

## COCKROACHES FROM THE KRAKATAU ISLANDS (DICTYOPTERA: BLATTARIA)

By LOUIS M. ROTH

Museum of Comparative Zoology, Harvard University, Cambridge, MA, 02138, USA  
Correspondence: P.O. Box 540, Sherborn, MA 01770, USA

### Abstract

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Literature dealing with cockroaches collected on the Krakatau Islands, since the original volcanic eruption, is reviewed and the cockroaches taken on these islands during the 1984 and 1985 expeditions to these islands are reported. Eighteen species have been recorded, but at least five of the earlier identifications are questionable or wrong. Among the new records are *Periplaneta americana* (Linn.), *Lobopterella dimidiatipes* (Bolivar), *Blattella radicefera* (Hanitsch), *Margattea nimbata* (Shelford) probably earlier reported as *Margattea ceylanica* (Saussure), *Margattea paraceylanica* Roth, and an undetermined nymph of *Balta*. A key is given to the adult cockroaches found on the four Krakatau Islands. *Margattea laxiretis* (Bolivar) is a junior synonym of *Balta notulata* (Stål).

### Introduction

The cataclysmic eruption of Krakatau in 1883 left little of the original island. Since then there has been considerable interest in the redevelopment of the biota on the four islands of the Krakatau group (Rakata, Sertung, Panjang, Anak Krakatau). This paper is the result of my attempt to identify specimens of cockroaches collected by personnel from institutions in Australia, Indonesia, and the United Kingdom during 1984 and 1985 expeditions to the Krakataus.

The floral and faunal surveys of the Krakatau group following the 1883 eruption, and the recent expeditions are discussed in Thornton and Rosengren (in press). Cockroaches were first collected on Krakatau (Anak Krakatau) and Sertung (Verlaten) islands in 1908 (Dammerman, 1922:97) and later in 1919–1922, 1924, and 1929–1933 (Dammerman, 1948; also included collections from Lang Island).

I redescribe or add diagnostic characters to some of the species, and provide a key to the adults. This study adds to our knowledge of the reintroduction of cockroaches into a tropical ecosystem from a sterile base-line.

### Material

The methods used for collecting the Krakatau material is given by Thornton and Rosengren (in press). The Krakatau material was borrowed from and returned to La Trobe University where it was distributed between Museum Zoologicum Bogoriense, Museum of Victoria, and the Australian National Insect Collection. In addition,

specimens were borrowed through the following entomologists or assistants, from the following museums:

ANSP—Academy of Natural Sciences of Philadelphia, Philadelphia, PA, USA; Mr Donald Azuma.

BMNH—British Museum (Natural History), London, England; Mrs Judith Marshall.

ISNB—Institut Royal des Sciences Naturelle de Belgique, Brussels, Belgium; Dr P. Grootaert.

KUKJ—Kagoshima University, Kagoshima-shi, Japan; Dr J. Yukawa.

MCZH—Museum of Comparative Zoology, Harvard University, Cambridge, MA, 02138, USA.

NMWA—Natural History Museum, Vienna, Austria; Dr A. Kaltenbach and Dr Ulrike Aspöck.

RNHL—Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands; Dr Jan van Tol.

TUVA—La Trobe University, Bundoora, Victoria, Australia; Dr I.W. B. Thornton and Mr Patrick J. Vaughan.

UGMG—University of Guam, Mangilao, Guam, USA; Dr Ilse Schreiner.

UZMC—Universitets Zoologiske Museum, Copenhagen, Denmark; the late Dr S.L. Tuxen.

ZILS—Zoological Institute, Lund, Sweden; Dr R. Danielsson.

### Early and Recent Identifications

Although at least eight papers record cockroaches from the Krakatau Islands, several of the more recent publications repeat earlier determinations (Table 1). Until the 1984–1985 expeditions,



Table 1. Cockroaches reported from the Krakatau Islands.

Species	Anak Krakatau	Sertung (Verlaten)	Rakata	Panjang (Lang)	Author
Blattoidea					
Blattidae					
1. <i>Periplaneta americana</i> (Linn.)	+				10
2. <i>Periplaneta australasiae</i> (Fab.)	+	+			1, 2, 3, 6, 10
3. <i>Blatta orientalis</i> Linn.	+				1, 2, 3, 6
4. <i>Hebardina concinna</i> (Haan)	+	+			6, 10
5. <i>Neostylopyga picea</i> (Brunner)	+	+	+	+	1, 2, 3, 4, 5, 6, 10
Blaberoidea					
Blattellidae					
6. <i>Margattea contingens</i> (Walker)	+	+		+	1, 2, 3, 6, 8
7. <i>Margattea anceps</i> (Krauss)	+			+	6
8. <i>Margattea ceylanica</i> (Saussure)	+				6, 7
9. <i>Margattea nimbata</i> Shelford	+				11
10. <i>Margattea paraceylanica</i> Roth		+	+	+	11
11. <i>Balta notulata</i> (Stål)	+	+	+	+	1, 3, 6, 10
12. <i>Balta vilis</i> (Brunner)	+	+	+	+	9, 10
13. <i>Balta</i> sp.		+	+	+	10
14. <i>Blattella radCIFera</i> (Hanitsch)		+			10
15. <i>Lobopterelladimidiatipes</i> (Bolívar)		+	+	+	10
Blaberidae					
16. <i>Pycnoscelus surinamensis</i> (Linn.)	+	+	+		1, 2, 3, 6, 10
17. <i>Haanina major</i> (Saussure)		+	+	+	3, 6, 9, 10
Total species	12	12	8	9	

\*(1) Karny in Dammerman, 1922. (2) Hanitsch, 1923a. (3) Hanitsch in Dammerman, 1929. (4) Hanitsch, 1923b. (5) Hanitsch, 1928. (6) Dammerman, 1948. (7) Bruijning, 1948. (8) Princis, 1969. (9) Yukawa et al., 1984. (10) this paper. (11) Roth, 1989.



about fifteen species were recorded but apparently some were misidentifications. Thirteen species of cockroaches were collected in 1984–1985. Not represented were the following previously reported taxa: *Blatta orientalis* Linn., *Margattea ceylanica* (Saussure), *Margattea contingens* (Walker), *Margattea anceps* (Krauss), and *Margattea humeralis* (Walker). Hanitsch (1923a: 198) listed 1 male and 4 females of *M. contingens* from Krakatau. I have seen three of these specimens and they are *Balta vilis* (Brunner). In his 1923a paper, Hanitsch agreed with Shelford's synonymy of *M. humeralis* (male from Singapore) with *M. contingens* (female from Sarawak) but later decided that these two species are valid. Princis (1969: 866) listed *M. humeralis* from Krakatau, even though none of the references given in his Catalogus record this species from that island. Princis probably listed *M. humeralis* from Krakatau because one of Hanitsch's published records of "*M. contingens*" was a male, and presumably the synonym *M. humeralis*. I have examined the types of *M. humeralis* and *M. contingens* and concluded that Shelford was correct in synonymizing them (Roth, 1989).

The records of *Margattea ceylanica* from the Krakataus probably referred to *Margattea nimbata* which has been considered to be its junior synonym, but both are valid species. The former may be restricted to Sri Lanka whereas *M. nimbata* is very widely distributed occurring in Australia (Northern Territory), Krakatau, Kei Island, Christmas Island, Thailand, Sarawak, Borneo, and Java. However, it is also possible that the Krakatau record of *M. ceylanica* was based on a misidentification of *Margattea paraceylanica* Roth, which has been found on Sertung, Rakata, and Panjang (Roth, 1989).

Although *Margattea anceps* was not taken on the 1984–1985 expeditions, its markings are sufficiently different from the other species of the genus (on the Krakataus) that it is readily identified. Its head is yellowish brown with a broad transverse dark

brown band on the vertex, and the tegmina have a dark brown macula on the basal portion (Roth, 1989).

Princis (1965: 376) listed *Anaplecta javanica* Saussure from Krakatau, Sumatra, and Java. Of the 11 references listed under this species by Princis, only Karny (in Dammerman, 1922: 107) gave records from Krakatau and Verlaten Islands. However, Karny also included records from Sebesy and listed *A. javanica* only from this island. Princis probably erred in listing this species from Krakatau.

In a preliminary report, Yukawa et al. (1984) listed *Platyzosteria denini* Hanitsch (Blattidae: Polyzosteriinae) from Sertung, and *Rhicnoda* sp. (Blaberidae) from Sertung and Rakata. Both were collected in 1982 and identified by S. Asahina. I have examined these specimens and determined the former as a female of *Neostylopyga picea* and the latter as a nymph of *Haanina major*.

The following are new records for the Krakataus: *Periplaneta americana* (Linn.), *Blattella radcliffeana* (Hanitsch), *Lobopterella dimidiatipes* (Bolívar), *Margattea paraceylanica* Roth, *Margattea nimbata* (Shelford) (probably earlier reported as *ceylanica*) and one undetermined species, probably a *Balta* (nymphs only).

Thornton and Rosengren (in press) discussed the possible causes of changes in species complement from one survey to the next (cryptoturnover, pseudoturnover, immigration, and extinction). The biota of Anak was largely destroyed by eruptions in 1952 and the vegetation again was severely damaged in 1972 so that this island "... is effectively no more than about three decades old." In spite of this relatively recent destruction, six species of cockroaches have already been reintroduced, only two or three species less than the number recorded from Rakata and Panjang. The largest number of cockroach species occur on Sertung (Table 1; at least three of the twelve species listed under Anak are questionable).

### Key to the cockroaches (adults only) from the Krakatau Islands

The following key includes fourteen of the species listed in Table 1. *Margattea contingens* and *M. ceylanica* are omitted because they were probably based on misidentifications. The males of these two species were recently redescribed (Roth, 1989) and both lack a tergal gland on the eighth segment, whereas the males of *M. paraceylanica* and *M. nimbata* have a tergal specialization on T8. The lateral corners of the male subgenital plate of *contingens* are produced and style-like so that there appears to be four styles rather than two as in the Krakatau species in the key.

1. Male subgenital plate with a pair of similar, elongate, cylindrical styles situated laterodistad on the subgenital plate (Figs 1A, B, 2B, 3E). Female subgenital plate with mesodistal portion valvular (Figs 1D, 3C). (Blattidae) .. 2
- Styles of subgenital plate not as above. Female subgenital plate not valvular ..... 7



2. Tegmina fully developed or reduced, hind wings present but may be reduced or vestigial ..... 3
- Tegmina short lateral pads, hind wings absent (e.g., Fig. 3B) ..... 6
3. Tegmina and wings fully developed (26–36 mm long). Pronotum with a pair of large blotches usually on a lighter yellowish background (e.g., Fig. 1E) 4
- Tegmina and wings usually reduced, rarely both developed, but if they are, less than 20 mm long ..... 5
4. Humeral area of tegmen (that portion anterior to the subcosta) yellow ( $\sigma$ ,  $\varphi$ ). Hind margin of  $\sigma$  supra-anal plate subtruncate (Fig. 1A) ..... *Periplaneta australasiae*
- Humeral area of tegmina not yellow, similar to the rest of the wing cover ( $\sigma$ ,  $\varphi$ ). Hind margin of  $\sigma$  supra-anal plate with a deep V-shaped excavation (Fig. 1F) ..... *Periplaneta americana*
5. Male first abdominal tergum unspecialized. Arolia subobsolete (Fig. 2D). Tegmina and wings reduced, covering only about two-thirds of the abdominal terga ( $\sigma$ ). ..... *Blatta orientalis*
- Male first abdominal tergum with a large, dense, setal specialization medially (Fig. 3A). Arolia moderately developed. Tegmina and wings usually reduced, but sometimes fully developed (in brachypterous males and most brachypterous females, hind wings usually are smaller and narrower (vestigial) than the tegmina (Fig. 3A), but some females have wings as long as the tegmina) ..... *Hebardina concinna*
6. Arolia subobsolete (Fig. 2E). Supra-anal plate with a mediolongitudinal ridge, distal margin angulate-emarginate (Fig. 2C). Tegmina usually extend only to about middle of metanotum. ( $\varphi$ ) ..... *Blatta orientalis*
- Arolia relatively large (Fig. 3G). Supra-anal plate not as above (Figs 3D, E). Tegmina usually shorter reaching to about hind margin of mesonotum (Fig. 3B) ( $\sigma$ ,  $\varphi$ ) ..... *Neostylopyga picea*
7. Cerci long and slender, extending well beyond supra-anal plate. Legs long and slender (Fig. 10C) ..... (Blattellidae) .. 8
- Cerci short, not projecting much beyond hind margin of supra-anal plate (Figs 11B E). Legs shorter and more stocky ..... (Blaberidae) .. 14
8. Tarsal claws distinctly asymmetrical (Fig. 6C) ..... 9
- Tarsal claws symmetrical (e.g., Figs 2D, E) ..... 10
9. Face and pronotal disk with characteristic pattern as in Figs 6A, B. Costal veins of hind wing thickened distad (Fig. 7D). Male: supra-anal plate trigonal, apex weakly indented (Figs 7A, E); subgenital plate widely, deeply, concavely excavated, with a distinct median lobe (Figs 7B, F). Female: intercalary sclerites poorly defined, mostly hidden under ovipositor valves (Fig. 6D) ..... *Balta notulata*
- Face and vertex of head with weak markings. Pronotal disk immaculate (Fig. 8E). Costal veins of hind wing not thickened (Fig. 8H). Male: supra-anal plate very short, rectangular (Fig. 8D); subgenital plate with a deep V-shaped excavation (Fig. 8A). Female: intercalary sclerites of genitalia distinct, narrowly rectangular, oblique (Fig. 8G) ..... *Balta vilis*
10. Anteroventral margin of front femur with large spines that decrease in length distad, terminating in 3 heavy spines, becoming longer in increasing ratio (Type A<sub>3</sub>); tarsal claws not serrated on ventral margins. In fully developed wings, costal veins of hind wing not clubbed ..... 11
- Anteroventral margin of front femur with 1 or more large proximal spines followed by a row of piliform spinules, terminating in 2 large spines (Type B<sub>2</sub>); tarsal claws minutely serrated on ventral margins (may be subobsolete and difficult to see). Costal veins of hind wings clubbed ..... 12
11. Tegmina and wings fully developed, extending beyond end of abdomen. Pronotal disk with dark brown pattern as in Fig. 10A ( $\sigma$ ,  $\varphi$ ). Male seventh abdominal tergum with a setal specialization (Fig. 10B) .. *Blattella radcifera*



- Tegmina reduced, not reaching beyond the third abdominal tergum; hind wings lateral, vestigial. Tegmina with a hyaline area anteromedially through which a pale mesonotal macula is visible. Second abdominal tergum with a pair of narrow, rectangular, hyaline spots. (Fig. 10C) (♂, ♀) .....  
..... *Lobopterella dimidiatipes*
- 12. Tegmina with a dark brown macula on basal portion (see Fig. 41 in Roth, 1989), that may extend the length of the wing cover (♂, ♀) .....  
..... *Margattea anceps*
- Tegmina without markings ..... 13
- 13. Abdominal sterna pale with broad dark brown lateral borders, this colour narrower on posterior segments. Hind margin of supra-anal plate distinctly concavely indented (♂, ♀) (Figs 16, 19 in Roth, 1989). Male median genital phallomere with a pair of large spinelike structures apically (can be seen in pinned specimens if the supra-anal and subgenital plates are separated; Fig. 18 in Roth, 1989) ..... *Margattea nimbata*
- Abdominal sterna without broad dark brown lateral borders. Hind margin of supra-anal plate more shallowly concave (Figs 8, 14 in Roth, 1989) (♂, ♀). Apex of male's median genital phallomere without a pair of spinelike processes (Fig. 10 in Roth, 1989) ..... *Margattea paraceylanica*
- 14. Pronotum shiny blackish brown with yellowish margins anteriorly and anterolaterally (amount of yellow sometimes greatly reduced), hind margin convex (Fig. 11A). Anteroventral margin of front femur fringed with regularly placed hairs, the more proximal longest, shorter distal hairs piliform, terminating in 1 large spine (♀; this species is parthenogenetic and generally produces only females) ..... *Pycnoscelus surinamensis*
- Pronotum hyaline with dark stippling, hind margin practically straight (Fig. 11C). Anteroventral margin of front femur with some large proximal spines followed by a row of piliform spinules terminating in 2 large spines ...  
..... *Haanina major*

# Records and redescriptions of some species

## *Periplaneta australasiae* (Fabricius)

Figure 1A-E

*Periplaneta australasiae* (Fab.).—Princis, 1966: 447-455 (references to biology, synonymy and records).—Roth and Willis, 1960: pl. 20 (habitus ♂, ♀).

**Material examined.** Anak Krakatau. (TUVa): 1 male, 1 nymph, 2 Sep 1984.

**Remarks.** The terminal abdominal segments of the male and the female, and the pronotal markings are shown in Figs 1A-E.

This circumtropical species has previously been reported from Krakatau and Verlaten Islands (Hanitsch, 1923a: 208; Dammerman, 1929: 112; 1948: 484) where it is found among fallen leaves and other vegetable debris.

## *Periplaneta americana* (Linnaeus)

Figure 1F

*Periplaneta americana* (Linn.).—Princis, 1966: 405-438 (references to biology, synonymy, and records).—Roth and Willis, 1960, pl. 19 (habitus ♂, ♀). **Material**

**examined.** Anak Krakatau. (TUVa 6°06'S, 105°26'E, mixed forest, at light, 1 ♀, 20 Aug 1985.

**Remarks.** This species differs superficially from *P. australasiae* by the absence of the yellowish humeral stripe on the tegmina. The male's supra-anal plates are distinctly different between these two species (cf. Figs 1A and 1F).

This is a cosmopolitan species and one of the most important domiciliary cockroach pests. It is the first record of *P. americana* from the Krakataus.

## *Blatta orientalis* Linnaeus

Figure 2

*Blatta orientalis* Linn.—Princis, 1966: 475-507 (references to biology, synonymy, and records).—Roth and Willis, 1960, pl. 4 (habitus, ♂, ♀).

**Remarks.** This blattid is sexually dimorphic. The male has brachypterous tegmina and wings that do not reach the end of the abdomen, whereas the female has short, lateral tegmina, and hind wings are absent. Dammerman (1948: 484) incorrectly stated that the female is apterous. Male and female



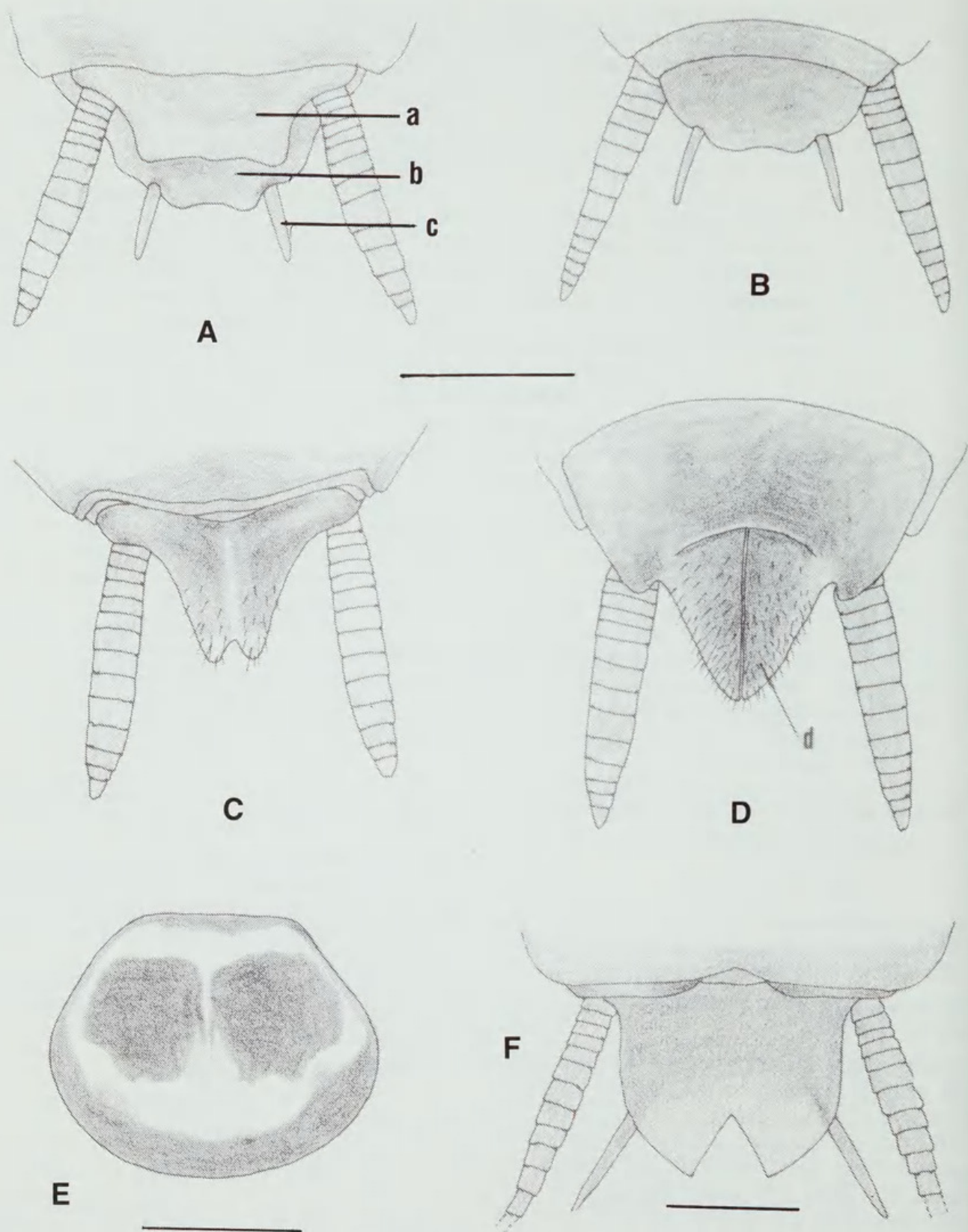


Figure 1. *Periplaneta* spp. A-E. *Periplaneta australasiae*: A, ♂ supra-anal and subgenital plates (dorsal); B, ♂ subgenital plate (ventral); C, ♀ supra-anal plate (dorsal); D, ♀ subgenital plate (ventral); E, ♂ pronotum. F, *Periplaneta americana*, ♂ supra-anal plate (dorsal). Abbreviations: a, supra-anal plate; b, subgenital plate; c, style; d, valve of last sternum. Scales (mm): A-D, 3.0; E, F, 2.0.



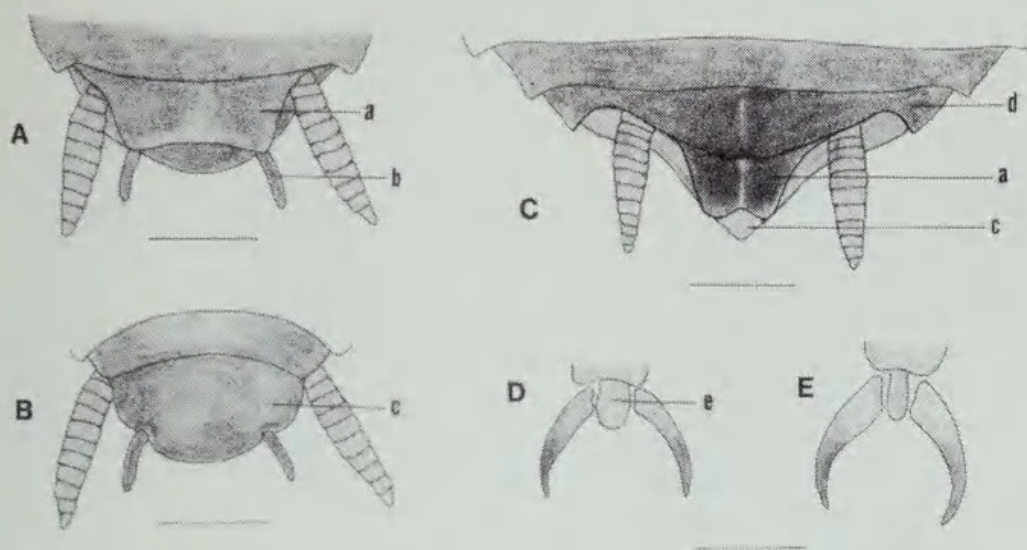


Figure 2. *Blatta orientalis*. A, ♂ supra-anal and subgenital plates (dorsal); B, ♂ subgenital plate (ventral); C, ♀ terminal abdominal segments (dorsal); D, ♂ tarsal claws and arolium; E, ♀ tarsal claws and arolium.

Abbreviations: a, supra-anal plate; b, style; c, subgenital plate; d, seventh abdominal tergum (T8 and T9 are greatly reduced and hidden under T7); e, arolium. Scales (mm): A–C, 2.0; D, E, 0.5.

terminal abdominal segments are shown in Figs 2A–C, and the reduced arolia in Figs 2D, E.

*Blatta orientalis* was not represented in the 1984 and 1985 Krakatau collections. It was previously reported from Krakatau by Hanitsch (1923a: 208) and Dammerman (1948: 484; this probably referred to Hanitsch's earlier record). Karny (in Dammerman, 1922: 107) listed it with a query, from Krakatau.

It seems unusual that this cosmopolitan domiciliary pest, if established on the Krakatau islands, has not been collected again since the original record. It is possible that it was misidentified and the specimen may have been *Hebardina concinna*.

### *Hebardina concinna* (Haan)

#### Figure 3A

*Blatta/Periplaneta concinna* Haan, 1842: 50 (♂, ♀).—Hanitsch, 1915: 104, pl. 1, fig. 60 (habitus).

*Hebardina concinna* (Haan).—Bey-Bienko, 1938: 23, 1950: 157.—Princis, 1966:466–467 (generic changes, synonyms, records).—Asahina, 1983, pl. 1, Fig. 5A (habitus).

**Material examined.** Krakatau Islands. (TUVa): Anak, 1 ♀, in litter, 12 Sep 1984, 6°06'S, 105°26'E, 1 ♀, under logs, 21 Aug 1985; Panjang, 6°05'S, 105°28'E, 1 ♂, 16 Aug 1985; Rakata, Owl Bay, 6°09'S, 105°28'E, 1 ♂ nymph, 100 m, under rocks, 26 Aug 1985; Sertung, 1 ♀, 15 Sep 1984.

Sumatra. (ANSP): Guenong Soegi, Lampong, 1 ♂, Oct–Nov 1901, A.C. Harrison Jr and Dr H.M. Miller (reported by Hebard, 1929: 84).

Java. (ANSP): Tjibodas, 1400 m, 2 ♀, Aug 1921; Java, 1 ♀, C. Pictet (det. by Saussure as *Stylopyga concinna*) (reported by Hebard, 1929: 84).

India. (ANSP): Trichinopoly, Madras Presidency, 1 ♀, C. Leigh (reported by Hebard, 1929: 84); Inde méridionale, 1 ♂, under rotten wood, 4 Mar, Voy. Carl et Escher; Calcutta, zoological garden, 1 ♀, under stone, 11 Nov 1910; Kota, Naini, Tal Dist. U.P., 1 ♂, 5 May 1908, R.H.; Sasan, Kathiawar, 1 ♀, 6–7 Dec 1912.

Philippine Islands, (ANSP): Los Baños, 1 ♀, 13 Nov 1930, N. Cuevas, 1 ♀, 26 Jun 1926, J. Pegiña, 1 ♂, 26 Aug 1927, B.M. Aquanta.

**Measurements** (mm) (♀ in parentheses). Length, 13.0–15.0 (10.6–20.0); pronotum length × width, 3.7–4.1 × 4.8–5.5 (3.9–5.2 × 4.8–6.5); tegmen length, 8.5–15.2 (7.5–11.0).

**Remarks.** The tegmina in both sexes of *H. concinna* usually are reduced, but the extent of reduction varies considerably (Bruijning, 1948: 115) (Fig. 4B). In brachypterous males and most brachypterous females, the hind wings are usually much smaller (reaching to about the hind margin of the second abdominal tergum) and narrower than the tegmina, but veins are still present. Some females have wings that are about the same size as the reduced tegmina. The male illustrated by Asahina (1983, pl. 1, fig. 5A) has fully developed tegmina that extend beyond the end of the abdomen. Males have a large, densely setose medial specialization on the first abdominal tergum (Fig. 3A, arrow). The species varies considerably in size; the females tend to be larger than males but their measurements overlap (Fig. 4A).

Dammerman (1948: 484) reported *H. concinna* from Krakatau. The present records from the Krakatau Islands are the first for Panjang, and Rakata. The species is widespread and has been



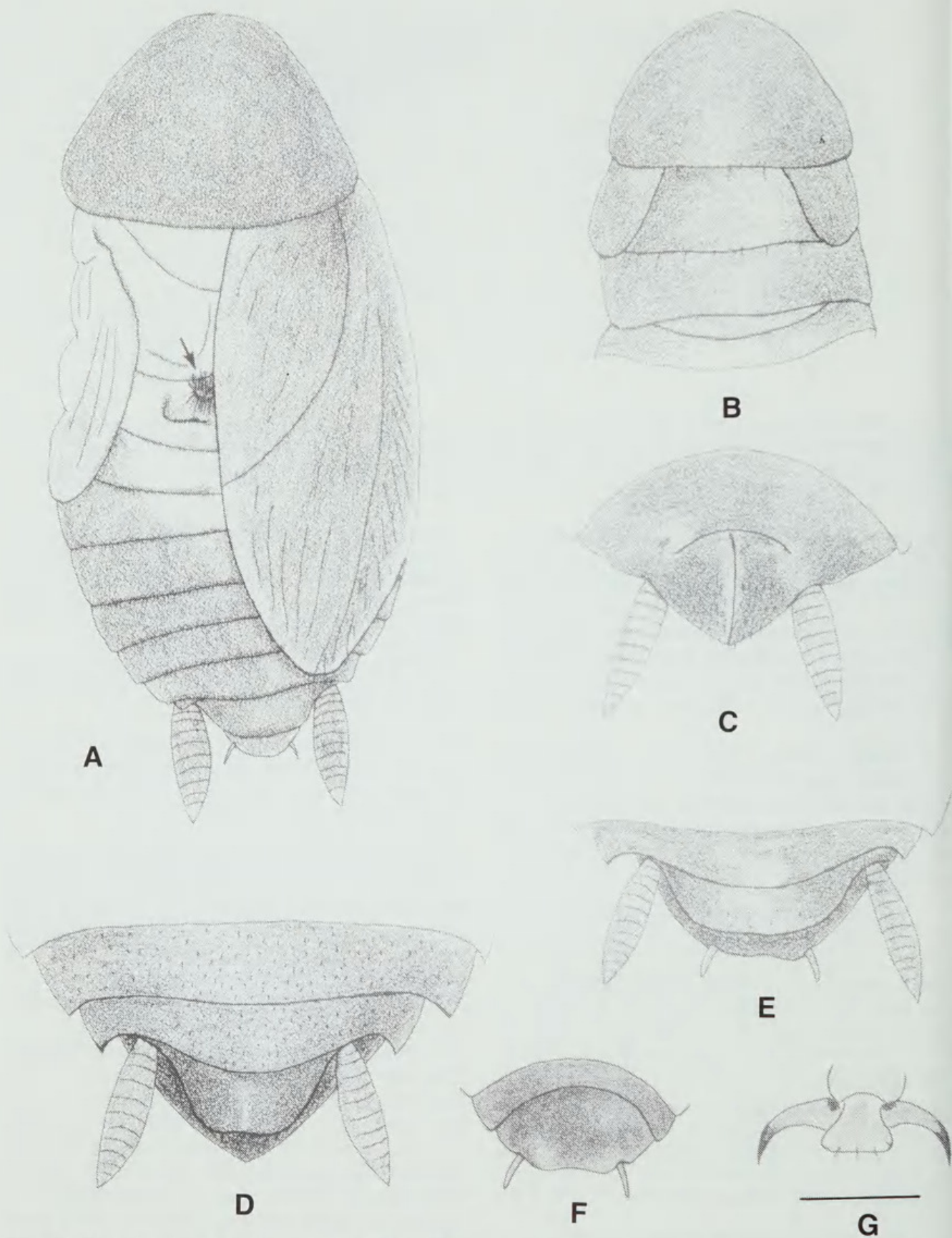


Figure 3. A, *Hebardina concinna*, ♂ habitus, from Panjang left tegmen removed to show vestigial hind wing; arrow indicates setal gland (partly hidden by right tegmen) on first abdominal tergum. B-G, *Neostylopyga picea* from Ser-tung: B, ♀ thorax, tegmina, and abdominal terga 1 and 2; C, ♀ subgenital plate (ventral); D, ♀ terminal abdominal segments (dorsal); E, ♂ terminal abdominal segments (dorsal); F, ♂ subgenital plate and styles (ventral); G, ♂ tarsal claws and arolium. Scales (mm): A-F, 2.0; G, 0.5.



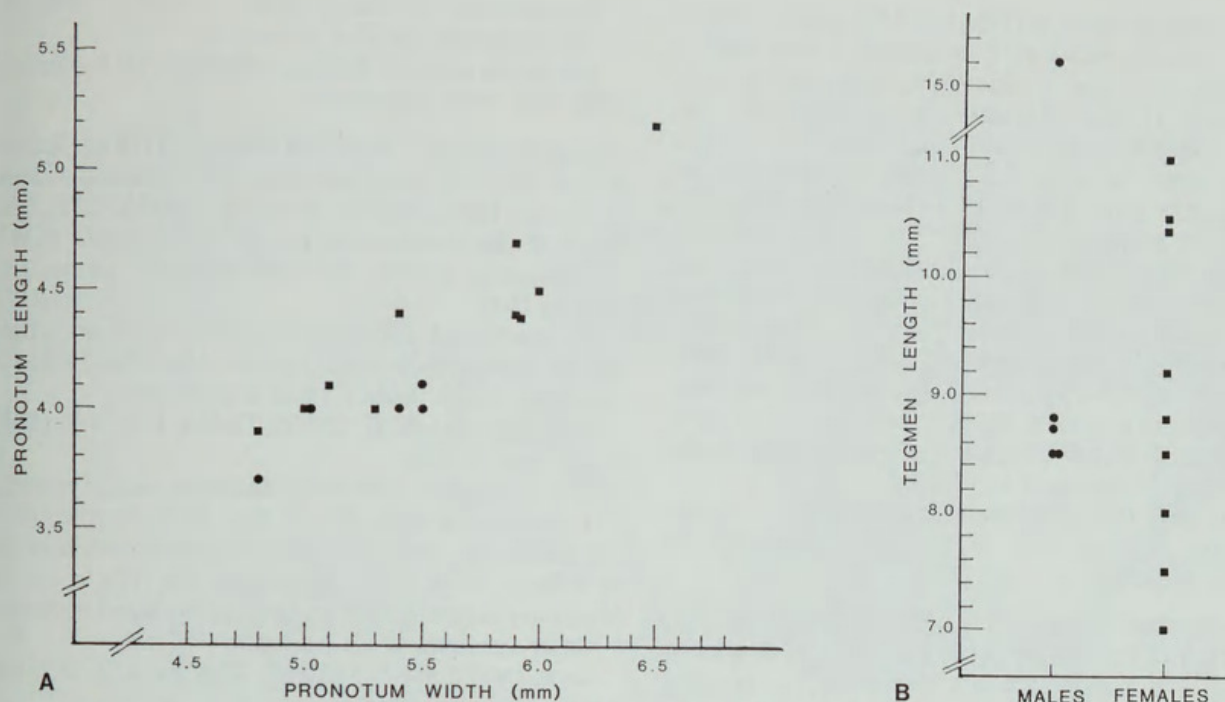


Figure 4. *Hebardina concinna*. A, variation in size of pronotum; B, variation in tegmen length. Circles = males; squares = females.

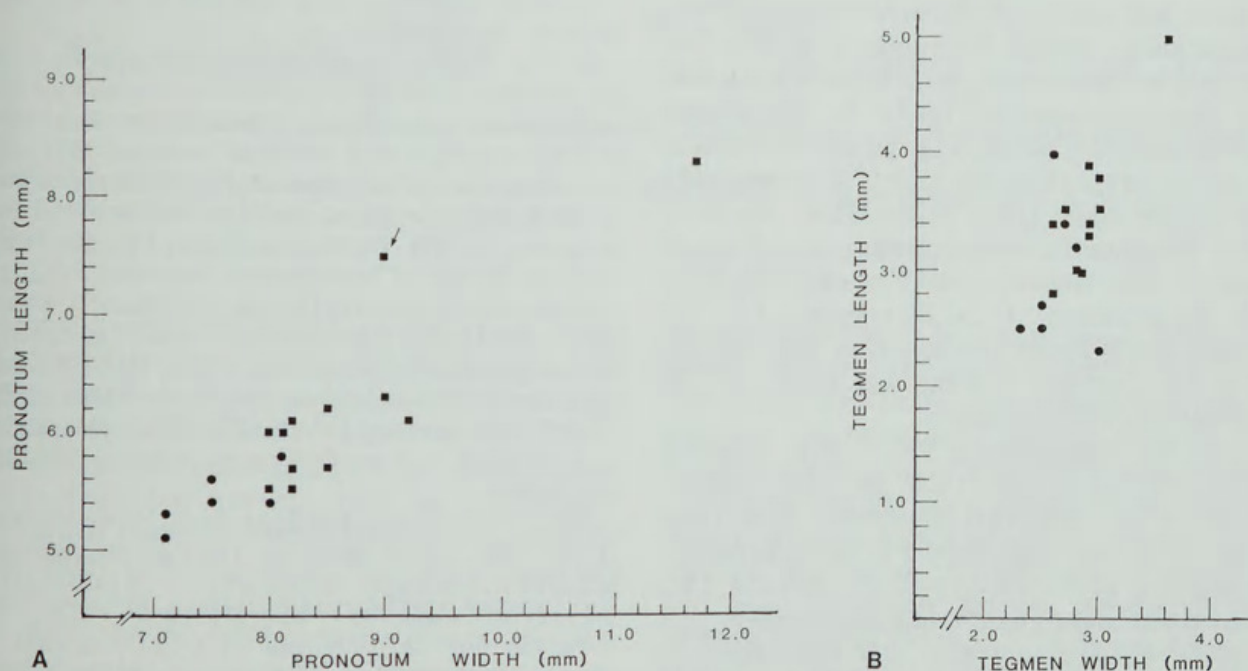


Figure 5. *Neostylopyga picea*. A, variation in size of pronotum; B, variation in tegmen size. Circles = males; squares = females; arrow indicates Brunner's measurement of the type ♀ from Sambelong Island, Nicobar group; the largest female measurements (pronotum and tegmen) are from a ♀ from Pulau Ubin.

recorded from Burma, Malakka, Sumatra, Java, and Borneo, with questionable records from India, Hong Kong, Vietnam, and the Philippines (Princis, 1966:466). The material, other than from the Krakataus, which I am reporting here shows that *H. concinna* is found in India and the Philippines. Asahina (1983:2) stated that the species occurs, but is scarce, in Thailand.

### *Neostylopyga picea* (Brunner)

#### Figure 3B-G

*Neostylopyga picea* (Brunner).—Princis, 1966: 537–538 (references to biology, records, and generic combinations).

*Material examined.* Krakatau Islands. (TUVa): Anak Krakatau, 6°06'S, 105°26'E, 1 ♀ nymph, 18 Nov 1986;



Rakata, Zwarte Hoek, 6°09'S, 105°25'E, under rocks, 1 ♂, 2 ♀ (1 with ootheca), 1 ♂ nymph, 1 Nov 1984, 1 ♂ nymph, under log, 15 Nov 1984, on rotten log, 2 ♀, 1 ♂ nymph, 11 Nov 1984, Base Camp, under rock, 1 ♂, 12 Nov 1984; Panjang, 6°05'S, 105°28'E, 1 ♀ nymph, 20 Nov 1984, in litter, 1 ♀ (with partially formed ootheca), 2 ♂ and 1 ♀ nymphs, 14 Nov 1984, under logs, 2 ♂, 2 ♂ nymphs, 16 Aug 1985; Sertung, 6°05'S, 105°23'E, 1 ♀ nymph, 15 Nov 1984, under bark of dead *Ficus* on beach, 1 ♂ nymph, 11 Nov 1984, forest III, under logs, 1 ♂, 18 Aug 1985, 1 ♂, 2 ♀, 19 Aug 1985, forest II, under logs near spring, 2 nymphs, 19 Aug 1985, spit 6°04'S, 105°24–25'E, *Casuarina* under bark and logs, 1 ♂ nymph, 18 Aug 1985. (KUKJ): Sertung, 1 ♀, at light, 4 Nov 1982, J. Yukawa (reported as *Platyzosteria denini* Hanitsch, by Yukawa et al., 1984).

Pulau Ubin (Strait of Johore). (ANSP): 1 ♀, under fallen log, 25 Nov 1921, F.N. Chasen (reported by Hebard, 1929: 83).

**Measurements** (mm) (♀ in parentheses). Length, 16.0–18.0 (17.0–30.0); pronotum length x width, 5.1–5.8 x 7.1–8.1 (5.5–8.5 x 7.1–11.7); tegmen length x width, 2.3–4.0 x 2.3–3.0 (2.8–5.0 x 2.6–3.6).

**Remarks.** Both sexes of *N. picea* have short, lateral, tegminal pads, and lack hind wings (Fig. 3B). The subgenital and supra-anal plates of both sexes, and tarsal claws are shown in Figs 3C–G. This species varies considerably in size (Fig. 5), and the females tend to be larger than the males. The unusually large female came from Pulau Ubin. Hanitsch (1923a: 209) gave the measurements (mm) of female specimens from Krakatau and Verlaten Islands as: body, 30; pronotum, 11 x 12; tegmina, 3.5. The pronotal length appears to be rather long, but the size of the specimen is somewhat similar to the specimen from Pulau Ubin.

Karny (in Dammerman, 1922: 107), Hanitsch (1923a: 209; 1923b: 436; 1928: 36) and Dammerman (1922: 83; 1948: 484) reported *N. picea* from Krakatau and Sertung where it is found in humus and decaying wood. Karny (1924: 7, 8; 1925: 191) discussed reproduction of Krakatau specimens supplied him by Dammerman, and illustrated the ootheca and nymph. Dammerman (1922: 83) stated that the nearest localities to Krakatau where *N. picea* was known, were Borneo and Singapore. According to Princis (1966: 537), the species is found in Java and Sumatra, as well as Nicobar Islands, Malacca, and questionably from Thailand.

#### ***Balta notulata* (Stål) comb. nov.**

Figures 6, 7

*Lupparia notulata* (Stål).—Princis, 1969: 958 (references to biology, synonymy, generic combinations, and distribution).

*Onychostylus notulatus* (Stål).—Asahina, 1965, figs 11–19 (Japanese: English summary).

*Margattea laxiretis* Bolívar, 1924: 327 (♂).—Princis, 1969: 868. New Synonymy.

**Material examined.** Krakatau Islands. (TUVa): Rakata, Zwarte Hoek, in decaying wood, 1 ♀ (genitalia slide no. 5), 11 Nov 1984; Panjang, north, 6°05'S, 105°28'E, beating, 1 ♂ (terminalia slide no. 6), 1 ♂ nymph, 16 Aug 1985; Sertung, 6°05'S, 105°23'E, forest III, sweep, 1 ♀, 19 Aug 1985.

Chagos Island. (BMNH): Salomon Atoll, male holotype of *Margattea laxiretis* Bolívar, May–Dec 1905, J.S. Gardiner, Percy Sladen Trust Expedition.

Marianas Islands. (UGMG): Tinian, 1 ♀, 8 Jan 1985, C.J.P. and C.D.B.

New Caledonia. (NMWA): Bachufer südl., Oubatche, 1 ♂ (terminalia slide 48), 15 Nov 1965, Austrian/New Caledonia Exp. 1965 [reported as *Lupparia notulata* (Stål) by Princis, 1974: 515]. Oubatche is the type locality of *Margattea scripta* Chopard (type in the Basel Museum), a junior synonym of *B. notulata*.

Java. (NMWA): Sukabumi, West Java, 1 ♂, Fruhstorfer, coll. Br. v. W.

Sulawesi. (NMWA): Samanga, S. Celebes, 1 ♀, Nov 1895. H. Fruhstorfer, coll. Br. v. W.

Sarawak. (NMWA): 1 ♂ (labelled *L. hieroglyphica* Brunner, by Ruschka).

Borneo. (NMWA): 1 ♂, Pfeiffer, 893, coll. Br. v. W. [According to Kaltenbach (personal communication) this specimen may be a syntype of *Phyllodromia hieroglyphica* (a junior synonym of *B. notulata*), provided “893” does not refer to the year of collection. Perhaps the label refers to the Australian explorer, Lady Ida Pfeiffer who arrived in Sarawak in 1851. The Natural History Museum Vienna received one part of her collection. However, Pfeiffer is a rather common name in Germany and Austria. Kaltenbach further stated that there is a “Borneo” specimen of *P. hieroglyphica* from the Novara Reise 1854–59 expedition. The label shows a faint but clearly visible locality “Taiti”. This specimen (which I have not seen) certainly is a syntype of *P. hieroglyphica*, but it has no identification label.]

Papua New Guinea. (ISNB): Madang, Nubia Village, 1 ♂, Jul 1981, J. Van Goethem. The following were collected by P. Grootaert: Awar bush, 1 ♂, 9 Jul 1982, 1zf, 2 Jun 1982; Laing, 1 ♂, 7 May 1982, 1 ♀, 18 Oct 1982.

Taiwan. (MCZH): “Kuraru”, 1 ♀, 11 Aug 1934, L. Gressitt (labelled *Onychostylus notulatus*, by Princis dated 1960).

**Description.** Tegmina and wings fully developed. Hind wing with costal veins clubbed, cubitus vein with 4 complete and 0 incomplete branches, apical triangle small (Fig. 7D). Anteroventral margin of front femur with 2 or 3 large proximal spines followed by a row of piliform spinules, terminating in 2 or 3 large apical spines; pulvilli present on 4 proximal tarsomeres, arolia present, tarsal claws distinctly asymmetrical (Fig. 6C). Male: Abdominal terga unspecialized. Supra-anal plate trigonal, apex shallowly indented; right and left paraprocts



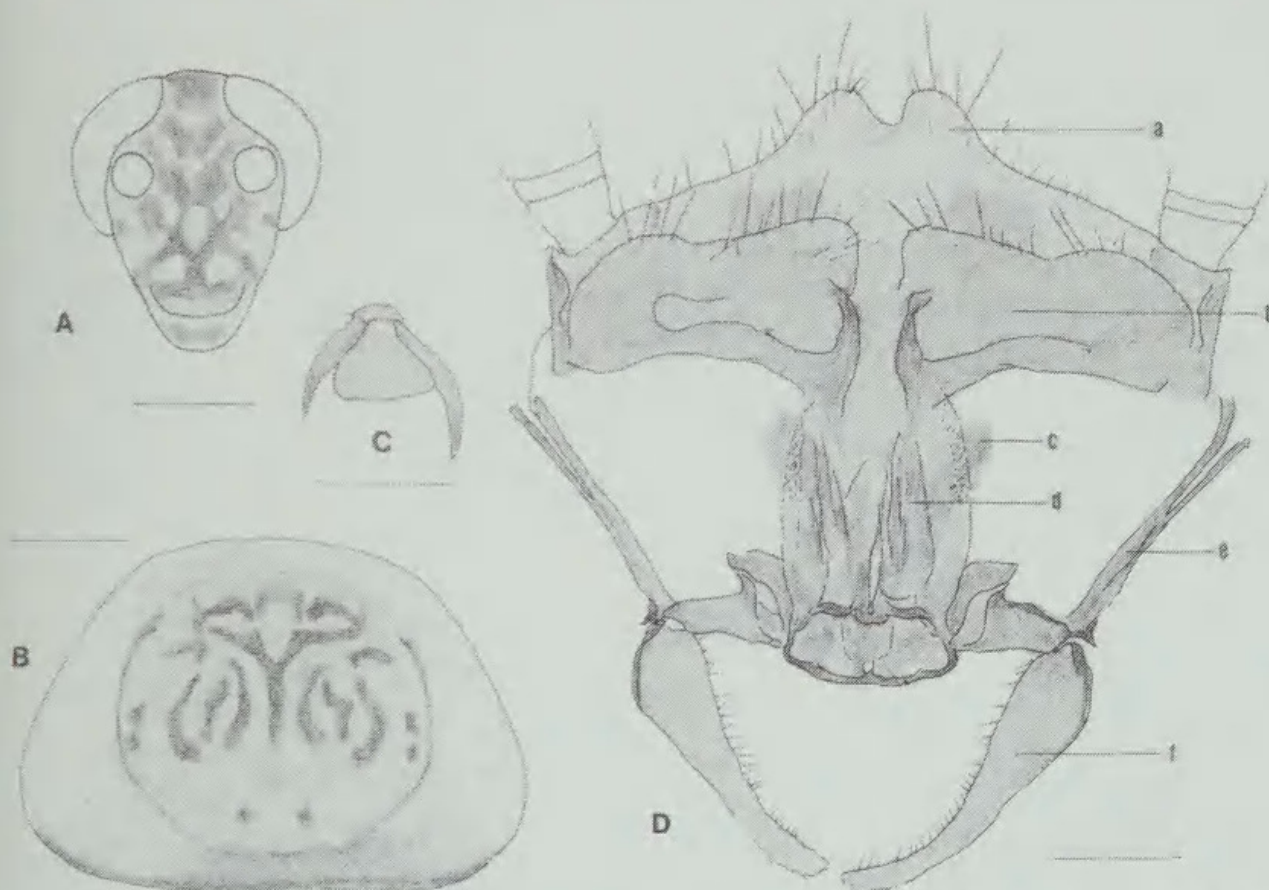


Figure 6. *Balta notulata*, ♀ from Rakata. A, head (frontal); B, pronotum; C, tarsal claws and arolium; D, genitalia (ventral).

Abbreviations: a, supra-anal plate; b, paraproct; c, intercalary sclerite; d, ovipositor valve; e, paratergite; f, first valvifer. Scales (mm): A, B, 1.0; C, 0.25; D, 0.5.

essentially similar plates (Figs 7A, E). Hind margin of subgenital plate deeply, concavely excavated with a small projecting medial lobe, styles small, bulbous (Figs 7B, F). Genitalia as in Figs 7C, G; hooklike genital phallomere on the right side (not left as claimed by Asahina, 1965, fig. 16). Female: Supra-anal plate transverse, apex deeply excavated (Fig. 6D). Genitalia as in Fig. 6D; intercalary sclerites small, mostly hidden under the ovipositor valves; paratergites bifurcated near middle; first valvifer with a fringe of setae along one margin.

**Coloration.** Brownish yellow. Head and pronotum with brown markings as in Figs 6A, B. Legs yellowish with small brown spots at the base of the spines and a brown spot at the base and apex of the internal surface of the anterior femurs. The pronotal and facial markings of the nymph are similar to those of the adult.

**Remarks.** The characteristic structures of the male from Panjang (Figs 7A–C) are similar to those of a male from New Caledonia (Figs 7E–G). The

colour markings are distinctive and the male's subgenital plate with its interstyral lobe make the species easily identifiable. I have examined the male holotype of *Margattea laxiretis* Bolívar, from Chagos Island, and it is clearly *Balta notulata*.

This species has been placed in the following genera: *Allacta*, *Blatta*, *Blattella*, *Eoblatta*, *Graptoblattella*, *Margattea*, *Onychostylus*, *Phyllodromia*, and finally *Lupparia* (Princis, 1969: 958). Based on male genitalia characters, as well as wing venation, front femur type, tarsal claws, and subgenital plate, I believe that *B. notulata* is a species of *Balta*. *Lupparia* is very close to it but its hind wing has a more distinct apical triangle. Unfortunately *Lupparia* was based on a female from the Philippines, and I have not seen a male of the type species *Lupparia adimonialis* (Walker).

*Balta notulata* is very widespread (Princis, 1969: 958). Karny (in Dammerman, 1922: 107) recorded it from Krakatau, and Dammerman (1948: 483) reported it from Krakatau, Sertung and Panjang. The present female taken on Rakata is the first record from that island.



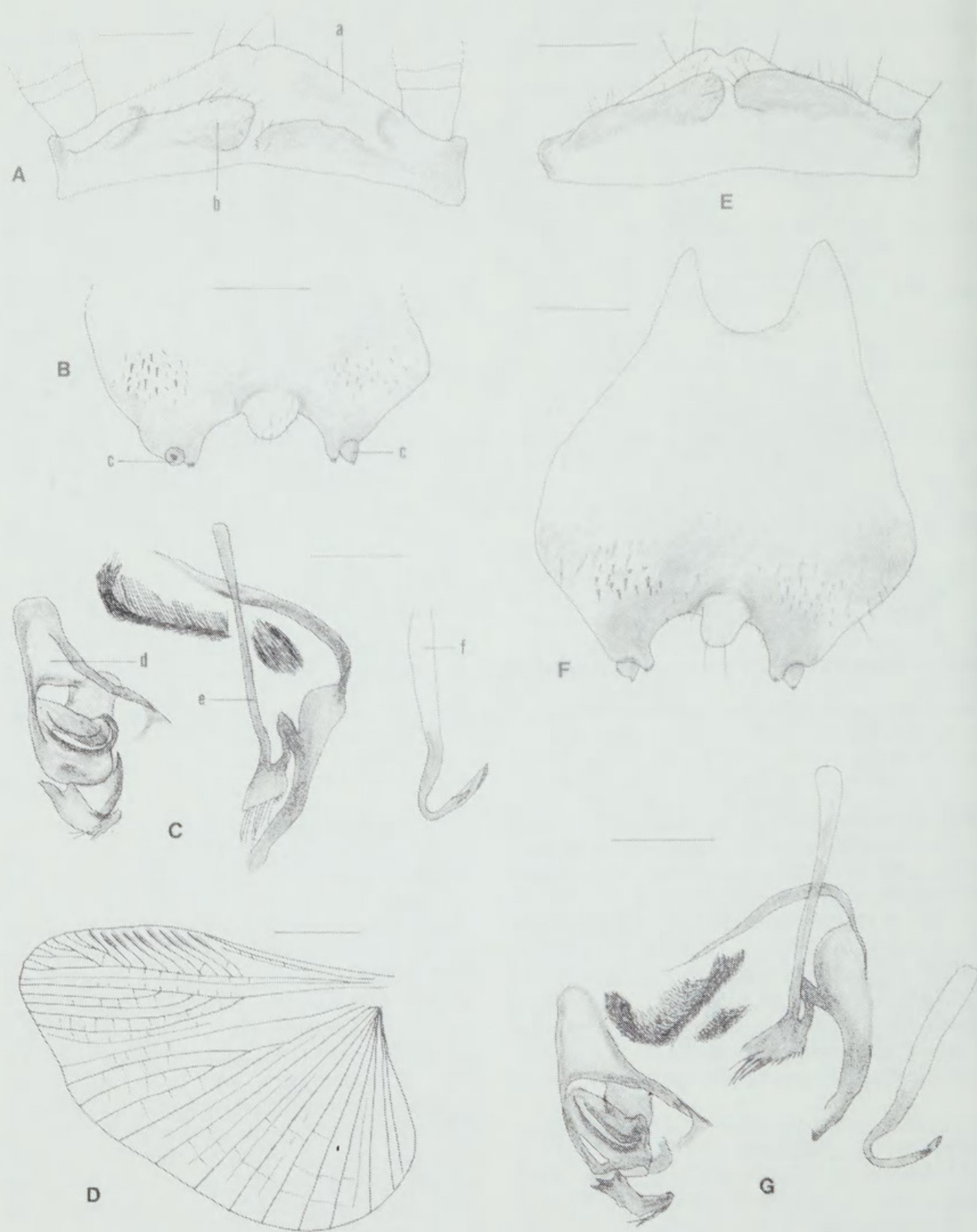


Figure 7. *Balta notulata* males. A-D, from Rakata: A, supra-anal plate and paraprocts (ventral); B, distal region of subgenital plate (dorsal); C, genitalia (dorsal); D, hind wing. E-G, from New Caledonia: E, supra-anal plate (ventral); F, subgenital plate (dorsal); G, genitalia (dorsal). Abbreviations: a, supra-anal plate; b, paraproct; c, style; d, left phallomere; e, median phallomere; f, hooklike right phallomere. Scales (mm): A-C, 0.5; D, 2.0; E-G, 0.5.



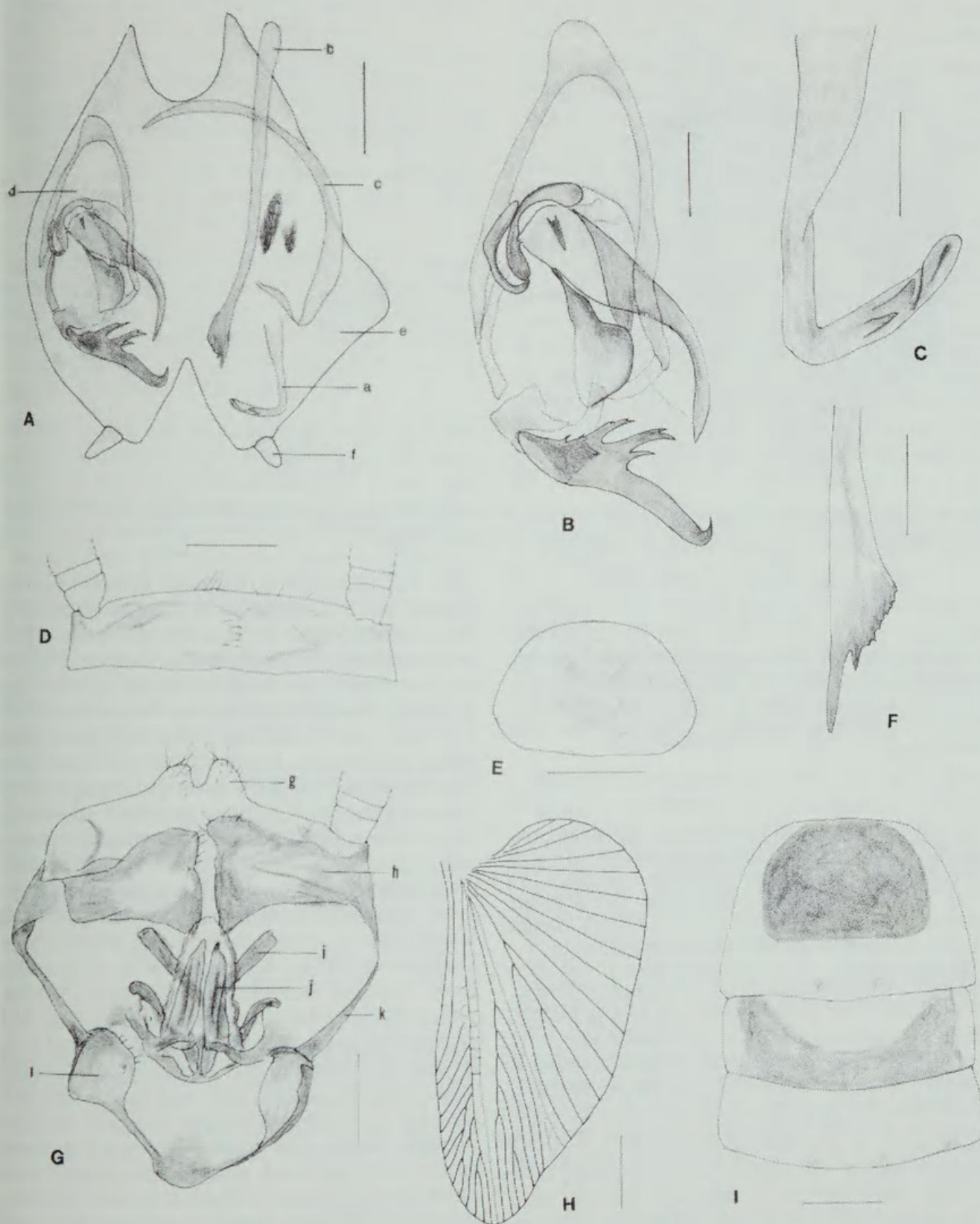


Figure 8. A-H, *Balta vilis*: A, B, ♂ from Sertung, subgenital plate and genitalia (dorsal), and left genital phallomere (dorsal). C-F, ♂ from Rakata: C, right hooklike phallomere; D, supra-anal plate (ventral); E, pronotum; F, apical region of median genital phallomere; G, ♀ from Anak, genitalia (ventral); H, ♂ hind wing. I, *Balta* sp., nymph from Panjang, pro-, meso-, and metanotum.

Abbreviations: a, hooklike right phallomere; b, median phallomere; c, accessory median phallomere; d, left phallomere; e, subgenital plate; f, style; g, supra-anal plate; h, paraproct; i, intercalary sclerite; j, ovipositor valve; k, paratergite; l, first valvifer. Scales (mm): A, 0.5; B, 0.25; C, 0.15; D, 0.5; E, 2.0; F, 0.15; G, 0.5; H, 2.0; I, 0.5.



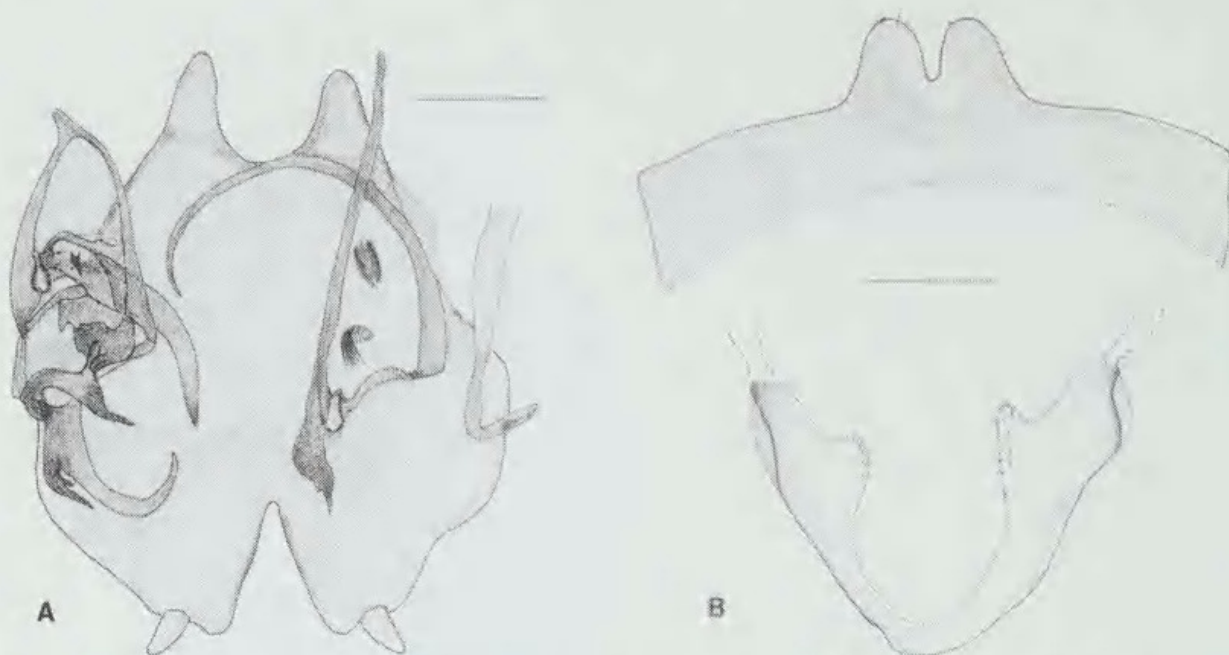


Figure 9. *Balta vilis*. A, ♂ from Macassar (type locality), subgenital plate and genitalia (dorsal); B, ♀ holotype, supra-anal plate, and first valvifer of genitalia (ventral). Scale (mm): 0.5.

***Balta vilis* (Brunner) comb. nov.**

Figures 8, 9

*Onychostylus vilis* (Brunner).—Asahina, 1965: 12, figs 20–26 (♂, ♀) (Japanese: English summary).

*Lupparia vilis* (Brunner).—Princis, 1969: 960 (references to synonymy, generic combinations, and distribution).

**Material examined.** Macassar. (NMWA): Female holotype of *Phyllodromia vilis* Brunner (genitalia slide 53), coll. Br. v. W. labelled *Onychostylus vilis* (Br. W.), by Princis, 1961; 1 ♂ (terminalia slide 54), coll. Br. v. W. [with the following labels: *Phyllodromia vilis* Brunner, labelled by Brunner; *Onychostylus vilis* (Brunner), labelled by Princis dated 1961; *Lupparia vilis* (Brunner)].

Krakatau Islands. (TUVa): Rakata, Zwarte Hoek, base camp, 1 ♂ (terminalia slide 1), 1 ♀, 12 Aug 1984; Anak (6°06'S, 105°26'E), mixed forest, 1 ♂, 20 Aug 1985, ex litter, 1 ♀ (genitalia slide 2), 10 Sep 1984, at light, 1 ♂, 15 Aug 1985, N. Foreland, 1 ♀, 28–29 Sep 1986, Malaise, camp, 1 nymph, 13–19 Aug 1985, 1 nymph, 22 Aug 1985, 20 nymphs, saccharum bait, 15 Aug 1985, 1 nymph, beat *Casuarina*, 1 nymph, 15 Aug 1985, 27 nymphs, beat broad leaved plants, 21 Aug 1985, 1 nymph, beat grass, 21 Aug 1985; Panjang, 6°05'S 105°28'E, 1 nymph, 16 Aug 1985; Sertung, spit, casuarinas, 11 nymphs, 8 Aug 1985, 10 m, 1 ♂ nymph, 12 Nov 1984. (KUKJ): Sertung, 1 ♂ (terminalia slide 1), at light, 9 Nov 1982, J. Yukawa (det. as *Onychostylus vilis*, by Asahina). (RNHL): Krakatau, 1 ♀, Sep 1920 (labelled *Phyllodromia contingens* Wlk.), 1 ♀, (abdomen missing), Dec 1919, Mus. Btzg., no. 6, 1 ♀, Sep 1920 (both labelled *Margattea contingens* Walk. by Hanitsch).

**Description.** Tegmina and wings fully developed. Costal veins of hind wings not clubbed, cubitus vein

with 2–5 complete (1 or more bifurcate) and 0 incomplete branches, apical triangle small (Fig. 8H). Anteroventral margin of front femur with 1 large proximal spine followed by a row of piliform spinules and terminating in 3 distal spines (Type B<sub>3</sub>; 1 specimen which lacked the abdomen has Type B<sub>3</sub> with 2 and 4 large proximal spines, the number being different on the two femurs); tarsal claws strongly asymmetrical, pulvilli and arolia present. Some specimens lack large proximal spines and have a row of piliform spinules only terminating in 3 large spines (Type C<sub>3</sub>). Male: Abdominal terga unspecialized. Supra-anal plate transverse, rectangular, hind margin entire or essentially so; right and left paraprocts, broad similar plates without spine-like processes (Fig. 8D). Subgenital plate with a deep V-shaped excavation, styles small, similar, cylindrical, each located laterad to the V (Fig. 8A). Genitalia as in Figs 8A, B, C, F, 9A; genital hook on the right side (not left as claimed by Asahina, 1965: fig. 24); shape and number of spinelike processes on the left phallomere are variable. Female: Supra-anal plate transverse, a broad median area produced, hind margin medially excavated forming a pair of small, apically rounded lobes (Figs 8G, 9B). Genitalia as in Fig. 8G; intercalary sclerites V-shaped, lightly sclerotized, partly hidden under the ovipositor valves; first valvifer swollen basally (Fig. 8G) or enlarged unevenly along its full length (Fig. 9B, lower). Three females have one front femur Type B<sub>3</sub> (with 1 large proximal spine), and the other femur Type C<sub>3</sub>. The female holotype has Type B<sub>3</sub> with 4 large proximal spines (only 1 femur present).



**Coloration.** Yellowish brown. Vertex of head with a light brown band, and a light transverse band between the top of the antennal sockets, face with 2 small dots near the antennal sockets and a band between them. Pronotum with broad lateral areas hyaline, disk essentially without markings (Fig. 8E).

**Nymphs.** Some of the nymphs have faint head markings similar to those of the adult. Front femurs Type B<sub>3</sub>, C<sub>2</sub> or C<sub>3</sub>.

**Measurements** (mm) (♀ in parentheses; measurements in brackets refer to ♂:♀ holotype, both from Macassar). Length, 11.0–11.5 (9.0–10.5) [9.8:9.3]; pronotum length × width, 2.5–2.6 × 3.8–4.0 (2.6–2.7 × 3.7–4.2) [2.6 × 4.0: 3.0 × 4.5]; 10.5–11.0 (9.5–10.8) [10.7:9.9].

**Remarks.** This species apparently varies in femur type. The shapes of the first valvifer of the holotype, and the left genital phallomere of the male from Macassar differ somewhat from these structures in the specimens from the Krakatau Islands. I believe these differences are simply variations of a single species, *B. vilis*.

*Balta vilis* is easily differentiated from *notulata* (the only other species of adult *Balta* so far recorded from the Krakataus) by differences in colour markings on the head and pronotum, and shapes of the male supra-anal and subgenital plates, and male and female genitalia.

Like *B. notulata*, this taxon is widely distributed and has been reported from Iwo Jima, China, Thailand, Malacca, Java, Randja, Komodo, Sumba, Sumbawa, Timor, and Wetar (Princis, 1969:960). Hanitsch incorrectly reported the species as *Margattea contingens*, from Krakatau. It now occurs on all four Krakatau Islands.

#### **Balta sp.**

#### **Figure 8I**

**Material examined.** Krakatau Islands. (TUVa): Panjang (6°05'S, 105°28'E), central, beat, 3 nymphs, under bark, 1 nymph, 17 Aug 1985, sweep, 1 nymph, 16 Aug 1985, 5 nymphs, 16 Aug 1985, 200 ft, beating, 1 nymph, 14 Sep 1984, north, beating, 1 nymph, 20 Sep 1984; Rakata, S. face, 200 m, 2 nymphs, 24 Aug 1985, 50–100 m, 3 nymphs, 26 Aug 1985, 20–50 m, 1 nymph, 25 Aug 1985, Zwarte Hoek, sweep, 1 nymph, 31 Aug 1984, litter, 1 nymph, 12 Sep 1984, beating 1 nymph, 15 Sep 1984, W. ridge, 850 ft, beating, 1 nymph, 16 Sep 1984, Malaise, 1 nymph, 19 Sep 1984; Sertung (6°05'S, 105°23'E), 1 nymph, Sep 1984, forest, beating, 100 ft, 1 nymph, 250 ft 1 nymph, 11 Sep 1984, forest III, east ridge, 4 nymphs, under logs, bark, 1 nymph, 19 Aug 1985, forest I, beating, 3 nymphs, 18 Aug 1985, forest II, beating, near spring, 2 nymphs, 18 Aug 1985, spit, transit zone (6°04'S,

105°24–25'E), beating, 1 nymph, 18 Aug 1985, forest south, east ridge, 6°05'S, 105°23'E, 1 nymph, 27 Sep 1986.

**Remarks.** The above nymphs are all small (early instars) and strikingly marked. The head is dark brown except for a whitish band on the vertex, and the pro-, meso-, and metanota are marked with brown as shown in Fig. 8I. The abdominal terga are speckled with brown. I consider these immature specimens to be a *Balta* because their front femur is Type C, and the tarsal claws are asymmetrical; so far *Balta* is the only genus on the Krakataus with asymmetrical tarsal claws. It seems unusual that no adults were collected, although nymphs apparently were abundant. Adults should be examined to confirm my provisional determination. The colour markings of the nymphs are distinctly different from those of *notulata* (nymphal markings similar to their adults) and *vilis* (pronotal disk without distinctive markings).

#### **Margattea ceylanica** (Saussure)

*Margattea ceylanica* (Saussure).—Princis, 1969: 862.—Roth, 1989: 211, figs 1–7 (♂, ♀).

**Remarks.** This species appears to be restricted to Sri Lanka and all of the localities other than this island, listed by Princis (1969) probably refer to *Margattea nimbata* Shelford which was considered to be a junior synonym of *M. ceylanica*.

#### **Margattea paraceylanica** Roth

*Margattea paraceylanica* Roth, 1989: 213, figs 8–14 (♂, ♀).

**Remarks.** This species was collected in Rakata, Panjang, and Sertung, on the 1984–1985 Krakatau expeditions. The males have a setal gland on T8 which is absent in *M. ceylanica*.

#### **Margattea nimbata** (Shelford)

*Margattea nimbata* (Shelford).—Princis, 1969: 863 (incorrectly listed as a synonym of *M. ceylanica*).—Roth, 1989: 215, figs 15–26 (♂, ♀).

**Remarks.** Until recently, *M. nimbata* was a junior synonym of *M. ceylanica* but the male and female genitalia differ strongly and both are valid taxa. Whereas *ceylanica* so far is limited to Sri Lanka, *M. nimbata* occurs on Krakatau, Northern Territory (Australia), Kei Island, Christmas Island, Thailand, Sarawak, Borneo (Kalimantan), and Java (Roth, 1989).

#### **Margattea anceps** (Krauss)

*Margattea anceps* (Krauss).—Princis, 1969: 864.—Roth, 1989: 220, figs 36–46 (♂, ♀).

**Remarks.** The dark brown macula on the tegmina distinguishes this species from the other species of



*Margattea* in the Krakataus. This species was not collected on the 1984–1985 expeditions to the Krakataus, but was listed for Krakatau by Dammern (1948: 483). The type locality of *M. anceps* is Java (Tjibodas) but Princis (1969:864) listed other localities, namely Malacca, Sumatra, Mentawi Islands, and Borneo. However, these localities are, for the most part, based on *Margattea nigrovittata* (Hanitsch) which Hanitsch claimed was a junior synonym of *M. anceps*. I have seen the type of *M. nigrovittata* and it is clearly a valid species distinctly different from *M. anceps* (Roth, 1989).

### ***Blattella radificera* (Hanitsch)**

Figures 10A, B

*Symploce radificera* (Hanitsch). — Princis, 1969: 881.

*Blattella radificera* (Hanitsch). — Roth, 1985: 106, figs 56E, F, 59A–G, 60A–F.

**Material examined.** Sertung. (TUVA): 2 ♀ (one with genitalia slide 8), 15 Sep 1984, forest III, 6°05'S, 105°23'E, sweep, 1 ♂, 1 nymph, under logs, bark, 19 Aug 1985.

**Remarks.** This species was redescribed by Roth (1985). The male of *B. radificera* is readily distinguished from other blattellids in the Krakataus by the setose gland on the seventh abdominal tergum, the shape of the supra-anal plate, and the cylindrical styles which are close together and located to the left of the midline on the hind margin of the subgenital plate (Fig. 10B). The markings on the adult pronotum (Fig. 10A) may vary. The nymph has dark longitudinal pronotal bands characteristic of immature specimens of *Blattella* spp. (e.g., *Blattella germanica*).

This is a rather common and widely distributed species having been recorded from Borneo, Java, Laos, Malaysia, Sabah, Sarawak, South Vietnam, Sumatra, and Thailand. The present specimens from Sertung are the first from the Krakataus.

### ***Lobopterella dimidiatipes* (Bolívar)**

Figure 10C

*Loboptera dimidiatipes* (Bolívar). — Zimmerman, 1948: 89, fig. 43. — Chopard, 1924: 319, fig. 27, pl. 3, fig. 2 (as *Temnopteryx bimaculata* Chopard). — Hanitsch, 1932: 72, fig. 13 (as *Scabina transversa* Hanitsch). — Hebard, 1933: 121. — Fullaway and Krauss, 1945: 35, pl. 2, fig. 14 [as *Loboptera sakalava* (Saussure and Zehntner)].

*Lobopterella dimidiatipes* (Bolívar). — Princis, 1957: 145. — McKittrick, 1964, figs 68A, B. — Gurney and Roth,

1966: 196, figs 5, 6, 21. — Roth, 1968, figs 112–114. — Princis, 1969: 856. — Asahina, 1973: 124, figs 4–8, 16–18. — Roth, 1988, fig. 6A.

**Material examined.** Krakatau Islands. (TUVA): Sertung, rainforest litter, 1 ♂, 11 Sep 1984; Rakata, W. ridge, 280 m, water trap, 1 (abdomen missing), 22 Sep 1984; Rakata, Zwarte Hoek, under rocks, 1 ♀, 6 Sep 1984.

Thailand. (ZILS): Sakaerat (ASRTC site), Khorat Province, 2 ♀ reared from nymphs, 1 nymph, 12 Oct 1967, N. Kobayashi.

**Description.** This distinctive species (Fig. 10C) should be easily identified from the following:

Tegmina reduced in length reaching to hind margin of metanotum, width normal, apical margin oblique; hind wings vestigial, lateral. Anteroven-tral margin of front femur Type A<sub>3</sub>, tarsal claws simple, symmetrical, pulvilli and arolia present. Male: Seventh abdominal tergum with a pair of minute nonsetose pits (Gurney and Roth, 1966: fig. 21; Roth, 1988: fig. 6A). Supra-anal plate broadly rounded (Asahina, 1973: fig. 5). Subgenital plate small, strongly convex, asymmetrical, deeply excavated, with styles and setose processes (Gurney and Roth, 1966: fig. 6; Chopard, 1924: fig. 27). Genitalia as in Gurney and Roth (1966: fig. 5).

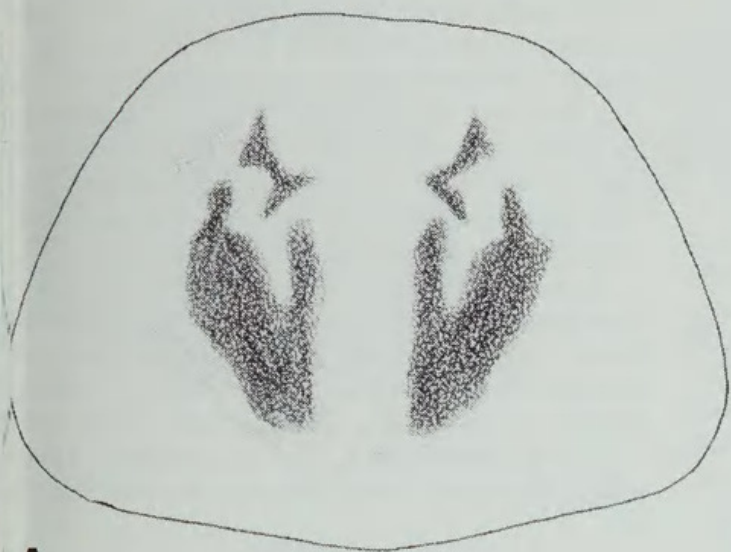
**Coloration.** Face blackish brown, cheeks and vertex pale, occiput dark; maxillary palps pale, fifth segment dark on basal half. Pronotum blackish brown except for narrow yellowish lateral and anterior borders. Tegmina dark brown, anterior border yellowish, a continuation of the pale pronotal border. Anteromedially on each tegmen is a hyaline area through which a pale macula on the mesonotum is visible. Metanotum with a smaller pair of pale maculae hidden by the tegmina. Abdominal terga dark brown, lateral borders pale, second tergum with a pair of narrow rectangular hyaline spots. Abdominal sterna dark brown, lateral borders pale. Cerci dorsally with slightly more than basal half dark brown, remainder pale, ventrally with basal portions of segments dark, remainder pale. Legs pale with dark brown spots as follows: coxae (anterior surface) with small basal maculae on front coxae, larger spots on basal half and smaller spots laterally on mid and hind coxae. Femur (anterior surface): basal spots on all femurs, and a distal spot as well on hind femur. Tibiae with basal and distal spots.

**Measurements** (mm). Length, 10.5; pronotum length × width, 3.0 × 4.5; tegmen length, 3.0.

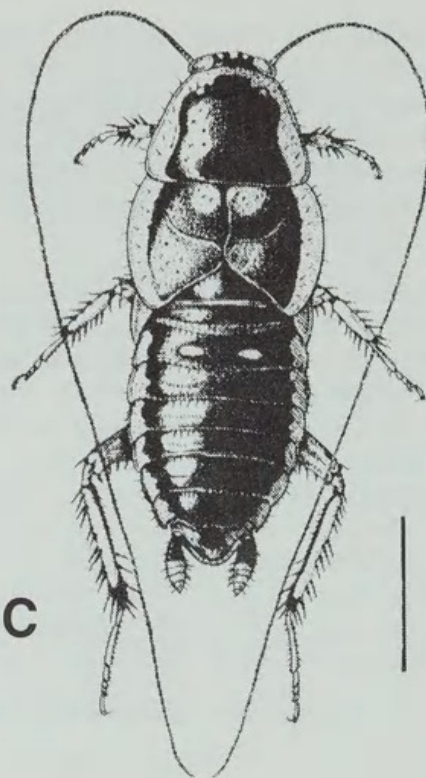
Figure 10. A, B, *Blattella radificera*, ♂ from Sertung: A, pronotum; B, abdominal terga 7 to 10, subgenital plate and styles (dorsal). C, *Lobopterella dimidiatipes*, ♀ (reproduced from Chopard, 1924, pl. 4, fig. 2).

Scales (mm): A, 1.0; B, 0.5; C, 3.5.

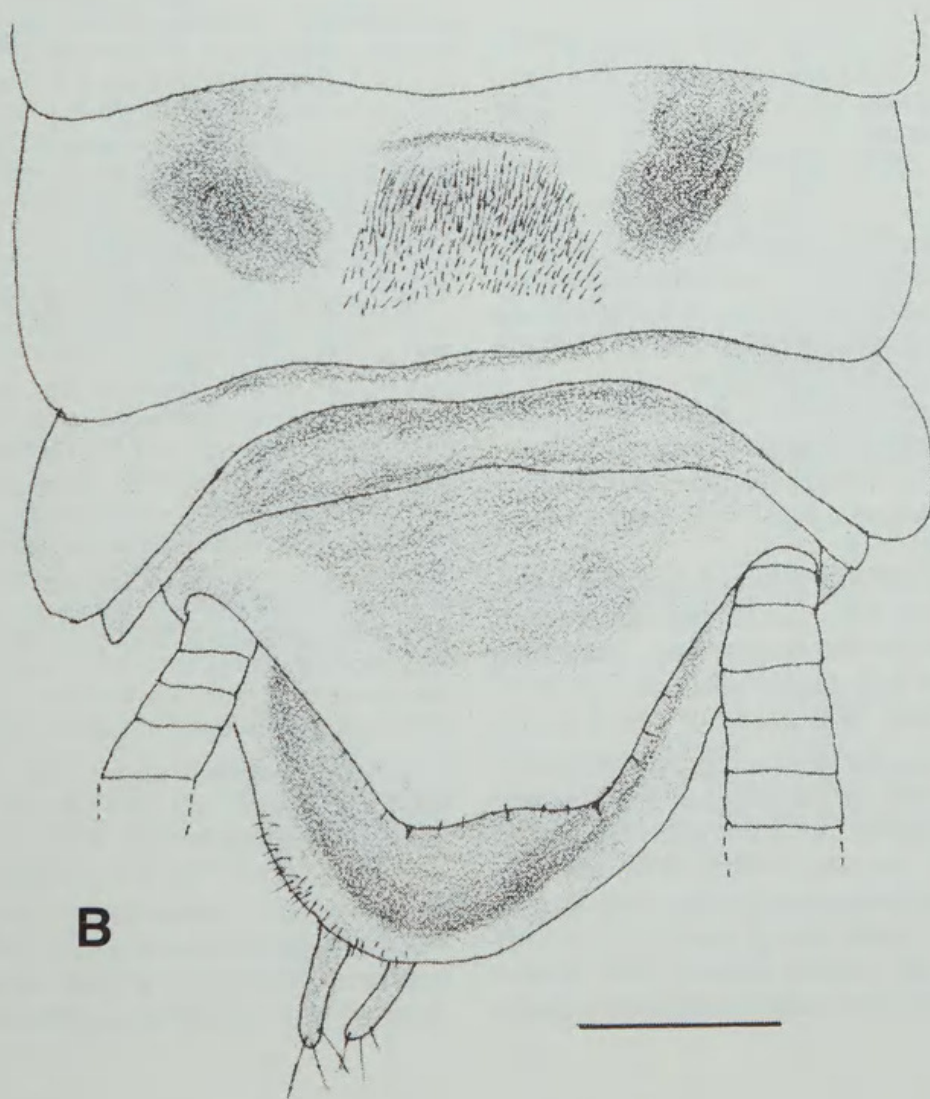




A



C



B



*Female.* The female essentially is similar to the male in tegmina and wing reduction, size, and colour pattern. The hind margin of the subgenital plate is rounded. Supra-anal plate trigonal, apex rounded (Asahina, 1973: fig. 8). Genitalia as in McKittrick (1964: figs 68A, B), and ootheca in Roth (1968: figs 112–114).

*Remarks.* In Hawaii, *Lobopterella dimidiatipes* is found on imported plants and appears to prefer wet districts where it is found under trash, stones, etc. (Fullaway and Krauss, 1945). The present record is the first for the Krakataus but the species is very widely distributed having been recorded from Hawaii, Marquesas, Tahiti, Samoa, Fiji, New Caledonia, Philippines, Sumatra, Madagascar, Seychelles, Zanzibar, Tanzania (Princis, 1969: 856), East Sumba, Flores, new Britain (Princis, 1957: 145), and from the Ryukyu Islands and southern Taiwan (Asahina, 1973: 128).

#### *Pycnoscelus surinamensis* (Linnaeus)

Figures 11A, B

*Pycnoscelus surinamensis* (Linn.).—Princis, 1964: 264 (references to biology, synonyms, and distribution).

*Material examined.* Krakatau Islands. (TUVA): Rakata, S. Fall, 400 m, 1 ♀, 24 Sep 1985, Sertung, 6°05'S, 105°23'E, forest II, under logs near spring, 1 ♀ nymph, 19 Aug 1985, under logs, 1 ♀ nymph, 18 Aug 1985, forest III, east ridge, under bark, etc., 1 ♀ nymph, 19 Aug 1985. Anak Krakatau, 6°06'S, 105°26'E, 2 ♀, 18 Sep 1986.

*Diagnosis.* Pronotum shining blackish brown with brownish yellow along anterolateral and anterior margins (Fig. 11A). Tegmina dark chestnut brown, marginal field yellowish brown. Colour markings vary considerably between geographical localities (see Fig. 1 in Roth, 1974). Hind margin of supra-anal plate convexly rounded and weakly indented medially (Fig. 11B). Anteroventral margin of front femur with row of slender piliform spinules only (proximal ones longer), and terminates in 1 large distal spine (Type C<sub>1</sub>).

Nymphs deep chestnut brown to blackish chestnut brown. Head, pro-, meso-, and metanotum, and first 3 abdominal terga shiny, remaining abdominal terga dull shagreenous (see figs 4A–C in Roth and Willis, 1961).

*Remarks.* *Pycnoscelus surinamensis* was originally described from Surinam specimens, but is widely distributed in tropical and subtropical regions; in colder climates it can survive in greenhouses. It is obligatorily parthenogenetic in the New World, where males normally do not occur. It probably originated in the Sunda Islands and Malay Archipelago where it may occur in the same regions

as its bisexual relative, *Pycnoscelus indicus* (Fabricius), which cannot reproduce parthenogenetically (Roth, 1967). The habitus of *P. indicus* and *P. surinamensis* are similar (see figs 5C and F in Roth and Willis, 1961: fig. 5C is *P. surinamensis* and 5F is *P. indicus*, which, at that time we considered to be a bisexual strain of *P. surinamensis*). The habitus of the nymphs of *P. indicus* and *P. surinamensis* are similar.

*Pycnoscelus surinamensis* is a multiclinal form composed of many genotypes that are successful invaders (Parker et al., 1977). It was previously reported from Krakatau and Sertung (= Verlaten) Islands by Karny (in Dammerman, 1922: 107), Hanitsch (1923a: 211), and Dammerman (1948: 484). The present records are the first for Rakata.

#### *Haanina major* (Saussure)

Figures 11C–F, 12

*Haanina major* (Saussure).—Hebard, 1929: 13.—Princis, 1967: 642 (distribution, synonymy, and generic combinations).

*Material examined.* Krakatau Islands. (TUVA): Rakata, base camp, 1 ♀, 12 Sep 1984, 250 m, 1 ♂, 4 Sep 1984, in litter, 850 ft, 5 nymphs, 19 Sep 1984, 1 ♀, 10 Sep 1984; Rakata, Zwarte Hoek (6°09'S, 105°25'E), at light, 1 ♂ nymph, 1–3 Sep 1984, on bush, 1 ♀ nymph, 16 Sep 1984, 1 ♂, 30–31 Aug 1984, 1 ♀, 1 Sep 1984, under rocks, 2 ♂ nymphs, 6 Sep 1984, 1 ♂ nymph, 16 Sep 1984, 1 ♂, 8 Sep 1984, in litter, 1 nymph, 12 Sep 1984; south side, beating vegetation, 1 ♂, 18 Sep 1984; Owl Bay (6°09'S, 102°28'E), beat thorny palm, 1 ♀, 26 Aug 1985, sweeping, 1 ♀ nymph, 22 Aug 1985; W. ridge, 250 m, 1 ♂ nymph, 1 Sep 1984; Sertung, in *Casuarina* litter, 2 nymphs, 11 Sep 1984; forest direct search, 6°05'S, 105°23'E, 2 ♀, 18 Aug 1985; forest I, under logs, 1 ♂ nymph, 18 Aug 1985; forest III, east ridge, beating, 1 ♂ nymph, 19 Aug 1985, sweep, 1 ♂, 1 ♀ nymph, 19 Aug 1985; spit, transit zone (6°04'S, 105°24–25'E), 1 ♂ (terminalia slide 9), 18 Aug 1985; forest, under logs, 6°05'S, 105°23'E, 2 ♀ nymphs, 18 Aug 1985; Panjang, litter in secondary rain forest, 2 nymphs, 14 Sep 1984. (KUKJ): Sertung, 1 nymph, Nov 1982, J. Yukawa (det. as *Rhionoda* sp. by Asahina).

Nicobar Island. (UZMC): 1 ♂ (terminalia slide 3), Galathea Expedition, 1845–48 [originally reported as *H. macassariensis* (Hahn) by Princis (1951: 37), but later determined as *H. major* (Princis, 1969: 643)].

*Diagnosis.* Tegmina and wings fully developed reaching beyond end of abdomen, or somewhat reduced reaching to about T7 (in ♂ from Nicobar Island, Fig. 12A). Tegmina punctate except for part of right tegmen covered by left one. Anteroventral margin of front femur Type B<sub>2</sub> (rarely B<sub>1</sub>), pulvilli large on 4 proximal tarsomeres, arolia large, tarsal claws simple, symmetrical. Hind margins of male



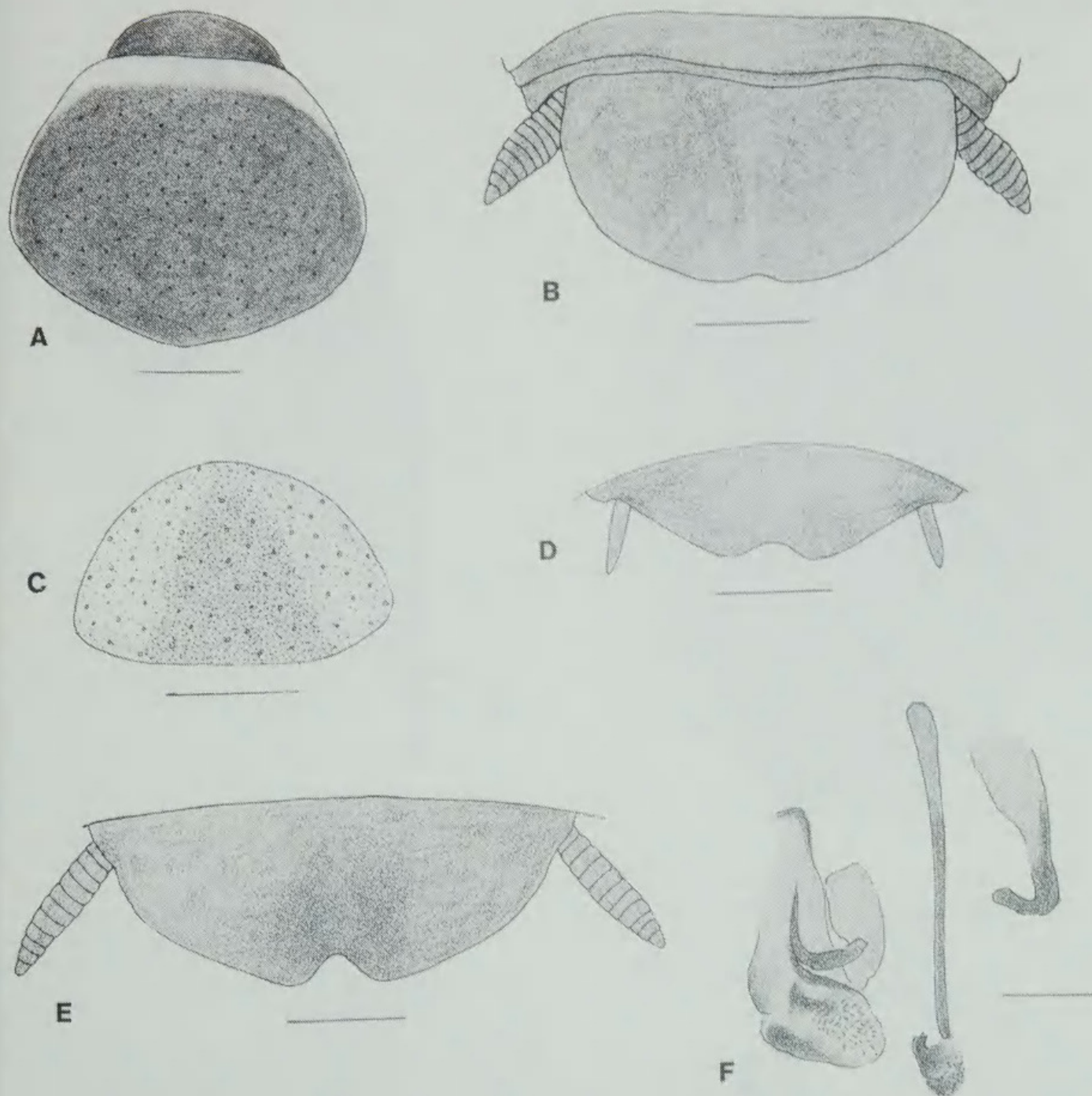


Figure 11. A, B, *Pycnoscelus surinamensis*, ♀, pronotum, and supra-anal plate. C-F, *Haanina major*, ♂ from Rakata: C, pronotum; D, subgenital plate and styles (ventral); E, supra-anal plate and cerci (dorsal); F, genitalia (dorsal). Scales (mm): A, 2.0; B, 1.0; C, 5.0; D, E, 1.0; F, 0.75.

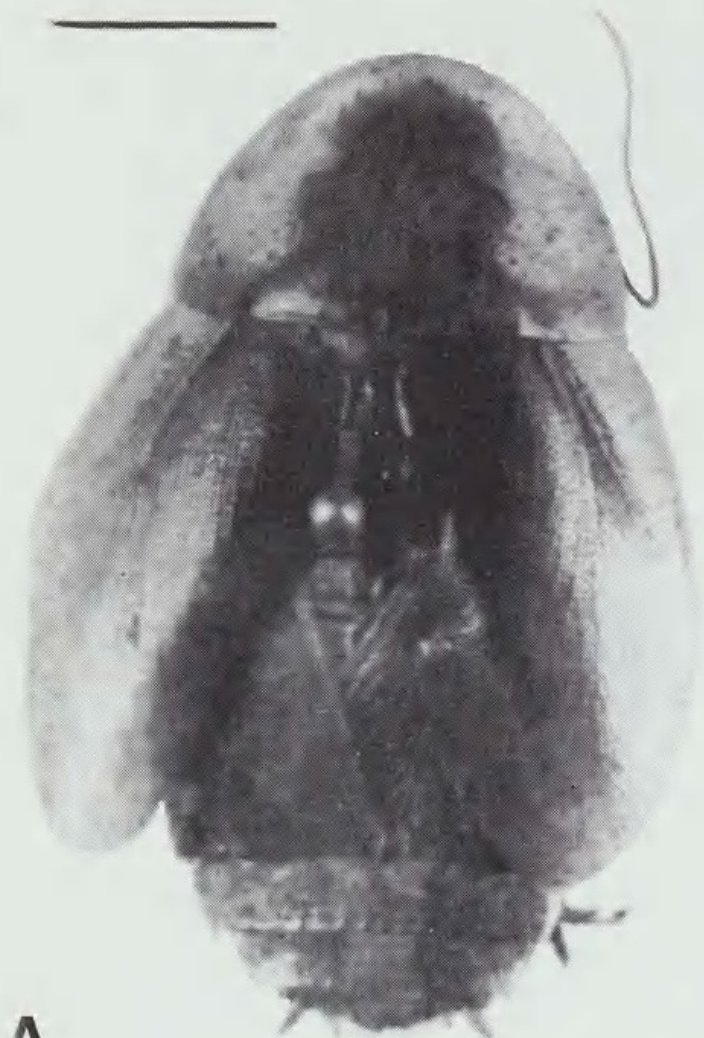
supra-anal (Fig. 11E) and subgenital (Fig. 11D) plates medially indented. Male genitalia as in Figs 11F, 12B-D. Hind margin of female supra-anal plate indented medially, hind margin of subgenital plate convexly rounded and entire.

**Coloration.** Tan to light brown with reddish tinge. Head with small and large black dots between eyes becoming denser on occiput, small oblique reddish maculae near each antennal socket, and an inter-

rupted median longitudinal streak becoming denser on clypeus, blackish maculae on genae. Pronotum translucent with fine stippling becoming denser on disk, small but larger round circles widely spaced over surface (Fig. 11C).

**Measurements** (mm) (♀ in parentheses). Length, 20.8–26.0 (25.0–28.0); pronotum length × width, 6.9–7.8 × 10.7–12.3 (8.1–8.6 × 12.2–13.5); tegmen length, 18.4–22.1 (22.0–23.0).



**A****B****D****C**



Nymph with small tubercles mostly along hind margins of thoracic and abdominal terga, giving it a roughened appearance. This differs from the smooth surface of *P. surinamensis* nymphs.

**Remarks.** This species has previously been reported from Sertung (Hanitsch, in Dammerman, 1929: 112; Dammerman, 1948: 483). Princis (1967: 642) listed it from Krakatau, Greater and Lesser Nicobar Islands, and Java. The present collections extend the distribution in the Krakataus to Rakata and Panjang.

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Figure 12. *Haanina major*, ♂ from Nicobar Island: A, habitus; B-D, genital phallomeres: B, right hook; C, apex of median; D, left.

Scales (mm): A, 5.0; B,C, 0.2; D, 0.3.



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