

PSOCIDS (PSOCOPTERA) FROM THE BATU CAVES, MALAYA

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Abstract: Two new psyllipsocids, *Psyllipsocus batuensis* and *Psyllipsocus hirsutus*, are described. They show such genitalic similarities that they are both placed in *Psyllipsocus* (*sensu lato* of Gurney) but the argument is advanced that the category *Paremptheria* should be retained as a subgenus of *Psyllipsocus*, and *P. hirsutus* included in it. An aberrant new Lepidopsocid is described and placed in a new genus, *Parasoa*, tentatively included within the Perientominae. *Ectopsocus maindroni* Badonnel is also recorded from the caves.

This paper is based on material collected in the Batu Caves, near Kuala Lumpur, Malaya, by Dr. H. E. McClure, and made available for study by Bishop Museum, Honolulu. The family Liposcelidae has not been dealt with; material of this family has been returned to Bishop Museum.

Gurney (1943) gives references to the comparatively scant records of psocids in caves, and in the same work describes a number of cave-dwelling species of the Psyllipsocidae, a family in which the cave-dwelling tendency is particularly prevalent. More recently, Badonnel (1959) has described a larval amphientomid from a cave in the Congo. *Ectopsocus maindroni* has recently been taken in Hong Kong in dark cupboards in dwelling houses (Thornton, 1962), so that its discovery in a Malayan cave is not altogether surprising.

PSYLLIPSOCIDAE

Pearman (1936) recognised two families within the Psocatropetae, namely Psocatropetidae and Scoliopsyllopsidae. Roesler (1944) combined these two groups as the Psyllipsocidae, which he separated into two subfamilies, Psyllipsocinae (being equivalent to Pearman's Psocatropetidae) and Prionoglarinae (equivalent to Pearman's Scoliopsyllopsidae, Ball having shown (1936) that *Scoliopsyllopsis* End. 1912 was identical with *Prionoglaris* End. 1909). Within the subfamily equivalent to the Psocatropetidae of Pearman, Roesler keys the genera *Paremptheria* End., *Gambrella* End., *Psocatropos* Rib., *Dorypteryx* Aaron, and *Psyllipsocus* Selys. However, Menon, (1942) regarded *Gambrella* End. as a synonym of *Psocatropos* End., and Gurney (1943) defined a new genus, *Spelektor*, which he included with *Psyllipsocus* and *Prionoglaris* in the tribe Psyllipsocini. More recently, Smithers (1958) has defined the genus *Dolopteryx*, which is allied to *Dorypteryx*.

The group is apparently an ancient one, which has avoided competing with more recent forms, and thus survived, by inhabiting caves and similar natural or man-made habitats.

Gurney (1943) considered *Paremptheria* a synonym of *Psyllipsocus* and this view was

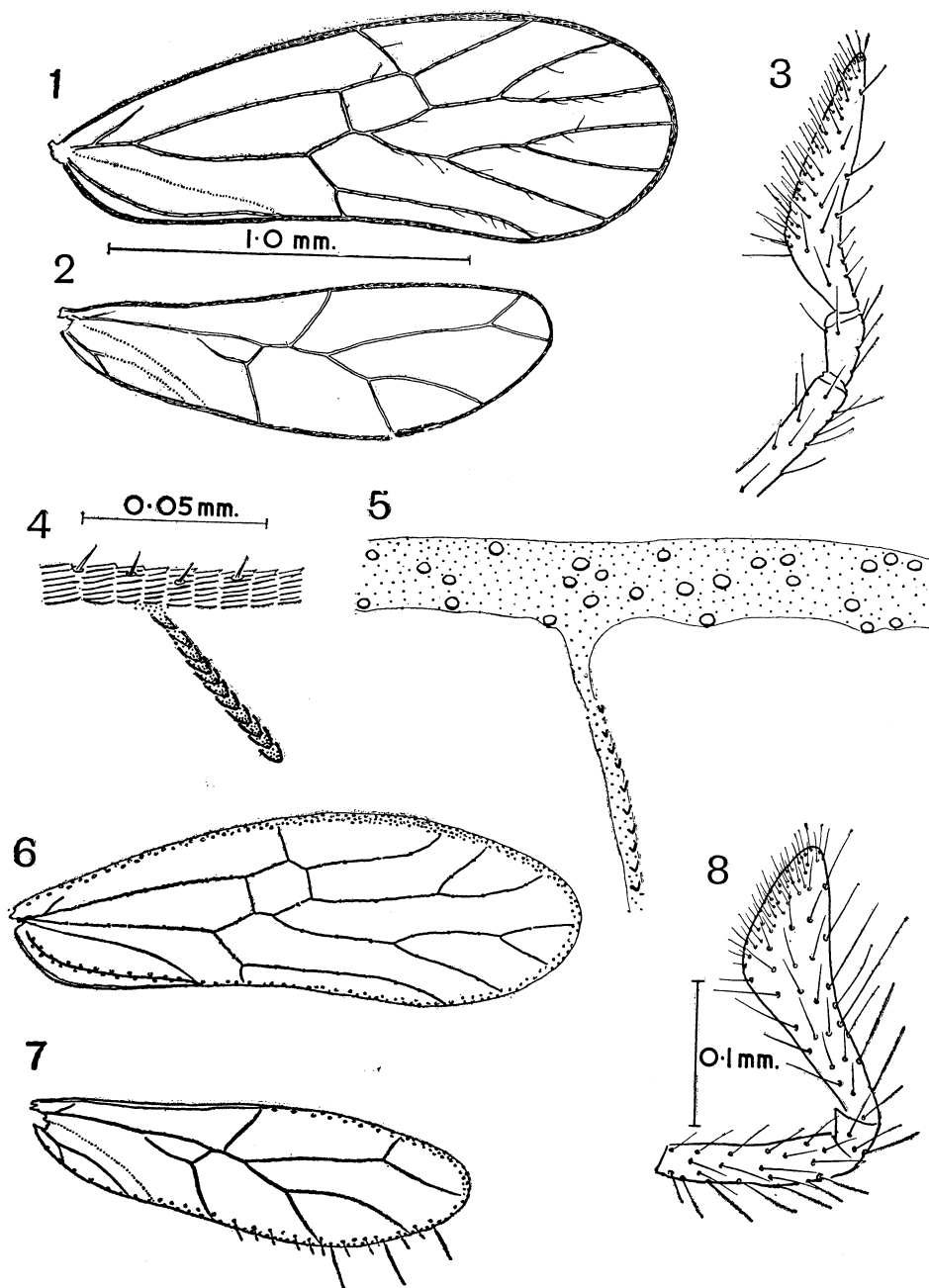
supported by Badonnel (1948). The type species of *Parempheria*, *Parempheria sauteri* End., was, as Gurney pointed out, originally described as lacking pre-apical teeth on the claws, and this was given as a generic character by Enderlein (1906). Gurney suggested that since Takahashi (1938) noticed minute teeth on the claws of the related species *Parempheria minutissima* End., the reported absence of teeth in *P. sauteri* was questionable. In fact, Enderlein (1908) provided a short redescription of *P. sauteri*, in which he corrected his original observation, and noted the presence of teeth on the claws. Thus the absence of preapical teeth on the claws falls as a generic character of *Parempheria* on the evidence of Enderlein himself. Gurney also stated that the genera *Parempheria* and *Psyllipsocus* could not be adequately separated on grounds of venation.

The remaining distinction between the two genera is that Enderlein defined *Parempheria* as having the wing margins pubescent, with many rows of fine hairs, whereas in *Psyllipsocus* although occasional setae are sometimes present on the veins, the wing margin is bare. This was used by Roesler (1944) in separating the two genera in his generic key, in conjunction with the relative sizes of the areola postica. Gurney, noting that in *Psyllipsocus yucatan* Gurney, minute, sparsely distributed setae occur on the wing margin together with regular, longitudinal, linear spicules, suggested that the pubescence described by Enderlein as a generic character of *Parempheria* was of a similar nature, and thus discounted it as being of little value. In this connection it should be noted that Takahashi (1938) as well as reporting the minute teeth on the claws of *Parempheria minutissima*, also remarked on the wings being pubescent on the whole margin, thus supporting Enderlein's original generic diagnosis. Zimmerman (1948) on the other hand, recording this species from Hawaii, keyed and figured it as having the fore wing margin bare, and followed Gurney in placing it in *Psyllipsocus*.

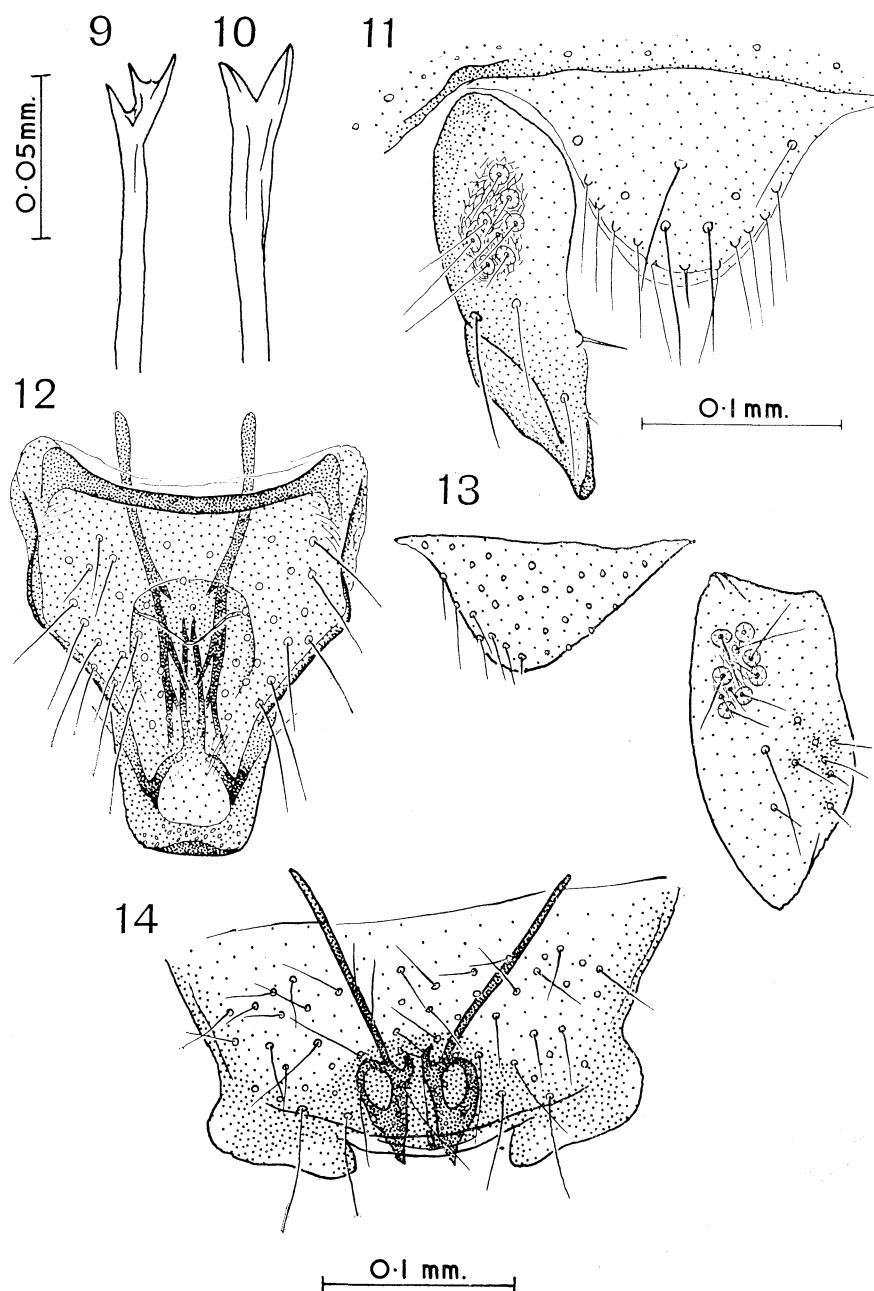
The two species described below have some bearing on this question, one possessing a wing margin as described by Gurney for *Psyllipsocus yucatan*, the other, despite the loss of numerous setae, agreeing with Enderlein's diagnosis of *Parempheria*. The shape of the areola postica in the two species also supports Roesler's distinction of the two genera on this basis. Moreover, for the first time, the genitalia of a species referable on wing characters to *Parempheria* are described.

***Psyllipsocus batuensis* Thornton, n. sp.**

Female. Coloration (after 1 year's storage in alcohol): Head pale buff, light brown pigmentation bordering epicranial suture, posterior margin of head and upper edge of orbit. Epicranial suture dark brown. Ocelli colourless, not sited on a protuberance. Cervical foramen bordered dark brown. Frons with a pale brown median patch from ocelli to post-clypeus. Eyes brown. Maxillary palps pale grayish brown, distal segment colourless. Antennae with scape and pedicel pale greyish brown, flagellum greyish brown. Prothoracic tergites brown. Mesothorax: antedorsum brown, median suture dark brown, posterior margin bordered with pale buff posteriorly; scutellum pale brown. Metathorax: sclerites brown, except pale buff area laterally on dorsal lobes, scutellum pale. Legs pale buff, almost colourless. Wings hyaline, veins brown, margin light brown. Abdomen dorsally with 4 zones: white over tergite I and anterior 1/2 of tergite II; grey-brown from here up to and including anterior 1/2 of tergite VII; posterior 1/2 of tergite VII and whole of VIII white dorsally, faint grey-brown laterally; rest of abdominal tergites grey-brown. Epiproct white, edged with brown on posterior margin. Abdomen ventrally white.

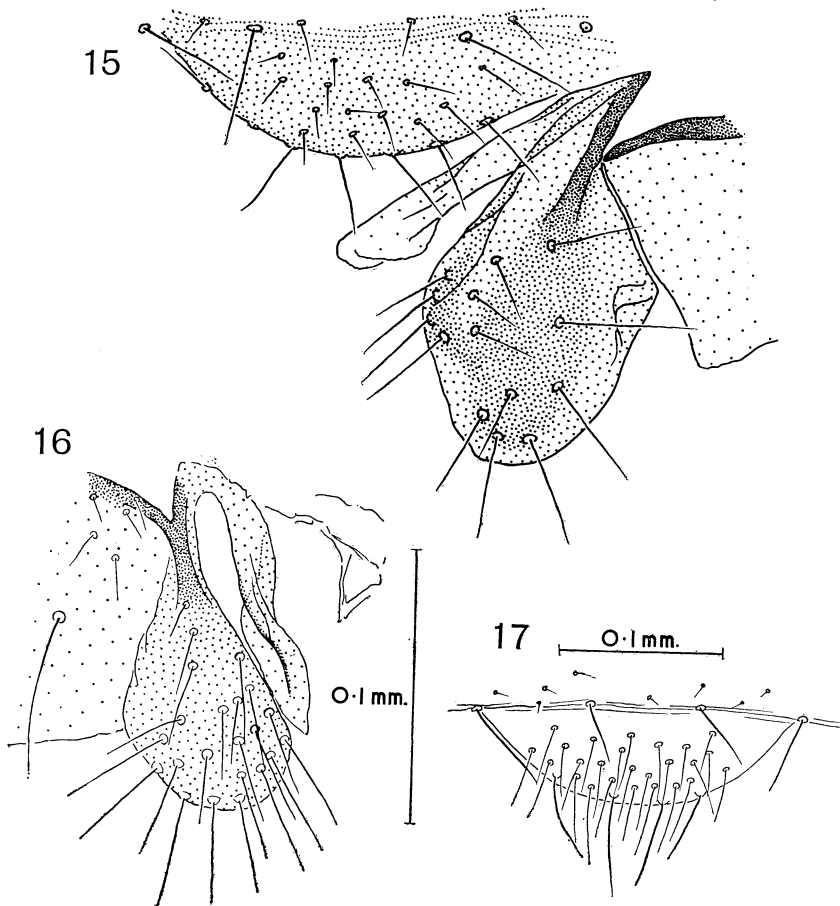


Figs. 1-8. Figs. 1-4. *Psyllipsocus batuensis*, male: 1, fore wing; 2, hind wing; 3, terminal segments of maxillary palp; 4, costal area of fore wing. Figs. 5-8. *Psyllipsocus (Paremptheria) hirsutus*, male: 5, costal area of fore wing; 6, fore wing; 7, hind wing; 8, terminal segments of maxillary palp. Figs. 1, 2, 6, 7; 4 and 5; 3 and 8; to common scales.



Figs. 9-14. Figs. 9, 10. Apex of maxillary pick of: 9, *P. hirsutus*; 10, *P. batuensis*. Figs. 11, 12. *P. batuensis* male: 11, epiproct and left paraproct; 12, hypandrium and phallosome. Figs. 13, 14. *P. hirsutus* male: 13, epiproct and right paraproct; 14, hypandrium and phallosome. Figs. 9 and 10; 11-13; to common scales.

Morphology: I.O.: D (Ratio between the interocular space and the apparent eye-diameter as seen from the front of the head, as measured by Pearman) (see Ball, 1943) = 2.0 : 1. Maxillary palp with apical segment elongate, sickle-shaped, sensory area long (fig. 3), maxillary pick with 2 apical teeth (fig. 10), basally fairly straight. Flagellar segments secondarily ringed. Fore wing veins (fig. 1) with a single row of setae, margin (fig. 4) with minute sparsely distributed setae and closely packed linear spicules. Veins in distal 1/2 of wing with minute pointed spicules regularly spaced along them, these larger and more densely arranged on distal segment of *sc* (fig. 4) and to a lesser degree on distal portion of *r*₁. Hind wing (fig. 2) veins lacking setae, but spiculate along marginal sections of veins, and along whole length of *cu*₂ and *ax*; margin as fore wing, except the minute setae only present on distal margin, 5 between radial forks, 2 anterobasal to these. Coxal organ present on hind leg; no preapical tooth on claw. Subgenital plate (fig. 17) evenly rounded, setose, not sclerotised, 4 long setae in a line at its base and 4 more along api-



Figs. 15-17. 15, *P. hirsutus* female subgenital plate and gonapophyses; 16, *P. batuensis* female gonapophyses; 17, *P. batuensis* female subgenital plate. Figs. 15 and 16 to common scale.

cal margin. Epiproct setose, triangular, with a single shorter seta at apex; paraprocts each with a sculptured sensefield containing 8 trichobothria sited in pits.

Gonapophyses (fig. 16): gonapophyses of segment IX: inner lobe (valvula II) with sclerotised supporting bar, outer lobe (valvula III) well developed, strongly setose, with sclerotised rod basally; gonapophyses of segment VIII (valvula I) possibly represented by an unsclerotised fleshy structure.

Dimensions: Body length (in alcohol): 1.8 mm. Dimensions of other characters as in Table 1.

Male. Coloration (after storage in alcohol for a year): As ♀. *Morphology*: Eyes not particularly prominent, I.O.: D=1.8:1. Apex of abdomen (fig. 11): Epiproct as ♀; paraprocts apically sclerotised, elongate and pointed, with an apical ventral groove.

Genitalia (fig. 12): hypandrium with sclerotised supports on anterior and lateral borders, setose, at apex 2 pointed sclerotised lobes covered by a stout angular cap, apex of this cap sclerotised posteriorly and bearing a number of translucent rounded tubercles; parameres curved, converging apically, with 3 mesially directed tines on apical 1/2; a pair of slender inner rods within these; above the parameres a weakly sclerotised oval structure.

Dimensions: Body length (in alcohol) 1.7 mm. Dimensions of various characters as in Table 1.

Table 1. Length (in mm) of various characters of 5 ♀♀ and 9 ♂♂ of *Psyllipsocus batuensis*. (Measurements accurate for *Fw* and *Hw* to 0.01 mm, for *Hf*, *Ht*, t_1 to 0.005 mm, and for t_2 and t_3 to 0.001 mm. Ratios calculated to the nearest 0.01.)

(a) 5 ♀♀		
	Range	Mean±S.D.
Fore wing (<i>Fw</i>)	1.630-1.810	1.751±0.171
Hind wing (<i>Hw</i>)	1.310-1.470	1.391±0.142
Hind femur (<i>Hf</i>)	0.345-0.395	0.378±0.084
Hind tibia (<i>Ht</i>)	0.675-0.775	0.746±0.156
1st hind tarsal segment (t_1)	0.275-0.330	0.306±0.098
2nd " " " (t_2)	0.048-0.052	0.050±0.011
3rd " " " (t_3)	0.049-0.054	0.052±0.011
Ratio t_1/t_2	5.35 -6.80	6.15 ±0.300
" t_2/t_3	0.90 -1.04	0.97 ±0.050
(b) 9 ♂♂		
	Range	Mean±S.D.
<i>Fw</i>	1.630-1.790	1.691±0.112
<i>Hw</i>	1.290-1.400	1.339±0.089
<i>Hf</i>	0.355-0.405	0.375±0.063
<i>Ht</i>	0.690-0.780	0.743±0.099
t_1	0.290-0.330	0.309±0.042
t_2	0.047-0.052	0.049±0.011
t_3	0.047-0.052	0.050±0.009
Ratio t_1/t_2	5.75 -6.80	6.32 ±0.167
" t_2/t_3	0.94 -1.04	0.98 ±0.034

BATU CAVES, NR. KUALA LUMPUR, MALAYA: 1 ♂, 8. XII. 1959, end of Cavern C, location 4; 3 ♂♂, 3 ♀♀ (including holotype & allotype), 8. XII. 1959, Cavern C, Penny Room, location 3, light; 3 ♀♀, 29. III. 1960, Cavern B, light trap; 1 ♂, 1 ♀, 10. V. 1960, Cavern C, Onyx Man, light; 1 ♂, 1 ♀, 10. V. 1960, Cavern C, light; 1 ♂, 16. VIII. 1960, Cavern B, near pool, light. Holotype ♀ (BISHOP 2707; slides 3a.1, 3a.2, tube 3a), allotype ♂ (slides 2.1, 2.2, 2.3, tube 2), data as above, in Bishop Museum. Paratypes in Bishop Museum, British Museum (Nat. Hist.) and my collection.

The above species differs from all others of the genus in the abdominal colour pattern. In fore wing length, it is shorter than the widely distributed *P. ramburii* Rib., and longer than other described species. The shape of the apical segment of the maxillary palp is closest to that of *P. ramburii*. The male genitalia of *P. yucatan* and *P. oculatus* Gurney have been described and figured by Gurney (1943), and those of the African species *P. collarti* Bad. by Badonnel (1946). Menon (1942) made a brief reference, without figures, to the male genitalia of *P. bombayensis* Menon, but did not comment on *P. edentulus* Menon in this respect. Males of *P. ramburii* and *P. spinosus* Bad. are unknown. Species of the genus show a high degree of uniformity in female genitalia.

The hypandrium of *P. batuensis* is most similar to that of *P. collarti* in shape and in the possession of lateral supporting struts, and it also resembles this species in the apical "cap", which, however, is larger in *P. batuensis*, recalling that of *Psocatropos microps* End. described by Badonnel (1946). The weakly sclerotised plate overlying the parameres has not been described in *P. collarti*, although a similar structure is present in *P. yucatan*, *P. ornatus* and *Psocatropos microps*. The female of *P. batuensis* also resembles the African species *P. collarti* and *P. spinosus* in the possession of weakly sclerotised structures possibly representing the gonapophyses of the eighth abdominal segment.

Psyllipsocus (Parempheria) hirsutus Thornton n. sp.

Male. Coloration (in alcohol, after storage for 1 year): Head pale buff, marked with lines and spots of dark brown: a dark spot at upper edge of orbit; a curved dark line from lower anterior edge of orbit extending mesially and dorsally to a point lateral and slightly dorsal to posterior ocelli; 3 dark spots immediately below the group of ocelli, arranged in the same way as ocelli, median spot joined to the 2 laterals by a thin dark line; antennal sockets edged with dark brown dorsally; postclypeus with 2 fairly large dark patches on basal 1/2. Ocelli colourless. Eyes dark brown. Maxillary palps pale, apical part of distal segment slightly darker. Antennae with scape and pedicel thinly ringed dark brown apically, flagellar segments dark brown, ringed pale buff at ends. Cervicum irregularly spotted dark brown laterally. Thorax buff, pleura irregularly spotted dark brown, legs pale, tibiae with broad brown mark on mesial face a short distance from proximal end, another longer such mark on distal 1/2 some distance from distal end. Abdomen pale buff, with dark brown spots along posterior edges of terga dorso-laterally.

Morphology: I. O.: D = 2.2 : 1. Maxillary pick with 3 well-defined apical teeth (fig. 9), basal 1/3 curved mesially. Maxillary palp (fig. 8) with terminal segment elongate, axe-shaped, sensory area relatively short (fig. 8). Antennae missing. Fore wing (fig. 6) veins with a single row of setae, except *cu*₂ bare, setae of *an* in double row. Margin (fig. 5), except for posterior margin of cell An, with irregularly sited setae, in several rows on anterior margin, about 2 rows on posterior margin; no linear regularly-arranged spicules

or minute setae. Distal portion of *sc* (fig. 5), subapical section of *r*₁, and cross-veins joining *r* and *m*, and *r*₁ and *rs*, with row of pointed spicules. In one specimen an oblique cross vein joins *r*₄₊₅ with *m*₁, in another *r*₁ does not reach wing margin, in 3 specimens distal section of *sc* is recurved at margin towards base of wing. Hind wing (fig. 7) veins bare, margin, except basal 1/2 of anterior margin, setose, with setae of 2 different lengths, setae on margin over 2× length of those sited just within margin (this possibly applies to fore wing also, where setae have been lost). Coxal organ present on hind leg. Claws with a prominent subapical tooth. Apex of abdomen (fig. 13): epiproct triangular, setose, apical seta shorter than rest; paraprocts with 1 extremely long and 8 shorter setae, and a sculptured sense-field containing 8 trichobothria, 7 sited in rosette sockets. Genitalia (fig. 14): hypandrium setose, with sclerotised lateral supports, a short broad lobe on each side of posterior margin; parameres anteriorly simple, fairly straight, apically complex, each apical sclerite having a large hole, mesial margin of sclerite with hyaline tubercles.

Dimensions: Body length (in alcohol) 1.6 mm. Dimensions of other characters as in Table 2.

Female. Coloration (in alcohol, after storage for a year): As ♂. *Morphology*: I. O.: D=2.2:1. Maxillary palps lost. Venation of fore wing as ♂, except that stalk of *rs* continues unbranched for a distance almost equal to 4× length of *r*₄₊₅. Subgenital plate (fig. 15) evenly rounded, setose, 4 long setae in a line at its base (1 dislodged). Epiproct and paraprocts as ♂. Gonapophyses (fig. 15): gonapophyses of segment IX: inner lobe (valvula II) unsclerotised, outer lobe (valvula III) well developed, with 14 setae, basal sclerotised rod and a central oval sclerotised area. Gonopophyses of segment VIII absent.

Dimensions: Body length (in alcohol) 1.7 mm. Dimensions of other characters as in Table 2.

Table 2. Length (in mm) of various characters of 1♀ and 9♂♂ of *Psyllipsocus (Parempheria) hirsutus*.

	♂	♀		
		No. measured	Range	Mean±S.D.
<i>Fw</i>	1.740	9	1.570–1.700	1.613±0.094
<i>Hw</i>	1.350	9	1.210–1.340	1.253±0.097
<i>Hf</i>	0.315	9	0.290–0.330	0.302±0.045
<i>Ht</i>	0.595	9	0.575–0.640	0.597±0.088
<i>t</i> ₁	0.250	8	0.240–0.290	0.264±0.057
<i>t</i> ₂	0.047	9	0.043–0.051	0.047±0.016
<i>t</i> ₃	0.048	9	0.043–0.048	0.047±0.012
Ratio <i>t</i> ₁ / <i>t</i> ₂	5.30	8	5.10–5.95	5.55 ±0.166
" <i>t</i> ₂ / <i>t</i> ₃	0.98	9	0.98–1.07	1.01 ±0.031

BATU CAVES, NR. KUALA LUMPUR, MALAYA: 1♂, 9.XII.1959, Cavern C, Black Cascade, location 5, light; 1♂, 22.III.1960, same location; 2♂♂, allotype ♀, 29.III.1960, Cavern B, light; holotype ♂, 3.V.1960, Cavern C, Penny Room, light; 1♂, 5.V.1960, Cavern B, light; 1♂, 10.V.1960, Cavern C, Onyx Man, light; 1♂, 16.VIII.1960, same location; 1♂, 22.XI.1960, Cavern B, by pool, light. Holotype ♂ (BISHOP 2708; slides 29.1, 29.2, tube 29), and allotype ♀ (slides 17c.1, 17c.2, tube 17c) in Bishop Museum, paratype ♂♂ in Bishop Museum, British Museum (Nat. Hist.) and my collection.

Three species have been ascribed to *Parempheria* in the past: *Psyllipsocus* (*Parempheria*) *sauteri* from Japan, *Psyllipsocus* (*Parempheria*) *metamicropterus* (End.) from Formosa, and *Psyllipsocus* (*Parempheria*) *minutissimus* from Hawaii, later recorded also from Formosa. As stated above, although Enderlein and Takahashi maintained that the wing margin in these species was pubescent, Gurney doubted and Zimmerman (in the case of *P. minutissimus*) denied it. The discovery of the above new species strongly supports Enderlein's contention, and, although the genitalia of the three described species have not been studied, it seems likely, on the basis of wing pubescence and the extremely long areola postica, that the four species represent a group of interrelated forms somewhat distinct from other species of *Psyllipsocus*.

Psyllipsocus (*Parempheria*) *hirsutus* differs from *P. minutissimus* in that the marginal pubescence of the wings in *P. hirsutus* is not continuous over the whole margins, and from *P. metamicropterus* in that in *P. hirsutus* the hind wings are not reduced. It shows a close resemblance to the descriptions of *P. sauteri*, in which the margin of cell An in the fore wing, and the basal anterior margin of the hind wing are bare. The rounded anterior margin of the fore wing is common to both species and the venation similar, except that the areolar postica in *P. sauteri* is not as elongate as that of *P. hirsutus*. Moreover, according to Enderlein's description of *P. sauteri*, *P. hirsutus* differs from it in pattern of coloration. In the absence of information on the genitalia of *P. sauteri*, the two species appear to be closely related. *P. hirsutus* differs from *Psyllipsocus collarti* and *Psyllipsocus batuensis* in that the male hypandrium lacks the apical "cap." This cap is also lacking in *Psyllipsocus yucatan* and *Psyllipsocus oculatus* from the American continent, although in these two species the underlying plate is not bifid apically as it is in *P. hirsutus*. Male genitalia therefore do not provide distinct differences warranting a generic separation of *Parempheria* and *Psyllipsocus*. It should be born in mind, however, that Badonnel (1946) has shown that the male genitalia of *Psyllipsocus* and *Psocatropos* are remarkably similar.

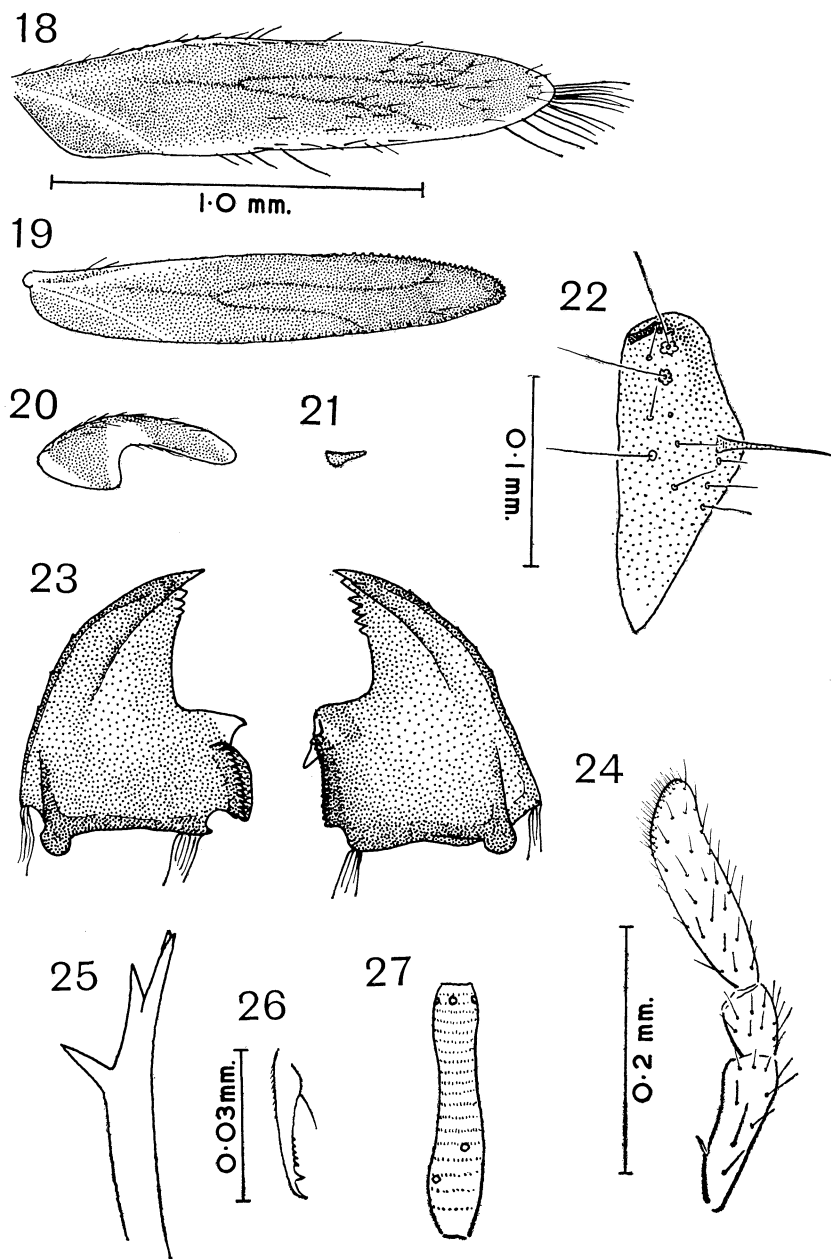
Although there are reasons for believing that the genus *Gambrella* should fall, venational variation in *Psocatropos* being such as to include the type of venation described as diagnostic of *Gambrella*, venation of the *Gambrella* type differs from that of the *Parempheria* group only to an extent probably consequent upon the differing sizes of the wings, and both groups have the wing-margin setose. Thus despite the absence of well-marked genitalic differences, there would seem to be a case for the retention of Enderlein's category *Parempheria* as a group distinct from *Psyllipsocus* s. str., and showing a closer relationship to the *Psocatropos* group. I have accordingly assigned to it the status of a subgenus of *Psyllipsocus*.

LEPIDOPSOCIDAE

Information on several characters, notably genitalia, is lacking for many genera of this family, so that there is difficulty in assessing their importance as generic and specific characters. For this reason, and also because the following species exhibits a number of aberrant features, higher group characters are also listed.

Parasoa n. gen.

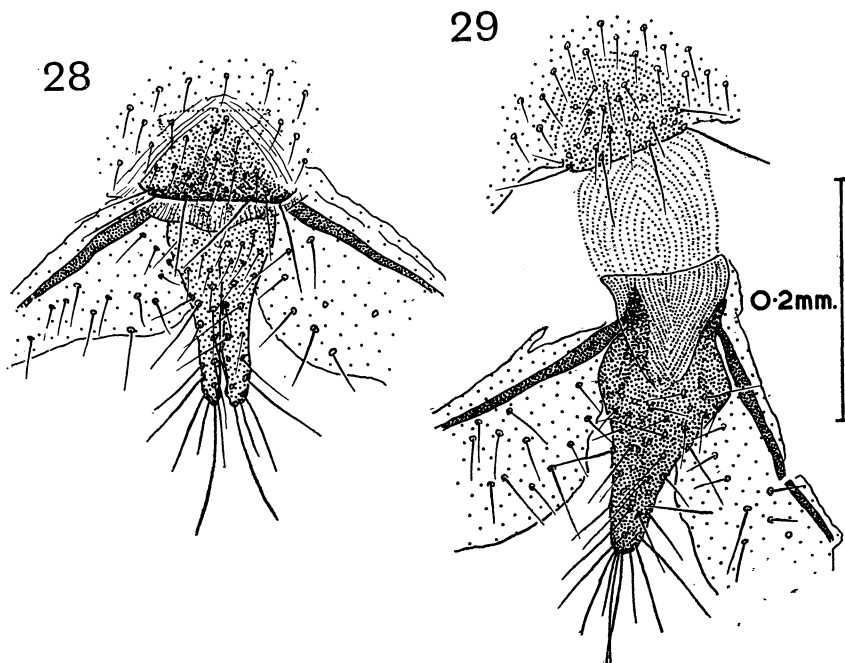
Characters common to Trogiomorpha: Chitinous cords of hypopharynx separated through-



Figs. 18-27. *Parasoa haploneura* female: 18, fore wing, long-winged form; 19, hind wing, long-winged form; 20, fore wing, brachypterous form; 21, hind wing, brachypterous form; 22, left paraproct; 23, mandibles from under side; 24, terminal three segments of maxillary palp; 25, apex of maxillary palp; 26, claw; 27, basal flagellar segment. Figs. 18-21; 22 and 23; 25-27; to common scales.

out their length; tarsi 3-segmented; (antennae with numerous joints*); paraprocts with long marginal spine; labial palps 2-segmented, maxillary palps with terminal segment dilated distally and truncated (in this latter feature the genus is not typical) (fig. 24). It is held by Roesler (1944) that a feature of this group is that the flagellar segments are not secondarily ringed. In this genus, flagellar segment I is secondarily ringed as viewed under high power. In *P. batuensis*, described above, the flagellar segments are also secondarily ringed.

Characters common to Atropetae: Median epicranial suture well-marked; right mandible concave between base of molar area and adductor muscle (fig. 23); left mandible with single large tooth at anterior end of molar area (fig. 23); maxillary palp with rod-shaped sense organ on inner side of segment II (fig. 24); apex of hind tibia with 2 strong short spines; ♀ genitalia exposed, consisting of only a single pair of valves (fig. 28); maxillary pick (lacinia) with 3 tines, the largest bifid at its tip (fig. 25).



Figs. 28, 29. *P. haploneura* female: 28, subgenital plate and gonopods in folded, resting position; 29, the same, extended. Common scale.

Characters common to Lepidopsocidae: Claws with preapical tooth and long setiform process at base (fig. 26); eyes pubescent, fine short hairs between ommatidia. No scales are present on any specimens, although a few lanceolate hairs occur on the femora of some. The middle and hind tibiae lack the long outstanding setae typical of the family. It is possible that these deficiencies are due to loss.

* Characters marked thus are taken from a drawing of the intact insect by "Chua Lai Hock" at Bishop Museum, and have not been actually observed by me.

Characters common to Perientominae: Basal flagellar segment much more than $2\times$ as long as wide (fig. 27); (antennae with less than 30 segments*); fore wing with long macrochaetae only on margin.

Generic or subfamilial characters: Head with sparse shaggy hairs; frontal sutures inconspicuous; claws with one large and 4 smaller subapical teeth (fig. 26); subgenital plate of ♀ with 4 long hairs on posterior margin (fig. 29); 3 ocelli; maxillary palp with terminal segment large, curved slightly; fore and hind wing with reduced venation.

Parasoa haploneura Thornton, n. sp.

Female. Coloration (after 1 year's storage in alcohol): Frons and vertex mid-brown, epicranial suture dark brown. Ocelli pale, ocellar protuberance dark brown. Genae pale buff, postclypeus pale buff, labrum dark brown. Eyes dark brown. Maxillary palps white. Antennae with scape and pedicel pale brown, flagellar segment I brown, remainder missing. Thoracic terga brown, pleura brown. Legs with coxae brown basally fading to colourless distally; femora buff, a brown transverse band near proximal end; tibiae and tarsi faint buff. Fore wing membrane brown with hyaline strips along cu_2 and posterior border (fig. 18). Hind wing (fig. 19) slightly paler, lacking the hyaline strip along posterior border. Abdomen dorsally buff, shading laterally to brown, tergite VIII shining, well sclerotised. Tergite IX and terminalia brown. Abdomen ventrally pale buff.

Morphology: I. O. : D=2.5 : 1. Maxillary palp with apical segment elongate, bluntly rounded apically, not obviously truncate (fig. 24), maxillary pick with 3 apical tines, the longest bifid (fig. 25). Basal flagellar segments secondarily ringed, about $5\times$ as long as wide (fig. 27). Fore wing (fig. 18) lanceolate, with cu_2 and one other forked vein ($r+m$?) which is not clearly defined basally. Short bristle-like hairs on veins and membrane and on margin basally, (longer stout hairs on margin in distal $1/2^*$). Hind wing (fig. 19) similar in shape, venation, (and arrangement of setae*). Tarsal combs lacking, claw with several preapical teeth (fig. 26). Abdominal tergite IX with 4 strong setae submarginally. Subgenital plate (fig. 29) sclerotised, with straight posterior margin bearing 4 long setae, body of plate beset with shorter hairs. Epiproct rounded posteriorly, setose; paraprocts (fig. 22) pointed and unsclerotised apically, basally with sclerotised ridge and a short hair near 2 trichobothria in rosette sockets, 7 other short hairs and 1 long one on body of paraproct, a long marginal spine. Gonapophyses (figs. 28, 29) represented only by sclerotised outer lobes of gonopods of segment IX, setose, with long setae apically, closely apposed medially.

Dimensions: Body length (in alcohol) 1.5 mm. Dimensions of other characters as in Table 3.

Male unknown.

Short-winged form: Apart from the wings, differs from long-winged form only in lacking ocelli, and in having generally paler coloration. Fore wings (fig. 20) hook-shaped, with 2 darkly pigmented areas on membrane, short setae on margin basally and on membrane, (longer marginal setae apically*), veins absent. Hind wing (fig. 21) reduced, lobed proximally, lacking setae and veins.

Dimensions: As in Table 3.

Table 3. Length (in mm) of various characters of 8 long-winged and 2 short-winged ♀♀ of *Parasoa haploneura*. For short-winged forms *Fw* accurate to 0.005 mm, *Hw* to 0.001 mm.

	Long-winged			Short-winged	
	No. measured	Range	Mean±S.D.		
<i>Fw</i>	7	1.490–1.550	1.526±0.063	0.545	0.550
<i>Hw</i>	8	1.280–1.360	1.305±0.061	—	0.175
<i>Hf</i>	—	—	—	0.460	0.470
<i>Ht</i>	1	0.570		0.555	0.550
<i>t</i> ₁	1	0.360		0.340	0.330
<i>t</i> ₂	1	0.060		0.062	0.557
<i>t</i> ₃	1	0.079		0.082	0.068
Ratio <i>t</i> ₁ / <i>t</i> ₂	1	6.06		5.46	5.92
" <i>t</i> ₂ / <i>t</i> ₃	1	0.76		0.75	0.82

BATU CAVES, NR. KUALA LUMPUR, MALAYA: 2 long-winged ♀♀, 3 short-winged ♀♀, 12. IV. 1960, Cavern A; 6 long-winged ♀♀ (including holotype), 26. IV. 1960, Cavern A. Holotype ♀ (BISHOP 2709; slides 12a.1, 12a.2, 12a.3, tube 12a) and paratype short-winged ♀ (slides 10d.1, 10d.2, tube 10d) in Bishop Museum, other paratypes in Bishop Museum, British Museum (Nat. Hist.) and my collection.

This species is tentatively placed in the subfamily Perientominae on antennal characters. Badonnel (1955) reports 4 long setae on the posterior margin of the subgenital plate of *Soa angolana* Bad., but the female genitalia of the present species are remarkably similar to those of *Echmepteryx* which is placed in the Lepidopsocinae. When more detailed information is available on this family, it may be necessary to place *Parasoa* in a separate subfamily.

PERIPSOCIDAE

Ectopsocus maindroni Badonnel 1935

Ectopsocus maindroni Badonnel 1935, 1936a, 1936b, Ball 1943, Thornton 1962.

Ectopsocus cryptomeriae Takahashi 1938, Jentsch 1939 *nec* Enderlein 1907.

BATU CAVES NR. KUALA LUMPUR, MALAYA: 1 ♀, 24. III. 1960, Black Cascade, Cavern C, at light; 1 ♀, same data but 29. III. 1960.

This species has been recorded from Africa, Arabia, Taiwan (Formosa), and Hong Kong, but this is the first time it is recorded as occurring in caves. It has been taken on the leaves and trunks of trees, and in Hong Kong it has recently been found in drawers, wardrobes and stored cereals in houses.

DISTRIBUTION IN THE CAVES

The Batu Caves themselves are fully described by McClure (1962). Both forms of *Parasoa haploneura* have been taken only from Cavern A (fig. 30) which extends for approximately 150 m from the entrance. The two psyllipsocid species, however, were found deep in the caves, in Caverns B and C, *P. batuensis* occurring at the end of Cavern C, about 360 m from the nearest chimney, and about 800 m from the entrance. *E. maindroni* also occurs in Cavern C, deep inside the caves. It is of interest to note that the species which occur deep in the caves were largely collected at light.

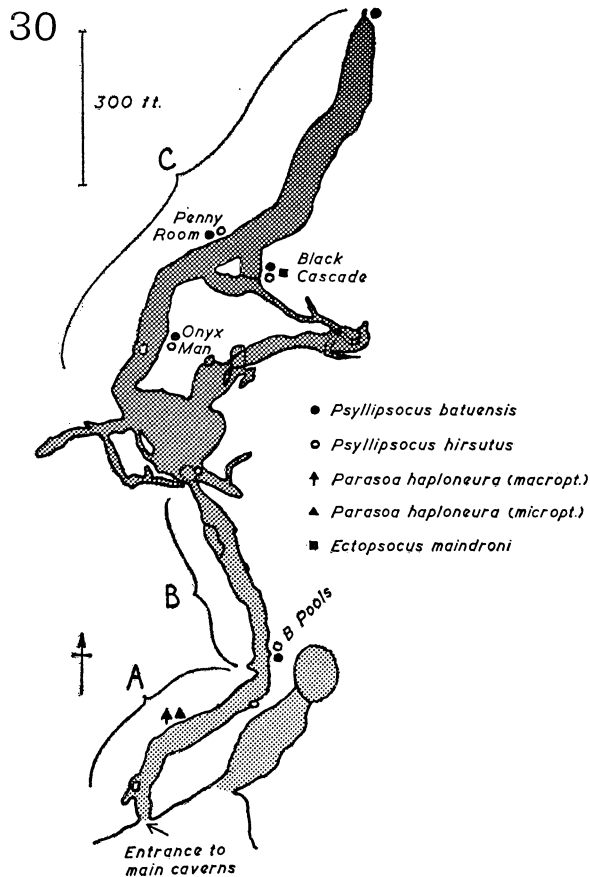


Fig. 30. Sketch map of Batu Caves (after McClure) showing distribution of psocids.

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