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Psocoptera (Insecta) of the island of Moorea, French Polynesia, and comparisons with other Pacific island faunas

by Ian W. B. THORNTON

Abstract. — Psocoptera were collected (by beating) during September and October 1987 on the island of Moorea, Society Islands, from sea level to 800 m elevation, in disturbed agricultural land and native forest. Thirty-six species were collected (and one occurs on Tahiti), representing 14 genera in 8 families. Eight species are newly described, and no adults were found of another undescribed species. The family with the best representation was the Lepidopsocidae, with 16 species. Peripsocidae (5 species), Pseudocaeciliidae (5), Ectopsocidae (4) and Myopsocidae (4) were fairly well represented, Caeciliidae, Philotarsidae and Psocidae each by but a single species. Diversity on Moorea is fairly low (α = 6.7), similar to Tonga and Galapagos, higher than Norfolk I. and Robinson Crusoe, and lower than the Krakataus, Bali and Lombok, and Fiji. Two-thirds of the Moorea fauna also occurs in Fiji, half in Tonga, and half in Hawaii. Four species are known elsewhere only from Fiji and Tonga. A further 13 species are known only from Pacific Islands, 8 more are also found in the Oriental Region (including Indonesia and the Philippines) and 3 are practically tropicopolitan.

Key words. — Psocoptera; Pacific zoogeography; dispersal; faunal comparisons; Society Islands.

Résumé. — Psocoptères récoltés (par battage) en septembre et octobre 1987 dans l'île de Moorea, îles de la Société, du niveau de la mer à 800 m, dans la zone de culture et la forêt primitive. Trente-six espèces ont été trouvées (plus une provenant de Tahiti), représentant 14 genres et 8 familles. Huit espèces sont décrites comme nouvelles, une neuvième, dont aucun adulte n'a été trouvé, reste inédite. La famille la mieux représentée est celle des Lepidopsocidae, avec 16 espèces. Les Peripsocidae (5 espèces), Pseudocaeciliidae (5), Ectopsocidae (4) et Myopsocidae (4) sont assez bien représentées; par contre, les Caeciliidae, Philotarsidae et Psocidae ne le sont respectivement que par une seule espèce. La diversité sur Moorea est faible (α = 6,7), semblable à celle des îles Tonga et des Galapagos, plus élevée que celle de l'île Norfolk et de Robinson Crusoe, et inférieure à celle des Krakatoa, Bali et Lombok, et Fidji. Les deux tiers de la faune de Moorea existent aussi aux Fidji, la moitié dans les Tonga et la moitié aux Hawaii. Quatre espèces seulement sont connues en dehors des Fidji et Tonga, 13 autres des îles du Pacifique; 8 ont aussi été trouvées dans la Région Orientale (Indonésie et Philippines incluses) et 3 sont tropicales.

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INTRODUCTION

Although specialist surveys of Psocoptera have been made on several islands and archipelagos of the inner and outer Melanesian arcs of islands in the west and southwest Pacific, many of the accounts that have been published so far treat only particular families (THORNTON & WONG, 1967, 1968; LEE & THORNTON, 1967; SMITHERS & THORNTON, 1973,

1974*a*, 1975*a*, 1977, 1979, 1981, 1982, 1988; THORNTON, 1980, 1981*a*, 1984*a*; THORNTON & NEW, 1977; THORNTON & SMITHERS, 1974, 1975, 1977, 1978, 1984; THORNTON *et al.*, 1977). Papers treating the whole psocopteran fauna, however, are available for Lord Howe I. (SMITHERS & THORNTON, 1975*b*; SMITHERS, 1979), Norfolk I. (SMITHERS & THORNTON, 1974*b*), and the Fiji and Tonga archipelagos (THORNTON, 1981*b*, 1981*c*). In the north Pacific the fauna of Micronesia has been studied from extensive general surveys of the archipelagos of that area (THORNTON *et al.*, 1972), and that of the Hawaiian Is. from intensive specialist surveys (THORNTON, 1981*d*, 1984). Specialist field work in the eastern Pacific has been confined to the Galapagos Is. (THORNTON & WOO, 1972) and the Juan Fernandez Is. (THORNTON & NEW, 1981).

Eleven, possibly more, species (only 2 of which were identified) in 7 genera were reported from the Marquesas by MUMFORD (1942), 13 species have been recorded from Samoa (KARNY, 1932; ZIMMERMAN, 1948) and 3 from Easter Island (MOCKFORD, 1972). ZIMMERMAN (1948) also reported collecting *Ectopsocus fullawayi* on Tubuai (Austral Is.), Pitcairn, Oeno, Henderson and Mangareva.

The only psocopterans so far recorded from the Society Is. are *Soa flaviterminata* Enderlein (PEARMAN, 1934), *Pseudocaecilius tahitiensis* (Karny) (KARNY, 1925; LEE & THORNTON, 1967) and *Lobocaecilius carinifex* Lee & Thornton (LEE & THORNTON, 1967), all from Tahiti.

Thus the psocopteran faunas of high island groups of the central Pacific remain relatively poorly known. This paper, based on 4 weeks of collecting on Moorea in the Society Is., is a small contribution towards filling that lacuna. Collections were made by beating, from 25.ix.87 to 21.ix.87, and an attempt was made to sample vegetation both in the mountains and the lowlands (fig. 1). The species-individuals discovery curve (fig. 2) suggests that the island was sampled fairly thoroughly.

A key to psocopteran families now known from the Society Islands is provided below.

1. Body and wings with scales, antenna more than 20 segments ..... Lepidopsocidae
— Body and wings without scales, antenna with 13 or fewer segments 2
2. Fore wing without areola postica 3
— Fore wing with areola postica 4
3. In hind wing, veins *rs* and *m* connected by cross-vein, claws without subapical tooth. Ectopsocidae
— In hind wing, veins *rs* and *m* fused for a length, claws with subapical tooth ... Peripsocidae
4. In fore wing areola postica joined to media (discoidal cell closed) 5
— In fore wing areola postica free (discoidal cell open) 6
5. Tarsi 2-segmented; fore wing largely hyaline, with simple brown pigment pattern ... Psocidae
— Tarsi 3-segmented; fore wing with complex pattern of clouds and spots ..... Myopsocidae
6. Tarsi 3-segmented ..... Philotarsidae
— Tarsi 2-segmented 7
7. Female gonapophyses not styliform, complete; abdomen smooth ventrally ... Pseudocaecillidae
— Female gonapophyses styliform, without outer valve; abdomen with ventral "blisters". Caeciliidae

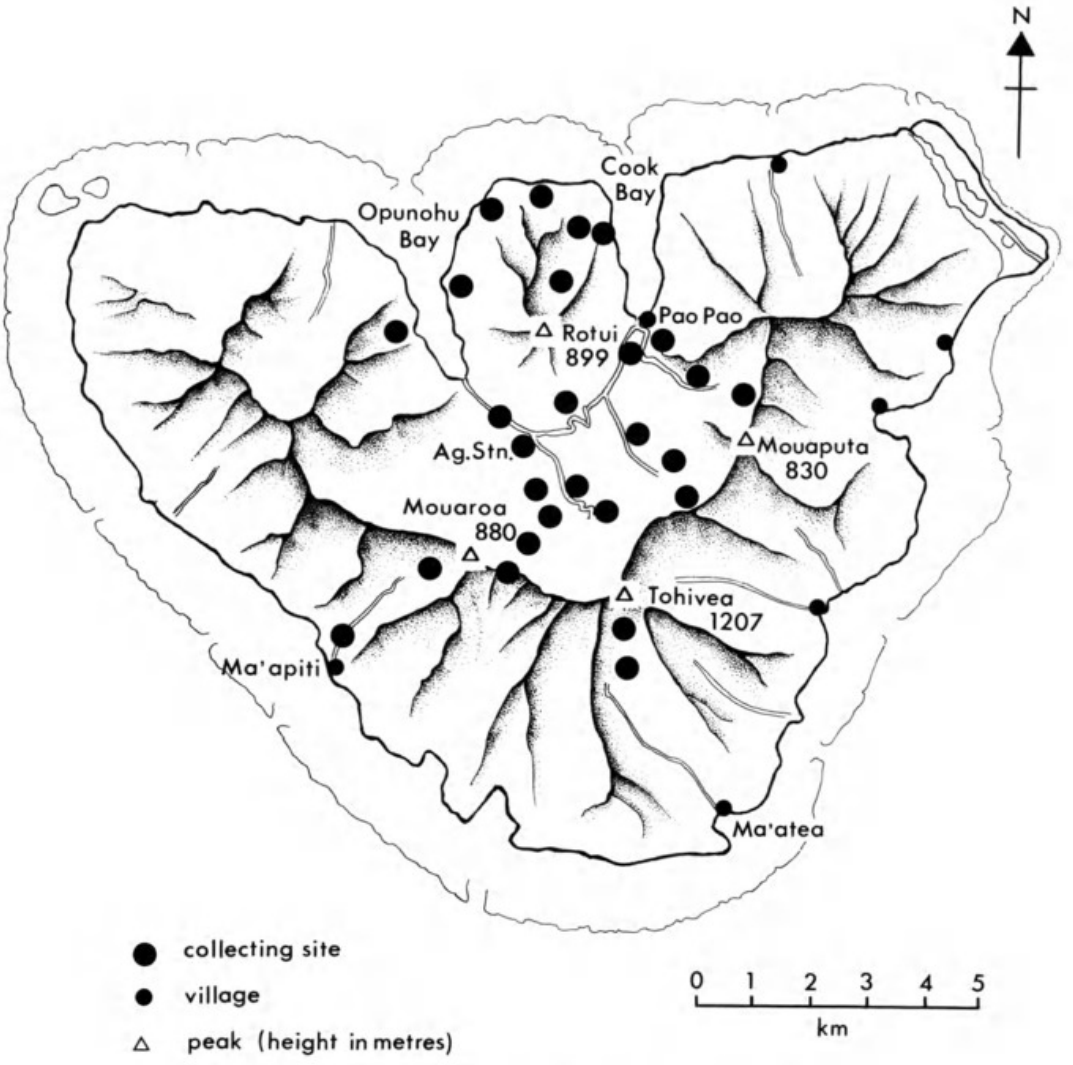


FIG. 1. — Map of collecting sites on Moorea.

CHECK-LIST OF PSOCOPTERA NOW KNOWN FROM THE SOCIETY ISLANDS

LEPIDOPSOCIDAE

Cyptophania hirsuta Banks (Hawaii)
Echmepteryx gumpi n. sp.
Echmepteryx lunulata Thornton *et al.* (Diego Garcia, Indonesia, Pacific)
Echmepteryx madagascariensis (Kolbe) (tropicopolitan)
Echmepteryx pallida Smithers (Indonesia, NE Australia)
Lepidopsocus aureus Thornton (Hawaii)
Lepidopsocus dindus Thornton (Fiji, Tonga)
Lepidopsocus fasciatus Thornton (Hawaii, Fiji, Tonga)
Lepidopsocus maculatus Thornton, Lee & Chui (Pacific)
Lepidopsocus magnus Thornton (Hawaii)
Lepidopsocus marmoratus (Banks) (Indonesia, Micronesia, Fiji, Hawaii)
Lepidopsocus pretiosus (Banks) (Indonesia, Micronesia, Fiji, Tonga)
Lepidopsocus pseudomaculatus Thornton (Fiji)

Lepidopsocus sp.
Nepticulomina lusiae Thornton (Indonesia, Fiji)
Soa flaviterminata Enderlein (Africa, Madagascar, Seychelles, Brazil)

CAECILIIDAE

Caecilius analis Banks (SE Asia, Pacific)

ECTOPSOCIDAE

Ectopsocus denervus Thornton & Wong (Philippines, Micronesia, Fiji, Tonga, Samoa)
Ectopsocus fullawayi Enderlein (Hawaii and South Pacific)
Ectopsocus perkinsi Banks (Hawaii and South Pacific)
Ectopsocus spilotus Thornton & Wong (Micronesia, Hawaii, Fiji, Tonga, Samoa)

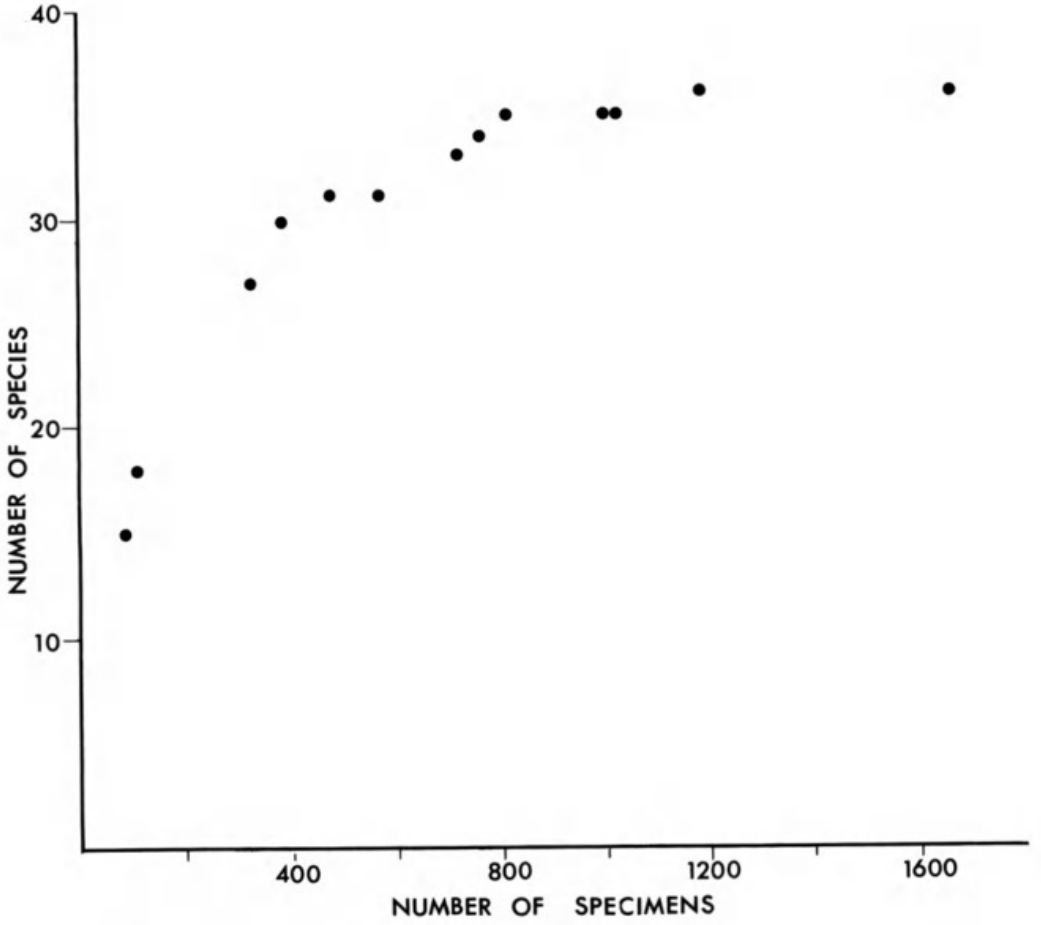


FIG. 2. — Species-individuals discovery curve for the present survey (collections randomised).

PERIPSOCIDAE

Peripsocus bonnieae n. sp.
Peripsocus ferrugineus Thornton & Wong (Micronesia, Hawaii, Fiji, Tonga, Samoa)
Peripsocus pauliani Badonnel (Africa, SE Asia, Philippines, Micronesia, Fiji, Tonga, Galapagos)
Peripsocus similis Enderlein (SE Asia, Hawaii, Fiji, Tonga)
Peripsocus stegeri n. sp.

PSEUDOCAECILIIDAE

Heterocaecilius dybasi Lee & Thornton (Micronesia)
Lobocaecilius carinifex Lee & Thornton [1] (Rapa)
Lobocaecilius nigroides n. sp.
Lobocaecilius mouaputa n. sp.
Pseudocaecilius tahitiensis (Karny) (Micronesia, Galapagos)

PHILOTARSIDAE

Aaroniella badonneli n. sp.

PSOCIDAE

Ptycta vitiensis (Karny) (Fiji)

MYOPSOCIDAE

Myopsocus albiceps n. sp.
Myopsocus opunohu n. sp.
Myopsocus punctatoides (Thornton) (Fiji, Tonga)
Myopsocus punctatus (Thornton) (Micronesia)

SYSTEMATIC TREATMENT OF FAUNA

Holotypes and allotypes will be deposited in the Muséum national d'Histoire naturelle, Paris (MNHN below). Paratypes will be deposited there and, where possible, also in the Australian Museum, Sydney (AM). Scale lines in figures 3 to 62 are in millimeters.

Family LEPIDOPSOCIDAE Pearman, 1936

KEY TO LEPIDOPSOCIDAE OF MOOREA

In this key head and wing pigment patterns are referred to as they appear after removal of scales and as seen under a stereomicroscope.

1. Fore wing horny, elytriform, meeting in straight median line, veins hardly recognisable; hind wings aborted ..... *Cyptophania hirsuta*
— Fore wing not elytriform, veins distinct after removal of scales; hind wings developed 2
2. Antenna with fewer than 30 segments, segments about 4 × as long as thick; distinct closed cell in both fore and hind wing, that of hind wing narrow, basal 3
— Antenna with 30 or more segments, segments about 2 × as long as thick; distinct closed cell never present in both fore and hind wing 4
3. Fore wing broad (greatest width more than 1/3 length), apically rounded, basal part of subcosta meeting closed cell ..... *Soa flaviterminata*
— Fore wing narrow (greatest width less than 1/3 length), pointed apically, basal part of subcosta not meeting closed cell, unconnected to its apical part ..... *Nepticulomima lusiae*

1. Not collected on Moorea in this survey but known from Tahiti.

4. In fore wing, veins *rs* and r_1 separate, or linked by cross-vein 5
— In fore wing, veins *rs* and r_1 fused for a distance 7
5. Fore wing membrane with broad brown longitudinal band; head markings only as narrow stripes from orbit to antennal socket ..... *Echmepteryx madagascariensis*
— Fore wing membrane hyaline, or if patterned, not with a longitudinal brown band; head with narrow crescentic mark anterior to ocelli in addition to antennal-orbital stripe 6
6. Fore wing membrane brown except apex hyaline ..... *Echmepteryx gumpi*
— Fore wing membrane hyaline or with very faint brown margin 7
7. Clypeus with dark band along anterior and posterior margins ..... *Echmepteryx lunulata*
— Clypeus without dark bands along anterior and posterior margins ..... *Echmepteryx pallida*
8. Front of head unpatterned; fore wing membrane concolorous ..... *Lepidopsocus aureus*
— Front of head patterned; fore wing membrane with some pigment pattern 8
9. Pigmented area each side extends over whole vertex posteriorly and is continuous with pigmented area on frons ..... *L. fasciatus*
— Pigmented areas on vertex not extending over posterior of vertex or not continuous with frons markings 10
10. Vertex viewed from front has two sets of pigment patches : each side a patch close to median epicranial suture and a lateral patch close to orbit 11
— Vertex viewed from front has only one set of pigment patches, either close to median epicranial suture or adjacent to orbit 14
11. Median pair of vertex pigment patches as broad as long, lateral pair crescent shaped, close to vertex-frons suture ..... *L. marmoratus*
— Median pair of vertex marks longer than broad, narrowing anteriorly, lateral patches extend posteriorly at least along half extent of orbit margin 12
12. On vertex lateral pair of pigment patches not extending broadly posteriorly beyond half extent of orbit margin, median pair not fusing in mid-line anteriorly; pigment patch in middle of fore wing covering less than 1/3 wing area, distinctly emarginate ..... *L. magnus*
— On vertex lateral pair of pigment patches extending broadly posteriorly along whole of orbit margin, median pair fused in mid-line between lateral ocelli; pigment patch in middle of fore wing vague, extending over 1/2 wing area 13
13. On vertex, median pair of pigment patches as dark or darker than lateral pair, darker than central area of anteclypeus ..... *L. pseudomaculatus*
— On vertex, median pair of pigment patches lighter than lateral pair, no darker than central area of anteclypeus ..... *L. maculatus*
14. Pigment patches on vertex triangular, close to mid-line; frons with a cream triangular central area partially enclosed by straight narrow bands of pigment ..... *L. dindus*
— Vertex marks not triangular or close to mid-line; central cream area of frons with curved lateral margins formed by lateral pigmented areas 15
15. Pigment patches on vertex with mesial edges curved smoothly towards mid-line posteriorly, continuous anteriorly with pigmented area on frons ..... *Lepidopsocus* sp. (nymphs only)
— Pigment patches on vertex with mesial edges not clearly curved towards mid-line posteriorly, separated from pigment on frons by broad cream area ..... *L. pretiosus*

Family LEPIDOPSOCIDAE Pearman, 1936

Genus **CYPTOPHANIA** Banks

Cyptophania Banks, 1931 : 440. Type species : *Cyptophania hirsuta* Banks. For synonymy see THORNTON 1981*a* : 19.

Cyptophania hirsuta Banks

Cyptophania hirsuta Banks, 1931 : 440. — ZIMMERMAN, 1948 : 123, 225. — BUTLER, 1961 : 381. — THORNTON, 1981*a* : 20; 1981*b* : 4.

MOOREA : inner crater wall between Mt. Tohivea and Mt. Mouaroa, 200-400 m 3 ♀.

DISTRIBUTION ELSEWHERE : Ovalau (Fiji), Laysan, Hawaiian Islands.

C. hirsuta was collected in Hawaii from ephemeral habitats such as birds' nests and dead leaves. It differs from *Cyptophania bifurcata* Karny from Samoa and *Cyptophania marginata* Thornton, Lee & Chui from Micronesia in fore wing pigmentation pattern.

Genus **ECHMEPTERYX** Aaron

Echmepteryx Aaron, 1886 : 17. Type-species : *Amphientomum hageni* Packard.

Echmepteryx gumpi n. sp.

Male : Coloration (after 6 months in alcohol) : General ground colour brown, pigment pattern darker brown. Head with a pair of comma-shaped pigment patches on vertex, frons with distinct pattern, postclypeus brown with fine median paler line. For wing membrane brown, fading at apex to very pale brown. Legs : hind femur buff, brown over basal quarter; tibia with two brown and two buff broad bands, the apical one buff; basal tarsal segment buff, brown over basal fifth, apical segments brown. Abdomen mid-brown.

Morphology : Head shining. Fore wing venation as figure 3. Genitalia as in figures 4 and 5.

Female : Coloration (after 6 months in alcohol) as male, but ground colour buff, pigment pattern brown, so contrast greater and pattern, for example of head (fig. 6), more easily discernible.

Morphology as male but larger. Gonapophyses as in figure 7.

Holotype ♂ : Moorea, Pao Pao, gardens, coconut, 7.x.87. Allotype ♀, two ♂ and three ♀ paratypes : same data as holotype.

OTHER SPECIMENS : Same data as holotype, 5 n; Mt. Mouaputa, beating *Inocarpus* forest 350 m 8 ♂ 19 ♀ 7 n; Ma'atea V., *Inophyllum* forest 300 m1 ♀, below Tohivea 0-230 m 11 ♀ 14 n; crater rim, between Mts. Tohivea and Mouaroa 400 m 2 n, 200-400 m 1 n; NW slopes Mt. Mouaputa, beating "mape" "kukui" and *Citrus* 250 m 20 + specimens; Mt. Mouaputa, SW face 250 m 8 ♂ 14 ♀ 8 n; Cook and Opunohu Bays 4 ♀ 3 n; inner wall of crater, 200-250 m 1 ♂ 21 ♀ 7 n.

The pattern of venation of the hind wing, used as a criterion of subgeneric placement (SMITHERS, 1965), is variable. In at least two specimens, veins m_1 and m_2 have a common stem in the left wing and vein m_2 is absent in the right; in other specimens veins m_1 and m_2 have a common stem in both wings; in yet others m_1 and m_2 arise separately in both wings. All specimens have the characteristic head pattern.

E. gumpi, particularly the darker ♂, generally resembles *Echmepteryx brunnea* Smithers 1965, known from Australia, and has a similarly coloured fore wing and a similar leg pattern. The head pattern, however, which is clear in the nymphs, is distinctive and quite unlike any other Pacific species of the genus.

Named after the benefactor of the research station on Moorea, Mr Richard GUMP.

Echmepteryx lunulata Thornton, Lee & Chui

Echmepteryx (*Thylacopsis*) *lunulata* Thornton, Lee & Chui, 1972 : 64. — THORNTON & WOO, 1973 : 6. — THORNTON, 1981*a* : 19; 1981*b* : 6; 1981*c* : 107; 1984 : 85.

MOOREA : Pao Pao, gardens 6 ♀; Opunohu Bay 2 ♀; Ma'atea V., *Inophyllum* forest 300 m 2 ♀; Mt. Mouaputa, NW slopes 250 m "mape" *Aleurites moluccana Citrus* 5 ♀, SW face 250 m 2 ♀, 350 m *Inocarpus fagiferus* 1 ♀; Mt. Rotui, NE valley 200 m, 12 ♀; eroded crater, 250 m 40 ♀ 19 n; inner crater wall between Mts. Tohivea and Mouaroa, 200-400 m, 36 ♀ 11 n; foot Mt. Mouaroa, 150 m *Casuarina equisetifolia* 8 ♀; Cook and Opunohu Bay, 5 m 50 ♀, 12 n.

DISTRIBUTION ELSEWHERE : Diego Garcia, Sumatra, Krakataus, Java, Bali, Bonins, Marianas, Carolines, Marshalls, Fiji, Tonga, Hawaii, Galapagos.

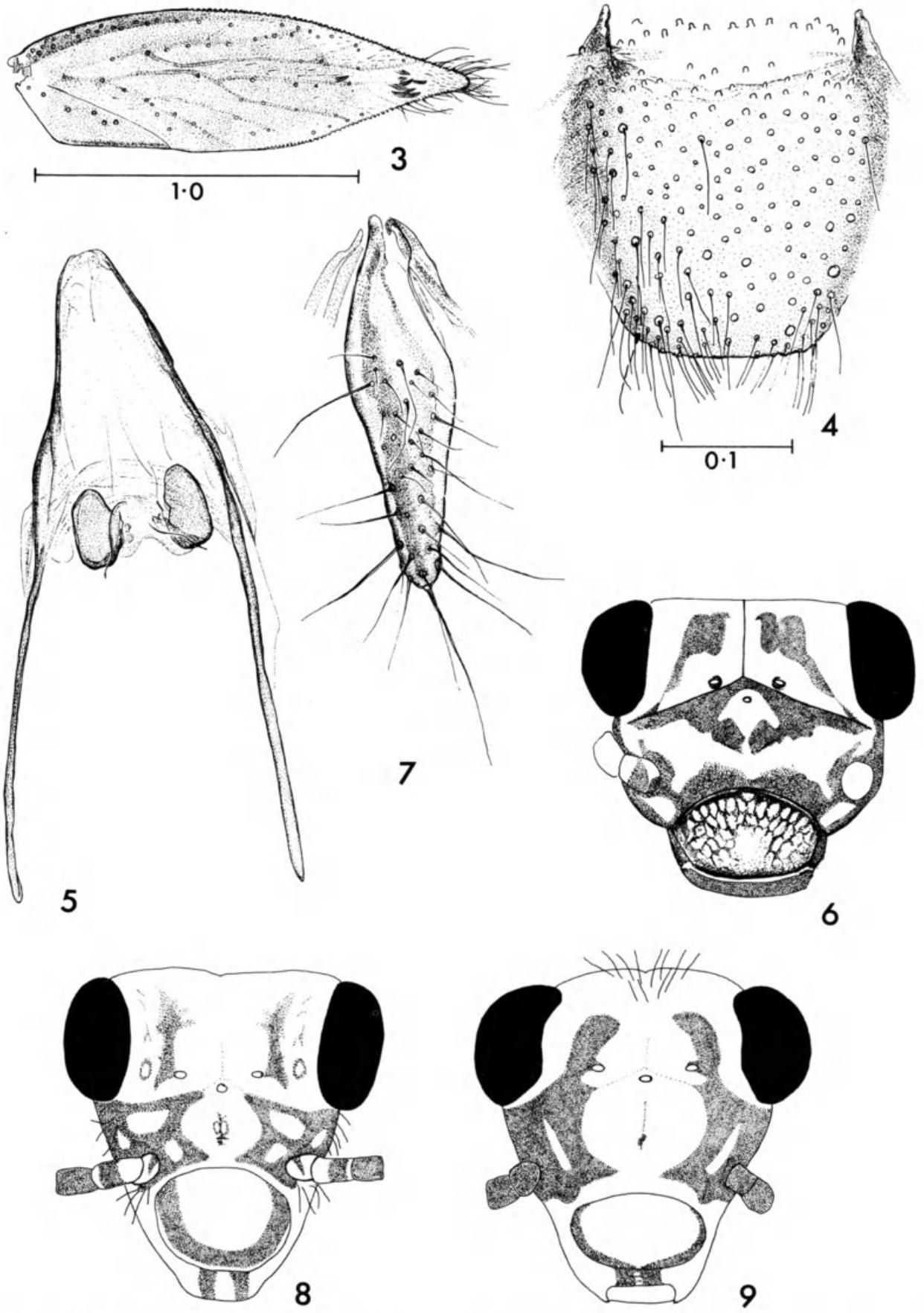
This common widespread species is probably parthenogenetic. It is commonly found in the lowlands but has been taken as high as 800 m on Viti Levu, Fiji.

Echmepteryx madagascariensis (Kolbe)

Thylax madagascariensis Kolbe, 1885 : 184.
Echmepteryx (*Thylacopsis*) *madagascariensis* (Kolbe) : THORNTON & WOO, 1973 : 7. For full synonymy see THORNTON & WOO (1973 : 7), and THORNTON (1981*b* : 6).

MOOREA : Cook and Opunohu Bays, 13 ♀; Mt. Rotui, NE valley 5 m 1 ♀; Ma'apiti V., lowlands 3 ♂ 1 ♀; Mt. Mouaroa, N face 200-400 m 1 ♀.

DISTRIBUTION ELSEWHERE : A tropicopolitan species on cultivated plants. Usually found in the lowlands, the species was captured at 1000 m on Mt. Rinjani, Lombok (Indonesia).



FIGS 3-9. — *Echmepteryx gumpi*, ♂ holotype : 3, fore wing; 4, hypandrium; 5, phallosome. ♀ allotype : 6, head; 7, gonapophyses. *Lepidopsocus pretiosus* ♀ : 8, head. *Lepidopsocus* sp., nymph : 9, head. (Figs 4, 5 and 7 to common scale, heads not to scale.)

Echmepteryx pallida Smithers

Echmepteryx (*Thylacopsis*) *pallida* Smithers, 1965 : 75.

MOOREA : Mt. Rotui, NE valley 200 m 1 ♀.

DISTRIBUTION ELSEWHERE : Sumatra, Krakataus, Java, Australia (Queensland), Bali, Lombok.

A single specimen of this species was collected with its congener, *E. lunulata*. The species have also been taken together in Indonesia, where *E. pallida* was collected from sea level to 800 m elevation. The species probably also occurs on other Pacific islands.

Genus **LEPIDOPSOCUS** Enderlein

Lepidopsocus Enderlein, 1903 : 328. Type-species : *Lepidopsocus nepticulides* Enderlein.

Lepidopsocus aureus Thornton

Lepidopsocus aureus Thornton, 1981*a* : 14-15.

MOOREA : Eroded crater, 200-250 m 4 ♀; Mt. Mouaroa, inner crater wall 200-400 m 1 ♀; Ma'apiti V., lowland vegetation 1 ♀.

DISTRIBUTION ELSEWHERE : Hawaii.

In Hawaii this species was found from sea level to 400 m altitude.

Lepidopsocus dindus Thornton

Lepidopsocus dindus Thornton, 1981*a* : 14-15.

MOOREA : Opunohu Bay, lowland vegetation 3 ♀ 1 n; Mt. Mouaputa, *Inocarpus* forest 350 m 3 ♀ 5 n. *Aleurites moluccana* " mape " *Citrus* 250 m 1 ♀ 1 n, SW face 250 m 3 ♀, *Inocarpus fagiferus* 350 m 4 ♀ 12 n; Mt. Rotui, NE valley, 200 m 2 ♀ 1 n; Ma'atea V., *Calophyllum inophyllum* 300 m 2 ♀ 9 n, below Tohivea 230 m 1 ♀ 3 n; Mt. Mouaroa, inner crater wall 200-400 m 3 ♀ 8 n; Cook and Opunohu Bays, 5 m 2 ♀ 7 n; eroded crater wall, 200-250 m 8 ♀ 12 n.

DISTRIBUTION ELSEWHERE : Fiji, Vava'u (Tonga).

This species evidently thrives at 200-400 m as well as occurring in the lowlands.

Lepidopsocus fasciatus Thornton

Lepidopsocus fasciatus Thornton, 1981*a* : 15-17.

MOOREA : Pao Pao, lowland gardens 1 n ; Opunohu Bay, lowland vegetation 6 ♀ 5 n (3 adults dark, 3 typical) ; Mouatea V., forest 300 m *Calophyllum inophyllum* 1 ♀ (typical) ; crater rim between Mt. Tohivea and Mt. Mouaroa, 400 m 3 ♀ (2 dark) 3 n, 200-400 m 2 ♀ (typical) 1 n ; Mt. Mouaputa, NW slopes *Aleurites moluccana* "mape" *Citrus* 250 m 9 ♀ (4 dark), SW face 250 m 2 ♀ (1 dark) 1 n, *Inocarpus fagiferus* 350 m 4 ♀ (2 dark) 1 n ; crater near Ag. Station, *Casuarina equisetifolia* 200 m 1 ♀ (typical) 1 n ; Mt. Rotui, NE valley sea level 3 ♀ (typical), 200 m 2 ♀ (dark) ; Ma'apiti V., lowland vegetation 3 ♀ (typical) 3 n, below Mt. Tohivea, 230 m 2 ♀ (dark) 6 n ; Mt. Mouaroa, *Casuarina equisetifolia* 150 m 6 ♀ (typical) 1 n ; Cook and Opunohu Bays, 5 m 4 ♀ (typical) 4 n ; crater, 200-250 m 10 ♀ (5 dark) 12 n.

DISTRIBUTION ELSEWHERE : Fiji, Tonga, Hawai.

As in Hawaii, Fiji and Tonga, dark and typical forms of this species occur together, with intermediates. The species' range extends to 400 m altitude. Males have not been collected.

Leptidopsocus maculatus Thornton, Lee & Chui

Lepidopsocus maculatus Thornton, Lee & Chui, 1972 : 68-70. — THORNTON & WOO, 1973 : 8-9. — THORNTON, 1981*a* : 16 ; 1981*b* : 17 ; 1981*c* : 111.

MOOREA : Mt. Mouaputa, *Inocarpus* 350 m 7 ♀ 8 n ; eroded crater wall, 200-250 m 7 ♀ 4 n.

DISTRIBUTION ELSEWHERE : S. Marianas, Fiji, Tonga, Hawaii, Galapagos.

Only taken above 200 m. This is the commonest lepidopsocid in Hawaii, where it was captured from sea level to 1150 m altitude. In the Galapagos I collected it up to 420 m and in Fiji up to 800 m.

Lepidopsocus magnus Thornton

Lepidopsocus magnus Thornton, 1981*a* : 17-18.

MOOREA : Opunohu Bay, lowland vegetation 1 ♀ 5 n ; Mt. Mouaputa, NW slope *Aleurites moluccana* "mape" *Citrus* 250 m 4 ♀.

DISTRIBUTION ELSEWHERE : Hawaii.

Not collected at high elevations in Hawaii.

Lepidopsocus marmoratus (Banks)

Echmepteryx marmorata Banks, 1931 : 439.
Lepidopsocus marmoratus (Banks) : THORNTON *et al.*, 1972 : 70. — THORNTON, 1981*b* : 21 ; 1984 : 86. For further synonymy see THORNTON *et al.*, 1972 : 70.

MOOREA : Crater rim between Mt. Tohivea and Mt. Mouaroa, 400 m 1 ♀, crater wall between Mt. Tohivea and Mt. Mouaroa, 200-400 m 1 n ; Mt. Mouaputa, NW slope *Aleurites moluccana* "mape"

Citrus 250 m 1 ♀ 1 n ; crater near Ag. Station, *Casuarina equisetifolia* 200 m 3 ♀ ; Mt. Rotui, NE valley sea level 1 ♀ 1 n, 200 m 2 ♀ ; Ma'apiti V., lowland vegetation 10 ♀ 7 n ; Ma'atea V., below Mt. Tohivea 230 m 2 ♀ ; foot of Mt. Mouaroa, *Casuarina equisetifolia*, 150 m 9 ♀ 10 n ; Cook and Opunohu Bays, 5 m 4 ♀ 9 n ; eroded crater wall, 200-250 m 13 ♀ 4 n.

DISTRIBUTION ELSEWHERE : Sumatra, Krakataus, Bali, Lombok, S. Marianas, Fiji, Hawaii.

The species appears to thrive at high elevations, but also occurs in the lowlands. In Fiji it occurs up to 870 m, and I have taken it at 1000 m on Lombok. This is the most easterly limit of its known Pacific distribution.

Lepidopsocus pretiosus (Banks)

Echmepteryx pretiosus Banks, 1942 : 28.
Lepidopsocus pretiosus (Banks) : THORNTON *et al.*, 1972 : 70-71. — THORNTON, 1981*b* : 28 ; 1981*c* : 111-113 ; 1984 : 86.

MOOREA : Opunohu Bay, lowland vegetation 14 ♀ 1 n ; Ma'atea V., forest *Calophyllum* 300 m 1 ♀ 1 n, below Tohivea, 230 m 1 ♀ 1 n ; Mt. Mouaputa, NW slopes *Aleurites moluccana* " mape " *Citrus* 250 m 6 ♀ 1 n ; crater near Ag. Station, *Casuarina equisetifolia* 200 m 20 ♀ 1 n ; NE valley Mt. Rotui, sea level 1 ♀ 7 n ; Ma'apiti V., lowland vegetation 2 ♀ 6 n ; foot Mt. Mouaroa, *C. equisetifolia*, 150 m 40 ♀ 17 n ; inner crater wall between Mt. Tohivea and Mt. Mouaroa, 200-400 m 3 ♀ 5 n ; Cook and Opunohu Bays, 5 m 9 ♀ 10 n ; inner wall of crater, 200-150 m 160 ♀ 20 n.

DISTRIBUTION ELSEWHERE : Sumatra, Krakataus, Java, Bali, widespread in Micronesia, lowlands of Fiji islands, Vava'u (Tonga).

In the majority (about 90 %) of Moorean specimens the frons pattern differs slightly from that found in Fiji (THORNTON, 1981, figure 79). The lateral enclosed pale areas on the frons are divided by a transverse pigment line (fig. 8). In all other respects of head pattern, fore wing pigment pattern and leg pattern, the insects conform to the descriptions of *pretiosus*. Evidently the Moorean population differs from typical *pretiosus* to an extent that some authors would regard as warranting subspecies status. Nymphs have the adult head pattern.

Lepidopsocus pseudomaculatus Thornton

Lepidopsocus pseudomaculatus Thornton, 1981*a* : 28-30.

MOOREA : crater rim between Mt. Tohivea and Mt. Mouaroa, 400 m 6 ♀ 3 n ; inner crater wall between Mt. Tohivea and Mt. Mouaroa, 200-400 m 1 ♀ ; Mt. Mouaputa, *Aleurites moluccana* " mape " *Citrus* 250 m 1 ♀ ; Mt. Rotui, NE valley sea level 1 ♀ 2 n, 200 m 6 ♀ ; Ma'apiti V., lowland vegetation 1 ♀ 1 n, below Tohivea, 230 m 1 n ; foot Mt. Mouaroa, *Casuarina equisetifolia* 150 m 15 ♀ 3 n ; Cook and Opunohu Bays, 5 m 3 n ; inner crater wall, 200-250 m 7 ♀ 7 n.

DISTRIBUTION ELSEWHERE : Viti Levu (Fiji)

On Moorea the distribution of this species extends from sea level to the crater rim ; on Viti Levu it was only taken in the highlands (from 400 to 900 m elevation).

Lepidopsocus sp. (nymphs only)

MOOREA : NW slopes Mt. Mouaputa, *Aleurites moluccana* " mape " *Citrus* 250 m 2 n ; NE valley Mt. Rotui, 5 m 2 n ; Ma'apiti V., lowland vegetation 1 n.

The nymphs of this species have a head pattern fairly similar to that of *L. pretiosus* nymphs, but the vertex markings differ quite distinctly. The vertex pigment patches are closer to the mid-line posteriorly than anteriorly, giving a concave mesial edge to each patch (fig. 9). I decline formally to describe and name this species until adults are discovered.

Genus **NEPTICULOMIMA** Enderlein

Nepticulomima Enderlein, 1906 : 95. Type-species : *Nepticulomima sakuntala* Enderlein.

Nepticulomima lusiae Thornton

Nepticulomima lusiae Thornton, 1981*a* : 35-38.

MOOREA : Mt. Mouaroa, eroded crater 200-400 m 2 ♀ ; Cook and Opunohu Bays, 5 m 4 ♀.

DISTRIBUTION ELSEWHERE : Sumatra, Krakataus, Java, Fiji.

Genus **SOA** Enderlein

Soa Enderlein, 1904 : 109. Type-species : *Soa dahliana* Enderlein.

Soa flaviterminata Enderlein

Soa flaviterminata Enderlein, 1906 : 79-80.

MOOREA : beating in lowlands of Cook and Opunohu Bays 1 ♀.

DISTRIBUTION ELSEWHERE : Africa, Madagascar, Seychelles, Brazil.

The species was also recorded from Tahiti by PEARMAN (1934 : 132).

Family CAECILIIDAE Pearman, 1936

Genus **CAECILIUS** Curtis

Caecilius Curtis, 1837 : 648 (see MOCKFORD, 1965*b*). Type-species : *Psocus fuscopterus* Latreille.

Caecilius analis Banks

Caecilius analis Banks, 1931 : 437. THORNTON, 1981*a* : 27.

MOOREA : within eroded crater, 200-250 m *Casuarina equisetifolia* and other plants 4 ♀; Mt. Rotui northeast valley, sea level 1 ♀; Ma'apiti V., lowland vegetation 1 ♀; Ma'atea V., below Tohivea 0-230 m 1 ♂; Cook and Opunohu Bays, 2 ♀; eroded crater, 200-250 m 1 ♀.

DISTRIBUTION ELSEWHERE : Malaya, Hong Kong, Carolines, Marianas, Marshalls, Hawaiian Is., Samoa, Marquesas.

These specimens are referred to *C. analis* provisionally; the species is in need of critical analysis. No genitalic details are provided in the description, and there may be a complex of several species with fore wings of the same simple pattern (dark axillary cell, otherwise very pale brown). The Moorea specimens, for example, differ from the description by BANKS in head pattern : the postclypeus is not brown, but buff like the rest of the head, with a short transverse brown mark, not mentioned by BANKS, immediately posterior to the antennal sockets. The male antennae are much thicker than those of the female, and in both sexes the basal flagellar segment is pale brown, the remainder of the antenna brown. For future reference, the gonapophyses and female subgenital plate (figs. 10 and 11 from a female from the eroded crater), and the phallosome (fig. 12 from the male from Ma'atea Valley) are illustrated. The subgenital plate is similar to that of *Caecilius fuscipennis* Thornton, Lee & Chui from the Carolines, which differs in fore wing pattern. *Caecilius leuroceps* Thornton, Lee & Chui, known from the Southern Marianas, is very similar but has a polished head and thorax and a female subgenital plate without distinct lateral apophyses.

Family ECTOPSOCIDAE Roesler, 1952

Genus **ECTOPSOCUS** McLachlan

Ectopsocus McLachlan, 1899 : 277. Type-species : *Ectopsocus briggsi* McLachlan. For synonymy see THORNTON *et al.*, 1972 : 101.

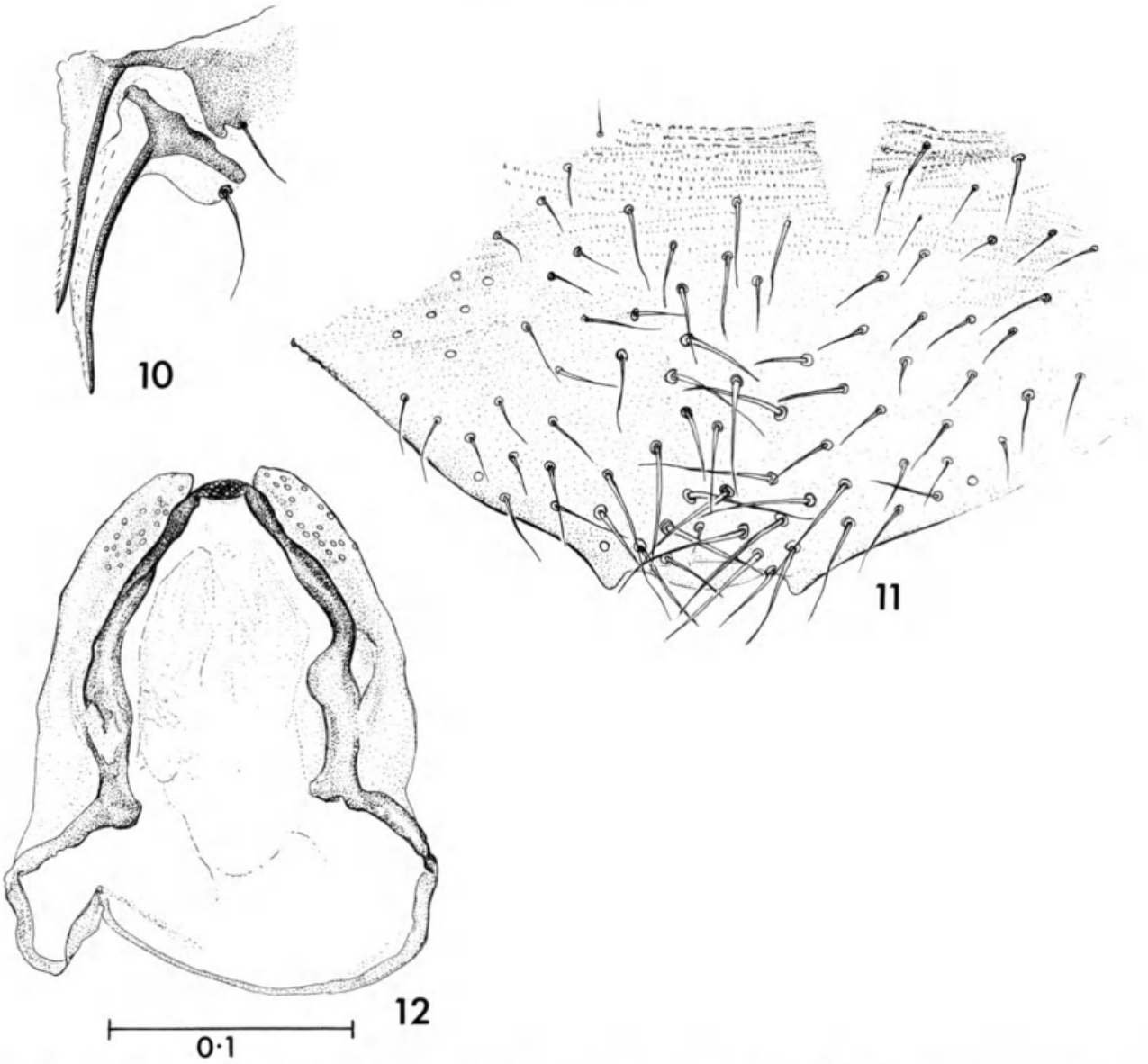
Ectopsocus denervus Thornton & Wong

Ectopsocus denervus Thornton & Wong, 1968 : 95-98. — THORNTON *et al.*, 1972 : 104. — THORNTON, 1981*b* : 43.

MOOREA : Inner crater wall, 200-250 m 1 ♂ 6 ♀, between Mt. Tohivea and Mt. Mouaroa 200-400 m 1 ♂ 2 ♀ 5 n ; Cook and Opunohu Bays, 5 m 1 ♂ 2 ♀.

DISTRIBUTION ELSEWHERE : Luzon (Philippines), S. Marianas, Carolines, Kiribati, Fiji, Tonga, Samoa.

In Fiji this species was found only in the lowlands.



FIGS 10-12. — *Caecilius analis* ♀ : 10, gonapophyses; 11, subgenital plate. ♂ : 12, phallosome. (Common scale.)

Ectopsocus fullawayi Enderlein

Ectopsocus fullawayi Enderlein, 1913 : 356. — THORNTON, 1981*b* : 43. For further synonymy see THORNTON, 1981*a* : 38.

MOOREA : Opunohu Bay, lowland vegetation 3 ♀ 5 n; Mt. Mouaputa, forest *Inocarpus fagiferus* 1 ♂; Mt. Rotui, NE valley 200 m, 1 ♂ 6 ♀; Ma'apiti V., lowland vegetation 2 ♀; Mt. Mouaputa, SW face 250 m 3 ♀, *I. fagiferus* 350 m 2 ♂ 1 ♀; crater wall, 200-250 m 3 ♂ 8 ♀; Ma'atea V. below Mt. Tohivea 230 m 2 ♂ 4 ♀; inner crater wall between Mt. Tohivea and Mt. Mouaroa, 200-400 m 6 ♂ 9 ♀; Cook and Opunohu Bays, 5 m 1 ♂ 5 ♀.

DISTRIBUTION ELSEWHERE : Wake, Laysan, Hawaii, Fiji (including Lau group), Tonga, Samoa, Tubuai, Rapa, Tuamotus, Marquesas, Pitcairn, Oeno, Mangareva, Henderson, Easter.

This widespread Pacific species was found at all elevations visited.

Ectopsocus perkinsi Banks

Ectopsocus perkinsi Banks, 1931 : 438. — THORNTON, 1981*b* : 44-45. For synonymy see THORNTON, 1981*a* : 41.

MOOREA : Mt. Mouaputa, *Inocarpus fagiferus* 350 m 1 ♂ 5 ♀; inner wall eroded crater, 200-250 m 1 ♂ 5 ♀, between Mt. Tohivea and Mt. Mouaroa 200-400 m 1 ♀; Cook and Opunohu Bays, 5 m 1 ♂ 10 ♀.

DISTRIBUTION ELSEWHERE : Kure, Midway, Hawaii, Fiji (including Lau group), Tonga, Samoa, Tubuai.

I have collected *E. perkinsi* in Fiji from sea level to 1300 m elevation; on present records it is somewhat more restricted in range than its similar congener above.

Ectopsocus spilotus Thornton & Wong

Ectopsocus spilotus Thornton & Wong, 1968 : 107. — THORNTON, 1981*a* : 40; 1981*b* : 45; 1981*c* : 118.

MOOREA : Opunohu Bay, lowland vegetation 3 ♀ 5 n; Ma'apiti V., lowland vegetation 1 ♀; Cook and Opunohu Bays, 5 m 1 ♂.

DISTRIBUTION ELSEWHERE : Marshalls, Kiribati, Hawaii, Fiji, Tonga, Samoa.

In Fiji this species is common in the lowlands on introduced vegetation but was collected at 1300 m on Mt. Victoria, Viti Levu.

The species of *Ectopsocus* reported upon above may be distinguished on fore wing characteristics. In *E. denervus* the fore wing is unpatterned and almost hyaline, and the hind wing lacks vein r_{2+3}. The fore wings of *spilotus, perkinsi* and *fullawayi* are strikingly patterned with brown pigment and hyaline areas. In *perkinsi* and *spilotus* the pterostigma contains a hyaline area; this is extensive in *spilotus*, taking up more than 1/2 the pterostigma but covers only the basal 1/3 to 1/2 in *perkinsi*. The pterostigma of *fullawayi* has no hyaline area, and this species lacks the marginal hyaline areas present as the wing apex in *perkinsi* and *spilotus*.

Family PERIPSOCIDAE Pearman, 1936

Genus **PERIPSOPUS** Hagen

Peripsocus Hagen, 1866 : 203. Type-species : *Psocus phaeopterus* Stephens.
Peripsocopsis Tillyard, 1923 : 193.

Peripscopus bonnieae sp. n.

Male : Coloration (after 6 months in alcohol) : Ground colour of head light brown, vertex pattern, clypeal striae, labrum and maxillary palps brown, striae absent from a median broad band on postclypeus; epicranial and frons-clypeal sutures dark brown; ocelli pale on black protuberance; eyes black. Antennae brown. Thoracic terga brown, broad cream median band between dorsal lobes, pleura and legs brown. Fore wing pattern (fig. 13, holotype) of brown clouds, but leaving wing margin and margin along veins unpigmented. (In one paratype male (fig. 14), pigment clouds fade towards centre of cells.) Hind wing hyaline. Abdomen cream, apical sclerites brown.

Morphology : 1.0 : D (interocular distance : greatest eye diameter as seen from front of head; method of PEARMAN *in* BALL, 1943) = 3.5. Ctenidia on hind tarsal segments : 7. Body length : 1.3 mm. Hypandrium (fig. 15) with 2 broad oblique bands of sclerotisation, 4 long marginal setae. Phallosome (fig. 16) narrow anteriorly and posteriorly, angular, with 2 long curved pointed sclerites and 2 irregular flat plates. Epiproct (fig. 17) with anterior corners curved posteriorly, clunial projection of ninth tergite with 7 close-set squarish teeth. Paraproct with field of 17 trichobothria.

Female : Coloration (after 6 months in alcohol) as male, but ground colour of head creamy-buff, head pattern thus more obvious (fig. 18). Fore wing pattern as figure 19.

Morphology : 1.0 : D = 4.0. Body length 1.7 mm. Ctenidia on basal hind tarsal segment : 13. Subgenital plate (fig. 20) apical lobe rather shorter than greatest width, 6 stout setae along apical margin. Gonapophyses (fig. 21): outer valve small, row of c. 12 prominent setae and 2 not part of row; dorsal valve with spines at apex and row of 6 setae along apical margin. Paraproct with field of 17 trichobothria.

Holotype, ♂, Moorea, Ma'atea V., below Mt. Tohivea, beating, below 230 m, 15.x.1987 I.W.B.T. (MNHN). Allotype ♀ (MNHN), 1 ♂ 2 ♀ paratypes (AM), Ma'apiti V., lowland vegetation, 8.x.1987; 6 ♀ paratypes (MNHN), data as holotype. Found in the lowlands.

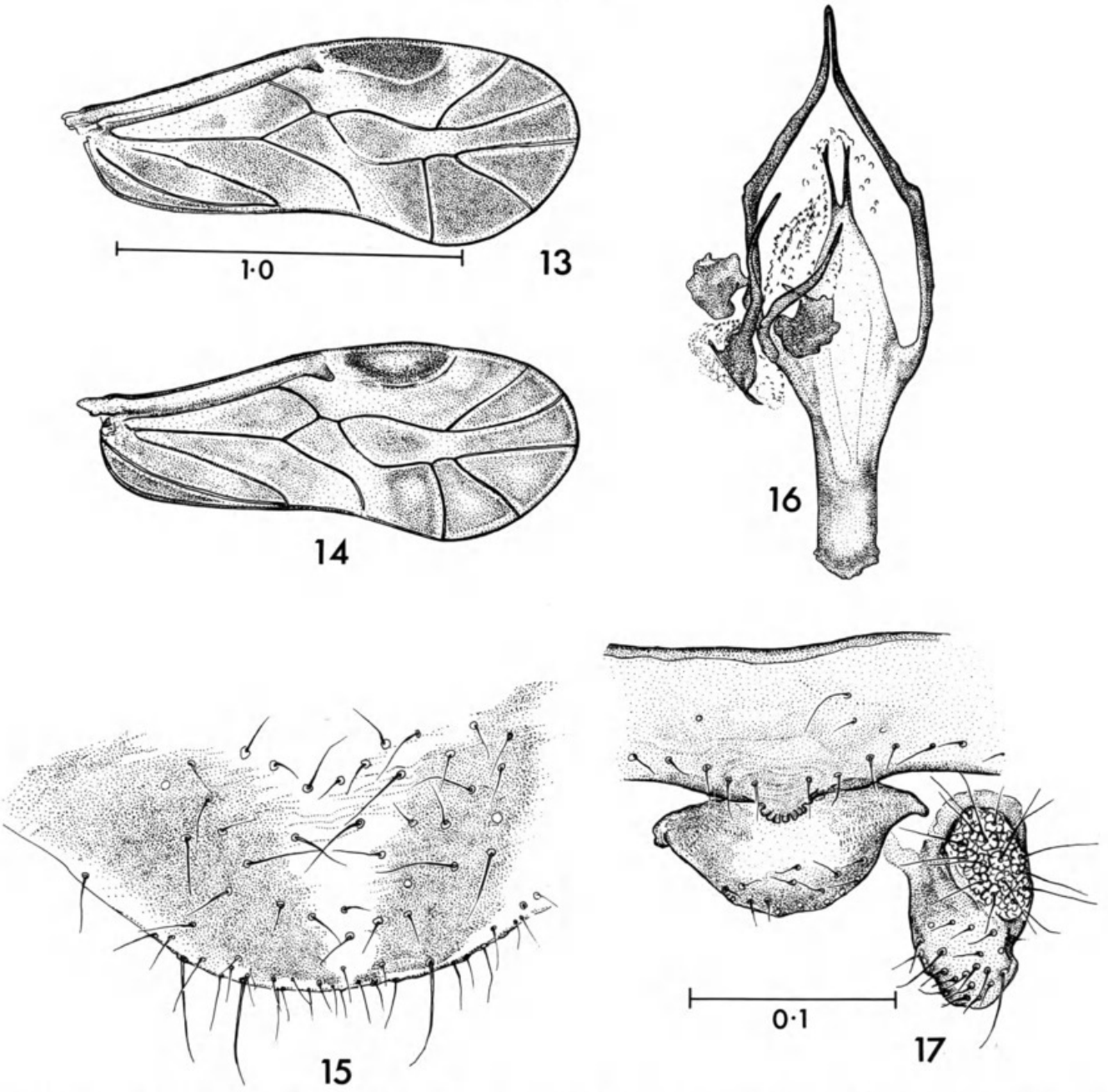
Named for Mrs. Bonnie STEGER in appreciation of her kindness.

Peripsocus ferrugineus Thornton & Wong

Peripsopus ferrugineus Thornton & Wong, 1968 : 91-93. — THORNTON *et al.*, 1972 : 107. — THORNTON, 1981*a* : 36; 1981*b* : 46; 1981*c* : 120.

MOOREA : Pao Pao, gardens 1 ♀; Opunohu Bay, lowland vegetation 2 ♂ 2 ♀; Ma'atea V., forest below Mt. Tohivea *Calophyllum inophyllum* 230 m 3 ♂ 11 ♀; crater, near Ag. station *Casuarina equisetifolia* 20 m 1 ♂ 4 ♀, 200-250 m 18 ♂ 64 ♀ 7 n; Mt. Rotui, NE valley sea level 1 ♀ 1 n; Ma'apiti V., lowland vegetation 3 ♂ 2 ♀ 1 n; Mt. Mouaputa, SW face 250 m 3 ♂ 2 ♀, NW slope 200 m *Citrus* 1 ♀, *Inocarpus fagiferus* 350 m 1 ♀; inner crater wall between Mt. Tohivea and Mt. Mouaroa, 200-400 m 3 ♀; Cook and Opunohu Bays, 5 m 1 ♂ 12 ♀ 8 n.

DISTRIBUTION ELSEWHERE : S. Marianas, Carolines, Hawaiian Islands, Fiji (including Lau group), Tonga, Samoa.

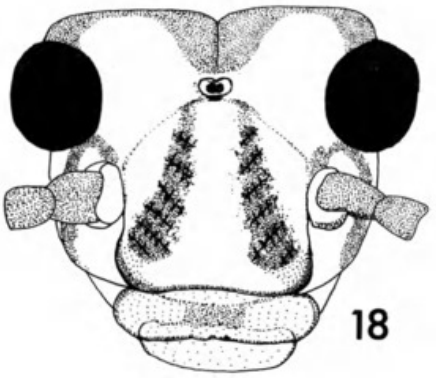


FIGS 13-17. — *Peripsocus bonnieae*, ♂ : 13, holotype fore wing; 14, paratype fore wing; 15, holotype hypandrium; 16, holotype phallosome; 17, holotype epiproct and paraproct. (Figs 13 and 14, and 15-17, to common scales.)

Occurring at elevations up to 850 m in Fiji, on Hawaii the species was predominantly found at elevations below 650 m but was captured on introduced plantation trees at 2200 m. The phallosome of a male collected in Ma'apiti Valley is shown in figure 22; it shows rather more detail than the figure of the type phallosome.

Peripsocus pauliani Badonnel

Peripsocus pauliani Badonnel, 1949 : 42. — THORNTON & WONG, 1968 : 20-22. — THORNTON *et al.*, 1972 : 107-108. — THORNTON & WOO, 1973 : 32-33. — TURNER, 1975 : 574-575. — THORNTON, 1981*b* : 46..



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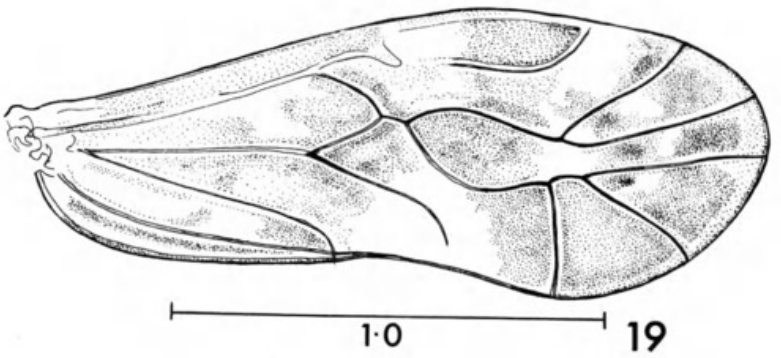

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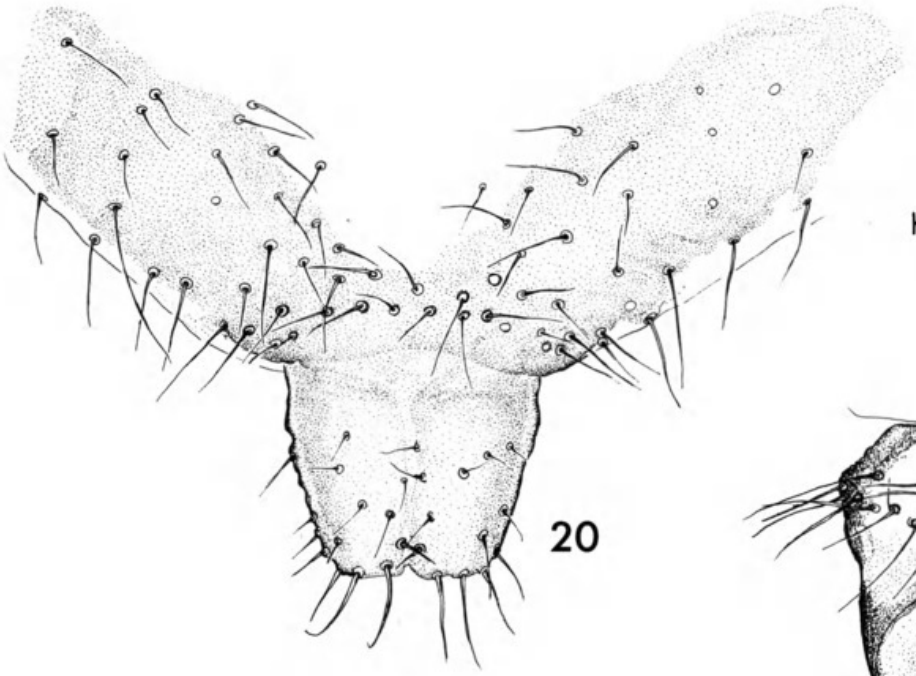

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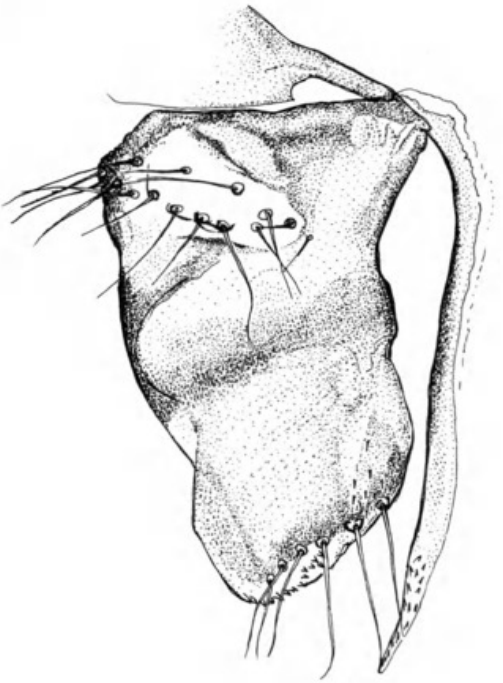

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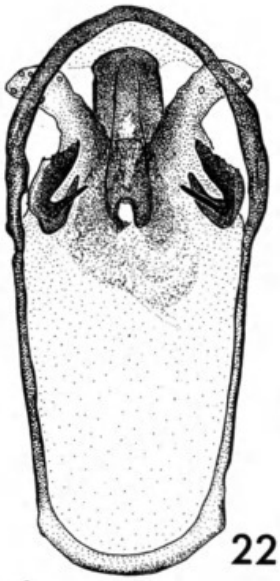

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FIGS 18-22. — *Peripsocus bonnieae*, ♀ allotype : 18, head; 19, fore wing; 20, subgenital plate; 21, gonapophyses. *Peripsocus ferrugineus*, ♂ : 22, phallosome. (Figs 20 and 21 to common scale; fig. 18 not to scale.)

MOOREA : Ma'apiti V., lowland vegetation 1 ♀.

DISTRIBUTION ELSEWHERE : Ivory Coast of Africa, Malay Peninsula, Hong Kong, Philippines, Volcanos, S. Marianas, Carolines, Marshalls, Fiji, Tonga, Galapagos.

Probably parthenogenetic, males are unknown. Collected at elevations up to 970 m in the Galapagos.

Peripsocus similis Enderlein

Peripscopus similis Enderlein, 1903 : 290 (*nec* Badonnel, 1955). — THORNTON, 1981*b* : 47. For full synonymy see THORNTON, 1981*a* : 36.

MOOREA : Cook and Opunohu Bays, 5 m 4 ♀.

DISTRIBUTION ELSEWHERE : Singapore, Krakataus, Hong Kong, Hawaii, Fiji, Tonga.

Found up to 1180 m elevation in the Hawaiian Islands, the species is evidently parthenogenetic, males being unknown.

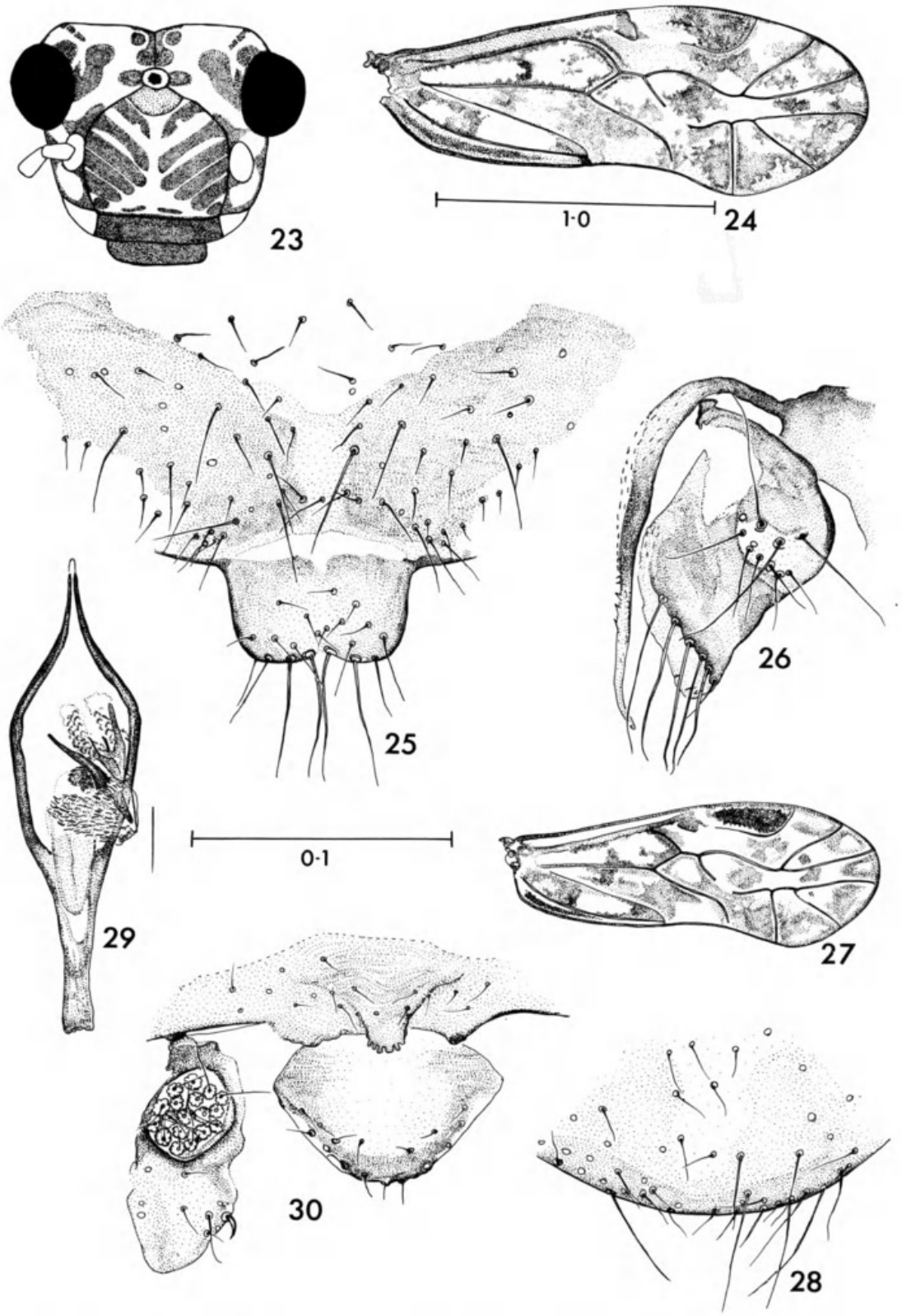
Peripsocus stegeri sp. n.

Female : Coloration (after 6 months in alcohol) : General ground colour of head cream, darker pigment pattern brown. Postclypeal striae forming distinctive pattern (fig. 23), anteclypeus brown, labrum dark brown, gena cream with brown zigzag mark, maxillary palp brown. Antenna brown, 2 basal flagellar segments somewhat paler at apices. Ocelli pale on very dark brown, protuberance, eyes black. Thoracic terga brown, median cream line narrow and short; pleura brown. Leg : coxa, trochanter and femur brown, trochanter and femur pale buff apically, tibia pale buff with vague brown subapical band, tarsal segments greyish brown. Fore wing (fig. 24) with pattern of clouds in shades of brown. Hind wing uniform very pale brown. Abdomen cream with diffuse brown pigmentation in incomplete rings, apical sclerites dark brown.

Morphology : 1.0 : D = 4.1. Head dull. Body length 1.5 mm. Ctenidobothria on basal hind tarsal segment : 14. Subgenital plate (fig. 25) median apical lobe short, broad, setose, length half greatest width, 4 prominent stout long setae on posterior margin, 2 stout long setae each side on main plate sclerotisation. Gonapophyses (fig. 26) : outer valve small, rounded, setose, 3 very long setae; dorsal valve with line of 6 prominent setae on apical margin; ventral valve with recurved spines apically. Paraproct with oval field of 15 trichobothria.

Male : Coloration as female but pigment pattern of fore wing (fig. 27) simplified somewhat.

Morphology as female with following exceptions : 1.0 : D = 3.0. Body length 1.7 mm. Hypandrium (fig. 28) simple, with 2 long stout setae on posterior margin and transverse row of 4 such setae preapically. Phallosome (fig. 29) very narrow anteriorly, narrowly pointed posteriorly, with pair of curved pointed sclerites. Epiproct and paraproct as in figure 30, posterior margin of ninth tergite with prominent narrow clunial projection bearing 6 small blunt teeth, field of 18 trichobothria on paraproct.



FIGS 23-30. — *Peripsocus stegeri*, ♀ holotype : 23, head ; 24, fore wing ; 25, subgenital plate ; 26, gonapophyses. ♂ allotype : 27, fore wing ; 28, hypandrium ; 29, phallosome ; 30, epiproct and paraproct. (Figs 24 and 27, and figs 25, 26 and 28-30, to common scales ; fig. 23 not to scale.)

Holotype, ♀, Moorea, eroded crater near Ag. Stn. 200 m, *Casuarina equisetifolia* 11.x.87 I.W.B.T. (MNHN). Allotype ♂ (MNHN), paratypes 1 ♂ 3 ♀ (AM), same data as holotype.

OTHER SPECIMENS : Ma'apiti V., lowland vegetation 1 ♂ 6 ♀; foot of Mt. Mouaroa, *Casuarina equisetifolia* 150 m 1 ♀; Cook and Opunohu Bays, beating lowland vegetation 1 ♀.

P. stegeri is easily identifiable on its unique wing pattern. The species is also unusual in the chaetotaxy of the apical lobe of the female subgenital plate and of the dorsal valve of the female gonapophyses.

Named for Dr R. STEGER, Director of the Richard Gump South Pacific Biological Research Station, in appreciation of assistance.

The following species of *Peripsocus* are now known from Pacific islands east of New Zealand, New Guinea and the Philippines : *P. suffitus* Enderlein (Micronesia), *P. ferrugineus* (Micronesia, Fiji, Samoa, Hawaii, Moorea), *P. similis* Enderlein (Fiji, Tonga, Hawaii, Moorea), *P. nitens* Thornton & Wong (Hawaii, Juan Fernandez, Galapagos), *P. pauliani* (Micronesia, Fiji, Tonga, Moorea, Galapagos), *P. milleri* (Tillyard) and *P. norfolkensis* Smithers & Thornton (Norfolk I.), and *P. bonnieae* and *P. stegeri* (Moorea, described above). Collections from New Caledonia and islands of the Outer Melanesian Arc have yet to be worked up.

MUMFORD (1942 : 835) states " the single Tahitian species [of *Peripsocus*] does not appear to agree with any from the Marquesas, and one of the latter is much like a New Zealand form. " From this statement it is clear that MUMFORD collected one species of *Peripsocus* from Tahiti, and the phrase " with any from the Marquesas " implies that he had more than two Marquesas species. The Marquesas species that he believed to be " much like a New Zealand form " could possibly be *P. nitens*; this species occurs in New Zealand, Hawaii, Galapagos, Juan Fernandez and Chile, but was not found on Moorea.

Family PSEUDOCAECILIIDAE Pearman, 1936

Genus **HETEROCAECILIUS** Lee & Thornton

Heterocaecilius Lee & Thornton, 1967 : 13. No type-species designated (Article 42c, International Code Zool. Nomencl.).

Heterocaecilius dybasi Lee & Thornton

Heterocaecilius dybasi Lee & Thornton, 1967 : 67-70.

MOOREA : Cook and Opunohu Bays, lowland vegetation 2 ♀.

DISTRIBUTION ELSEWHERE : Micronesia (Southern Marianas, Kiribati).

The Moorea females agree with the type from Saipan in having the long *rs-m* connection in the fore wing, the two dark marks on the mesial face of the tibia, and in genitalic features,

although the apical V-shaped indentation of the female subgenital plate is a little shallower, and the members of the apical pairs of setae slightly further apart.

Genus **LOBOCAECILIUS** Lee & Thornton

Lobocaecilius Lee & Thornton, 1967 : 12-13. Type-species : *Lobocaecilius cynara* Lee & Thornton.

Lobocaecilius carinifex Lee & Thornton

Lobocaecilius carinifex Lee & Thornton, 1967 : 107-109.

Known from Tahiti and Rapa, the species was not collected in this survey, although it probably also occurs on Moorea.

Lobocaecilius nigroides sp. n.

Male : Coloration (after 6 months in alcohol) : Head cream with following exceptions : eyes black ; ocelli pale with dark brown margins ; a pair of brown trapezoid marks at anterior quarter of post-clypeus ; antennae brown. Thorax, legs and abdomen pale creamy-buff. Fore wing membrane very faint brown, faint clouding at margins of cells Cu_2, Cu_1 and areola postica, veins brown with faint clouding at apices (fig. 31). Hind wing hyaline, veins barely discernible.

Morphology : 1.0 : D = 1.2. Body length 1.8 mm. Ctenidia on basal hind tarsal segment : 14. Phallosome (fig. 32, side view). Hypandrium (fig. 33) with two tines each side apically, inner pair sharply bent laterally near apex, outer pair with two small spines near apex. Paraproct with field of 10 trichobothria.

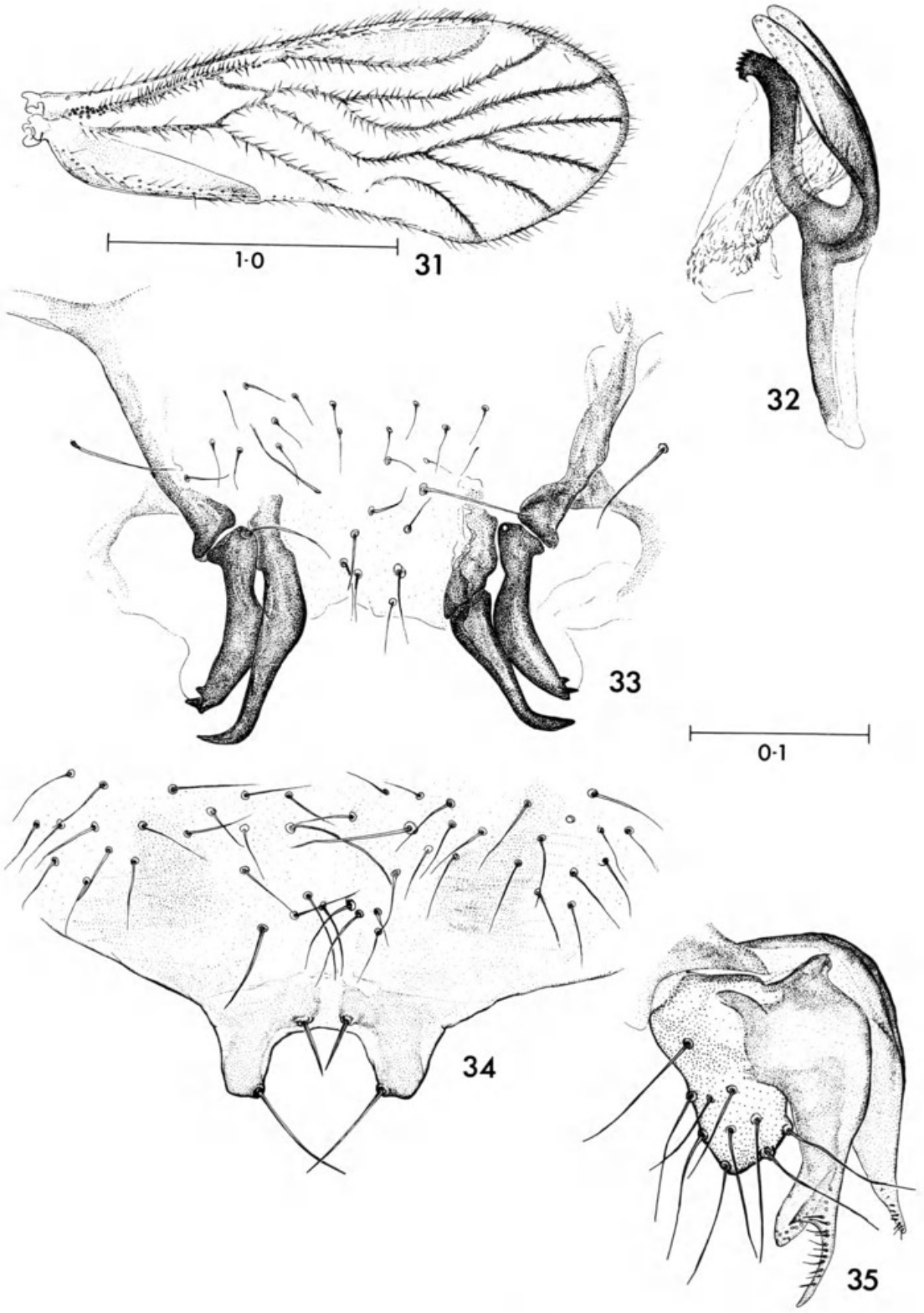
Female : Coloration as male, but brown vertex marks mesial to orbit discernible.

Morphology : 1.0 : D = 2.8. Body length 2.3 mm. Ctenidia on basal hind tarsal segment : 15. Subgenital plate (fig. 34) bilobed, lobes truncate, seta at each mesial apical corner. Gonapophyses (fig. 35). Paraproct with field of 11 trichobothria.

Holotype, ♂, Moorea, inner crater wall, between Mts. Tohivea and Mouaroa, 200-400 m, 11.x.87, I.W.B.T. (MNHN). Allotype ♀ : same data as holotype (MNHN). Paratypes : ♂, ♀ Ma'atea V., below Mt. Tohivea 0-230 m, 15.x.87, I.W.B.T. (AM).

OTHER SPECIMENS : SW face Mt. Mouaputa, 250 m 1 ♀ ; NW slopes Mt. Mouaputa, 200 m *Citrus* 1 ♀ ; eroded crater, 200-250 m 1 ♂ 11 ♀ 2 n ; Cook and Opunohu Bays, sea level 1 ♂ 6 ♀.

Similar to *Lobocaecilius nigrens* Lee & Thornton (Fiji : Viti Levu, Vanua Levu, Ovalau, Lau Group) in postclypeal markings, chaetotaxy of the female epiproct, and fore wing pigmentation, and to *L. carinifex* in outer valve of the female gonapophyses, *L. nigroides* differs from both in subgenital plate structure (apical lobes truncate, seta at mesial apical

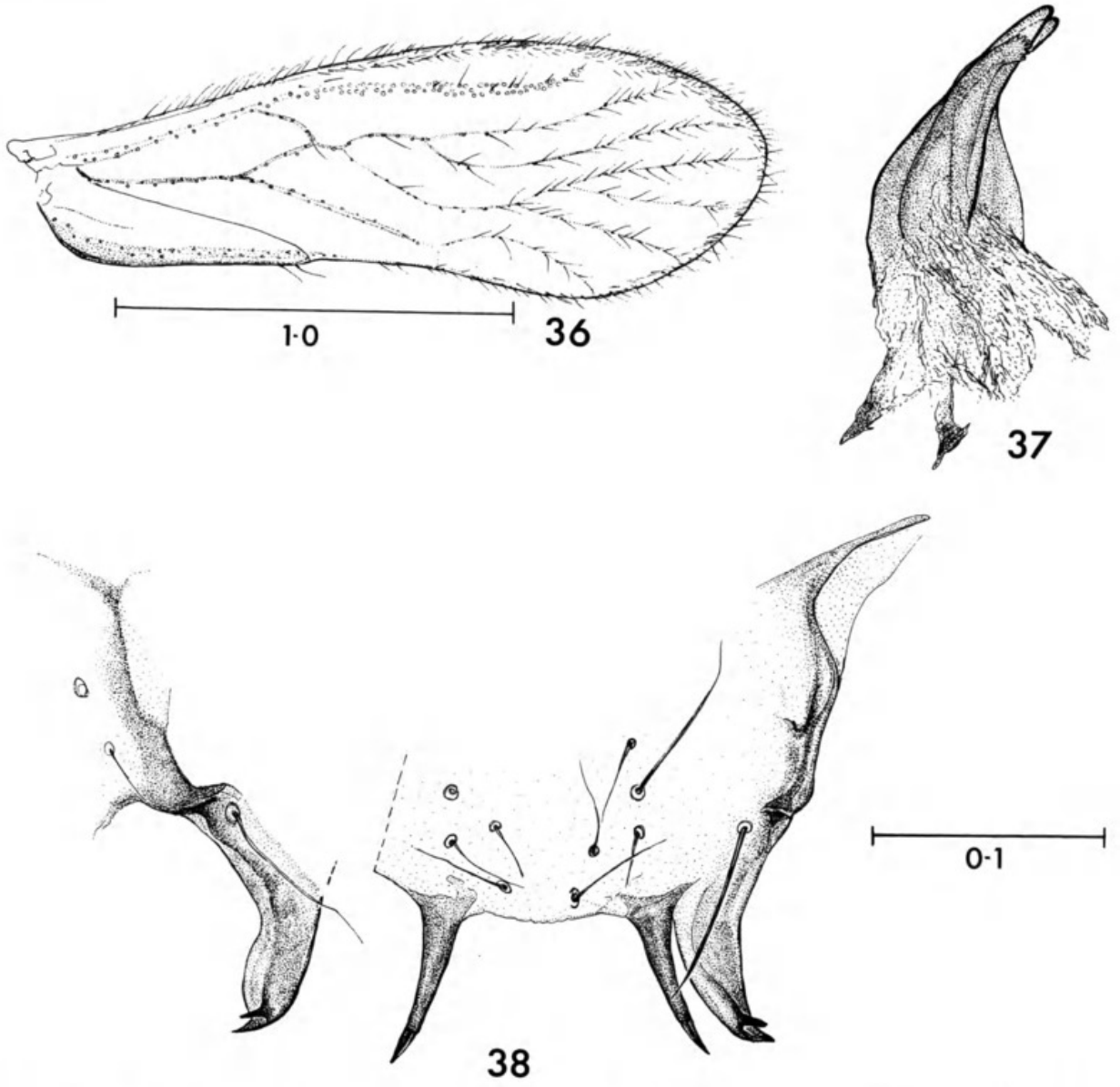


FIGS 31-35. — *Lobocaecilius nigroides*, ♂ holotype : 31, fore wing; 32, phallosome (side view); 33, hypandrium. ♀ allotype : 34, subgenital plate; 35, gonapophyses. (Figs 32-35 to common scale.)

corner of each lobe). Male hypandrial ornamentation is generally similar to that of *Lobocaecilius cynara* Lee & Thornton (Palaus), but in *L. nigroides* each of the inner pair of projections is markedly curved outwards, and the outermost "finger-nail sclerite" on each of the outer projections is sited on the projection directly, not on a short branch of it.

Lobocaecilius mouaputa sp. n.

Male : Coloration (after 6 months in alcohol) : Whole insect pale creamy-buff, except eyes black, ocelli with brown-black centripetal margins, antennae and anal cell of fore wing (fig. 36) pale brown.



FIGS 36-38. — *Lobocaecilius mouaputa*, ♂ holotype : 36, fore wing; 37, phallosome (side view); 38, hypandrium. (Figs 37 and 38 to common scale.)

Morphology : 1.0 : D = 1.0. Body length 2.4 mm. Ctenidia on basal hind tarsal segment : 14. Field of sensilla along subcostal margin of pterostigma (fig. 36). Phallosome (oblique view) as figure 37. Hypandrium (fig. 38) with two pairs of apical tines, inner pair smoothly and slightly curved outwards, outer pair with two short spines apically. Paraproct with field of 10 trichobothria.

Female : Coloration (after 6 months in alcohol) as male. Fore wing as figure 38.

Morphology : 1.0 : D = 3.0. Body length 2.6 mm. Ctenidia on hind tarsal segment : 16. Subgenital plate (fig. 40) bilobed, lobes smoothly rounded, each with a long seta at apex and a shorter one at base of lobe near mid-line. Gonapophyses (fig. 41) : outer valve axe-head shaped, with 10 long stout setae over surface, not in a line; dorsal valve with prominent subapical lobe, smoothly curved apical spine; ventral valve apical lobe less marked but clear distinction between basal part of valve and apical tine. Paraproct with field of 10 trichobothria. Epiproct as in figure 42.

Holotype ♂, Moorea, NW slopes Mt. Mouaputa, *Citrus* 200 m, 1.x.87, I.W.B.T. (MNHN). Allotype ♀, crater wall between Mts. Tohivea and Mouaroa, 200-400 m, 11.x.87, I.W.B.T. (MNHN). Paratype ♀ (and 3 n), inner crater wall, 200-250 m, 29.ix.87, I.W.B.T. (AM).

This species is most similar in female subgenital plate structure to *L. carinifex* Lee & Thornton. However, the two species differ clearly in chaetotaxy of the female epiproct (fig. 42, cf. Lee & Thornton, 1967, fig. 183) and in length of the terminal spine of the dorsal valve of the female gonapophyses, as well as in pigmentation of the fore wing. The male hypandrium is most similar to that of the sympatric *L. nigroides* (above), differing in the shape of the inner pair of apical tines.

Nine species are now known in this genus, which is represented in the Malayan peninsula, Indonesia, Micronesia, Hawaiian islands, Fiji (including the Lau Group), the Tongan archipelago, Society Is. and Rapa.

Genus **PSEUDOCAECILIUS** Enderlein

Pseudocaecilius Enderlein, 1903 : 260. — Lee & Thornton, 1967 : 9-10. Type-species : *Pseudocaecilius elutus* Enderlein.

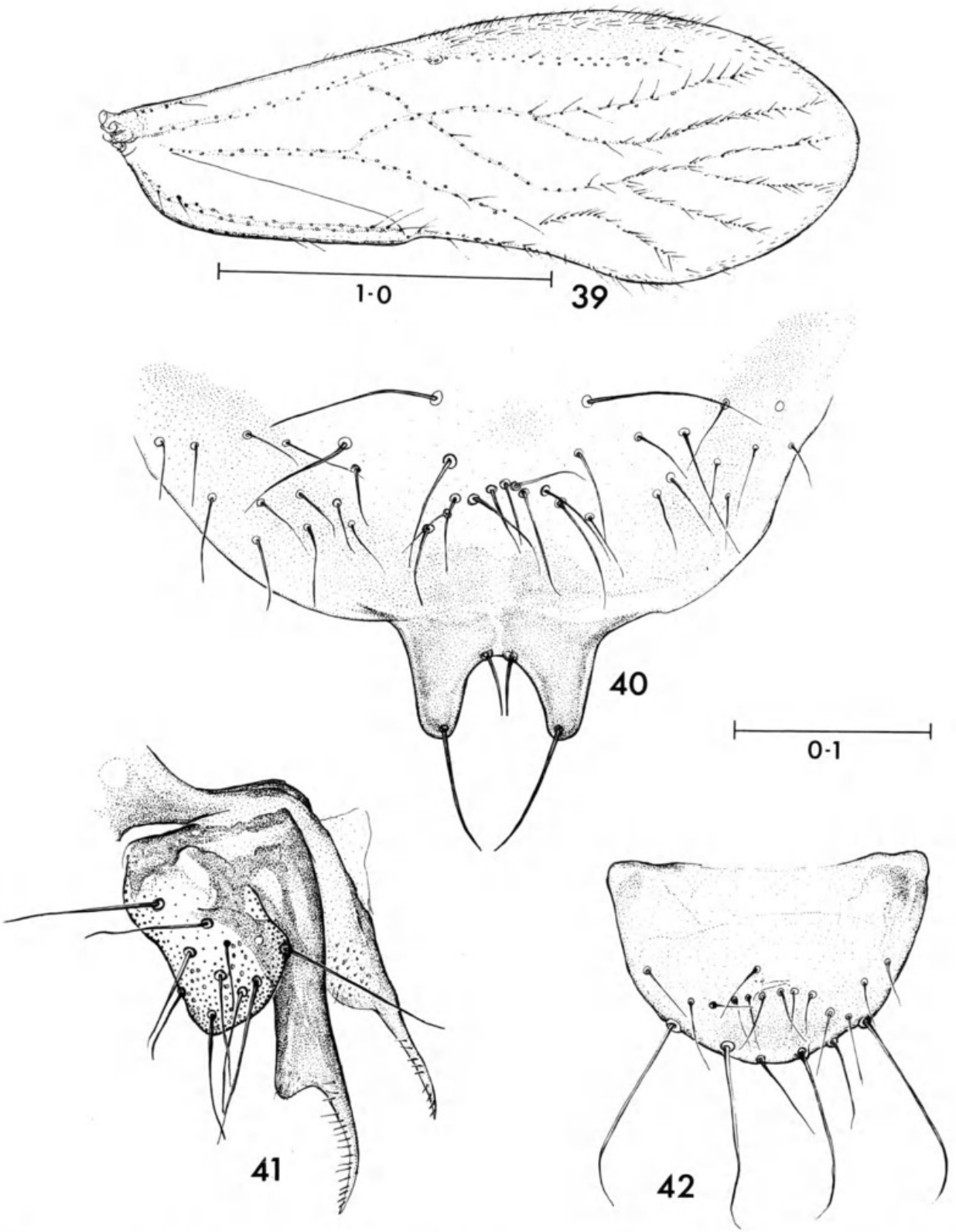
Pseudocaecilius tahitiensis (Karny)

Epipsocus tahitiensis Karny, 1926 : 288.
Pseudocaecilius tahitiensis (Karny) : Lee & Thornton, 1967 : 79-83.

Moorea : Opunohu Bay, lowland vegetation 2 ♀; Mt. Rotui, NE valley sea level 1 ♀.

Distribution elsewhere : S. Marianas, Tahiti, Galapagos.

I have collected this species at heights of up to 640 m in the Galapagos. Differences from the superficially very similar *Pseudocaecilius citricola* (Ashmead) (= *P. elutus* Enderlein), which is tropicopolitan, are detailed by Lee & Thornton (1967). *P. citricola* was not found in this survey.



FIGS 39-42. — *Lobocaecilius mouaputa*, ♀ allotype : 39, fore wing; 40, subgenital plate; 41, gonapophyses; 42, epiproct. (Figs 40-42 to common scale.)

Family PHILOTARSIDAE Pearman, 1936

Genus **AARONIELLA** Mockford

Aaroniella Mockford, 1951 : 102. Type-species : *Elipsocus maculosus* Aaron.

Aaroniella badonneli sp. n.

Female : Coloration (after 6 months in alcohol) : Ground colour buff, markings brown. Head pattern (fig. 43) much as *A. gressitti* Thornton, Lee & Chui 1972. Antennae dark brown, flagellar segments white apically. Legs buff, except hind coxa and tarsal segments brown. Pigment clouds on fore wing (fig. 44) in shades of brown.

Morphology : Body length 2.7 mm. 1.0 : D = 3.2. Ctenidia on hind tarsal segment : 14. Head (fig. 43) with 6 prominent dark brown setae each side on vertex, one pair associated with posterior ocelli. Claw with subapical tooth. Vein cu_2 in fore wing bare, basal section of costa with row of stout close-set setae. Ciliation of hind wing veins : r_1 12, *rs* 8, r_{2+3} 10, r_{4+5} 10, *m* 14, cu_1 0. Paraproct with field of 16 trichobothria. Gonapophyses (fig. 45) outer valve subtriangular, rounded apically, dorsal valve bluntly pointed. Subgenital plate (fig. 46) apical sclerite somewhat trapezoid, about 1.2 times as long as broad, apical margin almost straight, bearing 4 subapical setae; 4 long stout setae each side on subapical sclerotised field.

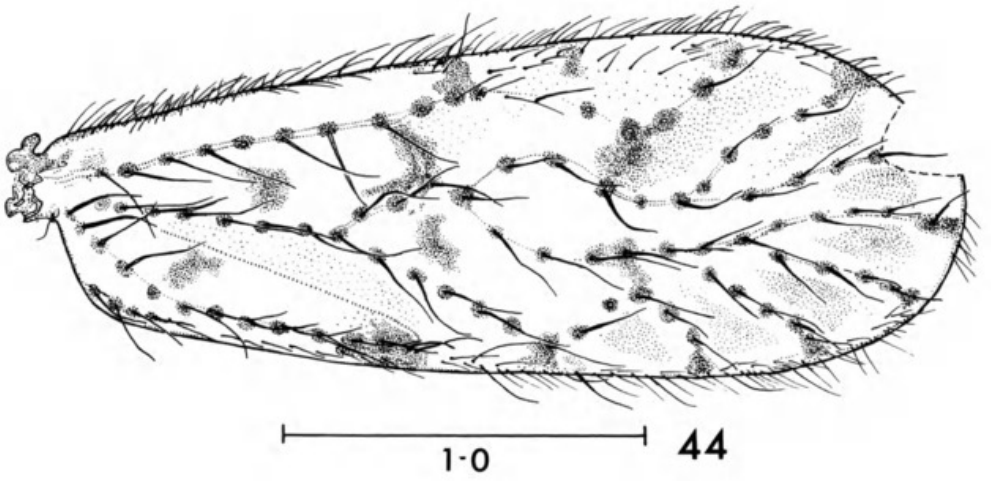
Male : Coloration as female, fore wing (fig. 47) rather more extensively pigmented.

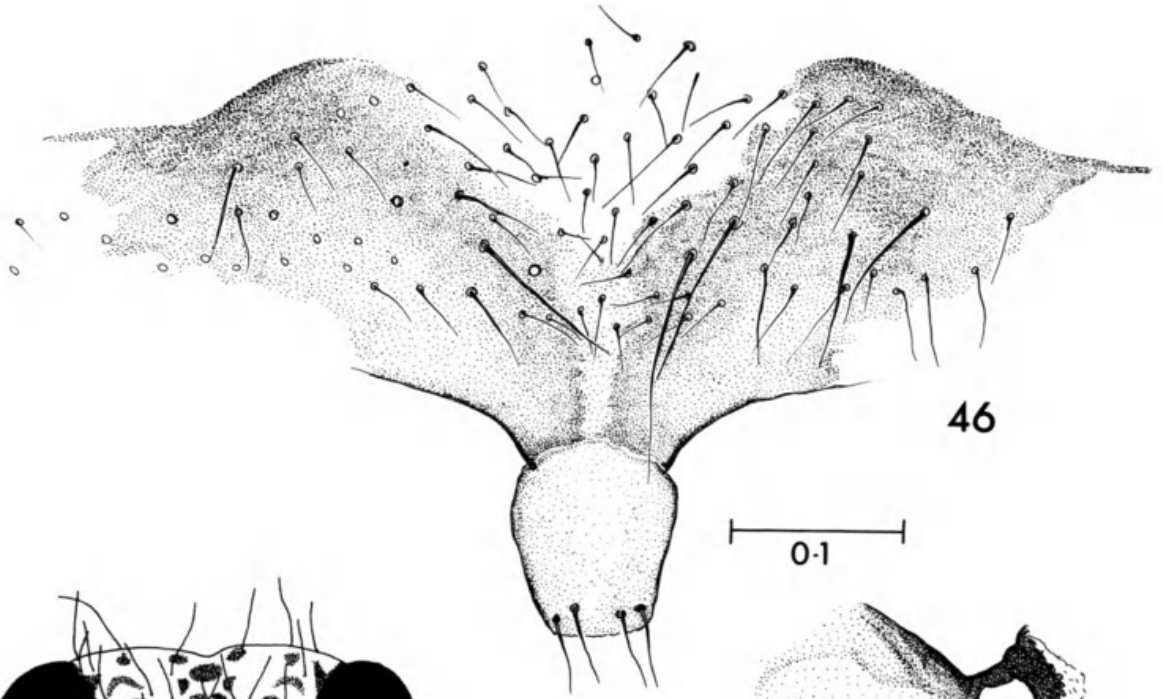
Morphology as female with following exceptions : Body length 2.4 mm. 1.0 : D = 2.7. Antennal setae longer than in female; group of 5 prominent setae on each mesothoracic dorsal lobe and 2 on antedorsum. Ctenidia on hind tarsal segment : 15. Fore wing (fig. 47) somewhat narrower than that of female. Vein cu_2 bare. Hind wing vein ciliation : r_1 15, *rs* 12, r_{2+3} 8, r_{4+5} 17, *m* 20, cu_1 0. Epiproct without rugose field, ninth tergite without median projection or ornamentation. Hypandrium (fig. 48) with apical field of short setae, subapical field of minute conical denticles. Phallosome (fig. 49) without penial bulb sclerites. A field of 22 trichobothria on each paraproct.

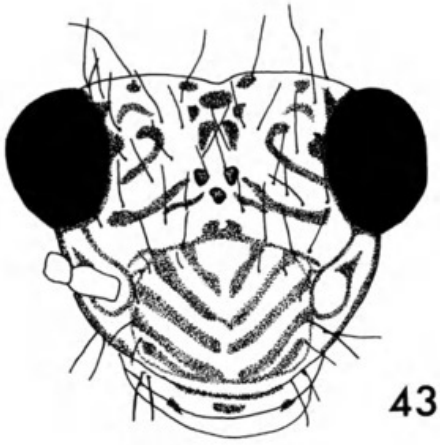
Holotype, ♀, Moorea : Mt. Mouaputa 350 m, forest beating *Inocarpus fagiferus*, 2.x.87 I.W.B.T. (MNHN). Allotype ♂ (MNHN), 1 ♂ 2 ♀ paratypes (AM), same data as holotype.

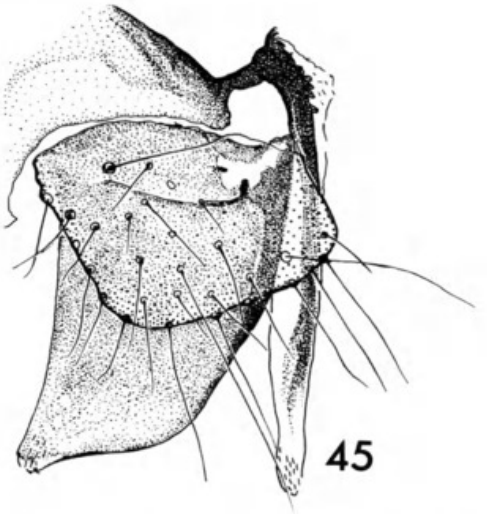
OTHER SPECIMENS : Moorea : Mt. Mouaputa, NW slopes 200-250 m beating *Aleurites moluccana* "mape" *Citrus* 6 ♀ 1 n, trunks of *I. fagiferus* 350 m 1 ♀ 2 n; Ma'atea V., below Mt. Tohivea; below 250 m 3 ♀; Cook and Opunohu Bays, beating lowland vegetation 1 ♂.

Named in honour of Dr A. BADONNEL, in his 91st year, in appreciation of his great contribution to knowledge of the Psocoptera over almost six decades.









FIGS 43-46. — *Aaroniella badonneli*, ♀ holotype : 43, head ; 44, fore wing ; 45, gonapophyses ; 46, subgenital plate. (Figs 45 and 46 to common scale ; fig. 43 not to scale.)

A. badonneli, in common with several other Oriental and Pacific species, has the fore wing setae sited on dark spots (in both sexes) up to the wing apex, and lacks massive penial bulb sclerites. Differences from other species within this group are shown in table 1.

TABLE 1. — Features of nine species of *Aaroniella* from the Oriental and Pacific regions.

Species	Distribution	Subapical dark band on tibia	Penial bulb sclerites in phallosome	Apical sclerite of subgenital plate		
				length : greatest breadth	apical setae	apical edge
maligawa	Sri Lanka	present	male unknown	1.5	3	convex
guttulata	Philippines	absent	2 slim rods	1.0	3	convex
bakeri	Philippines	present	male unknown	4.0	4	pointed
lombokensis	Lombok	present *	male unknown	2.0	4	convex
gressitti	Manus, Carolines	absent	absent	1.5	4	convex
trukensis	Truk, Solomons	present *	delicate sclerotisations	2.0	2	convex
pterosoma	Vanuatu, Fiji, Tonga	absent	2, feather-like	1.0	2	convex
samoana	Samoa	absent **	delicate sclerotisations	female unknown		
badonneli	Moorea	absent	2 weakly sclerotised rods	1.2	4	straight

* Also a sub-basal band; **femur with band.

A. badonneli is most similar, not to *pterosoma* or *samoana*, as might have been expected, but to *A. gressitti*, known from Manus and Micronesia. It differs from *A. gressitti* in fore wing pigmentation pattern, shape of the apical sclerite of the subgenital plate, details of hypandrium ornamentation, and in that the legs are not wholly brown, as they are in *gressitti*.

Family PSOCIDAE Stephens, 1829

Genus **PTYCTA** Enderlein

Ptycta Enderlein, 1925 : 102. — THORNTON, 1984 : 1-128. Type-species : *Psocus haleakalae* Perkins.

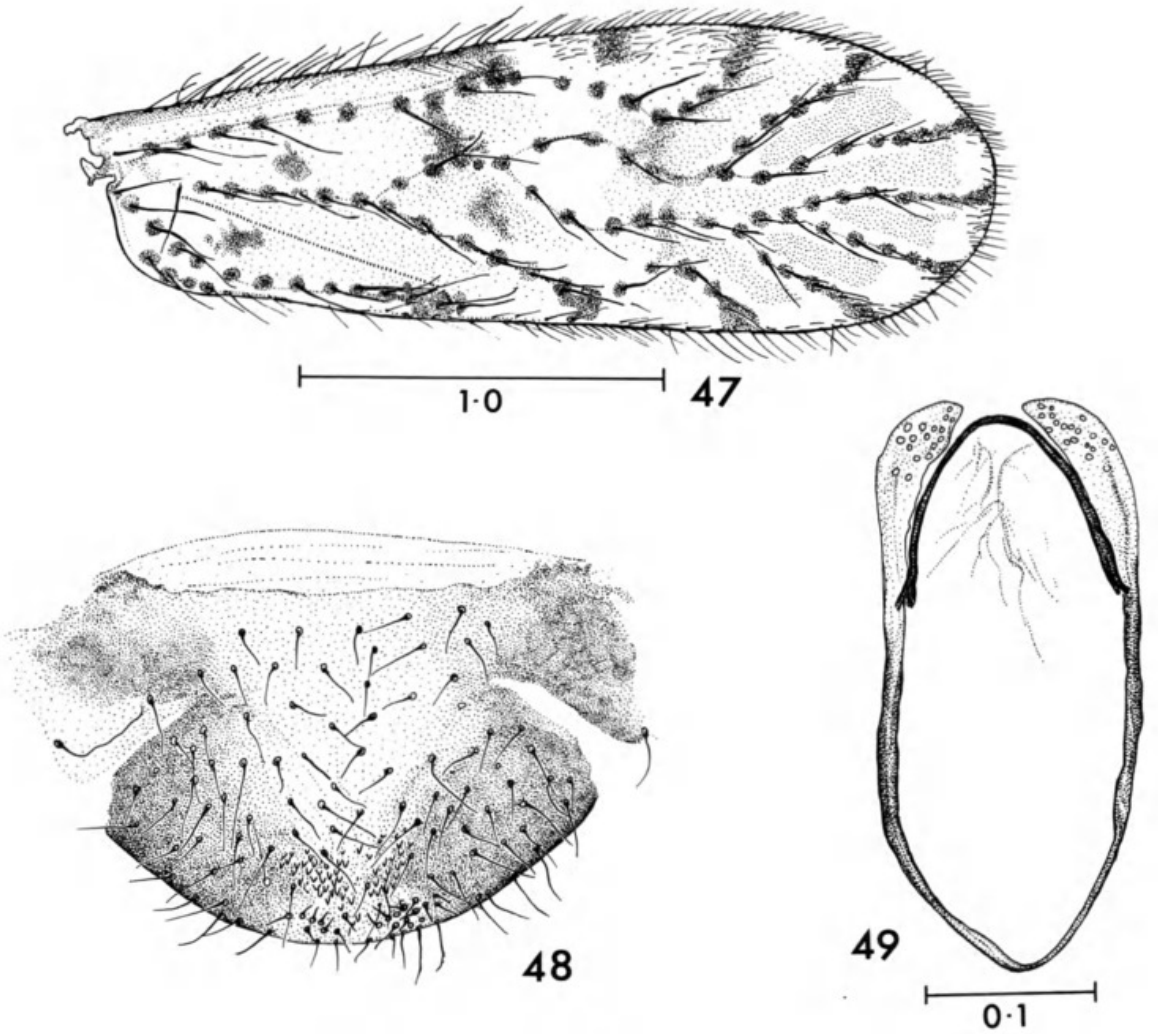
Ptycta vitiensis (Karny)

Psocus vitiensis Karny, 1926 : 285, 286.
Ptycta vitiensis (Karny) : THORNTON, 1981*b* : 79-81.

MOOREA : Ma'atea V., below Mt. Tohivea 230 m 2 ♀ 4 n.

DISTRIBUTION ELSEWHERE : Fiji.

On Fiji *P. vitiensis* occurs from sea level to 800 m elevation.



FIGS 47-49. — *Aaroniella badonneli*, ♂ allotype : 47, fore wing; 48, hypandrium; 49, phallosome. (Figs 48 and 49 to common scale.)

Family MYOPSOCIDAE Enderlein, 1903

Genus **MYOPSOCUS** Hagen

Myopsocus Hagen, 1866 : 210. Type-species : *Psocus unduosus* Hagen.
Phlotodes Enderlein, 1910 : 67.
Rhaptoneura Enderlein, 1910 : 68.

Myopsocus albiceps sp. n.

Female : Coloration (after 6 months in alcohol) : General ground colour buff. Head : genae brown, darker immediately below orbit; labrum, maxillary palps, scape and pedicel brown; flagellum pale brown; head pattern from front as in figure 50. Thoracic nota marked with brown, circular buff areas within brown field (mesonotum pattern as in figure 51); pleura brown. Legs pale buff, apex of tibia and apical tarsal segment brown, femur with faint light brown mottled pattern. Fore wing pattern as figure 52, hind wing hyaline. Abdomen granulated greyish-brown.

Morphology : 1.0 : D = 1.5. Body length : 3.0 mm. Ctenidia on hind tarsal segment : 23. Subgenital plate (fig. 53) apical lobe with 2 stout setae at apex on raised bosses, these setae at least twice length of others scattered over terminal third of lobe. Gonapophyses (fig. 54) : ventral valve short, pointed, single; outer valve narrow, with 3 very long stout setae and row of other setae along long axis of valve; dorsal valve long, narrow, with minute spines on mesial surface in apical quarter. Paraproct with field of 20 trichobothria.

Male : Coloration (after 6 months in alcohol) as female but clypeal markings fainter except anteromesially, clypeus thus appears lighter. Fore wing pattern as figure 55.

Morphology : 1.0 : D = 0.8. Body length : 2.7 mm. Ctenidia on hind tarsal segment : 23. Hind wing as figure 56. Phallosome as figure 57. Hypandrium (fig. 58) with 3 shallow apical lobes, and 4 long subapical setae, lateral ones each with a field of short fine setae posteriorly. Paraproct with field of 24 trichobothria.

Holotype ♀ : Moorea, foot (c. 150 m) NW side Mt. Mouaroa, *Casuarina equisetifolia*, 19.x.87, I.W.B.T. (MNHN). Allotype ♂ (MNHN), 3 ♀ paratypes (AM), same data holotype.

OTHER SPECIMENS : Inner crater wall, 200 m *C. equisetifolia* 1 ♀; Ma'apiti V., lowland vegetation 1 ♂ (AM) : Ma'atea V., below Mt. Tohivea 200 m 1 ♂; Cook and Opunohu Bays, lowland vegetation 1 ♂.

Similar to *M. punctatus* (with which it is sympatric on Moorea, see below), *albiceps* differs in the simpler head pattern (fig. 50) and in details of fore wing pattern (table 2).

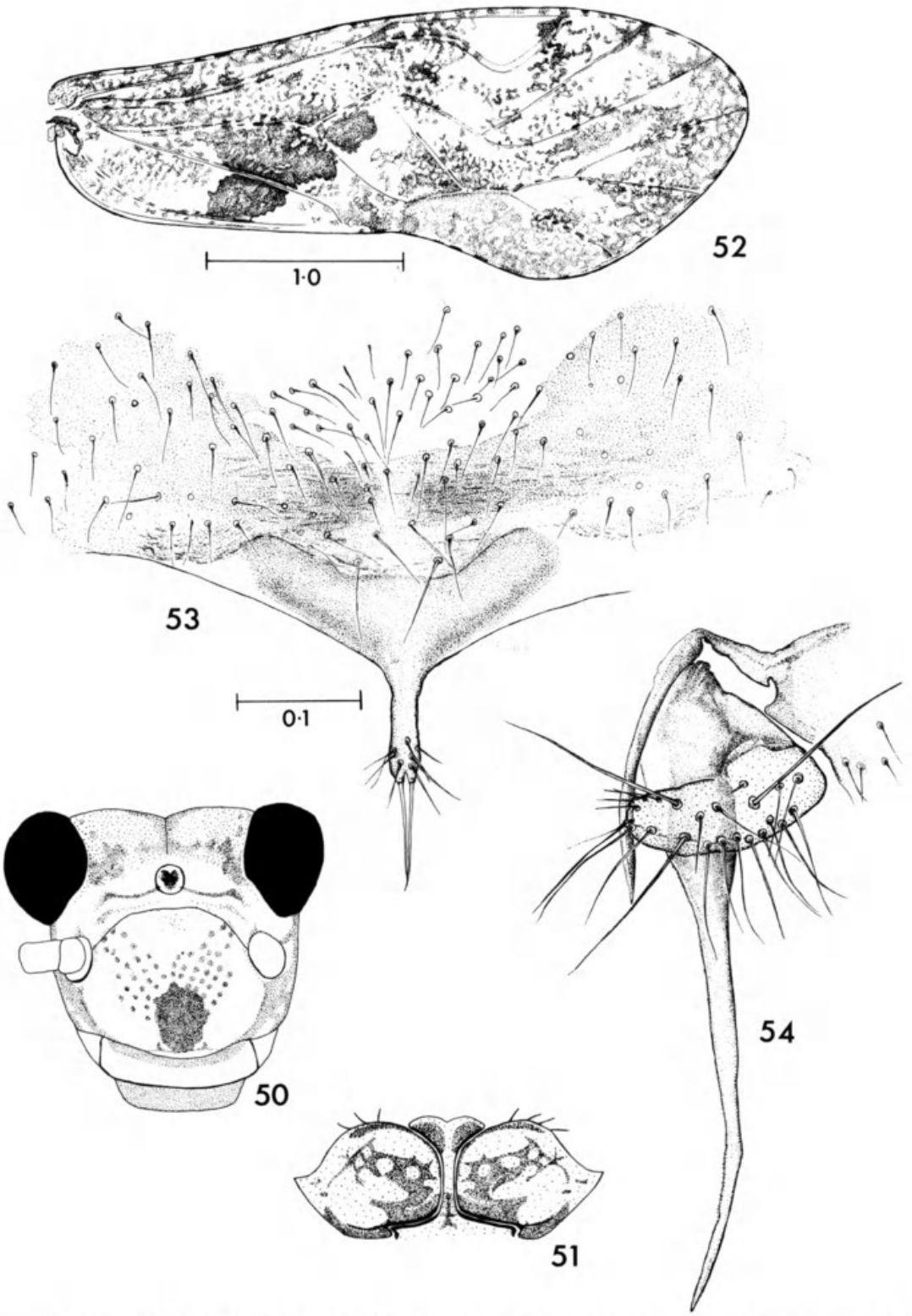
Myopsocus opunohu sp. n.

Male : Coloration (after 6 months in alcohol) : Insect generally pale creamy-buff, including labrum and maxillary palps. Head pattern as figure 60. Apex of tibia and apical tarsal segment very pale brown. Fore wing pattern as figure 59; hind wing hyaline.

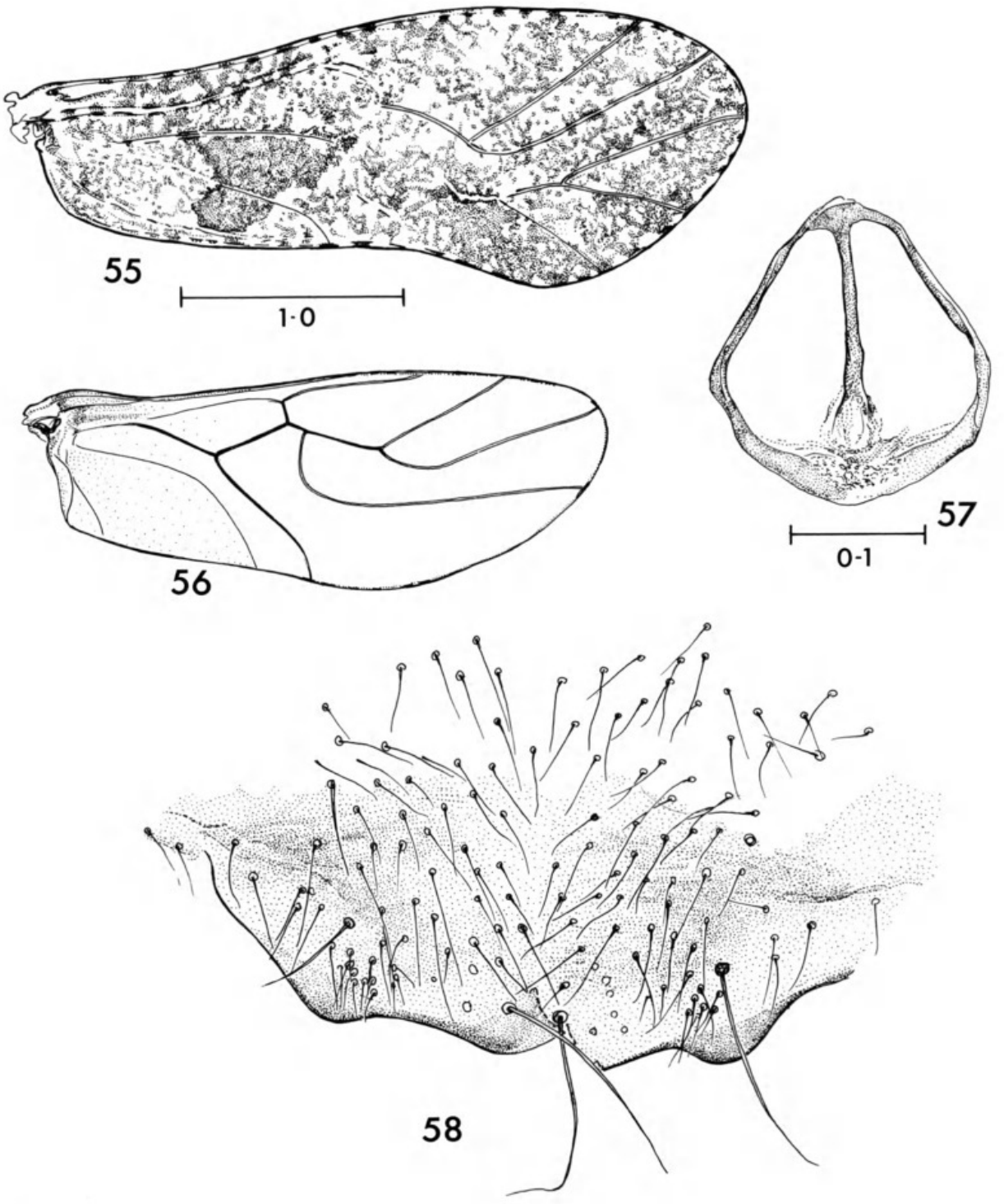
Morphology : 1.0 : D = 1.2. Body length : 2.4 mm. Ctenidia on basal hind tarsal segment : 19. Phallosome as figure 61. Hypandrium (fig. 62). A field of 23 trichobothria on paraproct.

Female : Unknown.

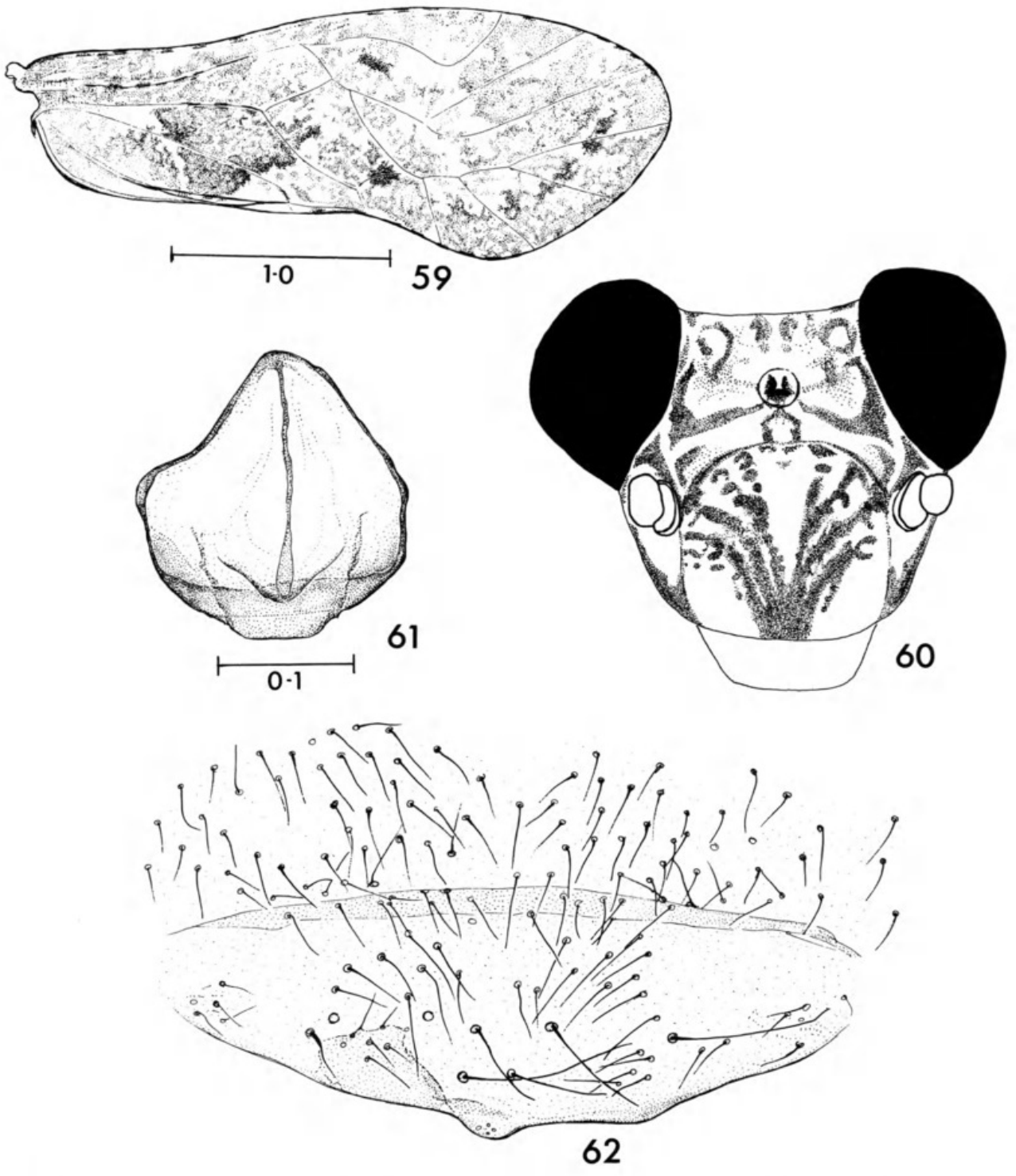
Holotype ♂ : Moorea, Opunohu Bay, lowland vegetation, 6.x.1987, I.W.B.T. (MNHN).



FIGS 50-54. — *Myopsocus albiceps*, ♀ holotype : 50, head ; 51, pattern of mesonotum ; 52, fore wing ; 53, subgenital plate ; 54, gonapophyses. (Figs 53 and 54 to common scale ; figs 50 and 51 not to scale.)



FIGS 55-58. — *Myopsocus albiceps*, ♂ allotype : 55, fore wing; 56, hind wing; 57, phallosome; 58, hypandrium. (Figs 55 and 56, and 57 and 58, to common scales.)



FIGS 59-62. — *Myopsocus opunohu*, ♂ holotype : 59, fore wing; 60, head; 61, phallosome; 62, hypandrium. (Figs 61 and 62 to common scale; fig. 60 not to scale.)

In male genitalia this species is similar to its three Moorea congeners. It is described here, in spite of the absence of females, because of the distinctive head pattern.

Myopsocus punctatoides (Thornton)

Phlotodes punctatoides Thornton, 1981*b* : 91-95.
Myopsocus punctatoides (Thornton) : MOCKFORD, 1982 : 214, 216.

MOOREA : Mt. Mouaputa, SW face 250 m 2 ♂ 3 ♀ 6 n ; Ma'atea V., below Mt. Tohivea 230 m 1 ♂ 1 ♀ 3 n ; inner wall eroded crater, 200-250 m 2 ♀ ; foot Mt. Mouaroa, *Casuarina equisetifolia* 150 m 1 ♀.

DISTRIBUTION ELSEWHERE : Fiji (including Lau Group), Tonga.

This species was found from sea level to 800 m in Fiji.

Myopsocus punctatus Thornton, Lee & Chui

Myopsocus punctatus Thornton, Lee & Chui 1972 : 132-134. — MOCKFORD, 1982 : 214-215.
Phlotodes punctatus (Thornton, Lee & Chui) : THORNTON, 1981*b* : 95.

MOOREA : Mt. Mouaputa, NW slopes 200 m 10 ♂ 10 ♀ 10 n ; foot Mt. Mouaroa, *C. equisetifolia* 150 m 1 ♂ 5 ♀ ; Ma'apiti V., lowland vegetation 5 ♂.

DISTRIBUTION ELSEWHERE : S. Marianas, Carolines, Marshalls.

M. punctatoides is easily distinguishable from the other three *Myopsocus* species on Moorea on leg colour, fore wing pattern and female subgenital plate. The remaining species differ from one another in details of the apical pattern of the fore wing and in details of the pigment pattern on the head and mesothoracic pronotum. Diagnostic features of the species are summarised in table 2.

M. albiceps was taken in Ma'atea Valley in the same beating sample as *punctatoides*, and in Ma'apiti Valley together with *punctatus*

DISCUSSION

The psocopteran faunas of nine Pacific island groups of about the same area are now known sufficiently comprehensively for comparisons to be made. Details of these faunas, with geographical data, collecting effort and, where possible, diversity, are shown in table 3. Also included in table 3 are comparative data for the Indonesian archipelago (representing a large fairly well-studied potential source fauna), the Krakatau Islands (a small group of islands well within this and close to much larger islands) and Bali and Lombok taken together (representing a sample on the edge of the Oriental Region, also close to a larger island).

TABLE 2. — Diagnostic characteristics of four species of *Myopsocus* from Moorea.

	albiceps	*opunohu*	*punctatoides*	*punctatus*
No. 3 1.0 : D of ♂	0.7	1.1	1.2	0.6 (Moorea) 1.0 (type)
Hind femur	pale buff, slightly darker basally	uniform very pale buff	brown, sub-basal buff band	pale buff to white
Hind tibia	buff, apex brown	pale creamy-buff, apex very faint brown	buff	buff, apex brown
Post-clypeal pattern : Y or V-shaped	stalk of Y dark, arms almost indistinguishable	broad spotted Y, arms with spots widely spaced	broad irregular V	broad spotted Y, arms with spots widely spaced
Frons pattern : transverse brown line anterior to ocellar protuberance	absent	sharp, clear, with backwardly projecting arm at ends	not obvious	sharp, clear
Mesothoracic pronotum pigment	dark brown	buff, pair of dark spots	dark brown	dark brown
Female fore wing : hyaline areas subapically, more marginal darker spots	confluent, including some of vein m_1, and extending into cell R_5; darker spots not obvious (fig. 52)	confluent; darker spots not obvious (♂ wing only — fig. 59)	separate; darker spots obvious	confluent but generally more marginal than vein m_1 and not extending into cell R_5; darker spots not obvious
Female subgenital plate : apical setae	apical pair clearly longer than others (fig. 53	♀ unknown	all same length	apical pair clearly longer than others

Species abundance data, where available, fit the log-series distribution (table 4), so that the use of the α diversity index is appropriate. Apart from the large Indonesian fauna (table 3), the faunas of Bali and Lombok (76 species in 31 genera, α with 95 % confidence limits = 23.6 $\pm$ 3.2) the Krakataus (80 spp., 28 gen., α = 16.7 $\pm$ 1.7) and the Fiji group (81 spp., 17 gen., α = 16.7 $\pm$ 1.6) are relatively diverse. The fauna of Micronesia, generally regarded as representing an extension of the Oriental fauna, has 90 species in 25 genera (α not determinable). The Hawaiian fauna, which includes large endemic complexes of 216 species, is extremely diverse (258 spp., 24 gen., α = 49.0 $\pm$ 2.0) as a result of explosive evolution. If endemic complexes are discounted (figures in brackets in table 3), its diversity (42 spp., 21 gen., α = 6.5 $\pm$ 0.7) is low, and similar to those of the other truly oceanic faunas of Tonga (35 spp., 14 gen., α = 7.5 + 1.2), Moorea (37 spp., 14 gen., α = 6.7 $\pm$ 0.9) and Galapagos (40 spp., 22 gen., α = 5.7 $\pm$ 0.7). The smaller isolated faunas of Norfolk-Phillip and Robinson Crusoe have even lower diversities (3.2 $\pm$ 0.6 and 1.5 $\pm$ 0.4 respectively). There are too few individuals collected on Lord Howe I. for a reliable determination of α.

The species-area relationship of these faunas is plotted in figure 63, and is approximately linear on the log-log plot, with the Krakatau archipelago having more than the expected number of species for this area (not surprisingly in its context, since it is a sample from within a very large presumed source fauna).

TABLE 3. — Representation of Psocoptera by number of families, genera and species on various Pacific island groups, together with area, maximum altitude, distance to larger potential source, collecting effort, number of individuals collected, and α diversity.

	ID	KR	BL	MI	LH	NP	FI	TO	HA	MO	GA	RC
Families	20	15	15	14	6	10	9	10	13	8	15	4
Genera	78	28	31	25	8	12	17	14	24 (21)	14	22	4
Species	284	80	76	90	10	19	81	35	258 (42)	37	40	9
Area (km^2)	1875000	24	10352	2600	13	36	18300	700*	16700	132	7700	93
Max. alt. (m)	5029	777	3726	950	863	318	1321	329*	4206	1207	1547	916
Distance (km) from nearest larger potential source	—	44	3	700	590	1400	1100	300	3700	3300	920	800
Potential source	—	Jav.-Sum.	Jav.	Phil.	Aus.	Aus.	N. Cal.	Fiji	N. Am.	Fiji	S. Am.	S. Am
Man-days collecting	70	42	10	—	13	54	59	12	c. 150	26	93	10
Individuals collected	?	2006	569	?	54	1145	2110	783	10270 (2920)	1671	6140	702
α	—	16.7 ± 1.7	23.6 ± 3.2	—	**	3.2 ± 0.6	16.7 ± 1.6	7.5 ± 1.2	49.0 ± 2.0 (6.5 ± 0.7)	6.7 ± 0.9	5.7 ± 0.7	1.5 ± 0.4

* — for islands surveyed; ** — too few individuals for α (3.6) to be reliable; ( ) — non-endemic fauna only; ID — Indonesia (including KR and BL) (various sources including VAUGHAN *et al.*, 1989*b*, THORNTON, 1984, and unpublished material); KR — Krakatau Islands (VAUGHAN *et al.*, 1989*a*); BL — Bali and Lombok (THORNTON, 1984); MI — Micronesia (THORNTON *et al.*, 1972); LH — Lord Howe (SMITHERS & THORNTON, 1975; SMITHERS, 1979); NP — Norfolk and Phillip Islands (SMITHERS & THORNTON, 1974; SMITHERS, 1986); FI — Fiji Islands (THORNTON, 1981*b*); TO — Tonga Archipelago (THORNTON, 1981*c*); HA — Hawaiian Islands (THORNTON, 1981*a*); MO — Moorea (Society Islands); GA — Galapagos Archipelago (THORNTON & WOO, 1973); RC — Robinson Crusoe Island (Juan Fernandez Archipelago) (THORNTON & NEW, 1981). Jav. — Java, Sum. — Sumatra, Phil. — Philippines, Aus. — Australia, N. Cal. — New Caledonia, N. Am. — North America, S. Am. — South America.

TABLE 4. — Fit of species abundance data to log-series distribution, and α index of diversity, for island psocopteran faunas.

Fauna	Individuals	Species	Fit to log-series X^2	d. of f.	P >	α
Krakatau Is.	2006	80	7.62	10	.65	16.7
Bali	413	65	2.64	7	.90	21.7*
Lombok	156	32	3.91	7	.75	12.2*
Bali/Lombok	569	76	9.22	7	.20	23.6
Lord Howe I.	54	10	0.76	6	.99	3.6*
Norfolk/Phillip	1145	19	6.14	10	.80	3.2
Fiji Is.	2110	81	9.65	9	.35	16.7
Tonga Is.	783	35	3.87	9	.90	7.5
Moorea	1671	37	5.68	10	.80	6.7
Galapagos Is.	6140	40	12.97	12	.35	5.7
Robinson Crusoe	702	9	4.16	2	.10	1.5

* Too few individuals for α to be reliable.

TABLE 5. — Representation of families of Psocoptera (by number of species) on various Pacific island groups. (Abbreviations as table 3.)

	KR	ID	BL	MI	LH	NP	FI	TO	HA	MO	GA	RC
Lepidopsocidae	11	24	5	13	2	4	26	12	10	16	6	0
Trogiidae	—	1	—	—	—	1	—	—	3	—	3	2
Psoquillidae	—	—	—	1	—	—	—	1	1	—	2	—
Psyllipsocidae	—	1	—	1	—	—	—	—	2	—	—	—
Amphientomidae	1	6	2	—	—	—	—	—	—	—	—	—
Liposcelidae	—	1	—	—	—	—	—	—	2	—	3	—
Pachytroctidae	4	9	3	4	—	—	2	1	1	—	3	—
Epipsocidae	2	7	1	—	—	—	—	—	—	—	1	—
Caeciliidae	18	59	15	12	1	2	4	2	4	1	3	—
Stenopsocidae	3	11	4	—	—	—	—	—	—	—	—	—
Amphipsocidae	1	5	3	—	—	—	—	—	—	—	—	—
Lachesillidae	—	—	—	1	—	—	—	—	2	—	2	—
Peripsocidae	11	19	4	3	—	2	3	3	3	5	4	1
Ectopsocidae	13	26	9	18	1	4	8	5	9	4	4	1
Hemipsocidae	2	5	2	2	—	—	—	—	2	—	—	—
Calopsocidae	—	4	—	—	—	—	—	—	—	—	—	—
Pseudocaeciliidae	3	27	8	18	2	1	15	4	2	5	2	—
Archipsocidae	3	5	2	2	—	—	—	—	—	—	1	—
Elipsocidae	—	—	—	—	2	1	—	—	1+165	—	—	5
Philotarsidae	3	12	2	4	2	1	2	2	—	1	1	—
Psocidae	3	45	13	6	—	1	9	2	0+51	1	4	—
Psilopsocidae	—	1	—	—	—	—	—	—	—	—	—	—
Myopsocidae	2	16	3	5	—	1	12	3	—	4	1	—

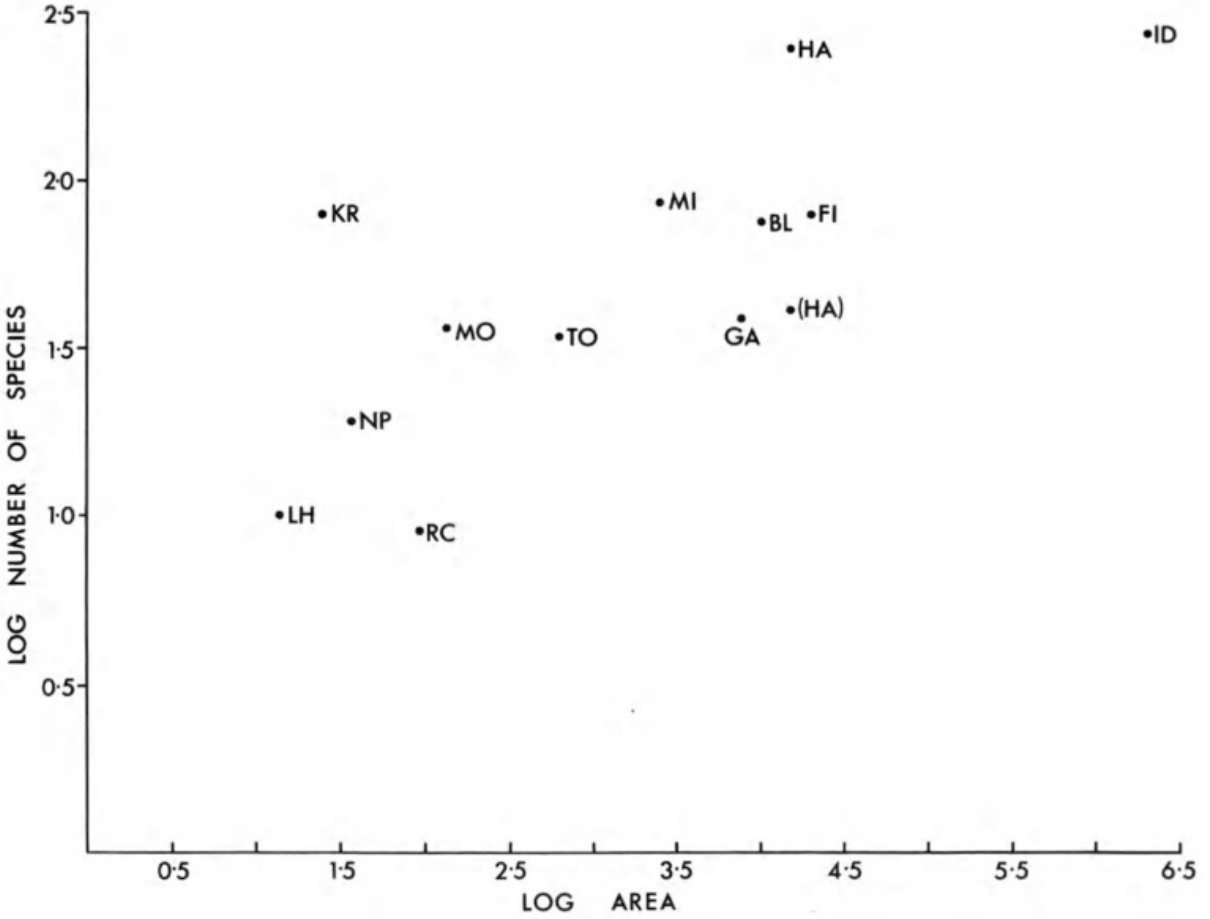


FIG. 63. — Species-area plot (log-log) for Pacific islands and archipelagos of which there is substantial knowledge of the psocopteran fauna. BL — Bali/Lombok; FI — Fiji archipelago; GA — Galapagos; HA — Hawaiian archipelago; (HA) Hawaiian archipelago omitting endemic complexes; ID — Indonesia (mainly Java); KR — Krakataus; LH — Lord Howe; MI — Micronesia; MO —Moorea; NP — Norfolk and Phillip islands; RC — Robinson Crusoe (Juan Fernandez group).

The family of psocopterans that has the best representation in the central Pacific, as measured by numbers of species present on Fiji, Tonga, Hawaii and Moorea compared with numbers in the Indonesian archipelago, is the Lepidopsocidae (table 5). Moorea, for example, carries more than half the number of species in this family known from Indonesia, and almost half Moorea's fauna consists of lepidopsocids. Only about a third of Moorea's lepidopsocid species (5) have been found in Indonesia, and the evidence to date suggests speciation of this family in the tropical Pacific. Two of the 16 Moorea species are known only from Moorea, 2 are tropicopolitan and 7 are not known from continental areas.

Ectopsocidae, Pseudocaeciliidae and Peripsocidae are fairly well represented on Pacific islands, by from a sixth to a quarter of the number of species known from Indonesia, the first two families having unusually high representation in Micronesia, and Pseudocaeciliidae also in Fiji, where a burst of speciation may be responsible. Only 2 of the 14 species of these families on Moorea are known from Indonesia, 4 are so far known only from Moorea, and 8 are known only from Pacific islands.

The Myopsocidae and Philotarsidae are unrepresented in Hawaii, but are quite well represented in Fiji, particularly the Myopsocidae, which, like the Pseudocaeciliidae, are possibly of autochthonous derivation.

The family Psocidae, which is very diverse in Indonesia, is weakly represented on Pacific islands, except on Fiji and Hawaii where there has been speciation (a very large-endemic complex on Hawaii). Similarly the Caeciliidae, the most diverse family in Indonesia on present evidence, is relatively poorly represented in the Pacific, in this case apart from in Micronesia, and there is no evidence of significant archipelago evolution in this family. No species of the Stenopsocidae has been recorded from any island beyond New Guinea.

Lepidopsocidae, Ectopsocidae and Peripsocidae, the three families with a Moorean representation equivalent to half or more of the Fijian fauna, are also the families with the highest relative colonisation ratios (RCR) for the recolonisation of the Krakataus from Java and Sumatra since the sterilising eruption a century ago (THORNTON *et al.*, 1988). RCR is the colonisation success of a family (as the proportion of species in the source fauna that have colonised) compared to that of the order Psocoptera as a whole. Pseudocaeciliidae, Psocidae and Myopsocidae have low RCRs for the Krakataus and Caeciliidae an RCR of 1 (neither an unusually successful nor unsuccessful colonising family). For the colonisation of the new island of Anak Krakatau, which emerged within the Krakatau archipelago in 1930 and because of recent volcanism is biologically about three decades old, Lepidopsocidae and Ectopsocidae again have high RCRs and that for Caeciliidae is again unity.

The Krakataus are but some 44 km from the presumed source islands, Java and Sumatra, and Anak Krakatau no more than 3 km from its older companion islands, so that the situation is very different from that in the central Pacific, involving vast distances and much smaller presumed source faunas. Nevertheless,the Lepidopsocidae and Ectopsocidae comprise exploitative, 'r-strategy' species that generally inhabit ephemeral habitats such as litter and dead leaves, feeding on the microflora (probably chiefly fungi) at particular stages of the microsuccession, then moving on to another such habitat that has become similarly exploitable. Such a strategy, involving mobility and the exploitation of common but unstable habitats, evidently allows relatively easy colonisation over distances of 3-44 km in a period of 100 years. Perhaps such species are preadapted also for longer-distance dispersal over much longer periods of time. In contrast, pseudocaeciliid, caeciliid and stenopsocid species are inhabitants of living foliage and grasses, probably feeding on microepiphytic algae, and populations may be expected to be more sedentary. Myopsocid and psocid species are bark-dwellers and fungal-feeders of predominantly stable, closed forest habitats; such 'k' selected species seldom have good powers of dispersal and colonisation.

In order to compare the faunas of Pacific islands and archipelagos for which the psocopteran fauna is now fairly well known, several binary coefficients of community were considered : Jaccard's Coefficient [JC = j/(a + b − j), where j is the number of shared species, a and b the total numbers in each fauna] (JACCARD, 1912); Czekanowski's Quotient of Similarity [(QS = 2j/(a + b)], which emphasises shared species (CZEKANOWSKI, 1913; DICE, 1945; SØRENSEN, 1948); and Kroeber's Coefficient [KC = j(a + b)/2ab], an index of the average resemblance between the two faunas (BALGOOY, 1971). All are affected to some extent by differences in faunal size between the areas compared but BALGOOY (1971) showed that KC is less affected than QS (and QS less than JC).

'Simpson's figure', the Association Index [SF = j/(a or b, whichever is the smaller)]

(SIMPSON, 1943; DICE, 1945), is independent of differences in faunal size, and assumes that collecting has been at random (BALGOOY, 1971).

BALGOOY (1960) used 'Demarcation Knot', DK = (a + b − 2j)/(a + b − j), (which is 1 − JC) as a measure of dissimilarity in comparing Pacific island floras on a generic basis (see also BALGOOY, 1971). This is used to measure the proportion of the total number of species of two areas that is confined to either of them.

WOLDA (1981) pointed out that the values of similarity indices must be related not to theoretical maxima, but to the expected values if samples of the same sizes were taken randomly from a single fauna of the diversity actually observed in the areas compared. He explored the effect of sample size and species diversity on several similarity indices by the use of computer-generated faunal samples, and showed that for all indices that he considered (including QS and SF) the relationship between theoretical and expected maxima depends on sample size and species diversity. Since number of individuals is not known for many of the samples compared here, WOLDA's corrections for sample size or diversity cannot be made, and interpretation of the binary indices above should be cautious. WOLDA pointed out that SF is to be preferred over QS where there is reason to believe that differences between samples are largely due to differences in sample size and QS to SF where there is reason to believe they are real. Islands with lowest species numbers are Lord Howe (10) and Robinson Crusoe (9). Both these small isolated islands have been well sampled by specialists and the low numbers are probably not due to inadequate surveys. Only in Micronesia has there been no specialist collecting, but the area has been the subject of extensive general collecting.

A modification of Percentage of Similarity, usually applied to community studies and involving number of individuals in each species, is used here to compare the faunal spectra of two areas in terms of the number of species in each family. This index is unaffected by differences in faunal size. Denoted ISS (index of spectral similarity), it is a summation of the smaller (for either fauna) percentage of the total fauna for each family, and thus of course emphasises the dominant families.

Values of these five indices, together with the number of species in common, are provided as a matrix of faunal comparison in table 6.

The coefficients of community involving the Bali/Lombok fauna (representing a sample of the Oriental fauna) are low for most comparisons but ISS is fairly high for the Micronesian comparison, reflecting large numbers of caeciliids in both faunas. All similarity indices are relatively low (and DK high) for comparisons involving the Galapagos. Comparisons for which all indices are relatively high (and DK low) are those between Fiji, Tonga and Moorea, the closest together of the archipelagos considered. Tonga's fauna is an extension of that of Fiji, 74 % of its species also occurring in Fiji. The group with the next highest similarity with Moorea is Hawaii (when the large endemic complexes on that island group are ignored).

Over half of the species on Moorea occur in Fiji, about half in Tonga and about half in Hawaii. A third are Micronesian. Many of the Moorean species that are responsible for these faunal similarities are widespread in the lowlands of Pacific archipelagos, occurring on many small islands, and some are virtually tropicopolitan. Species in Moorea's fauna that are evidently specifically Fijian-Tongan are *Lepidopsocus dindus, Lepidopsocus pseudomaculatus, Ptycta vitiensis* and *Myopsocus punctatoides*. Other Moorean species that appear to be Pacific forms and do not occur on continental areas include *Lepidopsocus aureus* and *Lepidopsocus magnus* (known otherwise only from Hawaii); *Cyptophania hirsuta* and *Lepidopsocus fasciatus*

TABLE 6. — Matrix of number of species in common (SC), Quotient of Similarity (QS), Kroeber's Coefficient of Community (KC), Simpson's Figure (SF), Index of Spectral Similarity (ISS) and a measure of dissimilarity, % Demarcation Knot (DK) between pairs of faunas of seven Pacific island groups. Total number of species is given after the name of the island group; endemic species complexes totalling over 200 species are omitted from the total for the Hawaiian Islands. Indices are shown as percentages to facilitate comparison; the two highest values for each similarity index and the two lowest values of DK are in italics.

		Micronesia	Fiji Is.	Tonga Is.	Hawaiian Is.	Society Is. (Moorea)	Galapagos Is. 40
	SC	9	2	1	5	6	3
	QS	11	3	2	8	11	5
Bali/Lombok 76	KC	11	3	2	9	12	6
	SF	12	3	3	12	16	8
	ISS	67	56	56	43	45	57
	DK	94	99	99	96	94	97
	SC		15	12	15	13	8
	QS		18	19	23	21	12
Micronesia 90	KC		18	24	26	25	14
	SF		19	34	36	35	20
	ISS		68	69	60	56	61
	DK		90	89	87	89	93
	SC			26	14	20	5
	QS			*45*	23	34	8
Fiji Is. 81	KC			*53*	25	39	9
	SF			*74*	33	*54*	13
	ISS			*81*	50	78	56
	DK			*71*	87	80	96
	SC				12	15	5
	QS				31	*42*	13
Tonga Is. 35	KC				31	*42*	13
	SF				34	43	14
	ISS				61	*82*	61
	DK				82	*74*	93
	SC					15	7
	QS					38	17
Hawaiian Is. 24	KC					38	17
	SF					41	18
	ISS					49	66
	DK					77	91
	SC						7
	QS						13
Micronesia 90	KC						13
	SF						14
	ISS						50
	DK						93

(Fiji and/or Tonga and Hawaii); and *Ectopsocus fullawayi* and *E. perkinsi* which are widespread Pacific species that are, remarkably, absent from Micronesia. There is a group of five Moorean species occurring in Micronesia but unknown from continental areas (*Lepidopsocus maculatus, Ectopsocus spilotus, Peripsocus ferrugineus, Pseudocaecilius tahitiensis* and *Myopsocus punctatus*), the ranges of several extending to the Galapagos. Eight species are known so far only from the Society Islands. Thus, in all, 19 Moorean species, almost two-thirds of the fauna, are confined to Pacific islands.

Eight species extend from the Oriental Region to the Societies (*Echmepteryx lunulata, Echmepteryx pallida, Lepidopsocus marmoratus, Lepidopsocus pretiosus, Nepticulomima lusiae, Ectopsocus denervus, Peripsocus pauliani* and *Peripsocus similis*). Four Moorean species are African-tropicopolitan (*Echmepteryx madagascariensis, Soa flaviterminata, Peripsocus pauliani* and *Pseudocaecilius citricola*). Apart from the cosmopolitan forms, no Moorean species is known also from Australia. *E. pallida, E. lunulata, L. pretiosus, P. similis* and *P. citricola* have colonised the Krakatau Islands since their defaunation a century ago, the first three being the most abundant psocopteran species there (THORNTON *et al.*, 1988) and must be regarded as good colonisers at least in the short term (a century) over fairly short distances.

Moorea is only 17 km distant from the larger, higher island of Tahiti, on which no specialist collecting has yet been done, and it is unlikely that the present collection includes more than 75 % of the Society Is. fauna.

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