is longer than the first two, the fourth by far the longest, the fifth next longest, and with three additional submarginal bristles below these; with one short bristle on posterior margin. Manubrium (MB.) as measured from union with ventral margin of P., almost half again as long as P. is broad; apex curving cephalad. Ninth sternum with proximal arm feebly sclerotized and indistinct. Distal arm of ninth sternum (fig. 20, D.A.9) long, well-developed; arched near insertion of crochet, particularly so at dorsal margin; digitoid in shape, but true ventral portion feebly sclerotized, its margin difficult to see; apex rounded; usually with but three bristles, one proximal, on ventral margin, the second submarginal and inserted near apex of ventral arch, the third bristle is subapical and borders what, at first glance, appears to be the ventral margin but in reality is a sclerotized line. With a very coiled long apodemal rod (fig. 19, AP.R.9) arising from angle of ninth sternum.

Aedeagal apodeme (fig. 19, AE.A.) about twice as long as endchamber, the limits of which are denoted by the well-developed proximal spur (P.S.); apodeme with a long partially coiled apical appendage (AP.A.). Aedeagus with a definite constriction or neck (N.) between proximal spur and aedeagal apodeme. Penis rods (P.R.) extremely long and coiled. Ventral intramural rod (V.I.R.) present. The endchamber dominated by the huge characteristic well-articulated crochets (CR. and fig. 20) which are roughly cleaver-shaped, the blade broad and proximal in position and almost as long as the handle; anterior border with a ventral convexity; apex of crochet expanded, knobbed. Median dorsal lobe (M.D.L.) bifid at apex, its ventro-apical margins acute and associated on each side with a sclerotized ridge (A.M.S.) probably representing undeveloped apicomedian sclerites. With a conspicuous angulate sinus between end of lateral lobes (L.L.) and apex of M.D.L. Crescent sclerite (C.S.) long, well-developed; above it on each side an anterior extension of the aedeagal apodeme (AE.A.). Sclerotized inner tube (S.I.T.) relatively straight, simple, unarmored, but with the rudiments of an apical sclerite.



*Modified Abdominal Segments. Female.*—Seventh sternum (fig. 21, 7S.) narrow, about twice as high as long; caudal margin deeply excised at midpoint forming a large sinus, diameter of sinus greater than that of spermatheca; lobe above sinus acuminate; ventral border of sinus obtuse. Seventh sternum usually with a row of five or six long bristles, rarely with seven or eight, but in those cases the supernumerary ones smaller and/or out of line. Eighth tergum (8T.) with about one marginal and four lateral bristles well below sensillum, a patch of about six ventral or subventral ones, and in apical ventral lobe a group of about 12 marginal and submarginal bristles, some quite small. Anal stylet (A.S. and fig. 24) small and broad, less than twice as long as broad, with a long apical bristle, the ventral and dorsal bristles represented by minute vestiges. Dorsal anal lobe with about three dorso-marginal bristles, one of these proximal, two apical; with two bristles at ventrocaudal angle. Ventral anal lobe (V.A.L. and fig. 23) relatively lightly sclerotized and with a total of about four bristles at lower angle, and about six near upper angle, including two very long stout marginal or submarginal bristles which are the most median of each group. Spermatheca (SP. and fig. 25) with a subglobular head and a tail which is longer than the head, upturned and apically dilated. Bursa copulatrix (B.C.) gently sinuate.

*Types.*—Holotype male and allotype female *ex Rousettus*, Mindanao, Davao City, Sitio Tegato, Luangbay Cave, 22 October 1946, Coll. H. Hoogstraal. Deposited in Chicago Natural History Museum. *Paratypes.*—4 ♂♂, 2 ♀♀ with same data (R.T. #6521) as holotype; 13 ♂♂, 9 ♀♀ *ex* "bat," Davao Province, Davao Gulf, Samal Is., Tawang, Bat Cave, sea level, Coll. H. Hoogstraal, 2 December 1946 (R.T. #6530); 1 ♀ *ex Eonycteris robusta*, Cotabato Province, Mindanao, Cotabato City, Central Cave, sea level, Coll. F. Werner 1947, (R.T. #6518). Paratypes deposited in U. S. National Museum, British Museum, Rocky Mountain Laboratory of U. S. Public Health Service, Canada Dept. of Agriculture, the author's collection and elsewhere.

*Remarks.*—It is interesting to note that Mr. Hoogstraal collected this species and *T. breviceps* simultaneously from the same set of bats (R.T. #6530).

The British Museum has records of this species from the Philippines, Java, and Borneo.

#### *Thaumapsylla breviceps* Rothschild 1907

The distinguishing characteristics of the species have been given in the diagnosis of *Thaumapsylla longiforceps*. The following description lists only other differences, but it should be noted that the chaetotaxy is somewhat variable in both species.

The gap in the postantennal row of bristles (fig. 28) is equal to about one-third to one-half of the length of the row. The mesonotum (fig. 27) bears a total of about 22-24 bristles, ignoring the tiny submarginal ones. Usually with four apical spinelets on each side of metanotum and first tergum. The most apical of the lateral bristles of the protibia proximad of midpoint or at level of midpoint.

Immovable process of clasper (fig. 30, P.) definitely less than twice as long as broad; dorsal margin with four thin bristles near height of



convexity; caudal margin straight or slightly concave above acetabular bristles. Exopodite (*F.*) without submarginal dorsal bristles. Male ninth sternum with distal arm long and narrow, the sclerotized portion distad of the arch more than thrice as long as broad (fig. 31). Aedeagus (fig. 26) with a twisted curved fusiform sclerite (*A.S.T.*) dorsad of apex of sclerotized inner tube. Lacking sclerotizations characteristics of or suggesting *A.M.S.* Apicoventral border of median dorsal lobe straight. Crochet (*CR*) at midpoint more than two-thirds as broad as base, slightly constricted here; apex slightly pointed, inclined downwards.

Female seventh sternum (fig. 29, *7S.*) with sinus definitely less in diameter than head of spermatheca; with seven to eleven (usually eight or nine) bristles, two of these usually ventromarginal. Bursa copulatrix somewhat S-shaped.

*Records.*—2 ♂♂, 4 ♀♀ *ex Rousettus*, Mindanao, Davao City, Sitio Tegato, Luangbay Cave, sea level, Coll. H. Hoogstraal, 22 October 1946 (R.T. #6521); 3 ♂♂, 5 ♀♀ *ex* "bat," Davao Province, Davao Gulf, Samal Is., Tawang Cave, sea level, Coll. H. Hoogstraal.

In the British Museum are specimens from South Africa, Ceylon, Java, Malaya, Siam, and the Philippines.

*Pulex irritans* Linnaeus

This species is probably abundant throughout much of the Philippines, especially at lower elevations.

*Records.*—28 ♂♂, 14 ♀♀ *ex* domestic dog. Cotabato Province, Mindanao: Parang, Bugasan, sea level, Coll. F. Werner, 2 December 1946 (R.T. #6519); 4 ♂♂, 3 ♀♀ *ex Mydans*, Palawan Province, Palawan Island, Brook Point, sea level, Coll. D. Rabor, 29 April 1947 (R.T. #6506).

*Ctenocephalides felis orientis* Jordan 1925

As is expected, this form was collected from a variety of hosts and locations.

*Records.*—1 ♂ *ex Sciurus*, Palawan Province, Busuanga Island, Dimaniang, near sea level, Coll. H. Hoogstraal, 17 March 1947 (R.T. #6492); 1 ♂, 1 ♀ *ex Paradoxurus* (Palm Civet), Palawan Province, Culion Island: San Pedro, Coll. H. Hoogstraal, 29 March 1947 (R.T. #6497); 1 ♂, 2 ♀♀ *ex Paradoxurus*, Palawan Island, Puerta Princesa, sea level, Coll. H. Hoogstraal, 21 April 1947 (R.T. #6519); 1 ♀ *ibid* but 22 April (R.T. #6515); 4 ♀♀ *ibid* but from domestic cat, 20 April (R.T. #6513); 1 ♀ *ibid* but *ex Mydans* (Badger Skunk), 29 April (R.T. #6516); 1 ♀ *ex Lutra cinerea*, *ibid*, 25 May 1947 (R.T. #6515); 1 ♀ *ex Mydans*, Palawan Island, Brook Point, Coll. D. Rabor, 29 April 1947, (R.T. #6506); 4 ♂♂, 1 ♀ *ex Felis bengalensis minuta*, loc. cit., Coll. M. Celestino, 10 May 1947 (R.T. #6510).

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## LIST OF ABBREVIATIONS

A.A.R.—aedeagal apodemal rod	MPS.—mesepisternum
A.B.—antepygidial bristle	MSN.—mesonotum
AE.A.—aedeagal apodeme	MTM.—metepimere
A.I.T.—armature of inner tube of aedeagus	MTN.—metanotum
A.M.S.—apical or apico-median sclerite of aedeagus	MTS.—metepisternum
AP.A.—apical appendage of aedeagal apodeme	MX.—maxillary lobe
AP.R.9—apodemal rod of ninth sternum	N.—neck or constriction of aedeagus
A.S.—anal stylet	P.—immovable process of clasper
A.S.T.—apical sclerite of inner tube of aedeagus	P.A.9—proximal arm of 9th sternum
B.C.—bursa copulatrix	PL.A.—pleural arch of metathorax
CR.—crochet of aedeagus	P.R.—penis rods
C.S.—crescent sclerite	P.S.—proximal spur of aedeagus
D.A.9—distal arm of 9th sternum	P.W.—wall of aedeagal pouch
D.T.—dorsal thumblike sclerite of aedeagus	R.—dorsal ridge of lateral metanotal area
E.A.A.—extension of aedeagal apodeme	S.I.T.—sclerotized inner tube
F.—exopodite or movable finger	SN.—sensillum
L.L.—lateral lobes of aedeagus	SP.—spermatheca
L.M.—lateral metanotal area	T.A.P.9—tergal apodeme of 9th tergum
L.P.—labial palpi	TR.—trochanter
L.P.T.—lateral plates of aedeagal apodeme	V.—vesicle
MB.—manubrium	V.A.L.—ventral anal lobe of proctiger
M.D.L.—median dorsal lobe	VC.3A.—accessory link below third vinculum
MI.P.—middle plate of aedeagal apodeme	V.I.R.—ventral intramural rod
MPM.—mesepimere	V.R.—ventral ridge of lateral metanotal area
	1T.—first tergum
	8T.—eighth tergum
	7S.—seventh sternum
	8S.—eighth sternum

## [Explanation of Plates I-VII]

## Plate I

- Fig. 1. *Stivalius pomerantzi* Head, male.  
 Fig. 2. *Stivalius robinsoni* (Rothschild 1905). Spermatheca.  
 Fig. 3. *Stivalius pomerantzi* Aedeagus.  
 Fig. 4. *Stivalius robinsoni* (Rothschild 1905). Aedeagus.

## Plate II

- Fig. 5. *Stivalius pomerantzi*. Modified abdominal segments. Male.  
 Fig. 6. Ibid. Metatibia.  
 Fig. 7. Ibid. Metathorax.

## Plate III

- Fig. 8. *Stivalius pomerantzi*. Clasper and exopodite.  
 Fig. 9. Ibid. Distal arm of ninth sternum.  
 Fig. 10. Ibid. Male eighth sternum.  
 Fig. 11. *Stivalius ralius*. Ventral anal lobe.

## Plate IV

- Fig. 12. *Stivalius ralius*. Head, female.  
 Fig. 13. Ibid. Thorax.



- Fig. 14. Ibid. Anal Stylet.
- Fig. 15. Ibid. Spermatheca.
- Fig. 16. Ibid. Modified abdominal segments. Female.

Plate V

- Fig. 17. *Thaumapsylla longiforceps*. Clasper and exopodite.
- Fig. 18. Ibid. Head, male.
- Fig. 19. Ibid. Aedeagus.

Plate VI

- Fig. 20. *Thaumapsylla longiforceps*. Distal portion of aedeagus.
- Fig. 21. Ibid. Modified abdominal segments, female.
- Fig. 22. Ibid. Thorax, male.
- Fig. 23. Ibid. Ventral anal lobe, female.
- Fig. 24. Ibid. Anal stylet.
- Fig. 25. Ibid. Spermatheca.
- Fig. 26. *Thaumapsylla breviceps* Rothschild 1907. Distal portion of aedeagus.

Plate VII

- Fig. 27. *Thaumapsylla breviceps*. Thorax, male.
- Fig. 28. Ibid. Head, male.
- Fig. 29. Ibid. Modified abdominal segments, female.
- Fig. 30. Ibid. Clasper and exopodite.
- Fig. 31. Ibid. Distal arm of ninth sternum.





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