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NEUROPTERA (INSECTA) OF THE KRAKATAU ISLANDS, INDONESIA

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CONTENTS

The Neuroptera of the Krakatau Islands are reviewed and discussed. One new species of Coniopterygidae is described, and representatives of Berothidae and Hemerobiidae recorded from the islands for the first time. Ten species were found in 1984–85, and their geographical affinities are discussed. *Spilosmylus modestus* (Gerstaecker) is redescribed and illustrated.

1. INTRODUCTION

This paper is an account of the Neuroptera of the Krakatau Islands, in the Sunda Strait between Java and Sumatra, Indonesia (figure 1). The Neuroptera of Indonesia – and, indeed, of many neighbouring countries – are not well known. A considerable number of species have been described, but many descriptions are brief and reliant on a limited range of superficial characters, and a comprehensive revision of the Neuroptera of Sundaland is warranted. The Indonesian taxa have received little attention since the pioneering studies of van der Weele (1909) and Esben-Petersen (1926, 1928). Most of the described species are known from few specimens, and inferences on distribution are difficult. As Monserrat (1982) showed, species

from the Malaysian Peninsula, Borneo, or the Philippines sometimes occur in Indonesia, and some species are even more widespread. With more comprehensive specialist collecting, the Indonesian fauna is likely to prove diverse.

The Krakataus occupy a unique position in biology, as aspects of the recolonization of Rakata, Sertung and Panjang since the sterilizing eruption of 1883, and the primary colonization of Anak Krakatau since its emergence in 1930 (and its probable sterilization in 1952) have provided one of the very few opportunities to study the development of complex tropical ecosystems *ab initio* (see Thornton (1984), Thornton & Rosengren (1988) for a general history of the development and exploration of the islands). As part of the ongoing documentation of the fauna, the Neuroptera collected on expeditions by La Trobe University/ Lembaga Ilmu Pengetahuan Indonesia (L.I.P.I.) in 1984 and 1985 are discussed below, together with a recapitulation of earlier records (Dammerman 1948).

On both expeditions Neuroptera were collected by beating, sweeping, direct search and light trapping, and Malaise traps were used in 1985. All material obtained was preserved in alcohol and sorted in Australia. The regions of the islands surveyed are indicated in figure 1.

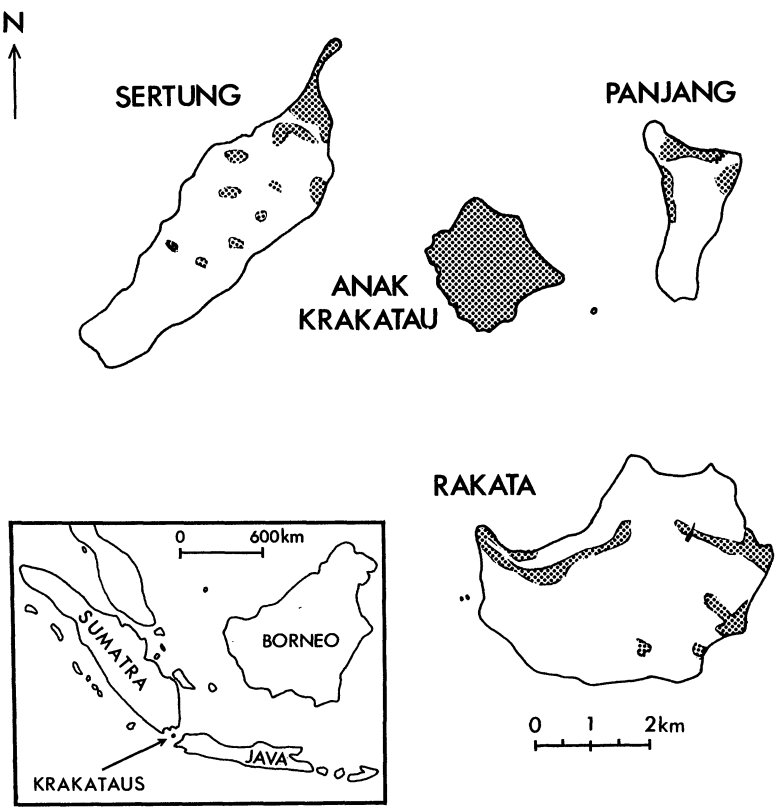


FIGURE 1. The Krakatau Islands, indicating areas (shaded) in which Neuroptera were sought in 1984 and 1985.

Taxonomic appraisal of the collection is by T.R.N., to whom authorship of the new species should be attributed. Some of Dammerman's specimens are now in the Zoological Museum, Bogor, or the Rijksmuseum van Natuurlijke Historie, Leiden, where they were examined by T.R.N. Types and voucher material from the present collections will be deposited in the Zoological Museum, Bogor. Measurements in descriptions are given in millimetres; wing

figures are drawn from camera lucida projections, and figures of genitalia are from cleared abdominal apices stored in glycerine. They are simplified by omission of all simple setae and trichobothria. Terminology for venation and genitalia follows that of more comprehensive works on each family cited in context.

2. Taxonomic section

(*a*) Coniopterygidae

Dammerman (1948) noted that unidentified specimens of this family were captured on Panjang (as 'Lang Island') in May 1908. His material has not been traced, and four species were collected in our surveys.

Coniocompsa meinanderi Monserrat
(Figures 2 and 3.)

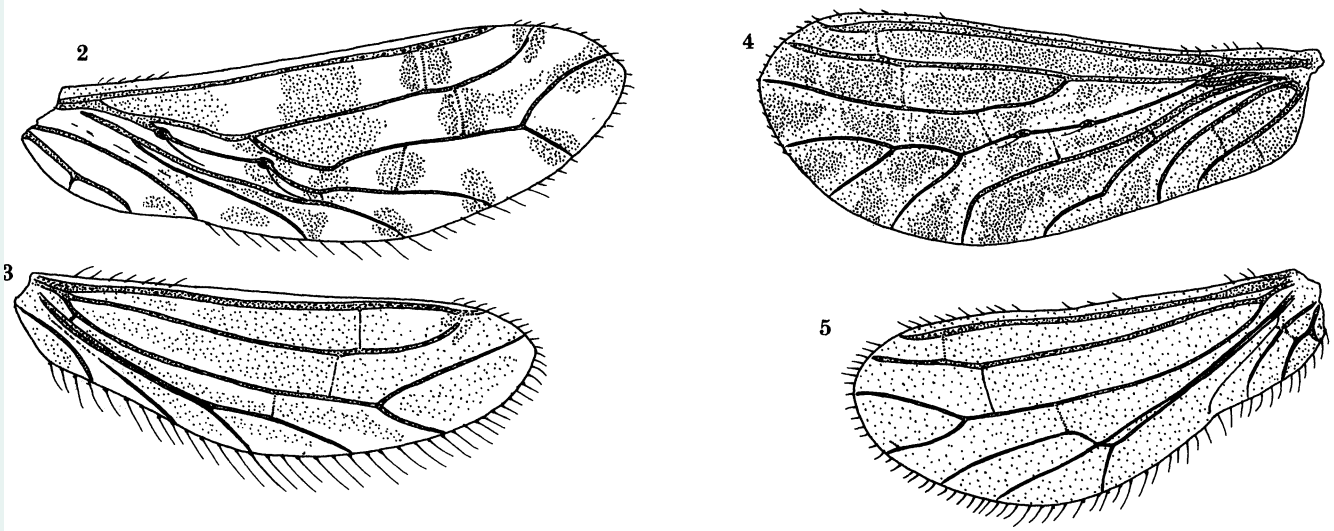
Coniocompsa meinanderi Monserrat, 1982. *Annali Mus. civ. Stor. nat. Giacomo Doria* **84**, p. 12.

Material examined

Rakata, Zwarte Hoek, 280 m, sweep, 14 Sep. 1984, 1 ♀; Ridge, 100 m, beaten, 1 Sep. 1984, 1 ♀; Panjang, 300 m, beat, 15 Sep. 1984, 1 ♂, 1 ♀; sweep near coast 17 Aug. 1985, 1 ♀; northeast shore, beaten, 17 Aug. 1985, 2 ♂, 3 ♀.

Comments

This species was described from Malaysia, with the type series from Penang and Singapore. The present specimens are clearly referable to *meinanderi*, and the male genitalia agree in all respects with Monserrat's (1982) figures. Some details of wing shading differ slightly, as in figures 2 and 3, but these appear to be trivial.



Figures 2–5. Wings of Coniopterygidae: 2, forewing and 3, hindwing of *Coniocompsa meinanderi* Monserrat; 4, forewing and 5, hindwing of *Heteroconis axeli*, sp.nov.

Heteroconis axeli New, sp. nov.
(Figures 4–11.)

Types

Holotype, ♂: Anak Krakatau, northwest coast, beaten from *Casuarina*, 15 Aug. 1985 (Zoological Museum, Bogor); paratypes (all ♀, all Anak Krakatau) 1, swept forest, 16 Aug. 1985; 1, Malaise trap at campsite (sea level) 13–19 Aug. 1985 (both foregoing in Zoological Museum, Bogor); 1, beating and sweeping low vegetation, 2 Sep. 1984, 1, swept, 3 Sep. 1984, (Australian National Insect Collection, Canberra).

Coloration

Buff. Eyes dark grey. Head very dark brown. Antennal scape and pedicel pale, basal two or three flagellar segments slightly darker, remainder of flagellum dark brown to black. Palpi uniform dark brown to black. Pronotum with small dark anterolateral streaks. Lateral lobes of mesonotum and metanotum dark brown; pleura pale except for dark suture lines. Abdomen pale. Forewing strongly marked with dark grey (figure 4); hindwing considerably paler, generally pale grey (figure 5). Legs with coxae dark, femora somewhat paler, tibiae darkened apically, basal tarsal segment pale, remainder of tarsus slightly darker.

Morphology

Male frons with elongate spoon-shaped corniform structure (figure 6) between antennae, slightly shorter than scape and about half its diameter at apex. Male scape without dorsal excavation, unornamented, about $2\frac{1}{2}$ times as long as broad; pedicel about twice as long as broad; flagellar segments almost quadrate. Wing venation as in figures 4 and 5; forewing distal R–M crossvein beyond 2nd medial thickening, M–Cu_1 crossvein between medial thickenings.

Female abdominal apex as in figure 7. Lateral gonapophyses fused into broad plate with tapered setose posterolateral lobes. Receptacular duct well sclerotized (figure 8).

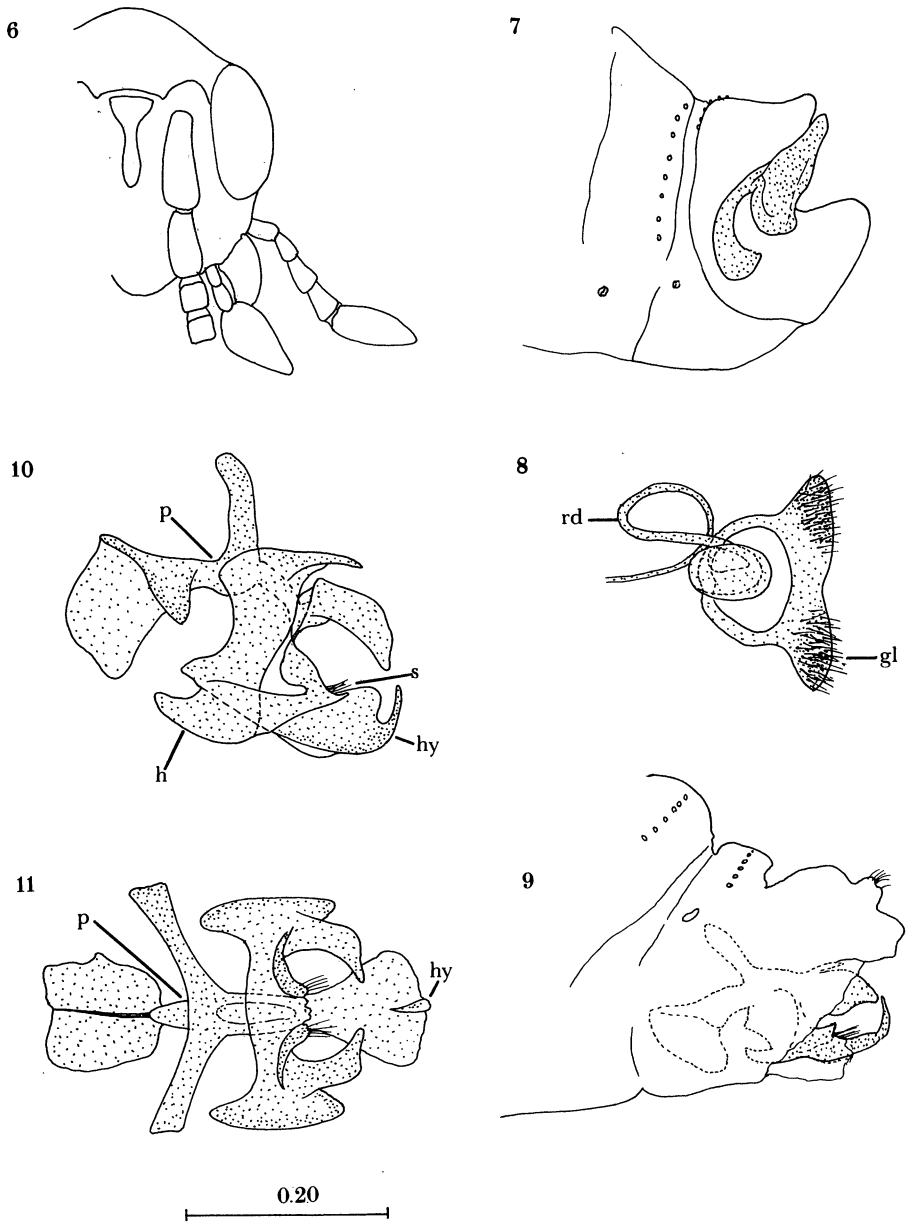
Male genitalia as in figure 9–11: penis with strong blunt dorsolateral processes; hypandrium and styli fused; hypocauda short, curved dorsally; ectoprocts small, tenth sternite weakly sclerotised.

Dimensions

Forewing length 1.95–2.10, hindwing length 1.7–1.85, antenna length *ca.* 1.2, 18-segmented, body length *ca.* 2.

Comments

Heteroconis is widely distributed in the Oriental region and Australia, and four species were described from Indonesia by Monserrat (1982). Tjeder (1973) noted six species from Irian Jaya, all of which appear to be distinct from the more westerly Indonesian taxa. The position of forewing crossvein M–Cu_1, between the two medial thickenings, and the strongly patterned forewing, associates *H. axeli* with a small group of species, most of which are immediately separable by having some of the distal flagellar segments pale. Of the remainder, *H. planifrontalis* Meinander (Australia) lacks the corniform process in the male, and *H. argylensis* New and *H. nigricornis* Meinander (Australia) have the forewing much less heavily patterned. Details of male genitalia readily differentiate *H. axeli* from all described species. The short simple hypocauda contrasts markedly with the longer structure found in other members of this



FIGURES 6–11. *Heteroconis axeli*, sp.nov.: **6**, frontal aspect of male head; **7**, female abdominal apex, lateral aspect; **8**, female genitalia ventral aspect; **9**, male abdominal apex, lateral aspect; **10**, **11**, male internal genitalia in (**10**) lateral and (**11**) dorsal aspect. Abbreviations: gl, lateral gonapophysis; h, hypandrium; hy, hypocauda; p, penis; rd, receptacular duct; s, stylus. (Scale in millimetres.)

species group. This species is named for Dr Axel Ridder, Carita, in appreciation of the substantial help given during our expeditions to the Krakataus.

Semidalis sp.

Material examined

All ♀: Rakata, Owl Bay, swept coastal vegetation, 26 Aug. 1985, 1; Panjang, north, beating, 20 Sep. 1984, 1; top northwest ridge, beating, 16 Aug. 1985, 1; central, beating, 17 Aug. 1985, 1; Anak Krakatau, sweeping, 17 Aug. 1985, 3; mixed forest, at light, 20 Aug. 1985, 1.

Comments

Semidalis species can be diagnosed adequately only from males, as the appearances of females of many species are very similar. This species is probably new, as it differs from the only described Indonesian species, *S. decipiens* (Roepke) (redescribed by Meinander (1972)) in several possibly important features:

(i) *decipiens* has the thorax almost black and the wings dark fuscous: the Krakatau individuals have pale greyish thorax and wings;

(ii) *decipiens* has 29–35 antennal segments: all the present individuals have 27 or 28, a difference that may be trivial;

(iii) the female of *decipiens* has a conspicuous, large, subanal plate: this is lacking in Krakatau specimens.

The widely distributed *S. aleyrodiformis* has been recorded from Malaysia, but has much more clearly defined thoracic spotting than the Krakatau species, and the forewing crossvein from R_1–Rs usually meets the anterior fork rather than the stem.

Coniopteryx (*Coniopteryx*) *tagalica* (Banks)

Parasemidalis tagalica Banks, 1937, *Philipp. J. Sci.* **63**, p. 153.

Coniopteryx (*Coniopteryx*) *tagalica* (Banks). Meinander, 1972, *Acta Zool. fenn.* **136**, p. 250.

Material examined

Sertung, spit, sweeping, 11 Sep. 1984, 1 ♂; Anak Krakatau, beating alang–alang, 15 Aug. 1985, 1 ♀; beating broad-leaved vegetation, 21 Aug. 1985, 1 ♀.

Comments

The somewhat damaged Sertung male has 19 remaining antennal segments, all being very dark brown. The flagellar segments have scales concentrated towards the apex and a single long basal seta. The genitalia closely resemble Meinander's (1972, p. 251) figures. *C. tagalica* was described from the Philippines, and recorded from Malaysia and Indonesia (Bali) by Monserrat (1982). The females are clearly conspecific, on wing characters, with the male, although the male is slightly brachypterous.

C. tagalica differs clearly from two early described Indonesian species of *Coniopteryx* in having the antennae (♂) wholly dark.

(*b*) Osmylidae

Spilosmylus modestus (Gerstaecker)

(Figures 12–22.)

Osmylus modestus Gerstaecker, 1893, *Mitt. vorpommern.* **25**, p. 169.

Spilosmylus modestus (Gerstaecker). Kolbe, 1897, *Netzfl. D. O. Afr.*, p. 33.

Material examined

Java, Sabal, 1300 m, Sitze Hiang, 6 Apl 1931, M.A.L., 2 ♂; Tjibodas, 1400 m, 1923, Karny 74, 1 ♂; Tengger Mtns, 450 m, Booeng, Feb. 1936, M. E. Walsh, 1 ♂; Rakata, Jan.–Oct. 1933, Dammerman, 2 ♂, 2 sex indet. (all Zoological Museum, Bogor); 1 ♀, 20 Jan. 1933 (Rijksmuseum van Natuurlijke Historie, Leiden).

Dammerman (1948) noted *S. modestus* also from Sertung ('Verlaten') in 1920, but we have

not seen any specimen with corresponding data: it was recorded by Esben-Petersen (1928) with a note that the abdomen was missing. Two of Dammerman's Rakata specimens now lack abdomens, but the others (one of each sex dissected) are clearly conspecific with individuals from Java. Van der Weele's (1909) appraisal of this species was based in part on the type, and notes the 'two short straight conical app. sup.' (= ectoprocts) which appear to be diagnostic for the male of this species. Spilosmylinae of the Indonesia – New Guinea region are now proving to be much more diverse than earlier suspected (New 1986), and, as published information on *S. modestus* is insufficient for detailed assessment, both sexes are redescribed and figured here.

Colouration

Buff, with dark brown to black markings. Eyes greyish brown. Antenna with scape and pedicel moderately dark, flagellum pale. Face and palpi pale. Vertex slightly darkened laterally, with long pale central hairs. Pronotum with dark dorsolateral streaks; three rows of sparse black dorsal setae; lateral setae long, pale. Mesonotum and metanotum dark, with black setae. Abdomen slightly darkened dorsally. Wings pale: forewing with most longitudinal veins intermittently darkened, most cross veins pale; Sc and R_1 with six short black lengths, cell Sc pale; embossed spot rather small, veins shaded with dark brown, intermediate membrane tawny. Hindwing venation pale; Sc and R_1 with three distinct dark lengths. Legs pale, except for two dark dots on outer edge of tibiae I and II.

Morphology

Pronotum about twice as long as broad. Wing venation as in figures 12 and 13. Female: abdominal apex as in figure 14: ectoproct slightly broadened ventrally, with circular field of about 45 small trichobothria; gonocoxite VIII elongate; lateral gonapophyses broad, with long stylus. Spermathecae (figure 15) very large, saclike, duct broad and unornamented. Male: abdominal apex as in figures 16–18: ectoproct with conspicuous rounded dorsal lobe, and field of about 50 small trichobothria; last sternite broad with apex slightly tapered. Genitalia (figures 19–22): subarcus broad, with trace of median process; gonarcus broad and medially excavated; parameres deep and apically tapered, with lateral process at about half length.

Dimensions

Forewing length 17–18, hindwing length 15–16, antenna length (broken) > 9, body length 10–12.

Comment

This species has apparently not been seen on the Krakatau Islands since 1933. The sac-like spermathecae and very long gonocoxite VIII differentiate the female from other *Spilosmylus* so far known from Indonesia or New Guinea, and the broad rounded dorsal ectoproct lobes of the male are very distinctive.

(*c*) Berothidae

Isoscelipteron nicobaricum (Navás)

Berotha nicobarica Navás, 1912, *Broteria* **10**, p. 108.

Acroberotha nicobarica (Navás): Navás, 1929, *Mems Acad. Cienc. exact. fís.-quim. nat. Zaragoza* **2**, p. 58.

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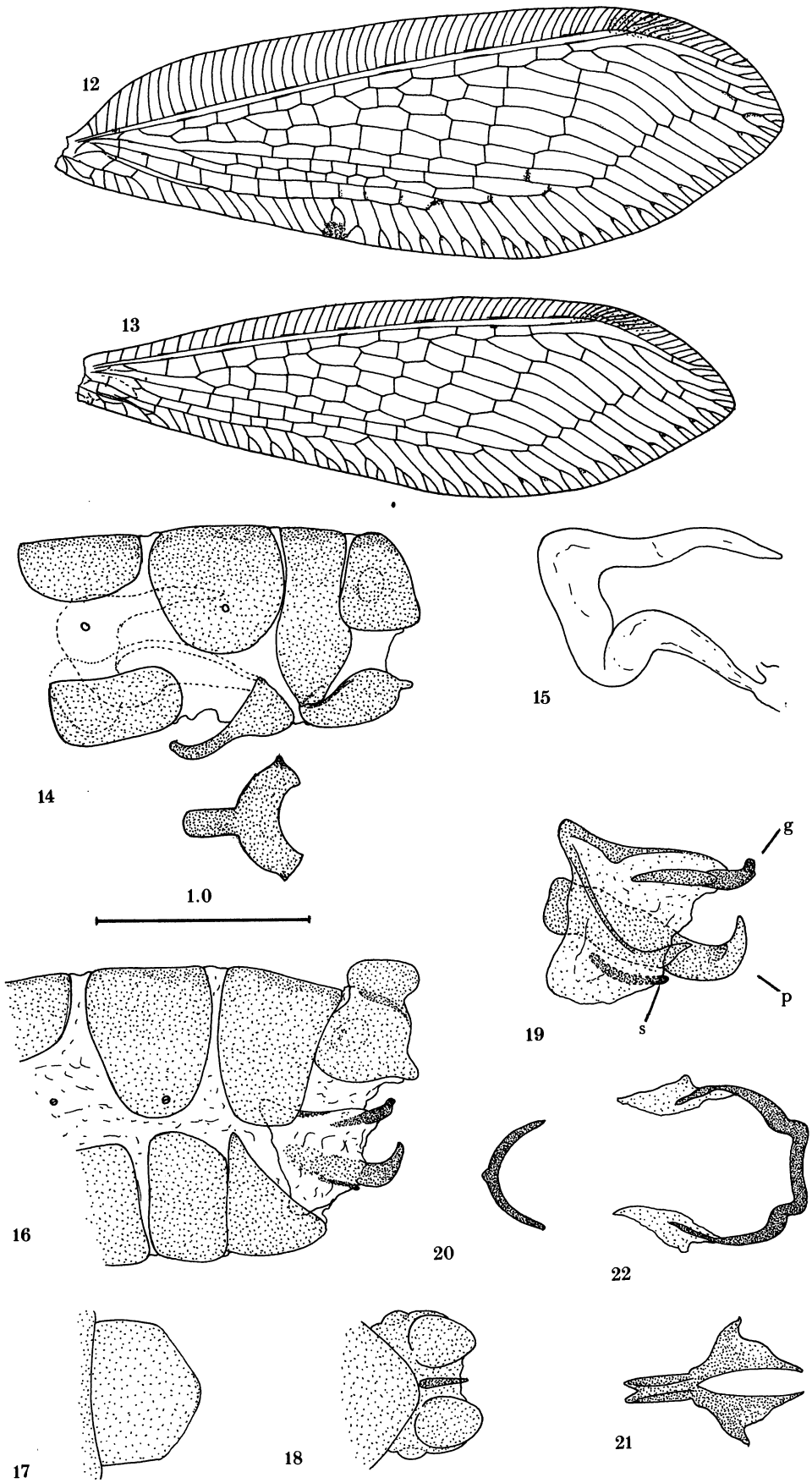

FIGURES 12–22. For description see opposite.

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Isoscelipteron nicobaricum (Navás): Aspöck & Aspöck, 1981, *Z. ArbGem. öst. Ent.* **33**, p. 5.

Material examined

Panjang, sweeping, 20 Sep. 1984, 1 ♂.

Comments

The type ♂ of *I. nicobaricum* (from the Nicobar Islands) was redescribed by Aspöck & Aspöck (1981), and the species is also known from parts of Malaysia. Male genitalia of the present individual resemble those of the type closely, including the distinctive shape of the 9th gonocoxite and the few spirals to the genitalic complex, and these features readily differentiate *nicobaricum* from other known species of *Isoscelipteron*. The occurrence of this species on the Krakataus was unexpected.

The only berothid earlier recorded from Indonesia (Java) is *Berotha piepersii* van der Weele; *Berotha* differs from *Isoscelipteron* in having much narrower wings, as well as in genitalic features.

(*d*) Chrysopidae

Chrysopa ramburi Schneider

Chrysopa ramburi Schneider, 1851, *Symb. Monogr. Chrysopae*, p. 107, (for synonymy see New (1980), p. 46).

Material examined

Anak Krakatau, swept, 5 Sep. 1984, 1 ♀.

Comment

This widely distributed Pacific species was recorded (as *C. deutera* Navás) from Rakata by Dammerman (1948), and (as *C. vicina* Kempny) from Java and Sumatra by van der Weele (1909).

Chrysopa sp.

Material examined

Anak Krakatau, swept, 13 Sep. 1984, 1 ♂; Malaise trap on outer crater rim, 19–20 Aug. 1985, 1 ♀.

Comment

The above two individuals are similar in having an elongate black inter-antennal streak, and a black mark on the distal outer region of the scape: they are otherwise wholly pale. They grossly resemble *C. signata* Schneider (recorded from Java by van der Weele (1909)) but lack the dark vertex markings characteristic of most individuals of that species, and differ in some details of male genitalia. The chrysopid fauna of Indonesia is not well known and most species have not been re-examined since they were described. This species is probably new.

FIGURES 12–22. *Spilosmylus modestus* (Gerstaecker): 12, forewing, 13, hindwing; female: 14, apex of abdomen, lateral aspect with insert of gonocoxite VIII, ventral aspect; 15, spermatheca lateral aspect; male: 16, apex of abdomen, lateral aspect; 17, last sternite, ventral aspect; 18, ectoprocts, dorsal aspect; 19, genitalic complex, lateral aspect; 20, subarcus, ventral aspect; 21, parameres, ventral aspect; 22, gonarcus, dorsal aspect. Abbreviations: g, gonarcus, p, parameres; s, subarcus. (Scale to figures 14 and 16 in millimetres.)

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Chrysopa jacobsoni van der Weele

Chrysopa jacobsoni van der Weele, 1909, *Notes Leyden Mus.* **31**, p. 65.

Material examined

Panjang, northeast shore, 27 Oct. 1982, I. W. B. Thornton, 1 ♀.

Comments

A very pale species, marked only with a dark genal spot and some darkening of the palpi. Wing venation is very similar to specimens of *C. jacobsoni* from W. Java determined by van der Weele (in Zoological Museum, Bogor), and is characterized by an unusually small intramedian cell. Although we have not critically compared material from other parts of Indonesia, we have little doubt of the identity of the Panjang individual. A male from the islands would help to finally confirm identity, as genitalia of the females of this group of oriental species are sometimes very similar.

Other Chrysopidae

Dammerman (1948) noted the incidence of an unnamed species of Chrysopidae on Rakata (April 1934), and also a '*Nothochrysa*' (the genus now known as *Italochrysa* Principi) from Panjang (October 1933). These specimens are in the Rijksmuseum van Natuurlijke Historie, Leiden and have been seen by T.R.N.

The two specimens of the small '*Chrysopa*' are both females, and are conspecific. They grossly resemble *C. flaveola* Schneider, which is widespread in Indonesia and which appears to be rather variable in the extent of the crimson facial markings clearly present in the Dammerman specimens. Identity cannot at this stage be confirmed. *Italochrysa aequalis* (Walker) has been recorded from Sumatra, Java and Borneo, and van der Weele (1909) raised separate subspecies of the, generally, larger *I. evanescens* (McLachlan) for individuals from Sumatra and Java. T.R.N. has seen specimens of both these species, which are very closely related, and it is likely that Dammerman's Panjang specimen is referable to this complex: in body coloration it resembles specimens identified as *I. aequalis*, but a revision of the Indonesian taxa is needed to confirm its identity.

Several chrysopid larvae were beaten from vegetation: Anak Krakatau, 27 Oct. 1982, 1; Panjang, north, 20 Sep. 1984, 1; Rakata, South Bay,
10 Sep. 1984, 2; West Ridge, 100 m, 1 Sep. 1984, 1.

At least two species are represented, but larvae closely resembling van der Weele's (1909) illustrations of *C. jacobsoni* were found on all three islands. The larva of *C. ramburi* was not found.

(*e*) Hemerobiidae

Micromus timidus Hagen

Micromus timidus Hagen, 1853, *Ber. Verh. K. Preuss. Akad. Wiss. Berl.*, p. 481, (for synonymy see Tjeder (1961), p. 315)

Material examined

1 ♀, Anak Krakatau, swept on north foreland, 22 Aug. 1985.

Comment

M. timidus is very widely distributed in the old world tropics, and has been recorded from Sumatra, Java and Bali in Indonesia. The above individual is the first representative of the family from the Krakataus.

(*f*) Myrmeleontidae

?*Myrmeleon frontalis* Burmeister.

Myrmeleon frontalis Burmeister, 1839, *Handbk. Ent.* **2**, p. 993.

Comments

No adult Myrmeleontidae were found on the islands during our surveys. Larvae of a species of *Myrmeleon* were found in sheltered areas in caves on Panjang (26 Aug. 1985), and Dammerman (1948) noted larvae of *M. frontalis* from Rakata and Sertung. The present larvae are identical to ones found in Carita (west Java, 1985) and Pulau Peucang (southwest Java, 1984), and a single adult *M. frontalis* was caught at the latter site, the only adult antlion seen there.

The larval markings correspond closely to the illustration of *M. frontalis* given by van der Weele (1909, p. 39) and the larvae appear to represent this species.

M. frontalis belongs to a small group of dark Oriental–Australian *Myrmeleon*, for which specific and distributional limits are by no means clear. It was described from Java, where it appears to be widespread, and two females were recorded from Rakata by Esben-Petersen (1928).

3. Discussion

The distribution on the Krakataus of the Neuroptera noted above is summarized in table 1. As more records accumulate, it is becoming clear that many Neuroptera are widely distributed along the eastern–southern Oriental 'fringe', from the Philippines through Indonesia to Malaysia, and a more comprehensive review of the total fauna is needed before sound geographical inferences can be made.

Coniopterygidae are small and vagile and, whereas many species have been recorded only from single localities, some are clearly very widely distributed in small numbers. *Coniocompsa meinanderi*, for example, is now known from several parts of Malaysia, and from Rakata and Panjang, but not from elsewhere in Indonesia, and this is likely to reflect a collecting artefact. However, the relatively intensive collecting of this family on the islands revealed the new species of *Heteroconis* only on Anak Krakatau, and this could reflect successful colonization only of this island. The genus is represented by several other species in Indonesia, but *H. axeli* appears to be closest to an undescribed New Guinea species. In contrast to *Heteroconis*, the *Semidalis* was found on three islands, and *C. tagalica* on two. Other Coniopterygidae may be expected to occur on the Krakataus. A single female of a *Spiloconis* sp. was captured at Carita (west Java, beaten from banana leaves, 15 Sep. 1984), representing a considerable extension to the known oriental range of this genus. The species appears to be new and, although resembling both *notata* (Navás) (Philippines) and *sexguttata* Enderlein (Japan, Taiwan, China, Thailand, ?Bali), differs in details of antennal colour. Species such as this, occurring on the mainlands adjacent to the Krakataus, are likely candidates for dispersal to them. Other coniopterygid genera known from Indonesia are *Cryptoscenea* (Bali) and *Conwentzia* (Bali).

Larvae of most species are likely to be arboreal and to be generalist predators on a range of small arthropod prey.

The single osmylid is clearly widespread in Java, but has not yet been recorded from Sumatra. Several other Spilosmylinae are also known from Java. The record of *Isoscelipteron* is of particular interest in substantially extending the known distribution of a rare and unusual taxon: it should now be sought in, especially, Sumatra and Java to determine whether or not the Krakataus may represent the easternmost distribution of *I. nicobaricum*. Nothing is known of the biology of either of the above species.

TABLE 1. SUMMARY OF RECORDS OF NEUROPTERA ON THE KRAKATAU ISLANDS, UNTIL 1985

(×, Present record; D, recorded by Dammerman; A, adult record; L, larval record, identification tentative.)

	Rakata	Sertung	Panjang	Anak Krakatau
Coniopterygidae				
Coniocompsa meinanderi	A ×	—	A ×	—
Heteroconis axeli	—	—	—	A ×
Semidalis sp.	A ×	—	A ×	A ×
Coniopteryx tagalica	—	A ×	—	A ×
unidentified spp.	—	—	D	—
Osmylidae				
Spilosmylus modestus	AD	AD	—	—
Berothidae				
Isoscelipteron nicobaricum	—	—	A ×	—
Chrysopidae				
Chrysopa ramburi	AD	—	—	A ×
C. jacobsoni	L ×	—	A × L ×	L ×
C. sp(p.) indet.	AD	—	—	A ×
Italochrysa sp.	—	—	Ad	—
Hemerobiidae				
Micromus timidus	—	—	—	A ×
Myrmeleontidae				
Myrmeleon frontalis	LD	LD	L ×	—
total families	4	3	4	3
total species (maximum)	7	7	7	3
total species (1984–85 confirmed)	3	6	5	1

Chrysopidae, at least as larvae, are active predators. Both of the identified *Chrysopa* species appear to be widely distributed. *C. ramburi* occurs over much of the western Pacific, Micronesia and Australia, and is one of very few chrysopids known from Christmas Island and the Cocos–Keeling group. *C. jacobsoni*, from the limited information available, is one of the commonest chrysopids in Java, and is presumed to be a generalist predator. Several more taxonomically specialized Chrysopidae, such as species of *Ankylopteryx*, *Leucochrysa*, *Sencera* and *Stigmachrysa*, occur on Java or Sumatra or both, and some were collected there during our surveys. The absence from the Krakataus of these forest taxa is not altogether surprising, although it is likely that they may eventually become established there. Virtually nothing is known of the biology of these taxa. Dammerman's (1948) record of *Italochrysa* from the islands represents the most ecologically specialized chrysopid so far known from there, and we had hoped to find additional specimens. Little is known of the biology of most species of *Italochrysa*, but larvae of a European species are among the most specialized feeders in the family and are

(apparently obligate) predators in ant nests (Principi 1946). This habit is likely to be more widespread in the genus (New 1983). Recent increases in ant diversity on the Krakataus may foster development of such specialized habits.

The scarcity of Hemerobiidae is rather surprising. Specimens of *Notiobiella* and *Micromus* were captured at Carita, but only a singleton of *M. timidus* Hagen was found on the Krakataus. It appears to be common in Java and Sumatra (recorded as *M. pusillus* Gerstaecker). Several other Hemerobiidae are also recorded from Java or Sumatra. *M. timidus* is likely to be a generalist predator and, by analogy with closely related forms such as *M. tasmaniae* (Walker), to be reasonably vagile. Other lacewing families known from Indonesia but not yet found on the Krakataus are predominantly specialized forms. Dammerman (1948) suggested that the absence of Ascalaphidae could reflect their dependence on forest habitats, but there now seems no sound ecological reason why such strongly flying insects could not establish on Rakata. Several widespread species are found in Java. Mantispidae appear to be considerably less diverse in western Indonesia than in New Guinea, and the montane Rapismatidae are likely to disperse very little.

Anak Krakatau is the only one of the four islands not to have yielded larvae of *Myrmeleon*. Neuroptera of that island so far comprise only Coniopterygidae, Hemerobiidae and Chrysopidae, all of which contain 'pioneer' species, and Anak Krakatau thus supports fewer lacewing families than some other islands. Numbers of species, though, are close to those on Rakata and Panjang.

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Note added in proof (14 *October* 1988).

Since this paper was accepted for publication, Tsukaguchi & Yukawa (1988) have published on the Neuroptera collected by the 1982 Kagoshima University Expedition. They record four species, two of which are described as new: *Italochrysa rugosa* (Sertung) and *Chrysoperla krakatauensis* (Sertung). The *Italochrysa* is clearly different from Dammerman's species, and *C. krakatauensis* is a member of a diverse Malaysian–Indonesian group. The other records are *Mallada* sp. (Chrysopidae: Anak Krakatau) and *Myrmeleon frontalis* (Panjang, Sertung).

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